NORTHGATE AND ERBSVILLE KARTWAY SUBDIVISIONS
BEAVER CREEK MEADOWS DISTRICT, WATERLOO

Functional Servicing Report

Project Location:
East of Erbsville Road
West of Beaver Creek Road
South of Conservation Drive
Waterloo, Ontario

Prepared for:
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July 5, 2017

MTE File No.: 39502-104

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1.0 INTRODUCTION

1.1 Overview

MTE Consultants Inc. was retained by Mr. Brian Groff, on behalf of 1017081 Ontario Limited and Gabriella Groff (Northgate Subdivision) and Mr. Steve Fries on behalf of 1455136 Ontario Inc. (Erbsville Kartway Subdivision), to prepare this Functional Servicing Report in support of draft plan approval of the proposed Northgate and Erbsville Kartway Subdivision. The Northgate property (49.290 ha) and the Erbsville Kartway property (6.424 ha) encompass a total of 55.714 ha of land within the City of Waterloo (City), which forms part of the Regional Municipality of Waterloo (Region). Note that the Northgate property (49.290 ha) consists of 33.159 ha of land located within the proposed subdivision and 16.131 ha along Beaver Creek, identified as "additional lands" to be protected as open space. The Northgate and Erbsville Kartway properties are collectively referred to as the "subject lands".

The subject lands are part of the Beaver Creek Meadows District, which abut the intersection of Beaver Creek Road and Conservation Drive, East of Erbsville Road and being 550m south of the municipal boundary between the City of Waterloo and the Township of Woolwich. The lands are entirely within the Laurel Creek Watershed, specifically areas 391, 309, and 310 as defined in the *Laurel Creek Watershed Study* (LCWS).

The location of the subject lands is illustrated in **Figure 1.0**, along with the general extent of the Beaver Creek Meadows District. They are surrounded by the Laurel Creek Conservation Area, Reservoir, and Nature Centre to the southeast, Creekside Church to the northwest, residential subdivisions to the east and south, and agricultural fields and rural homes to the north and west.

It is our understanding that the Monarch/Cook lands (28.647 ha) and Activa lands (7.363 ha) located immediately north and north-east of the Northgate Subdivision have or are in the process of submitting subdivision application.

A Draft Plan of Subdivision for the proposed development has been prepared by MHBC Planning (dated July 4, 2017) and forms the basis for the proposed servicing concepts. The subdivision design was developed in an iterative fashion with input from the project team. The Draft Plan of Subdivision includes single family residential blocks, multiple residential blocks, stormwater management blocks, sanitary pumping station blocks, park blocks, open space blocks, walkways, emergency access and service corridor blocks, and municipal right-of-ways. A full-size drawing of the Draft Plan is enclosed at the back of this report.

This report presents the recommended servicing strategy for the proposed subject lands as described above and outlines how the subdivisions can be developed on full municipal services, including sanitary sewage collection, domestic water, storm drainage and utilities. This report should be read in conjunction with the following other reports; *Northgate and Erbsville Kartway Subdivision Preliminary Stormwater Management Report (July 2017), Preliminary Noise Report (July 2017), Preliminary Water Distribution Analysis (July 2017) and Hydrogeology Study (July 2017),* all prepared by MTE Consultants Inc.

1.2 Background Information

A Scoped Subwatershed Study, the North Waterloo Scoped Subwatershed Study (NWSSS), dated November 2013 was undertaken for the Beaver Creek Meadows District by the City of Waterloo and area landowners. The NWSSS informed the preparation of the District Plan and related policy and provides the necessary background and environmental framework that is to be considered in preparing more detailed reports in support of development applications. The NWSSS was intended to reflect the goals of the overall LCWS and be used to guide the development of these lands.

A Municipal Class Environmental Assessment (EA) was undertaken for the upgrading of Beaver Creek Road and Conservation Drive within the North Waterloo lands, by Stantec Consulting, on behalf of the City of Waterloo, and completed December 14, 2015. The EA was completed in order to review and implement infrastructure upgrades required for the proposed developments within the Beaver Creek Meadows District and other lands in the vicinity.

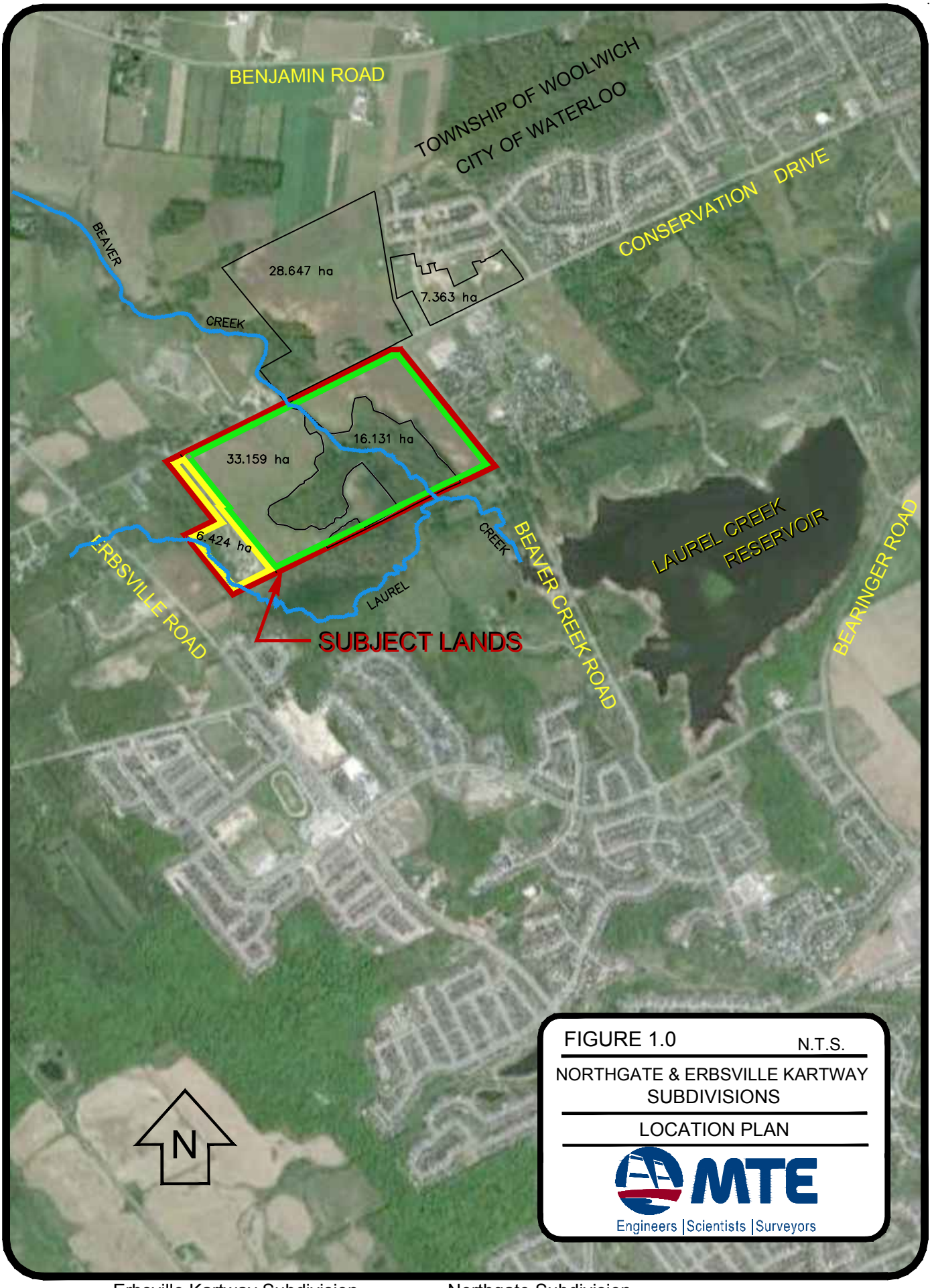


FIGURE 1.0 N.T.S.

NORTHGATE & ERBSVILLE KARTWAY SUBDIVISIONS

LOCATION PLAN

MTE Engineers | Scientists | Surveyors

Erbsville Kartway Subdivision Northgate Subdivision

CAD: P:\P\39502\104\39502-104-F21_LOCATION Project: 39502-104

July 5, 2017 - 8:42 a.m. - Plotted By: ccarre

2.0 EXISTING CONDITIONS AND BACKGROUND INFORMATION

2.1 Topographical Information

The subject lands consist of approximately 55.714 ha of land, which are used for interim agricultural purposes, open space and a Kartway. The open space areas are comprised of some forested areas within Beaver Creek, a surface water feature which flows from north to south across the middle of the Northgate lands.

The soils are generally sandy and well-drained, as the area is located along the eastern flank of the Waterloo Moraine or Waterloo Sand Hills (NWSSS 2013).

MTE conducted a detailed topographical survey of the subject lands in 2010. Existing topographic conditions for the subject lands as well as the surrounding lands are shown on **Figure 2.0**. Also refer to the enclosed **MTE Drawing 39502-104 EC1.1**.

The subject lands are moderately sloped with slopes generally ranging between 2% and 10%. Existing elevations range between 342.5m near the southern edge of the Northgate lands where Beaver Creek exits the subject property and 360m on a knoll located in the northeast corner of the site just south of Conservation Drive and west of Beaver Creek Road.

2.2 Pre-Development Conditions

The subject lands are located within the Laurel Creek Watershed, specifically within portions of Subwatershed Areas 391, 309, and 310 as defined within the LCWS. Topographic conditions within the subject lands direct drainage to Beaver Creek (subwatershed area 391) Laurel Creek (subwatershed area 309) and directly to the Laurel Creek Reservoir (subwatershed area 310). Refer to Stantec Figure 6.1 from the NWSSS.

The western portion (Area 309) of the Northgate lands (10.8 ha), which include lands that are outside of the Northgate plan of subdivision, drains to Laurel Creek to the southwest. Laurel Creek is the main water feature within the Laurel Creek Reservoir, and it turns to flow east approximately 200m south of the site before its confluence with Beaver Creek which outlets to the Laurel Creek Reservoir.

The central portion (Area 391) of the site (101.6 ha), including lands outside of the plans of subdivision, drains to Beaver Creek, which flows from north to south through the middle of the site. Beaver Creek has a main branch approximately 6.1 km long, and drains a 697 ha watershed (including areas 301 and 381) consisting of interim agricultural land and open space. Beaver Creek joins Laurel Creek immediately to the south of the site, upstream of the Laurel Creek Reservoir.

The eastern portion (Area 310) of the site (70.1 ha), including lands outside of the plans of subdivision, drains overland directly to the Laurel Creek Reservoir. The Laurel Creek Reservoir is an engineered flood control for the City which is managed by the GRCA.

There are existing 300mm diameter watermains on Beaver Creek Road and Conservation Drive, which operate in different pressure zones (but with similar hydraulic grade lines) and do not yet extend into the Beaver Creek Meadows District. The majority of existing homes and facilities within the North Waterloo lands are serviced via onsite septic systems.

2.3 Geotechnical and Hydrogeological Information

In 2010, Stantec carried out a hydrogeological investigation for the NWSSS. The fieldwork for this investigation included the following, on the subject lands; 6 boreholes to depths ranging from 3.66m to 39.68m completed as 50mm monitoring wells (MW08-13), 4 Drive-Points (DP3-5 and 7), 3 Guelph-Permeameter tests (GP2-4) and 7 Test-Pits (TP3-4 and 6-10).

Based on the results of Stantec's detailed hydrogeological investigation (NWSSS - page 178, 2013), the subsurface stratigraphy is generally described as;

> *"surficial deposits of sandy silt, clayey silt to silty clay material for the western portion of the subject lands. These deposits were noted extending from ground surface to depths of 1.8m to 11.5m below ground surface."*
>
> *"surficial deposits of fine to medium grained sand for the eastern portion of the subject lands. These deposits were noted extending from ground surface to depths of 3.5m to 6.1m below ground surface."*

MTE was retained to complete a Hydrogeology Study for the subject lands. Refer to *Hydrogeology Study (July 2017), prepared by MTE Consultants Inc.*

MTE carried out hydrogeological work in 2014 to supplement Stantec's hydrogeological investigation. MTE's work involved additional fieldwork comprising 12 monitoring wells distributed over the subject lands. Refer to MTE drawing 39502-104-EC1.1 at the back of this report for locations.

The field data shows the depth to groundwater level ranging from 0.2m to 6.2m bgs. The greatest depth to groundwater occurs near the topographic in the northeast corner of the subject lands at MW101-14 (MTE). The shallowest depth occurs adjacent to the PSW, east of Beaver Creek, in the south central portion of the subject lands at MW10-10 (Stantec). This being an area that was identified with groundwater seeps by MTE and the NWSSS.

For MTE and NWSSS borehole and test-pit logs refer to **Appendix A**.

CONSERVATION DRIVE

BEAVER CREEK ROAD

Laurel Creek Floodline

Beaver Creek Floodline

Laurel Creek

LEGEND

- PROPERTY BOUNDARY
- EXISTING CONTOURS
- EXISTING EMBANKMENT
- EXISTING DRIPLINE

FIGURE 2.0

Date: JUL.05/17
Scale: 1:3000

NORTHGATE & ERBSVILLE KARTWAY SUBDIVISIONS

EXISTING CONDITIONS PLAN

MTE
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3.0 PROPOSED DEVELOPMENT

The Draft Plans of Subdivision for this residential development are comprised of the following:

- Single detached residential dwellings;
- Multiple residential/mixed use;
- Stormwater management facilities;
- Sanitary pumping station facilities;
- Park and open space network;
- Walkways, emergency access and service corridor blocks;
- Municipal right-of-ways with widths of 20.0m and 18.0m;
- Road widenings.

4.0 PROPOSED GRADING

4.1 Considerations

The following list of constraints influenced and/or governed the grading design of the Northgate and Erbsville Kartway Subdivisions:

- Match proposed centerline road elevations of Conservation Drive and Beaver Creek Road established in Stantec (EA 2015);
- Ensure compatibility with the proposed realignment and grading of Conservation Drive and Beaver Creek Road (final profile of Beaver Creek Road is currently being negotiated by all parties);
- Match existing and proposed boundary grades around the perimeter of the property while respecting existing natural heritage features (established buffers);
- Minimize grading within recommended buffers associated within natural heritage features;
- Ensure adequate cover is provided over municipal services;
- Ensure major storm event overland flows are directed towards the existing road right-of-way where applicable, or towards the proposed stormwater management facilities;
- Comply with municipal standards for minimum and maximum road grades;
- Ensure adequate separation between composite high groundwater and proposed underside of house footings;
- Optimize earthmoving to minimize cutting and filling;
- Respect the 100 year flood limit;
- Maintain water balance (recharge), and;
- Maintain surface water balance to wetland features.

4.2 Roadworks and Lot Grading

As shown on the Draft Plan, the proposed development is serviced by local and collector roads.

The roadways will be constructed to full urban cross sections including asphalt pavement, concrete curb and gutters, concrete sidewalks, roadway illumination and boulevard landscaping all in accordance with the City of Waterloo Engineering and Development Standards. The right-of-way widths of Conservation Drive and Beaver Creek Road are both shown as 20.0m, with Conservation Drive to be increased through land dedication as the area develops (EA, 2015). Right-of-way widths within the proposed development area are shown in Table 4.2.1.

TABLE 4.2.1 - PROPOSED ROAD CLASSIFICATIONS

Road	Classification	Right-Of-Way Width
Conservation Drive	Major Collector	26.0m (ultimate)
Beaver Creek Road	Minor Collector	20.0m
Streets One and Three	Local	20.0m
Streets Two, Four, Five and Six	Local	18.0m

Utilizing the proposed road layout, preliminary slopes for centerline of road ranging from 0.5% (design minimum) to 5.0% (design maximum) were used to design the preliminary lot grading design. In addition, the considerations listed in Section 4.1 above were incorporated into the overall proposed grading design, as illustrated on **Figure 3.0**.

Lot grades range from 2.5% (design minimum) to 6.0% (design maximum) with a combination of traditional back to front drainage, split drainage, and walk-out type lots. Preliminary finished grades are designed to optimize the earthmoving (minimize cutting and filling) required for road and lot construction. The preliminary finished grade contours are shown on the enclosed **MTE Drawing 39502-104 AG1.1**.

The groundwater surface was modeled as per the NWSSS, and the preliminary house grades and underside of footing elevations were designed to maintain the minimum vertical separation of 0.6m above composite high groundwater elevations. The groundwater separation is illustrated on enclosed **MTE Drawing 39502-104 QU6.1**. In addition, it is estimated that the majority of services will be situated above the existing groundwater level, the exception being the sanitary sewer from the Condo Block to the proposed Conservation Drive sanitary pumping station.

A preliminary geotechnical investigation for the proposed development will be completed prior to final design. The proposed pavement structure is summarized in Table 4.2.2 below, being City of Waterloo minimum standard. The pavement structure will be determined prior to construction and communicated through the final design drawing approval process.

TABLE 4.2.2 - PROPOSED PAVEMENT STRUCTURES

Pavement Structure	Local Roads (mm)	Collector Roads (mm)	Bus Routes (mm)
Asphaltic Concrete-Surface	40	40	40
Asphaltic Concrete-Binder	50	50	100
Granular 'A' Base	150	150	150
Granular 'B' Sub-Base	300	500	500

4.3 Wetland & Vegetation Buffers

A comprehensive analysis was undertaken to determine recommended wetland buffers, development setbacks and limits of grading as part of the NWSSS report. These buffers and setbacks were identified as follows:

- 30m from a Provincially Significant Wetland (PSW) ;
- 30m from Beaver Creek and Laurel Creek;
- 15m from a Non-Provincially Significant Wetland;
- 10m from Upland Woodlands, and;
- 5m from Hedgerows

Grading within the buffers and development setbacks is generally not permitted, however certain fixed factors and engineering design considerations (road profile/elevation and steep slopes) have influenced the overall grading resulting in 3:1 embankments into the buffers in three areas:

- Along rear lot line Street Two south of Street One to 4.2m into 10m dripline buffer
- Along rear lot line Streets Three and Six to 5.1m into the 30m wetland buffer
- Along SWM Block 23 to 6.5m into the 30m wetland buffer

4.4 Multi-Use Trails

Community trails are proposed within the buffers surrounding the wetland along the east side of Beaver Creek. The proposed trail will be located outside of the natural features and their buffers or will be located within the outer 5m of the buffer where appropriate. The final grading design associated with these trails will be coordinated with City of Waterloo Parks Department.

4.5 Ecological Linkages / Wildlife Passages

Ecological linkages are intended to maintain or enhance the connectivity within and between large natural areas, and to restore or create new defined linkage areas between natural areas where existing connectivity is degraded. The NWSS identified a series of existing ecological linkages within the North Waterloo lands, the main one within the study area being along Beaver Creek Road between ESPA 80 (refer to NWSSS Figure 5.3: Surface Water Features and Environmentally Sensitive Areas) and the lands to the north.

CONSERVATION DRIVE

(351.58) (352.36) (358.41) (357.00)

(352.68) (H.P.) (352.60) (351.29)

STREET FOUR

STREET THREE

STREET THREE

STREET SIX

(349.16) (L.P.)

(352.20) (350.90)

STREET FIVE

(351.80) (350.98) (350.45)

Stage 3

SWM FACILITY 5914

Stage 2

SWMF 5915

Stage 2

STREET ONE

(356.03)

(353.48) (L.P.)

(353.65)

100YR PIPE

BEAVER CREEK ROAD

Stage 4

Stage 5

Stage 1

Stage 1

STREET TWO

(349.73)

(350.25)

(346.85)

Beaver Creek

Floodline

Floodline

Floodline

Laurel Creek

Floodline

Laurel Creek

(353.05) (H.P.)

(352.60)

(353.37) (H.P.)

(L.P.) (349.62)

LID 5917

(350.69)

Stage 1

LEGEND

- SUBJECT LANDS
- DRAINAGE SPLIT
- ⌑(350.69) CL ROAD GRADE
- (H.P.) HIGH POINT
- (L.P.) LOW POINT
- OVERLAND FLOW ROUTE (MAJOR STORM)

FIGURE 3.0

Date: JUL.05/17
Scale: 1:3000

NORTHGATE & ERBSVILLE KARTWAY SUBDIVISIONS

PRELIMINARY ROAD GRADING PLAN

MTE
Engineers | Scientists | Surveyors

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5.0 MUNICIPAL SERVICING

5.1 Sanitary Servicing

Sanitary sewage from the proposed development, and surrounding areas, has been planned and designed to ultimately outlet to the existing 375mm diameter sanitary trunk on Beaver Creek Road, 720m south of the southeast corner of the subject property.

As discussed in the EA for upgrading Conservation Drive and Beaver Creek Road, two sanitary pumping stations (SPS) are required to service the Beaver Creek Meadows District and other lands in the vicinity. Refer to Stantec Figure 4-4 and Table 4-5 for drainage areas totaling 165.6 ha, generating a flow of 176.1 L/s. The subject lands consist of Areas 7-10 totaling approximately 31.3 ha.

Preferred Alterative 2 locates the proposed Conservation Drive SPS on the subject lands just southwest of Conservation Drive and Beaver Creek, and the proposed Beaver Creek SPS near the southeast corner of the subject lands as shown on Stantec Figure 4-6. The SPS blocks are also shown on the enclosed Draft Plan as Block 22, Stage 3 and Block 10 Stage 1, respectively. The Conservation Drive SPS is proposed to have a capacity of 100 L/s with twin 200mmØ forcemains and the Beaver Creek SPS is proposed to have a capacity of 180 L/s with twin 250mmØ forcemains.

The subdivision lands on the west side of Beaver Creek will flow to the proposed Conservation Drive SPS, as well as potential upstream areas. The subdivision lands located on the east side of Beaver Creek will flow to the proposed Beaver Creek SPS, as well as potential upstream areas. Due to grading constraints on Block 2 Stage 2, the east half can flow by gravity to Street One, however, the west half will require private pumping to the gravity sewer on Street One, or it could be routed to the Conservation Drive SPS within the south side of Conservation Drive. This routing will involve the crossing of Beaver Creek.

The Conservation Drive SPS will be pumped under Beaver Creek and east along Conservation Drive to a proposed gravity sewer just west of Beaver Creek Road and Conservation Drive. The remainder of the subject lands east of Beaver Creek will combine with the remainder of potential upstream areas and flow by gravity to the Beaver Creek SPS. The entire 165.6 ha sanitary drainage area will then be pumped to the existing 375mm diameter gravity sanitary trunk as mentioned above.

The proposed consolidated Draft Plan for the Northgate and Erbsville Kartway Subdivision is proposing a range of 640 to 861 units, comprising single family residential (143 to 221), multiple-family (417-560) and Vacant Land Condominium (80) units.

Some proposed sanitary sewer is deeper than 5m due to filling of the site to provide groundwater separation with house footings. The dual sewer is illustrated on Figure 4.0. Refer to **Figure 4.0** for the conceptual sanitary servicing plan. Refer to **Appendix B** for sanitary design calculations and drainage area figure for the subject lands.

CONSERVATION DRIVE

F/G=351.36
SAN OBV.=348.56±
DEPTH=2.80m±

STREET THREE

F/G=348.50
SAN OBV.=341.20±
DEPTH=7.30m±

SPS

MULTI-BLOCK 3 PUMPED TO STREET ONE

F/G=358.00
SAN OBV.=355.20±
DEPTH=2.80m±

STREET FOUR

F/G=350.90
SAN OBV.=348.10±
DEPTH=2.80m±

STREET SIX

STREET FIVE

STREET TWO

STREET ONE

F/G=356.03
SAN OBV.=349.90±
DEPTH=6.13m±

F/G=353.50
SAN OBV.=350.70±
DEPTH=2.80m±

F/G=351.80
SAN OBV.=347.00±
DEPTH=4.80m±

F/G=349.16
SAN OBV.=342.13±
DEPTH=7.03m±

Beaver Creek

BEAVER CREEK ROAD

F/G=350.98
SAN OBV.=342.86±
DEPTH=8.12m±

F/G=349.62
SAN OBV.=346.82±
DEPTH=2.80m±

F/G=353.37
SAN OBV.=345.03±
DEPTH=8.34m±

Laurel Creek

F/G=352.60
SAN OBV.=344.16±
DEPTH=8.44m±

F/G=350.25
SAN OBV.=347.45±
DEPTH=2.80m±

SPS

F/G=348.50
SAN OBV.=343.00±
DEPTH=5.50m±

F/G=353.05
SAN OBV.=350.25±
DEPTH=2.80m±

Stage 1
Stage 2
Stage 3
Stage 4
Stage 5

LEGEND

- SUBJECT LANDS
- INTERNAL SANITARY DRAINAGE AREA
- EXTERNAL SANITARY DRAINAGE AREA
- EXTERNAL GRAVITY SEWER
- EXTERNAL FORCEMAIN

F/G=346.00
SAN OBV.=343.80±
DEPTH=2.20m±

- C/L ROAD GRADE
- LOCAL SANITARY OBVERT
- SANITARY COVER
- MANHOLE
- FLOW ROUTE
- PROPOSED SANITARY PUMPING STATION

FIGURE 4.0

Date: JUL.05/17
Scale: 1:3000

NORTHGATE & ERBSVILLE KARTWAY SUBDIVISIONS

SANITARY SERVICING PLAN

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5.2 Water Distribution

The proposed development is located within City of Waterloo's Zone 5 distribution system. The hydraulic grade line (HGL) of Zone 5 is 405m.

As discussed in the EA for Conservation Drive and Beaver Creek Road, upgrades are planned for the water distribution system to strengthen the supply and provide looping in the north-west area of Waterloo.

These upgrades include the extension of the 300mm watermain on Conservation Drive at Roy Schmidt Road (Zone 4C) to the existing 300mm diameter watermain on Erbsville Road (Zone 5). Both these zones have the same hydraulic grade line and it is planned that these two pressure zones will be interconnected and operated as one consolidated zone. An additional upgrade is planned for Beaver Creek Road (Zone 5) to extend the existing 300mm watermain north to Conservation Drive to provide desired looping.

Water supply for the proposed development will be provided by four connection points to the planned extension of the existing municipal water distribution system:

- Direct connection to a new 300mm diameter watermain extension along Conservation Drive (currently the 300mm diameter watermain terminates 60m east of Beaver Creek Road) at the following three locations:
    - the proposed intersection of Street One and Conservation Drive; and,
    - the proposed intersections of east and west legs of Street Three and Conservation Drive.
- Direct connection to a new 300mm diameter watermain extension along Beaver Creek Road (currently the 300mm diameter watermain terminates 650m north of Laurelwood Drive) at the following location:
    - the proposed intersection of Street One and Beaver Creek Road.

A water distribution analysis was completed for the proposed development to confirm that adequate pressure and flow demands can satisfactorily be met. Refer to **Figure 5.0** for the proposed watermain layout and **Appendix C** for the Preliminary Water Distribution Analysis (July 2017), prepared by MTE Consultants Inc.

Based on the preliminary analysis the following conclusions can be made:

- the new 300mm diameter watermain extensions on Conservation Drive and Beaver Creek Road will adequately service the proposed development

- under the proposed development condition the recommended FUS fire flows are satisfied at the minimum MOE pressure requirement of 140 kPa

- pressure reducing valves are not required as maximum system pressures are all below the MOE guideline of 550 kPa

CONSERVATION DRIVE

PROPOSED 300mmØ WTM EXTENTION

PROPOSED 300mmØ WTM EXTENTION

EX. 300mmØ WTM

PROPOSED 300mmØ WTM EXTENTION

BEAVER CREEK ROAD

WATERLOO PRESSURE ZONE 5

STREET ONE

STREET TWO

STREET THREE

STREET FOUR

STREET FIVE

STREET TWO

300mmØ WTM

300mmØ WTM

300mmØ WTM

300mmØ WTM

150mmØ WTM

200mmØ WTM

150mmØ WTM

200mmØ WTM

200mmØ WTM

150mmØ WTM

200mmØ WTM

200mmØ WTM

Stage 1

Stage 2

Stage 2

Stage 2

Stage 3

Stage 3

Stage 3

Stage 4

Stage 5

Stage 5

Beaver Creek

Laurel Creek

Laurel Creek

N

LEGEND

	SUBJECT LANDS
150mmØ WTM	PROPOSED 150mmø WTM
200mmØ WTM	PROPOSED 200mmø WTM
300mmØ WTM	PROPOSED 300mmø WTM
300mmØ WTM	PROPOSED 300mmø WTM EXTENSIONS BY OTHERS
300mmØ WTM	EXISTING 300mmø WTM

FIGURE 5.0

Date: JUL.05/17
Scale: 1:3000

NORTHGATE & ERBSVILLE KARTWAY SUBDIVISIONS

WATER DISTRIBUTION PLAN

MTE

Engineers |Scientists |Surveyors

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5.3 Storm Drainage

Storm drainage for the proposed development will be provided through a combination of minor (piped) and major (overland) drainage systems within municipal road right-of-ways, multiple blocks and vacant land condominium road allowances. The proposed development area will drain via conventional storm sewers to proposed downstream SWM Facilities as shown on **Figure 6.0**.

Four distinct stormwater management facilities are proposed to handle storm drainage from the subject lands:

- The largest facility will occupy Block 23, Stage 3 southwest of Conservation Drive and Beaver Creek, handling most of the proposed development west of Beaver Creek (12.088 ha). This area includes Stages 3 and 4 of the Northgate subdivision, the Erbsville Kartway lands, as well as the west portion of the Condo Block – Stage 5, and will consist of a wetpond with forebay and cooling trench.

- The east portion of the Condo Block – Stage 5 (also on the west side of Beaver Creek) will be handled using a combination of Low Intensity Development (LID) measures which represent the balance of the proposed development west of Beaver Creek (1.137 ha). Proposed measures include; permeable pavement on the roadway, bio-swale in the landscaped island and communal infiltration gallery for 7 roofs.

- A small portion of Block 2, Stage 2 southeast of Conservation Drive and Beaver Creek will consist of a volume reduction facility designed to handle all roof and non-roof area within this block only (1.895 ha). This facility will be a private stormwater management facility, the design of which will be finalized through the site plan approval process.

- The balance of the subject lands, east of Beaver Creek (8.434 ha), will drain to an off-site communal SWM Facility, located on the east side of Beaver Creek Road. This facility will be a shared facility with other lands currently proposed for development north of Conservation Drive, as shown on Figure 1.0. SWM Facility 5106 is currently in preliminary design.

The storm sewer system will be designed for the City of Waterloo 1:5 year storm event with overland flow routes generally following the proposed road allowances.

Major overland flow from the three on-site facilities noted above will be directed to Beaver Creek. Major overland flow from the off-site communal SWM facility will be to the Laurel Creek Reservoir via Beaver Creek Road.

CONSERVATION DRIVE

STREET ONE

STREET TWO

STREET THREE

STREET FOUR

STREET FIVE

STREET SIX

BEAVER CREEK ROAD

SWM FACILITY 5914

SWMF 5915

LID 5917

Stage 1

Stage 2

Stage 3

Stage 4

Stage 5

Stage 6

Beaver Creek Floodline

Laurel Creek Floodline

100YR PIPE

F/G=352.55
STM OBV.=350.90±
DEPTH=1.65m±

F/G=351.36
STM OBV.=349.86±
DEPTH=1.50m±

F/G=350.48
STM OBV.=348.63±
DEPTH=1.85m±

F/G=351.72
STM OBV.=349.95±
DEPTH=1.77m±

F/G=349.16
STM OBV.=347.53±
DEPTH=1.63m±

F/G=350.95
STM OBV.=349.17±
DEPTH=1.78m±

F/G=353.32
STM OBV.=351.82±
DEPTH=1.50m±

F/G=353.05
STM OBV.=351.55±
DEPTH=1.50m±

F/G=352.63
STM OBV.=350.81±
DEPTH=1.82m±

F/G=358.00
STM OBV.=356.50±
DEPTH=1.50m±

F/G=355.90
STM OBV.=351.93±
DEPTH=3.97m±

F/G=353.48
STM OBV.=352.28±
DEPTH=1.20m±

F/G=352.70
STM OBV.=349.95±
DEPTH=2.75m±

F/G=350.80
STM OBV.=349.30±
DEPTH=1.50m±

F/G=349.57
STM OBV.=347.95±
DEPTH=1.62m±

F/G=355.00
STM OBV.=353.20±
DEPTH=1.80m±

LEGEND

- SUBJECT LANDS
- STORM DRAINAGE AREA
- MAJOR OVERLAND FLOW ROUTE
- C/L ROAD GRADE
- LOCAL STORM OBVERT
- STORM COVER
- STORM MANHOLE

FIGURE 6.0

Date: JUL.05/17
Scale: 1:3000

NORTHGATE & ERBSVILLE KARTWAY SUBDIVISIONS

STORM SERVICING PLAN

MTE
Engineers | Scientists | Surveyors

Project No.: 39502-104

July 5, 2017 — 8:55 a.m. — Plotted By: mbrown

P:\P\39502\104\39502-104-F15-STM.dwg

5.4 Stormwater Management

The proposed stormwater management infrastructure on the subject lands will include infiltration of Multi-Res Block roof water (0.275 ha west of Beaver Creek), infiltration of 2.556 ha upstream drainage area in Park Block 20, “amended top-soil” (0.555 ha) on all but 39 Single-Family lots, a private “volume-reduction” facility on Multi-Res Block 2, Stage 2 and LID measures for the east portion of Condo Block (Stage 5 as described in Section 5.3).

The SWM Facilities are generally in the same location as shown in the NWSSS. The overall stormwater management scheme and analysis for the subject lands are presented in the *North Waterloo Community Northgate Subdivision Preliminary Stormwater Management Report*, prepared by MTE Consultants Inc. (2017). The following is a general summary:

- The stormwater management strategy for the subject lands will provide the appropriate levels of quality, quantity, and water balance controls in keeping with the intent of the NWSSS, 2013.
- An Enhanced level of water quality control will be provided as follows;
  - in SWM Facility 5914 west of Beaver Creek utilizing the proposed forebay and wetpond cells;
  - in SWM Facility 5915 utilizing an OGS;
  - in SWM Facility 5917 by utilizing LID measures;
  - in the proposed communal SWM Facility 5106 east of Beaver Creek Road utilizing the proposed forebay and wetpond cells.
- Water quantity and erosion control will be provided utilizing extended detention to control all runoff from the site, to the required unit flow rates published in the NWSSS.
- Temperature mitigation, through enhanced groundwater baseflow, will be achieved through the implementation of infiltration, as outlined above, and with the implementation of a “cooling-trench” at the outlet of SWM Facility 5914.

Storm drainage for the proposed development will be provided through a combination of minor (piped) and major (overland) drainage systems. The proposed development area will drain via storm sewers to the proposed downstream SWM Facilities as shown on **Figure 6.0**.

6.0 UTILITY SERVICING

Utility servicing of the proposed development will be through the connection to and extension of existing services along Conservation Drive and Beaver Creek Road. Waterloo North Hydro (electrical), Bell Canada (telephone), Union Gas (natural gas), and Rogers Cable (cable TV) are all expected to extend their services to the proposed development prior to building permit stage. Confirmation of utility servicing will be undertaken at the appropriate time, to ensure services are available prior to occupancy.

7.0 SUMMARY

The main findings of the Functional Servicing Report for the Northgate Subdivision are:

1. The proposed development can be adequately serviced with the planned construction of the Conservation Drive and Beaver Creek Road sanitary pumping stations.

   Final design of these two facilities is currently under-way by Stantec.

2. Water supply for the proposed development will be provided by four connection points to the planned extension of the existing municipal water distribution system.

   It is expected that the 300mm watermain extensions will be undertaken coincident with upgrading both Conservation Drive and Beaver Creek Road prior to servicing of the subject lands.

3. Stormwater management for the development can be accommodated in the proposed downstream SWM Facilities as outlined in the *Preliminary Stormwater Management Report – MTE, June 2017.*

4. Overall site grading will provide for 'major' overland flow conveyance to the downstream SWM Facilities, provide adequate cover over municipal services and generally match existing road and boundary grades with appropriate slopes. The following are the only exceptions; two narrow 3:1 slopes within setback buffers and 50m of 1.2m maximum height retaining wall, as shown on MTE Drawing 39502-104-AG1.1 enclosed.

5. Adequate services exist or are planned for to accommodate the proposed development.

All of which is respectfully submitted;

MTE CONSULTANTS INC.

CERTIFIED ENGINEERING TECHNICIAN
05 JULY 17
OACETT
ONTARIO
MARK S. BROWN
Nº 050607

Mark Brown, C.E.T.
Senior Designer

LICENSED PROFESSIONAL ENGINEER
July 05/17
V. LAZIC
100025286
PROVINCE OF ONTARIO

Valentina Lazic, P.Eng.
Design Engineer

APPENDIX A

MTE & NWSSS BOREHOLES AND TEST-PITS

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

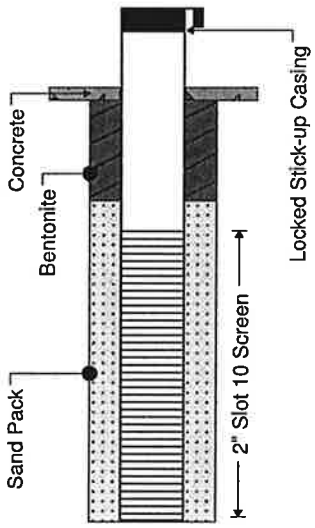
Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW100-14

Job Number: 39502-104

Drill Date: 12/12/14

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
0.00	344.68	Ground Elevation							
0.00	343.92	**TOPSOIL** borwn, sandy silt, trace organics, damp							
0.76	343.16	**SILT** stiff, brown, clayey silt, little sand, trace gravel, moist		1	SS	3			
1.52	342.39	**SAND** compact, borwnish grey, medium sand, some gravel, little silt, saturated		2	SS	14			
2.29	341.58	compact, brown, fine sand		3	SS	13			
3.10	340.87	**CLAY** stiff, grey, silty clay, wet		4	SS	26			
3.81	340.11	**SAND** compact, brown, fine sand, brown, saturated		5	SS	22			
4.57	339.50	**CLAY TILL** very stiff, grey, clay till , some silt, wet		6	SS	21			
5.18		no clasts observed, some silt							
		Borehole Terminated at 5.18m							



January 9, 2015
Water Level 1.8 mbTOC (343.77 masl)

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes:

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Logged By: TFC

Sheet: 1 of 1

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW101-14

Job Number: 39502-104

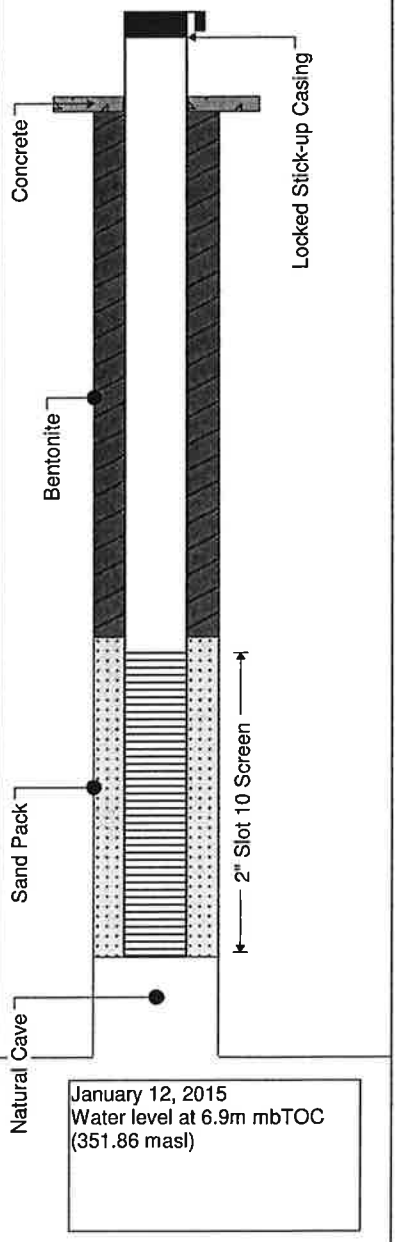
Drill Date: 12/12/14

Depth (m)	Elevation (m)	Soil Description	Number	Type	N-Value
	357.85	Ground Elevation			
0.0	0.00	**TOPSOIL** light brown, silty sand, little organics, damp			
	357.09				
	0.76	**SAND** loose, brown, medium to coarse sand, trace gravel, moist	1	SS	6
	356.33				
2.0	1.52	compact, grey brown, medium to coarse sand, little gravel, moist	2	SS	11
			3	SS	8
	354.80				
	3.05	compact, grey brown, fine to medium sand, trace gravel, moist	4	SS	13
	354.04				
4.0	3.81	compact, grey borwn, fine to medium sand, moist	5	SS	22
	353.58				
	4.27	wet	6	SS	30
	352.52				
	5.33	compact, grey brown, fine to medium sand, trace gravel, wet	7	SS	21
	352.06				
6.0	5.79	saturated			
		compact, grey brown, fine sand	8	SS	18
	350.23				
	7.62	compact, brown, fine sand	9	SS	25
8.0					
	348.71				
	9.14	compact, grey brown, medium to coarse sand	10	SS	30
	348.10				
10.0	9.75	Borehole Terminated at 9.75			

Standard Penetration Graph: 25 50 75

Headspace (ppm)

Groundwater Observations and Well Details



Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes:

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Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

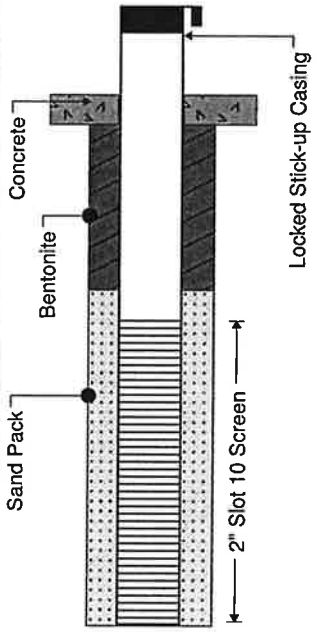
Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW102-14

Job Number: 39502-104

Drill Date: 12/12/14

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
0.0	350.95	Ground Elevation							
0.0	350.95	**TOPSOIL** dark brown, silty sand, little organics, damp							
0.76	350.19	**SILT TILL** firm, brown, clayey silt till, some sand, trace gravel, moist		1	SS	6			
1.52	349.43	stiff, brown, oxidation staining, mottled tan brown, some fine sand moist		2	SS	17			
1.98	348.97	stiff, grey, clayey silt till, trace sand, grey, wet		3	SS	11			
3.05	347.90	**SILT** stiff, grey, clayey silt, saturated		4	SS	9			
				5	SS	13			
				6	SS	11			
5.94	345.01	Borehole Terminated at 5.94		7	SS	16			



January 12, 2015
Water level 1.8 mbTOC (349.9 masl)

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes:

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Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW103-14

Job Number: 39502-104

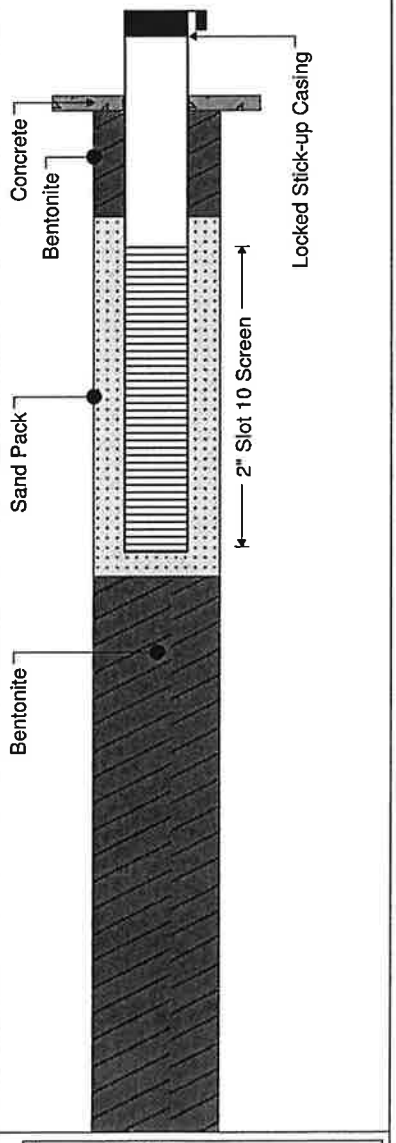
Drill Date: 12/11/14

Depth (m)	Elevation (m)	Soil Description	Number	Type	N-Value
	345.78	Ground Elevation			
	0.00	**TOPSOIL** dark brown, silty sand, little organics, moist			
	345.02 0.76	**SAND** loose, brown, medium to course sand, few gravel, trace organics, wet	1	SS	8
	344.26 1.52		2	SS	26
2.0	343.80 1.98	compact, brown, medium sand, trace gravel, saturated			
		compact, greyish brown, medium to course sand, trace gravel	3	SS	16
	342.88 2.90	**CLAY TILL** very stiff, grey, clay till, some silt, trace fine sand, wet	4	SS	17
4.0		**SAND** compact, grey, medium sand, grey, saturated	5	SS	12
	341.21 4.57	**CLAY** very stiff, grey, clay till, some silt, trace fine sand, wet	6	SS	17
	340.45 5.33	**SILT** compact, grey, sandy silt, saturated	7	SS	10
6.0	339.68 6.10	**SILT** compact, brownish grey, clayey silt, some fine sand, saturated	8	SS	2
	338.16 7.62	**SAND** very loose, brownish grey, silty fine sand	9	SS	17
8.0		compact brownish grey, fine sand, some silt			
			10	SS	36
	335.87 9.91	**SAND** dense, brownish grey, silty fine sand	11	SS	33
10.0	335.26 10.52	Borehole Terminated at 10.52m			

Standard Penetration Graph: 25 50 75

Headspace (ppm)

Groundwater Observations and Well Details



January 8, 2015
Water level 1.3 mbTOC (345.3 masl)

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes:

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Sheet: 1 of 1

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

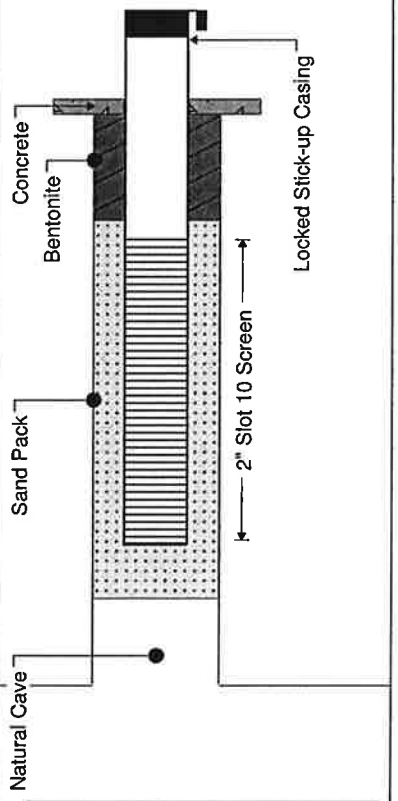
Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW104-14

Job Number: 39502-104

Drill Date: 12/11/14

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
	346.17	Ground Elevation							
0.00		**TOPSOIL** dark brown, silty sand, little organics, damp							
	345.41								
0.76		**SAND** loose, orange brown, fine sand, moist		1	SS	7			
	344.65								
1.52		compact, saturated		2	SS	14			
2.0				3	SS	10			
				4	SS	15			
	342.64								
3.53		compact, greyish brown, fine sand		5	SS	26			
4.0				6	SS	11			
				7	SS	4			
	340.23								
5.94		Borehole Terminated at 5.94							
6.0									
8.0									
10.0									



January 8, 2015
Water level 1.9 mbTOC (345.19 masl)

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes:

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Sheet: 1 of 1

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW105A-14

Job Number: 39502-104

Drill Date: 12/15/14

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
0.0	349.58	Ground Elevation							
0.0	0.00	**TOPSOIL** brown, silty sand, little organics, damp							
	348.82								
	0.76	**SILT** firm, brown, clayey silt, little sand, laminated grey silt layers, moist		1	SS	8			
2.0	348.28			2	SS	6			
	1.30								
	347.29	**SAND** loose, brown, silty fine sand,wet saturated		3	SS	7			
	2.29								
4.0	345.77			4	SS	20			
	3.81	**SAND** compact, dark brown, fine sand		5	SS	13			
				6	SS	23			
6.0				7	SS	19			
				8	SS	23			
	341.96								
	7.62	**SILT** dense, grey, clayey silt till		9	SS	18			
8.0				10	SS	26			
10.0				11	SS	20			

Concrete

Locked Stick-up Casing

Bentonite

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes: * Sampler advanced under static pressure

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Sheet: 1 of 2

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

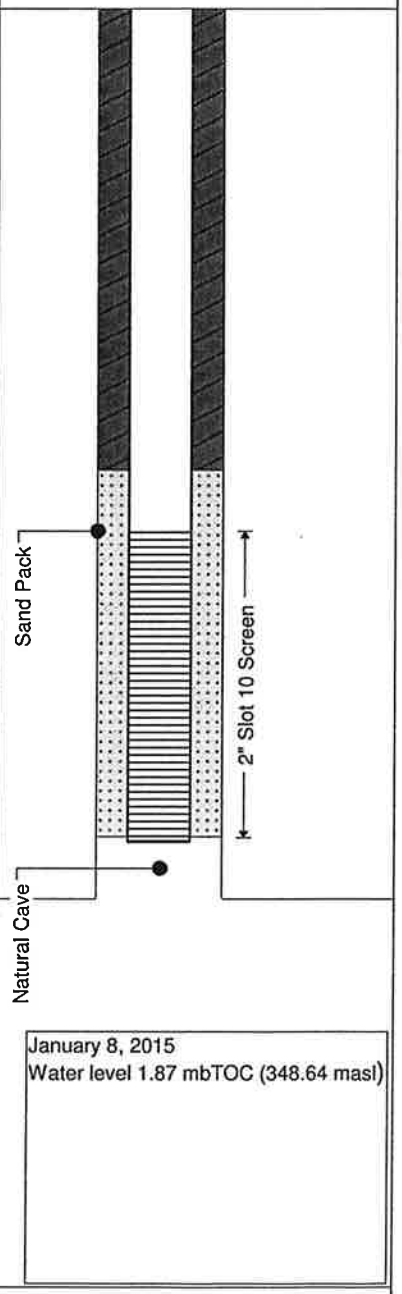
Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW105A-14

Job Number: 39502-104

Drill Date: 12/15/14

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
40.0	337.39								
	12.19	**SILT** compact, grey		12	SS	15			
42.0									
13.0									
44.0									
46.0				13	SS	14			
48.0									
15.0									
50.0				14	SS	14			
52.0									
54.0									
17.0									
56.0									
58.0									
60.0	331.29								
	18.29	**SAND** very loose, greyish brown, fine sand		15	SS	0*			
62.0									
19.0									
64.0									
66.0	329.16			16	SS	15			
	20.42	Borehole Terminate at 20.42m							
68.0									
21.0									
70.0									
72.0									
74.0									
23.0									
76.0									
78.0									



Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes: * Sampler advanced under static pressure

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Sheet: 2 of 2

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW105B-14

Job Number: 39502-104

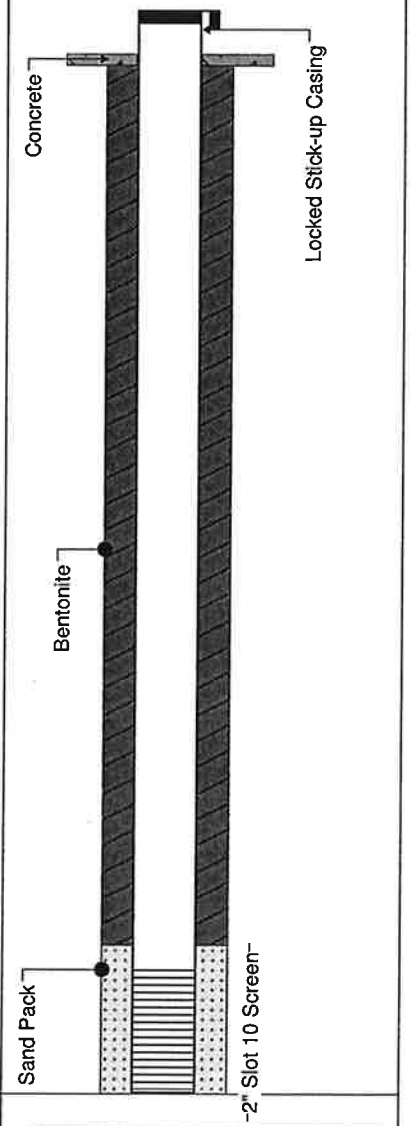
Drill Date: 12/15/14

Depth (m)	Elevation (m)	Soil Description	Number	Type	N-Value
	349.66	Ground Elevation			
	0.00	**TOPSOIL** brown, silty sand, little organics, moist			
	348.90		1	SS	8
	0.76	**SILT** firm, brown, clayey silt, little sand, laminated grey silt layers, moist	2	SS	6
	348.36				
	1.30				
2.0	347.37		3	SS	7
	2.29	**SAND** loose, brown, silty fine sand, wet saturated	4	SS	20
	345.85				
4.0	3.81	**SAND** compact, dark brown, fine sand	5	SS	13
			6	SS	23
			7	SS	19
6.0			8	SS	23
	342.04				
	7.62	**SILT TILL** dense, grey, clayey silt till	9	SS	18
8.0					
			10	SS	26
10.0					
			11	SS	20
	337.47				
12.0	12.19	**SILT** compact, grey	12	SS	15
	336.86				
	12.80	Borehole Terminate at 12.8m			
14.0					

Standard Penetration Graph: 25 50 75

Headspace (ppm)

Groundwater Observations and Well Details



January 8, 2015
Water level 1.87 mbTOC (348.33 masl)

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes: * Sampler advanced under static pressure

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Logged By: TFC

Sheet: 1 of 1

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW106-14

Job Number: 39502-104

Drill Date: 12/10/14

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
	350.79	Ground Elevation							
0.0	0.00	**TOPSOIL** light brown, silty sand, little organics, damp							
	350.03								
	0.76	**SILT** compact, tan, sandy silt, little fine sand, little clay, trace organic, moist		1	SS	10			
	349.27								
2.0	1.52			2	SS	9			
		wet		3	SS	27			
	347.74								
	3.05	**SILT TILL** dense, light brown, silt till, moist		4	SS	33			
	346.98								
4.0	3.81	**SILT** compact, grey, clayey silt till, moist		5	SS	22			
				6	SS	34			
	345.46								
	5.33	compact, grey, clayey silt		7	SS	40			
6.0	344.69								
	6.10	**SILT** compact, grey, silt		8	SS	28			
		saturated							
	343.17								
	7.62	compact, grey, some fine sand layers		9	SS	14			
8.0									
				10	SS	21			
10.0									
				11	SS	16			
12.0									
	337.99			12	SS	12			
	12.80								January 8, 2015 Water level 3.08 mbTOC (348.55 masl)
14.0									

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes:

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Sheet: 1 of 1

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

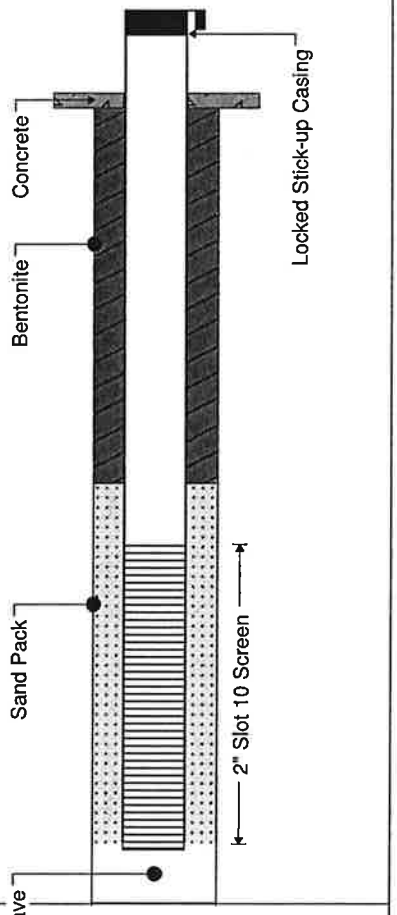
Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW107-14

Job Number: 39502-104

Drill Date: 12/17/14

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
ft / m	350.58	Ground Elevation							
	0.00	**TOPSOIL** grey brown to dark brown, sandy silt, trace organics, damp							
	349.74								
	0.84	**SAND** loose, brown, silty fine sand, damp		1	SS	4			
2.0		**SAND** compact, tan, fine sand, damp		2	SS	12			
				3	SS	16			
	347.53								
	3.05	moist		4	SS	15			
	346.62								
4.0	3.96	compact, dark brown, fine sand, wet		5	SS	25			
	346.01								
	4.57	saturated		6	SS	27			
				7	SS	20			
6.0				8	SS	5			
	342.90								
	7.68	dense, brownish grey, fine sand		9	SS	48			
8.0	342.35								
	8.23	Borehole Terminated at 8.23m							
10.0									



January 7, 2015
Water level 5.18 mbTOC (346.26 masl)

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes: Aardvark

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Sheet: 1 of 1

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW108-14

Job Number: 39502-104

Drill Date: 12/16/14

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
	346.21	Ground Elevation							
0.00		**TOPSOIL** brown to dark brown, some clay, organics, damp							
0.76	345.45	**SILT** stiff, tan, clayey silt, trace course sand, trace organics, damp		1	SS	11			
1.52	344.69	compact, tan, clayey silt, some fine sand, trace course sand, moist		2	SS	14			
2.29	343.92	**SAND** compact, tan, fine sand, saturated		3	SS	17			
				4	SS	20			
3.81	342.40	dense, mottled tan brown with oxidation staining, fine sand		5	SS	40			
4.57	341.64	dense, brown, fine sand							
		compact, grey brown, fine sand		6	SS	14			
				7	SS	20			
6.10	340.11	compact, grey, fine sand		8	SS	15			
6.71	339.50	Borehole Terminated at 6.71m							

Concrete
Bentonite
Sand Pack
Natural Cave
Locked Stick-up Casing
2" Slot 10 Screen

January 8, 2015
Water level 1.85 mbTOC (345.08 masl)

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes:

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Sheet: 1 of 1

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW109A-14

Job Number: 39502-104

Drill Date: 12/18/14

Depth (m)	Elevation (m)	Soil Description	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
	349.77	Ground Elevation						
0.00		**TOPSOIL** loose, dark brown, fill, silty sand, little organics, damp	1	SS	8			
1.0			2	SS	15			
3.0		**SILT TILL** stiff, brown, clayey silt till, moist	3	SS	15			
5.0								
2.0		mottled brown, no clasts observed, moist	4	SS	9			
7.0								
9.0	346.72							
3.05		**CLAY** stiff, grey, little silt, moist	5	SS	10			
11.0								
4.0			6	SS	7			
13.0								
15.0			7	SS	9			
17.0	344.41							
5.36		**SAND** loose, brown, silty fine sand, wet	8	SS	8			
6.0	343.67							
6.10		**SAND** loose, brownish grey, fine to medium sand, saturated	9	SS	18			
21.0		compact, brown, fine sand						
23.0								
25.0			10	SS	16			
8.0								
27.0								
29.0			11	SS	5			
31.0								
10.0								
33.0								
35.0			12	SS	11			
37.0								
39.0								
12.0	337.58							
12.19		compact, brown, fine sand, little silt	13	SS	14			
41.0								
43.0								
45.0	336.05							
13.72		compact brownish grey, fine sand, little silt	14	SS	23			
14.0								
47.0								

Concrete

Locked Stick-up Casing

Bentonite

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes:

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Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

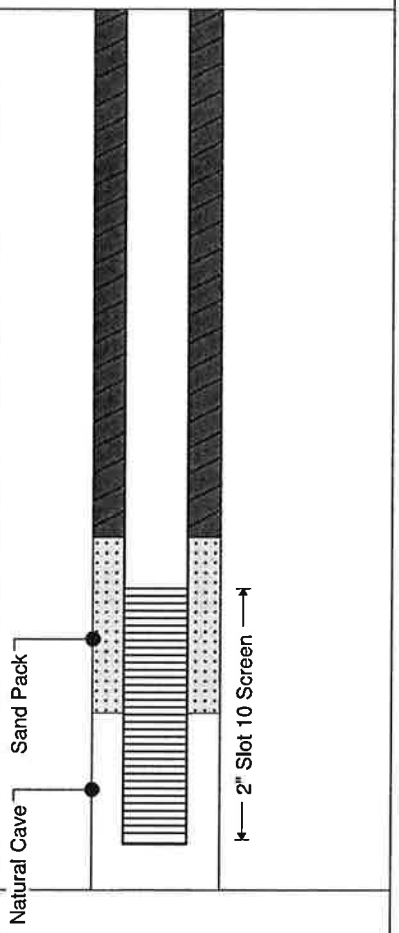
Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW109A-14

Job Number: 39502-104

Drill Date: 12/18/14

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
49.0									
51.0				15	SS	30			
53.0	16.0								
55.0	333.01								
	16.76	**CLAY** hard, brownish grey, silty clay, some fine sand,wet		16	SS	40			
57.0									
59.0	18.0								
	331.48								
	18.29	**SAND** dense, brown, fine sand, saturated		17	SS	37			
61.0									
63.0		**CLAY** hard, brownish grey, clay, wet							
65.0	20.0			18	SS	22			
67.0									
69.0									
	328.43								
	21.34	**SAND** dense, brownish grey, silty fine sand, saturated		19	SS	36			
71.0									
73.0	22.0								
75.0				20	SS	37			
77.0									
79.0	24.0								
81.0				21	SS	19			
	324.78								
	24.99	Borehole Terminated at 24.99m							
83.0									
85.0	26.0								
87.0									
89.0									
91.0	28.0								
93.0									
95.0									
97.0									



January 7, 2015
Water level 3.87 mbTOC (346.62 masl)

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes:

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Sheet: 2 of 2

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

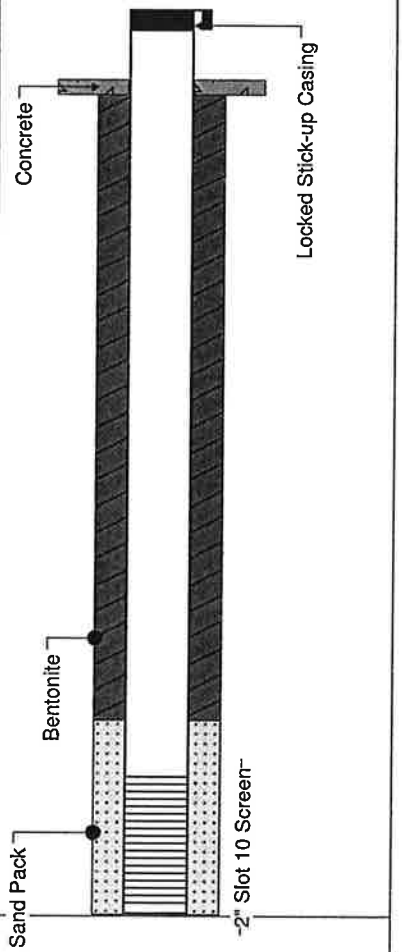
Location: Conservation Dr. Waterloo, Ontario

Borehole Number: MW109B-14

Job Number: 39502-104

Drill Date: 12/18/14

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
	349.77	Ground Elevation							
0.00		**TOPSOIL** loose, dark brown, fill, silty sand, little organics, damp		1	SS	8			
2.0		**SILT TILL** stiff, brown, clayey silt till, moist; mottled brown, no clasts observed, moist		2	SS	15			
				3	SS	15			
				4	SS	9			
	346.72								
3.05		**CLAY** stiff, grey, little silt, moist		5	SS	10			
4.0				6	SS	7			
				7	SS	9			
	344.41								
5.36		**SAND** loose, brown, silty fine sand, wet		8	SS	8			
6.0	343.67								
6.10		**SAND** loose, brownish grey, fine to medium sand, saturated; compact, brown, fine sand		9	SS	18			
8.0				10	SS	16			
	340.63								
9.14		Borehole Terminated at 9.14m							
10.0									
12.0									



January 5, 2015
Water level 4.76 mbTOC (345.76 masl)

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes:

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Sheet: 1 of 1

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

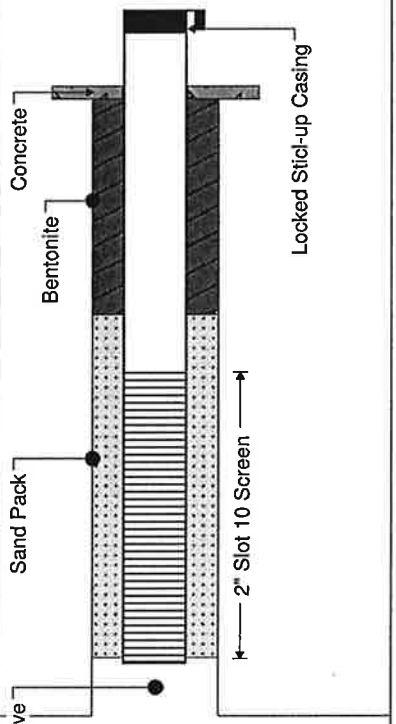
Location: 675 Conservation Dr. Waterloo, Ontario

Borehole Number: MW110-14

Job Number: 39502-104

Drill Date: 12/17/14

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
0.0	349.37	Ground Elevation							
0.0 – 0.76	349.37 – 348.61	**TOPSOIL** dark brown, silty sand, trace organics, moist							
0.76 – 1.52	348.61 – 347.85	**SAND** compact, grey, fine to medium sand,some silt, some gravel, wet		1	SS	19			
1.52 – 2.44	347.85 – 346.93	compact, brownish grey, fine sand, some silt, wet		2	SS	16			
2.44 – 6.71	346.93 – 342.66	saturated		3	SS	13			
				4	SS	8			
				5	SS	9			
				6	SS	14			
				7	SS	0*			
				8	SS	1			
6.71	342.66	Borehole Terminated at 6.71m							



January 7, 2015
Water level 2.10 mbTOC (348.08 masl)

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes: * Sampler advanced under static pressure

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Sheet: 1 of 1

Client: Northgate Lands Corp.

Project: Northgate Lands Subdivision

Location: 675 Conservation Dr. Waterloo, Ontario

Borehole Number: MW111-14

Job Number: 39502-104

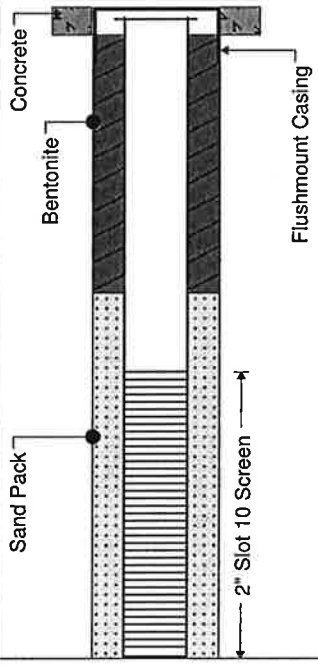
Drill Date: 12/17/14

Depth (m)	Elevation (m)	Soil Description	Number	Type	N-Value
	349.43	Ground Elevation			
0.0	0.00	**TOPSOIL** tan brown, silty sand, trace organics, moist			
	348.67				
0.76	0.76	**SILT** firm, mottled borwn, clayey silt till, moist	1	SS	6
1.5			2	SS	9
2.0	347.14				
	2.29	**SAND** compact, brown, silty fine sand, saturated	3	SS	21
3.0		**CLAY** very stiff, brown, clay, little silt, little sand, wet	4	SS	19
4.0		**SAND** compact, grey, fine sand, saturated	5	SS	26
	344.86				
	4.57	**CLAY** very stiff, brown, clay, little silt, little sand, wet	6	SS	43
6.0	343.33	**SILT** hard, grey, clayey silt, little sand, wet	7	SS	34
	6.10		8	SS	17
	342.50				
	6.93	**CLAY** very stiff, grey, clay, some silt, wet			
8.0		Borehole Terminated at 6.93m			
10.0					
12.0					

Standard Penetration Graph: 25 50 75

Headspace (ppm)

Groundwater Observations and Well Details



January 7, 2015
Water level 0.75 mbTOC (348.56 masl)

Reviewed By: ALB

Method: CME75 Hollow Stem Auger

Notes:

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Sheet: 1 of 1

Monitoring Well: MW8-10

Project:	North Waterloo Subwatershed Study	**Field investigator:**	R.Dong/L.Veale
Client:		**Contractor:**	Pro Core Drilling
Location:	North Waterloo, ON; 08	**Drilling method:**	Track Mount, CME55, Hollow Stem Auger
Number:	160340875	**Date started/completed:**	05-Mar-2010 / 08-Mar-2010

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS					WELL DETAILS
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) / Depth (m BGS)	Hydro-Stratigraphic Unit	Description	Sample Number	Sample Type	N Value	Recovery	GS Elev: 350.44 m AMSL TOC Elev: 351.28 m AMSL Easting: 532289 Northing: 4814537 Stick-up: 0.82 m GS Elev: 350.38 m AMSL TOC Elev: 351.28 m AMSL Easting: 532271 Northing: 4814538 Stick-up: 0.90 m
			Ground Surface	350.44							
0	0		TOPSOIL some organic material, dark brown, stiff, dry	0.00 349.60			1	SS	2-2-2-3 (4)	12" 50%	Cement
			SILT little fine sand, trace clay, light brown	0.84 348.91			2	SS	5-7-9-2 (16)	9" 38%	Holeplug
5			becoming wet at 1.37 m BGS	1.52							
	2		SILT light brown, homogeneous, stiff, wet				3	SS	3-5-7-12 (12)	24" 100%	52 mm Schedule 40 PVC casing
							4	SS	9-13-14-14 (27)	24" 100%	
10							5	PQ	n/a	29" 161%	Top of sand (2.74 m BGS)
	4		some clay beginning at 3.6 m BGS, becoming brownish grey, firm		ATB1	Upper Maryhill Till and Equivalents	6	PQ	n/a	54" 90%	Top of screen (3.05 m BGS) No.2 Silica Sand No.10 Slot PVC screen 50 mm diameter
15											
20	6						7	PQ	n/a	54" 90%	Bottom of screen (4.57 m BGS)
							8	PQ	n/a	54" 90%	
25	8			341.93							
			SAND fine grained, some silt, brown, homogeneous, wet	8.51			9	PQ	n/a	49" 82%	
30	10		trace silt beginning at 9.8 m BGS				10	PQ	n/a	55" 92%	
35											
40	12		little silt beginning at 12.5 m BGS, becoming greyish brown, soft				11	PQ	n/a	51" 85%	52 mm Schedule 80 PVC casing
							12	PQ	n/a	55" 92%	
45	14						13	PQ	n/a	55" 92%	
50											
55	16		layer of fine sand, trace silt, stiff at 16.2 to 17.1 m BGS				14	PQ	n/a	28" 47%	
60	18						15	PQ	n/a	55" 92%	Bentonite Grout
			some silt beginning at 18.9 m BGS				16	PQ	n/a	58" 97%	
65	20										
70							17	PQ	n/a	56" 93%	
	22		trace silt beginning at 21.6 m BGS				18	PQ	n/a	37" 62%	
75				328.03 22.40							
			fine grained, little medium grained sand, grey brown, wet		AFB1 / AFB2	Upper / Middle Moraine Stratified Sediments and Equivalents	19	PQ	n/a	38" 63%	
80	24		seam of grey brown, fine sand with little silt 0.2 m thick at 24.5 m BGS								
			medium sand content between 24.7 to 26.2 m BGS				20	PQ	n/a	44" 73%	
85	26										
							21	PQ	n/a	60" 100%	
90			seam of medium sand 0.2 m thick at 27.7 m BGS								

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
SS - split-spoon sample
PQ - wireline continuous core sample
n/a - not available

mAMSL - metres above mean sea level
mBGS - metres below ground surface

PQ - continuous core sampling
SS - split spoon sampling

Drawn By/Checked By: OR/LV

Stantec

STANTEC BOREHOLE AND WELL - CLUST 11X17 160340875 - DPS.GPJ EDGE DATA TEMPLATE.GDT 2/4/11 MJFRASER

Monitoring Well: MW8-10

Project:	North Waterloo Subwatershed Study	**Field Investigator:**	R.Dong/L.Veale
Client:		**Contractor:**	Pro Core Drilling
Location:	North Waterloo, ON; 08	**Drilling method:**	Track Mount, CME55, Hollow Stem Auger
Number:	160340875	**Date started/completed:**	05-Mar-2010 / 08-Mar-2010

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS				WELL DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	N Value	Recovery	GS Elev: 350.44 m AMSL TOC Elev: 351.26 m AMSL Easting: 532269 Northing: 4814537 Stick-up: 0.82 m
95			little silt from 28.0 to 28.7 m BGS fine grained, little medium grained sand, grey brown, wet				22	PQ	n/a	60" 100%	
100	30						23	PQ	n/a	14" 23%	
105	32						24	PQ	n/a	50" 83%	Bentonite Grout
110	34		seam of fine sand 5 cm thick at 33.8 m BGS				25	PQ	n/a	25" 42%	
115	36						26	PQ	n/a	3" 5%	Holeplug
120			seam of homogeneous fine sand between 36.9 and 37.4 m BGS, and				27	PQ	n/a	3" 5%	Top of sand (35.97 m BGS) Top of screen (36.58 m BGS)
125	38		37.8 and 38.1 m BGS, and				28	PQ	n/a	60" 100%	No.2 Silica Sand
			38.8 and 38.8 m BGS	311.42							No.10 Slot PVC screen 50 mm diameter
			trace gravel beginning at 39.0 m BGS	39.01			29	PQ	n/a	41" 82%	
130	40		SAND AND COBBLE large cobble at 39 m BGS, at 39.5 m and 39.7 m BGS	310.76	AFB3	Lower Moraine Stratified Sediments					Bottom of screen (39.68)
			End of Borehole	39.68							
135	42										
140											
145	44										
150	46										
155											
160	48										
165	50										
170	52										
175											
180	54										
185	56										

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
SS - split-spoon sample
PQ - wireline continuous core sample
n/a - not available

mAMSL - metres above mean sea level
mBGS - metres below ground surface

PQ - continuous core sampling
SS - split spoon sampling

Drawn By/Checked By: OR/LV

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STANTEC BOREHOLE AND WELL - CLIENT 11X17 - MOD0875 - DPS.GPJ EQUIS DATA TEMPLATE.GDT 2/1/11 MAFRASER

Monitoring Well: MW9-10

Project:	North Waterloo Subwatershed Study	**Field Investigator:**	J.Koch
Client:		**Contractor:**	Pro Core Drilling
Location:	North Waterloo, ON; 09	**Drilling method:**	Track Mount, CME75, Hollow Stem Auger
Number:	160340875	**Date started/completed:**	02-Mar-2010 / 04-Mar-2010

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS				WELL DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) / Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	N Value	Recovery	GS Elev: 345.71 m AMSL TOC Elev: 346.50 m AMSL Easting: 532634 Northing: 4814717 Stick-up: 0.79 m
			Ground Surface	345.71							
0	0		TOPSOIL some clay and silt, dark brown	0.00 344.95			1	SS	n/a	6" 25%	Cement
			CLAY some silt, trace gravel, brown, firm	0.76 344.19			2	SS	2-5-7-9 (12)	14" 58%	Holeplug
5	2		brownish grey, homogeneous, firm, wet	1.52	ATB1	Upper Maryhill Port Stanley Till and Equivalents	3	SS	4-5-7-9 (12)	15" 63%	52 mm Schedule 40 PVC casing
							4	SS	2-3-4-6 (7)	15" 63%	Top of sand (2.61 m BGS)
10							5	PQ	n/a	25" 96%	Top of screen (3.05 m BGS)
	4			341.90							No.2 Silica Sand
			SANDY SILT some clay, brownish grey, firm, wet	3.81 340.93			6	PQ	n/a	52.5" 88%	No.10 Slot PVC screen 50 mm diameter
15			SAND medium grained, silty to some silt, brownish grey, soft, wet	4.76 340.02							Bottom of screen (4.57 m BGS)
20	6		SILT sandy to some sand, greyish brown, very stiff, wet	5.69			7	PQ	n/a	44" 73%	
			seam of fine sand, little silt between 6.6 and 9.5 m BGS				8	PQ	n/a	59" 98%	
25	8		little clay between 8.1 and 9.5 m BGS				9	PQ	n/a	58" 96%	
30			stratified layers of clayey silt, little to some sand, firm to soft and silt, little clay, very hard between 9.5 and 11.3 m BGS								52 mm Schedule 80 PVC casing
	10		becoming soft at 11.3 m BGS				10	PQ	n/a	58" 95%	
35											
40	12				AFB1 / AFB2	Upper / Mide Moraine Stratified Sediments and Equivalents	11	PQ	n/a	59" 100%	
			laminated sediments at 13.4 m BGS				12	PQ	n/a	57" 95%	Bentonite Grout
45	14		little fine sand beginning at 14.2 m BGS, soft to firm								
50							13	PQ	n/a	51" 85%	
	16						14	PQ	n/a	58" 97%	
55			laminated sediments at 17.1 m BGS								
60	18		trace fine sand beginning at 18.8 m BGS				15	PQ	n/a	54" 88%	
65	20		cobble, 11 cm diameter, at 19.8 m BGS	325.82 19.89			16	PQ	n/a	43" 73%	
			SAND AND GRAVEL coarse grained gravel, some fine gravel, some cobbles, rounded particles		AFB3	Lower Moraine Stratified Sediments	17	PQ	n/a	n/a	
70				324.09							
	22		SILT TILL some fine sand, some coarse gravel, trace fine gravel, grey, very hard, moist	21.82			18	PQ	n/a	60" 101%	
75											Holeplug
	24				ATC1	Upper/ Main Catfish Creek Till	19	PQ	n/a	45" 61%	Top of sand (23.98 m BGS)
80											Top of screen (24.48 m BGS)
85	26						20	PQ	n/a	54" 90%	No.2 Silica Sand
											No.10 Slot PVC screen 50 mm diameter
90	28		End of Borehole	318.20 27.51							Bottom of screen (27.51)

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
SS - split-spoon sample
PQ - wireline continuous core sample
n/a - not available

mAMSL - metres above mean sea level
mBGS - metres below ground surface

PQ - continuous core sampling
SS - split spoon sampling

Drawn By/Checked By: OR/LV

Stantec

Sheet 1 of 1

STANTEC BOREHOLE AND WELL - CLIENT 11X17 - 160340875 - DPS.GPJ EGAS DATA TEMPLATE.GDT 3/1/11 MJFRASER

Monitoring Well: MW10-10

Project:	North Waterloo Subwatershed Study	**Drilling method:**	Track Mount, CME55, Hollow Stem Auger
Client:		**Date started/completed:**	19-Mar-2010
Location:	North Waterloo, ON	**Ground surface elevation:**	346.25 m AMSL
Number:	160340875	**Top of casing elevation:**	347.05 m AMSL
Field investigator:	A.Vandenhoff	**Easting:**	532654
Contractor:	Pro Core Drilling	**Northing:**	4814388

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS				WELL DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	N Value	Recovery	Diagram	Description
												Stick-up = 0.80 m
0	0		Ground Surface	346.25								
			TOPSOIL some clay, organics, dark brown	0.00 345.94								Concrete
			SAND fine to medium grained, light brown with oxidation staining throughout	0.30			1	SS	2-4-5-8 (9)	16" 67%		Holeplug
							2	SS	10-8-6-6 (14)	0" 0%		52 mm Schedule 40 PVC casing
5				344.57								Top of sand (0.9 m BGS)
			SILTY CLAY light brown	1.68 344.42	AFB1 / AFB2	Upper / Midle Moraine Stratified Sediments and Equivalents	3	SS	3-5-5-5 (10)	18" 75%		Top of screen (1.5 m BGS)
	2		SAND fine grained, some medium sand and silt, light brown, loose to compact, wet	1.83								No.2 Silica Sand
			becoming finer with depth				4	SS	2-3-4-5 (7)	8" 33%		No.10 Slot PVC screen 50 mm diameter
10							5	SS	6-8-10-8 (18)	16" 67%		Bottom of screen (3.1 m BGS)
				342.59								
			End of Borehole	3.66								
	4											
15												
20	6											
25												
	8											

Screen Interval: 1.52 - 3.05 m BGS
Sand Pack Interval: 0.91 - 3.05 m BGS
Well Seal Interval: 0.30 - 0.91 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
SS - split-spoon sample
n/a - not available

Drawn By/Checked By: OR/LV

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STANTEC BOREHOLE AND WELL 160330875 - DPS.GPJ EQUIS DATA TEMPLATE.GDT 2/1/11 MJFRASER

Monitoring Well: MW11-10

Project:	North Waterloo Subwatershed Study	**Drilling method:**	Track Mount, CME55, Hollow Stem Auger
Client:		**Date started/completed:**	05-Mar-2010 / 08-Mar-2010
Location:	North Waterloo, ON	**Ground surface elevation:**	355.07 m AMSL
Number:	160340875	**Top of casing elevation:**	355.96 m AMSL
Field investigator:	A.Vandenhoff	**Easting:**	533047
Contractor:	Pro Core Drilling	**Northing:**	4814655

SUBSURFACE PROFILE					HYDROGEOLOGY		SAMPLE DETAILS				WELL DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	N Value	Recovery	Diagram	Description
												Stick-up = 0.69 m
0	0		Ground Surface	355.07								
			SAND fine to medium grained, trace silt and organics, light brown	0.00 354.76								Concrete
			SAND fine to medium grained, light brown, some oxidation staining, loose	0.30			1	SS	1-3-3-5 (6)	11" 46%		
			some coarse sand and gravel at 0.8 to 1.4 m BGS				2	SS	4-6-7-6 (13)	6" 25%		52 mm Schedule 40 PVC casing
5							3	SS	4-7-12-14 (19)	14" 58%		
	2		SILTY SAND fine grained sand, light brown, compact, moist	353.09 1.98 352.93								Holeplug
			SAND fine grained, some medium sand, light brown, loose to compact, moist	2.13			4	SS	5-10-12-12 (22)	15" 63%		
10					AFB1 / AFB2	Upper / Midle Moraine Stratified Sediments and Equivalents	5	SS	2-10-16-18 (26)	15" 63%		
			fine to coarse grained sand, trace gravel, light brown, loose, wet	351.41 3.66								Top of sand (3.7 m BGS)
	4											Top of screen (4.3 m BGS)
15							6	SS	7-11-12-12 (23)	20" 83%		No.2 Silica Sand
												No.10 Slot PVC screen 50 mm diameter
	6			348.97								Bottom of screen (5.8 m BGS)
20			SILTY CLAY grey	6.10			7	SS	2-4-5-5 (9)	24" 100%		Natural Cave
				348.36								
			End of Borehole	6.71								
25												
	8											

Screen Interval: 4.27 - 5.79 m BGS
Sand Pack Interval: 3.66 - 5.79 m BGS
Well Seal Interval: 0.30 - 3.66 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
SS - split-spoon sample
n/a - not available

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Sheet 1 of 1

STANTEC BOREHOLE AND WELL 160330875 - DPS.GPJ EQUIS DATA TEMPLATE.GDT 2/1/11 MJFRASER

Monitoring Well: MW12-10

Project:	North Waterloo Subwatershed Study	**Field Investigator:**	R Dong
Client:		**Contractor:**	Pro Core Drilling
Location:	North Waterloo, ON; 12	**Drilling method:**	Track Mount, CME55, Hollow Stem Auger
Number:	160340875	**Date started/completed:**	09-Mar-2010 / 11-Mar-2010

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS				WELL DETAILS
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) / Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	N Value	Recovery	GS Elev: 348.63 m AMSL TOC Elev: 349.52 m AMSL Easting: 532584 Northing: 4814125 Stick-up: 0.89 m
			Ground Surface	348.63							
0	0		TOPSOIL brown, decaying wood, moist	0.00			1	SS	2-3-4-4 (7)	12" 50%	Cement
				347.26			2	SS	3-4-4-4 (8)	10" 42%	Holeplug
5	2		CLAYEY SILT trace fine sand, light and dark brown mottled, soft, moist	1.37			3	SS	6-1-7-4 (8)	8" 33%	
			SILTY CLAY light brown and brown mottled, very stiff, moist	340.34 2.29			4	SS	6-6-8-14 (14)	17" 71%	52 mm Schedule 40 PVC casing
10			SILT little clay, trace coarse and fine gravel, trace well graded sand, brown, very soft, moist to wet	346.17 2.46			5	SS	n/a	14" 74%	Holeplug
				345.25							
15	4		SILTY CLAY little fine sand, trace cobbles, light brown, firm, moist to wet	3.38			6	PQ	n/a	24" 40%	Top of sand (4.57 m BGS)
			becoming stiff, brown at 4.9m BGS								Top of screen (5.18 m BGS)
			seam of wet, brown, fine sand, 0.23 m thick at 5.3 m BGS								No.2 Silica Sand
20	6		becoming brown grey at 5.9 m BGS		ATB1	Upper Maryhill Port Stanley Till and Equivalents	7	PQ	n/a	48" 79%	No.10 Slot PVC screen 50 mm diameter
			trace gravel beginning at 7.0 m BGS								Bottom of screen (6.71m BGS)
			trace coarse and medium sand beginning at 7.5 m BGS lensed trace soft clay pockets (1-2 mm in diameter), red and grey starting at 7.5 m BGS				8	PQ	n/a	50" 83%	
25	8		lensed trace to little silt pockets								52 mm Schedule 80 PVC casing
			laminated 2 mm thick of soft grey clay at 9.4 m BGS				9	PQ	n/a	61" 100%	
30	10										
			seam of wet silt and very fine sand, 0.05 m thick at 10.4 m BGS seam of little fine and coarse gravel, little well graded sand, 0.2 m thick at 10.5 m BGS seam of silt and very fine sand 0.05 thick between 10.7 and 11.0 m BGS				10	PQ	n/a	49" 83%	
35			seam of fine sand 2 mm thick at 11.4 m BGS	337.10							
			SILT AND SAND fine grained, brown grey, homogeneous, wet	11.53 336.64			11	PQ	n/a	52" 93%	
40	12		SAND fine grained, brown grey, homogeneous, wet	11.99							Bentonite Grout
			seam of silt, 0.01 m thick at 12.9 m BGS				12	PQ	n/a	46" 102%	
45			seam of silt, 0.01 m thick at 13.3 m BGS								
	14		seam of silt, 0.01 m thick at 14.4 m BGS				13	PQ	n/a	42" 70%	
50											
	16		seam of browny grey silty clay with lensed grey clay 0.05 m thick at 15.8 m BGS some medium sand between 16.1 and 16.5 m BGS		AFB1 / AFB2	Upper / Middle Moraine Stratified Sediments and Equivalents	14	PQ	n/a	43" 63%	
55							15	PQ	n/a	42" 89%	
60	18		pocket of very fine sand, 0.03 m diameter at 18.5 m BGS some medium sand between 18.3 and 18.7 m BGS seam of firm silty clay 0.03 m thick at 18.7 m BGS								
			seam of coarse gravel 0.05 m thick at 19.3 m BGS				16	PQ	n/a	34" 59%	
65	20		seam of sand, stiff, 0.1 m thick at 20.0 m BGS								
			seam of some silt 0.04 m thick at 20.8 m BGS seam of some silt 0.13 m thick at 20.9 m BGS stratified clayey silt 0.03 m thick at 21.1 m BGS	327.50 21.13 327.09			17	PQ	n/a	48" 89%	
70			SAND AND SILT stratified fine sand with little silt, 2 cm thick and coarse sand with fine gravel 0.2 cm thick browny grey, wet	21.54							Holeplug
	22		SAND AND GRAVEL well graded, brown and grey, wet				18	PQ	n/a	36" 74%	Top of sand (21.95 m BGS)
75											Top of screen (22.56 m BGS)
					AFB3	Lower Moraine Stratified Sediments					
80	24										No.2 Silica Sand
				323.48							No.10 Slot PVC screen 50 mm diameter
			SANDY SILT TILL little medium sand coarse sand, trace to little fine and coarse gravel, grey brown, brown very hard, moist	25.15	ATC1	Upper/Main Catfish Creek Till	19	PQ	n/a	44" 69%	
85	26			322.37							Bottom of screen (25.60 m BGS)
			End of Borehole	26.26							
90	28										

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
SS - split-spoon sample
PQ - wireline continuous core sample
n/a - not available

mAMSL - metres above mean sea level
mBGS - metres below ground surface

PQ - continuous core sampling
SS - split spoon sampling

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Sheet 1 of 1

STANTEC BOREHOLE AND WELL - CLUST 1 (V3) - MOSSKRR - DPS.GPJ - EQUIS DATA TEMPLATE.GDT - 2/3/11 - MURHAISER

Monitoring Well: MW13-10

Project:	North Waterloo Subwatershed Study	**Drilling method:**	Track Mount, CME55, Hollow Stem Auger
Client:		**Date started/completed:**	19-Mar-2010
Location:	North Waterloo, ON	**Ground surface elevation:**	345.34 m AMSL
Number:	160340875	**Top of casing elevation:**	346.15 m AMSL
Field investigator:	A.Vandenhoff	**Easting:**	533060
Contractor:	Pro Core Drilling	**Northing:**	4814339

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS				WELL DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	N Value	Recovery	Diagram	Description
												Stick-up = 0.81 m
0	0		Ground Surface	345.34								
			TOPSOIL clay, organic material, dark brown	0.00			1	SS	1-2-4-6 (6)	7" 29%		Concrete
				344.42								Holeplug
			SILTY CLAY light brown	0.91			2	SS	1-2-4-4 (6)	24" 100%		
5			becoming coarser with depth		ATB1	Upper Maryhill Port Stanley Till and Equivalents						52 mm Schedule 40 PVC casing
	2		becoming clayey silt, some sandy silt				3	SS	2-3-6-8 (9)	14" 58%		
				343.05								
			SANDY SILT fine grained sand, light brown, moist	2.29			4	SS	6-6-6-7 (12)	2" 8%		Top of sand (2.4 m BGS)
10				342.14								Top of screen (3.1 m BGS)
			SILTY SAND fine grained, light brown, wet	3.20			5	SS	0-3-3-7 (6)	16" 67%		No.2 Silica Sand
	4				AFB1 / AFB2	Upper / Midle Moraine Stratified Sediments and Equivalents						No.10 Slot PVC screen 50 mm diameter
15			some medium sand, trace silt beginning at 4.6 m BGS				6	SS	1-2-2-3 (4)	24" 100%		Bottom of screen (4.6 m BGS)
				340.16								
			End of Borehole	5.18								
20	6											
25	8											

Screen Interval: 3.05 - 4.57 m BGS
Sand Pack Interval: 2.44 - 4.57 m BGS
Well Seal Interval: 0.30 - 2.44 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
SS - split-spoon sample
n/a - not available

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Sheet 1 of 1

STANTEC BOREHOLE AND WELL 160330875 - DPS.GPJ EQUIS DATA TEMPLATE.GDT 2/1/11 MJFRASER

Test Pit: TP3-10

Project:	North Waterloo Subwatershed Study	**Drilling method:**	Rubber Tire Backhoe
Client:		**Date started/completed:**	10-Mar-2010
Location:	North Waterloo, ON	**Ground surface elevation:**	350.20 m AMSL
Number:	160340875	**Top of casing elevation:**	n/a
Field investigator:	L.Jo	**Easting:**	532454
Contractor:	Pro Core Drilling	**Northing:**	4814491

SUBSURFACE PROFILE					HYDROGEOLOGY		SAMPLE DETAILS		
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery
			Ground Surface	350.20					
			TOPSOIL silt, organics, dark brown, moist	0.00					
				349.90					
			SANDY SILT fine grained, light brown, loose, moist	0.30	ATB1	Upper Maryhill Port Stanley Till and Equivalents			
2	1								
4									
6	2								
8									
10	3								
12			End of Test Pit	346.54 3.66					
	4								
14									

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
n/a - not available

No standing water encountered within excavation

Drawn By/Checked By: OR/LV

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STANTEC BOREHOLE AND WELL 160330875 - DPS.GPJ EQUIS DATA TEMPLATE.GDT 1/18/11 MJFRASER

Test Pit: TP4-10

Project:	North Waterloo Subwatershed Study	**Drilling method:**	Rubber Tire Backhoe
Client:		**Date started/completed:**	10-Mar-2010
Location:	North Waterloo, ON	**Ground surface elevation:**	346.80 m AMSL
Number:	160340875	**Top of casing elevation:**	n/a
Field investigator:	L.Jo	**Easting:**	532628
Contractor:	Pro Core Drilling	**Northing:**	4814574

SUBSURFACE PROFILE					HYDROGEOLOGY		SAMPLE DETAILS		
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery
			Ground Surface	346.80					
			TOPSOIL clayey silt with organics, dark brown, moist	0.00					
				346.40					
			SAND medium grained, some fine and coarse sand, light brown, loose, moist	0.40					
2					AFB1 / AFB2	Upper / Middle Moraine Stratified Sediments and Equivalents			
	1		becoming wet at 1.0 m BGS	345.79					
			SAND some fine gravel, light brown, loose, well graded, wet	1.01					
4									
			standing water encountered at 1.8 m BGS	345.03					
6			End of Test Pit	1.77					
	2								
8									
10	3								
12									
	4								
14									

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
n/a - not available

Drawn By/Checked By: OR/LV

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Sheet 1 of 1

STANTEC BOREHOLE AND WELL 160330875 - DPS.GPJ EQUIS DATA TEMPLATE.GDT 1/18/11 MJFRASER

Test Pit: TP6-10

Project:	North Waterloo Subwatershed Study	**Drilling method:**	Rubber Tire Backhoe
Client:		**Date started/completed:**	11-Mar-2010
Location:	North Waterloo, ON	**Ground surface elevation:**	350.60 m AMSL
Number:	160340875	**Top of casing elevation:**	n/a
Field investigator:	L.Jo	**Easting:**	532803
Contractor:	Pro Core Drilling	**Northing:**	4814702

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS		
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery
			Ground Surface	350.60					
			TOPSOIL organics, dark brown, moist	0.00					
				350.20					
			CLAYEY SILT light brown, soft, moist	0.40					
2	1		wet layer at 1.1 m BGS		ATB1	Upper Maryhill Port Stanley Till and Equivalents			
4									
6	2								
				348.31					
8			SILT some clay, grey, soft, moist to wet	2.29					
				347.70					
10	3		CLAY grey, soft to firm, moist to wet	2.90					
				347.49					
			End of Test Pit	3.11					
12	4								
14									

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
n/a - not available

No standing water encountered within excavation

Drawn By/Checked By: OR/LV

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STANTEC BOREHOLE AND WELL 160330875 - DPS.GPJ EQUIS DATA TEMPLATE.GDT 1/18/11 MJFRASER

Test Pit: TP7-10

Project:	North Waterloo Subwatershed Study	**Drilling method:**	Rubber Tire Backhoe
Client:		**Date started/completed:**	10-Mar-2010
Location:	North Waterloo, ON	**Ground surface elevation:**	352.80 m AMSL
Number:	160340875	**Top of casing elevation:**	n/a
Field investigator:	L.Jo	**Easting:**	532458
Contractor:	Pro Core Drilling	**Northing:**	4814292

SUBSURFACE PROFILE					HYDROGEOLOGY		SAMPLE DETAILS		
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery
			Ground Surface	352.80					
			TOPSOIL clayey sand, organics, brown	0.00 352.50					
			SAND fine grained, brown, loose, moist	0.30	AFB1 / AFB2	Upper / Middle Moraine Stratified Sediments and Equivalents			
2									
	1								
4									
6									
	2								
8									
10									
	3								
12									
	4		End of Test Pit	348.84 3.96					
14									

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
n/a - not available

No standing water encountered within excavation

Drawn By/Checked By: OR/LV

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Sheet 1 of 1

STANTEC BOREHOLE AND WELL 160330875 - DPS.GPJ EQUIS DATA TEMPLATE.GDT 1/18/11 MJFRASER

Test Pit: TP8-10

Project:	North Waterloo Subwatershed Study	**Drilling method:**	Rubber Tire Backhoe
Client:		**Date started/completed:**	10-Mar-2010
Location:	North Waterloo, ON	**Ground surface elevation:**	346.30 m AMSL
Number:	160340875	**Top of casing elevation:**	n/a
Field investigator:	L.Jo	**Easting:**	532890
Contractor:	Pro Core Drilling	**Northing:**	4814475

SUBSURFACE PROFILE					HYDROGEOLOGY		SAMPLE DETAILS		
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery
			Ground Surface	346.30					
			CLAYEY SILT some organics, brown, moist	0.00	ATB1	Upper Maryhill Port Stanley Till and Equivalents			
				345.08					
			SILT some clay, light brown, soft to firm, moist	1.22					
				344.47					
			SAND fine grained, little silt, light brown, loose	1.83	AFB1 / AFB2	Upper / Middle Moraine Stratified Sediments and Equivalents			
			becoming wet at 2.3 m BGS						
			standing water encountered at 3.35 m BGS	342.95					
			End of Test Pit	3.35					

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
n/a - not available

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STANTEC BOREHOLE AND WELL 160330975 - DPS.GPJ EQUIS DATA TEMPLATE.GDT 1/18/11 MJFRASER

Test Pit: TP9-10

Project:	North Waterloo Subwatershed Study	**Drilling method:**	Rubber Tire Backhoe
Client:		**Date started/completed:**	11-Mar-2010
Location:	North Waterloo, ON	**Ground surface elevation:**	356.60 m AMSL
Number:	160340875	**Top of casing elevation:**	n/a
Field investigator:	L.Jo	**Easting:**	533098
Contractor:	Pro Core Drilling	**Northing:**	4814768

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS		
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery
			Ground Surface	356.60					
			TOPSOIL FROST fine grained with organics, dark brown, moist	0.00 356.30					
			SAND fine to medium grained, medium to light brown, loose, moist	0.30	AFB1 / AFB2	Upper / Middle Moraine Stratified Sediments and Equivalents			
2	1								
4									
6	2								
8									
10	3								
12									
	4		End of Test Pit	352.66 3.94					
14									

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
n/a - not available

No standing water encountered within excavation

Drawn By/Checked By: OR/LV

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Sheet 1 of 1

STANTEC BOREHOLE AND WELL 160330875 - DPS.GPJ EQUIS DATA TEMPLATE.GDT 1/18/11 MJFRASER

Test Pit: TP10-10

Project:	North Waterloo Subwatershed Study	**Drilling method:**	Rubber Tire Backhoe
Client:		**Date started/completed:**	10-Mar-2010
Location:	North Waterloo, ON	**Ground surface elevation:**	355.20 m AMSL
Number:	160340875	**Top of casing elevation:**	n/a
Field investigator:	L.Jo	**Easting:**	533243
Contractor:	Pro Core Drilling	**Northing:**	4814589

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS		
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery
			Ground Surface	355.20					
			TOPSOIL fine to medium grained sand with organics, dark brown, moist	0.00 354.90					
			SAND fine to medium grained, some coarse sand, trace gravel, trace cobbles (rounded), trace boulders, light brown, loose, moist	0.30					
2	1		gravel seam approx 0.15 m thick at 0.9 m BGS						
4									
6	2				AFB1 / AFB2	Upper / Middle Moraine Stratified Sediments and Equivalents			
8									
10	3			351.33					
12	4		End of Test Pit	3.87					
14									

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
n/a - not available

No standing water encountered within excavation

Drawn By/Checked By: OR/LV

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Sheet 1 of 1

STANTEC BOREHOLE AND WELL 160330875 - DPS.GPJ EQUIS DATA TEMPLATE.GDT 1/18/11 MJFRASER

APPENDIX B

SANITARY DESIGN CALCULATIONS

Drawing on experience...Building on strength.

NORTHGATE SUBDIVISION

CITY OF WATERLOO, Ontario

Project Number: 39502-104
Date: July 4, 2017
Design By: MSB
Checked By: XXX
File: Q:\39502\104\Prelim Sanitary\39502-104 Sanitary Sewer Design Sheet Waterloo (SSMS) Rev4.xls

SANITARY SEWER DESIGN SHEET

ENGINEERING AND PUBLIC WORKS

Drainage Area Plan No: Figure 7.0

Design Parameters

Average Daily Flow
Residential 0.00318 L/s/c
275.0 L/c/day
Commercial 1.5 L/s/ha
Industrial 0.5 L/s/ha
Inst. / School 2.5 L/s/ha

Mannings "*n*" 0.0130
Min. Velocity 0.6 m/sec
Max. Velocity 3.0 m/sec
Residential Harmon Peaking Factor (F)
Residential Areas Infiltration 0.15 L/s/ha

LOCATION				RESIDENTIAL AREAS and POPULATION						SCHOOL, INSTITUTIONAL			COMMERCIAL			INDUSTRIAL				INFILTRATION			DESIGN					
										HECTARES AND FLOW OF EACH ZONING																	
										2.50 *L/s/ha*			1.50 *L/s/ha*			0.50 *L/s/ha*											
STREET	AREA NO.	MANHOLE LOCATION FROM MH	MANHOLE LOCATION TO MH	MAX UNITS	DENSITY	POPUL.	CUMUL POPUL.	PEAK FACTOR "F"	PEAK RES. FLOW	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW	TOTALS-C-I FLOW	AREA	CUMUL AREA	INFIL FLOW	TOTAL VOLUME FLOW	LENGTH	SLOPE	PIPE SIZE	CAPACITY	FULL FLOW VELOCITY
				each	*ppu*	*1000s*	*1000s*		*L/sec*	*ha*	*ha*	*L/sec*	*ha*	*ha*	*L/sec*	*ha*	*ha*	*L/sec*	*L/sec*	*ha*	*ha*	*L/sec*	*L/sec*	*m*	*%*	*mm*	*L/sec.*	*m/s*
To CONSERVATION DRIVE SPS																												
Condo Block (east)	1			15	3.30	0.050	0.050	4.315582	0.6799	0.00	0.00	0.0000	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	1.95	1.95	0.2925	0.9724	0.0	0.50	250	42.0285	0.857
Condo Block (central)	2			39	3.30	0.129	0.178	4.16589	2.3628		0.00	0.0000		0.00	0.0000		0.00	0.0000	0.0000	3.30	5.25	0.7875	3.1503	0.0	0.50	250	42.0285	0.857
Condo Block (west)	3			26	3.30	0.086	0.086	4.261186	1.1637	0.00	0.00	0.0000	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	2.05	2.05	0.3075	1.4712	0.0	0.60	200	25.3927	0.809
Stage 3 (west)	4			35	3.30	0.116	0.116	4.225916	1.5535	0.00	0.00	0.0000	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	2.00	2.00	0.3000	1.8535	0.0	0.60	200	25.3927	0.809
Stage 3 (Multi-Res)	5			48	2.18	0.105	0.105	4.238131	1.4115	0.00	0.00	0.0000	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.65	0.65	0.0975	1.5090	0.0	0.60	200	25.3927	0.809
Stage 3 (central)	6			49	3.30	0.162	0.266	4.100033	3.4757		0.00	0.0000		0.00	0.0000		0.00	0.0000	0.0000	3.15	3.80	0.5700	4.0457	0.0	0.60	200	25.3927	0.809
Stage 3 (south)	7			27	3.30	0.089	0.735	3.882268	9.0815	0.00	0.00	0.0000	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	1.35	14.45	2.1675	11.2490	0.0	0.50	250	42.0285	0.857
Stage 4	8			43	3.30	0.142	0.877	3.836076	10.7060		0.00	0.0000		0.00	0.0000		0.00	0.0000	0.0000	1.85	16.30	2.4450	13.1510	0.0	0.50	250	42.0285	0.857
Stage 3 (Multi-Res)	9			51	2.18	0.111	0.988	3.803369	11.9606		0.00	0.0000		0.00	0.0000		0.00	0.0000	0.0000	0.85	17.15	2.5725	14.5331	0.0	0.50	250	42.0285	0.857
							58	ppha																				
To BEAVER CREEK ROAD SPS																												
Stage 2 (Multi-Res)	11			373	2.18	0.813	0.813	3.856127	9.9801	0.00	0.00	0.0000	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	6.00	6.00	0.9000	10.8801	0.0	0.60	200	25.3927	0.809
Stage 1 (Multi-Res)	12			88	2.18	0.192	1.005	3.798608	12.1507	0.00	0.00	0.0000	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	1.25	7.25	1.0875	13.2382	0.0	0.60	200	25.3927	0.809
Stage 1 (SF)				67	3.30	0.221	1.226	3.741182	14.5998		0.00	0.0000		0.00	0.0000		0.00	0.0000	0.0000	2.80	10.05	1.5075	16.1073	0.0	0.60	200	25.3927	0.809
							122	ppha																				
				861	Max. units		81	ppha	(Avg.)																			

CONSERVATION DRIVE

BEAVER CREEK ROAD

MULTI-BLOCK PUMPED TO STREET ONE

SPS

STREET ONE

STREET TWO

STREET THREE

STREET FOUR

STREET FIVE

STREET SIX

5 — 0.65

4 — 2.00

6 — 3.15

9 — 0.85

11 — 6.00

7 — 1.35

8 — 1.85

3 — 2.05

2 — 3.30

1 — 1.95

12 — 4.05

Stage 1

Stage 2

Stage 3

Stage 4

Stage 5

Surveyed Wetland

Floodline

Beaver Creek

Laurel Creek

LEGEND

- SUBJECT LANDS
- SANITARY DRAINAGE AREA
- CATCHMENT NUMBER
- AREA (ha.)
- FLOW ROUTE

FIGURE 7.0

Date: JUL.05/17
Scale: 1:3000

NORTHGATE & ERBSVILLE KARTWAY SUBDIVISIONS

SANITARY DRAINAGE AREAS

MTE
Engineers | Scientists | Surveyors

Project No.: 39502-104

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APPENDIX C

PRELIMINARY
WATER DISTRIBUTION ANALYSIS

Drawing on experience...Building on strength.

NORTHGATE & ERBSVILLE KARTWAY SUBDIVISIONS
BEAVER CREEK MEADOWS DISTRICT, WATERLOO

Preliminary
Water Distribution Analysis

Project Location:
East of Erbsville Road
West of Beaver Creek Road
South of Conservation Drive
Waterloo, Ontario

Prepared for:
1017081 Ontario Limited and Gabriella Elizabeth Groff (Northgate Subdivision)
1455136 Ontario Inc. (Erbsville Kartway Subdivision)
c/o Mr. Paul Grespan
675 Riverbend Drive
Kitchener, ON N2K 3S3

Prepared by:
MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, ON N2B 3X9



July 5, 2017

MTE File No.: 39502-104

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1.0 INTRODUCTION

1.1 Overview

MTE Consultants Inc. (MTE) was retained by Mr. Brian Groff, on behalf of 1017081 Ontario Limited and Gabriella Groff (Northgate Subdivision) and Mr. Steve Fries on behalf of 1455136 Ontario Inc. (Erbsville Kartway Subdivision), to undertake a Preliminary Water Distribution Analysis for the proposed Northgate and Erbsville Kartway residential subdivisions, located in the City of Waterloo. The analysis has been prepared for the two subdivisions as part of a "complete application" and to support Draft Plan approval. The location of the proposed development is presented in **Figure 1.0**.

MTE has prepared this Preliminary Water Distribution Analysis to determine if adequate pressure and flow demands are able to be met through connections to the proposed water distribution network. This analysis was also used to determine the pipe sizes for the proposed internal water distribution network.

1.2 Background and Macro Water Distribution System Overview

The entire subject lands are approximately 55.71 ha, of which approximately 49.29 ha are part of the Northgate Land Corp property and 6.42 ha are part of the Erbsville Kartway property. Approximately 16.13 ha of land along Beaver Creek, within the Northgate Lands Corp property are located outside the plan of subdivision and will be maintained as open space. The remaining 33.16 ha of the Northgate Lands Corp property is subject to the subdivision application to be filled for the Northgate Lands. The Erbsville Kartway property is subject to separate application. One report has been prepared for both properties given inter-related design considerations.

The subject lands are part of the Beaver Creek Meadows District. The subject lands are generally bounded by Conservation Drive to the north, Beaver Creek Road to the east, Laurel Creek and associated conservation lands to the south, and Laurel Creek and agricultural lands to the west. Further west is Erbsville Road. The proposed Draft Plans of Subdivision (reduced to 11x17) showing the blocks and proposed unit counts is included as **Appendix A**. In general the proposed development can be broken down into two separate areas: the east side (east of Beaver Creek) and the west side (west of Beaver Creek). On the west side of Beaver Creek, the overall neighbourhood will be developed in three stages. The neighbourhood will include detached homes, stacked townhomes, and a condominium development. To the east of Beaver Creek, the development is primarily multiple residential and stacked townhomes, but also includes a small number of detached homes.

The subject lands are located within Waterloo Pressure Zone 5 ("WAT5"). Pressure information from Region of Waterloo modelling suggests that the average day hydraulic grade line ("HGL") is between 404.38 and 404.42 mASL for zone WAT5.

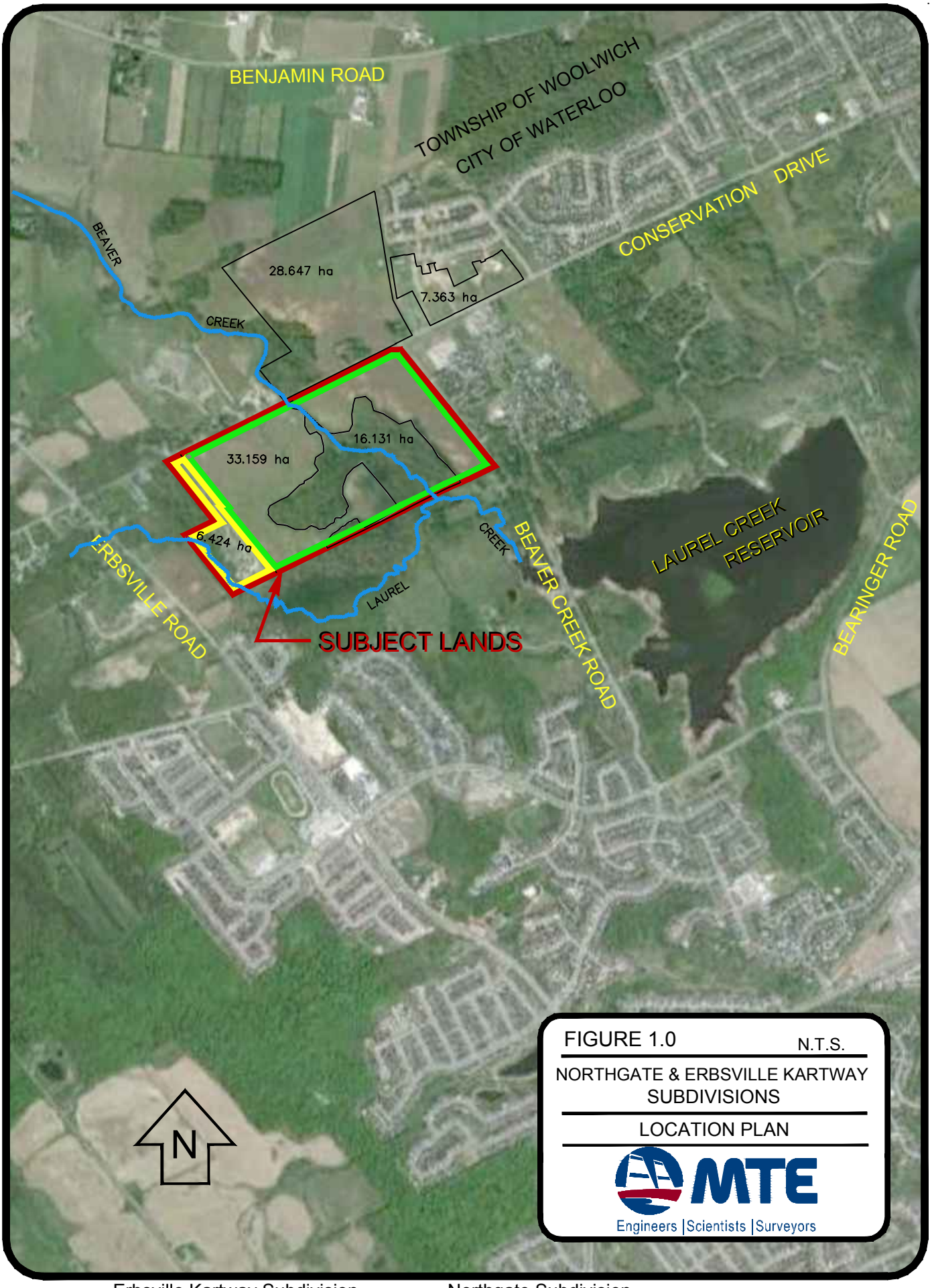


FIGURE 1.0 N.T.S.

NORTHGATE & ERBSVILLE KARTWAY SUBDIVISIONS

LOCATION PLAN

MTE Engineers | Scientists | Surveyors

Erbsville Kartway Subdivision Northgate Subdivision

CAD: P:\P\39502\104\39502-104-F21_LOCATION Project: 39502-104

July 5, 2017 - 8:42 a.m. - Plotted By: ccarre

2.0 ANALYSIS METHODOLOGY

2.1 Micro Water Distribution System Model Development

The Haestad Methods water distribution system analysis program WaterCAD (Version 8.0) was utilized for the analysis of the local water distribution system for this study. The Region of Waterloo maintains a macro scale water distribution model, developed for trunk supply, using Innovyze's Infowater. The macro scale pressure and flow information from the Region's Infowater model is used in MTE's micro scale model to ensure the system operates within the allowable pressure ranges. The WaterCAD model also includes the proposed lot fabric and watermain connectivity to size the internal watermains, accounting for looping and headlosses in the local system.

At this time, MTE is proposing two options for providing water service to the proposed development. The only difference between the options is the method by which the proposed condominium complex in the southwestern portion of the development is serviced. Option 1 involves the condominium complex having two connections, complete with backflow valves, to the municipal water distribution system at Street Three. The layout of the water distribution network for Option 1, which includes the location of Regional nodes, local water demand junctions, and water demand areas, is presented in **Figure 2.0**. Option 2 involves the condominium complex having only one connection to the municipal water distribution system, which is also equipped with a backflow valve, while the watermain for the condominium is looped internally. The layout of the water distribution network for Option 2 is presented in **Figure 3.0**.

2.1.1 *Network Connections*

Both the west and east areas of the proposed development connect directly to the proposed Regional watermains on Conservation Drive and Beaver Creek Road. There will be a total of five connection points for the entire proposed development: two for the west side and three for the east side. The connections to the municipal water distribution system are as follows:

West of Beaver Creek

- Connection to the proposed 300 mm diameter watermain extension on Conservation Drive at the intersection with the west branch of Street Three;
- Connection to the proposed 300 mm diameter watermain extension on Conservation Drive at the intersection with the east branch of Street Three;

East of Beaver Creek

- Connection to the proposed 300 mm diameter watermain extension on Conservation Drive at the intersection with the north branch of Street One;
- Connection to the proposed 300 mm diameter watermain extension on Beaver Creek Road at the intersection with the south branch of Street One; and,

J-1/JCT_78138

PROPOSED 300mmØ WTM EXTENTION

J-2/JCT_78137

CONSERVATION DRIVE

PROPOSED 300mmØ WTM EXTENTION

J-18

EX. 300mmØ WTM

J-27/
JCT_78135

PROPOSED 300mmØ WTM EXTENTION

J-26/
JCT_78134

BEAVER CREEK ROAD

J-25/
JCT_78133

J-24

J-23

STREET TWO

200mmØ WTM

J-22

J-21

300mmØ WTM

J-20

STREET ONE

J-19

200mmØ WTM

STREET THREE

J-4

200mmØ WTM

J-3

STREET FOUR

J-5

STREET SIX

J-6

J-7

J-8

J-9

STREET FIVE

STREET THREE

200mmØ WTM

J-11

150mmØ WTM

J-12

BCK FLOW

J-10

BCK FLOW

J-13

150mmØ WTM

J-14

200mmØ WTM

J-15

J-16

J-17

200mmØ WTM

Stage 1

Stage 2

Stage 3

Stage 4

Surveyed Wetland

Floodline

Laurel Creek

WATERLOO PRESSURE ZONE 5

N

LEGEND

SUBJECT LANDS	
J-3 DEMAND JUNCTION	150mmØ WTM — PROPOSED 150mmø WTM
J-1/ JCT_78138 REGION OF WATERLOO SUPPLY NODE	200mmØ WTM — PROPOSED 200mmø WTM
BCK FLOW BACKFLOW PREVENTER VALVE	300mmØ WTM — PROPOSED 300mmø WTM WTM EXTENSIONS
JUNCTION CONTRIBUTING AREA	300mmØ WTM — EXISTING 300mmø WTM

FIGURE 2.0

Date: JUL.05/17
Scale: 1:3000

NORTHGATE & ERBSVILLE
KARTWAY SUBDIVISIONS

CONCEPTUAL WATER
DISTRIBUTION NETWORK OPTION 1

MTE
Engineers | Scientists | Surveyors

Project No.: 39502-104

July 5, 2017 — 1:49 p.m. — Plotted By: ccarre

P:\P\39502\104\39502-104-F17-FIGURE 2.0.dwg

J-1/JCT_78138

PROPOSED 300mmØ WTM EXTENTION

J-2/JCT_78137

CONSERVATION DRIVE

PROPOSED 300mmØ WTM EXTENTION

J-18

EX. 300mmØ WTM

J-27/
JCT_78135

J-19

PROPOSED 300mmØ WTM EXTENTION

200mmØ WTM

200mmØ WTM

STREET THREE

J-4

200mmØ WTM

J-3

STREET FOUR

J-5

Stage 3

Stage 2

Stage 2

STREET ONE

STREET SIX

J-6

J-7

J-8

J-9

J-20

300mmØ WTM

J-21

J-26/
JCT_78134

STREET FIVE

Stage 4

Stage 3

J-11

J-22

J-10

150mmØ WTM

J-12

J-28/BCK FLOW

200mmØ

WATERLOO PRESSURE ZONE 5

Surveyed Wetland

Creek

Floodline

Floodline

Surveyed Wetland

Stage 1

J-23

STREET TWO

BEAVER CREEK ROAD

200mmØ WTM

Stage 1

Stage 1

200mmØ WTM

J-14

150mmØ WTM

J-13

Surveyed Wetland

Laurel Creek

Floodline

Stage 5

J-24

J-25/
JCT_78133

J-15

J-16

J-17

200mmØ WTM

LEGEND

	SUBJECT LANDS
J-3	DEMAND JUNCTION
J-1/ JCT_78138	REGION OF WATERLOO SUPPLY NODE
BCK FLOW	BACKFLOW PREVENTER VALVE
	JUNCTION CONTRIBUTING AREA
150mmØ WTM	PROPOSED 150mmø WTM
200mmØ WTM	PROPOSED 200mmø WTM
300mmØ WTM	PROPOSED 300mmø WTM WTM EXTENSIONS
300mmØ WTM	EXISTING 300mmø WTM

FIGURE 3.0

Date: JUL.05/17
Scale: 1:3000

NORTHGATE & ERBSVILLE KARTWAY SUBDIVISIONS

CONCEPTUAL WATER DISTRIBUTION NETWORK OPTION 2

MTE

Engineers | Scientists | Surveyors

Project No.: 39502-104

July 5, 2017 — 1:50 p.m. — Plotted By: ccarre

P:\P\39502\104\39502-104-F17-FIGURE 3.0.dwg

- Connection to the proposed 300 mm diameter watermain extension on Beaver Creek Road at the intersection with Street Two.

The nearest existing Region of Waterloo Water Distribution Model nodes are JCT_78138 and JCT_78134. Node JCT_78138 is located at the intersection of Conservation Drive and Street Three; whereas node JCT_78134 is located at the intersection of Beaver Creek Road and Street One. Node JCT_78138 was used to supply water for the west side of the proposed development and node JCT_78134 was used to supply the east side.

2.1.2 System Pressure

The system pressure information used for this analysis is based on the Region of Waterloo's Infowater water distribution model results provided by the Region of Waterloo (Mr. Kevin Dolishny) on March 24, 2017 for nodes JCT_78138 and JCT_78134. The system pressures were determined for the average day, maximum day, peak hour, minimum hour, and maximum day plus fire flow scenarios.
TABLE 2.2, provides a summary of the system flows and pressures for each Regional node. **Appendix B** contains the flow and pressure information received from the Region of Waterloo.

2.2 Design Criteria

The network for the analysis was developed by assigning physical parameters to each node and pipe. The model was run under five demand scenarios: Average Day, Maximum Day, Minimum Hour, Peak Hour, and Maximum Day + Fire Flow. Each scenario was checked against guidelines for pressure and fire flow availability. The parameters and criteria are outlined in the following sections.

2.2.1 System Demands

The system demands were based on land use, unit density and Region of Waterloo typical usage rates. Typical unit densities were obtained from the Region of Waterloo's *2017 Water and Wastewater Monitoring Report (ROW, 2017)*. The population density information used is summarized in Table 2.1 below:

TABLE 2.1 - POPULATION DENSITIES

Structure Type	PPU
Single detached	3.25
Semi-detached	3.25
Townhouse	2.44
Apartment	1.77
Multiple Unit Types	2.11
Unspecified Unit Type	3.05

System demands for the proposed development were based on a rate of 225 L/p/d, as specified in the *Tri-City Distribution System Study (Aecom, 2009)*. The proposed

number and type of units used in calculating population were obtained from the Draft Plan of Subdivision prepared by MHBC. The Draft Plan consists of detached homes, townhouses, stacked townhomes, and condominiums of varying densities. Based on the Draft Plans and the unit densities summarized in Table 2.1, the Northgate and Erbsville Kartway subdivisions proposed population is estimated at up to 2,108. The population was multiplied by the average daily per capita demand for residential development to generate a demand for the site. The usage rates and demand calculations for each node are provided in **Appendix C**.

TABLE 2.2 - SYSTEM PRESSURE USED IN THE MODEL FOR NODES JCT_78138 AND JCT_78134

JCT_78138		JCT_78134	
Available Flow (L/s)	**Residual Pressure (m)**	**Available Flow (L/s)**	**Residual Pressure (m)**
0.0	52.0	0.0	52.0
10.0	51.7	10.0	51.7
20.0	51.1	20.0	51.2
30.0	50.5	30.0	50.6
40.0	49.7	40.0	49.8
50.0	48.8	50.0	49.0
60.0	47.8	60.0	48.0
70.0	46.7	70.0	46.9
80.0	45.4	80.0	45.7
90.0	44.0	90.0	44.4
100.0	42.5	100.0	43.0
110.0	40.9	110.0	41.4
120.0	39.2	120.0	39.8
130.0	37.4	130.0	38.1
140.0	35.4	140.0	36.2
150.0	33.4	150.0	34.3
160.0	31.2	160.0	32.2
170.0	29.0	170.0	30.1
180.0	26.6	180.0	27.9
190.0	24.1	190.0	25.5
200.0	21.6	200.0	23.1
210.0	18.9	210.0	20.5
219.0	16.4	215.0	19.2

2.2.2 Peaking Factors

Section B.2.2.5 of the Region of Waterloo's *Design Guidelines and Supplemental Specifications for Municipal Services (RMOW, 2017)* ("DGSSMS") states the peaking factors used to calculate minimum hour, maximum day, and peak hour demands must be based on: historical information, the Tri-City Water Distribution Master Plan, Ministry of the Environment and Climate Change guidelines, or as directed by the municipality. MTE has also referenced the recently published update to the water distribution master plan where appropriate. Table 2.3 summarizes the peaking factors used for this analysis:

TABLE 2.3 - PEAKING FACTORS

Demand Scenario	Factor
Average Day	1.00
Maximum Day	1.44
Peak Hour	3.38
Minimum Hour	0.45

2.2.3 Pressure Requirements

As outlined in Section B.2.4 of the Region of Waterloo's DGSSMS, the pressure guidelines used for all demand scenarios are shown in Table 2.4.

TABLE 2.4 - MOE PRESSURE REQUIREMENTS

Demand Scenario	Pressure Guidelines (kPa)	
	Minimum	Maximum
Average Day	350	550
Maximum Day	350	550
Peak Hour	275	700
Minimum Hour	275	700
Max Day + Fire	140	700

The maximum static pressure in the watermain system should not exceed 700 kPa under any scenario. In cases where all services are protected by an individual pressure reducing device, the maximum pressure in the watermain system shall not exceed 825 kPa. The use of individual pressure reducing valves, if required, shall be approved by the municipality.

2.2.4 Fire Flow Requirements

Various guidelines and references exist for calculating the required water supply for firefighting purposes. In Ontario, 2 standards/guidelines are most often referenced. They are:

1. Ontario Building Code (OBC) – Provincial codes and guidelines published by the Ministry of Municipal Affairs and Housing for the Province of Ontario.
2. The Fire Underwriters Survey (FUS) – an insurance industry guideline.

Many municipalities in Ontario use both the OBC and the FUS fire flow requirements for assessing firefighting water supply requirements. Ideally, fire flow demands for new developments are calculated based on the FUS criteria, however it is not reasonable to expect that the existing municipal watermain infrastructure always has the operational capacity to supply water at the rates prescribed in the FUS guidelines. As a result, at no time shall the available fire flow be less than that required by the Ontario Building Code. *Water Supply for Public Fire Protection, A Guide to Recommended Practice (1999), Fire Underwriter's Survey (FUS)*. Based on the FUS manual, the required fire flow is as follows:

- High-density, 4 story, 16 unit multi-residential – 9,000 L/min (150 L/s)
- High-density, 4 story, 24 unit multi-residential – 11,000 L/min (183 L/s)
- Medium-density, contiguous multi-block Townhomes - 8,000 L/min (133 L/s)
- Medium-density, single family homes < 3m separation - 6,000 L/min (100 L/s)

The calculation of the required fire flow for the high-density multi-residential blocks is included in **Appendix D**.

2.2.5 Friction Factors

Section B.2.3.1 of the *DGSSMS* recommends the following Hazen-Williams "C" values be used to estimate frictional losses through the system, regardless of size. The friction factors, as specified in the DGSSMS guidelines, include an allowance for age.

TABLE 2.5 - HAZEN-WILLIAMS C-FACTORS

Material (mm)	C-Factor
PVC	150
DI	130
CPP	130
HDPE	140
Unknown	140

2.2.6 Velocity Requirements

Section C.2.3.4 of the *DGSSMS* recommends that velocities throughout the distribution system not exceed a maximum of 5 m/s under all flow conditions.

2.2.7 Minor Losses

Minor losses are caused by appurtenances and fittings along the length of pipe in the system. For this preliminary analysis, a conservative K value of 1.0 was used for all pipes.

3.0 RESULTS

Both scenarios of the model were run to analyze the pipe sizes according to the aforementioned design criteria, under the various demand scenarios. **Appendix E** provides the proposed network and a series of tables summarizing the output results of the WaterCAD analyses.

3.1 Option 1 Results

Table 3.1 demonstrates that for Option 1 the water distribution system will adequately provide the recommended pressures under average day, maximum day, peak hour, and minimum hour; and the recommended FUS fire flows at the minimum MOECC pressure of 140 kPa under the proposed development conditions. The maximum velocity in each pipe is less than the Region's limit of 5 m/s for all flow scenarios.

3.2 Option 2 Results

Table 3.2 demonstrates that for Option 2 the water distribution system will adequately provide the recommended pressures under average day, maximum day, peak hour, and minimum hour; and the recommended FUS fire flows at the minimum MOECC pressure of 140 kPa under the proposed development conditions. The maximum velocity in each pipe is less than the Region's limit of 5 m/s for all flow scenarios.

Based on the similar modelling results, it can be concluded that both water distribution options can be adequately serviced as described in this analysis. MTE's preferred option is Option 1.

TABLE 3.1 - MODELLING RESULTS FOR PROPOSED DEVELOPMENT – OPTION 1

Node	Elev. (m)	Pressure (kPa)				Maximum Day + Fire Flow				
		Avg. Day	Max. Day	Min. Hour	Peak Hour	Total Flow Required (L/s)	Total Flow Available (L/s)	Residual Pressure (kPa)[1]	Pipe w/ Max. Velocity	Velocity of Max Pipe (m/s)
J-1	352.00	506.2	506.1	506.3	505.1	100.00	215.00	162.7	P-66	0.28
J-2	352.00	506.2	506.1	506.3	505.1	100.00	212.61	140.0	P-32	2.30
J-3	352.60	500.3	500.2	500.5	499.1	100.19	201.86	140.0	P-25	3.89
J-4	351.89	507.3	507.1	507.4	506.0	183.51	193.91	140.0	P-25	3.36
J-5	351.26	513.2	513.0	513.3	511.9	183.53	203.79	143.1	P-28	3.52
J-6	352.21	504.2	504.0	504.3	502.9	100.11	190.44	140.0	P-26	3.77
J-7	351.60	510.1	510.0	510.3	508.8	100.18	149.27	154.0	P-6	3.38
J-8	350.90	517.0	516.8	517.1	515.7	100.13	193.74	141.4	P-27	3.78
J-9	349.43	531.4	531.2	531.5	530.1	100.47	152.00	140.0	P-22	4.37
J-10	351.80	508.2	508.0	508.3	506.9	100.08	182.25	140.0	P-24	3.55
J-11	350.98	516.2	516.0	516.3	514.9	100.17	182.45	140.0	P-25	3.17
J-12	350.45	521.4	521.2	521.5	520.1	100.21	188.60	140.0	P-27	3.37
J-13	352.59	500.4	500.3	500.6	499.1	100.35	139.20	140.1	P-8	4.60
J-14	352.05	505.7	505.6	505.9	504.4	100.22	160.25	143.7	P-6	3.99
J-15	352.60	500.3	500.2	500.5	499.1	100.08	159.43	140.0	P-45	4.52
J-16	353.03	496.1	496.0	496.3	494.8	100.13	133.66	140.1	P-58	4.26
J-17	352.53	501.0	500.9	501.2	499.7	100.18	119.95	140.0	P-58	3.82
J-18	358.50	442.9	442.7	443.0	441.3	100.00	196.72	140.0	P-39	1.44
J-19	357.62	451.5	451.3	451.6	449.9	188.71	200.65	145.6	P-50	1.52
J-20	357.01	457.4	457.3	457.6	455.9	133.21	200.76	148.9	P-50	1.85
J-21	356.09	466.4	466.3	466.6	464.9	100.19	202.64	159.1	P-52	1.84
J-22	353.82	488.7	488.5	488.8	487.1	183.29	204.05	182.9	P-52	2.23
J-23	353.67	490.1	489.9	490.3	488.6	100.62	195.19	140.0	P-53	3.52
J-24	349.72	528.8	528.6	529.0	527.3	183.29	204.76	173.1	P-56	4.55
J-25	348.00	545.6	545.4	545.8	544.1	100.00	204.61	209.3	P-41	2.25
J-26	352.00	506.5	506.3	506.6	505.0	100.00	204.82	203.6	P-67	0.27
J-27	357.00	457.5	457.3	457.7	456.0	100.00	199.49	150.3	P-39	1.75

Notes:

1. Residual pressure is the lesser of the calculated residual pressure of the node or the minimum pressure remaining in the network at the total available fire flow condition.

TABLE 3.2 - MODELLING RESULTS FOR PROPOSED DEVELOPMENT – OPTION 2

Node	Elev. (m)	Pressure (kPa)				Maximum Day + Fire Flow				
		Avg. Day	Max. Day	Min. Hour	Peak Hour	Total Flow Required (L/s)	Total Flow Available (L/s)	Residual Pressure (kPa)[1]	Pipe w/ Max. Velocity	Velocity of Max Pipe (m/s)
J-1	352.00	506.2	506.1	506.3	505.0	100.00	215.00	162.3	P-66	0.28
J-2	352.00	506.2	506.1	506.3	504.9	100.00	212.45	140.0	P-32	2.30
J-3	352.60	500.3	500.2	500.5	499.0	100.19	201.69	140.0	P-25	3.89
J-4	351.89	507.3	507.1	507.4	505.9	183.51	193.76	140.0	P-25	3.36
J-5	351.26	513.1	513.0	513.3	511.8	183.53	202.81	145.6	P-28	3.50
J-6	352.21	504.1	504.0	504.3	502.8	100.11	190.28	140.0	P-26	3.77
J-7	351.60	510.1	509.9	510.3	508.6	100.18	142.91	154.0	P-68	4.58
J-8	350.90	517.0	516.8	517.1	515.6	100.13	192.15	146.0	P-27	3.76
J-9	349.43	531.3	531.2	531.5	529.9	100.47	151.88	140.0	P-22	4.37
J-10	351.80	508.2	508.0	508.3	506.7	100.08	182.08	140.0	P-24	3.55
J-11	350.98	516.2	516.0	516.3	514.8	100.17	176.53	160.1	P-25	3.08
J-12	350.45	521.4	521.2	521.5	520.0	100.21	186.27	147.4	P-27	3.33
J-13	352.59	500.4	500.2	500.6	499.0	100.35	129.13	140.0	P-68	4.14
J-14	352.05	505.7	505.5	505.8	504.3	100.22	153.32	145.4	P-68	4.91
J-15	352.60	500.3	500.2	500.5	498.9	100.08	159.31	140.0	P-45	4.52
J-16	353.03	496.1	495.9	496.3	494.6	100.13	129.02	140.0	P-68	4.14
J-17	352.53	501.0	500.8	501.1	499.5	100.18	116.59	140.0	P-68	3.74
J-18	358.50	442.9	442.7	443.0	441.3	100.00	196.72	140.0	P-39	1.44
J-19	357.62	451.5	451.3	451.6	449.9	188.71	200.65	145.6	P-50	1.52
J-20	357.01	457.4	457.3	457.6	455.9	133.21	200.76	148.9	P-50	1.85
J-21	356.09	466.4	466.3	466.6	464.9	100.19	202.64	159.1	P-52	1.84
J-22	353.82	488.7	488.5	488.8	487.1	183.29	204.05	182.9	P-52	2.23
J-23	353.67	490.1	489.9	490.3	488.6	100.62	195.19	140.0	P-53	3.52
J-24	349.72	528.8	528.6	529.0	527.3	183.29	204.76	173.1	P-56	4.55
J-25	348.00	545.6	545.4	545.8	544.1	100.00	204.61	209.3	P-41	2.25
J-26	352.00	506.5	506.3	506.6	505.0	100.00	204.82	203.6	P-67	0.27
J-27	357.00	457.5	457.3	457.7	456.0	100.00	199.49	150.3	P-39	1.75
J-28	350.98	516.2	516.0	516.3	514.7	100.17	169.86	160.1	P-68	5.44

Notes:

1. Residual pressure is the lesser of the calculated residual pressure of the node or the minimum pressure remaining in the network at the total available fire flow condition.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the preliminary water distribution analysis, the following conclusions and recommendations are provided:

- Connections to the proposed Regional watermains will adequately service the proposed water distribution network, for both Option 1 and Option 2, for the proposed Northgate and Erbsville Kartway Subdivisions. It is expected that the 300 mm watermain extensions will be undertaken coincident with upgrading both Conservation Drive and Beaver Creek Road prior to servicing of the subject lands.

- The proposed water distribution network will provide system pressures within the respective pressure guidelines for both Option 1 and Option 2 and will not require pressure reducing valves.

- Under both proposed development conditions the recommended FUS fire flows are satisfied at the minimum MOECC pressure requirement of 140kPa.

- For both Option 1 and Option 2 the maximum velocity in the system is less than the Region's limit of 5 m/s for all demand scenarios.

- MTE's preferred servicing option is Option 1.

- It is recommended that a final water distribution analysis report be prepared during the final design of each of the proposed Northgate Subdivision and Erbsville Kartway Subdivision.

All of which is respectfully submitted,

MTE CONSULTANTS INC.

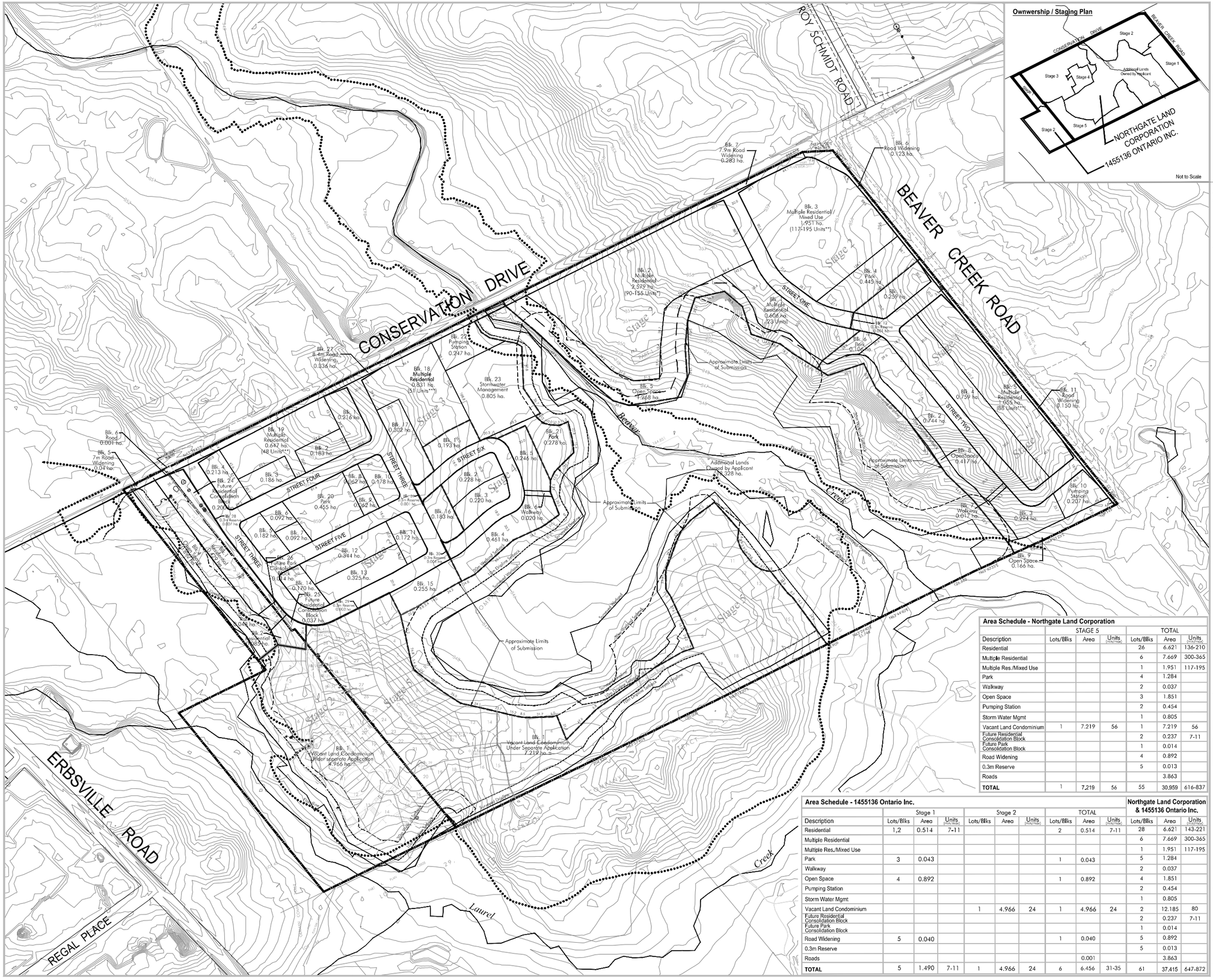
LICENSED PROFESSIONAL ENGINEER
July 5/17
V. LAZIC
100025286
PROVINCE OF ONTARIO

Charles Carré, E.I.T.
Designer

Valentina Lazic, P.Eng.
Design Engineer

APPENDIX A

DRAFT PLAN OF SUBDIVISION

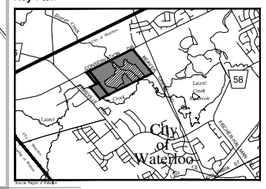


Ownership / Staging Plan

Legal Description

PART OF LOT 28, GERMAN COMPANY TRACT,
(GEOGRAPHIC TOWNSHIP OF WATERLOO),
CITY OF WATERLOO,
REGIONAL MUNICIPALITY OF WATERLOO

Key Plan



Additional Information Required Under Section 51(17) of the Planning Act R.S.O. 1990, c.P.13 as Amended

A. As Shown — B. As Shown — C. As Shown
D. Residential, Park, Open Space, Stormwater Management
E. As Shown — F. As Shown
G. As Shown — H. Municipal Water Supply — I. Sandy Loam
J. As Shown — K. All Services As Required — L. As Shown

Area Schedule - Northgate Land Corporation — 30T - _____

Description	STAGE 1 Lots/Blks	Area	Units (min/max)	STAGE 2 Lots/Blks	Area	Units (min/max)
Residential	1-4	2.056	45-67			
Multiple Residential	5	1.055	88	1,2	3.185	113-178
Multiple Res./Mixec Use				3	1.951	117-195
Park	6	0.106		4	0.445	
Walkway	7	0.017				
Open Space	8, 9	0.583		5	1.268	
Pumping Station	10	0.207				
Storm Water Mgmt						
Road Widening	11	0.150		6, 7	0.406	
0.3m Reserve	12	0.001				
Roads		0.878			0.461	
TOTAL	12	5.053	133-155	7	7.716	230-373

Description	STAGE 3 Lots/Blks	Area	Units (min/max)	STAGE 4 Lots/Blks	Area	Units (min/max)
Residential	1-17	3.217	64-100	1-5	1.348	27-43
Multiple Residential	18,19	1.478	99			
Park	20,21	0.733				
Walkway				6	0.020	
Open Space						
Pumping Station	22	0.247				
Storm Water Mgmt	23	0.805				
Future Residential Consolidation Block	24,25	0.237	7-11			
Future Park Consolidation Block	26	0.014				
Road Widening	27	0.336				
0.3m Reserve	28-31	0.012				
Roads		1.992			0.532	
TOTAL	31	9.071	170-210	6	1.900	27-43

Area Schedule - Northgate Land Corporation

Description	STAGE 5 Lots/Blks	Area	Units (min/max)	TOTAL Lots/Blks	Area	Units (min/max)
Residential				26	6.621	136-210
Multiple Residential				6	7.669	300-365
Multiple Res./Mixed Use				1	1.951	117-195
Park				4	1.284	
Walkway				2	0.037	
Open Space				3	1.851	
Pumping Station				2	0.454	
Storm Water Mgmt				1	0.805	
Vacant Land Condominium	1	7.219	56	1	7.219	56
Future Residential Consolidation Block				2	0.237	7-11
Future Park Consolidation Block				1	0.014	
Road Widening				4	0.892	
0.3m Reserve				5	0.013	
Roads					3.863	
TOTAL	1	7.219	56	55	30.959	616-837

Area Schedule - 1455136 Ontario Inc.

Description	Stage 1 Lots/Blks	Area	Units (min/max)	Stage 2 Lots/Blks	Area	Units (min/max)	TOTAL Lots/Blks	Area	Units (min/max)	Northgate Land Corporation & 1455136 Ontario Inc. Lots/Blks	Area	Units (min/max)
Residential	1,2	0.514	7-11				2	0.514	7-11	28	6.621	143-221
Multiple Residential										6	7.669	300-365
Multiple Res./Mixed Use										1	1.951	117-195
Park	3	0.043					1	0.043		5	1.284	
Walkway										2	0.037	
Open Space	4	0.892					1	0.892		4	1.851	
Pumping Station										2	0.454	
Storm Water Mgmt										1	0.805	
Vacant Land Condominium				1	4.966	24	1	4.966	24	2	12.185	80
Future Residential Consolidation Block										2	0.237	7-11
Future Park Consolidation Block										1	0.014	
Road Widening	5	0.040					1	0.040		5	0.892	
0.3m Reserve										5	0.013	
Roads								0.001			3.863	
TOTAL	5	1.490	7-11	1	4.966	24	6	6.456	31-35	61	37.415	647-872

Notes:

- Boundary information provided by MacDonald Tamblyn Surveying Ltd., February 5,2008, Plan 58R-16404.
- Topographic information provided by Stantec Consulting, Contour Interval - 0.5m.
- *- BCM District Plan, Low Density Residential 2 calculated at 35-60 Units per Hectare
- **- BCM District Plan, Mixed Use Medium Density Residential calculated at 60-100 Units per Hectare
- ***- Multiple Block Unit Yield based on Conceptual Site Plan prepared by MHBC Planning.
- VLC - denotes Vacant Land Condominium.
- Floodline mapping obtained from North Waterloo Scoped Subwatershed Study, November 2012 and GRCA Developement Resource On-Line Mapping, January 23,2017.

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
200-540 BINGEMANS CENTRE DR. KITCHENER, ON. N2B 3X9 | P. 519.576.3650 F. 519.576.0121 | WWW.MHBCPLAN.COM

Approval Stamp

Date July 4,2017

File No. 14148A

Plan Scale 1:1,250

Drawn By L.H.B. / G.M.C.

Checked By P.B. / D.A.

Northgate Land Corporation & 1455136 Ontario Inc.
Conservation Drive
Waterloo, Ontario

File Name

DRAFT PLAN CONSOLIDATION

K:\14148A-NORTHGATE-WATERLOO\DRAFT PLAN\DRAFT PLAN CONSILIDATION JULY 4 2017.DWG

APPENDIX B

PRESSURE INFORMATION (REGION OF WATERLOO)

Region of Waterloo

TRANSPORTATION AND
ENVIRONMENTAL SERVICES
Water Services

150 Frederick Street
Kitchener ON Canada N2G 4J3
Telephone: (519) 575-4426
Fax: (519) 575-4452
www.region.waterloo.on.ca

Date: March 24, 2017
File #: E18-10/WA

Gavin Vemeer, P. Eng.,
Design Engineer
MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, ON N2B 3X9
t. 519.743.6500x1279
e. GVemeer@mte85.com

Dear: Gavin

Re: Northgate Subdivision Conservation Dr, Waterloo

Please find the results of the modeling simulations for boundary conditions requested on February 17, 2017. The results included a figure showing the locations of the nodes from the Region's model. Additional infrastructure was added for this modelling request to reflect the proposed 300 mm dia watermains to be constructed in the near future. This added infrastructure represents a pressure zone Wat 5 loop in the northern section of the existing pressure zone boundary. All supply of water for this modelling request is from the existing pressure zone 5 with no merging of the adjoining pressure zone Wat 4c. All elevations for the new nodes are based on the existing contours (2014).

New nodes created:

Node (model)	**Node (consultant id)**	**Pressure Zone**	**Elevation** (mASL)
JCT_78134	J-26	Wat 5	352.0
JCT_78138	J-1	Wat 5	352.0
JCT_78139		Wat 5	349.5
JCT_78137	J-2	Wat 5	352.0
JCT_78136	J-18	Wat 5	358.5
JCT_78135		Wat 5	357.0
JCT_78138	J-25	Wat 5	348.0

Attached are a series of spreadsheets containing results for Average Day, Maximum Day demands and available fire flows for node JCT_78134 located at the intersection of Beaver Creek Rd and Proposed Street One and for node JCT_78138 located at the intersection of Conservation Dr and proposed Street Two, Waterloo. The diurnal 24 hour demand distribution accounts for the minimum hour and peak hour peaking factors. The minimum hourly demand on the average day represents the minimum hour, and the maximum hourly demand on the maximum day represents the peak hour.

Demands as applied to nodes in the Northgate Subdivision:

Node	Pressure Zone	Elevation (mASL)	Residential Demand (L/s)		Fire Flow Results	
			Average Day	Maximum Day	Design Flow (L/s)	Design Pressure (m)
JCT_78134	Wat 5	352.0	2.97	4.28	215.0	19.2
JCT_78138	Wat 5	352.0	2.82	4.06	219.0	16.4

A fire flow analysis shows the maximum flow available at a node with an associated design pressure during the maximum day scenario while maintaining the minimum design pressure of 14 m (140 kPa) at all nodes within the pressure zone.

Under existing conditions connectivity to Pressure Zone Wat 4c will improve the fire flow results with the connection to the Lakeshore Pumping Station.

Growth in the proposed Beaver Creek District Plan includes a proposed phasing plan (see Map 6 in the attachments). The initial phase will include a development of a commercial site east of this application. The development of this commercial site could change some of the proposed timing as recommended below. Additional modelling will be required.

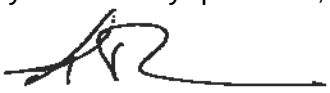
In the Stantec report, Consolidation of Waterloo North Pressure Zones – Staging and Implementation Plan dated October 4 2106.

Section 4.3 recommended the following:

- Northfield PS out of Service (All Watermain upgrades are to be completed prior to the decommissioning of Northfield PS).
- Proposed pump replacement at Lakeshore PS for WB16 **and/or** WB18 (domestic duty pump) with a pump rated for approximately 50 L/s at a TDH of 24 m. The pump replacement should be completed prior to the decommissioning of the Northfield PS.
- Note: A minimum of one pump is to be replaced. A second pump can be replaced depending on preferred level of redundancy and timing for scheduled pump replacement based on asset age.

No timing for the replacement of the pumps has been determined at the Lakeshore Pumping Station.

If you have any questions, please contact me.



Kevin Dolishny P.Eng.
Senior Project Engineer, Servicing and Development Planning
t. 519.575.4757 x 3862
e-mail: kdolishny@regionofwaterloo.ca

WAT 4 Infowater

JCT_78134 Average Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	1.72	404.61	52.61
01:00 hrs	1.28	404.64	52.64
02:00 hrs	1.48	404.60	52.60
03:00 hrs	1.60	404.58	52.58
04:00 hrs	1.43	404.58	52.58
05:00 hrs	1.16	404.59	52.59
06:00 hrs	1.84	404.49	52.49
07:00 hrs	3.95	404.31	52.31
08:00 hrs	4.81	404.16	52.16
09:00 hrs	3.95	404.30	52.30
10:00 hrs	3.86	404.32	52.32
11:00 hrs	3.68	404.36	52.36
12:00 hrs	3.47	404.41	52.41
13:00 hrs	3.30	404.46	52.46
14:00 hrs	3.06	404.51	52.51
15:00 hrs	2.85	404.46	52.46
16:00 hrs	3.03	404.44	52.44
17:00 hrs	3.21	404.42	52.42
18:00 hrs	3.71	404.32	52.32
19:00 hrs	4.04	404.23	52.23
20:00 hrs	4.07	404.19	52.19
21:00 hrs	3.80	404.21	52.21
22:00 hrs	3.36	404.37	52.37
23:00 hrs	2.67	404.49	52.49
Average Day HGL:		404.42	
Minimum Hour:		404.64	

JCT_78134 Maximum Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	2.01	404.31	52.31
01:00 hrs	1.24	404.41	52.41
02:00 hrs	1.58	404.40	52.40
03:00 hrs	1.88	404.31	52.31
04:00 hrs	1.80	404.28	52.28
05:00 hrs	1.50	404.29	52.29
06:00 hrs	2.78	403.85	51.85
07:00 hrs	5.78	402.55	50.55
08:00 hrs	6.76	402.32	50.32
09:00 hrs	4.84	403.07	51.07
10:00 hrs	3.77	403.53	51.53
11:00 hrs	3.51	403.71	51.71
12:00 hrs	3.08	403.92	51.92
13:00 hrs	3.94	403.50	51.50
14:00 hrs	5.18	403.12	51.12
15:00 hrs	4.32	403.39	51.39
16:00 hrs	5.78	402.84	50.84
17:00 hrs	6.08	402.68	50.68
18:00 hrs	7.10	402.12	50.12
19:00 hrs	7.62	401.72	49.72
20:00 hrs	7.53	401.63	49.63
21:00 hrs	6.76	402.33	50.33
22:00 hrs	4.58	403.52	51.52
23:00 hrs	3.21	403.88	51.88
Maximum Day HGL:		403.32	
Peak Hour:		401.63	

Available Flow (L/s)	Residual Pressure (m)
0.0	52.0
10.0	51.7
20.0	51.2
30.0	50.6
40.0	49.8
50.0	49.0
60.0	48.0
70.0	46.9
80.0	45.7
90.0	44.4
100.0	43.0
110.0	41.4
120.0	39.8
130.0	38.1
140.0	36.2
150.0	34.3
160.0	32.2
170.0	30.1
180.0	27.9
190.0	25.5
200.0	23.1
210.0	20.5
215.0	19.2

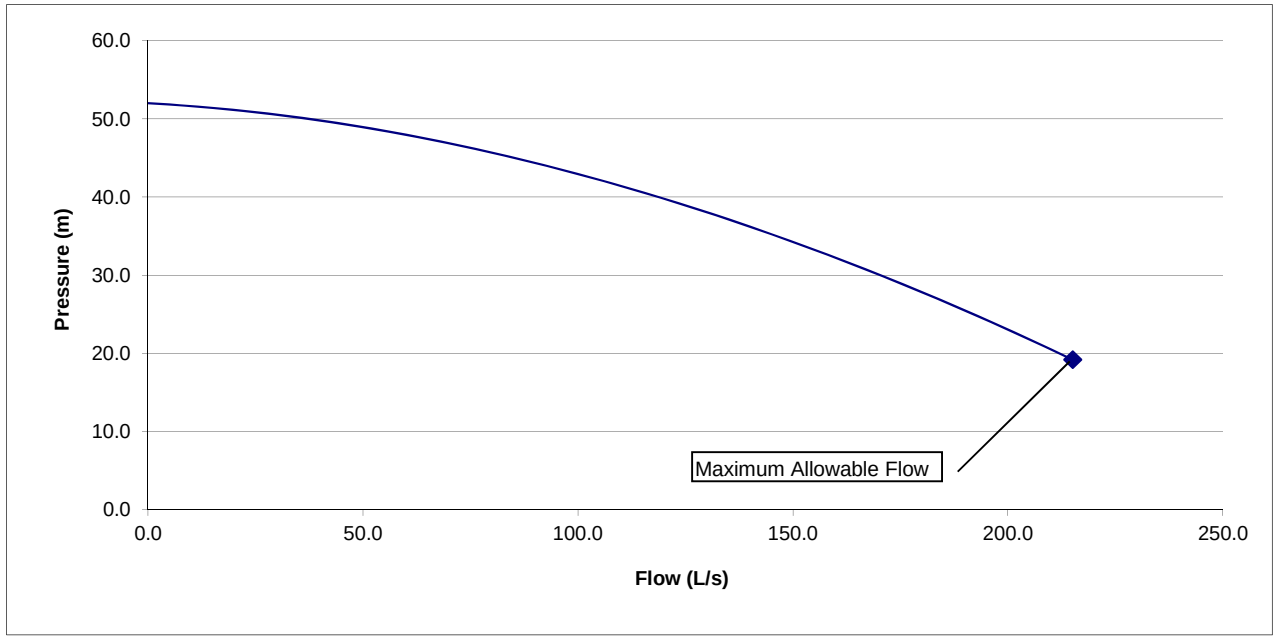
Fire Flow Analysis

Fire Flow Node:	JCT_78134
Design Flow (L/s):	215.0
Design Pressure (m):	19.2

Design Flow: *The final adjusted flow at the node to maintain the minimum design pressure (14m (140 kPa)) at ALL locations within the pressure zone.*

Design Pressure: *The lowest allowable pressure at the node to maintain the minimum design pressure (14m (140 kPa)) at ALL locations within the pressure zone.*

Critical Node ID: *The constraining node within the pressure zone that drops to the minimum design pressure of (14m (140 kPa)) during the design flow.*



WAT 5 Infowater

JCT_78138 Average Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	1.64	404.58	52.58
01:00 hrs	1.21	404.62	52.62
02:00 hrs	1.41	404.58	52.58
03:00 hrs	1.52	404.55	52.55
04:00 hrs	1.35	404.55	52.55
05:00 hrs	1.10	404.56	52.56
06:00 hrs	1.75	404.46	52.46
07:00 hrs	3.75	404.26	52.26
08:00 hrs	4.57	404.10	52.10
09:00 hrs	3.75	404.25	52.25
10:00 hrs	3.67	404.28	52.28
11:00 hrs	3.50	404.32	52.32
12:00 hrs	3.30	404.37	52.37
13:00 hrs	3.13	404.42	52.42
14:00 hrs	2.90	404.48	52.48
15:00 hrs	2.71	404.42	52.42
16:00 hrs	2.88	404.40	52.40
17:00 hrs	3.05	404.39	52.39
18:00 hrs	3.52	404.27	52.27
19:00 hrs	3.84	404.18	52.18
20:00 hrs	3.86	404.14	52.14
21:00 hrs	3.61	404.16	52.16
22:00 hrs	3.19	404.33	52.33
23:00 hrs	2.54	404.45	52.45
Average Day HGL:		404.38	
Minimum Hour:		404.62	

JCT_78138 Maximum Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	1.91	404.31	52.31
01:00 hrs	1.18	404.41	52.41
02:00 hrs	1.50	404.40	52.40
03:00 hrs	1.79	404.31	52.31
04:00 hrs	1.71	404.28	52.28
05:00 hrs	1.42	404.29	52.29
06:00 hrs	2.64	403.84	51.84
07:00 hrs	5.48	402.54	50.54
08:00 hrs	6.41	402.32	50.32
09:00 hrs	4.59	403.07	51.07
10:00 hrs	3.57	403.53	51.53
11:00 hrs	3.33	403.71	51.71
12:00 hrs	2.92	403.92	51.92
13:00 hrs	3.74	403.49	51.49
14:00 hrs	4.91	403.12	51.12
15:00 hrs	4.10	403.39	51.39
16:00 hrs	5.48	402.84	50.84
17:00 hrs	5.77	402.67	50.67
18:00 hrs	6.74	402.11	50.11
19:00 hrs	7.23	401.72	49.72
20:00 hrs	7.15	401.62	49.62
21:00 hrs	6.41	402.33	50.33
22:00 hrs	4.34	403.52	51.52
23:00 hrs	3.04	403.88	51.88
Maximum Day HGL:		403.32	
Peak Hour:		401.62	

Available Flow (L/s)	Residual Pressure (m)
0.0	52.0
10.0	51.7
20.0	51.1
30.0	50.5
40.0	49.7
50.0	48.8
60.0	47.8
70.0	46.7
80.0	45.4
90.0	44.0
100.0	42.5
110.0	40.9
120.0	39.2
130.0	37.4
140.0	35.4
150.0	33.4
160.0	31.2
170.0	29.0
180.0	26.6
190.0	24.1
200.0	21.6
210.0	18.9
219.0	16.4

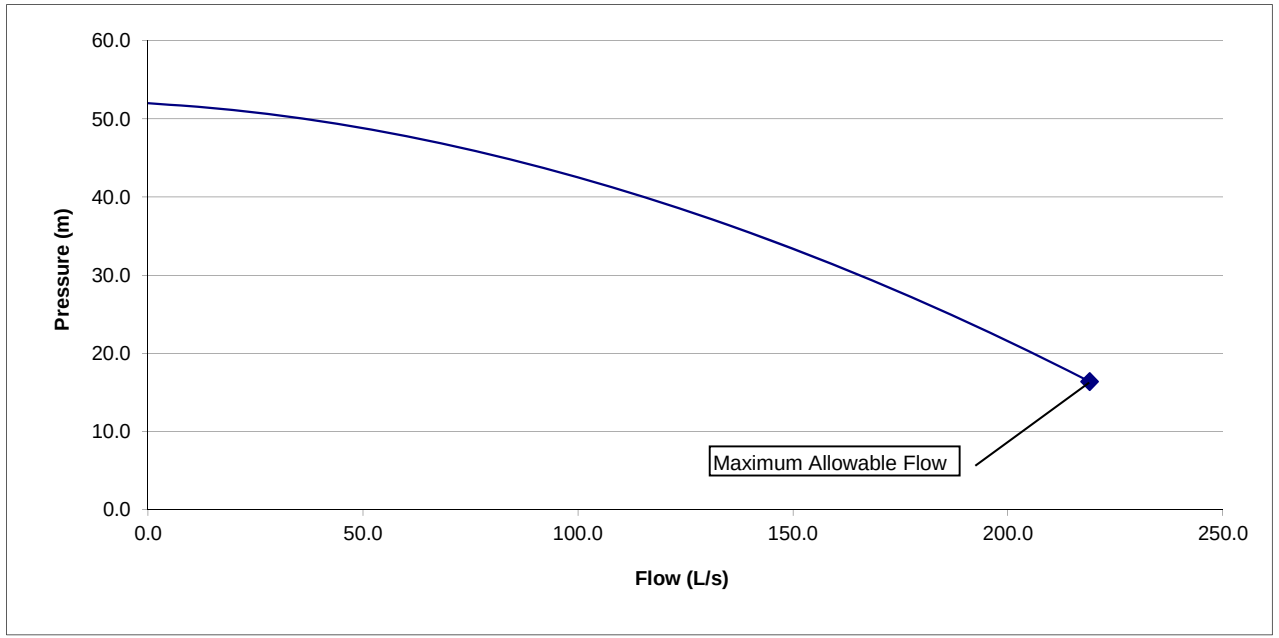
Fire Flow Analysis

Fire Flow Node:	JCT_78138
Design Flow (L/s):	219.0
Design Pressure (m):	16.4

Design Flow: *The final adjusted flow at the node to maintain the minimum design pressure (14m (140 kPa)) at ALL locations within the pressure zone.*

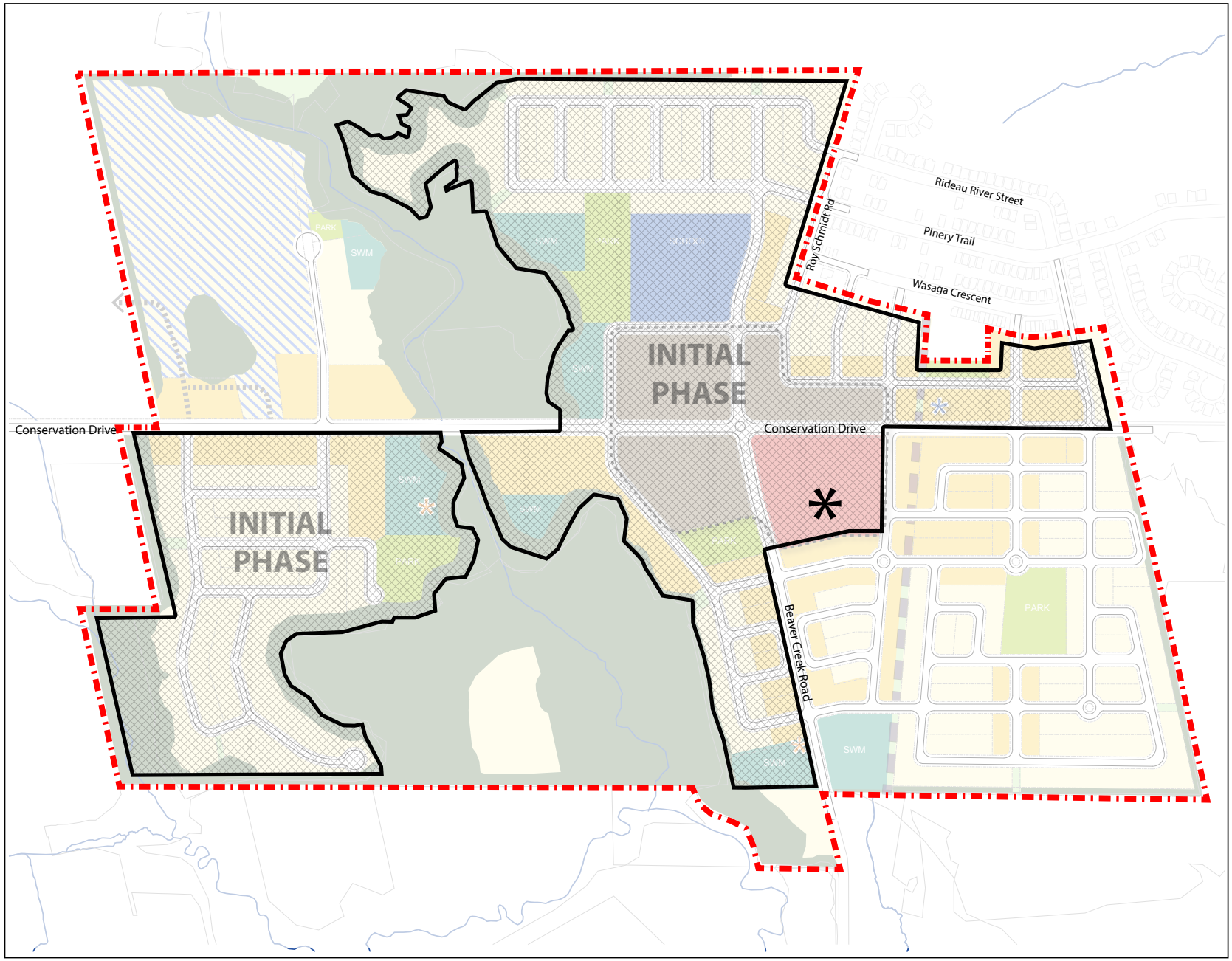
Design Pressure: *The lowest allowable pressure at the node to maintain the minimum design pressure (14m (140 kPa)) at ALL locations within the pressure zone.*

Critical Node ID: *The constraining node within the pressure zone that drops to the minimum design pressure of (14m (140 kPa)) during the design flow.*



BEAVER CREEK MEADOWS DISTRICT PLAN

MAP 6
PHASING
COMMUNITY STRUCTURE

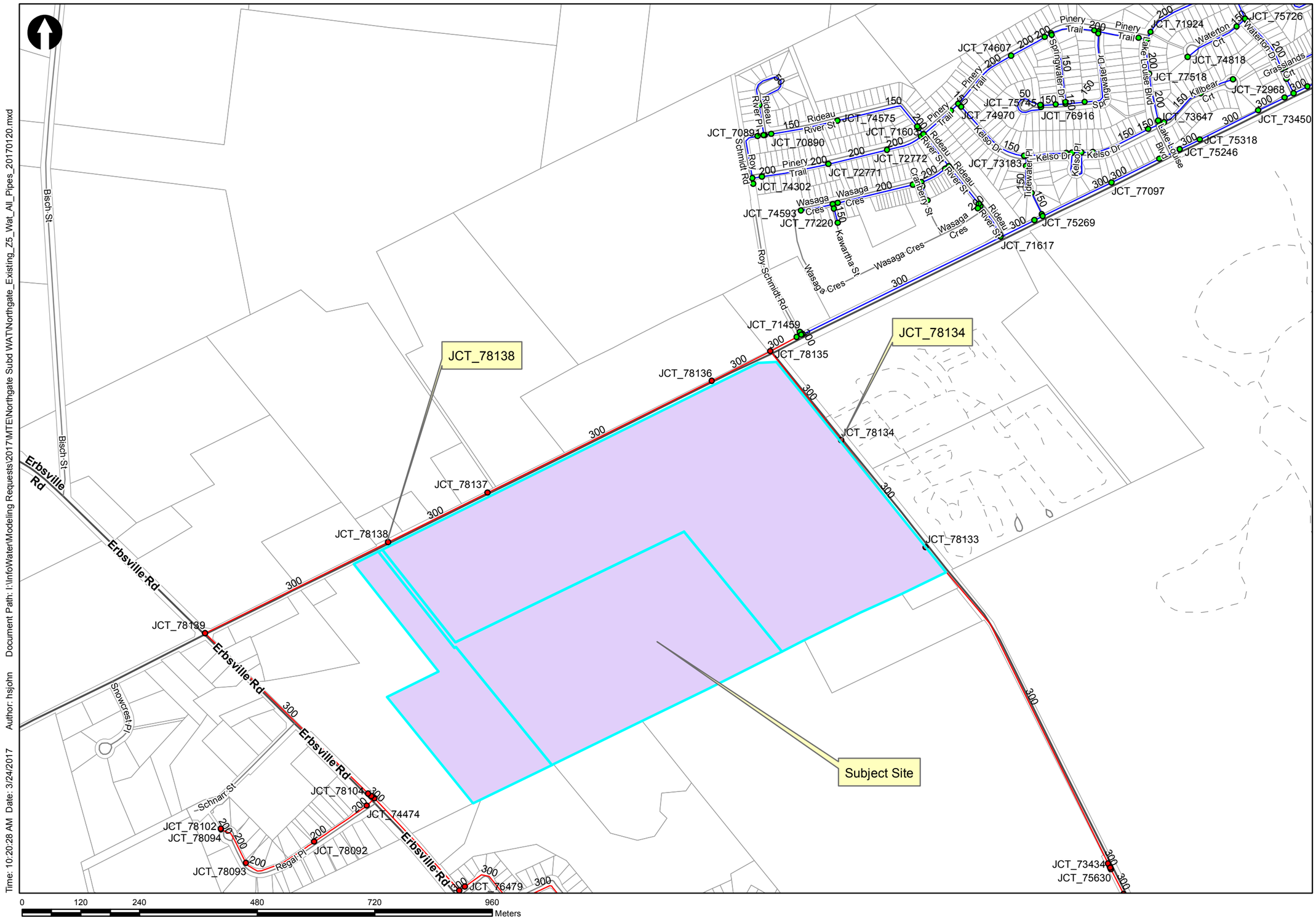


LEGEND

- District Plan Boundary
- Initial Phase
- * Development of the commercial site, whether fully or partially, subject to market demand

0 50 100 200 300 metres

Last Updated: January 19, 2016



Time: 10:20:28 AM Date: 3/24/2017 Author: hsjohn Document Path: I:\InfoWater\Modeling Requests\2017\MTE\Northgate Subd WAT\Northgate_Existing_Z5_Wat_All_Pipes_20170120.mxd

Region of Waterloo

TRANSPORTATION AND ENVIRONMENTAL SERVICES

Water Services

150 Frederick Street
Kitchener ON Canada N2G 4J3
Telephone: (519) 575-4426
Fax: (519) 575-4452
www.regionofwaterloo.ca

Legend

Junction
TYPE
- Active
- Domain

Tank
TYPE
- Active
- Domain

Reservoir
TYPE
- Active
- Domain

Pump
TYPE
- Active
- Domain

Valve
TYPE
- Active
- Domain

Pipe
TYPE
- Active
- Domain
- Highway
- Regional
- Local
- Private
- Proposed
- Ownership Parcels
- Subject Property

Northgate Subd Waterloo

APPENDIX C

USAGE RATES/WATER DEMANDS & DESIGN VALUES

Northgate and Erbsville Kartway Subdivisions

City of Waterloo
Project No: 39502-104
Date: June 27, 2017
By: CJC

Node ID	Residential									Final Demands[4] (l/s)					Road Elevation (m)
	Single Detached and Semi-detached			Townhomes			Apartment (or equivalent level of density)			Average Day	Maximum Day	Minimum Hour	Peak Hour	Max Day + Fire Flow[5]	
	# Units[1]	# Persons[2]	Demand[3] (l/s)	# Units[1]	# Persons[2]	Demand[3] (l/s)	# Units[1]	# Persons[2]	Demand[3] (l/s)	Q_{avg}	$Q_{max.day}$	$Q_{min.hr}$	Q_{peak}	$Q_{max.day+fire}$	
J-1		0	0.000		0	0.000		0	0.000	0.000	0.000	0.000	0.000	0.00	352.00
J-2		0	0.000		0	0.000		0	0.000	0.000	0.000	0.000	0.000	0.00	352.00
J-3	16	52	0.135		0	0.000		0	0.000	0.135	0.195	0.061	0.458	100.20	352.60
J-4	16	52	0.135		0	0.000	48	85	0.221	0.357	0.514	0.161	1.206	183.85	351.89
J-5	16	52	0.135		0	0.000	51	90	0.235	0.370	0.534	0.167	1.252	183.87	351.29
J-6	9	29	0.076		0	0.000		0	0.000	0.076	0.110	0.034	0.257	100.11	352.21
J-7	15	49	0.127		0	0.000		0	0.000	0.127	0.183	0.057	0.429	100.18	351.60
J-8	11	36	0.093		0	0.000		0	0.000	0.093	0.134	0.042	0.315	100.13	350.90
J-9	39	127	0.330		0	0.000		0	0.000	0.330	0.475	0.149	1.116	100.48	349.43
J-10	7	23	0.059		0	0.000		0	0.000	0.059	0.085	0.027	0.200	100.09	351.80
J-11	14	46	0.118		0	0.000		0	0.000	0.118	0.171	0.053	0.400	100.17	350.98
J-12	17	55	0.144		0	0.000		0	0.000	0.144	0.207	0.065	0.486	100.21	350.45
J-13	29	94	0.245		0	0.000		0	0.000	0.245	0.353	0.110	0.830	100.35	352.59
J-14	18	59	0.152		0	0.000		0	0.000	0.152	0.219	0.069	0.515	100.22	352.05
J-15	7	23	0.059		0	0.000		0	0.000	0.059	0.085	0.027	0.200	100.09	352.60
J-16	11	36	0.093		0	0.000		0	0.000	0.093	0.134	0.042	0.315	100.13	353.03
J-17	15	49	0.127		0	0.000		0	0.000	0.127	0.183	0.057	0.429	100.18	352.53
J-18		0	0.000		0	0.000		0	0.000	0.000	0.000	0.000	0.000	0.00	358.50
J-19		0	0.000	155	378	0.985	195	345	0.899	1.884	2.713	0.848	6.367	186.05	357.62
J-20		0	0.000	23	56	0.146		0	0.000	0.146	0.210	0.066	0.494	133.54	357.01
J-21	16	52	0.135		0	0.000		0	0.000	0.135	0.195	0.061	0.458	100.20	356.09
J-22		0	0.000		0	0.000	44	78	0.203	0.203	0.292	0.091	0.686	183.63	353.82
J-23	51	166	0.432		0	0.000		0	0.000	0.432	0.622	0.194	1.459	100.62	353.67
J-24		0	0.000		0	0.000	44	78	0.203	0.203	0.292	0.091	0.686	183.63	349.72
J-25		0	0.000		0	0.000		0	0.000	0.000	0.000	0.000	0.000	0.00	348.00
J-26		0	0.000		0	0.000		0	0.000	0.000	0.000	0.000	0.000	0.00	352.00
J-27		0	0.000		0	0.000		0	0.000	0.000	0.000	0.000	0.000	0.00	357.00
Sub-total	**307**	**998**	**2.598**	**178**	**434**	**1.131**	**382**	**676**	**1.761**	**5.490**	**7.906**	**2.471**	**18.557**		
				Total Units =		**867**									
				Total Population =		**2108**									

Table Notes:

1. Unit Count based on MHBC document: Draft Plan of Subdivision (June 26, 2017)

2. Population Density	
Structure Type	**PPU**
Single, detached	3.25
Semi-detached	3.25
Townhouse	2.44
Apartment	1.77
Multiple Unit Types	2.11
Unspecified Unit Type	3.05

Reference: Region of Waterloo 2017 Water and Wastewater Monitoring Report (Region of Waterloo, May 2017)

3. Water Demand	
Residential (Medium Density)	225 l/d/person 0.00260 l/s/person
Multiple Residential (High Density)	225 l/d/person 0.00260 l/s/person

Reference: Water Demand per person from the Tri-City Distribution System Study (AECOM, May 2009)

4. Peaking Factors	
Average Day	1.00
Maximum Day*	1.44
Minimum Hour	0.45
Peak Hour	3.38

Reference: Design Guidelines for Drinking-Water System. MOE, 2008. Table 3-1: Peaking Factors (population 2001 to 3000)
*Max Day Peak Factor taken from Tri-City Distribution System Study (AECOM, May 2009)

5. Fire Flow	
Single Family <3m separation	6,000 l/min 100 l/s
High-density (Townhomes)	8,000 l/min 133 l/s
24-unit, ~3.5 story multiresidential	11,000 l/min 183 l/s

Reference: *Water Supply for Public Fire Protection, A Guide to Recommended Practice (1999), Fire Underwriter's Survey (FUS)*.

APPENDIX D

FIRE FLOW CALCULATION FOR HIGH-DENSITY RESIDENTIAL

Northgate and Erbsville Kartway Subdivisions

City of Waterloo
Project No: 39502-104
Date: March 28, 2017
By: GDV

FIRE FLOW DEMAND REQUIREMENTS - FIRE UNDERWRITERS SURVEY (FUS GUIDELINES)

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Protection" (Fire Underwriters Survey, 1999).

An estimate of the fire flow required is given by the following formula:

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

where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = Total floor area in square metres

Adjustments to the calculated fire flow can be made based on occupancy, sprinkler protection and exposure to other structures. The table below summarizes the adjustments made to the basic fire flow demand.

			(1)		(2)		(3)		(4)		**Final Adjusted**		
Building	Area "A" [A] (m^2)	C [B]	Fire Flow "F" (l/min)	(l/s)	Occupancy [C] %	Adjusted Fire Flow (L/min)	Sprinkler [D] %	Adjustment (L/min)	Exposure [E] %	Adjustment (L/min)	**Fire Flow (L/min)**	**Rounded(L/min)**	**(L/s)**
16-Unit Multiple Residential	1,500	1.0	9,000	150.0	-15	7,650	0	0	15	1,148	8,798	9,000	**150**
24-Unit Multiple Residential	2,280	1.0	11,000	183.3	-15	9,350	0	0	15	1,403	10,753	11,000	**183**

(2) Occupancy

Non-Combustible	-25%
Limited Combustible	-15%
Combustible	No charge
Free Burning	15%
Rapid Burning	25%

(3) Sprinkler

40% credit for adequately designed system per NFPA 13. Additional 10% if water supply standard for both the system and fire department hose lines.

(4) Exposure

0 to 3m	25%	
3.1 to 10m	20%	Calculate for all
10.1 to 20m	15%	sides. Maximum
20.1 to 30m	10%	charge shall not
30.1 to 45m	5%	exceed 75%

[A] Building areas confirmed by Architect
[B] Coefficient related to the type of construction
[C] Retirement Home Occupancy is taken to be Limited Combustible.
[D] Building sprinkler confirmed with Architect
[E] Refer to Notes on Exposure Calculation below

*Note: 30% Exposure Calculation (Hospitality) as follows -> 48m to the north (0%) + 10m to the west (20%) + 156m to the southeast (0%) + 26m to the east (10%)
*Note: 10% Exposure Calculation (Care) as follows -> 79m to the north (0%) + 26m to the west (10%) + 213m to the east (0%) + 150m to the southeast (0%)
*Note: 25% Exposure Calculation (Lifestyle) as follows -> 67m to the west (0%) + 52m to the south (0%) + 9m to the east (20%) + 43m to the north (5%)
*Note: 45% Exposure Calculation (Pavillion) as follows --> 35m to the north (5%) + 9m to the west (20%) + 65m to the south (0%) + 10m to the east (20%)

APPENDIX E

WATERCAD OUTPUT FILES

39502-104-Option 1.wtg

Active Scenario: Avg Day

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.72	506.2
45	J-2/JCT_78137	352.00	0.00	403.72	506.2
38	J-3	352.60	0.13	403.72	500.3
109	J-4	351.89	0.36	403.72	507.3
39	J-5	351.29	0.37	403.72	513.2
35	J-6	352.21	0.08	403.72	504.2
41	J-7	351.60	0.13	403.72	510.1
84	J-8	350.90	0.09	403.72	517.0
81	J-9	349.43	0.33	403.72	531.4
54	J-10	351.80	0.06	403.72	508.2
42	J-11	350.98	0.12	403.72	516.2
76	J-12	350.45	0.14	403.72	521.4
69	J-13	352.59	0.25	403.72	500.4
66	J-14	352.05	0.15	403.72	505.7
112	J-15	352.60	0.06	403.72	500.3
130	J-16	353.03	0.09	403.72	496.1
63	J-17	352.53	0.13	403.72	501.0
47	J-18/JCT_78136	358.50	0.00	403.75	442.9
115	J-19	357.62	1.88	403.75	451.5
118	J-20	357.01	0.15	403.75	457.4
50	J-21	356.09	0.13	403.75	466.4
121	J-22	353.82	0.20	403.75	488.7
124	J-23	353.67	0.43	403.75	490.1
127	J-24	349.72	0.20	403.75	528.8
51	J-25/JCT_78133	348.00	0.00	403.75	545.6
48	J-26/JCT_78134	352.00	0.00	403.75	506.5
56	J-27/JCT_78135	357.00	0.00	403.75	457.5

39502-104-Option 1.wtg
Active Scenario: Avg Day



39502-104-Option 1.wtg

Active Scenario: Max Day + Fire

Label	Elevation (m)	Fire Flow Iterations	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Calculated Residual) (kPa)	Velocity of Maximum Pipe (m/s)	Pipe w/ Maximum Velocity
J-1/JCT_78138	352.00	3	True	100.00	215.00	100.00	215.00	162.7	0.28	P-66
J-2/JCT_78137	352.00	4	True	100.00	212.61	100.00	212.61	140.0	2.30	P-32
J-3	352.60	4	True	100.00	201.66	100.19	201.86	140.0	3.89	P-25
J-4	351.89	3	True	183.00	193.39	183.51	193.91	140.0	3.36	P-25
J-5	351.29	5	True	183.00	203.25	183.53	203.79	143.1	3.52	P-28
J-6	352.21	4	True	100.00	190.33	100.11	190.44	140.0	3.77	P-26
J-7	351.60	6	True	100.00	149.08	100.18	149.27	154.0	3.38	P-6
J-8	350.90	6	True	100.00	193.60	100.13	193.74	141.4	3.78	P-27
J-9	349.43	4	True	100.00	151.52	100.47	152.00	140.0	4.37	P-22
J-10	351.80	4	True	100.00	182.16	100.08	182.25	140.0	3.55	P-24
J-11	350.98	4	True	100.00	182.28	100.17	182.45	140.0	3.17	P-25
J-12	350.45	4	True	100.00	188.39	100.21	188.60	140.0	3.37	P-27
J-13	352.59	3	True	100.00	138.84	100.35	139.20	140.1	4.60	P-8
J-14	352.05	6	True	100.00	160.03	100.22	160.25	143.7	3.99	P-6
J-15	352.60	4	True	100.00	159.34	100.08	159.43	140.0	4.52	P-45
J-16	353.03	3	True	100.00	133.53	100.13	133.66	140.1	4.26	P-58
J-17	352.53	3	True	100.00	119.76	100.18	119.95	140.0	3.82	P-58
J-18/JCT_78136	358.50	4	True	100.00	196.72	100.00	196.72	140.0	1.44	P-39
J-19	357.62	5	True	186.00	197.94	188.71	200.65	145.6	1.52	P-50
J-20	357.01	6	True	133.00	200.55	133.21	200.76	148.9	1.85	P-50
J-21	356.09	6	True	100.00	202.45	100.19	202.64	159.1	1.84	P-52
J-22	353.82	4	True	183.00	203.75	183.29	204.05	182.9	2.23	P-52
J-23	353.67	4	True	100.00	194.57	100.62	195.19	140.0	3.52	P-53
J-24	349.72	5	True	183.00	204.47	183.29	204.76	173.1	4.55	P-56
J-25/JCT_78133	348.00	5	True	100.00	204.61	100.00	204.61	209.3	2.25	P-41
J-26/JCT_78134	352.00	5	True	100.00	204.82	100.00	204.82	203.6	0.27	P-67
J-27/JCT_78135	357.00	6	True	100.00	199.49	100.00	199.49	150.3	1.75	P-39

39502-104-Option 1.wtg

Active Scenario: Max Day

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.71	506.1
45	J-2/JCT_78137	352.00	0.00	403.71	506.1
38	J-3	352.60	0.20	403.71	500.2
109	J-4	351.89	0.51	403.71	507.1
39	J-5	351.29	0.53	403.71	513.0
35	J-6	352.21	0.11	403.71	504.0
41	J-7	351.60	0.18	403.71	510.0
84	J-8	350.90	0.13	403.71	516.8
81	J-9	349.43	0.47	403.71	531.2
54	J-10	351.80	0.09	403.71	508.0
42	J-11	350.98	0.17	403.71	516.0
76	J-12	350.45	0.21	403.71	521.2
69	J-13	352.59	0.35	403.71	500.3
66	J-14	352.05	0.22	403.71	505.6
112	J-15	352.60	0.09	403.71	500.2
130	J-16	353.03	0.13	403.71	496.0
63	J-17	352.53	0.18	403.71	500.9
47	J-18/JCT_78136	358.50	0.00	403.73	442.7
115	J-19	357.62	2.71	403.73	451.3
118	J-20	357.01	0.21	403.73	457.3
50	J-21	356.09	0.20	403.73	466.3
121	J-22	353.82	0.29	403.73	488.5
124	J-23	353.67	0.62	403.73	489.9
127	J-24	349.72	0.29	403.73	528.6
51	J-25/JCT_78133	348.00	0.00	403.73	545.4
48	J-26/JCT_78134	352.00	0.00	403.73	506.3
56	J-27/JCT_78135	357.00	0.00	403.73	457.3

39502-104-Option 1.wtg

Active Scenario: Min Hour

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.74	506.3
45	J-2/JCT_78137	352.00	0.00	403.74	506.3
38	J-3	352.60	0.06	403.74	500.5
109	J-4	351.89	0.16	403.74	507.4
39	J-5	351.29	0.17	403.74	513.3
35	J-6	352.21	0.03	403.74	504.3
41	J-7	351.60	0.06	403.74	510.3
84	J-8	350.90	0.04	403.74	517.1
81	J-9	349.43	0.15	403.74	531.5
54	J-10	351.80	0.03	403.74	508.3
42	J-11	350.98	0.05	403.74	516.3
76	J-12	350.45	0.06	403.74	521.5
69	J-13	352.59	0.11	403.74	500.6
66	J-14	352.05	0.07	403.74	505.9
112	J-15	352.60	0.03	403.74	500.5
130	J-16	353.03	0.04	403.74	496.3
63	J-17	352.53	0.06	403.74	501.2
47	J-18/JCT_78136	358.50	0.00	403.77	443.0
115	J-19	357.62	0.85	403.77	451.6
118	J-20	357.01	0.07	403.77	457.6
50	J-21	356.09	0.06	403.77	466.6
121	J-22	353.82	0.09	403.77	488.8
124	J-23	353.67	0.19	403.77	490.3
127	J-24	349.72	0.09	403.77	529.0
51	J-25/JCT_78133	348.00	0.00	403.77	545.8
48	J-26/JCT_78134	352.00	0.00	403.77	506.6
56	J-27/JCT_78135	357.00	0.00	403.77	457.7

39502-104-Option 1.wtg

Active Scenario: Peak Hour

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.61	505.1
45	J-2/JCT_78137	352.00	0.00	403.61	505.1
38	J-3	352.60	0.46	403.60	499.1
109	J-4	351.89	1.21	403.60	506.0
39	J-5	351.29	1.25	403.60	511.9
35	J-6	352.21	0.26	403.59	502.9
41	J-7	351.60	0.43	403.59	508.8
84	J-8	350.90	0.31	403.59	515.7
81	J-9	349.43	1.12	403.59	530.1
54	J-10	351.80	0.20	403.59	506.9
42	J-11	350.98	0.40	403.59	514.9
76	J-12	350.45	0.49	403.59	520.1
69	J-13	352.59	0.83	403.59	499.1
66	J-14	352.05	0.51	403.59	504.4
112	J-15	352.60	0.20	403.59	499.1
130	J-16	353.03	0.31	403.59	494.8
63	J-17	352.53	0.43	403.59	499.7
47	J-18/JCT_78136	358.50	0.00	403.59	441.3
115	J-19	357.62	6.37	403.59	449.9
118	J-20	357.01	0.49	403.59	455.9
50	J-21	356.09	0.46	403.59	464.9
121	J-22	353.82	0.69	403.59	487.1
124	J-23	353.67	1.46	403.59	488.6
127	J-24	349.72	0.69	403.59	527.3
51	J-25/JCT_78133	348.00	0.00	403.59	544.1
48	J-26/JCT_78134	352.00	0.00	403.60	505.0
56	J-27/JCT_78135	357.00	0.00	403.59	456.0

39502-104-Option 2.wtg

Active Scenario: Avg Day

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.72	506.2
45	J-2/JCT_78137	352.00	0.00	403.72	506.2
38	J-3	352.60	0.13	403.72	500.3
109	J-4	351.89	0.36	403.72	507.3
39	J-5	351.29	0.37	403.72	513.1
35	J-6	352.21	0.08	403.72	504.1
41	J-7	351.60	0.13	403.72	510.1
84	J-8	350.90	0.09	403.72	517.0
81	J-9	349.43	0.33	403.72	531.3
54	J-10	351.80	0.06	403.72	508.2
42	J-11	350.98	0.12	403.72	516.2
76	J-12	350.45	0.14	403.72	521.4
69	J-13	352.59	0.25	403.72	500.4
66	J-14	352.05	0.15	403.72	505.7
112	J-15	352.60	0.06	403.72	500.3
130	J-16	353.03	0.09	403.72	496.1
63	J-17	352.53	0.13	403.72	501.0
47	J-18/JCT_78136	358.50	0.00	403.75	442.9
115	J-19	357.62	1.88	403.75	451.5
118	J-20	357.01	0.15	403.75	457.4
50	J-21	356.09	0.13	403.75	466.4
121	J-22	353.82	0.20	403.75	488.7
124	J-23	353.67	0.43	403.75	490.1
127	J-24	349.72	0.20	403.75	528.8
51	J-25/JCT_78133	348.00	0.00	403.75	545.6
48	J-26/JCT_78134	352.00	0.00	403.75	506.5
56	J-27/JCT_78135	357.00	0.00	403.75	457.5
165	J-28	350.98	0.12	403.72	516.2

39502-104-Option 2.wtg
Active Scenario: Avg Day



39502-104-Option 2.wtg

Active Scenario: Max Day + Fire

Label	Elevation (m)	Fire Flow Iterations	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Calculated Residual) (kPa)	Velocity of Maximum Pipe (m/s)	Pipe w/ Maximum Velocity
J-1/JCT_78138	352.00	3	True	100.00	215.00	100.00	215.00	162.3	0.28	P-66
J-2/JCT_78137	352.00	4	True	100.00	212.45	100.00	212.45	140.0	2.30	P-32
J-3	352.60	4	True	100.00	201.50	100.19	201.69	140.0	3.89	P-25
J-4	351.89	3	True	183.00	193.24	183.51	193.76	140.0	3.36	P-25
J-5	351.29	5	True	183.00	202.27	183.53	202.81	145.6	3.50	P-28
J-6	352.21	4	True	100.00	190.17	100.11	190.28	140.0	3.77	P-26
J-7	351.60	6	True	100.00	142.73	100.18	142.91	154.0	4.58	P-68
J-8	350.90	6	True	100.00	192.02	100.13	192.15	146.0	3.76	P-27
J-9	349.43	4	True	100.00	151.41	100.47	151.88	140.0	4.37	P-22
J-10	351.80	4	True	100.00	182.00	100.08	182.08	140.0	3.55	P-24
J-11	350.98	6	True	100.00	176.36	100.17	176.53	160.1	3.08	P-25
J-12	350.45	6	True	100.00	186.06	100.21	186.27	147.4	3.33	P-27
J-13	352.59	3	True	100.00	128.78	100.35	129.13	140.0	4.14	P-68
J-14	352.05	6	True	100.00	153.10	100.22	153.32	145.4	4.91	P-68
J-15	352.60	4	True	100.00	159.22	100.08	159.31	140.0	4.52	P-45
J-16	353.03	3	True	100.00	128.89	100.13	129.02	140.0	4.14	P-68
J-17	352.53	3	True	100.00	116.40	100.18	116.59	140.0	3.74	P-68
J-18/JCT_78136	358.50	4	True	100.00	196.72	100.00	196.72	140.0	1.44	P-39
J-19	357.62	5	True	186.00	197.94	188.71	200.65	145.6	1.52	P-50
J-20	357.01	6	True	133.00	200.55	133.21	200.76	148.9	1.85	P-50
J-21	356.09	6	True	100.00	202.45	100.19	202.64	159.1	1.84	P-52
J-22	353.82	4	True	183.00	203.75	183.29	204.05	182.9	2.23	P-52
J-23	353.67	4	True	100.00	194.57	100.62	195.19	140.0	3.52	P-53
J-24	349.72	5	True	183.00	204.47	183.29	204.76	173.1	4.55	P-56
J-25/JCT_78133	348.00	5	True	100.00	204.61	100.00	204.61	209.3	2.25	P-41
J-26/JCT_78134	352.00	5	True	100.00	204.82	100.00	204.82	203.6	0.27	P-67
J-27/JCT_78135	357.00	6	True	100.00	199.49	100.00	199.49	150.3	1.75	P-39
J-28	350.98	6	True	100.00	169.69	100.17	169.86	160.1	5.44	P-68

39502-104-Option 2.wtg

Active Scenario: Max Day

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.71	506.1
45	J-2/JCT_78137	352.00	0.00	403.71	506.1
38	J-3	352.60	0.20	403.71	500.2
109	J-4	351.89	0.51	403.71	507.1
39	J-5	351.29	0.53	403.71	513.0
35	J-6	352.21	0.11	403.70	504.0
41	J-7	351.60	0.18	403.70	509.9
84	J-8	350.90	0.13	403.70	516.8
81	J-9	349.43	0.47	403.70	531.2
54	J-10	351.80	0.09	403.70	508.0
42	J-11	350.98	0.17	403.70	516.0
76	J-12	350.45	0.21	403.70	521.2
69	J-13	352.59	0.35	403.70	500.2
66	J-14	352.05	0.22	403.70	505.5
112	J-15	352.60	0.09	403.70	500.2
130	J-16	353.03	0.13	403.70	495.9
63	J-17	352.53	0.18	403.70	500.8
47	J-18/JCT_78136	358.50	0.00	403.73	442.7
115	J-19	357.62	2.71	403.73	451.3
118	J-20	357.01	0.21	403.73	457.3
50	J-21	356.09	0.20	403.73	466.3
121	J-22	353.82	0.29	403.73	488.5
124	J-23	353.67	0.62	403.73	489.9
127	J-24	349.72	0.29	403.73	528.6
51	J-25/JCT_78133	348.00	0.00	403.73	545.4
48	J-26/JCT_78134	352.00	0.00	403.73	506.3
56	J-27/JCT_78135	357.00	0.00	403.73	457.3
165	J-28	350.98	0.17	403.70	516.0

39502-104-Option 2.wtg

Active Scenario: Min Hour

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.74	506.3
45	J-2/JCT_78137	352.00	0.00	403.74	506.3
38	J-3	352.60	0.06	403.74	500.5
109	J-4	351.89	0.16	403.74	507.4
39	J-5	351.29	0.17	403.74	513.3
35	J-6	352.21	0.03	403.74	504.3
41	J-7	351.60	0.06	403.74	510.3
84	J-8	350.90	0.04	403.74	517.1
81	J-9	349.43	0.15	403.74	531.5
54	J-10	351.80	0.03	403.74	508.3
42	J-11	350.98	0.05	403.74	516.3
76	J-12	350.45	0.06	403.74	521.5
69	J-13	352.59	0.11	403.74	500.6
66	J-14	352.05	0.07	403.74	505.8
112	J-15	352.60	0.03	403.74	500.5
130	J-16	353.03	0.04	403.74	496.3
63	J-17	352.53	0.06	403.74	501.1
47	J-18/JCT_78136	358.50	0.00	403.77	443.0
115	J-19	357.62	0.85	403.77	451.6
118	J-20	357.01	0.07	403.77	457.6
50	J-21	356.09	0.06	403.77	466.6
121	J-22	353.82	0.09	403.77	488.8
124	J-23	353.67	0.19	403.77	490.3
127	J-24	349.72	0.09	403.77	529.0
51	J-25/JCT_78133	348.00	0.00	403.77	545.8
48	J-26/JCT_78134	352.00	0.00	403.77	506.6
56	J-27/JCT_78135	357.00	0.00	403.77	457.7
165	J-28	350.98	0.05	403.74	516.3

39502-104-Option 2.wtg

Active Scenario: Peak Hour

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.60	505.0
45	J-2/JCT_78137	352.00	0.00	403.59	504.9
38	J-3	352.60	0.46	403.59	499.0
109	J-4	351.89	1.21	403.58	505.9
39	J-5	351.29	1.25	403.58	511.8
35	J-6	352.21	0.26	403.58	502.8
41	J-7	351.60	0.43	403.57	508.6
84	J-8	350.90	0.31	403.58	515.6
81	J-9	349.43	1.12	403.58	529.9
54	J-10	351.80	0.20	403.58	506.7
42	J-11	350.98	0.40	403.58	514.8
76	J-12	350.45	0.49	403.58	520.0
69	J-13	352.59	0.83	403.57	499.0
66	J-14	352.05	0.51	403.57	504.3
112	J-15	352.60	0.20	403.58	498.9
130	J-16	353.03	0.31	403.57	494.6
63	J-17	352.53	0.43	403.57	499.5
47	J-18/JCT_78136	358.50	0.00	403.59	441.3
115	J-19	357.62	6.37	403.59	449.9
118	J-20	357.01	0.49	403.59	455.9
50	J-21	356.09	0.46	403.59	464.9
121	J-22	353.82	0.69	403.59	487.1
124	J-23	353.67	1.46	403.59	488.6
127	J-24	349.72	0.69	403.59	527.3
51	J-25/JCT_78133	348.00	0.00	403.59	544.1
48	J-26/JCT_78134	352.00	0.00	403.60	505.0
56	J-27/JCT_78135	357.00	0.00	403.59	456.0
165	J-28	350.98	0.40	403.58	514.7

39502-104-Option 1.wtg
Active Scenario: Avg Day



39502-104-Option 1.wtg

Active Scenario: Max Day + Fire

Label	Elevation (m)	Fire Flow Iterations	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Calculated Residual) (kPa)	Velocity of Maximum Pipe (m/s)	Pipe w/ Maximum Velocity
J-1/JCT_78138	352.00	3	True	100.00	215.00	100.00	215.00	162.7	0.28	P-66
J-2/JCT_78137	352.00	4	True	100.00	212.61	100.00	212.61	140.0	2.30	P-32
J-3	352.60	4	True	100.00	201.66	100.19	201.86	140.0	3.89	P-25
J-4	351.89	3	True	183.00	193.39	183.51	193.91	140.0	3.36	P-25
J-5	351.29	5	True	183.00	203.25	183.53	203.79	143.1	3.52	P-28
J-6	352.21	4	True	100.00	190.33	100.11	190.44	140.0	3.77	P-26
J-7	351.60	6	True	100.00	149.08	100.18	149.27	154.0	3.38	P-6
J-8	350.90	6	True	100.00	193.60	100.13	193.74	141.4	3.78	P-27
J-9	349.43	4	True	100.00	151.52	100.47	152.00	140.0	4.37	P-22
J-10	351.80	4	True	100.00	182.16	100.08	182.25	140.0	3.55	P-24
J-11	350.98	4	True	100.00	182.28	100.17	182.45	140.0	3.17	P-25
J-12	350.45	4	True	100.00	188.39	100.21	188.60	140.0	3.37	P-27
J-13	352.59	3	True	100.00	138.84	100.35	139.20	140.1	4.60	P-8
J-14	352.05	6	True	100.00	160.03	100.22	160.25	143.7	3.99	P-6
J-15	352.60	4	True	100.00	159.34	100.08	159.43	140.0	4.52	P-45
J-16	353.03	3	True	100.00	133.53	100.13	133.66	140.1	4.26	P-58
J-17	352.53	3	True	100.00	119.76	100.18	119.95	140.0	3.82	P-58
J-18/JCT_78136	358.50	4	True	100.00	196.72	100.00	196.72	140.0	1.44	P-39
J-19	357.62	5	True	186.00	197.94	188.71	200.65	145.6	1.52	P-50
J-20	357.01	6	True	133.00	200.55	133.21	200.76	148.9	1.85	P-50
J-21	356.09	6	True	100.00	202.45	100.19	202.64	159.1	1.84	P-52
J-22	353.82	4	True	183.00	203.75	183.29	204.05	182.9	2.23	P-52
J-23	353.67	4	True	100.00	194.57	100.62	195.19	140.0	3.52	P-53
J-24	349.72	5	True	183.00	204.47	183.29	204.76	173.1	4.55	P-56
J-25/JCT_78133	348.00	5	True	100.00	204.61	100.00	204.61	209.3	2.25	P-41
J-26/JCT_78134	352.00	5	True	100.00	204.82	100.00	204.82	203.6	0.27	P-67
J-27/JCT_78135	357.00	6	True	100.00	199.49	100.00	199.49	150.3	1.75	P-39

39502-104-Option 1.wtg

Active Scenario: Avg Day

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.72	506.2
45	J-2/JCT_78137	352.00	0.00	403.72	506.2
38	J-3	352.60	0.13	403.72	500.3
109	J-4	351.89	0.36	403.72	507.3
39	J-5	351.29	0.37	403.72	513.2
35	J-6	352.21	0.08	403.72	504.2
41	J-7	351.60	0.13	403.72	510.1
84	J-8	350.90	0.09	403.72	517.0
81	J-9	349.43	0.33	403.72	531.4
54	J-10	351.80	0.06	403.72	508.2
42	J-11	350.98	0.12	403.72	516.2
76	J-12	350.45	0.14	403.72	521.4
69	J-13	352.59	0.25	403.72	500.4
66	J-14	352.05	0.15	403.72	505.7
112	J-15	352.60	0.06	403.72	500.3
130	J-16	353.03	0.09	403.72	496.1
63	J-17	352.53	0.13	403.72	501.0
47	J-18/JCT_78136	358.50	0.00	403.75	442.9
115	J-19	357.62	1.88	403.75	451.5
118	J-20	357.01	0.15	403.75	457.4
50	J-21	356.09	0.13	403.75	466.4
121	J-22	353.82	0.20	403.75	488.7
124	J-23	353.67	0.43	403.75	490.1
127	J-24	349.72	0.20	403.75	528.8
51	J-25/JCT_78133	348.00	0.00	403.75	545.6
48	J-26/JCT_78134	352.00	0.00	403.75	506.5
56	J-27/JCT_78135	357.00	0.00	403.75	457.5

39502-104-Option 1.wtg

Active Scenario: Max Day

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.71	506.1
45	J-2/JCT_78137	352.00	0.00	403.71	506.1
38	J-3	352.60	0.20	403.71	500.2
109	J-4	351.89	0.51	403.71	507.1
39	J-5	351.29	0.53	403.71	513.0
35	J-6	352.21	0.11	403.71	504.0
41	J-7	351.60	0.18	403.71	510.0
84	J-8	350.90	0.13	403.71	516.8
81	J-9	349.43	0.47	403.71	531.2
54	J-10	351.80	0.09	403.71	508.0
42	J-11	350.98	0.17	403.71	516.0
76	J-12	350.45	0.21	403.71	521.2
69	J-13	352.59	0.35	403.71	500.3
66	J-14	352.05	0.22	403.71	505.6
112	J-15	352.60	0.09	403.71	500.2
130	J-16	353.03	0.13	403.71	496.0
63	J-17	352.53	0.18	403.71	500.9
47	J-18/JCT_78136	358.50	0.00	403.73	442.7
115	J-19	357.62	2.71	403.73	451.3
118	J-20	357.01	0.21	403.73	457.3
50	J-21	356.09	0.20	403.73	466.3
121	J-22	353.82	0.29	403.73	488.5
124	J-23	353.67	0.62	403.73	489.9
127	J-24	349.72	0.29	403.73	528.6
51	J-25/JCT_78133	348.00	0.00	403.73	545.4
48	J-26/JCT_78134	352.00	0.00	403.73	506.3
56	J-27/JCT_78135	357.00	0.00	403.73	457.3

39502-104-Option 1.wtg

Active Scenario: Min Hour

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.74	506.3
45	J-2/JCT_78137	352.00	0.00	403.74	506.3
38	J-3	352.60	0.06	403.74	500.5
109	J-4	351.89	0.16	403.74	507.4
39	J-5	351.29	0.17	403.74	513.3
35	J-6	352.21	0.03	403.74	504.3
41	J-7	351.60	0.06	403.74	510.3
84	J-8	350.90	0.04	403.74	517.1
81	J-9	349.43	0.15	403.74	531.5
54	J-10	351.80	0.03	403.74	508.3
42	J-11	350.98	0.05	403.74	516.3
76	J-12	350.45	0.06	403.74	521.5
69	J-13	352.59	0.11	403.74	500.6
66	J-14	352.05	0.07	403.74	505.9
112	J-15	352.60	0.03	403.74	500.5
130	J-16	353.03	0.04	403.74	496.3
63	J-17	352.53	0.06	403.74	501.2
47	J-18/JCT_78136	358.50	0.00	403.77	443.0
115	J-19	357.62	0.85	403.77	451.6
118	J-20	357.01	0.07	403.77	457.6
50	J-21	356.09	0.06	403.77	466.6
121	J-22	353.82	0.09	403.77	488.8
124	J-23	353.67	0.19	403.77	490.3
127	J-24	349.72	0.09	403.77	529.0
51	J-25/JCT_78133	348.00	0.00	403.77	545.8
48	J-26/JCT_78134	352.00	0.00	403.77	506.6
56	J-27/JCT_78135	357.00	0.00	403.77	457.7

39502-104-Option 1.wtg

Active Scenario: Peak Hour

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.61	505.1
45	J-2/JCT_78137	352.00	0.00	403.61	505.1
38	J-3	352.60	0.46	403.60	499.1
109	J-4	351.89	1.21	403.60	506.0
39	J-5	351.29	1.25	403.60	511.9
35	J-6	352.21	0.26	403.59	502.9
41	J-7	351.60	0.43	403.59	508.8
84	J-8	350.90	0.31	403.59	515.7
81	J-9	349.43	1.12	403.59	530.1
54	J-10	351.80	0.20	403.59	506.9
42	J-11	350.98	0.40	403.59	514.9
76	J-12	350.45	0.49	403.59	520.1
69	J-13	352.59	0.83	403.59	499.1
66	J-14	352.05	0.51	403.59	504.4
112	J-15	352.60	0.20	403.59	499.1
130	J-16	353.03	0.31	403.59	494.8
63	J-17	352.53	0.43	403.59	499.7
47	J-18/JCT_78136	358.50	0.00	403.59	441.3
115	J-19	357.62	6.37	403.59	449.9
118	J-20	357.01	0.49	403.59	455.9
50	J-21	356.09	0.46	403.59	464.9
121	J-22	353.82	0.69	403.59	487.1
124	J-23	353.67	1.46	403.59	488.6
127	J-24	349.72	0.69	403.59	527.3
51	J-25/JCT_78133	348.00	0.00	403.59	544.1
48	J-26/JCT_78134	352.00	0.00	403.60	505.0
56	J-27/JCT_78135	357.00	0.00	403.59	456.0

39502-104-Option 2.wtg
Active Scenario: Avg Day



39502-104-Option 2.wtg

Active Scenario: Max Day + Fire

Label	Elevation (m)	Fire Flow Iterations	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Calculated Residual) (kPa)	Velocity of Maximum Pipe (m/s)	Pipe w/ Maximum Velocity
J-1/JCT_78138	352.00	3	True	100.00	215.00	100.00	215.00	162.3	0.28	P-66
J-2/JCT_78137	352.00	4	True	100.00	212.45	100.00	212.45	140.0	2.30	P-32
J-3	352.60	4	True	100.00	201.50	100.19	201.69	140.0	3.89	P-25
J-4	351.89	3	True	183.00	193.24	183.51	193.76	140.0	3.36	P-25
J-5	351.29	5	True	183.00	202.27	183.53	202.81	145.6	3.50	P-28
J-6	352.21	4	True	100.00	190.17	100.11	190.28	140.0	3.77	P-26
J-7	351.60	6	True	100.00	142.73	100.18	142.91	154.0	4.58	P-68
J-8	350.90	6	True	100.00	192.02	100.13	192.15	146.0	3.76	P-27
J-9	349.43	4	True	100.00	151.41	100.47	151.88	140.0	4.37	P-22
J-10	351.80	4	True	100.00	182.00	100.08	182.08	140.0	3.55	P-24
J-11	350.98	6	True	100.00	176.36	100.17	176.53	160.1	3.08	P-25
J-12	350.45	6	True	100.00	186.06	100.21	186.27	147.4	3.33	P-27
J-13	352.59	3	True	100.00	128.78	100.35	129.13	140.0	4.14	P-68
J-14	352.05	6	True	100.00	153.10	100.22	153.32	145.4	4.91	P-68
J-15	352.60	4	True	100.00	159.22	100.08	159.31	140.0	4.52	P-45
J-16	353.03	3	True	100.00	128.89	100.13	129.02	140.0	4.14	P-68
J-17	352.53	3	True	100.00	116.40	100.18	116.59	140.0	3.74	P-68
J-18/JCT_78136	358.50	4	True	100.00	196.72	100.00	196.72	140.0	1.44	P-39
J-19	357.62	5	True	186.00	197.94	188.71	200.65	145.6	1.52	P-50
J-20	357.01	6	True	133.00	200.55	133.21	200.76	148.9	1.85	P-50
J-21	356.09	6	True	100.00	202.45	100.19	202.64	159.1	1.84	P-52
J-22	353.82	4	True	183.00	203.75	183.29	204.05	182.9	2.23	P-52
J-23	353.67	4	True	100.00	194.57	100.62	195.19	140.0	3.52	P-53
J-24	349.72	5	True	183.00	204.47	183.29	204.76	173.1	4.55	P-56
J-25/JCT_78133	348.00	5	True	100.00	204.61	100.00	204.61	209.3	2.25	P-41
J-26/JCT_78134	352.00	5	True	100.00	204.82	100.00	204.82	203.6	0.27	P-67
J-27/JCT_78135	357.00	6	True	100.00	199.49	100.00	199.49	150.3	1.75	P-39
J-28	350.98	6	True	100.00	169.69	100.17	169.86	160.1	5.44	P-68

39502-104-Option 2.wtg

Active Scenario: Avg Day

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.72	506.2
45	J-2/JCT_78137	352.00	0.00	403.72	506.2
38	J-3	352.60	0.13	403.72	500.3
109	J-4	351.89	0.36	403.72	507.3
39	J-5	351.29	0.37	403.72	513.1
35	J-6	352.21	0.08	403.72	504.1
41	J-7	351.60	0.13	403.72	510.1
84	J-8	350.90	0.09	403.72	517.0
81	J-9	349.43	0.33	403.72	531.3
54	J-10	351.80	0.06	403.72	508.2
42	J-11	350.98	0.12	403.72	516.2
76	J-12	350.45	0.14	403.72	521.4
69	J-13	352.59	0.25	403.72	500.4
66	J-14	352.05	0.15	403.72	505.7
112	J-15	352.60	0.06	403.72	500.3
130	J-16	353.03	0.09	403.72	496.1
63	J-17	352.53	0.13	403.72	501.0
47	J-18/JCT_78136	358.50	0.00	403.75	442.9
115	J-19	357.62	1.88	403.75	451.5
118	J-20	357.01	0.15	403.75	457.4
50	J-21	356.09	0.13	403.75	466.4
121	J-22	353.82	0.20	403.75	488.7
124	J-23	353.67	0.43	403.75	490.1
127	J-24	349.72	0.20	403.75	528.8
51	J-25/JCT_78133	348.00	0.00	403.75	545.6
48	J-26/JCT_78134	352.00	0.00	403.75	506.5
56	J-27/JCT_78135	357.00	0.00	403.75	457.5
165	J-28	350.98	0.12	403.72	516.2

39502-104-Option 2.wtg

Active Scenario: Max Day

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.71	506.1
45	J-2/JCT_78137	352.00	0.00	403.71	506.1
38	J-3	352.60	0.20	403.71	500.2
109	J-4	351.89	0.51	403.71	507.1
39	J-5	351.29	0.53	403.71	513.0
35	J-6	352.21	0.11	403.70	504.0
41	J-7	351.60	0.18	403.70	509.9
84	J-8	350.90	0.13	403.70	516.8
81	J-9	349.43	0.47	403.70	531.2
54	J-10	351.80	0.09	403.70	508.0
42	J-11	350.98	0.17	403.70	516.0
76	J-12	350.45	0.21	403.70	521.2
69	J-13	352.59	0.35	403.70	500.2
66	J-14	352.05	0.22	403.70	505.5
112	J-15	352.60	0.09	403.70	500.2
130	J-16	353.03	0.13	403.70	495.9
63	J-17	352.53	0.18	403.70	500.8
47	J-18/JCT_78136	358.50	0.00	403.73	442.7
115	J-19	357.62	2.71	403.73	451.3
118	J-20	357.01	0.21	403.73	457.3
50	J-21	356.09	0.20	403.73	466.3
121	J-22	353.82	0.29	403.73	488.5
124	J-23	353.67	0.62	403.73	489.9
127	J-24	349.72	0.29	403.73	528.6
51	J-25/JCT_78133	348.00	0.00	403.73	545.4
48	J-26/JCT_78134	352.00	0.00	403.73	506.3
56	J-27/JCT_78135	357.00	0.00	403.73	457.3
165	J-28	350.98	0.17	403.70	516.0

39502-104-Option 2.wtg

Active Scenario: Min Hour

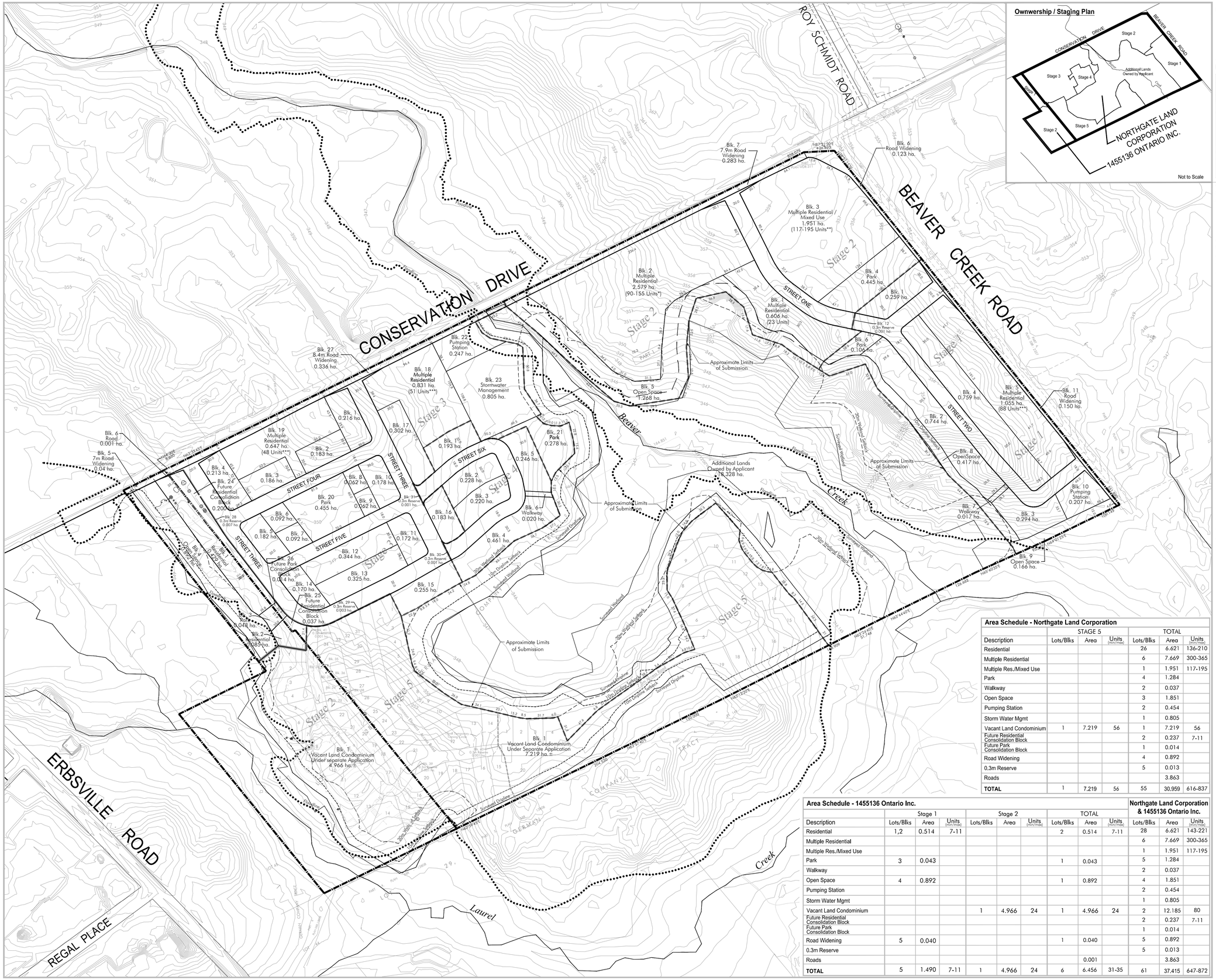
ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.74	506.3
45	J-2/JCT_78137	352.00	0.00	403.74	506.3
38	J-3	352.60	0.06	403.74	500.5
109	J-4	351.89	0.16	403.74	507.4
39	J-5	351.29	0.17	403.74	513.3
35	J-6	352.21	0.03	403.74	504.3
41	J-7	351.60	0.06	403.74	510.3
84	J-8	350.90	0.04	403.74	517.1
81	J-9	349.43	0.15	403.74	531.5
54	J-10	351.80	0.03	403.74	508.3
42	J-11	350.98	0.05	403.74	516.3
76	J-12	350.45	0.06	403.74	521.5
69	J-13	352.59	0.11	403.74	500.6
66	J-14	352.05	0.07	403.74	505.8
112	J-15	352.60	0.03	403.74	500.5
130	J-16	353.03	0.04	403.74	496.3
63	J-17	352.53	0.06	403.74	501.1
47	J-18/JCT_78136	358.50	0.00	403.77	443.0
115	J-19	357.62	0.85	403.77	451.6
118	J-20	357.01	0.07	403.77	457.6
50	J-21	356.09	0.06	403.77	466.6
121	J-22	353.82	0.09	403.77	488.8
124	J-23	353.67	0.19	403.77	490.3
127	J-24	349.72	0.09	403.77	529.0
51	J-25/JCT_78133	348.00	0.00	403.77	545.8
48	J-26/JCT_78134	352.00	0.00	403.77	506.6
56	J-27/JCT_78135	357.00	0.00	403.77	457.7
165	J-28	350.98	0.05	403.74	516.3

39502-104-Option 2.wtg

Active Scenario: Peak Hour

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
44	J-1/JCT_78138	352.00	0.00	403.60	505.0
45	J-2/JCT_78137	352.00	0.00	403.59	504.9
38	J-3	352.60	0.46	403.59	499.0
109	J-4	351.89	1.21	403.58	505.9
39	J-5	351.29	1.25	403.58	511.8
35	J-6	352.21	0.26	403.58	502.8
41	J-7	351.60	0.43	403.57	508.6
84	J-8	350.90	0.31	403.58	515.6
81	J-9	349.43	1.12	403.58	529.9
54	J-10	351.80	0.20	403.58	506.7
42	J-11	350.98	0.40	403.58	514.8
76	J-12	350.45	0.49	403.58	520.0
69	J-13	352.59	0.83	403.57	499.0
66	J-14	352.05	0.51	403.57	504.3
112	J-15	352.60	0.20	403.58	498.9
130	J-16	353.03	0.31	403.57	494.6
63	J-17	352.53	0.43	403.57	499.5
47	J-18/JCT_78136	358.50	0.00	403.59	441.3
115	J-19	357.62	6.37	403.59	449.9
118	J-20	357.01	0.49	403.59	455.9
50	J-21	356.09	0.46	403.59	464.9
121	J-22	353.82	0.69	403.59	487.1
124	J-23	353.67	1.46	403.59	488.6
127	J-24	349.72	0.69	403.59	527.3
51	J-25/JCT_78133	348.00	0.00	403.59	544.1
48	J-26/JCT_78134	352.00	0.00	403.60	505.0
56	J-27/JCT_78135	357.00	0.00	403.59	456.0
165	J-28	350.98	0.40	403.58	514.7

FULL SIZE DRAWINGS



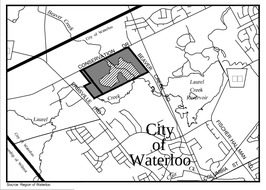
Ownership / Staging Plan

Not to Scale

Legal Description

PART OF LOT 28, GERMAN COMPANY TRACT,
(GEOGRAPHIC TOWNSHIP OF WATERLOO),
CITY OF WATERLOO,
REGIONAL MUNICIPALITY OF WATERLOO

Key Plan



Subject Lands

Additional Lands Owned by Applicants

north

Not to Scale

Additional Information Required Under Section 51(17) of the Planning Act R.S.O. 1990, c.P.13 as Amended

A. As Shown	B. As Shown	C. As Shown
D. Residential, Park, Open Space, Stormwater Management		
E. As Shown	F. As Shown	
G. As Shown	H. Municipal Water Supply	I. Sandy Loam
J. As Shown	K. All Services As Required	L. As Shown

Area Schedule - Northgate Land Corporation

30T - _____

	STAGE 1			STAGE 2		
Description	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)
Residential	1-4	2.056	45-67			
Multiple Residential	5	1.055	88	1,2	3.185	113-178
Multiple Res./Mixec Use				3	1.951	117-195
Park	6	0.106		4	0.445	
Walkway	7	0.017				
Open Space	8, 9	0.583		5	1.268	
Pumping Station	10	0.207				
Storm Water Mgmt						
Road Widening	11	0.150		6, 7	0.406	
0.3m Reserve	12	0.001				
Roads		0.878			0.461	
TOTAL	12	5.053	133-155	7	7.716	230-373
	STAGE 3			STAGE 4		
Description	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)
Residential	1-17	3.217	64-100	1-5	1.348	27-43
Multiple Residential	18,19	1.478	99			
Park	20,21	0.733				
Walkway				6	0.020	
Open Space						
Pumping Station	22	0.247				
Storm Water Mgmt	23	0.805				
Future Residential Consolidation Block	24,25	0.237	7-11			
Future Park Consolidation Block	26	0.014				
Road Widening	27	0.336				
0.3m Reserve	28-31	0.012				
Roads		1.992			0.532	
TOTAL	31	9.071	170-210	6	1.900	27-43

Area Schedule - Northgate Land Corporation

	STAGE 5			TOTAL		
Description	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)
Residential				26	6.621	136-210
Multiple Residential				6	7.669	300-365
Multiple Res./Mixed Use				1	1.951	117-195
Park				4	1.284	
Walkway				2	0.037	
Open Space				3	1.851	
Pumping Station				2	0.454	
Storm Water Mgmt				1	0.805	
Vacant Land Condominium	1	7.219	56	1	7.219	56
Future Residential Consolidation Block				2	0.237	7-11
Future Park Consolidation Block				1	0.014	
Road Widening				4	0.892	
0.3m Reserve				5	0.013	
Roads					3.863	
TOTAL	1	7.219	56	55	30.959	616-837

Area Schedule - 1455136 Ontario Inc.

	Stage 1			Stage 2			TOTAL			Northgate Land Corporation & 1455136 Ontario Inc.		
Description	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)
Residential	1,2	0.514	7-11				2	0.514	7-11	28	6.621	143-221
Multiple Residential										6	7.669	300-365
Multiple Res./Mixed Use										1	1.951	117-195
Park	3	0.043					1	0.043		5	1.284	
Walkway										2	0.037	
Open Space	4	0.892					1	0.892		4	1.851	
Pumping Station										2	0.454	
Storm Water Mgmt										1	0.805	
Vacant Land Condominium				1	4.966	24	1	4.966	24	2	12.185	80
Future Residential Consolidation Block										2	0.237	7-11
Future Park Consolidation Block										1	0.014	
Road Widening	5	0.040					1	0.040		5	0.892	
0.3m Reserve										5	0.013	
Roads								0.001			3.863	
TOTAL	5	1.490	7-11	1	4.966	24	6	6.456	31-35	61	37.415	647-872

Notes:
- Boundary information provided by MacDonald Tamblyn Surveying Ltd., February 5,2008, Plan 58R-16404.
- Topographic information provided by Stantec Consulting, Contour Interval - 0.5m.
- *- BCM District Plan, Low Density Residential 2 calculated at 35-60 Units per Hectare
- **- BCM District Plan, Mixed Use Medium Density Residential calculated at 60-100 Units per Hectare
- ***- Multiple Block Unit Yield based on Conceptual Site Plan prepared by MHBC Planning.

VLC - denotes Vacant Land Condominium,
- Floodline mapping obtained from North Waterloo Scoped Subwatershed Study, November 2012 and GRCA Developement Resource On-Line Mapping, January 23,2017.

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
200-540 BINGEMANS CENTRE DR. KITCHENER, ON. N2B 3X9 | P: 519.576.3650 F: 519.576.0121 | WWW.MHBCPLAN.COM

Approval Stamp

Date July 4,2017

File No. 14148A

Plan Scale 1:1,250

Drawn By L.H.B. / G.M.C.

Checked By P.B. / D.A.

Northgate Land Corporation & 1455136 Ontario Inc.
Conservation Drive
Waterloo, Ontario

north

File Name

DRAFT PLAN CONSOLIDATION

K:\14148A-NORTHGATE-WATERLOO\DRAFT PLAN\DRAFT PLAN CONSILIDATION JULY 4 2017.DWG

39502-104-EC1.1
MTE FILE No:
EXISTING CONDITIONS PLAN
P:_P\39502\104\39502-104-EC1.DWG

July 5, 2017 – 9:25 a.m. – Plotted By: kaylor

CONSERVATION DRIVE

BEAVER CREEK ROAD

LEGEND OF EXISTING FEATURES

- SITE BOUNDARY
- EXISTING SPOT ELEVATIONS/CONTOURS (326)
- EXISTING SANITARY SEWER (Ex. 300mmø SAN., Ex. MH)
- EXISTING WATERMAIN (Ex. 200mmø WTM., Ex. HYD. SET)
- EXISTING STORM SEWER (Ex. 375mmø STM., Ex. MH)
- EXISTING FENCE
- EXISTING EMBANKMENT (SLOPE AS NOTED) (TOP) (BOTTOM)
- TEST PITS (STANTEC, 2010)
- MONITORING WELL
  - -10 STANTEC S=SHALLOW D=DEEP
  - -14 MTE A=DEEP B=SHALLOW

SITE BENCHMARK ELEV=351.265

Laurel Creek Floodline

Beaver Creek Floodline

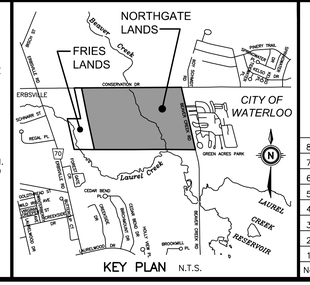
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KEY PLAN N.T.S.

No.	REVISION	BY	DATE
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GEODETIC BM ELEV. = 349.950m
TABLET SET ON N.E. END OF E. CURB OF CONCRETE BOX CULVERT ON REGIONAL RD. 16 IN ERBSVILLE, 4.9m E. OF CONTRELINE OF REGIONAL RD. 16 32m N.E. OF THE N.E. CORNER OF WHITE FRAME HOUSE, 161m S. OF THE INTERSECTION OF REGIONAL RD. 14 AND 16.

SITE BENCHMARK ELEV. = 351.265m
TOP OF SIB (SEE PLAN FOR LOCATION)

OWNER
1017081 ONTARIO LIMITED & GABRIELLA ELIZABETH GROFF/1455136 ONTARIO INC
1455136 ONTARIO INC. KITCHENER

PROJECT
NORTHGATE AND ERBSVILLE KARTWAY SUBDIVISIONS
CONSERVATION DRIVE WATERLOO

DRAWING
EXISTING CONDITIONS PLAN

MTE
Engineers | Scientists | Surveyors
(519)743-6500 www.mte85.com

Project Manager V.LAZIC	Project No. 39502-104
Design By	Checked By
Drawn By KAT	Checked By MSB
Surveyed By MTE	Drawing No. EC1.1
Date Aug.14/14	
Scale 1:1500	Sheet of

39502-104-AG1.1
MTE FILE No:
FINISHED GRADE CONTOURS PLAN
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July 5, 2017 – 9:38 a.m. – Plotted By: klaylor

CREEKSIDE CHURCH

CONSERVATION DRIVE

BEAVER CREEK ROAD

LEGEND OF EXISTING FEATURES

- SITE BOUNDARY
- STAGE LIMIT
- EXISTING CONTOURS
- FINSIHED GRADE CONTOURS
- PROPOSED SPOT ELEVATIONS
- PROPOSED DIRECTION OF DRAINAGE

STREET ONE
STREET TWO
STREET THREE
STREET FOUR
STREET FIVE
STREET SIX
STREET SEVEN
STREET EIGHT

Stage 1
Stage 2
Stage 3
Stage 4

SITE BENCHMARK ELEV=351.265

3:1 EMBANKMENT INTO BUFFER

50m RETAINING WALL MAXIMUM HEIGHT 1.2m

PROP. 13m–375mmø STM @ 3.8%

PROP. 28x2.4x1.2m BOX CULVERT @ 0.5%

Laurel Creek
Floodline
Beaver Creek

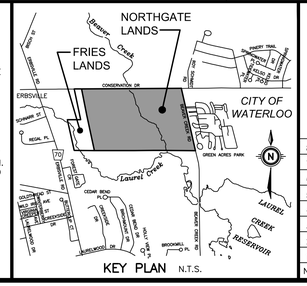
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Project Manager: V.LAZIC	Project No.: 39502-104
Design By:	Checked By:
Drawn By: KAT	Checked By: MSB
Surveyed By: MTE	Drawing No.: AG1.1
Date: May.02/17	
Scale: 1:1500	Sheet of

MTE FILE No: 39502-104-QU6.1

PRELIMINARY GROUNDWATER SEPARATION PLAN

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July 5, 2017 — 9:36 a.m. — Plotted By: ktaylor

CONSERVATION DRIVE

BEAVER CREEK ROAD

STREET ONE

STREET TWO

STREET THREE

STREET FOUR

STREET FIVE

Stage 1

Stage 2

Stage 3

Stage 4

Stage 5

Laurel Creek Floodline

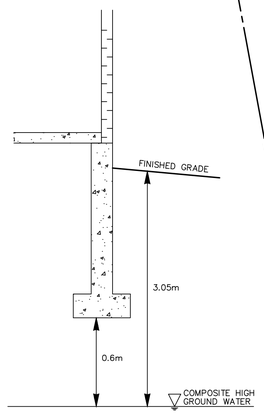
Beaver Creek Floodline

SITE BENCHMARK ELEV=351.265

LEGEND

- PROPERTY BOUNDARY
- STAGING LIMIT
- EXISTING CONTOURS (326)
- PROPOSED CONTOURS (326)
- GROUNDWATER CONTOURS (326)
- −0.28 LESS THAN 3.05m
- +0.27 GREATER THAN 3.05m
- * SEE DETAIL 'A' BELOW.

TICKS ARE READ AS SEPARATION BETWEEN 0.6m BELOW UNDERSIDE (U/S) OF FOOTING AND EXISTING HIGH GROUNDWATER.



DETAIL 'A'

N.T.S.

NOTES:

1. THIS ANALYSIS IS VALID ON; REAR TO FRONT DRAINING, SPLIT DRAINING AND FRONT HALF OF WALKOUT LOT TYPES.
2. NOT APPLICABLE ON; STREETS, PARK BLOCKS, SWM BLOCKS AND REAR HALF OF WALKOUT LOTS.

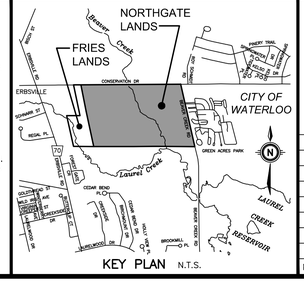
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