Water Balance Assessment

31 Marlwood Avenue

Town of Wasaga Beach

Prepared for:
Loft Planning Inc.

Prepared by:
Azimuth Environmental
Consulting, Inc.

Updated February 2020

AEC 15-273

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Environmental Assessments & Approvals

February 5th 2020 AEC 15-273

Loft Planning Inc.
P.O. Box 246 STN MAIN
Collingwood, Ontario
L9Y 3Z5

Attention: Kristine Loft, MCIP RPP

Re: **Water Balance Assessment**
31 Marlwood Avenue, Town of Wasaga Beach, Ontario

Dear Ms. Loft:

Azimuth Environmental Consulting, Inc. (Azimuth) is pleased to provide our Water Balance Assessment for the property located at 31 Marlwood Avenue within the Town of Wasaga Beach (the "Site"). This evaluation focused on the existing soil and ground water regime underlying the Site and the potential for the proposed development to impact the existing conditions. The Water Balance Assessment has been revised to reflect recent changes to the Site Plan.

Should you have any questions or wish to discuss the report in greater detail, please do not hesitate to contact the undersigned.

Yours truly,
AZIMUTH ENVIRONMENTAL CONSULTING, INC.

JMillington

Jennifer Millington, M.A.Sc., P.Geo.
Hydrogeologist

Mike Jones, M.Sc., P.Geo.
President

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1.0 INTRODUCTION

Azimuth Environmental Consulting, Inc. ("Azimuth") has been retained by Loft Planning Inc. to conduct a Water Balance for the proposed development located at 31 Marlwood Avenue within the Town of Wasaga Beach, Ontario (the "Site")(Figure 1).

The Site is approximately 55.0 hectares (ha) in size and currently contains the Marlwood Golf Course. The Site fronts onto Golf Course Road, and the current clubhouse is accessible off of Marlwood Crescent (Figure 2).

It is our understanding that a portion of the Site will be developed into 60 single detached residential homes in two phases. The proposed development will take a portion of the existing golf course land, with the remaining land to be redesigned to maintain the golf course use. The proposed residential lots will be serviced with municipal services. The purpose of this assessment is to characterize the existing hydrogeological conditions at the Site and the potential for the proposed development to impact the existing environmental conditions.

The first phase of development will include 9 detached residential units along the western boundary of the golf course between existing residential homes on Briton Court and Marlwood Avenue. The lots will have frontage on Golf Course Road. Phase 1 is approximately 0.85 ha in size.

The second phase of development will include 51 detached residential units in the southwest portion of the golf course. The lots are situated in an L-shape and will be accessible off of Golf Course Road. Phase 2 is approximately 7.43ha in size.

Draft Plans of Subdivision (dated January 14th 2020) for both phases of development are provided in Appendix B.

2.0 ENVIRONMENTAL SETTING

2.1 Soil

The soil map of Simcoe County (Soil Survey Report No. 29, Scale 1:63,360) shows the uppermost soil at the Site to be composed of Minesing marly clay or Tioga sandy loam (Hoffman *et al.*, 1962). Minesing marly clay is classified within hydrologic soil group "C". Group C represent soils which have low infiltration rates when thoroughly wet and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. Tioga sandy loam is classified within hydrologic soil group "A". Group A represents soils with a low runoff potential and high infiltration

rates even when thoroughly wet. They consist chiefly of deep, well to excessively drained sand or gravel. The proposed development is primarily located in the Minesing marly clay.

2.2 Physiography

The Ontario Geologic Survey (Chapman and Putnam, 1984) describes the area as being located within the Simcoe Lowlands physiographic region, specifically within the Nottawasaga Basin. The Simcoe Lowlands were at one time part of the floor of glacial Lake Algonquin and its surface beds are therefore deposits of deltaic and lacustrine origin.

2.3 Topography and Drainage

According to local topographic mapping the Site is found at an elevation of 185 to190 m above sea level (masl). In general, the Site is sloped toward Marl Lake, with local gradients toward the golf course ponds and forest area along Golf Course Road. A Provincially Significant Wetland (Jack's Lake Wetland) is located on the south west corner of Marl Lake, immediately adjacent to the golf course property. Marl Lake is drained by Marl Creek, which is part of the Lower Nottawasaga River subwatershed and drains into Georgian Bay. The Marl Lake outlet into Marl Creek is controlled by a man made outfall structure constructed in the 1990s. The outfall structure is constructed using a sheet pile barrier wall and removable members to allow for adjustment of water levels and maintenance of habitat within both the lake and its associated wetland.

The existing surface water catchment areas were delineated by R.J. Burnside & Associates (Appendix B).

In Phase 1, the Site topography generally drains east to south east towards the golf course and the existing pond feature within the golf course. There is currently no storm water infrastructure along Golf Course Road along the frontage of Phase 1. After development, runoff will therefore be directed into soak away pits and an infiltration trench within each lot. An emergency overland flow route will direct runoff toward the golf course via the public easement where it will travel 200m toward the existing golf course pond adjacent to Marl Lake. For Phase 1, the pre- and post-development drainage pathways are maintained and therefore can be considered one catchment for the water balance assessment.

In Phase 2, the existing Site topography is generally sloped toward two golf course ponds to the east, and to the forest to the south. The regional topography is sloped toward Marl Lake. According to information provided in Appendix B the proposed drainage patterns

will generally be maintained compared to pre-development conditions. A centralized storm water management pond will be used to collect runoff and will outlet into an open channel which will dissipate energy prior to entering the adjacent wetland.

The Marlwood Golf Course currently pumps water directly from Marl Lake for irrigation. This is facilitated through the use of a submersible pump that is suspended within the lake (~2 m below water surface) through the base of a small wooden shed that is constructed at the end of an approximately 20 m long wooden pier structure. From the lake, pumped water is transferred up to an irrigation head pond (dugout type) situated on the 9th hole of the golf course using a 203 mm∅ I.D. HDPE (partially) buried forcemain. From the irrigation head pond, water is utilized on an as-needed basis by the irrigation system.

2.4 Bedrock Geology

The Ontario Geologic Survey Earth Database shows that the uppermost bedrock unit at the subject property consists of limestone and shale of the Verulam Formation of the Simcoe Group (OGS, 2017). The Verulam Formation is Middle Ordovican in age. Bedrock is sufficiently deep (70m+) and does not influence the water balance assessment.

2.5 Quaternary Geology

The surficial material for the Site is consists of lacustrine deposits which may be composed of both silt and clay associated with basin or quiet water deposits, or sand, gravelly sand and gravel associated with near shore and beach deposits (OGS, 2017).

2.6 Hydrogeology

The Ontario Ministry of the Environment, Conservation, and Parks (MECP) Water Well Records were references for any recorded well information in the vicinity of the Subject Site (GIN, 2017; Table 1). Well records can be used to gain subsurface information which can provide insight into geological formations within the area.

Table 1: MOECC Water Well Database Summary[1]

Well ID	Elevation (masl)	Date Drilled	Static Water Level (mbgs)	Depth to Bedrock (m)	Total Depth (m)	Well Type	Primary Use
5729422	186	1992-06-12	9.2	-	41.2	Overburden	Domestic
5734995	186	2000-03-21	4.6	-	13.1	Overburden	Domestic
5726707	186	1990-06-06	9.1	-	41.5	Overburden	Domestic
5733732	197	1998-08-17	11.6	-	53.0	Overburden	Domestic
5731265	193	1994-11-24	10.1	-	44.5	Overburden	Domestic
5709060	191	1971-08-06	-	74.4	79.3	Bedrock	Abandoned
5709061	191	1971-08-13	-	-	54.9	Overburden	Test Hole
5733570	186	1998-06-24	8.5	-	41.4	Overburden	Domestic

Notes: [1] - values rounded for presentation purposes

The surrounding wells in the MECP database were drilled primarily for domestic use, with one well listed for test hole purposes and one well listed as abandoned. In general, wells were advanced primarily through a thick (11-25 m) surficial sand unit overlying a clay or silt layer which overlies a second, confined sand or gravel unit. Bedrock was encountered in one record at a depth of 74 mbgs. The static water table upon borehole completion was between 4.6 – 11.6 mbgs with an average depth of 8.9 mbgs.

A portion of the Site is considered a Significant Ground Water Recharge Area (SGRA) and a Highly Vulnerable Aquifer (HVA). The Site overlaps with a Wellhead Protection Area (WHPA) and is classified as WHPA-D. A portion of the Site is also located within the Nottawasaga Valley Conservation Authority (NVCA) Regulated Area.

The Oak Ridges Moraine Ground water Program (ORMGP, 2018) includes a water table layer which was created by contouring the static water levels from all wells where the well screen is less than 20 m deep. This layer is meant to represent an average water table since the values used in its creation were collected from all seasons over time. ORMGP (2018) suggests that the actual water table at any given time of the year may be up to 2-3m lower or higher than the values indicated on the water table layer. According to ORMGP (2018) the water table at the Site is found between 189 to 183 masl. The ground water flow is toward Marl Lake. Maps from the ORMGP (2018) are included in Appendix D.

3.0 MONITORING

3.1 Geotechnical Program

A preliminary geotechnical program was completed for the Site by SPL Consultants Limited in November 2015, and updated by WSP in January 2020. The geotechnical program included advancing twelve (12) boreholes (BH15-01 to BH15-12) at the Site within the Phase 1, Phase 2, and existing golf course lands. The boreholes were drilled to depths between 5.2 and 8.2 mbgs.

The SPL (2015) and WSP (2020) reports indicates the subsurface geology to be composed of topsoil overlying silty sand to sandy silt fill, overlying sand to silty sand and gravel. Marl was observed in six boreholes at various depths and extended up to 2.3mbgs.

3.2 Ground Water Elevations

Ground water measurements were collected at five installed monitoring wells (BH15-01, BH15-05, BH15-07, BH15-09, & BH15-12) on a monthly basis between October 2015

and August 2016. These wells overlapped with both the Phase 1 and Phase 2 lands. A summary of the water measurements are found in the below Table 2:

Table 2: Summary of Ground Water Measurements (WSP, 2020)

Borehole ID	High Ground Water Level		Low Ground Water Level		Range (m)
	mbgs	masl	mbgs	masl	
BH15-01	2.37	186.63	3.13	185.87	0.76
BH15-05	0.99	186.01	1.48	185.52	0.49
BH15-07	2.77	184.23	3.27	183.73	0.50
BH15-09	4.38	185.62	4.91	185.09	0.53
BH15-12	1.44	188.56	2.20	187.80	0.76

The high ground water level at the Site is therefore between 188.56 and 184.23 masl or 4.38 and 0.99 mbgs. The local ground water flow direction is toward Marl Lake. It should be noted that the water table elevation will fluctuate seasonally and will display the highest value in the spring months (March or June). The complete set of borehole logs and ground water measurements can be found in WSP (2020).

4.0 WATER BALANCE

In order to determine the potential changes to the natural ground water recharge conditions, a pre- and post-development water balance assessment has been completed using the Thornthwaite and Mather method (1957). This method evaluates evapotranspiration based on precipitation and temperature. Residual soil saturation is a function of topography and soil type. Monthly data are tabulated from daily average temperature and precipitation, and the water budget is a continuous calculation over the period of record. To clarify, the method and the approach used by many individuals in examining infiltration resets annual conditions (moisture deficit, snow storage, etc) over the winter months because of the general lack of infiltration during the frost period. However, we maintain those records and carry them forward from month to month during the entire period of record.

Values were determined on a monthly basis, compiled from daily Environment Canada meteorological data station located in Collingwood, Ontario between 1960 and 2010 (Collingwood Climate Data). The calculations are based on the average conditions during this period. The average precipitation was 888 millimeters (mm), rainfall was 656 mm, evapotranspiration was 495 mm, and the surplus was 393 mm per year.

4.1 Land Use

4.1.1 Pre-Development

Using an aerial image, the Site was classified according to land use/ vegetation type. Land within the pre-development area can be classified as forest, landscaped grass, and surface water (Table 3).

Table 3: Pre Development Area Classification

Land Use	Land Area (m^2)
Phase 1	
Forest	6,127
Landscaped Grass	2,373
Phase 1 TOTAL	**8,500**
Phase 2	
Forest	29,736
Landscaped Grass	42,799
Surface Water	1,765
Phase 2 TOTAL	**74,300**
Site TOTAL	**82,800**

Land within the pre-development scenario is considered 2% impervious. The impervious area is associated with the existing surface water "hazards" within the golf course.

4.1.2 Post-Development

To determine the post-development land use designations, the following assumptions have been made:

- The rooftop area was obtained from information reviewed within Appendix B and is assumed to be 50% of lot area. The total rooftop area in Phase 1 is 4,315 m^2 and the total rooftop area in Phase 2 is 16,524 m^2;
- The average driveway is 40 m^2;
- The internal road area within Phase 2 is 11,900 m^2. Phase 1 does not contain any internal roads other than driveways;
- The storm water pond in Phase 2 will be lined and considered 50% impervious. The pumping station within Phase 2 is also considered 50% impervious;
- About 15,200 m^2 of land will remain forest in the post-development scenario of Phase 2 (Block 55)
- All additional land within each lot and the storm water pond block is assumed to be landscaped grass;

Land within the post-development Site is summarized in the below Table 4:

Table 4: Post-Development Area Classification

Land Use	Land Area (m^2)
Phase 1	
Structures	4,315
Driveway	360
Landscaped Grass	3,825
Phase 1 TOTAL	**8,500**
Phase 2	
Structures	16,524
Driveway	2,040
Landscaped Grass	21,836
Forest	15,200
Roads	11,900
Storm Water Pond & Pumping Station - Impervious	6,800
Phase 2 TOTAL	**74,300**
Site TOTAL	**82,800**

Land within the post-development scenario is considered 51 % impervious. The impervious area is associated with the structures, driveways, storm water management pond, pump station, and internal road.

4.2 Infiltration

Infiltration is generated one of two ways: (1) directly from rainfall impact on pervious surfaces; and (2) indirectly when runoff from impervious surfaces is diverted into adjacent naturalized areas.

Infiltration factors for the Site were estimated based on the underlying soil, local topography, and ground cover as per Table 2 of the Ministry of Environment and Energy (MOEE) Hydrogeological Technical Information Requirements for Land Development Applications (1995).

The soil variable factor was determined by taking into account information obtained from the regional geologic mapping (Section 3.0) and the geotechnical program completed for the Site (Section 4.1). This information suggests that the dominant soil type in the area is sand, with some local marl deposits near Marl Lake. The soil is therefore considered a sandy loam for the purpose of the water balance assessment. The infiltration factors utilized in the water balance assessment are summarized in Table 5 below.

The topography factor was based on the pre- and post-development slope information provided on the Preliminary Grading Plans for each Phase included within the Burnside

(2017a & 2017b) reports. Based on the information reviewed, the pre- and post-development land can be classified as rolling land for both Phase 1 and Phase 2.

Table 5: Summary of Pervious Land Infiltration Factor (See Appendix E)

Scenario	Land Use	Infiltration Factor	Assumption
Pre-Development	Forest	0.80	Rolling land, sandy loam soil, woodland
	Landscaped Grass	0.65	Rolling land, sandy loam soil, grass
	Surface Water	0.0	Saturated soil does not promote infiltration
Post-Development	Forest	0.80	Rolling land, sandy loam soil, woodland
	Landscaped Grass	0.65	Rolling land, sandy loam soil, grass
	Stormwater Pond	0.0	The storm water pond will be lined and therefore no infiltration will occur.

4.2.1 Pre-Development

Pre-development infiltration was determined by multiplying the annual average surplus amount, the area of each land use, and the infiltration factor for each land use. The pre-development annual infiltration is therefore 22,815 m^3/year which includes 2,533m^3/year from Phase 1 and 20,282 m^3/year from Phase 2. (Appendix E).

4.2.2 Post-Development

Post-development infiltration (without mitigation) was determined by multiplying the annual average surplus amount, the area of each land use, and the infiltration factor for each land use. The post-development annual direct infiltration is therefore 11,334 m^3/year, which includes 977 m^3/year from Phase 1 and 10,357 m^3/year from Phase 2. There is therefore a decrease across the entire Site in infiltration of 11,481 m^3/year from pre- to post-development without mitigation which represents 50%. This represents a decrease of 1,555 m^3/year in Phase 1 (61%) and 9,925 m^3/year in Phase 2 (49%).

Additional infiltration will also be gained through low impact development (LID). According to the information provided by Burnside (Appendix B), soakaway pits will be used at the lot scale to collect and infiltrate runoff from rooftop surfaces. In Phase 1, the soakaway pits will infiltrate up to the 5mm event, and the remaining rooftop runoff (up to the 25mm event) will be infiltrated through an infiltration trench. In Phase 2, the soakaway pits will infiltrate up to the 12mm event from the rooftop area.

In order to correlate event based rainfall data, for which the LID's are designed (i.e. 20 mm rainfall event), to annual averages, as is what is utilized in water balances, an event based assessment has been completed for a climate station in Southern Ontario (Barrie). Rainfall events over the past 5 years of complete data (2013 – 2017) were broken down by event size, such that total volumes for each of these events could be calculated. It was determined that an event rainfall depth of 5mm or less represents 46% of annual rainfall, an event rainfall depth of 12mm or less represents 76% of annual rainfall, and an event rainfall depth of 25mm or less represents 93% of annual rainfall.

If the soakaway pit/infiltration trench combinations in Phase 1 are designed to capture up to the 25mm storm event over the 4,315 m^2 impervious area, an additional 2,632 m^3 of runoff will be incorporated as infiltration (93% x 656 mm x 4,315 m^2). Half of the remaining rooftop runoff that is not captured will be directed to the adjacent landscaped grass. The other half will be directed to the front lawn/driveway which would drain to the storm water infrastructure. This infiltration represents 52 m^3/year (7% x 656 mm x 4,315 m^2 x 0.65 x 80% x 50%). This value is also multiplied by the infiltration coefficient of the grass and includes a 20% loss factor for evapotranspiration.

If the soak away pits in Phase 2 are designed to capture up to the 12mm storm event over the 16,524 m^2 rooftop area, an additional 8,238 m^3 of runoff will be incorporated as infiltration (76% x 656 mm x 16,524 m^2). As in Phase 1, half of the remaining rooftop runoff that is not captured will be directed to the adjacent landscaped grass. This infiltration represents 676 m^3/year (54% x 656 mm x 16,524 m^2 x 0.65 x 80% x 50%).

The total post-development infiltration for the entire Site after incorporating mitigation measures is therefore 22,933 m^3, which is 100% of pre-development levels. This represents an increase of 45% from pre- to post-development in Phase 1 and a decrease of 5% from pre- to post-development in Phase 2.

4.3 Water Balance Summary

Using the climate model data and calculations mentioned above, the water balance was completed for pre-development, post-development, and post-development with mitigation (Appendix E).

The total infiltration at the Site is 22,815 m^3 in the pre-development scenario, which represents 2,533 m^3 from Phase 1 and 20,282 m^3 from Phase 2. The total infiltration is reduced by 50% when no mitigation measures are employed. This decrease is associated with the increase in impervious surfaces such as roads, driveways, and structures.

The decrease is eliminated when runoff from rooftops is incorporated into soak away pits, infiltration trenches, or is directed onto grassed surfaces in the post-development scenario. An additional 2,684 m^3/year is incorporated into Phase 1, and an additional 8,915 m^3/year is incorporated into Phase 2. The total Phase 1 infiltration after mitigation is 3,661 m^3, and the total Phase 2 infiltration after mitigation is 19,271 m^3. The total post-development infiltration after mitigation is 22,933 m^3, which represents 100% of the pre-development volume.

4.4 Sensitive Features: Jack's Lake Wetland

In the pre-development scenario, the existing conditions within Phase 1 contained approximately 2,533 m^3 of infiltration and 808 m^3 of runoff. The runoff drained via sheet flow east to south east towards the golf course and the existing pond feature within the golf course. In the post-development with mitigation scenario, Phase 1 contains approximately 3, 661 m^3 of infiltration and 637 m^3 of runoff. The infiltration will therefore increase, with a slight decrease in runoff. The runoff flow path for Phase 1 is also maintained, since the flow will be directed toward the golf course via the public easement where it will travel 200m toward the existing golf course pond.

In the pre-development scenario, the existing conditions within Phase 2 contained approximately 20,282 m^3 of infiltration and 9,478 m^3 of runoff. The runoff drained toward Master's Lane, the existing Golf Course ponds, Golf Course Road, or south toward residential homes along "The Boardwalk". According to Burnside (Appendix B) the proposed drainage patterns will generally be maintained compared to pre-development conditions. A centralized storm water management pond will be used to collect runoff and will outlet into an open channel which will dissipate energy prior to entering the adjacent wetland. In the post-development with mitigation scenario, Phase 2 contains approximately 19,271 m^3 of infiltration which represents 95% of pre-development levels. Phase 2 also contains 21,756 m^3 of runoff.

Based on the local topography, the Jack's Lake wetland feature likely receives some sheet flow runoff from the adjacent golf course land. Based on the information provided above, the total runoff will increase from pre- to post-development. Since the proposed drainage patterns will generally be maintained, the runoff contributions to the wetland feature should increase from pre- to post development.

The wetland is located around the vicinity of a large surface water feature, and therefore the primary contributing source of water within the wetland is Marl Lake. As identified above, the outlet of Marl Lake into Marl Creek is controlled through a man made outfall structure. When considering Phase 1 and Phase 2 together, there will be no decrease in the amount of infiltration into Marl Lake after development. When considering only

Phase 2, there will be a slight (5%) decrease after development. This isolated deficit is not considered significant. The slight decrease (5%) in infiltration at Phase 2 will be offset by the increase in infiltration from Phase 1, and the increase in runoff contributions into Marl Lake from both Phase 1 and Phase 2 within the proposed storm water pond. The pond will outlet via an open channel which will dissipate energy prior to entering the adjacent wetland. Based on this assessment, no significant changes in the water level of Jack's Lake Wetland are anticipated as a result of the proposed development.

5.0 SUMMARY AND CONCLUSIONS

Azimuth was retained by Loft Planning Inc. to conduct a Water Balance for the proposed development located at 31 Marlwood Avenue within the Town of Wasaga Beach, Ontario. The Site is approximately 55.0 hectares (ha) in size and currently contains the Marlwood Golf Course. The Site fronts onto Golf Course Road, and the current clubhouse is accessible off of Marlwood Crescent

It is our understanding that a portion of the Site will be developed into 60 single detached residential homes in two phases. The proposed development will take a portion of the existing golf course land, with the remaining land to be redesigned to maintain the golf course use. The proposed residential lots will be serviced with municipal services. The purpose of this assessment is to characterize the existing hydrogeological conditions at the Site and the potential for the proposed development to impact the existing environmental conditions.

The Site is found at an elevation of 185 to190 m above sea level (masl). In general, the Site is sloped toward Marl Lake, with local gradients toward the golf course ponds and forest area along Golf Course Road. A Provincially Significant Wetland (Jack's Lake Wetland) is located on the south west corner of Marl Lake, immediately adjacent to the golf course property. Marl Lake is drained by Marl Creek, which is part of the Lower Nottawasaga River subwatershed and drains into Georgian Bay. The Marl Lake outlet into Marl Creek is controlled by a man made outfall structure constructed in the 1990s.

A geotechnical evaluation was completed for the Site by SPL Consultants Limited in November 2015 and updated by WSP in 2020. The surficial material is composed of topsoil overlying silty sand to sandy silt fill, overlying sand to silty sand and gravel. Marl was observed in four boreholes and extended up to 2.3mbgs. Five monitoring wells were installed as part of the geotechnical program. The high ground water level at the Site is therefore between 188.56 and 184.23 masl or 4.38 and 0.99 mbgs. The local ground water flow direction is toward Marl Lake.

A pre- and post-development water balance assessment was completed to assess any impacts to the infiltration rate at the Site. The post-development with mitigation runoff contributions will increase, while the post-development with mitigation infiltration volume will not change.

When considering Phase 1 and Phase 2 together, there will be no decrease in the amount of infiltration into Marl Lake after development. When considering only Phase 2, there will be a slight (5%) decrease after development. This isolated deficit is not considered significant. The slight decrease (5%) in infiltration at Phase 2 will be offset by the increase in infiltration from Phase 1, and the increase in runoff contributions into Marl Lake from both Phase 1 and Phase 2 within the proposed storm water pond. The pond will outlet via an open channel which will dissipate energy prior to entering the adjacent wetland. Based on this assessment, no significant changes in the water level of Jack's Lake Wetland are anticipated as a result of the proposed development.

Based upon our assumptions above and the interpretation of the available data it is concluded that the present hydrogeological conditions of the Site and surrounding area will not experience a significant change due to the proposed development.

6.0 REFERENCES

Barnett, P.J., Cowan, W.R. and Henry, A.P. 1991. Quaternary Geology of Ontario, Ontario Geological Survey, Map 2556, Scale 1:1,000,000.

Chapman L.J., and D.F. Putnam, 1984. The Physiography of Southern Ontario. 3rd Edition, OGS Special Volume 2, Ministry of Natural Resources.

Ontario Geological Survey (OGS).2018. OGS Earth Mapping. Obtained from: https://www.mndm.gov.on.ca/en/mines-and-minerals/applications/ogsearth

Ontario Ministry of the Environment and Climate Change (MOECC), 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications.

Ontario Ministry of Transportation (MTO), 1997. Drainage Management Manual. Drainage and Hydrology Section Transportation Engineering Branch Quality and Standards Division.

Thornthwaite, C.W., and Mather, J.R., 1957. Instructions and tables for computing potential evapotranspiration and the water balance. Climatology, v

Toronto and Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC). 2010. Low Impact Development Stormwater Management Planning And Design Guide. Version 1

APPENDICES

Appendix A: **Figures**
Appendix B: **Engineering Drawings & Draft Plans of Subdivision**
Appendix C: **MECP Well Records**
Appendix D: **ORMGP (2018) Maps**
Appendix E: **Water Balance Information**

APPENDIX A

Figures

LEGEND:

Approx. Study Area

250m 0 750m

HORIZONTAL SCALE 1:25,000

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Study Area Location

Golf Course Rd.,
Wasaga Beach, ON

DATE ISSUED: *September 2015*	Figure No.
CREATED BY: *JLM*	
PROJECT NO.: *15-273*	1
REFERENCE: *MNRF*	

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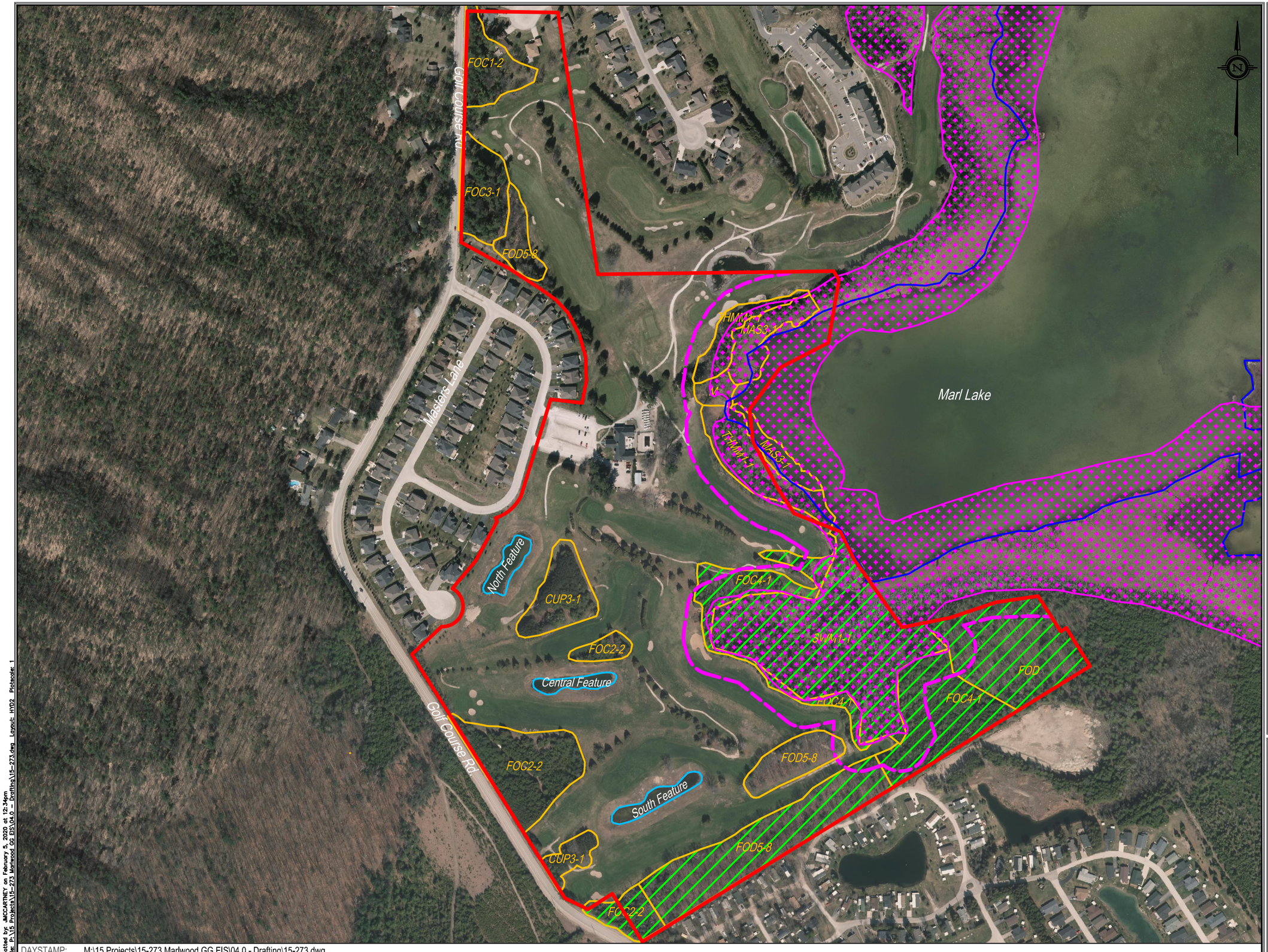

LEGEND:

- Approx. Study Area
- Lake
- Offline Water Hazard Feature
- Jack's Lake PSW (LIO)
- 30m Wetland Buffer
- Significant Woodland
- Vegetation Communities

CUP3-1	Red Pine Coniferous Plantation
FOC1-2	Dry-Fresh White Pine-Red Pine Coniferous Forest Type
FOC2-2	Dry-Fresh White Cedar Coniferous Forest
FOC3-1	Fresh-Moist Hemlock Coniferous Forest
FOC4-1	Fresh-Moist White Cedar Coniferous Forest Type
FOD	Deciduous Forest Type
FOD5-8	Dry-Fresh Sugar Maple-White Ash Deciduous Forest Type
MAS3-1	Cattail Organic Shallow Marsh
M	Maintained Lands
SWM1-1	White Cedar-Hardwood Organic Mixed Swamp
THMM1-1	Dry-Fresh Native Mixed Regeneration Thicket Type

60m 0 120m

HORIZONTAL SCALE 1:4,000

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Existing Conditions

Marlwood
Wasaga Beach, ON

DATE ISSUED:	December 2019	Figure No.
CREATED BY:	JLM	2
PROJECT NO.:	15-273	
REFERENCE:	Simcoe County Mapping	

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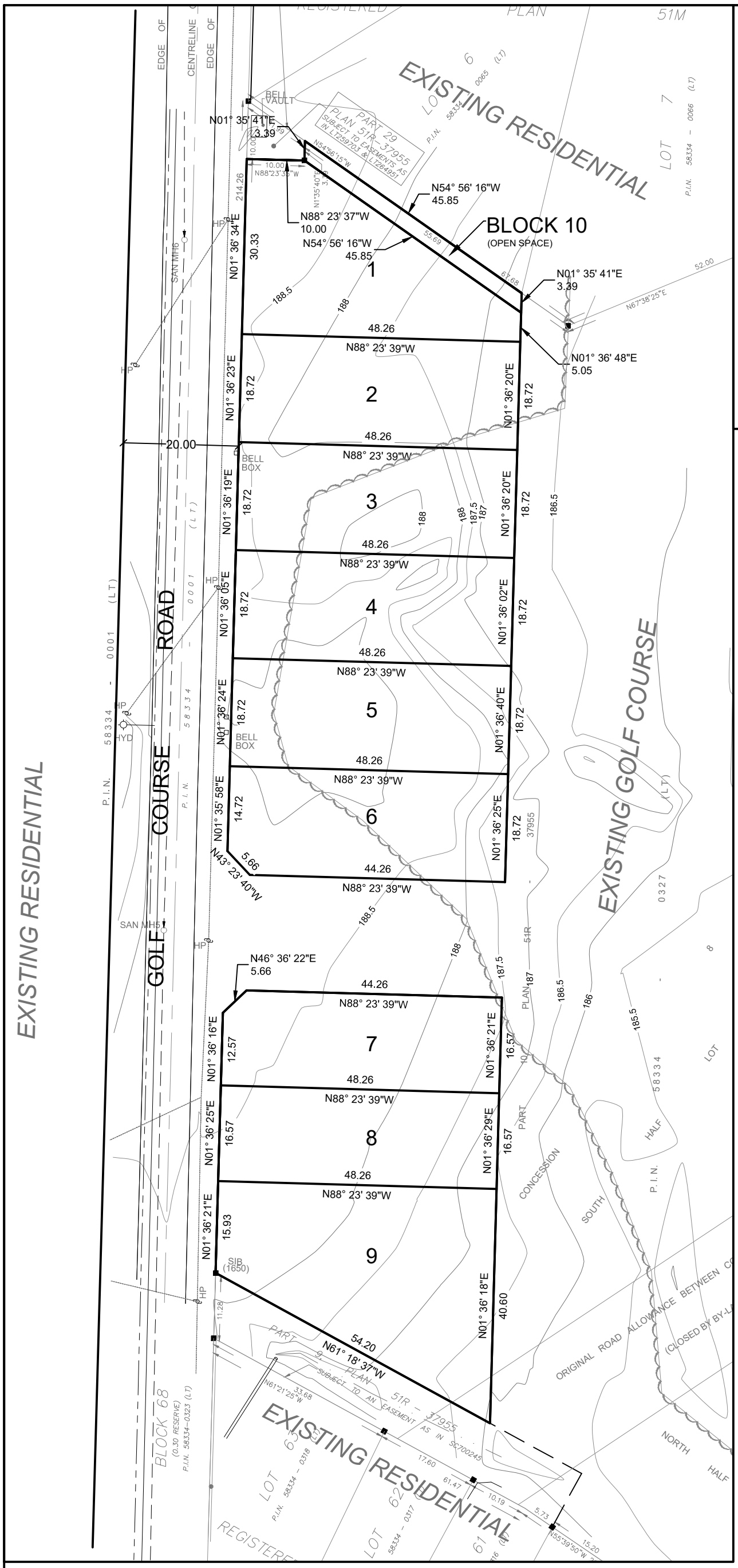
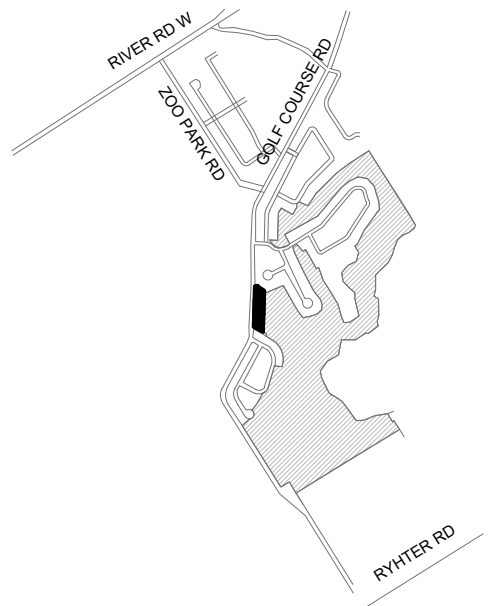
APPENDIX B

Engineering Drawings & Draft Plans of Subdivision





KEY PLAN
N.T.S.

SUBJECT PROPERTY
ADDITIONAL LANDS OWNED BY APPLICANT

ADDITIONAL INFORMATION

As required under Section 51(17) of the Planning Act.

a), b), e), f), g) & j) – on plan
c) – on key plan
d) – see statistics
h) – piped water to be installed by developer
i) – sandy
k) – all municipal services to be made available
l) – DO WE HAVE TO INCLUDE THE BELL EASEMENT AND DRAINAGE BLOCK TO THE SOUTH IN THIS DRAFT PLAN

STATISTICS

PROPOSED LAND USE	LOT/BLOCK	AREA
SINGLE DETACHED RESIDENTIAL	1-9	0.84ha
OPEN SPACE	10	0.01ha

APPROVED SUBJECT TO CONDITIONS IN ACCORDANCE WITH SECTION 51(31) OF THE PLANNING ACT, RSO, CAP. P.13, AS AMENDED,

THIS _____ DAY OF _____,_____

DIRECTOR OF PLANNING, DEVELOPMENT AND TOURISM, COUNTY OF SIMCOE

OWNER'S CERTIFICATE

We authorize LOFT Planning Inc. to prepare and submit this Plan of Subdivision for approval.

A.S.O. _____

TPC MARLWOOD INC. date

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands being subdivided and their relationship to the adjacent lands are accurately and correctly shown.

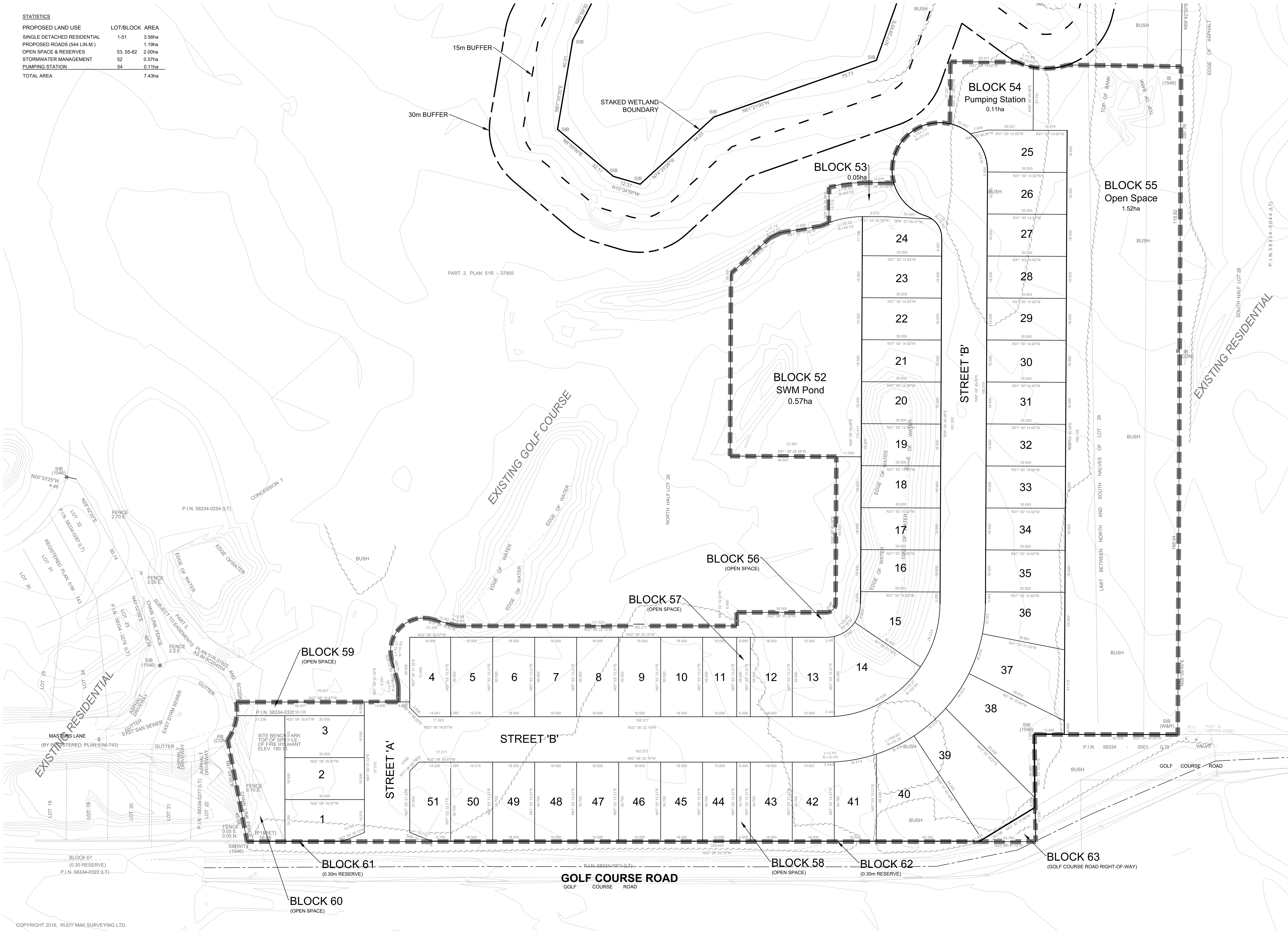
RUDY MAK SURVEYING LTD. date

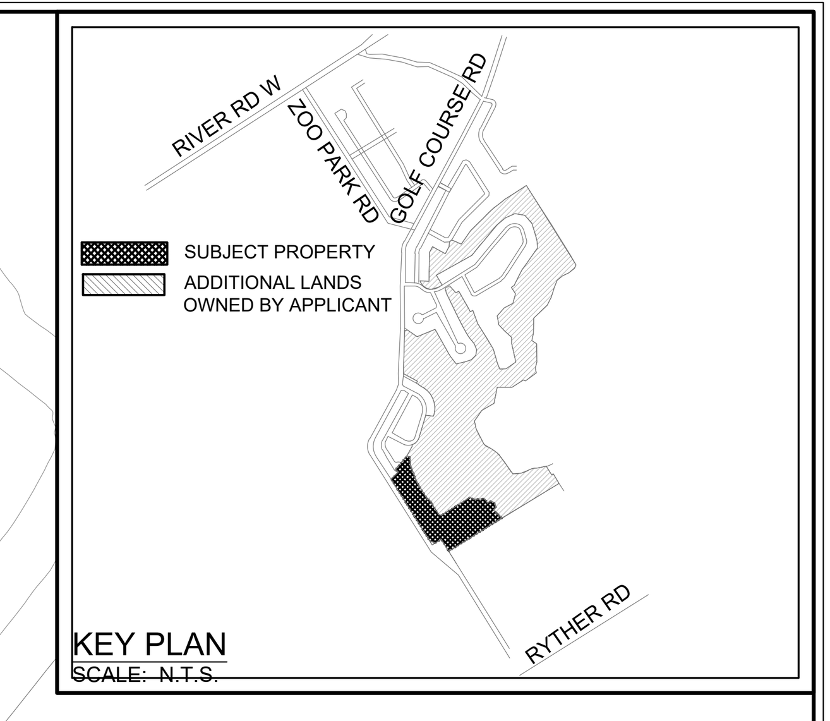
I-T-0003
DRAFT PLAN OF SUBDIVISION
Part of south half of Lot 26
Concession 7
Town of Wasaga Beach
County of Simcoe
(Geographic Township of Flos)

Date: January 14, 2020

STATISTICS

PROPOSED LAND USE	LOT/BLOCK	AREA
SINGLE DETACHED RESIDENTIAL	1-51	3.56ha
PROPOSED ROADS (544 LIN.M.)		1.19ha
OPEN SPACE & RESERVES	53, 55-62	2.00ha
STORMWATER MANAGEMENT	52	0.57ha
PUMPING STATION	54	0.11ha
TOTAL AREA		7.43ha





ADDITIONAL INFORMATION

As required under Section 51(17) of the Planning Act.

a), b), e), f), g) & j) – on plan
c) – on key plan
d) – see statistics
h) – piped water to be installed by developer
i) – sandy
k) – all municipal services to be made available
l) – nil

APPROVED SUBJECT TO CONDITIONS IN ACCORDANCE WITH SECTION 51(31) OF THE PLANNING ACT, RSO, CAP. P.13, AS AMENDED,

THIS_______ DAY OF _________________,__________

DIRECTOR OF PLANNING, DEVELOPMENT AND TOURISM, COUNTY OF SIMCOE

OWNER'S CERTIFICATE

We authorize LOFT Planning Inc. to prepare and submit this Plan of Subdivision for approval.

_______________________ A.S.O. ______________

TPC MARLWOOD INC. date

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands being subdivided and their relationship to the adjacent lands are accurately and correctly shown.

_______________________ ______________

RUDY MAK SURVEYING LTD. date

LEGEND

PROPERTY LINE

LOT LINE

0 50 100 200 300 400
Metres

BURNSIDE

Client

TPC MARLWOOD INC.

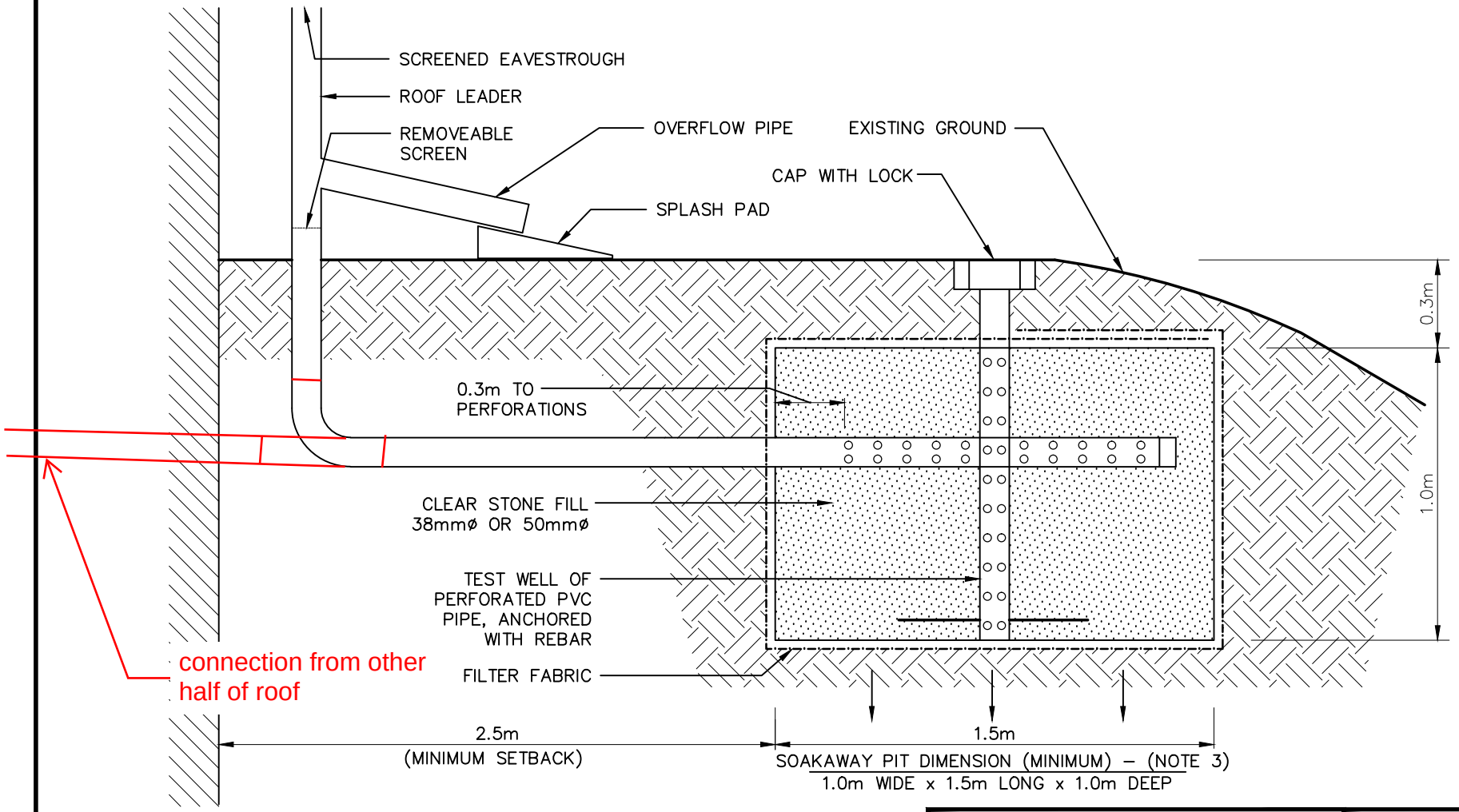
Figure Title

MARLWOOD MASTER'S LANE EXTENSION

PRELIMINARY DRAFT PLAN

Drawn	Checked	Date	Figure No.
EDT	JO	20/01/14	1
Scale		Project No.	
1:750		300037815	

File: \\collingwood\Shared Work Areas\037815 - Marlwood Preliminary Engineering\07_Figures\190604 (Draft Plan Options)\



NOTE:

1. FILTER FABRIC TERRAFIX 270R OR EQUAL.
2. PROVIDE MINIMUM 0.5m CLEARANCE TO WATER TABLE FROM BOTTOM OF PIT.
3. SOAKAWAY PIT DIMENSIONS SHALL BE SIZED PER DESIGN ENGINEER RECOMMENDATION.
4. SOAKAWAY PIT TO BE INSPECTED BY DEVELOPER'S ENGINEER PRIOR TO BACKFILL.

TOWN OF WASAGA BEACH

ROOF LEADER
SOAKAWAY PIT DETAIL

DRAWN: TMM	SCALE: N.T.S.
DESIGN: MJP	PLOT: 1=1
CHECKED: MJP	DATE: MAR 2015

TOWN OF WASAGA BEACH • INCORPORATED 1974 •

STD.DWG.No.11

Soakaway Pit Sizing - 51 Lots

TPC Marlwood Inc.
31 Marlwood Ave, Wasaga Beach ON

Project #: 300037815
Date: 4-Dec-19
Designed: AH
Checked: JS

Runoff Depth to be Infiltrated: 12 mm
Design Infiltration Rate: 15 mm/hr
Maximum Drawdown Time: 48 hrs

Catchment ID	Roof Coverage (Full Roof)	Lot Area (m^2)	Area to be Infiltrated (Roof) (m^2)	Runoff to be Infiltrated (m)	Required Runoff Volume to be Infiltrated (m^3)	Drawdown Time (hrs)	Drawdown Rate (m^3/hr)	Design Infiltration Rate (m/hr)	Minimum Infiltration Gallery Footprint Area (m^2)	Length (m) *Minimum 1.5m	Width (m) *Minimum 1.0m	Infiltration Height (m) * Minimum 1.0m	Soakaway Pit Footprint Volume (m^3)	Void Ratio	Available Volume (m^3)
Typical Lot	50%	648	324	0.012	3.89	19	0.20	0.015	13.5	4.0	3.4	0.72	9.71	0.4	3.9

Soakaway Pit and Infiltration Trench Sizing - 9 Lots

TPC Marlwood Inc.
31 Marlwood Ave, Wasaga Beach ON

BURNSIDE
[THE DIFFERENCE IS OUR PEOPLE]

Project #: 300037815
Date: 14-Nov-19
Designed: AH
Checked: JS

Runoff Depth to be Infiltrated on Private Lots	5	mm
Runoff Depth to be Infiltrated within Proposed Easement	25	mm
Design Infiltration Rate:	15	mm/hr
Maximum Drawdown Time:	48	hrs

Catchment ID	Roof Coverage	Lot Area (m^2)	Area to be Infiltrated (Roof) (m^2)	Runoff to be Infiltrated (m)	Required Runoff Volume to be Infiltrated (m^3)	Drawdown Time (hrs)	Drawdown Rate (m^3/hr)	Design Infiltration Rate (m/hr)	Minimum Infiltration Gallery Footprint Area (m^2)	Length (m) *Minimum 1.5m	Width (m) *Minimum 1.0m	Infiltration Height (m) * Minimum 1.0m	Soakaway Pit Footprint Volume (m^3)	Void Ratio	Available Volume (m^3)
Lot 1 - Soakaway	50%	1115	558	0.005	2.8	19	0.15	0.015	9.7	4.0	2.4	0.72	6.97	0.4	2.8
Lot 2 - Soakaway	50%	900	450	0.005	2.3	19	0.12	0.015	7.8	3.5	2.2	0.72	5.63	0.4	2.3
Lot 3 - Soakaway	50%	905	453	0.005	2.3	19	0.12	0.015	7.9	3.5	2.2	0.72	5.66	0.4	2.3
Lot 4 - Soakaway	50%	905	453	0.005	2.3	19	0.12	0.015	7.9	3.5	2.2	0.72	5.66	0.4	2.3
Lot 5 - Soakaway	50%	905	453	0.005	2.3	19	0.12	0.015	7.9	3.5	2.2	0.72	5.66	0.4	2.3
Lot 6 - Soakaway	50%	900	450	0.005	2.3	19	0.12	0.015	7.8	3.5	2.2	0.72	5.63	0.4	2.3
Lot 7 - Soakaway	50%	800	400	0.005	2.0	19	0.10	0.015	6.9	3.5	2.0	0.72	5.00	0.4	2.0
Lot 8 - Soakaway	50%	800	400	0.005	2.0	19	0.10	0.015	6.9	3.5	2.0	0.72	5.00	0.4	2.0
Lot 9 - Soakaway	50%	1400	700	0.005	3.5	19	0.18	0.015	12.2	4.0	3.0	0.72	8.75	0.4	3.5
Remaining rooftop volume up to 25 mm - Infiltration Trench	50%	8630	4315	0.020	86.3	19	4.49	0.015	299.7	200.0	1.5	0.72	215.75	0.4	86.3

APPENDIX C

MECP Well Records

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5729422
External identity : ca.on.waterWell.5729422
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 41.15m
Elevation : NaNm
Water level : 9.14m
Water yield : 36.37lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown
Screen components : From 39.9288 to 41.15m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	12.50	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
12.50	24.99	**Sand**	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
24.99	39.93	**Silt**	SILT	[34,61]%	[1E-9,2E-5]m.s-1
39.93	41.15	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
41.15	41.15	**Clay**	CLAY STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5734995
External identity : ca.on.waterWell.5734995
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 13.11m
Elevation : NaNm
Water level : 4.57m
Water yield : 31.82lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown
Sealing components : From 0.00 to 4.57m.
Screen components : From 11.5824 to 12.80m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	4.27	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
4.27	8.53	**Sand** **Silt** **Unknown material**	SAND SILT CEMENTED	[26,53]% [34,61]%	[2E-7,6E-3]m.s-1 [1E-9,2E-5]m.s-1
8.53	11.58	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
11.58	12.80	**Sand**	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
12.80	13.11	**Sand** **Clay**	SAND CLAY	[26,53]% [34,57]%	[2E-7,6E-3]m.s-1 [1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5726707
External identity : ca.on.waterWell.5726707
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 41.45m
Elevation : NaNm
Water level : 9.14m
Water yield : 45.46lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown
Sealing components : From 2.44 to 3.05m.
Screen components : From 40.5384 to 41.76m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	12.80	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
12.80	23.47	**Sand**	SAND CLAY SANDY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
23.47	31.09	**Clay**	CLAY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
31.09	39.01	**Sand**	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
39.01	41.45	**Sand**	SAND CLEAN WATER-BEARING	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5733732
External identity : ca.on.waterWell.5733732
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 53.04m
Elevation : NaNm
Water level : 11.58m
Water yield : 54.55lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown
Sealing components : From 1.52 to 3.66m.
Screen components : From 52.1208 to 53.34m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	7.01	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
7.01	12.50	**Sand**	SAND WOOD FRAGMENTS	[26,53]%	[2E-7,6E-3]m.s-1
		Organic material			
12.50	16.46	**Sand**	SAND CLAY LAYERED	[26,53]%	[2E-7,6E-3]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
16.46	20.42	**Clay**	CLAY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
20.42	29.26	**Clay**	CLAY SOFT HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
		Unknown material			
29.26	36.88	**Clay**	CLAY SAND GRAVEL	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
36.88	42.06	**Clay**	CLAY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
42.06	44.81	**Sand**	SAND CLAY SANDY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
44.81	51.82	**Clay**	CLAY HARD SOFT	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
		Unknown material			
51.82	53.04	**Sand**	SAND CLEAN WATER-BEARING	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5731265
External identity : ca.on.waterWell.5731265
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 44.50m
Elevation : NaNm
Water level : 10.06m
Water yield : 90.92lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown
Sealing components : From 1.83 to 3.35m.
Screen components : From 43.5864 to 44.50m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	14.94	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
14.94	17.37	**Clay**	CLAY SOFT	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
17.37	27.43	**Clay**	CLAY SOFT	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
27.43	42.06	**Clay**	CLAY SAND GRAVEL	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
42.06	44.50	**Sand**	SAND CLEAN WATER-BEARING	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5709060
External identity : ca.on.waterWell.5709060
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 79.25m
Elevation : 190.50m
Well status : Abandoned-Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	11.58	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
11.58	25.91	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
25.91	43.59	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
43.59	53.64	**Gravel**	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
53.64	57.30	**Sand**	COARSE SAND	[26,53]%	[2E-7,6E-3]m.s-1
57.30	74.37	**Clay**	CLAY MEDIUM	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
74.37	79.25	**Limestone**	LIMESTONE	[7,56]%	[1E-9,6E-6]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5709061
External identity : ca.on.waterWell.5709061
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 54.86m
Elevation : 190.50m
Well status : Test Hole
Well type : Unknown
Screen components : From 40.8432 to 46.94m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	11.58	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
11.58	25.91	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
25.91	43.59	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
43.59	51.82	**Gravel**	GRAVEL MEDIUM	[24,44]%	[3E-4,3E-2]m.s-1
		Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
51.82	54.86	**Clay**	CLAY MEDIUM	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5733570
External identity : ca.on.waterWell.5733570
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 41.15m
Elevation : NaNm
Water level : 8.53m
Water yield : 136.38lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown
Sealing components : From 2.44 to 3.66m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	17.07	**Sand** **Gravel**	SAND STONES	[26,53]% [24,44]%	[2E-7,6E-3]m.s-1 [3E-4,3E-2]m.s-1
17.07	23.77	**Clay** **Unknown material**	CLAY SOFT	[34,57]%	[1E-11,4.7E-9]m.s-1
23.77	31.39	**Clay** **Gravel**	CLAY STONES	[34,57]% [24,44]%	[1E-11,4.7E-9]m.s-1 [3E-4,3E-2]m.s-1
31.39	37.80	**Clay** **Sand** **Unknown material**	CLAY SAND CEMENTED	[34,57]% [26,53]%	[1E-11,4.7E-9]m.s-1 [2E-7,6E-3]m.s-1
37.80	39.32	**Clay** **Unknown material** **Unknown material**	CLAY HARD LAYERED	[34,57]%	[1E-11,4.7E-9]m.s-1
39.32	41.15	**Sand** **Unknown material** **Unknown material**	SAND CLEAN WATER-BEARING	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

APPENDIX D

ORMGP (2018) Maps

41 Marlwood Avenue Ground Water (masl)

Legend

- CAMC Boundary
- Oak Ridges Moraine Boundary
- Well
- Strahler Class 4 to 7 Streams

Water Table (mASL)

High : 530.229

Low : 45.0948

AZIMUTH ENVIRONMENTAL CONSULTING, INC.
Environmental Assessments & Approvals

229.3 0 114.66 229.3 Metres

1: 4,514

Map Compiled by the Conservation Authorities Moraine Coalition
101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

This map is for information purposes only and the Conservation Authorities Moraine Coalition takes no responsibility for, nor guarantees, the accuracy of all the information contained within the map.

SOURCE: CAMC, 2018; MNR, 2018;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary Sphere

DATE PRINTED: November 23, 2018

41 Marlwood Avenue Ground Water (masl)

Legend

- CAMC Boundary
- Oak Ridges Moraine Boundary
- Well
- Strahler Class 4 to 7 Streams

Water Table (mASL)

High : 530.229

Low : 45.0948

AZIMUTH ENVIRONMENTAL CONSULTING, INC.
Environmental Assessments & Approvals

229.3 0 114.66 229.3 Metres

1: 4,514

Map Compiled by the Conservation Authorities Moraine Coalition
101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

This map is for information purposes only and the Conservation Authorities Moraine Coalition takes no responsibility for, nor guarantees, the accuracy of all the information contained within the map.

SOURCE: CAMC, 2018; MNR, 2018;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary Sphere

DATE PRINTED: November 23, 2018

APPENDIX E

Water Balance

Water Balance Summary Table - Pre-Development

Catchment Designation	Phase 1		Phase 2			Total
	Forest	Landscaped	Forest	Landscaped	Surface Water	
Area (m^2)	6,127	2,373	29,736	42,799	1,765	82,800
Pervious Area (m^2)	6,127	2,373	29,736	42,799	-	81,035
Impervious Area (m^2)	-	-	-	-	1,765	1,765
Infiltration Factors						
Topography Infiltration Factor	0.2	0.2	0.2	0.2	0	
Soil Infiltration Factor	0.4	0.4	0.4	0.4	0	
Land Cover Infiltration Factor	0.2	0.05	0.2	0.05	0	
Infiltration Factor	0.8	0.65	0.8	0.65	0	
Run-Off Coefficient	0.2	0.35	0.2	0.35	1	
Run-Off From Impervious Surfaces	0.8	0.8	0.8	0.8	0.8	
Inputs (Per Unit Area)						
Precipitation (mm/yr)	888	888	888	888	888	888
Rainfall (mm/yr)	656	656	656	656	656	656
Run-On (mm/yr)	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0		0	0
Total Inputs (mm/yr)	**888**	**888**	**888**	**888**	**888**	888
Outputs (Per Unit Area)						
Precipitation Surplus (mm/yr)	393	393	393	393	710	
Net Surplus (mm/yr)	393	393	393	393	710	
Evapotranspiration (mm/yr)	495	495	495	495	178	
Infiltration (mm/yr)	314	255	314	255	0	
Supplemental Infiltration (mm/yr)	0	0	0	0	0	
Total Infiltration (mm/yr)	314	255	314	255	0	
Run-Off Pervious Areas (mm/yr)	79	138	79	138	0	
Run-Off Impervious Areas (mm/yr)	0	0	0	0	710	
Total Run-Off (mm/yr)	79	138	79	138	710	
Total Outputs (mm/yr)	**888**	**888**	**888**	**888**	**888**	
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**	
Inputs (Volumes)						
Precipitation (m^3/yr)	5,441	2,107	26,406	38,006	1,567	73,526
Run-On (m^3/yr)	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0
Total Inputs (m^3/yr)	**5,441**	**2,107**	**26,406**	**38,006**	**1,567**	**73,526**
Outputs (Volumes)						
Precipitation Surplus (m^3/yr)	2,408	933	11,686	16,820	1,254	33,101
Net Surplus (m^3/yr)	2,408	933	11,686	16,820	1,254	33,101
Evapotranspiration (m^3/yr)	3,033	1,175	14,719	21,186	313	40,426
Infiltration (m^3/yr)	1,926	606	9,349	10,933	0	22,815
Rooftop Infiltration (m^3/yr)	0	0	0	0	0	0
Total Infiltration (m^3/yr)	***1,926***	***606***	***9,349***	***10,933***	***0***	22,815
Run-Off Pervious Areas (m^3/yr)	482	326	2,337	5,887	0	9,032
Run-Off Impervious Areas (m^3/yr)	0	0	0	0	1,254	1,254
Total Run-Off (m^3/yr)	482	326	2,337	5,887	1,254	10,286
Total Outputs (m^3/yr)	**5,441**	**2,107**	**26,406**	**38,006**	**1,567**	**73,526**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**	**0**

Water Balance Summary Table - Post-Development (no mitigation)

Catchment Designation	Phase 1			Phase 2						Total
	Structure	Driveway	Landscaped	Structure	Driveway	Roads	Impervious SWM Pond & Pumping Station	Forest	Landscaped	
Area (m^2)	4315	360	3825	16524	2040	11900	6800	15,200	21,836	82,800
Pervious Area (m^2)	0	0	3825	0	0	0	0	15,200	21,836	40,861
Impervious Area (m^2)	4315	360	0	16524	2040	11900	6800	0	0	41,939
Infiltration Factors										
Topography Infiltration Factor	0	0	0.2	0	0	0	0	0.2	0.2	
Soil Infiltration Factor	0	0	0.4	0	0	0	0	0.4	0.4	
Land Cover Infiltration Factor	0	0	0.05	0	0	0	0	0.2	0.05	
Infiltration Factor	0	0	0.65	0	0	0	0	0.8	0.65	
Run-Off Coefficient	1	1	0.35	1	1	1	1	0.2	0.35	
Run-Off From Impervious Surfaces	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	
Inputs (Per Unit Area)										
Precipitation (mm/yr)	888	888	888	888	888	888	888	888	888	
Rainfall (mm/yr)	656	656	656	656	656	656	656	656	656	
Run-On (mm/yr)	0	0	0	0	0	0	0	0	0	
Other Inputs (mm/yr)	0	0	0	0	0	0	0	0	0	
Total Inputs (mm/yr)	**888**	**888**	**888**	**888**	**888**			**888**	**888**	888
Outputs (Per Unit Area)										
Precipitation Surplus (mm/yr)	710	710	393	710	710	710	710	393	393	
Net Surplus (mm/yr)	710	710	393	710	710	710	710	393	393	
Evapotranspiration (mm/yr)	178	178	495	178	178	178	178	495	495	
Infiltration (mm/yr)	0	0	255	0	0	0	0	314	255	
Supplemental Infiltration (mm/yr)	0	0	0	0	0	0	0	0	0	
Total Infiltration (mm/yr)	0	0	255	0	0	0	0	314	255	
Run-Off Pervious Areas (mm/yr)	0	0	138	0	0	0	0	79	138	
Run-Off Impervious Areas (mm/yr)	710	710	0	710	710	710	710	0	0	
Total Run-Off (mm/yr)	710	710	138	710	710	710	710	79	138	
Total Outputs (mm/yr)	**888**	**888**	**888**	**888**	**888**	**888**	**888**	**888**	**888**	
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**	**888**	**888**	**0**	**0**	
Inputs (Volumes)										
Precipitation (m^3/yr)	3,832	320	3,397	14,673	1,812	10,567	6,038	13,498	19,390	73,526
Run-On (m^3/yr)	0	0	0	0	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	0	0	0
Total Inputs (m^3/yr)	**3,832**	**320**	**3,397**	**14,673**	**1,812**	**10,567**	**6,038**		**19,390**	**73,526**
Outputs (Volumes)										
Precipitation Surplus (m^3/yr)	3,065	256	1,503	11,739	1,449	8,454	4,831	5,974	8,582	45,852
Net Surplus (m^3/yr)	3,065	256	1,503	11,739	1,449	8,454	4,831	5,974	8,582	45,852
Evapotranspiration (m^3/yr)	766	64	1,893	2,935	362	2,113	1,208	7,524	10,809	27,675
Infiltration (m^3/yr)	0	0	977	0	0	0	0	4,779	5,578	11,334
Rooftop Infiltration (m^3/yr)	0	0	0	0	0	0	0	0	0	0
Total Infiltration (m^3/yr)	***0***	***0***	***977***	***0***	***0***	***0***	***0***	***4,779***	***5,578***	11,334
Run-Off Pervious Areas (m^3/yr)	0	0	526	0	0	0	0	1,195	3,004	4,724
Run-Off Impervious Areas (m^3/yr)	3,065	256	0	11,739	1,449	8,454	4,831	0	0	29,793
Total Run-Off (m^3/yr)	3,065	256	526	11,739	1,449	8,454	4,831	1,195	3,004	34,518
Total Outputs (m^3/yr)	3,832	320	3,397	14,673	1,812	10,567	6,038	13,498	19,390	73,526
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13,498**	**0**	**0**

Water Balance Summary Table - Post-Development (with mitigation)

Catchment Designation	Phase 1			Phase 2						Total
	Structure	Driveway	Landscaped	Structure	Driveway	Roads	SWM Pond	Forest	Landscaped	
Area (m^2)	4315	360	3825	16524	2040	11900	6800	15,200	21,836	82,800
Pervious Area (m^2)	0	0	3825	0	0	0	0	15,200	21,836	40,861
Impervious Area (m^2)	4315	360	0	16524	2040	11900	6800	0	0	41,939
Infiltration Factors										
Topography Infiltration Factor	0	0	0.2	0	0	0	0	0.2	0.2	
Soil Infiltration Factor	0	0	0.4	0	0	0	0	0.4	0.4	
Land Cover Infiltration Factor	0	0	0.05	0	0	0	0	0.2	0.05	
Infiltration Factor	0	0	0.65	0	0	0	0	0.8	0.65	
Run-Off Coefficient	1	1	0.35	1	1	1	1	0.2	0.35	
Run-Off From Impervious Surfaces	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	
Inputs (Per Unit Area)										
Precipitation (mm/yr)	888	888	888	888	888	888	888	888	888	
Rainfall (mm/yr)	656	656	656	656	656	656	656	656	656	
Run-On (mm/yr)	0	0	0	0	0	0	0	0	0	
Other Inputs (mm/yr)	0	0	0	0	0	0	0	0	0	
Total Inputs (mm/yr)	**888**	**888**	**888**	**888**	**888**	**888**	**888**	**888**	**888**	
Outputs (Per Unit Area)										
Precipitation Surplus (mm/yr)	710	710	393	710	710	710	710	393	393	
Net Surplus (mm/yr)	710	710	393	710	710	710	710	393	393	
Evapotranspiration (mm/yr)	178	178	495	178	178	178	178	495	495	
Infiltration (mm/yr)	0	0	255	0	0	0	0	314	255	
Supplemental Infiltration (mm/yr)	622	0	0	539	0	0	0	0	0	
Total Infiltration (mm/yr)	622	0	255	539	0	0	0	314	255	
Run-Off Pervious Areas (mm/yr)	0	0	138	0	0	0	0	79	138	
Run-Off Impervious Areas (mm/yr)	88	710	0	171	710	710	710	0	0	
Total Run-Off (mm/yr)	88	710	138	171	710	710	710	79	138	
Total Outputs (mm/yr)	**888**	**888**	**888**	**888**	**888**	**888**	**888**	**888**	**888**	
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Inputs (Volumes)										
Precipitation (m^3/yr)	3,832	320	3,397	14,673	1,812	10,567	6,038	13,498	19,390	73,526
Run-On (m^3/yr)	0	0	0	0	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	0	0	0
Total Inputs (m^3/yr)	**3,832**	**320**	**3,397**	**14,673**	**1,812**	**10,567**	**6,038**		**19,390**	**73,526**
Outputs (Volumes)										
Precipitation Surplus (m^3/yr)	3,065	256	1,503	11,739	1,449	8,454	4,831	5,974	8,582	45,852
Net Surplus (m^3/yr)	3,065	256	1,503	11,739	1,449	8,454	4,831	5,974	8,582	45,852
Evapotranspiration (m^3/yr)	766	64	1,893	2,935	362	2,113	1,208	7,524	10,809	27,675
Infiltration (m^3/yr)	0	0	977	0	0	0	0	4,779	5,578	11,334
Supplemental Infiltration (m^3/yr)	2,684	0	0	8,915	0	0	0	0	0	11,599
Total Infiltration (m^3/yr)	***2,684***	***0***	***977***	***8,915***	***0***	***0***	***0***	***4,779***	***5,578***	22,933
Run-Off Pervious Areas (m^3/yr)	0	0	526	0	0	0	0	1,195	3,004	4,724
Run-Off Impervious Areas (m^3/yr)	381	256	0	2,824	1,449	8,454	4,831	0	0	18,195
Total Run-Off (m^3/yr)	381	256	526	2,824	1,449	8,454	4,831	1,195	3,004	22,919
Total Outputs (m^3/yr)	3,832	320	3,397	14,673	1,812	10,567	6,038	13,498	19,390	73,526
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13,498**	**0**	**0**

Overall Water Balance Summary Table

Characteristic	Site						
	Pre-Development	Post-Development	Change (Pre to Post)		Post-Development with Mitigation	Change (Pre to Post with Mitigation)	
Inputs (Volume)							
Precipitation (m^3/yr)	73,526	73,526	0	0%	73,526	0	0%
Run-On (m^3/yr)	0	0	0	0%	0	0	-
Other Inputs (m^3/yr)	0	0	0	0%	0	0	-
Total Inputs (m^3/yr)	73,526	73,526	0	0%	73,526	0	0%
Outputs (Volume)							
Precipitation Surplus (m^3/yr)	33,101	45,852	12,751	39%	45,852	12,751	39%
Net Surplus (m3/yr)	33,101	45,852	12,751	39%	45,852	12,751	39%
Evapotranspiration (m^3/yr)	40,426	27,675	-12,751	-32%	27,675	-12,751	-32%
Infiltration (m^3/yr)	22,815	11,334	-11,481	-50%	11,334	-11,481	-50%
Supplemental Infiltration (m^3/yr)	0	0	0	0%	11,599	11,599	-
Total Infiltration (m^3/yr)	***22,815***	***11,334***	***-11,481***	***-50%***	22,933	***118***	***0.52%***
Run-Off Pervious Areas (m^3/yr)	9,032	4,724	-4,308	-48%	4,724	-4,308	-48%
Run-Off Impervious Areas (m^3/yr)	1,254	29,793	28,540	0%	18,195	16,941	-
Total Run-Off (m^3/yr)	10,286	34,518	24,232	236%	22,919	12,633	123%
Total Outputs (m^3/yr)	**73,526**	**73,526**	**0**	0%	73,526	0	0%