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TECHNICAL MEMORANDUM

To:	Kingsway Entertainment District Inc.	**RVA:**	237002
From:	Candice Green, P.Eng., LEED AP, ENV SP		
Date:	March 28, 2024		
Subject:	KED Waste Management Site – Conceptual Stormwater Management Plan		

1.0 Background

Waste Management intends to construct a new Waste Transfer Station within the Kingsway Employment District Industrial Park in the City of Greater Sudbury (The City). Kingsway Entertainment District Inc. (KED) intends to sell Lot 4 and Lot 5 within the Industrial Park to Waste Management, for the development of their Waste Transfer Sation. A condition of the sale of the lands is rezoning the property to accommodate the proposed development. R.V. Anderson Associates Limited (RVA) was retained by KED to prepare a conceptual stormwater management plan, as part of the works associated with rezoning the property.

This Technical Memorandum outlines RVA's conceptual stormwater management plan for the proposed Waste Management Site within the City of Greater Sudbury (CGS).

2.0 Pre-Development Conditions

The proposed subject site is located on undeveloped lands and consists of undulating brush, trees, bedrock, with wetlands nearby. The property is bisected by a watershed boundary with the southern half of the site draining towards Ramsey Lake and the northern half of the site draining towards the Wahnapitae River Watershed. The Ramsey Lake Watershed is subject to restrictions as it is an Intake Protection Zone (IPZ3).

For stormwater management purposes, the subject site was split into two drainage catchment areas along the IPZ limit. The southern catchment, PRE1 is 2.00 ha and is within the IPZ. The northern catchment, PRE2, is 3.08 ha and is within the Wahnapitae River Watershed. The pre-development drainage area plan is shown in Figure 1.

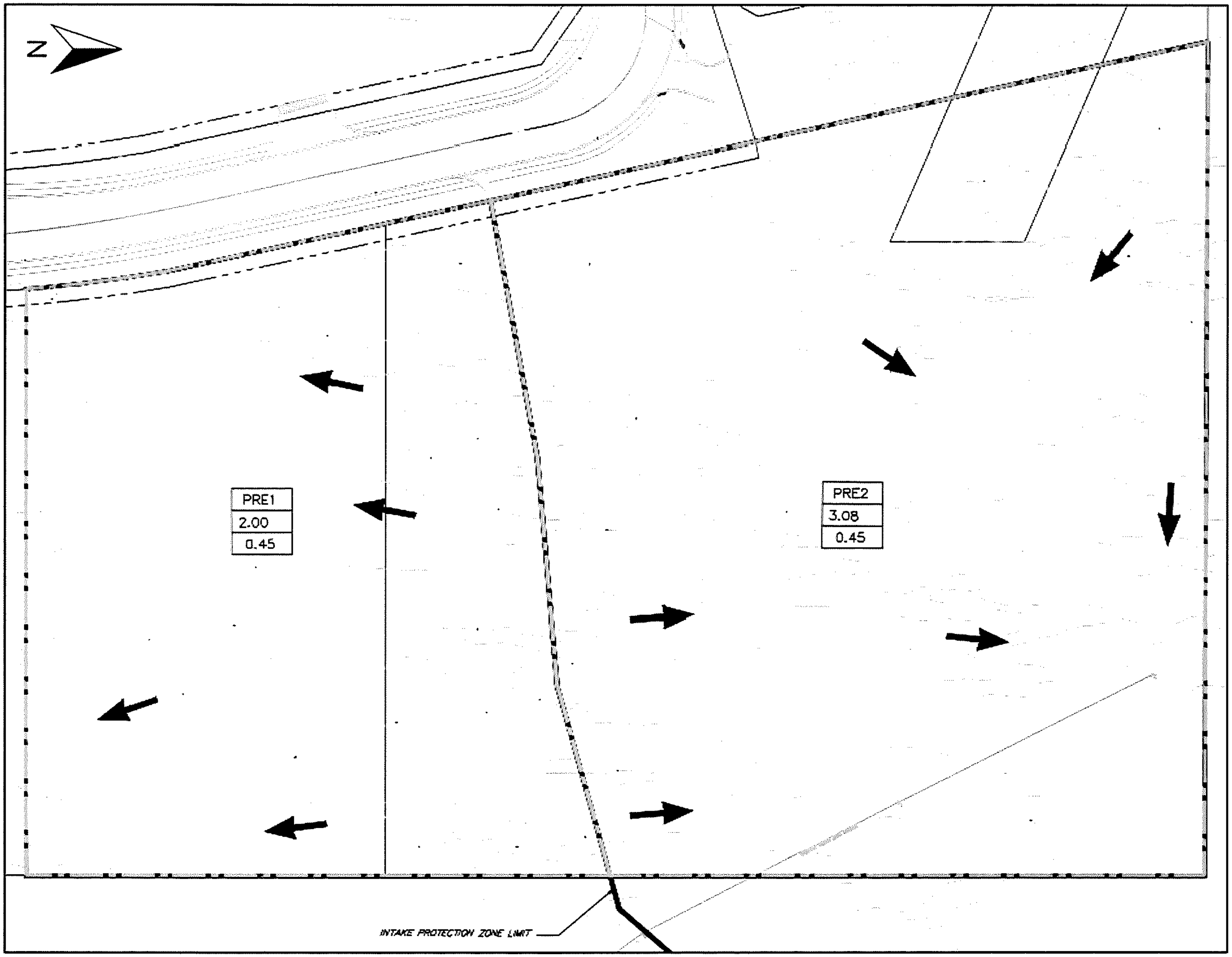

Figure 1: Pre-development Catchment Areas

2.1 Pre-development Hydrologic Model

Pre-development runoff conditions of the subject area were calculated using the Rational Method. Based on CGS standards, the Chicago type distribution was used to evaluate peak flows and runoff volume. Visual OTTHYMO (VO) software version 6.2 was used to generate the 6-hour Chicago design storms. The Intensity-Duration-Frequency (IDF) curve parameters used for generating the design storms were as per the CGS Supplemental Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains, December 2022. The hydrologic response of the pre-development area was evaluated for the 5-year and 100-year design storm events. The A, B, and C values to determine the rainfall intensity are shown in Table 2.1.

Table 2.1 – Sudbury Rainfall – IDF Curve Parameters

Design Storm Event	A	B	C
5-year	600.938	4.000	0.7325
100-year	1092.988	3.656	0.7350

Based on the subject site land use and topography being a mix of dense vegetation, woodland, and some bare rock coverage, with flat to rolling slopes, a runoff coefficient of 0.45 was chosen. The pre-development runoff calculations are shown in Appendix 1. Table 2.2 shows the hydrologic results for the pre-development conditions.

Table 2.2 – Pre-Development Runoff Peak Flow Rate

Design Storm Event	PRE1 - Runoff Peak Flow (m^3/s)	PRE2 - Runoff Peak Flow (m^3/s)
5-year	0.175	0.270
100-year	0.401	0.617

3.0 Post-Development Conditions

The proposed development includes an office, service shop, and parking spaces within the southern portion of the site. The northern portion of the site includes truck parking, truck scales stations, space for the storage of waste bins, and the waste transfer station. Stormwater can be conveyed through the subject site overland, via catch basins, storm sewers and/or swales. The two halves of the site will be controlled by two separate stormwater management facilities, one draining to the storm sewer network on Street ‘C’ within the Ramsey Lake Watershed and one draining to the existing environment within the Wahnapitae River Watershed.

For the conceptual design, the post-development catchment areas were assumed to be the same as the pre-development catchments. Under post-development conditions, all the proposed development areas including the entrances and the vehicle/waste truck access areas around the buildings were assumed to be impervious. All remaining undeveloped areas were assumed to be a pervious surface such as grass. The catchment areas POST1 and POST2 are shown are outlined in the post-development drainage area plan shown in Figure 2. A runoff coefficient of 0.9 and 0.2 was used for the impervious and pervious areas, respectively. The weighted runoff coefficient calculated for POST1 and POST2 is 0.55 and 0.57, respectively, for the 2–10-year design storm events.

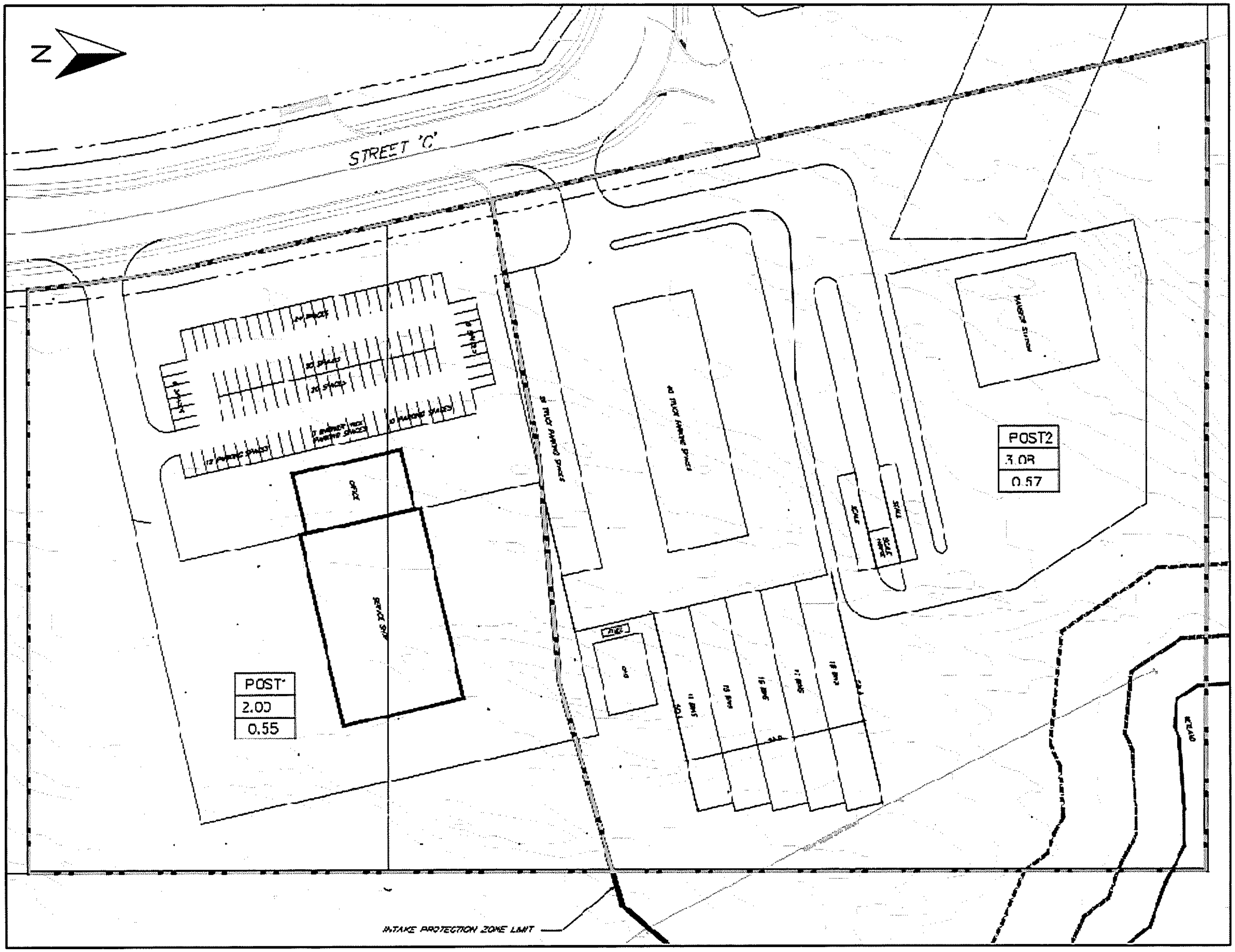

Figure 2: Post-development Catchment Areas

3.1 Post-development Hydrologic Model

Post-development runoff conditions of the subject area were calculated using the Rational Method. The hydrologic response was evaluated for the 5-year and 100-year 6-hour Chicago design storms.

The post-development runoff calculations are shown in Appendix 2. Table 3.1 shows the hydrologic results for the post-development conditions.

Table 3.1 – Post-Development Runoff Peak Flow and Runoff Volume

Design Storm Event	POST1 - Runoff Peak Flow (m^3/s)	POST2 - Runoff Peak Flow (m^3/s)
5-year	0.216	0.342
100-year	0.493	0.782

3.2 Quantity Control

The City requirements for the site development include controlling post-development peak flows to pre-development levels within the Wahnapitae River Watershed, and reducing the post-development peak flow rate to 80% of the pre-development flow rate within the Ramsey Lake Watershed.

The Modified Rational Method was used to calculate the storage volume required to control post-development peak flow rates to the pre-development levels. The 100-year storm was used for this analysis, to determine the maximum required storage. The Modified Rational Method is based off the formula $V_S=0.5*t_b*(Q_P-Q_A)$ where V_S is the storage required (m^3), $0.5*t_b$ can be seen as the time to peak/time of concentration, Q_P is the peak post-development runoff rate (m^3/s) based on that time of concentration, and Q_A is the allowable peak runoff rate (m^3/s).

This formula was iterated for increasing time of concentration values until the maximum potential storage volume required was found. The results show that for catchment area POST1, to achieve the additional 20% flow rate reduction for quantity control, the peak storage volume plus a 30% allowance is 235 m^3. For catchment area POST2, the peak storage volume plus a 30% allowance is 307 m^3. The Modified Rational Method calculations and results are shown in Appendix 3.

Two separate stormwater management (SWM) facilities are proposed to provide quantity control, based on the two separate watersheds and catchment areas. Two conceptual SWM ponds are shown in the sketch shown in Figure 3.

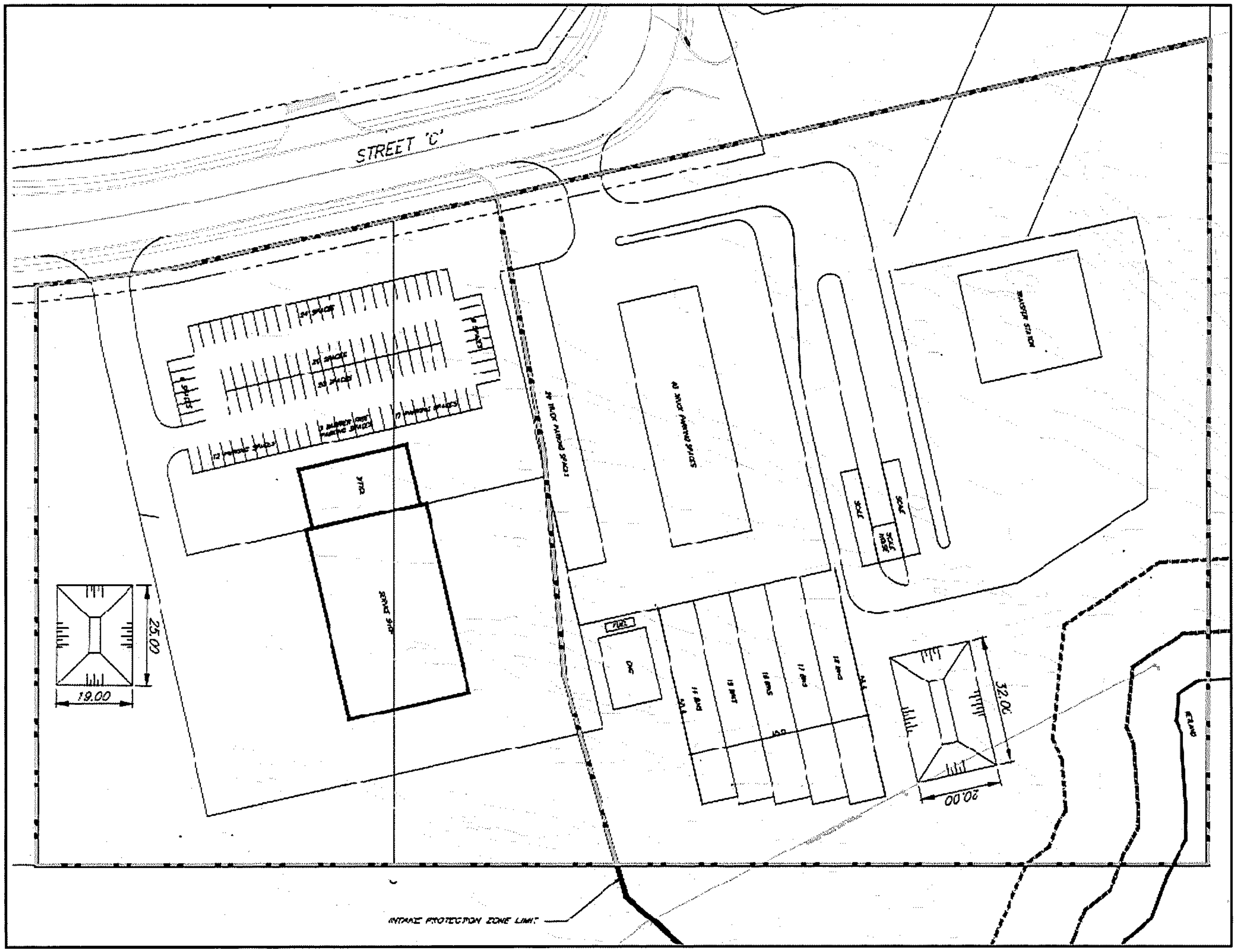

Figure 2: Post-development Catchment Areas

One SWM pond is conceptually located near the south end of the property. Catchment area POST1 will drain to this SWM pond, then eventually outlet at the controlled rate to the storm sewer system on Street 'C'. The proposed pond bottom is 9.0 m long by 3.0 m wide, with a depth of 2.0 m and 4:1 side slopes, so the surface dimensions are 25.0 m long by 19.0 m wide. The maximum volume of this SWM pond is 417 m^3, which exceeds the requirement of 235 m^3.

The second SWM pond is conceptually located near the northeast corner of the property, outside of the wetland limits. Catchment area POST2 will drain to this SWM pond, and the pond will control the outflow to the environment to the allowable rate. The proposed pond bottom is 16.0 m long by 4.0 m wide, with a depth of 2.0 m and 4:1 side slopes, so the surface dimensions are 32.0 m long by 20.0 m wide. The maximum volume of this SWM pond is 619 m^3, which exceeds the requirement of 307 m^3.

3.3 Quality Control

The conceptual SWM ponds can be designed to each provide the water quality objective of long-term average removal of 80% total suspended solids (TSS) in the runoff volume for 'enhanced' protection levels. Table 3.2 from the Ontario Ministry of the Environment (MOE) Stormwater Management Planning and Design Manual (March 2003) was used to estimate the required pond volume for water quality control purposes. Catchment area POST1 has an area of 2.0 ha and an imperviousness of 51%, therefore the required storage volume for 80% TSS removal is 380 m^3. Catchment area POST2 has an area of 3.08 ha and an imperviousness of 53%, therefore the required storage volume for 80% TSS removal is 585 m^3. The proposed conceptual SWM ponds both provide the storage necessary to meet the water quality objective.

4.0 Conclusions and Recommendations

This report conceptually reviews whether the City's requirements for quality and quantity stormwater management can be spatially achieved on the site. Specific details of the arrangement, location and dimensions of the stormwater management facilities will be developed during the detailed design. The following information conceptually complies with the City's requirements:

- A 417 m^3 SWM pond at the south end of the property provides quantity and quality control for the portion of the site within the Ramsey Lake Watershed Intake Protection Zone 3. The proposed SWM pond storage volume is adequate for providing 'enhanced' quality protection level and controlling post-development peak outflow to 80% of the pre-development peak flow rate.

- A 619 m^3 SWM pond at the northeast corner of the property provides quantity and quality control for the portion of the site within the Wahnapitae River Watershed. The proposed SWM pond storage volume is adequate for providing 'enhanced' quality protection level and controlling the post-development peak outflow to the pre-development peak flow rate.

We trust that the above satisfies the City's requirements. If you have any questions or would like to discuss the above, please contact our office at your convenience.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

Candice Green

Candice Green, P.Eng., LEED AP, ENV SP

Principal, Regional Manager

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APPENDIX 1

PRE-DEVELOPMENT CALCULATIONS

The Rational Method calculations were completed using the formula Q=0.00278*C*I*A. Where Q = peak runoff rate (m^3/s), C = composite runoff coefficient, I = rainfall intensity (mm/hr), and A = drainage area (ha).

Project: KED Waste Management Facility
Project No.: 237002
Date: 2024-03-25
Designed: M.P.A
Checked:

PRE-DEVELOPMENT

Catchment	Total Area (ha)	C (2-10 yr)	C + 25% (for 100-yr)
PRE1	2.000	0.45	0.56
PRE2	3.080	0.45	0.56

Chicago 6hr 15min - Peak Intensity		
Design Storm	**5 Year**	**100 Year**
Peak Intensity (mm/hr)	69.5	127.2
Calculated Peak Runoff Rate Based on Rational Method		
PRE1	0.175	0.401
PRE2	0.270	0.617

NOTES:

1) C values for 5-year design storm based upon Ministry of Transportation Drainage Management Manual

2) Overall C values for 100-year storm were determined by adding an additioanl 25% to the 5-year values according to MTO Drainage Management Manual

APPENDIX 2

POST-DEVELOPMENT CALCULATIONS

Project: KED Waste Management Facility
Project No.: 237002
Date: 2024-03-25
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Checked:

POST-DEVELOPMENT

Catchment	Total Area (ha)	Impervious Area	Pervious Area	C Impv.	C Perv.	C (2-10 yr)	C + 25% (for 100-yr)
POST1	2.000	1.01	0.99	0.9	0.2	0.55	0.69
POST2	3.080	1.63	1.45	0.9	0.2	0.57	0.71

Chicago 6hr 15min - Peak Intensity		
Design Storm	**5 Year**	**100 Year**
Peak Intensity (mm/hr)	69.5	127.2
Calculated Peak Runoff Rate Based on Rational Method		
POST1	0.216	0.493
POST2	0.342	0.782

NOTES:

1) **C values for 2-year design storm based upon Ministry of Transportation Drainage Management Manual**

2) **Overall C values based upon a weighted calculation**

3) **Overall C values for 100-year storm were determined by adding an additioanl 25% to the 5-year values according to MTO Drainage Management Manual**

APPENDIX 3

POND STORAGE CALCULATIONS

Modified Rational Method Preliminary Storage Sizing

Project: 237002 - KED WM Site
Date: March 25, 2024

1

Pre Dev. Site Area (ha) =	2
Post Dev. Site Area (ha) =	2.000
Pre Dev. Runoff Coeficeint =	0.56
Post Dev.Runoff Coefficient =	0.69
Max. Allowed Runoff Coefficeint =	0.56

2

CGS IDF

$i = a/(t+b)^c$,

where, i = rainfall intensity (mm/hr), and t = rainfall duration (minutes)

Return Period (Year)	A	B	C	I (mm/hr)
2	429.375	4.25	0.7325	49.20
5	600.938	4	0.7325	69.53
10	726.563	3.938	0.7400	82.42
25	847.03	3.938	0.7400	96.09
50	986.25	3.75	0.7375	113.54
100	1092.988	3.656	0.7350	127.22
T_c=	15		min	

3

Allowed Peak Discharge Rate - 100yr

Rational Method

Q = 0.0028 * C * I * A

where
Q = Peak runoff rate, m³/s
C = Composite runoff coefficient
I = Rainfall intensity, mm/h
A = Drainage area, ha

Q Allowed =	0.399	L/s
Q 100 =	0.492	L/s

4

On Site Detention Storage

100 Yr Storm Event

Post Development Runoff Coefficeint =	0.69
Site Area (ha) =	2
Allowed Realease Rate (cu.m/s) =	0.319
Peak Storage + 30% Allowance (m3) =	235.000

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	
1	352.879	1.364	1.044	62.661	
2	305.859	1.182	0.863	103.520	
3	271.365	1.049	0.729	131.288	
4	244.835	0.946	0.627	150.448	
5	223.711	0.864	0.545	163.573	
6	206.438	0.798	0.479	172.260	
7	192.014	0.742	0.423	177.562	
8	179.763	0.695	0.375	180.207	
9	169.211	0.654	0.335	180.713	***max***
10	160.012	0.618	0.299	179.466	
11	151.913	0.587	0.268	176.758	
12	144.719	0.559	0.240	172.813	
13	138.280	0.534	0.215	167.809	
14	132.480	0.512	0.193	161.890	
15	127.222	0.492	0.172	155.171	
16	122.432	0.473	0.154	147.747	
17	118.047	0.456	0.137	139.699	
18	114.016	0.441	0.121	131.092	
19	110.295	0.426	0.107	121.985	
20	106.849	0.413	0.094	112.424	
21	103.646	0.400	0.081	102.453	
22	100.661	0.389	0.070	92.108	
23	97.871	0.378	0.059	81.420	
24	95.258	0.368	0.049	70.416	
25	92.803	0.359	0.039	59.123	
26	90.493	0.350	0.030	47.560	
27	88.313	0.341	0.022	35.749	
28	86.254	0.333	0.014	23.706	
29	84.305	0.326	0.007	11.446	
30	82.456	0.319	0	-	
31	80.701	0.312	0	-	
32	79.031	0.305	0	-	
33	77.441	0.299	0	-	
34	75.924	0.293	0	-	
35	74.475	0.288	0	-	
36	73.090	0.282	0	-	

Modified Rational Method Preliminary Storage Sizing

Project: 237002 - KED WM Site
Date: March 25, 2024

1

Pre Dev. Site Area (ha) =	3.08
Post Dev. Site Area (ha) =	3.080
Pre Dev. Runoff Coeficeint =	0.56
Post Dev.Runoff Coefficient =	0.71
Max. Allowed Runoff Coefficeint =	0.56

2

CGS IDF

i=a/(t+b)^c,

where, i = rainfall intensity (mm/hr), and t = rainfall duration (minutes)

Return Period (Year)	A	B	C	I (mm/hr)
2	429.375	4.25	0.7325	49.20
5	600.938	4	0.7325	69.53
10	726.563	3.938	0.7400	82.42
25	847.03	3.938	0.7400	96.09
50	986.25	3.75	0.7375	113.54
100	1092.988	3.656	0.7350	127.22

T_c= 15 min

3

Allowed Peak Discharge Rate - 100yr

Rational Method

Q = 0.0028 * C * I * A

where
Q = Peak runoff rate, m³/s
C = Composite runoff coefficient
I = Rainfall intensity, mm/h
A = Drainage area, ha

Q Allowed =	0.614	L/s
Q 100 =	0.779	L/s

4

On Site Detention Storage

100 Yr Storm Event

Post Development Runoff Coefficeint =	0.71
Site Area (ha) =	3.08
Allowed Realease Rate (cu.m/s) =	0.614
Peak Storage + 30% Allowance (m3) =	307.000

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	
1	352.879	2.161	1.546	92.777	
2	305.859	1.873	1.258	151.005	
3	271.365	1.662	1.047	188.490	
4	244.835	1.499	0.885	212.334	
5	223.711	1.370	0.755	226.613	
6	206.438	1.264	0.650	233.861	
7	192.014	1.176	0.561	235.745	***max***
8	179.763	1.101	0.486	233.417	
9	169.211	1.036	0.422	227.702	
10	160.012	0.980	0.365	219.208	
11	151.913	0.930	0.316	208.398	
12	144.719	0.886	0.272	195.628	
13	138.280	0.847	0.232	181.181	
14	132.480	0.811	0.197	165.283	
15	127.222	0.779	0.165	148.117	
16	122.432	0.750	0.135	129.836	
17	118.047	0.723	0.108	110.564	
18	114.016	0.698	0.084	90.407	
19	110.295	0.675	0.061	69.457	
20	106.849	0.654	0.040	47.789	
21	103.646	0.635	0.020	25.471	
22	100.661	0.616	0.002	2.559	
23	97.871	0.599	0	-	
24	95.258	0.583	0	-	
25	92.803	0.568	0	-	
26	90.493	0.554	0	-	
27	88.313	0.541	0	-	
28	86.254	0.528	0	-	
29	84.305	0.516	0	-	
30	82.456	0.505	0	-	
31	80.701	0.494	0	-	
32	79.031	0.484	0	-	
33	77.441	0.474	0	-	
34	75.924	0.465	0	-	
35	74.475	0.456	0	-	
36	73.090	0.448	0	-	
37	71.764	0.439	0	-	