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STORM WATER REPORT

1344 BARFIELD ROAD
OSGOODE WARD, GREELY
CITY OF OTTAWA
ONTARIO

PREPARED FOR:

Wicked Garage Inc.
2760 Carousel Crescent - Apt 1104
Ottawa, Ontario
K1T 2N4

PROJECT #
100667

DISTRIBUTION:

7 copies – Wicked Garage Inc..
1 copy – Kollaard Associates Inc.

Revision 0 - Prepared for Site Plan Control

December 22, 2010

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INTRODUCTION

Kollaard Associates Inc. was retained by Mr. Roger Grenon on behalf of Wicked Garage Inc. to provide a storm water management design system for the proposed Wicked Garage automobile fabrication shop at 1344 Barfield Road, Greely, Ontario.

The proposed works will consist of a about 520 square metre building, asphalt entrance and public parking area, a gravel rear parking area, stormwater control facilities, a well and private wastewater facilities. The facility is to be used to fabricate custom automobiles.

Existing stormwater runoff in general consists of uncontrolled sheet flow to the front and back of the site. The existing site surface consists in general of undeveloped grassed areas.

It is understood that the site is in the Shield's Creek Subwatershed. As such the site is subject to the following stormwater management criteria:

- All stormwater management run-off for off-site areas draining to the site must be accounted for in the design.
- Quantity Control is to be designed so that all storms from the 1:5 year event up to the 1:100 year event are controlled to the pre-development levels. The pre-development run-off coefficient should be taken as the lower of the existing pre-development run-off coefficient or 0.5, whichever is lower.
- The 1:2 year post-development storm event is to be controlled to 50% of the predevelopment 1:2 year storm event. Alternatively, post-development infiltration levels can be equal to pre-development infiltration levels.
- Quality Control will be required at a level of protection of 80% TSS removal.

In general the stormwater management design consists of directing the flow by means of sheet runoff and shallow swales to a grassed retention pond and then through a sand filter or over a rectangular weir into a subdivision drainage easement, which runs behind the developed portion of the property.

CURRENT (PRE-DEVELOPMENT) SITE CONDITIONS

The site is located on the west side of Barfield Road, south of Hiram Drive, Greely, Ontario as shown on the attached Figure 1. The site has an area of about 0.2 hectares of usable land. The site is currently undeveloped. The site is located on a portion of land currently zoned for industrial use. There is a drainage easement and a natural gas pipeline easement running along the rear portion of the parcel.

The predevelopment runoff coefficients will be set based on the actual site conditions at the time of this report. The predevelopment runoff coefficients are as follows: 2 and 5 year storm event C = 0.30; 100 year storm event C = 0.38 for the purposes of this stormwater management design.

Existing stormwater runoff in general consists of uncontrolled sheet flow to the roadside ditch to the east of the site and to the drainage easement to the west of the site.

PRE-DEVELOPMENT OFF SITE DRAINAGE

The site is located within an area of industrial development (Greely Industrial Park). The site is bordered on the south and west sides by vacant, undeveloped land, on the north by a property occupied by a gravel surfaced parking area with several parked vehicles and equipment. That property is followed by Hiram Drive with Marathon Drilling located at the north side of Hiram Drive. On the east side, the site is bordered by Barfield Road followed partially by Fortran Steel, a welding and metal fabrication shop and storage yard and partially by a building occupied by a company called Conley with parked heavy equipment (forklifts).

The pre-developed land is low and poorly drained. It is proposed that the property be raised relative to the surrounding properties on all sides, thus preventing any offsite runoff from being directed towards the site. As such there is no requirement to address the offsite stormwater runoff in the stormwater management design for the site.

PROPOSED PROPERTY USE

The proposed works will consist of a 520 square metre building. The site will be occupied by Wicked Garage Inc. The front parking and access areas will be used for public (client) access. The proposed building will be serviced by a Class 4 onsite septic system, a Class 2 onsite septic system for grey water and by a drilled cased well. Runoff from the controlled area portions of the site will be directed towards a grassed retention pond in the north west corner of the site, to the north of the gravel parking area, adjacent to the rear drainage easement.

STORM WATER QUANTITY

Peak Flow for runoff quantities for the Pre-Development and Post-Development stages of the project were calculated using the rational method. The rational method is a common and straightforward calculation, which assumes that the entire drainage area is subject to uniformly distributed rainfall. The formula is:

$$Q = \frac{CiA}{360}$$

where

Q is the Peak runoff measured in ***m^3/s***

C is the Runoff Coefficient, **Dimensionless**

A is the runoff area in ***hectares***

i is the storm intensity measure in ***mm/hr***

The *Runoff Coefficient, C*, is a measure of the amount of rainfall that converts to surface runoff. For example a value of C=1 represents a condition in which all rainwater would leave the area under study as surface runoff. None of the water would infiltrate or evaporate during a rainfall event. However, a value of C=0.5 is used when it is estimated that only half of the water leaves the area as surface runoff. The other half would infiltrate or evaporate on site.

The *Storm Intensity, i*, is a function of geographic location, and is a measure of average rainfall quantity. Storm Intensity values consider three factors: storm intensity, time period of storm event, and return period of storm. These factors are represented by Intensity – Duration – Frequency Curves (IDF Curves).

All values for intensity, i, for this project were derived from IDF curves provided by the City of Ottawa for data collected at the Ottawa International airport. For this project three return periods, were considered: The 2 year, 5 year and the 100 year event. The formulas for each are:

2-Year Event

$$i = \frac{732.951}{(t_c + 6.199)^{0.81}}$$

5-Year Event

$$i = \frac{998.071}{(t_c + 6.05)^{0.814}}$$

100-Year Event

$$i = \frac{1735.071}{(t_c + 6.014)^{0.82}}$$

where t_c is time of concentration

Pre-Development Baseline Conditions

The pre-development baseline runoff rate was established using the rational method. Following the method described in the City of Ottawa Storm Sewer Design Guideline, the time of concentration was estimated to be 15 minutes - the longest distance of travel for the area contained within the limit of development is approximately 55 metres over a low sloped grass covered ground surface. A fifteen-minute duration yields an intensity of 61.77 mm/hr for a 2-year storm event on the IDF curve.

The pre-development runoff coefficient was set to C = 0.30 for the 2 and 5 year storm event and to C=0.38 for the 100 year storm event to model the existing surface conditions.

The total allowable runoff for the site based on the pre-development conditions and the stormwater management criteria:

$$Q = \frac{CiA}{360}$$

For the 2-year Storm event

= (0.30 x 61.77 x 0.201)/360

= 0.010 m^3/s

= 10 Litres per second

For the 5-year Storm event

= (0.30 x 83.56 x 0.201)/360

= 0.014 m^3/s

= 14 Litres per second

For the 100-year Storm event

= (0.38 x 142.89 x 0.201)/360

= 0.030 m^3/s

= 30 Litres per second

Post-Development Stage

The proposed works will consist of a about 520 square metre building, asphalt entrance and public parking area, a gravel rear parking area, stormwater control facilities, a well and private wastewater facilities The post-developed site has been divided into uncontrolled and controlled areas. The uncontrolled area includes the area of the property that is not being captured by the stormwater design. The controlled area includes all the area that is being retained and controlled by the post-developed storm water design.

Controlled and Uncontrolled Areas

For the purposes of this storm water management design, the site has been divided into uncontrolled and controlled areas. The uncontrolled area consists of the front yard landscaped area including the surface of the Class 4 and Class 2 septic systems. The controlled areas are those areas where the runoff is directed by sheet flow to the proposed grassed retention pond at the northwest corner of the site. The uncontrolled area within the drainage easement and the natural gas pipeline easement can not be developed and has not been incorporated into the storm water calculations. The controlled and uncontrolled areas are listed in Table II below.

Table II

Pre and Post Development Area and C Factors

Description	Coefficient of Runoff 5-Yr	Coefficient of Runoff 100-Yr	Area	Area
			m^2	Ha
Pre-development Conditions				
Total Catchment Area			2014	0.201
Building Area	0.90	1.00	0	0.000
Granular Surfaces	0.70	0.88	0	0.000
Asphalt Surfaces	0.90	1.00	0	0.000
Grass & Landscape Areas	0.30	0.38	2014	0.201
Weighted Average C	0.30	0.38		
Post-development Conditions				
Controlled Areas				
Building Area	0.90	1.00	520	0.052
Granular Surfaced Parking / Access	0.70	0.88	535	0.054
Asphalt Surfaced Parking / Access	0.90	1.00	401	0.040
Grass Surfaced/Landscaped Areas	0.30	0.38	105	0.011
Uncontrolled Areas				
Building Area	0.90	1.00	0	0.000
Granular Surfaced Parking / Access	0.70	0.88	0	0.000
Asphalt Surfaced Parking / Access	0.90	1.00	0	0.000
Grass Surfaced/Landscaped Areas	0.30	0.38	453	0.045
Controlled Area Weighted Average C	*0.79*	0.91		
Un-Controlled Area Weighted Average C	*0.30*	*0.38*		
Total Controlled Area			*1561*	*0.156*
Total Uncontrolled Area			*453*	*0.045*

Impervious Ratio

The impervious ratio, the total impervious area divided by the total area, is about 49 percent for the entire site.

STORM WATER QUALITY CONTROL

Controlled Runoff

The receiving body for the storm water discharged from the site is the rear drainage easement. The ditch within the drainage easement ultimately discharges into Shield's Creek and in accordance with the Shield's Creek Subwatershed Study, an enhanced level of stormwater treatment is required. The Ministry of Environment's *Stormwater Management Planning and Design Manual* [manual] details the requirements for storm water quality based on the receiving body of water. Enhanced treatment corresponds to a long-term average removal of 80% of suspended solids.

In the manual, *Table 3.2 Water Quality Storage Requirements Based on Receiving Waters* outlines the storm water storage requirements for quality purposes required to achieve the desired level of protection. In Part 4, the Manual details the design requirements of several types of end of pipe storm water management facilities. In particular, Part 4 section 4.6.7 describes the use of filters to remove suspended solids from the storm water.

It is proposed to allow site runoff to filter through a sand filter berm along one side of the grassed retention pond prior to discharge via a storm sewer pipe to the rear drainage easement to achieve the desired level of treatment. In section 4.6.7 it is stated that Volumetric Sizing Water Quality volumes to be used in the design of a filter as provided in Table 3.2 under the "infiltration" heading. As indicated above, the impervious ratio for the site is about 49 percent. From Table 3.2 it was determined that the water quality storage requirement for a 49 percent impervious ratio at an enhanced level of treatment was 20 cubic metres per hectare. Based on a quality storage requirement of 20 cubic metres per hectare and the surface area of the site, the total water quality storage requirement is 4 cubic metres.

Part 4 section 4.6.7 states that pre-treatment is recommended for all filters. Ideally, a pre-treatment settling chamber should be incorporated into the design. The pre-treatment chamber should have a volume equal to 25% of the design water quality control volume. Other methods of pre-treatment include vegetated filter strips, grassed swales and oil/grit separators.

Pre-treatment for the stormwater runoff at this site will take the form of a sump within the proposed stormwater retention pond. The sump will be constructed beginning at an elevation of 98.55 metres and will extend to 98.68 metres which is equal to the elevation of the bottom sand filter for a total volume of about 2.36 m^3. The sump will be filled with 50 mm clear stone with a void ratio of about 0.45 to prevent exposed standing water. The sump will have a storage capacity of about 1.03 m^3 which is greater than the required pre-treatment storage capacity. The bottom of the pond can be planted with emergent vegetation such as cattail or bulrush.

The proposed infiltration will be through a sand filter constructed along the side of the retention pond. Details for the proposed design are shown on Kollaard Associates Inc. drawing 100667-2.

The Manual states that the size of the filter may be determined using the Darcy Equation, which is equation 4.12 in the manual and is as follows.

$$A = \frac{1000Vd}{k(h+d)t}$$

Where:	A	= surface area of the filter in m^2	
	V	= design volume (m^3) to be outlet through filter	= 4 m^3
	d	= depth (m) of the controlling filter medium (sand)	= 0.5 m
	k	= soil percolation rate in mm/hr	= 720 mm/hr
	h	= average operating head of water on the filter (m)	= 0.32 m
	t	= design drawdown time in hours	= 24 hr

Using this equation, the required surface area of the filter would be about 0.14 square metres.

Based on the size of the proposed sand filter, the surface area of the filter is 3 square metres. Therefore the size of the filter allows considerably more of the storm water to be treated by passing through the filter. The storage pond discharge rate through the sand filter with respect to pond depth and storage volume is shown in Appendix B.

The storage will outlet either completely through the sand filter or over a rectangular weir.

Stormwater quality control is achieved by storing a sufficient volume of water as calculated in MOE Manual Table 3.2. The stormwater report shows the calculation and that the resulting quality storage volume requirement is 4 cubic metres.

From the discharge table, shown in appendix B, it is indicated that discharge over the rectangular weir does not occur until after a storage of about 14.28 (16.64 - 2.36) cubic metres. Since this is approximately 4 times greater than the minimum MOE stormwater quality control storage requirement of 4 cubic metres the quality control criterion is met.

Uncontrolled Runoff

As previously indicated, the uncontrolled runoff is considered to be the runoff not directed to the retention pond at the northwest corner of the site. The uncontrolled runoff originates from the grassed area between the building and the front property line. This runoff will be directed to the roadside ditch along the east (front) property line.

Filter Maintenance.

Removal of accumulated sediment from the sump should be conducted when the accumulation of the sediment begins to significantly affect the void ratio within the clear stone forming the sump. This can be accomplished by removing and replacing the 50 mm clear stone. Silt/sediment should be removed from the surface of the sand berm when 2-3 cm of sediment has accumulated. The upper layer of the filter material (e.g., 0.1 to 0.15 m) should be removed and replaced with clear material when accumulated sediment is removed from the filter.

STORM WATER STORAGE

The proposed stormwater storage will be provided within the retention pond to be located at the north east corner of the property. The minimum required storage was determined by the quantity storage requirement of 33.1 cubic metres (during a 100-year, 20 minute event).

The runoff quantity storage requirement is determined by the restriction on the release rate from the storage pond. In order to achieve the allowable controlled area storm water release rate, storm water runoff from the controlled areas will be directed to the proposed retention pond. The outflow from the proposed storage will be restricted to the allowable controlled area release rates by the permeability of the sand filter material and by the height of water (head) over the rectangular weir. Restricting the release rate from the proposed storage will result in a runoff storage volume requirement.

The proposed storage area is shown in Kollaard Associates Inc. drawing # 100667-2 Grading and Drainage Plan. The bottom of the sump in the storage will be at an elevation of about 98.55 while the bottom of the storage above the sump will be set at an elevation of 98.68 m. The top elevation of the berm around the retention pond is set at an elevation of 99.50 metres. The available storage volume in the stormwater storage is show as a function of depth in Appendix B. The storage release rate with respect to depth is also shown in Appendix B.

The stormwater will be released from the storage by means of infiltration through the sand filter and over a rectangular weir when the level in the pond reaches an elevation of 99.20. The 100 year ponding level in the storage area is at an elevation of 99.34 metres. The 100-yr ponding area includes a portion of the gravel parking area and the sub-drained swale along the north property line.

Control of Release Rate

The proposed storage will release water to the ditch in the rear drainage easement. As previously stated, the release from the storage will be through the sand filter and over a rectangular weir.

The seepage rate through the sand berm will be controlled by the permeability of the filter sand and is a function of the filter area, the thickness of the filter and the head on the filter. The release rate

over the rectangular weir is a function of the ponding depth (head above the weir) and is shown in Appendix B.

Runoff Storage

In order to meet the peak storage requirement conditions for a 100-year storm event the proposed storage will be constructed at the north west corner of the site. All of the controlled area runoff is directed to this retention pond. As previously mentioned, the controlled area runoff will flow over the surface by means of sheet flow to the storage area. The stormwater for quality control purposes will be stored in the stormwater storage area between the elevations of 98.68 and 99.34 metres. The storage volume with respect to pond depth is provided in Appendix B.

As discussed above, the required storage volume is the greater of the quality storage requirement and the quantity storage requirement. The quantity storage requirement, which governs in this design, is determined by the outlet restriction. The storage volume requirements for the 2-year, 5-year and 100-year storm events are indicated in the attached Appendix C.

In order to meet the stormwater quantity control restriction, the post development runoff rate for the 2 year storm event cannot exceed 50 percent to of the 2 year pre-development runoff rate. For a 2 year storm event, the post development runoff rate is restricted to a maximum of 4 litres per second. The actual release rate through the sand filter during a 2 year storm event as a function of the ponding depth and storage requirement is 4 litres per second. The corresponding maximum storage requirement for the 2 year storm event is 17.5 cubic metres.

The maximum allowable post development release rate for the 5 year storm event is restricted to 10 litres per second. As a result of the control required for the 2 year storm event, the actual 5 year restriction is 7 litres per second. The corresponding maximum storage requirement for the 5 year storm event is 20.2 cubic metres.

The allowable post development runoff rate is restricted to a maximum 22 litres per second for the 100 year storm event. The actual release rate through the sand filter and outlet weir during a 100 year storm event as a function of the ponding depth and storage requirement is 20.0 litres per second. The corresponding maximum storage requirement for the 100 year storm event is 33.1 cubic metres.

SEDIMENT AND EROSION CONTROL

The site in general slopes to the east and west. In order to limit the amount of sediment carried in stormwater runoff from the site during construction, it is recommended to install a silt fence around the perimeter of the property. The silt fence may be polypropylene, nylon, polyester or ethylene yarn (see drawing 100667-2 for location and details).

If a standard filter fabric is used, it must be backed by a wire fence supported on posts not over 2.0 m apart. Extra strength filter fabric may be used without a wire fence backing if posts are not over 1.0 m apart. Fabric joints should be lapped at least 150 mm (6") and stapled. The bottom edge of the filter fabric should be anchored in a 300 mm (1 ft) deep trench, to prevent flow under the fence. Sections of fence should be cleaned, if blocked with sediment and replaced if torn.

The exposed landscaped areas of the site should be seeded with a rapid growing grass mixture as soon as possible. The proposed asphaltic concrete surfaced areas should be surfaced as soon as possible.

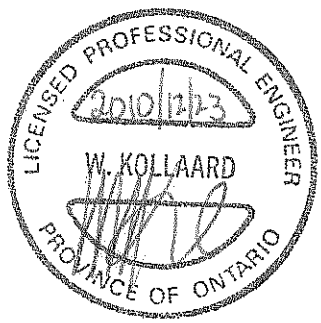
The silt fences should only be removed once the site is stabilized and vegetation is established.

These measures will reduce the amount of sediment carried from the site during storm events that may occur during construction.

We trust that this report provides sufficient information for your present purposes. If you have any questions concerning this report or if we can be of any further assistance to you on this project, please do not hesitate to contact our office.

Sincerely,

KOLLAARD ASSOCIATES INC.



William Kollaard, P.Eng.

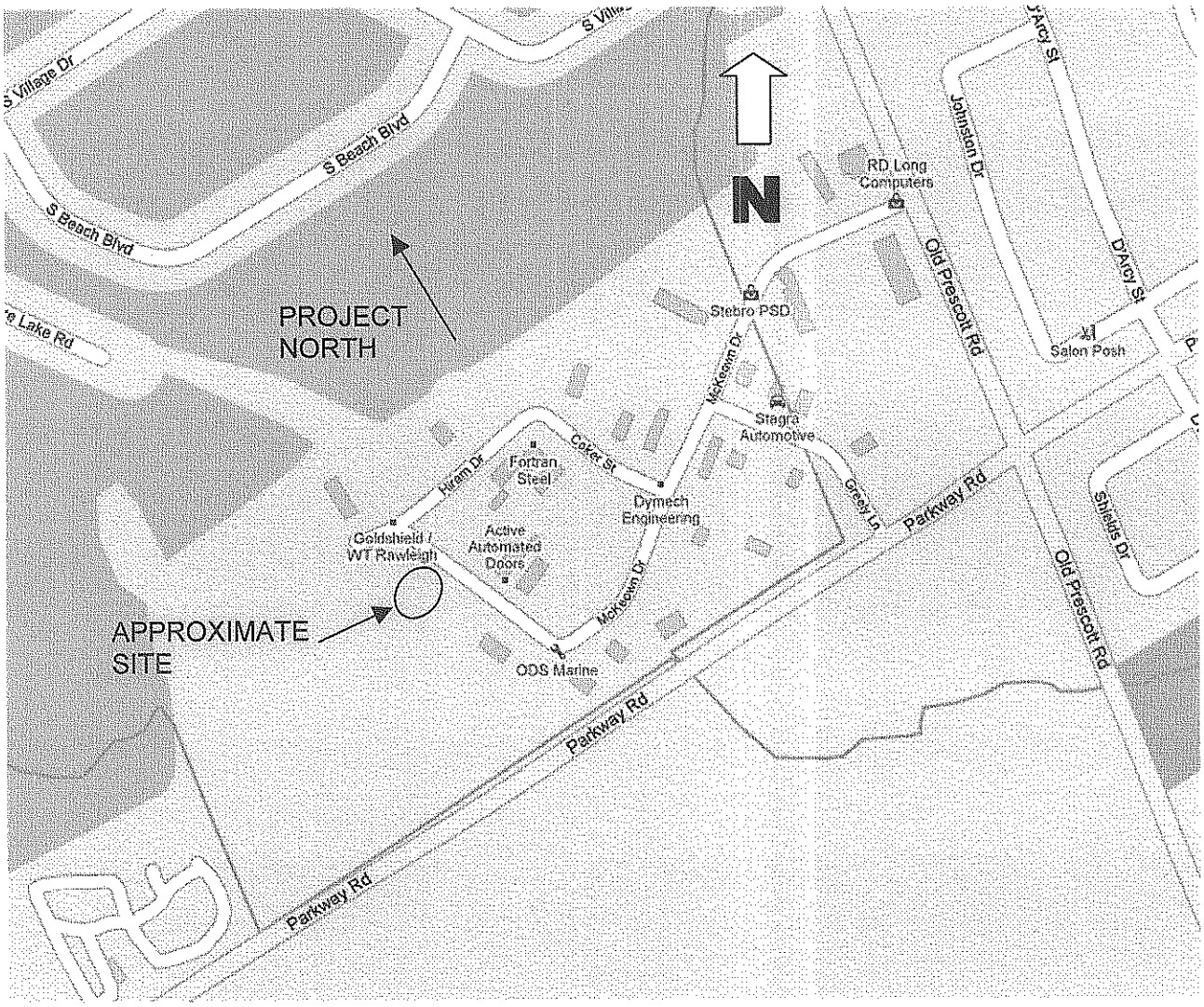
Related Drawings

Drawing # 100758-2 Grading and Drainage Plan

Attachments
Figure 1 - Key Plan
Figure 2 - Catchment Areas.
Appendix A – Stormwater Management - Rational Method
Allowable Controlled Area Release Rate
Appendix B – Treatment Pond Volume and Discharge Rate
Appendix C – Stormwater Management - Rational Method Calculation Sheet,
Actual Discharge Rate and Storage Volume Requirements

KEY PLAN

FIGURE 1

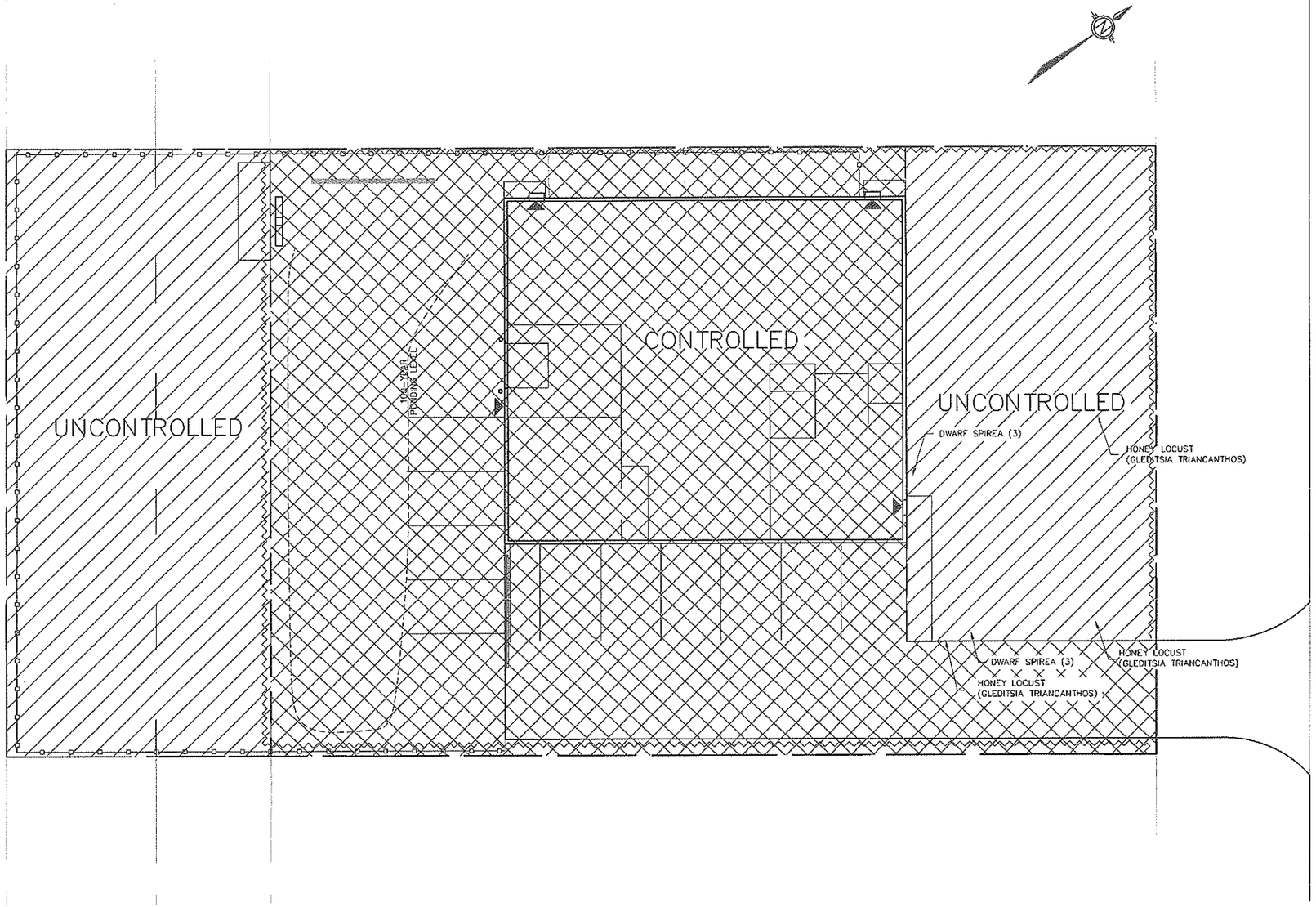


NOT TO SCALE

Kollaard Associates
Engineers

Project No. 100667

Date December 2010



BARFIELD STREET

DRAWING NUMBER:

FIGURE 2

CONSTRUCTION NOTES:

1. All dimensions and elevations are in metres.
2. TBM = Nail in utility pole (NE property corner).
Elevation= 99.65 (Geodetic)
3. Contractor is responsible for location and protection of utilities.
4. Top of Foundation (TOF) elevation and Underside of Footing (USF) elevation for dwelling are as shown on drawing 100667-2.
5. Finished grade around dwelling to be as shown.
6. Maximum allowable slope on site is 3H:1V. Finished grade to slope away from house at all sides at a minimum of 2%, and a maximum of 7%. Maximum slope away from septic system area is 4H:1V.
7. All dimensions to be verified on site by contractor prior to construction.
8. Any changes made to this plan must be verified and approved by Kollaard Associates Inc.
9. Client is responsible for acquiring all necessary permits.
10. The proposed grades have been set and verified for site grading control only. The grade raise at the structure location should be verified with regard to subsurface conditions by qualified geotechnical personnel after completion of the excavation.
11. The underside of footing elevation may not have accounted for actual ground water conditions at the exact structure location and should be verified by qualified geotechnical personnel upon completion of the excavation.
12. A geotechnical engineer should be retained to provide geotechnical recommendations with respect to the sub-grade conditions prior to footing installation.

REV.	NAME	DATE	DESCRIPTION

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Engineers

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CLIENT:
WICKED GARAGE

PROJECT:
FABRICATION SHOP

LOCATION:
1344 BARFIELD ROAD
PLAN 4M-351 PT BLK 5RP:
4R05427 PARTS 62,63 &64
LOT 5 - CON 4, OSGOODE,
CITY OF OTTAWA, ONTARIO

DESIGNED BY:	*DATE:*
WK	DEC. 13, 2010
DRAWN BY:	*SCALE:*
ML	1:300

KOLLAARD FILE NUMBER:
100667

APPENDIX A
STORMWATER MANAGEMENT - RATIONAL METHOD
ALLOWABLE CONTROLLED AREA RELEASE RATE

APPENDIX A: STORMWATER MANAGEMENT MODEL

RATIONAL METHOD CALCULATION SHEET - ALLOWABLE CONTROLLED AREA RELEASE RATE

Client: Wicked Garage Inc.
Job No.: 100667
Location: 1344 Barfield Road, Greely, Ottawa, Ontario
Date: December 21, 2010

Design Criteria:

TOTAL DEVELOPED AREA	0.201	hectares
Controlled	0.156	hectares
Uncontrolled	0.045	hectares
	0.494	impervious ratio
Pre-Development		
Time of Concentration, (Pre) Tc =	15	minutes
Pre-Development 2 & 5 yr C =	0.30	
Pre-Development 100 yr C =	0.38	
Post-Development		
2 & 5 - Yr Post-Development C (Controlled)=	0.79	
2 & 5 - Yr Post-Development C (Uncontrolled)=	0.30	
100 - Yr Post-Development C (Controlled)=	0.91	
100 - Yr Post-Development C (Uncontrolled)=	0.38	
Time of Concentration, (Post) Tc =	10	minutes

2 YEAR STORM	I =	61.77	mm/hr
CALCULATED OUTFLOW RESTRICTION =		0.010	m^3/s
5 YEAR STORM	I =	83.56	mm/hr
CALCULATED OUTFLOW RESTRICTION =		0.014	m^3/s
100 YEAR STORM	I =	142.89	mm/hr
CALCULATED OUTFLOW RESTRICTION =		0.030	m^3/s

2 YEAR STORM RUNOFF EVENT ALLOWABLE CONTROLLED AREA RELEASE RATE CALCULATION

		PRE-DEVELOPMENT	POST-DEVELOPMENT		ALLOWABLE
RAINFALL	RAINFALL	PEAK	CONTROLLED	UNCONTROLLED	CONTROLLED AREA
DURATION	INTENSITY	RUNOFF	PEAK RUNOFF	PEAK RUNOFF	RELEASE RATE
(min.)	(mm/hr)	(m^3/s)	(m^3/s)	(m^3/s)	m^3/s
5	103.6	0.017	0.036	0.004	0.003
10	76.8	0.013	0.026	0.003	0.004
15	61.8	0.010	0.021	0.002	0.004
20	52.0	0.009	0.018	0.002	0.004
25	45.2	0.008	0.015	0.002	0.004
30	40.0	0.007	0.014	0.002	0.004
60	24.6	0.004	0.008	0.001	0.005
90	18.1	0.003	0.006	0.001	0.005

Allowable release rate from the controlled area of the site for a 2 year storm event based on a post-development Time of concentration of 10 minutes is **0.004 m^3/s**

5 YEAR STORM RUNOFF EVENT ALLOWABLE CONTROLLED AREA RELEASE RATE CALCULATION

		PRE-DEVELOPMENT	POST-DEVELOPMENT		ALLOWABLE
RAINFALL	RAINFALL	PEAK	CONTROLLED	UNCONTROLLED	CONTROLLED AREA
DURATION	INTENSITY	RUNOFF	PEAK RUNOFF	PEAK RUNOFF	RELEASE RATE
(min.)	(mm/hr)	(m^3/s)	(m^3/s)	(m^3/s)	m^3/s
5	141.2	0.024	0.048	0.005	0.009
10	104.2	0.017	0.036	0.004	0.010
15	83.6	0.014	0.029	0.003	0.011
20	70.3	0.012	0.024	0.003	0.011
25	60.9	0.010	0.021	0.002	0.012
30	53.9	0.009	0.019	0.002	0.012
60	32.9	0.006	0.011	0.001	0.013
90	24.3	0.004	0.008	0.001	0.013

Allowable release rate from the controlled area of the site for a 5 year storm event based on a post-development Time of concentration of 10 minutes is **0.010 m^3/s**

100 YEAR STORM RUNOFF EVENT ALLOWABLE CONTROLLED AREA RELEASE RATE CALCULATION

		PRE-DEVELOPMENT	POST-DEVELOPMENT		ALLOWABLE
RAINFALL	RAINFALL	PEAK	CONTROLLED	UNCONTROLLED	CONTROLLED AREA
DURATION	INTENSITY	RUNOFF	PEAK RUNOFF	PEAK RUNOFF	RELEASE RATE
(min.)	(mm/hr)	(m^3/s)	(m^3/s)	(m^3/s)	m^3/s
5	242.7	0.041	0.096	0.011	0.019
10	178.6	0.030	0.071	0.008	0.022
15	142.9	0.024	0.057	0.007	0.023
20	120.0	0.020	0.048	0.006	0.024
25	103.9	0.017	0.041	0.005	0.025
30	91.9	0.015	0.036	0.004	0.026
60	55.9	0.009	0.022	0.003	0.027
90	41.1	0.007	0.016	0.002	0.028

Allowable release rate from the controlled area of the site for a 100 year storm event based on a post-development Time of concentration of 10 minutes is **0.022 m^3/s**

APPENDIX B
TREATMENT POND VOLUME AND DISCHARGE RATES

APPENDIX B: TREATMENT POND VOLUME
AND DISCHARGE RATE CALCULATIONS

Kollaard Associates Inc.
Client: Wicked Garage Inc.
Job No.: 100667
Location: 1344 Barfield Road, Greely, Ottawa, Ontario
Date: December 21, 2010

Elevation	Surface area	Layer Volume	Cumulative Volume	Pond Depth	Ave Head On Sand Filter	Surface Area of Filter	Discharge through Filter	Head on Weir	Discharge Over Weir	Total Discharge
m	m^2	m^3	m^3	m	m	m^2	L/sec	m	L/sec	L/s
98.500	10.0	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.000	0.0
98.550	11.8	0.55	0.55	0.05	0.02	0.4	0.20	0.00	0.000	0.2
98.600	13.6	0.64	1.18	0.10	0.02	0.7	0.39	0.00	0.000	0.4
98.650	15.5	0.73	1.91	0.15	0.02	1.1	0.59	0.00	0.000	0.6
98.700	17.3	0.82	2.73	0.20	0.02	1.5	0.79	0.00	0.000	0.8
98.750	19.1	0.91	3.64	0.25	0.02	1.9	0.98	0.00	0.000	1.0
98.800	20.9	1.00	4.64	0.30	0.02	2.2	1.18	0.00	0.000	1.2
98.850	22.7	1.09	5.73	0.35	0.02	2.6	1.38	0.00	0.000	1.4
98.900	24.6	1.18	6.91	0.40	0.02	3.0	1.57	0.00	0.000	1.6
98.950	26.4	1.27	8.19	0.45	0.02	3.4	1.77	0.00	0.000	1.8
99.000	28.2	1.36	9.55	0.50	0.27	3.7	2.91	0.00	0.000	2.9
99.050	30.0	1.46	11.01	0.55	0.32	4.1	3.40	0.00	0.000	3.4
99.100	31.8	1.55	12.55	0.60	0.37	4.1	3.61	0.00	0.000	3.6
99.150	33.7	1.64	14.19	0.65	0.42	4.1	3.82	0.00	0.000	3.8
99.200	35.60	1.73	15.92	0.70	0.47	4.1	4.02	0.00	0.738	4.8
99.250	93.60	3.23	19.15	0.75	0.52	4.1	4.23	0.00	2.088	6.3
99.300	154.00	6.19	25.34	0.80	0.57	4.1	4.43	0.00	5.906	10.3
99.350	206.00	9.00	34.34	0.85	0.62	4.1	4.64	0.00	42.888	47.5
99.400	258.00	11.60	45.94	0.90	0.67	4.1	4.85	0.00	66.030	70.9

APPENDIX C
STORMWATER MANAGEMENT - RATIONAL METHOD CALCULATION SHEET
ACTUAL DISCHARGE RATE AND STORAGE VOLUME REQUIREMENTS

APPENDIX C: STORMWATER MANAGEMENT MODEL

RATIONAL METHOD CALCULATION SHEET - REQUIRED STORAGE AND RELEASE RATE

Client: Wicked Garage Inc.

Job No.: 100667

Location: 1344 Barfield Road, Greely, Ottawa, Ontario

Date: December 21, 2010

Design Criteria:

Total Site Area	**0.201**	hectares
Total Controlled Area from Site	0.156	hectares
Total Uncontrolled Area from Site	0.045	hectares
Impervious ratio	0.494	

Stormwater Quality Treatment Method
Vegetative Filtration / Sand Filter
Quality Storage Requirement =
20 m^3/ha
See Storm Water Design Report 100623

Pre-Development	Pre-Development C 2 & 5 yr =	0.30
	Pre-Development C 100 yr =	0.38
Post-Development		
	2 & 5 - Yr Post-Development C (Controlled)=	0.79
	2 & 5 - Yr Post-Development C (Uncontrolled)=	0.30
	100 - Yr Post-Development C (Controlled)=	0.91
	100 - Yr Post-Development C (Uncontrolled)=	0.38

Maximum Allowable Release Rate 2 year Storm Event
0.004 (m^3/s)
Maximum Allowable Release Rate 5 year Storm Event
0.010 (m^3/s)
Maximum Allowable Release Rate 100 year Storm Event
0.022 (m^3/s)

2 YEAR STORM RUNOFF EVENT CALCULATION OF MAXIMUM STORAGE AND ACTUAL FLOW RATE FROM SITE

		PRE-DEVELOPMENT		POST-DEVELOPMENT				
RAINFALL DURATION (min.)	RAINFALL INTENSITY (mm/hr)	PEAK RUNOFF (m^3/s)	TOTAL RUNOFF (m^3)	UNCONTROLLED SITE RUNOFF (m^3/s)	CONTROLLED SITE RUNOFF (m^3/s)	ACTUAL STORAGE RELEASE RATE m^3/s	REQ'D STORAGE (m^3)	TOTAL FLOW RATE FROM SITE (m^3/s)
5	103.6	0.017	5.2	0.004	0.036	0.004	9.5	0.008
10	76.8	0.013	7.7	0.003	0.026	0.004	13.4	0.007
15	61.8	0.010	9.3	0.002	0.021	0.004	15.5	0.006
20	52.0	0.009	10.5	0.002	0.018	0.004	16.6	0.006
25	45.2	0.008	11.4	0.002	0.015	0.004	17.2	0.006
30	40.0	0.007	12.1	0.002	0.014	0.004	17.5	0.006
60	24.6	0.004	14.8	0.001	0.008	0.004	15.9	0.005
90	18.1	0.003	16.4	0.001	0.006	0.004	12.0	0.005

5 YEAR STORM RUNOFF EVENT CALCULATION OF MAXIMUM STORAGE AND ACTUAL FLOW RATE FROM SITE

		PRE-DEVELOPMENT		POST-DEVELOPMENT				
RAINFALL DURATION (min.)	RAINFALL INTENSITY (mm/hr)	PEAK RUNOFF (m^3/s)	TOTAL RUNOFF (m^3)	UNCONTROLLED SITE RUNOFF (m^3/s)	CONTROLLED SITE RUNOFF (m^3/s)	ACTUAL STORAGE RELEASE RATE m^3/s	REQ'D STORAGE (m^3)	TOTAL FLOW RATE FROM SITE (m^3/s)
5	141.2	0.024	7.1	0.005	0.048	0.003	13.6	0.008
10	104.2	0.017	10.5	0.004	0.036	0.005	18.4	0.009
15	83.6	0.014	12.6	0.003	0.029	0.007	19.5	0.010
20	70.3	0.012	14.1	0.003	0.024	0.007	20.2	0.010
25	60.9	0.010	15.3	0.002	0.021	0.007	20.2	0.010
30	53.9	0.009	16.3	0.002	0.019	0.007	20.0	0.009
60	32.9	0.006	19.9	0.001	0.011	0.006	19.1	0.007
90	24.3	0.004	22.0	0.001	0.008	0.005	18.0	0.006

100 YEAR STORM RUNOFF EVENT CALCULATION OF MAXIMUM STORAGE AND ACTUAL FLOW RATE FROM SITE

		PRE-DEVELOPMENT		POST-DEVELOPMENT				
RAINFALL DURATION (min.)	RAINFALL INTENSITY (mm/hr)	PEAK RUNOFF (m^3/s)	TOTAL RUNOFF (m^3)	UNCONTROLLED SITE RUNOFF (m^3/s)	CONTROLLED SITE RUNOFF (m^3/s)	ACTUAL STORAGE RELEASE RATE m^3/s	REQ'D STORAGE (m^3)	TOTAL FLOW RATE FROM SITE (m^3/s)
5	242.7	0.041	12.2	0.011	0.096	0.010	25.9	0.021
10	178.6	0.030	18.0	0.008	0.071	0.019	31.1	0.027
15	142.9	0.024	21.6	0.007	0.057	0.020	33.0	0.027
20	120.0	0.020	24.2	0.006	0.048	0.020	33.1	0.026
25	103.9	0.017	26.1	0.005	0.041	0.020	31.8	0.025
30	91.9	0.015	27.8	0.004	0.036	0.019	31.4	0.023
60	55.9	0.009	33.8	0.003	0.022	0.014	29.4	0.017
90	41.1	0.007	37.3	0.002	0.016	0.011	28.7	0.013