161-00941-00

April 13, 2017

Mr. John Velick, Engineering Manger
Town of Collingwood
97 Hurontario Street
Collingwood, ON
L9Y 2L8

Re: Site Feasibility and Stormwater Management Design
40 Sandford Fleming Drive
Town of Collingwood

Dear Mr. Velick:

WSP was retained by Mr. Ray Smith in order to assess the site feasibility (sanitary and water) and existing and proposed stormwater conditions for his property located at 40 Sandford Fleming Drive in Collingwood. It is understood that the proposed industrial development is to not adversely affect the existing stormwater system on 40 Sandford Fleming Drive.

Water Servicing
The existing 25mm diameter water service will be used for the site. The proposed building will house offices, a few washrooms and room for the industrial process. Industrial water use is limited to bottle washing.

Recent water records for ISOWATER (the tenant) were obtained from their existing site based on Municipal water bills:

Date	Water Usage (m3)	Average Daily Usage (L/day)
January 2017	0.21	10.5
December 2016	0.26	13.0
November 2016	0.36	18.0
October 2016	0.29	14.5

Based on the above water records, the existing service will be sufficient for the site.

Sanitary Servicing
The existing 150mm diameter sanitary service will be used for the site. Wastewater will be limited to a few on site washrooms and some wash water used to clean bottles. Existing water records show minor water usage for an industrial type building. Based on the water records provided above, the existing service will be sufficient for the site.

Stormwater Management
The site previously consisted of a large gravel parking area, storage containers and landscape materials. The remainder of the undevelopable site was forest and brush. Most of the existing stormwater on site currently sheet flows to the front of the property to the ditch on Sandford

WSP Canada Inc.
1450 1st Avenue West
Suite 101
OWEN SOUND, ON
N4K 6W2
www.wspgroup.com

Fleming Drive. A portion drains east to the neighbours property and then north to the Sandford Fleming ditch. A small portion at the back of the property flows south to neighbouring lands.

Since Mr. Smith acquired the property, the site has been stripped and tree clearing has occurred for the proposed development.

Test pits were completed at the site on March 29th, 2016. The testpits generally conform as follows: 0.3-0.6m topsoil or gravel, 1.3 m of sandy silt till/gravel. Digging refusal at roughly 1.6m below grade on average due large stones and consolidated the soil into a solid state

See Drawing 161-00941-01 Existing Conditions attached and associated pre-development conditions storm water calculations (2, 5, 10, 25, 50 and 100 year storm events).

The developed area consists of the proposed industrial building, the pedestrian walkways, asphalt parking area to the west of the building and the gravel parking area (including loading areas) south of the building. Further, a fenced in storage area is located to the south of the building and will be constructed of ¾" clear stone. The remaining site will be sodded or seeded and will include grass lined swales.

The proposed stormwater works include the entire site being directed via two (2) swales to the Sandford Fleming Drive ditch. See Drawing 161-00941-02.

Stormwater calculations were completed for the proposed post – development conditions (2, 5, 10, 25, 50 and 100 year storm events). The gravel parking area was assumed as asphalt for the purposes of the stormwater calculations. The time of concentration was calculated for each catchment area using the Airport formula. A minimum time of concentration of 10min was utilized per the Town standards. C factors were calculated based on MOE design guidelines and increased by 10% for 25-year, 20% for 50-year and 25% for 100-year to account for soil saturation. See attached proposed conditions site plan, 161-00941-03, and associated calculations.

Stormwater from Area P3 will be contained within the clear stone storage area and exfiltrate into the native soils. The storage calculations assume 40% voids in the clear stone. It was found through calculation that the existing sandy soil can infiltrate at 0.84 L/s (see attached calculations). This is considered a conservative calculation as safety factors were applied. In order to determine infiltration from the proposed storage area, the existing soils were reviewed for permeability. Based on the attached tables, a K value was assumed of $5x10^{-6}$ m/s for the sandy silt till/gravel soil. A safety factor of 2 was applied to this value. Over a 72hr period, the area can exfiltrate 217.7m3.

Considering the above, no stormwater control within the swales will be required. Due to the runoff travel distance in long swales on site, permeability of existing soils and proposed sheet flow, the proposed flows to the Sandford Fleming Drive ditch are less than the calculated existing pre-development condition flows.

Stormwater quality is being proposed via the grass lined swales on the east and west side of the property.

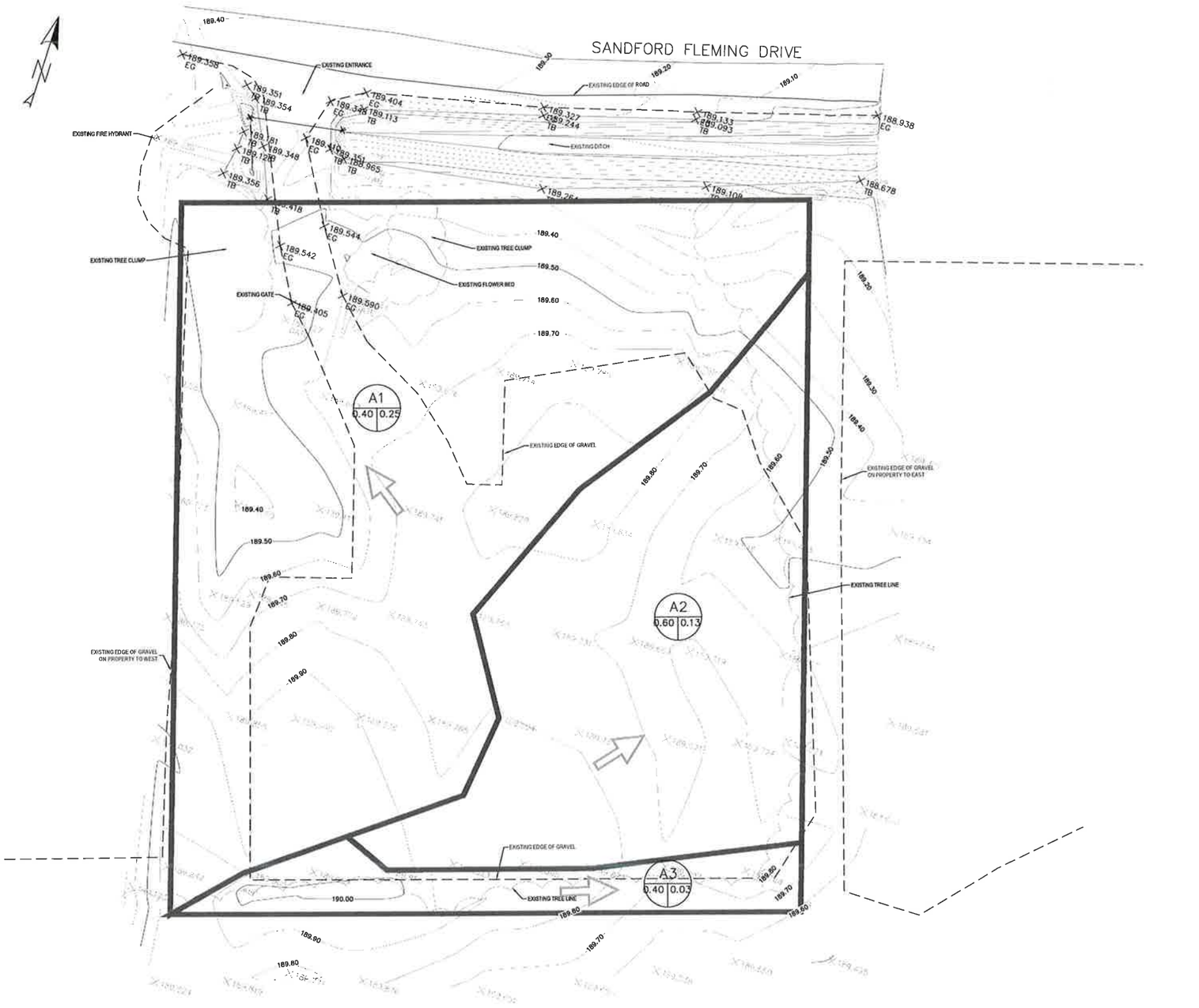
If you have any questions regarding this report or with the proposed storm water system, please do not hesitate to contact the undersigned at (519) 376-7612 ext. 13218 or at Kim.Pilon@wspgroup.com.

Yours truly,

WSP Canada Inc.

Kim Pilon, EIT
KP/GLP
Encl.
cc: Mr. Ray Smith, Property Owner

George L. Prentice, P. Eng.



ZONING M-5

SETBACKS FRONT – 12m
REAR – 7.5m
SIDE – 6m

AREA OF SITE – 0.415 Ha
AREA OF BUILDING – 910m² – 22%
PARKING SPACES – 35
HANDICAPPED SPACES – 4
LANDSCAPED AREA – 1,430m² – 34.5%
(NOT INCLUDING SIDWALKS)

KEY PLAN

LEGEND

EXISTING CONDITIONS

- SANITARY SEWER
- STORM SEWER
- WATERMAIN
- PROPERTY LINE
- EDGE OF PAVEMENT
- EDGE OF GRAVEL
- CENTERLINE
- FENCELINE
- TREELINE
- SANITARY MANHOLE
- CBMH – CATCHBASIN MANHOLE
- CB – CATCHBASIN
- WV – WATER VALVE
- CSV – CURBSTOP
- CO – SANITARY CLEANOUT (APPROX. LOCATION)
- FH – FIRE HYDRANT
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- HP – HYDRO POLE
- AN – POLE ANCHOR
- IB – IRON BAR
- 179.5 – EXISTING CONTOUR

PROPOSED WORK

- SIDEWALK
- WATER SERVICE 50mm w/ EX. CURBSTOP
- SANITARY SERVICE 150mm w/ EX. CLEANOUT (APPROX. LOCATION–LOCATION TO BE VERIFIED PRIOR TO CONSTRUCTION)
- SWALE
- EX: 189.90 – EXISTING GRADING
- EL:189.90 – PROPOSED GRADING

DRAINAGE

- DRAINAGE FLOW
- A1 0.30 0.16 – CATCHMENT AREA ID / CATCHMENT AREA (ha) / MANNINGS n VALUE (RUNOFF COEFFICIENT)
- STORM DRAINAGE BOUNDARY

KEY PLAN

DISCLAIMER — COPYRIGHT

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ISSUED FOR - REVISION

IS	RV	DATE	DESCRIPTION
	1	FEB 2016	ISSUED FOR ENGINEERING REVIEW #1

SEAL: G. L. PRENTICE — Registered Professional Engineer — Province of Ontario

CLIENT: APPLEVALE PROPERTIES LTD
CLIENT REF #: 161-00941-00

PROJECT: 40 SANDFORD FLEMING DRIVE
PROJECT NO: 161-00941-00
DATE: FEB 2016

WSP
101-1450 1st AVENUE W
OWEN SOUND (ONTARIO) CANADA N4K 6W2
TEL 519-376-7612 | FAX 519-376-8008 | WWW.WSPGROUP.COM

ORIGINAL SCALE: 1:200
IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE
25mm

TITLE: EXISTING CONDITIONS AND DRAINAGE PLAN
40 SANDFORD FLEMING DRIVE
TOWN OF COLLINGWOOD

SHEET NUMBER: 161-00941-01
SHEET # 1 OF 1

DESIGNED BY: K. PILON
DRAWN BY: C. HAINES
CHECKED BY: C. WILSON
DISCIPLINE: EXISTING CONDITIONS
ISSUE: ISSUED FOR REVIEW
REV #: 0
DATE OF ISSUE: JULY 21 2016

Design Chart 1.07: Runoff Coefficients

- Urban for 5 to 10-Year Storms

Land Use		Runoff Coefficient Min.	Runoff Coefficient Max.
Pavement	- asphalt or concrete	0.80	0.95
- brick		0.70	0.85
Gravel roads and shoulders, parking lot		0.40	0.60
Roofs		0.70	0.95
Business	- downtown	0.70	0.95
- neighbourhood		0.50	0.70
- light		0.50	0.80
- heavy		0.60	0.90
Residential	- single family urban	0.30	0.50
- multiple, detached		0.40	0.60
- multiple, attached		0.60	0.75
- suburban		0.25	0.40
Industrial	- light	0.50	0.80
- heavy		0.60	0.90
Apartments		0.50	0.70
Parks, cemeteries		0.10	0.25
Playgrounds (unpaved)		0.20	0.35
Railroad yards		0.20	0.35
Unimproved areas		0.10	0.30
Lawns	- Sandy soil		
- flat, to 2%		0.05	0.10
- average, 2 to 7%		0.10	0.15
- steep, over 7%		0.15	0.20
- Clayey soil			
- flat, to 2%		0.13	0.17
- average, 2 to 7%		0.18	0.22
- steep, over 7%		0.25	0.35

pre → Gravel roads and shoulders, parking lot

post → Industrial - light

For flat or permeable surfaces, use the lower values. For steeper or more impervious surfaces, use the higher values. For return period of more than 10 years, increase above values as 25-year - add 10%, 50-year - add 20%, 100-year - add 25%.

The coefficients listed above are for unfrozen ground.

Design Chart 1.07: Runoff Coefficients (Continued)

- Rural

Land Use & Topography[3]	Soil Texture		
	Open Sand Loam	Loam or Silt Loam	Clay Loam or Clay
CULTIVATED			
Flat 0 - 5% Slopes	0.22	0.35	0.55
Rolling 5 - 10% Slopes	0.30	0.45	0.60
Hilly 10- 30% Slopes	0.40	0.65	0.70
PASTURE			
Flat 0 - 5% Slopes	0.10	0.28	0.40
Rolling 5 - 10% Slopes	0.15	0.35	0.45
Hilly 10- 30% Slopes	0.22	0.40	0.55
WOODLAND OR CUTOVER			
Flat 0 - 5% Slopes	0.08	0.25	0.35
Rolling 5 - 10% Slopes	0.12	0.30	0.42
Hilly 10- 30% Slopes	0.18	0.35	0.52
BARE ROCK	COVERAGE[3]		
	30%	50%	70%
Flat 0 - 5% Slopes	0.40	0.55	0.75
Rolling 5 - 10% Slopes	0.50	0.65	0.80
Hilly 10- 30% Slopes	0.55	0.70	0.85
LAKES AND WETLANDS	0.05		

[2] Terrain Slopes

[3] Interpolate for other values of % imperviousness

Sources: American Society of Civil Engineers - ASCE (1960)
U.S. Department of Agriculture (1972)

C Values For Existing Conditions
40 Sandford Fleming Drive

		Area (ha)	C Factor From Table	C Factor Calculated
A1	Total	0.03		0.4
	Gravel	0.011	0.6	
	Grass	0.019	0.25	
A2	Total	0.13		0.6
	Gravel	0.12	0.6	
	Grass	0.01	0.25	
A3	Total	0.25		0.4
	Gravel	0.11	0.6	
	Grass	0.14	0.25	

* The above values are based on the MTO Drainage Manual Design Chart 1.07

40 Sandford Fleming Drive
Pre-Development Site Drainage
5 Year Design Storm

LOCATION					INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
CATCHMENT ID	AREA TOTAL (HA)	WATERSHED LENGTH	WATERSHED SLOPE, %	RUNOFF COEFFICIENT, C					
A1	0.25	65	1.2	0.40	0.278	0.278	17	57.97	16.12
A2	0.130	52	0.85	0.60	0.217	0.217	12	70.06	15.19
A3	0.030	8	1.3	0.40	0.033	0.033	10	78.28	2.61

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

NOTES

$$I\,2_{YR} = \frac{807.44}{(t+6.75)^{0.828}}$$

Designed By : KP

Checked By :

40 Sandford Fleming Drive
Pre-Development Site Drainage
5 Year Design Storm

LOCATION									
CATCHMENT ID	AREA TOTAL (HA)	WATERSHED LENGTH	WATERSHED SLOPE, %	RUNOFF COEFFICIENT, C	INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
A1	0.25	65	1.2	0.40	0.278	0.278	17	76.22	21.19
A2	0.130	52	0.85	0.60	0.217	0.217	12	91.79	19.90
A3	0.030	8	1.3	0.40	0.033	0.033	10	102.27	3.41

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

NOTES

$$I_{5YR} = \frac{1135.4}{(t+7.50)^{0.841}}$$

Designed By : KP

Checked By :

40 Sandford Fleming Drive
Pre-Development Site Drainage
10 Year Design Storm

LOCATION					INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
CATCHMENT ID	AREA TOTAL (HA)	WATERSHED LENGTH	WATERSHED SLOPE, %	RUNOFF COEFFICIENT, C					
A1	0.25	65	1.2	0.40	0.278	0.278	17	88.45	24.59
A2	0.130	52	0.85	0.60	0.217	0.217	12	106.36	23.06
A3	0.030	8	1.3	0.40	0.033	0.033	10	118.36	3.95

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

NOTES

$$I_{10YR} = \frac{1387}{(t+7.97)^{0.852}}$$

Designed By : KP

Checked By :

40 Sandford Fleming Drive
Pre-Development Site Drainage
25 Year Design Storm

LOCATION									
CATCHMENT ID	AREA TOTAL (HA)	WATERSHED LENGTH	WATERSHED SLOPE, %	RUNOFF COEFFICIENT, C	INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
A1	0.25	65	1.2	0.44	0.306	0.306	16	107.25	32.80
A2	0.130	52	0.85	0.66	0.239	0.239	11	132.74	31.66
A3	0.030	8	1.3	0.44	0.037	0.037	10	138.40	5.08

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

NOTES

$$I_{25YR} = \frac{1676.2}{(t+8.30)^{0.858}}$$

Designed By : KP

Checked By :

Comments:
C values factored per MOE guidelines - 10% for 25-year, 20% for 50-year and 25% for 100-year
Tc calculated using Airport Formula, minimum 10 min
IDF calculated based on Owen Sound Values

40 Sandford Fleming Drive
Pre-Development Site Drainage
50 Year Design Storm

CATCHMENT ID	LOCATION: AREA TOTAL (HA)	LOCATION: WATERSHED LENGTH	LOCATION: WATERSHED SLOPE, %	LOCATION: RUNOFF COEFFICIENT, C	INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
A1	0.25	65	1.2	0.48	0.334	0.334	15	123.53	41.21
A2	0.130	52	0.85	0.72	0.260	0.260	10	153.18	39.86
A3	0.030	8	1.3	0.48	0.040	0.040	10	153.18	6.13

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

NOTES

$$I_{50YR} = \frac{1973.1}{(t+9.00)^{0.868}}$$

Designed By : KP

Checked By :

40 Sandford Fleming Drive
Pre-Development Site Drainage
100 Year Design Storm

LOCATION									
CATCHMENT ID	AREA TOTAL (HA)	WATERSHED LENGTH	WATERSHED SLOPE, %	RUNOFF COEFFICIENT, C	INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
A1	0.25	65	1.2	0.50	0.348	0.348	15	138.24	48.04
A2	0.130	52	0.85	0.75	0.271	0.271	10	168.45	45.66
A3	0.030	8	1.3	0.50	0.042	0.042	10	168.45	7.02

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

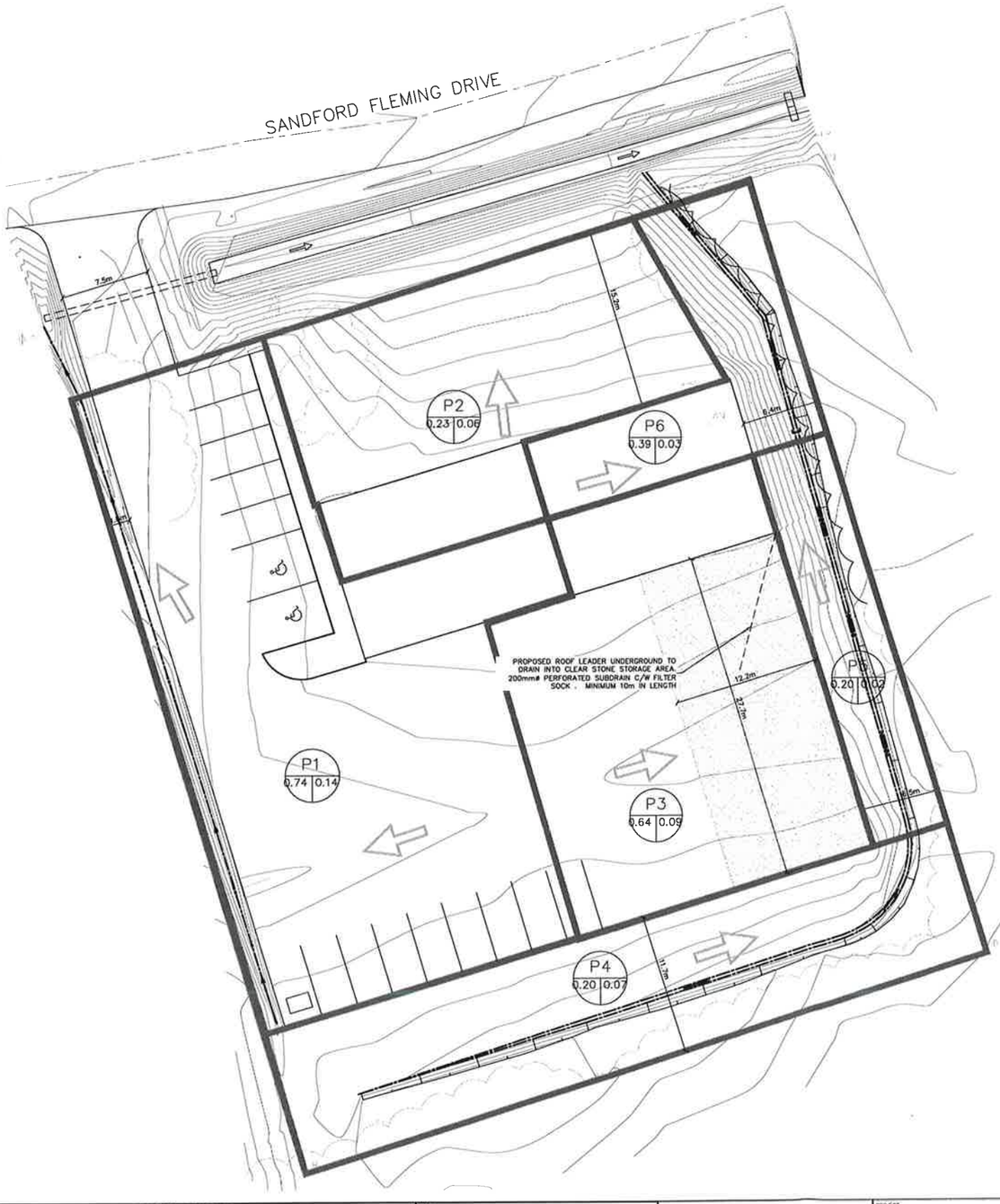
NOTES

$I\ 100_{YR} = \frac{2193.1}{(t+9.04)^{0.871}}$

Designed By : KP

Checked By :

Comments:
C values factored per MOE guidelines - 10% for 25-year, 20% for 50-year and 25% for 100-year
Tc calculated using Airport Formula, minimum 10 min
IDF calculated based on Owen Sound Values



KEY PLAN

LEGEND

EXISTING CONDITIONS

- SANITARY SEWER
- STORM SEWER
- WATERMAIN
- PROPERTY LINE
- EDGE OF PAVEMENT
- SIDEWALK
- CENTERLINE
- FENCELINE
- TREELINE
- SANITARY MANHOLE
- CBMH — CATCHBASIN MANHOLE
- CB — CATCHBASIN
- WV — WATER VALVE
- CSV — CURBSTOP
- CO — SANITARY CLEANOUT (APPROX. LOCATION)
- FH — FIRE HYDRANT
- GV — GAS VALVE
- HP — HYDRO POLE
- AN — POLE ANCHOR
- IB — IRON BAR
- 179.5 — EXISTING CONTOUR

PROPOSED WORK

- SIDEWALK
- WATER SERVICE 50mm w/ EX. CURBSTOP
- SANITARY SERVICE 150mm w/ EX. CLEANOUT (APPROX. LOCATION–LOCATION TO BE VERIFIED PRIOR TO CONSTRUCTION)
- SWALE
- + EX. 189.90 — EXISTING GRADING
- + EL=189.90 — PROPOSED GRADING

DRAINAGE

- DRAINAGE FLOW
- A1 / 0.30 / 0.18 — CATCHMENT AREA ID / CATCHMENT AREA (ha) / MANNINGS n VALUE (RUNOFF COEFFICIENT)
- STORM DRAINAGE BOUNDARY
- 20mm CLEAR STONE AREA

KEY PLAN

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ISSUED FOR - REVISION

IS	RV	DATE	DESCRIPTION
	1	FEB 2016	ISSUED FOR ENGINEERING REVIEW #1

SEAL: G. L. PRETTICE — 09/15/17 — Province of Ontario

CLIENT: APPLEVALE PROPERTIES LTD
CLIENT REF.#: 161-00941-00

PROJECT: 40 SANDFORD FLEMING DRIVE
PROJECT NO: 161-00941-00
DATE: MARCH 2017

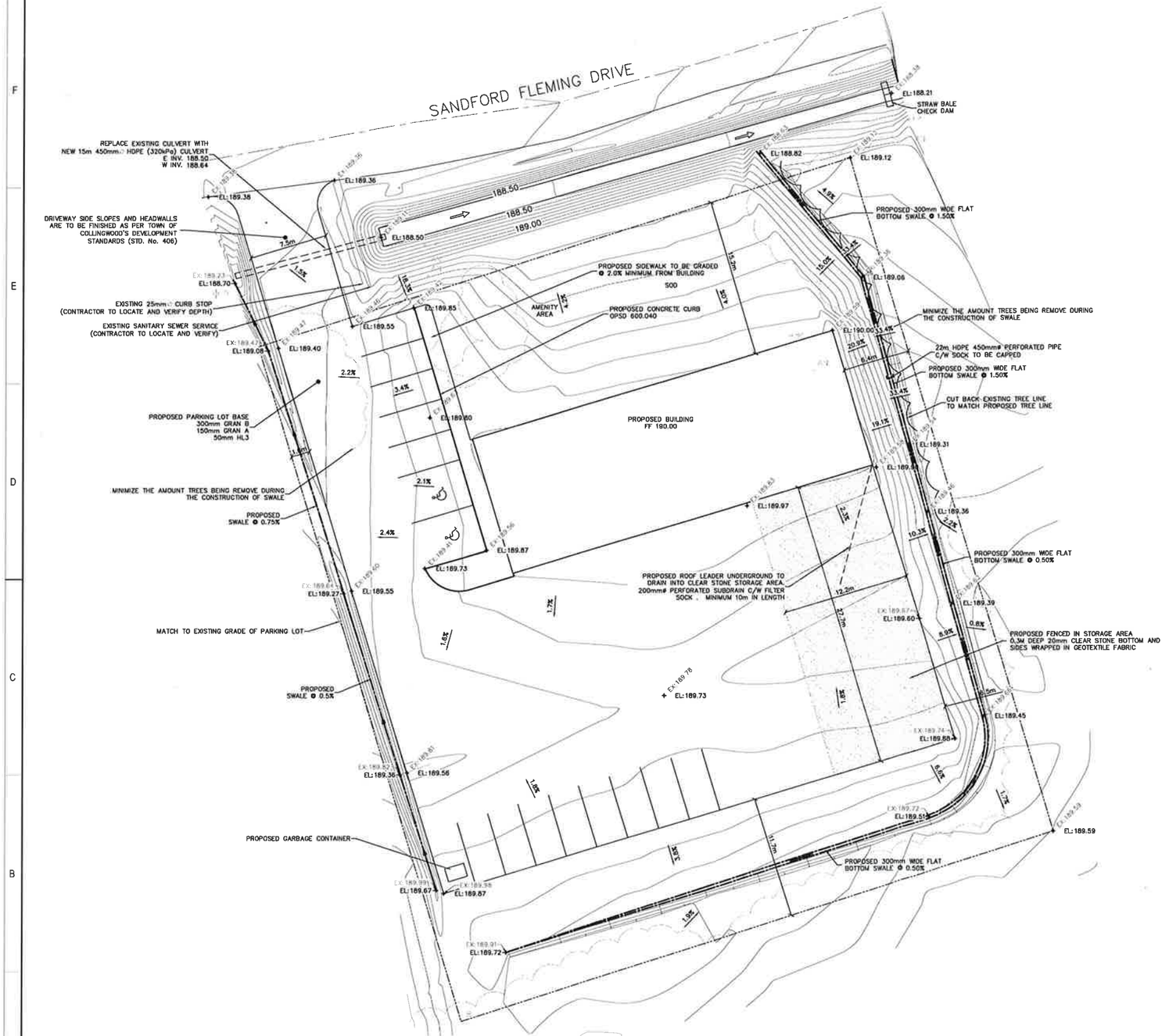
WSP
101-1450 1st AVENUE W
OWEN SOUND (ONTARIO) CANADA N4K 0W2
TEL 519 376-7612 | FAX 519-376-8006 | WWW.WSPGROUP.COM

ORIGINAL SCALE: 1:200
IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE
25mm

TITLE: PROPOSED DRAINAGE AREAS
40 SANDFORD FLEMING DRIVE
TOWN OF COLLINGWOOD

SHEET NUMBER: 161-00941-02
SHEET # 2 OF 2

DESIGNED BY: K. PILON
DRAWN BY: C. HAINES
CHECKED BY: C. WILSON
DISCIPLINE: SITE GRADING
ISSUE: ISSUED FOR REVIEW
RV #: 0
DATE OF: JULY 21 2016



ZONING M-5

SETBACKS FRONT – 12m
REAR – 7.5m
SIDE – 6m

AREA OF SITE – 0.415 Ha
AREA OF BUILDING – 910m² – 22%
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- 20mm CLEAR STONE AREA

KEY PLAN

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IS	RV	DATE	DESCRIPTION
1		FEB 2016	ISSUED FOR ENGINEERING REVIEW #1

SEAL: G. L. PRENTICE — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

CLIENT: APPLEVALE PROPERTIES LTD
CLIENT REF # 161-00941-00

PROJECT: 40 SANDFORD FLEMING DRIVE
PROJECT NO 161-00941-00
DATE FEB 2018

WSP
101-1450 1st AVENUE W
OWEN SOUND (ONTARIO) CANADA N4K 6W2
TEL 519-370-7612 | FAX 519-370-8006 | WWW.WSPGROUP.COM

ORIGINAL SCALE 1:200
IF THIS BAR IS NOT 25mm LONG ADJUST YOUR PLOTTING SCALE
25mm

TITLE: PROPOSED LOT GRADING PLAN
40 SANDFORD FLEMING DRIVE
TOWN OF COLLINGWOOD

SHEET NUMBER 161-00941-03
SHEET # 1 OF 2

DESIGNED BY K. PILON
DRAWN BY C. HAINES
CHECKED BY C. WILSON
DISCIPLINE SITE GRADING
ISSUE ISSUED FOR REVIEW
RV # 0
DATE OF JULY 31 2018

Design Chart 1.07: Runoff Coefficients

- Urban for 5 to 10-Year Storms

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Roofs		0.70	0.95
Business	- downtown	0.70	0.95
- neighbourhood		0.50	0.70
- light		0.50	0.80
- heavy		0.60	0.90
Residential	- single family urban	0.30	0.50
- multiple, detached		0.40	0.60
- multiple, attached		0.60	0.75
- suburban		0.25	0.40
Industrial	- light	0.50	0.80
- heavy		0.60	0.90
Apartments		0.50	0.70
Parks, cemeteries		0.10	0.25
Playgrounds (unpaved)		0.20	0.35
Railroad yards		0.20	0.35
Unimproved areas		0.10	0.30
Lawns	- Sandy soil		
- flat, to 2%		0.05	0.10
- average, 2 to 7%		0.10	0.15
- steep, over 7%		0.15	0.20
- Clayey soil			
- flat, to 2%		0.13	0.17
- average, 2 to 7%		0.18	0.22
- steep, over 7%		0.25	0.35

pre → Gravel roads and shoulders, parking lot

post → Industrial - light

For flat or permeable surfaces, use the lower values. For steeper or more impervious surfaces, use the higher values. For return period of more than 10 years, increase above values as 25-year - add 10%, 50-year - add 20%, 100-year - add 25%.

The coefficients listed above are for unfrozen ground.

Design Chart 1.07: Runoff Coefficients (Continued)

- Rural

Land Use & Topography[3]	Soil Texture		
	Open Sand Loam	Loam or Silt Loam	Clay Loam or Clay
CULTIVATED			
Flat 0 - 5% Slopes	0.22	0.35	0.55
Rolling 5 - 10% Slopes	0.30	0.45	0.60
Hilly 10- 30% Slopes	0.40	0.65	0.70
PASTURE			
Flat 0 - 5% Slopes	0.10	0.28	0.40
Rolling 5 - 10% Slopes	0.15	0.35	0.45
Hilly 10- 30% Slopes	0.22	0.40	0.55
WOODLAND OR CUTOVER			
Flat 0 - 5% Slopes	0.08	0.25	0.35
Rolling 5 - 10% Slopes	0.12	0.30	0.42
Hilly 10- 30% Slopes	0.18	0.35	0.52
BARE ROCK	COVERAGE[3]		
	30%	50%	70%
Flat 0 - 5% Slopes	0.40	0.55	0.75
Rolling 5 - 10% Slopes	0.50	0.65	0.80
Hilly 10- 30% Slopes	0.55	0.70	0.85
LAKES AND WETLANDS	0.05		

Pre →

[2] Terrain Slopes

[3] Interpolate for other values of % imperviousness

Sources: American Society of Civil Engineers - ASCE (1960)
U.S. Department of Agriculture (1972)

C Values For Proposed Conditions
40 Sandford Fleming Drive

		Area (m2)	C Factor From Table	C Factor Calculated
P1	Total	1102		0.74
	Asphalt	937	0.8	
	Building	57	0.8	
	Grass	108	0.1	
P2	Total	638		0.23
	Building	122	0.8	
	Grass	516	0.1	
P3	Total	837		0.64
	Clear Stone	337	0.4	
	Building	125	0.8	
	Asphalt	375	0.8	
P4	Total	700		0.2
	Grass	700	0.2	
P5	Total	200		0.2
	Grass	200	0.2	
P6	Total	296		0.39
	Building	121	0.8	
	Grass	175	0.1	

* The above values are based on the MTO Drainage Manual Design Chart 1.07

40 Sandford Fleming Drive
Post-Development Site Drainage
2 Year Design Storm

LOCATION									
CATCHMENT ID	AREA TOTAL (HA)	WATERSHED LENGTH	WATERSHED SLOPE, %	RUNOFF COEFFICIENT, C	INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
P1	0.14	67	0.5	0.74	0.288	0.288	12	71.06	**20.47**
P2	0.06	20	4.3	0.23	0.038	0.038	10	78.28	**3.00**
P3	0.09	40	2.3	0.64	0.160	0.160	10	78.28	12.53
P4	0.07	62	2.0	0.20	0.039	0.039	18	55.95	2.18
P5	0.02	38	2.0	0.20	0.011	0.210	33	38.46	8.08
P6	0.03	27	3.5	0.39	0.033	0.243	41	33.04	**8.02**

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

NOTES

$$I\,2_{YR} = \frac{807.44}{(t+6.75)^{0.828}}$$

Designed By : KP

Checked By :

Comments:
C values factored per MOE guidelines - 10% for 25-year, 20% for 50-year and 25% for 100-year
Tc calculated using Airport Formula, minimum 10 min
IDF calculated based on Owen Sound Values

40 Sandford Fleming Drive
Post-Development Site Drainage
5 Year Design Storm

LOCATION									
CATCHMENT ID	AREA TOTAL (HA)	WATERSHED LENGTH	WATERSHED SLOPE, %	RUNOFF COEFFICIENT, C	INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
P1	0.14	67	0.5	0.74	0.288	0.288	12	93.07	**26.81**
P2	0.06	20	4.3	0.23	0.038	0.038	10	102.27	**3.92**
P3	0.09	40	2.3	0.64	0.160	0.160	10	102.27	16.38
P4	0.07	62	2.0	0.20	0.039	0.039	18	73.60	2.86
P5	0.02	38	2.0	0.20	0.011	0.210	33	50.74	10.66
P6	0.03	27	3.5	0.39	0.033	0.243	41	43.61	**10.58**

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

NOTES

$$I_{5YR} = \frac{1135.4}{(t+7.50)^{0.841}}$$

Designed By : KP

Checked By :

Comments:
C values factored per MOE guidelines - 10% for 25-year, 20% for 50-year and 25% for 100-year
Tc calculated using Airport Formula, minimum 10 min
IDF calculated based on Owen Sound Values

40 Sandford Fleming Drive
Post-Development Site Drainage
10 Year Design Storm

LOCATION					INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
CATCHMENT ID	AREA TOTAL (HA)	WATERSHED LENGTH	WATERSHED SLOPE, %	RUNOFF COEFFICIENT, C					
P1	0.14	67	0.5	0.74	0.288	0.288	12	107.84	**31.06**
P2	0.06	20	4.3	0.23	0.038	0.038	10	118.36	**4.54**
P3	0.09	40	2.3	0.64	0.160	0.160	10	118.36	18.95
P4	0.07	62	2.0	0.20	0.039	0.039	18	85.43	3.32
P5	0.02	38	2.0	0.20	0.011	0.210	33	58.93	12.39
P6	0.03	27	3.5	0.39	0.033	0.243	41	50.62	**12.29**

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

NOTES

$$I_{10YR} = \frac{1387}{(t+7.97)^{0.852}}$$

Designed By : KP

Checked By :

Comments:
C values factored per MOE guidelines - 10% for 25-year, 20% for 50-year and 25% for 100-year
Tc calculated using Airport Formula, minimum 10 min
IDF calculated based on Owen Sound Values

40 Sandford Fleming Drive
Post-Development Site Drainage
25 Year Design Storm

LOCATION									
CATCHMENT ID	AREA TOTAL (HA)	WATERSHED LENGTH	WATERSHED SLOPE, %	RUNOFF COEFFICIENT, C	INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
P1	0.14	67	0.5	0.81	0.317	0.317	10	141.10	**44.70**
P2	0.06	20	4.3	0.25	0.042	0.042	10	138.40	**5.84**
P3	0.09	40	2.3	0.70	0.176	0.176	10	138.40	24.38
P4	0.07	62	2.0	0.22	0.043	0.043	18	101.49	4.35
P5	0.02	38	2.0	0.22	0.012	0.231	32	70.24	16.24
P6	0.03	27	3.5	0.43	0.036	0.267	40	60.66	**16.20**

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

NOTES

$$I_{25YR} = \frac{1676.2}{(t+8.30)^{0.858}}$$

Designed By : KP

Checked By :

Comments:
C values factored per MOE guidelines - 10% for 25-year, 20% for 50-year and 25% for 100-year
Tc calculated using Airport Formula, minimum 10 min
IDF calculated based on Owen Sound Values

40 Sandford Fleming Drive
Post-Development Site Drainage
50 Year Design Storm

LOCATION									
CATCHMENT ID	AREA TOTAL (HA)	WATERSHED LENGTH	WATERSHED SLOPE, %	RUNOFF COEFFICIENT, C	INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
P1	0.14	67	0.5	0.89	0.346	0.346	10	153.18	**52.94**
P2	0.06	20	4.3	0.28	0.046	0.046	10	153.18	**7.05**
P3	0.09	40	2.3	0.77	0.192	0.192	10	153.18	29.43
P4	0.07	62	2.0	0.24	0.047	0.047	18	114.52	5.35
P5	0.02	38	2.0	0.24	0.013	0.252	31	79.73	20.11
P6	0.03	27	3.5	0.47	0.039	0.291	38	69.29	**20.18**

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

NOTES

$$I_{50YR} = \frac{1973.1}{(t+9.00)^{0.868}}$$

Designed By : KP

Checked By :

Comments:
C values factored per MOE guidelines - 10% for 25-year, 20% for 50-year and 25% for 100-year
Tc calculated using Airport Formula, minimum 10 min
IDF calculated based on Owen Sound Values

40 Sandford Fleming Drive
Post-Development Site Drainage
100 Year Design Storm

LOCATION					INDIV. 2.78 AR	ACCUM. 2.78 AR	TIME OF CONC.	RAINFALL INTENSITY I (mm/hr)	PEAK FLOW Q (L/s)
CATCHMENT ID	AREA TOTAL (HA)	WATERSHED LENGTH	WATERSHED SLOPE, %	RUNOFF COEFFICIENT, C					
P1	0.14	67	0.5	0.93	0.360	0.360	10	168.45	**60.64**
P2	0.06	20	4.3	0.29	0.048	0.048	10	168.45	**8.08**
P3	0.09	40	2.3	0.80	0.200	0.200	10	168.45	33.72
P4	0.07	62	2.0	0.25	0.049	0.049	17	126.73	6.17
P5	0.02	38	2.0	0.25	0.014	0.263	31	88.27	23.19
P6	0.03	27	3.5	0.49	0.041	0.303	38	76.89	**23.33**

PROJECT :	40 Sandford Fleming Drive
PROJECT NUMBER :	161-00941-00
CLIENT :	Applevale Properties Ltd.
DATE :	April 13, 2017

NOTES

$I\ 100_{YR} = \dfrac{2193.1}{(t+9.04)^{0.871}}$

Designed By : KP

Checked By :

Comments:
C values factored per MOE guidelines - 10% for 25-year, 20% for 50-year and 25% for 100-year
Tc calculated using Airport Formula, minimum 10 min
IDF calculated based on Owen Sound Values

Existing Conditions						
Q L/s						
	2-year	5-year	10-year	25-year	50-year	100-year
A1	16.1	21.2	24.6	32.8	41.2	48.0
A2	15.2	19.9	23.1	31.7	39.9	45.7
A3 (Does not outlet to Sandford)	*2.6*	*3.4*	*3.9*	*5.1*	*6.1*	*7.0*
Total discharge to Municipal Ditch(L/s) - A1+A2	**31.3**	**41.1**	**47.7**	**64.5**	**81.1**	**93.7**

Proposed Conditions Outlet to Sandford*						
Q L/s						
	2-year	5-year	10-year	25-year	50-year	100-year
P1	*20.47*	*26.81*	*31.06*	*44.70*	*52.94*	*60.64*
P2	3.00	3.92	4.54	5.84	7.05	8.08
P6	8.02	10.58	12.29	16.20	20.18	23.33
Total	**31.5**	**41.3**	**47.9**	**66.7**	**80.2**	**92.0**
Assumes flow of P3 into swale						

Proposed Conditions Outlet to Sandford*						
Q L/s						
	2-year	5-year	10-year	25-year	50-year	100-year
P1	*20.47*	*26.81*	*31.06*	*44.70*	*61.09*	*75.04*
P2	3.37	4.38	5.06	6.58	8.00	9.22
P6	2.73	3.60	4.18	5.51	6.86	7.94
Total	**26.6**	**34.8**	**40.3**	**56.8**	**76.0**	**92.2**
Assumes NO flow of P3 into swale						

WSP

PROJECT: EXFITRATION ANALYSIS No.: 40 SANDFORD FLEMING
SUBJECT: 161-00941-00

Sheet no. 1 of 1
Date 4/13/2017
By KP

Assume $k_{soil} = 5 \times 10^{-6}$ m/s

use factor of safety = 2.

$\therefore k_{soil} = 2.5 \times 10^{-6}$ m/s.

Clear stone Parking/storage area

$27.7^{m} \times 12.2^{m} = 337.94\ m^2$.

Calculate hydraulic gradient = i

$i = \frac{h}{l} = \frac{\text{available head}}{\text{flow distance through pervious soil}}$

Assume groundwater table at 1.5 mbgl

$i = \frac{1.5 + 0.1}{1.5} = 1.07$

Assume $i = 1$

Calculate exfiltration from clear stone storage area

$Q = A \cdot K \cdot i$
$= 337.94 \cdot 2.5 \times 10^{-6} \cdot 1$
$= 0.84$ L/s

Note: Area can drain 217.7 m^3 in 72 hours.

Calculate available storage.
0.3 m deep clear stone
40% voids.

40.44 m^3 of storage available.

DISTRIBUTION:

Soil permeability coefficient

Geotechdata.info - Updated 07.10.2013

The soil permeability is a measure indicating the capacity of the soil or rock to allow fluids to pass through it. It is often represented by the permeability coefficient (k) through the Darcy's equation:

V=ki

Where v is the apparent fluid velocity through the medium i is the hydraulic gradient , and K is the coefficient of permeability (hydraulic conductivity) often expressed in m/s

K depends on the relative permeability of the medium for fluid constituent (often water) and the dynamic viscosity of the fluid as follows.

K= (Gamma_w)*K/ (eta)

where Where Gamma_w is the unit weight of water Eta is the dynamic viscosity of water K is an absolute coefficient depending on the characteristics of the medium (m2)

The permeability coefficient can be determined in the laboratory using falling head permeability test, and constant head permeability test. On the field, the permeability can be estimated using Lugeon test.

Typical values of soil permeability

Some typical values of permeability coefficient are given below for different soil types. It refers to normally consolidated condition unless otherwise mentioned. These values should be used only as guidline for geotechnical problems; however, specific conition of each engineering problem often needs to be considered for an appropriate choice of geotechnical parameters.

Description	USCS	min (m/s)	max (m/s)	Specific value (m/s)	Reference
Well graded gravel, sandy gravel, with little or no fines	GW	5.00E-04	5.00E-02		[1],
Poorly graded gravel, sandy gravel, with little or no fines	GP	5.00E-04	5.00E-02		[1],
Silty gravels, silty sandy gravels	GM	5.00E-08	5.00E-06		[1],
Alluvial sand and gravel	(GM)	4.00E-04	4.00E-03		[2&3 in 4]
Clayey gravels, clayey sandy gravels	GC	5.00E-09	5.00E-06		[1],
Well graded sands, gravelly sands, with little or no fines	SW	1.00E-08	1.00E-06		[1],
Very fine sand, very well sorted	(SW)			8.40E-05	[5] ,
Medium sand, very well sorted	(SW)			2.23E-03	[5] ,
Coarse sand, very well sorted	(SW)			3.69E-01	[5] ,
Poorly graded sands, gravelly sands, with little or no fines	SP	2.55E-05	5.35E-04		[1], [2&3 in 4]

Clean sands (good aquifers)	(SP-SW)	1.00E-05	1.00E-02		[5],
Uniform sand and gravel	(SP-GP)	4.00E-03	4.00E-01		[2&3 in 4]
Well graded sand and gravel without fines	(GW-SW)	4.00E-05	4.00E-03		[2&3 in 4]
Silty sands	SM	1.00E-08	5.00E-06		[1],
Clayey sands	SC	5.50E-09	5.50E-06		[1], [5]
Inorganic silts, silty or clayey fine sands, with slight plasticity	ML	5.00E-09	1.00E-06		[1],
Inorganic clays, silty clays, sandy clays of low plasticity	CL	5.00E-10	5.00E-08		[1],
Organic silts and organic silty clays of low plasticity	OL	5.00E-09	1.00E-07		[1],
Inorganic silts of high plasticity	MH	1.00E-10	5.00E-08		[1],
Inorganic clays of high plasticity	CH	1.00E-10	1.00E-07		[1],
Compacted silt	(ML-MH)	7.00E-10	7.00E-08		[2&3 in 4]
Compacted clay	(CL-CH)	-	1.00E-09		[2&3 in 4]
Organic clays of high plasticity	OH	5.00E-10	1.00E-07		[1],
Peat and other highly organic soils	Pt	-	-		

Empirical relations for dtermine the soil permeability coefficient

For Sands, the coefficient of permeability can be estimated from the Hazen's equation:

$k = 10^{-2} D_{10}^2$

D_{10} is the effevtive size in mm.

REFERENCES

1. Swiss Standard SN 670 010b, Characteristic Coefficients of soils, Association of Swiss Road and Traffic Engineers
2. Carter, M. and Bentley, S. (1991). Correlations of soil properties. Penetech Press Publishers, London.
3. Leonards G. A. Ed. 1962, Foundation ENgineering. McGraw Hill Book Company
4. Dysli M. and Steiner W., 2011, Correlations in soil mechanics, PPUR
5. West, T.R., 1995. Geology applied to engineering. Prentice Hall, 560 pp.

Citation :
Geotechdata.info, Soil void ratio, http://geotechdata.info/parameter/permeability.html (as of October 7, 2013).

Table 1
Subsurface Field Investigation – 40 Sandford Fleming Drive
Soil Test Pit Log
Project Number 161 - 00941 - 01

Test Pit Identification	Depth Below Surface (metres)	Soil Moisture	Staining / Odour	Sample Number	Stratigraphy Description
TP1	0 - 0.30 m	Wet	None	None	Dark brown Humic Topsoil.
	0.30 - 1.52 m	Moist - Dry	None	TP1 - GS1	Light brown Sandy Silt TILL with Gravel. Compacted, some boulders. Some wet sandier pockets within TILL.
	@ 1.52 m				End of Hole. Refusal due to compacted soil and boulders.
Testpit excavated March 29, 2016, using a minihoe excavator.					

Test Pit Identification	Depth Below Surface (metres)	Soil Moisture	Staining / Odour	Sample Number	Stratigraphy Description
TP2	0 - 0.61 m	Wet	None	None	FILL – Gravel, crushed stone, cobbles, concrete fragments, sand, silt.
	0.30 - 1.68 m	Moist	None	TP2-GS1	Light brown Sandy Silt TILL with Gravel. Seems sandier than TP1. Compacted, some boulders
	@ 1.68 m				End of Hole. Refusal due to compaction of TILL.
Testpit excavated March 29, 2016, using a minihoe excavator.					

Test Pit Identification	Depth Below Surface (metres)	Soil Moisture	Staining / Odour	Sample Number	Stratigraphy Description
TP3	0 - 0.61 m	Wet - Saturated	None	None	Some minimal gravel on surface then dark brown Humic Topsoil.
	0.61 - 1.83 m	Moist - Wet	None	TP3 - GS1	Light brown Sandy Silt TILL with Gravel. Compacted. Seems sandier than TP1 and TP2. Water seeping in through tree root channels at 1.10 mbgl
	@ 1.83 m				End of Hole. Refusal due to compacted soil and boulders.
Testpit excavated March 29, 2016, using a minihoe excavator.					

Table 1
Subsurface Field Investigation – 40 Sandford Fleming Drive
Soil Test Pit Log
Project Number 161 - 00941 - 01

Test Pit Identification	Depth Below Surface (metres)	Soil Moisture	Staining / Odour	Sample Number	Stratigraphy Description
TP4	0 - 0.61 m	Wet - Saturated	None	None	Some minimal gravel on surface then dark brown Humic Topsoil. Water seeping in through root channels.
	0.61 - 1.68 m	Moist - Dry	None	TP4 - GS1	Light brown Sandy Silt TILL with Gravel and Cobbles. Compacted.
	@ 1.68 m				End of Hole. Refusal due to compacted soil and cobbles.
Testpit excavated March 29, 2016, using a minihoe excavator.					

Test Pit Identification	Depth Below Surface (metres)	Soil Moisture	Staining / Odour	Sample Number	Stratigraphy Description
TP5	0 - 0.61 m	Wet - Saturated	None	None	FILL – Gravel, crushed stone, cobbles. Water is flowing into testpit rapidly.
	0.61 - 1.22 m	Moist - Wet	None	None	Light brown Sandy Silt TILL with Gravel and Cobbles. Compacted.
	@ 1.22 m				End of Hole. Refusal due to compacted soil and cobbles and caving of saturated upper Fill layer.
Testpit excavated March 29, 2016, using a minihoe excavator.					