Stormwater Management Brief

1533 McAdoo's Lane. Kingston, ON

Prepared for American Iron & Metal
by IBI Group
December 9, 2022

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1 Introduction

IBI Group was retained by American Iron & Metal (AIM) to prepare a Stormwater Management (SWM) Brief for the proposed site redevelopment of 1533 McAdoo's Lane in Kingston, ON.

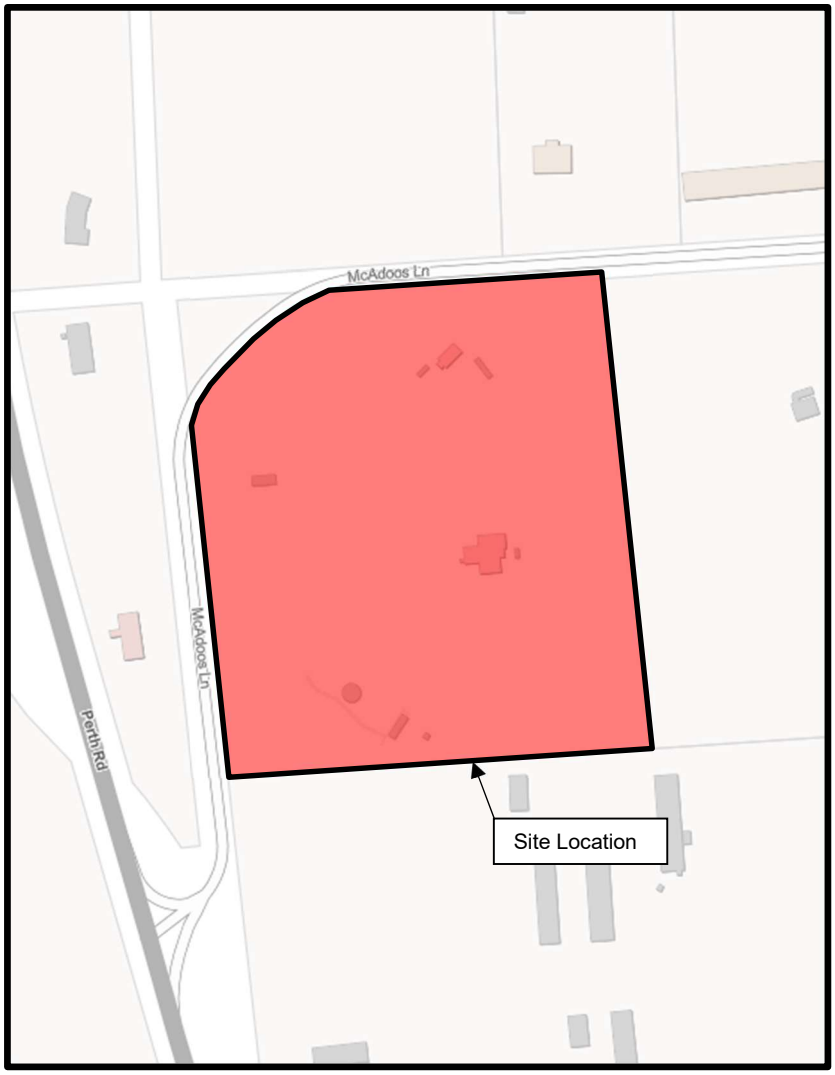

Figure 1 - Site Location (KMaps, 2018)

The purpose of this report is to provide a hydrologic evaluation of the existing site and to compare this to the proposed development condition in order to assure that the proposed development does not adversely impact the neighbouring properties in terms of stormwater runoff. This study reports the effect of the proposed redevelopment on the peak stormwater runoff rates, as well as outlines the methods for attenuating the post-development peak runoff flows to meet the pre-development (existing site) condition.

This stormwater management plan has been prepared in accordance with the Site Plan Control Guidelines of the City of Kingston (Kingston 2009), as well as the SWM Planning & Design Manual of the Ministry of the Environment (MOE 2003).

The redevelopment consists of a proposed metal recycling yard and an auto parts and automobile recycling operation (AIM Recycling/Kenny U-Pull).

The redevelopment is located on a 6.25 hectare parcel of land, which is bounded by McAdoo's Lane to the north and west, industrial lands to the east, and open space/park to the south.

The subject site's legal description is:

PART OF LOTS 11 AND 12
CONCESSION WEST OF THE GREAT CATARAQUI RIVER
CITY OF KINGSTON
COUNTY OF FRONTENAC

2 Analysis

2.1 Methodology

The existing and proposed peak runoff flows for the property were calculated using the Rational Method. In order to delineate drainage areas, the existing topographic survey and proposed grading plan were used.

To evaluate the quantity of stormwater runoff, design storm events (1:2, 1:5, 1:10, 1:25, 1:50, and 1:100-year return period) were analyzed to quantify the stormwater runoff from the site. The minor storm (1:5-year) event is based on the City of Kingston standard intensity duration equation:

$$i_{(\text{Minor Storm})} = \frac{1778}{t_c + 13}, \quad t_{c(\text{minutes})}$$

A minimum inlet time of concentration (tc) of 15 min is used, following the design guidelines of the City of Kingston. Runoff Coefficients are based on the Technical Standards and Specifications of the City of Kingston, Appendix 1G: Design Standards – Storm Sewer Systems.

The remaining storm event intensities are calculated using the Environment and Climate Change Canada IDF interpolation values for Kingston Pumping Station, and based on the following equations:

$$i_{(\text{2-year})} = 19.1 * t^{-0.681}, \quad t_{(\text{hour})}$$

$$i_{(\text{10-year})} = 28.8 * t^{-0.676}, \quad t_{(\text{hour})}$$

$$i_{(\text{25-year})} = 33.6 * t^{-0.674}, \quad t_{(\text{hour})}$$

$$i_{(\text{50-year})} = 37.3 * t^{-0.673}, \quad t_{(\text{hour})}$$

$$i_{(\text{100-year})} = 40.9 * t^{-0.672}, \quad t_{(\text{hour})}$$

The Modified Rational Method is used to calculate the required storage volumes to limit the post-development peak runoff rates to the existing site conditions.

The Cataraqui Region Conservation Authority (CRCA) requires a "normal" level of quality control for this property (i.e., 70% TSS removal).

2.2 Existing Condition

The subject lands are the former site of Kingston Family Fun World, and are currently developed with a drive-in theatre, mini golf course, and go-kart track. The majority of the existing site is relatively flat, and generally slopes gently from north east to south west. Greater embankment slopes exist in areas near the west and south west property boundaries, and similarly drain from north east to south west. The gradient of the road and roadside ditching along McAdoo's Lane generally slopes from east to west, and from north to south. Runoff from the site generally outlets to the existing roadside ditch along the south/east side of McAdoo's Lane. A Pre-Development Exhibit in **Appendix A** provides a detailed depiction of the existing flow patterns on the site.

A small portion of the neighbouring property to the east contributes external flows which drain across the south east portion of the subject site to the neighbouring property to the south.

2.3 Proposed Condition

The subject lands are proposed to be redeveloped into a metal recycling yard and an auto parts and automobile recycling operation (AIM Recycling/Kenny U-Pull). The proposed redevelopment will increase the runoff coefficient of the site with impermeable surfaces accounting for approximately 20% of the lot area. In order to prevent any adverse effects due to the increase in impervious surfaces, the proposed project includes the installation of a stormwater collection network including catchbasins, catchbasin manholes and storm sewer piping. Stormwater quantity control will be achieved using a dry pond stormwater storage area to detain stormwater runoff and limit post-development peak runoff rates to the existing pre-development condition. Stormwater quality control will be achieved using a hydrodynamic separator (Stormceptor Model EFO4) and a Jellyfish Filter (Model JF10-17-4). The hydrodynamic separator will be installed downstream of the proposed Crusher Unit, in order to collect and prevent any hydrocarbon remnants from entering the dry pond facility and/or leaving the site. The Jellyfish filter will be installed downstream of the orifice-controlled outlet and proposed dry pond to provide stormwater quality control prior to discharging to the existing municipal ditch. Refer to **Appendix A** for illustrations of the proposed stormwater management system.

The proposed site grading design encourages the majority of the stormwater runoff from the subject lands to remain on-site. Catchment area 201 (see **Appendix A**), which consists of mainly landscaped areas, shall drain off-site unattenuated into the existing drainage ditch on the East side of McAdoos Lane. The flow from catchment area 201 will account for a negligible portion of the pre-development runoff rate and will maintain quality control due to the surface being landscaped. The Runoff from the remaining catchment areas (202-210) will be collected on-site, and detained to limit the post-development peak runoff rates to the pre-development condition. A 0.5 m wide flat-bottom swale is proposed adjacent to the eastern property boundary in order to intercept external flows from a small portion of the lands to the east. This swale will allow the external flows to be routed around the perimeter of the subject site, and outlet to the south in general accordance with existing drainage patterns.

Inlet structures will be placed along low points in order to collect stormwater runoff. Collected runoff will flow through a Jellyfish Filter before discharging to the existing roadside ditch along McAdoo's Lane. Runoff rates will be restricted to the pre-development peak rates upstream of the Jellyfish Filter unit. Excess stormwater runoff will back up in the collection system, and flow into the proposed dry pond stormwater storage area.

The stormwater collection system has been designed for both the minor storm event (1:5 year return period) and major storm event (1:100 year return period). Site grading has also been designed to promote the major overland flow route towards the proposed stormwater management dry pond located in the south west corner of the site. The pond has been designed to store the major storm event (1:100 year return period). An emergency spillway from the pond to the existing roadside ditch along McAdoo's Lane has been designed to provide an emergency overflow outlet in the event the pond's capacity is exceeded. The emergency overflow is designed to convey the major storm peak runoff rate for all contributing catchment areas (202-210) assuming the orifice-controlled outlet is blocked.

Table 1 provides a comparison of the existing and proposed condition of the site without attenuation measures. These calculations were carried out as noted in Section 2.1 and have been included in **Appendix B**.

Table 1: Pre vs. Post Comparison (Without Attenuation)

Catchment Area	1:2-yr Pre (L/s)	1:5-yr (Minor Storm) Pre (L/s)	1:10-yr Pre (L/s)	1:25-yr Pre (L/s)	1:50-yr Pre (L/s)	1:100-yr (Major Storm) Pre (L/s)
101 (Ex.)	363	469	543	632	700	931
Total (Ex.)	**363**	**469**	**543**	**632**	**700**	**931**
	Post (L/s)	**Post (L/s)**	**Post (L/s)**	**Post (L/s)**	**Post (L/s)**	**Post (L/s)**
201 (Prop.)	22	29	33	39	43	59
202 (Prop.)	40	52	60	70	77	90
203 (Prop.)	22	29	33	39	43	50
204 (Prop.)	5	7	8	9	10	11
205 (Prop.)	1	1	1	2	2	2
206 (Prop.)	93	120	139	162	180	246
207 (Prop.)	321	416	481	560	621	821
208 (Prop.)	10	13	15	17	19	22
209 (Prop.)	49	63	73	85	94	129
210 (Prop.)	16	21	24	28	31	42
Total (Prop.)	**580**	**750**	**868**	**1,010**	**1,119**	**1,471**

The proposed redevelopment results in an increase in peak stormwater runoff for the minor storm event of 276 L/s, and 531 L/s for the major storm event. In order to comply with the City of Kingston's requirement to limit stormwater flows for redevelopments to the pre-development condition, a dry pond stormwater storage facility is proposed in the south west corner of the subject lands as shown on the Grading Plan (C-300 in **Appendix A**).

The stormwater storage facility will consist of a 1.37 m deep dry pond with 5:1 side slopes, and 0.43 m of freeboard. The dry pond has been designed in accordance with the MECP Stormwater Management Planning and Design Manual. Stormwater runoff in excess of the pre-development runoff rates will flow into the pond via a connection to the control structure (MH2) upstream of the Jellyfish Filter unit. MH2 will be equipped with a steel plate orifice-controlled outlet. The orifice has been sized to restrict peak flows to the pre-development condition for the 1:2-year storm event during minor storms and to the pre-development condition for the 1:5-year storm event during major storms which results in an orifice with a diameter of 435 mm at an invert elevation of 117.78 m. Refer to **Appendix B** for orifice sizing calculations. Outflow from the dry pond's emergency overflow install and through headwall 1 will be deposited onto a riprap with filter cloth underlay built into the existing roadside ditch for erosion protection in the ditch.

Analysis was conducted to determine the stage-storage-discharge relationship between the dry pond and orifice-controlled outlet for the various storm events. Based on the analysis, the 100-year water surface level (high water level) in the pond is expected to be 119.59 m and results in a discharge flow rate of 511 L/s through the orifice located in MH2 during major storms. When accounting for the unattenuated flow rate of 59 L/s from Catchment Area 201, the total discharge from the site under the 100-year event is 570 L/s. Based on the Modified Rational Method calculations, as presented in **Appendix B**, the required storage volume to limit the post development peak runoff rate from the major storm event (1,471 L/s) to this peak discharge rate of 570 L/s is approximately 823 m^3. The proposed dry pond stormwater storage facility has been designed to store a volume of 834 m^3 at the high-water level water surface elevation of 119.59 m. Table 2 provides a summary of the proposed condition with attenuation in the dry pond storage facility.

Table 2: Proposed Development with Stormwater Storage

Design Storm (Return Period)	Total Allowable Release Rate (L/s)	Post-Dev. Release Rate (L/s)			Required Storage Volume (m^3)
		Orifice (Area 202-210)	Unattenuated (Area 201)	Total	
1:2-Year	363	341	22	363	258
1:5-Year	469	387	29	416	301
1:10-Year	543	414	34	448	417
1:25-Year	632	441	39	480	508
1:50-Year	700	459	43	502	582
1:100-Year	931	511	59	570	823

As shown in Table 2 above, the proposed project will maintain the post-development peak flows leaving the site under the 1:2-year storm and reduce the peak flows for the remainder of the design storm events. Post-Development Drainage Exhibit (**Appendix A**) depicts the location of the catchment areas in Table 2.

As mentioned above, stormwater quality control will be achieved by the use of a hydrodynamic separator (Stormceptor Model EFO4) downstream of the on-site crusher, and by directing runoff through a Jellyfish Filter (Model JF10-17-4) prior to discharging flows to the existing roadside ditch along McAdoo's Lane.

Sizing of a hydrodynamic separator was conducted and indicates that a Stormceptor Model EFO4 would provide an estimated net annual sediment (TSS) load reduction of 85% for the contributing catchment areas (203, 204, 205 and 208). The particle size distribution (PSD) used to size the hydrodynamic separator is based on the Canadian Environmental Technology Verification (ETV) PSD. See **Appendix B** for the Stormceptor EF Sizing Report.

As indicated by the Cataraqui Region Conservation Authority (CRCA), the target requirement for TSS removal is 70% or greater. Based on the sizing report referenced above, the Stormceptor EFO4 would satisfy the required TSS removal for stormwater quality treatment of the contributing catchment areas. In addition, the EFO4 provides a 265 L oil volume capacity in the event a spill was to occur at the crusher.

Sizing of a Jellyfish Filter was conducted and illustrates that a Jellyfish Model JF10-17-4 would by sufficient for this site. According to the sizing report (see **Appendix B**), The Jellyfish Filter Model JF10-17-4 is recommended to meet the water quality objective by treating a flow of 78.9 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 44 years of Kingston

Pumping Station rainfall data. The model will also provide a TSS Removal rate of 89% for the corresponding flow, bringing the total TSS removal rate for the site, including attenuated an unattenuated areas, to 84%. The model also has a sediment capacity of 1081 kg, which meets or exceeds the estimated average annual sediment. The Jellyfish Filter has the ISO 14034 ETV Verification.

3 SEDIMENT AND EROSION CONTROL PLAN

3.1 General

The following erosion and sediment controls are proposed for implementation during construction to minimize erosion potential and soil migration from the site to adjacent lands/receiving waters:

- Install silt fence in accordance with OPSD 219.130 at the downslope side of disturbed areas along the perimeter of the development site, prior to the start of construction.
- Install stone mud mats at all construction entrances.
- Stockpile topsoil at designated locations and stockpiles shall be contained by silt fences on the downslope side.
- Temporary swales with check dams are to be constructed prior to the beginning of site grading.
- The accumulated silt shall be removed from all sediment control devices as required during construction and disposed in the locations approved by the City and the Conservation Authority.
- All exposed soils are to be stabilized and vegetated as soon as possible using seed and mulch application on 100 mm of topsoil, as directed by the engineer.
- Additional erosion/sediment controls may be required on site as determined by the engineer.
- No construction activity/machinery shall intrude beyond the silt fence or property limit. All construction vehicles shall enter and leave the site via the designated entrances.
- All regraded areas that are not occupied by building facility, roads, sidewalks, driveways, parks, and other services shall be covered by 100 mm topsoil and sodded/seeded immediately after completion of final grading operations, as directed by the engineer.
- All temporary erosion and sediment controls must be installed prior to the commencement of site grading, must be inspected on a regular basis and after every rainfall event, and must be cleaned and maintained as required to prevent the migration of sediment from the site.
- All temporary erosion and sediment controls must be removed after construction once the development site has been stabilized to the City's satisfaction.
- All areas disturbed by erosion or sediment control devices are to be restored with 100 mm topsoil and sodded/seeded after construction.
- The contractor shall keep public roadways free of debris during construction. Any material tracked from the site shall be promptly removed from roadways at the contractor's expenses.

- All material and workmanship shall conform to the current OPSD and standards endorsed by the City, the Conservation Authority and other regulatory agencies.
- The contractor is responsible to locate and protect all existing utilities and municipal services and make arrangements with utility companies prior to construction.
- All excavations shall be in accordance with the Ontario "Occupational Health and Safety Act", and other federal and provincial regulations related to construction projects

4 Site Maintenance

Regular maintenance is essential to ensure the performance of the proposed stormwater management features of this project are met. The following inspections and/or maintenance intervals shall be accepted as a minimum, unless the manufacturer recommends shorter intervals, in which case the more stringent requirement shall apply. The manufacturer's guidelines and procedures shall be followed for all maintenance activities.

Landscaped areas and hardscape should be kept clean of all debris and maintained in working condition in order to assure that the intended performance is achieved. Gravel areas should be maintained to ensure drainage as per the Grading Plan and prevent ponding and potholes from forming. Special inspections should be carried out after severe rainfall events (greater than 25mm). Any damaged or poorly performing area should be repaired immediately.

The water level of the dry pond should be monitored to ensure proper function, and a maximum dry time of 48 hours. When visual inspection of the pond indicates sediment build up, the sediment should be removed.

The Stormceptor EFO4 should be cleaned out when the sediment depth reaches 200 mm. The unit should also be maintained immediately after any oil, fuel, or other chemical spill. This should be completed by hydro vaccing the unit and disposed inline with current regulations and best practices. Operations and maintenance shall comply with manufacturers requirements.

The Jellyfish Filter JF10-17-4 should be inspected monthly, and after all storms beyond the 1:5-year event until enough historical performance data has been logged to comfortably initiate an alternative inspection interval. Sediment is to be removed when it reaches 305 mm or every three years. Operations and maintenance shall comply with manufacturers requirements.

During construction, the developer will be responsible for the inspection and maintenance of the proposed stormwater management features of this project. Silt fencing shale be installed at all downstream slopes during the construction period, until vegetation has taken hold. After construction, maintenance of drainage features within the private property are the responsibility of the landowner. Stormwater management systems and components shall be inspected twice a year, before and after the winter season.

5 Conclusion

With the proposed redevelopment of the site, the permeability within the subject property generally decreased due to the proposed building footprint and paved driveway/parking areas. To maintain or improve drainage conditions within the site, grading is proposed to direct surface runoff towards a proposed stormwater collection system, with excess flows directed to a dry pond storage facility. Quality control will be achieved by directing runoff through a hydrodynamic separator and Jellyfish Filter. Overall, the proposed site drainage will still be conveyed to follow the existing drainage patterns towards McAdoo's Lane at or below the pre-development flow rates.

In our opinion, the redevelopment of this site demonstrates that the proposed Stormwater Management does not inflict an increase of runoff with respect to the existing development condition.

The drainage design for the proposed property follows the drainage design guidelines of the City of Kingston Subdivision Development Guidelines & Technical Standards.

Report prepared by:	Report reviewed by:
Jasmine Leikucs, Engineering Intern	William Thomas, M.Eng., P.Eng. Associate – Manager Civil Engineering

6 References

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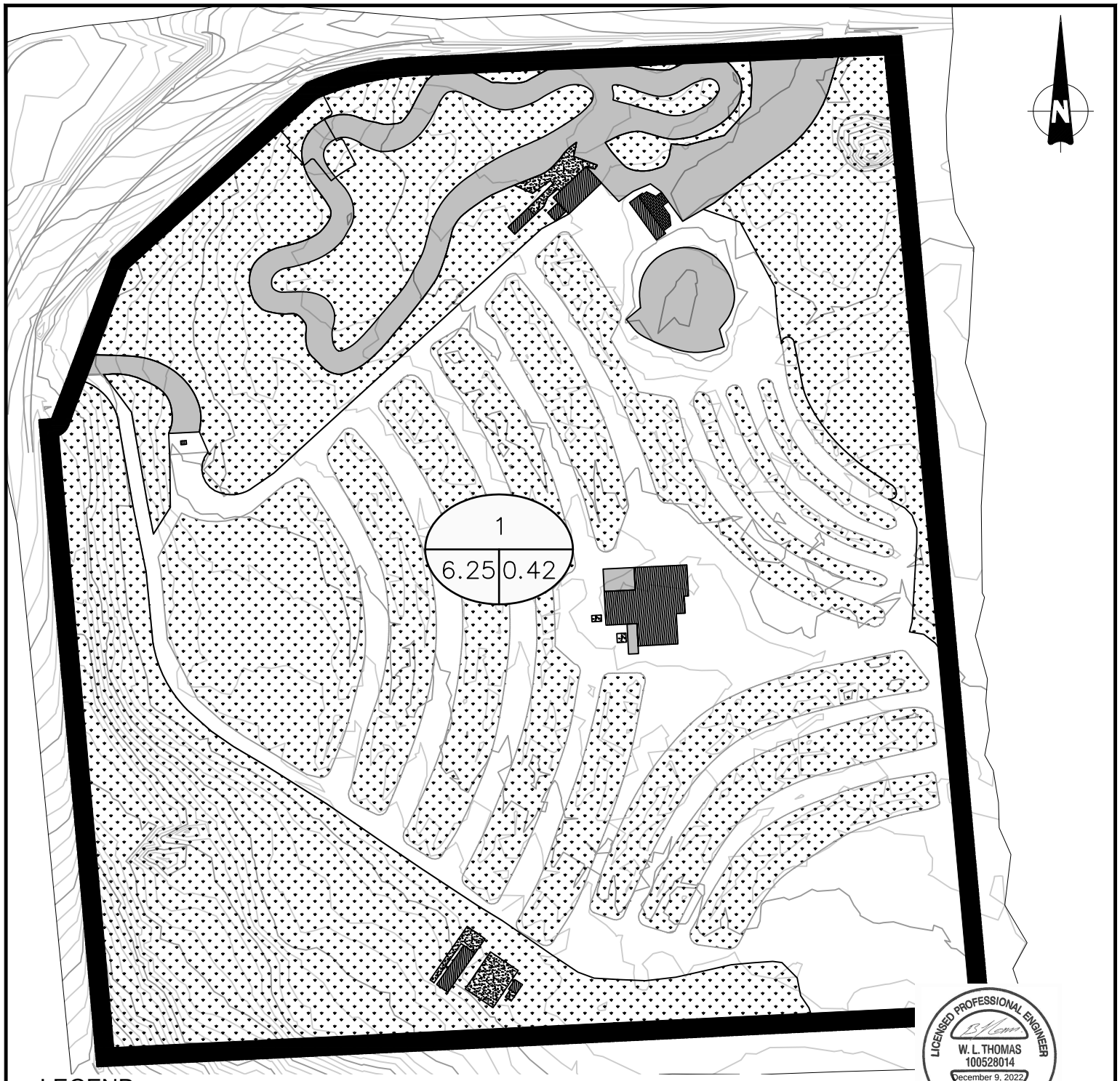
Appendix A

1. Existing Drainage Exhibit
2. Post-Development Drainage Exhibit
3. C-200 Stormwater Servicing Plan
4. C-300 Grading Plan
5. C-301 McAdoo's Lane Elevation Plan



LICENSED PROFESSIONAL ENGINEER
W. L. THOMAS
100528014
December 9, 2022
PROVINCE OF ONTARIO

LEGEND

- EX. LANDSCAPED AREA
- EX. GRAVEL AREA
- EX. ASPHALT
- EX. CONCRETE
- EX. BUILDING
- EX. FRAME DECK
- EX. CATCHMENT AREA

1:1500

50 m 0 50 m

DRAINAGE AREA LABEL

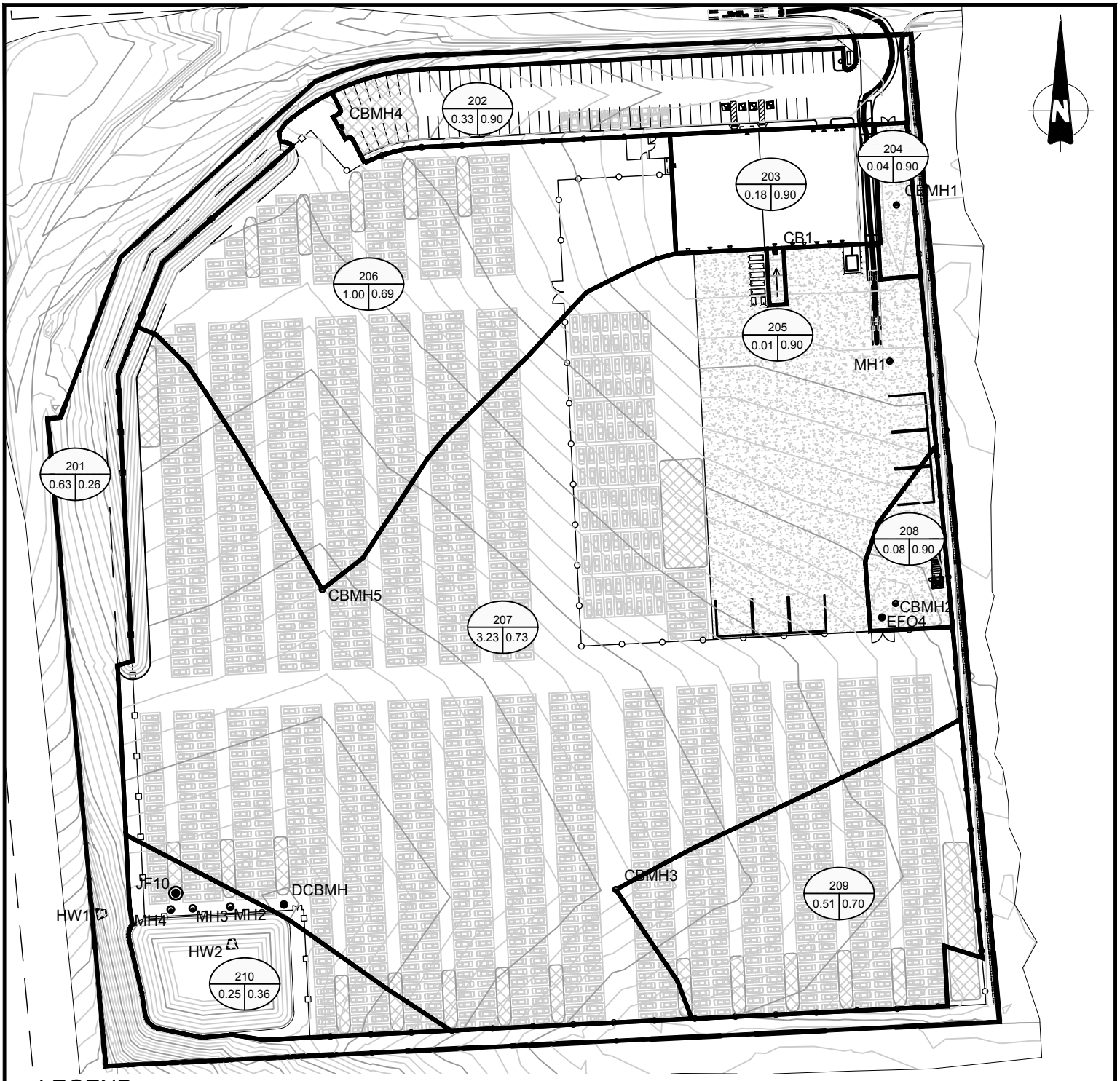
1
0.75 | 0.90

AREA (ha.) — RUNOFF COEFFICIENT

CLIENT AMERICAN IRON & METAL 9100, BOUL. HENRI-BOURASSA EST MONTREAL, QC H1E 2S4	PROJECT NAME KENNY U-PULL 1533 MCADOO'S LANE KINGSTON, ON	IBI GROUP Unit 110 - 650 Dalton Avenue Kingston ON K7M 8N7 Canada tel 613 531 4440 fax 613 531 7789 ibigroup.com	
	SCALE: 1:1500 / DATE: 2022-12-09	FIGURE NAME EXISTING DRAINAGE EXHIBIT	FIGURE NO. SWM1 / REVISION 1
	PROJECT ENG: B.T. / DRAWN BY: C.A.		
	CHECKED BY: B.T. / APPROVED BY: B.T.		
	PROJECT NO: 124600		

File Location: \\caneast.ibigroup.com\UTO\124600_1533McAdooLN7.0_Production\7.03_Design\04_Civil\Sheets\124600_SWM_2022-07-06.dwg Last Saved: October 6, 2022, by jasmine.leikucs Plotted: Wednesday, December 7, 2022 2:00:59 PM by Jasmine Leikucs

SCALE CHECK 10mm 1 in



LEGEND

PR. CATCHMENT AREA

DRAINAGE AREA LABEL

1
0.75 | 0.90

AREA (ha.)

RUNOFF COEFFICIENT

1:1500

50 m 0 50 m

LICENSED PROFESSIONAL ENGINEER
W. L. THOMAS
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CLIENT AMERICAN IRON & METAL 9100, BOUL. HENRI-BOURASSA EST MONTREAL, QC H1E 2S4	PROJECT NAME KENNY U-PULL 1533 MCADOO'S LANE KINGSTON, ON		**IBI GROUP** Unit 110 - 650 Dalton Avenue Kingston ON K7M 8N7 Canada tel 613 531 4440 fax 613 531 7789 **ibigroup.com**
	SCALE: 1:1500	DATE: 2022-12-09	FIGURE NAME: POST-DEVELOPMENT DRAINAGE EXHIBIT
	PROJECT ENG: B.T.	DRAWN BY: C.A.	FIGURE NO.: SWM2
	CHECKED BY: B.T.	APPROVED BY: B.T.	REVISION: 3
	PROJECT NO: 124600		

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1.0 GENERAL

1.1 TOPOGRAPHIC SURVEY INFORMATION WAS OBTAINED FROM LESLIE M. HIGGINSON SURVEYING LTD. (FILE: K'N WGCR-11.12 | 2020-0139 HGNDC POS).

1.2 THE SITE IS LOCATED AT 1533 McADOO'S LANE, CITY OF KINGSTON, COUNTY OF FRONTENAC.

1.3 OWNER TO ENSURE EROSION AND SEDIMENT CONTROL MEASURES ARE INSTALLED PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, ACCORDING TO THEIR MANUFACTURER'S GUIDELINES AND RELEVANT OPSD DETAILS, SHALL BE CHECKED ON A DAILY BASIS, AND SHALL BE REMOVED, ALONG WITH ACCUMULATED SEDIMENT, IMMEDIATELY FOLLOWING THE EFFECTIVE STABILIZATION OF THE SITE.

1.4 CONTRACTOR SHALL OBTAIN LOCATES FOR ALL EXISTING U/G SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION. CONTRACTOR TO CONFIRM ALL TIE IN LOCATIONS, ELEVATIONS AND EXISTING PIPE SIZES PRIOR TO CONSTRUCTION. ANY DISCREPANCIES FROM THESE DRAWINGS SHALL BE REPORTED TO THE ENGINEER PRIOR TO CONSTRUCTION.

1.5 ALL CONCRETE CURBS AND SIDEWALKS TO CONFORM TO O.P.S. AND CONSTRUCTED TO DETAILS PROVIDED. ALL CONCRETE SHALL BE "NORMAL PORTLAND CEMENT" IN ACCORDANCE WITH O.P.S.S. 1350 AND SHALL ACHIEVE A MINIMUM STRENGTH OF 30MPa AT 28 DAYS.

1.6 ALL DISTURBED AREAS BEYOND PROPERTY LIMITS TO BE REINSTATED TO MATCH EXISTING CONDITIONS AS DIRECTED BY ENGINEER. ALL BOUNDARIES TO BE BLENDED TO EXISTING CONDITIONS.

2.0 STORM

2.1 ALL MATERIALS AND WORKMANSHIP TO BE IN ACCORDANCE WITH THE ONTARIO BUILDING CODE.

2.2 ALL STORM SEWERS TO BE CSA CERTIFIED PVC DR 35, BELL AND SPIGOT TYPE, WITH ELASTOMERIC GASKET AS PER OPSS 1841 AND CSA B182.2 M1990. ONLY FACTORY FITTINGS TO BE USED.

2.3 MINIMUM DEPTH OF COVER FOR STORM SEWER MAINS AND LATERALS IS 1.0m.

2.4 CONTRACTOR TO VERIFY TIE-IN LOCATION AND ELEVATION PRIOR TO CONSTRUCTION.

2.5 CB1 - OPSD 705.010 C/W OPSD 400.010.
CBMH1 - OPSD 701.010 C/W OPSD 400.010.
CBMH2 - OPSD 701.010 C/W OPSD 400.010.
CBMH3 - OPSD 701.010 C/W OPSD 400.010.
CBMH4 - OPSD 701.010 C/W OPSD 400.010.
CBMH5 - OPSD 701.010 C/W OPSD 400.010.
DCBMH - OPSD 701.011 C/W OPSD 703.021, 2x OPSD 400.010.
MH1 - OPSD 701.010 C/W OPSD 401.010 TYPE B.
MH2 - OPSD 701.011 C/W OPSD 401.010 TYPE B.
MH3 - OPSD 701.011 C/W OPSD 401.010 TYPE B.
MH4 - OPSD 701.011 C/W OPSD 401.010 TYPE B.
EFO4 - STORMCEPTOR MODEL EFO4.
JF10 - JELLYFISH FILTER MODEL JF10-17-4.
HW1 - OPSD 804.040.
HW2 - OPSD 804.040.

2.6 STEEL PLATE ORIFICE CONTROL TO BE INSTALLED AT WEST OUTLET FROM MH2. SEE DETAIL.

2.7 INSTALL SEDIMENT BASKET IN ALL CATCHBASINS AND CATCHBASIN MANHOLES.

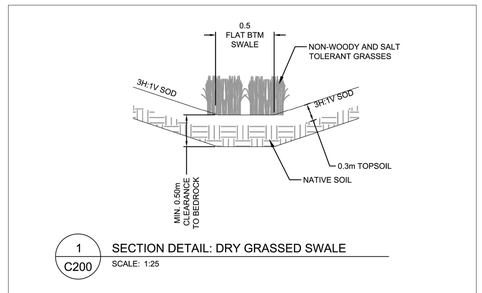
2.8 INSTALL 5 m x 5 m 100 mm THICK ASPHALT AREA AROUND DCBMH, CBMH3 AND CBMH5.

2.9 STORMWATER STOARGE TO BE PROVIDED BY DRY POND LOCATED IN THE SOUTHWEST CORNER OF THE SITE. POND TO PROVIDE A MINIMUM STORAGE VOLUME OF 802 m³. POND TO HAVE 5:1 (MAX) SIDE SLOPES.

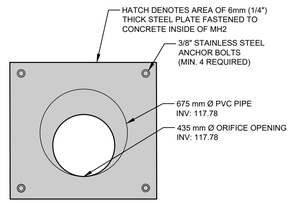
CONSTRUCTION NOTES - ENVIRONMENTAL

WHILE UNDERTAKING CLEARING, DEMOLITION, EXCAVATION OR CONSTRUCTION THE OWNER AND THEIR CONTRACTORS SHALL BE VIGILANT FOR THE POTENTIAL PRESENCE OF UNDERGROUND FUEL TANKS, CONTAMINATED SOIL OR GROUNDWATER, BURIED WASTES, DESIGNATED SUBSTANCES OR ABANDONED WATER WELLS. IF ANY OF THE ABOVE ARE ENCOUNTERED OR SUSPECTED, THE OWNER SHALL ENSURE THAT:

1. THE CITY OF KINGSTON'S ENVIRONMENT DIVISION IS ADVISED THAT CONTAMINANTS OR WASTES HAVE BEEN DISCOVERED OR ARE SUSPECTED.
2. ANY SOIL OR GROUNDWATER CONTAMINATION ENCOUNTERED IS REMEDIATED TO APPLICABLE STANDARDS AS DEFINED WITHIN O.REG. 153/04 OR AS REVISED.
3. ANY WASTES GENERATED BY SITE CLEAN-UPS ARE MANAGED IN ACCORDANCE WITH APPLICABLE LAWS AND STANDARDS;
4. ANY ABANDONED FUEL TANKS ENCOUNTERED ARE DECOMMISSIONED IN ACCORDANCE WITH APPLICABLE LAWS AND STANDARDS;
5. ANY UNUSED WATER WELLS (DRILLED OR DUG) ARE PROPERLY ABANDONED IN ACCORDANCE WITH ONTARIO REGULATION 903 - WELLS OR AS REVISED ;
6. IF IT APPEARS LIKELY THAT CONTAMINATION, INCLUDING THE PRESENCE OF DESIGNATED SUBSTANCES. EXTENDS BEYOND THE BOUNDARIES OF THE SUBJECT PROPERTY, THE OWNER NOTIFIES THE LOCAL OFFICE OF THE MINISTRY OF THE ENVIRONMENT AND THE CITY OF KINGSTON'S ENVIRONMENT DIVISION;
7. CONSTRUCTION WASTES ARE NOT TO BE BURIED WITHIN THE PROPERTY THAT IS THE SUBJECT OF THIS AGREEMENT, AND
8. THAT THE OWNER AND THEIR CONTRACTORS REPORT ALL SPILLS TO THE MINISTRY OF THE ENVIRONMENT'S SPILLS ACTION CENTER (1-800-268-6060) AND TO THE MUNICIPALITY (546-4291 EXT. 1368) FORTHWITH.



1 / C200 SECTION DETAIL: DRY GRASSED SWALE
SCALE: 1:25



2 / C200 STEEL PLATE ORIFICE DETAIL
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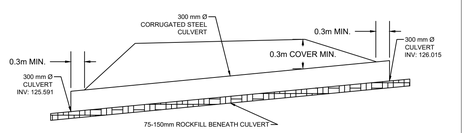
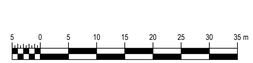
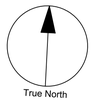


3 / C200 CULVERT DETAIL
SCALE: N.T.S.

1:500





CLIENT

AMERICAN IRON & METAL

9100, BOUL. HENRI-BOURASSA EST
MONTREAL, QC H1E 2S4

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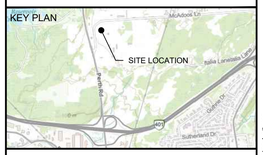
ISSUES

No.	DESCRIPTION	DATE
1	ISSUED FOR ZBA	2020-07-16
2	REISSUED FOR ZBA	2021-02-22
3	REISSUED FOR ZBA	2021-05-28
4	ISSUED FOR SPC	2022-03-22
5	REISSUED FOR SPC	2022-10-11
6	REISSUED FOR SPC	2022-12-09

FOR REVIEW

KEY PLAN



LEGEND:

- PROPERTY BOUNDARY
- PROPOSED STORM (<675mm)
- PROPOSED STORM (≥675mm)
- PROPOSED CATCH BASIN
- PROPOSED CATCH BASIN MANHOLE
- PROPOSED DOUBLE CATCH BASIN MANHOLE
- PROPOSED MANHOLE
- PROPOSED STORMCEPTOR
- PROPOSED HEADWALL

LICENSED PROFESSIONAL ENGINEER
W. L. THOMAS
100528014
December 9, 2022
PROVINCE OF ONTARIO

PRIME CONSULTANT

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PROJECT

KENNY U-PULL
KINGSTON

1533 MCADOO'S LANE

PROJECT NO: 124600	SCALE: AS SHOWN
DRAWN BY: N.A.	CHECKED BY: B.T.
PROJECT MGR: B.T.	APPROVED BY: B.T.

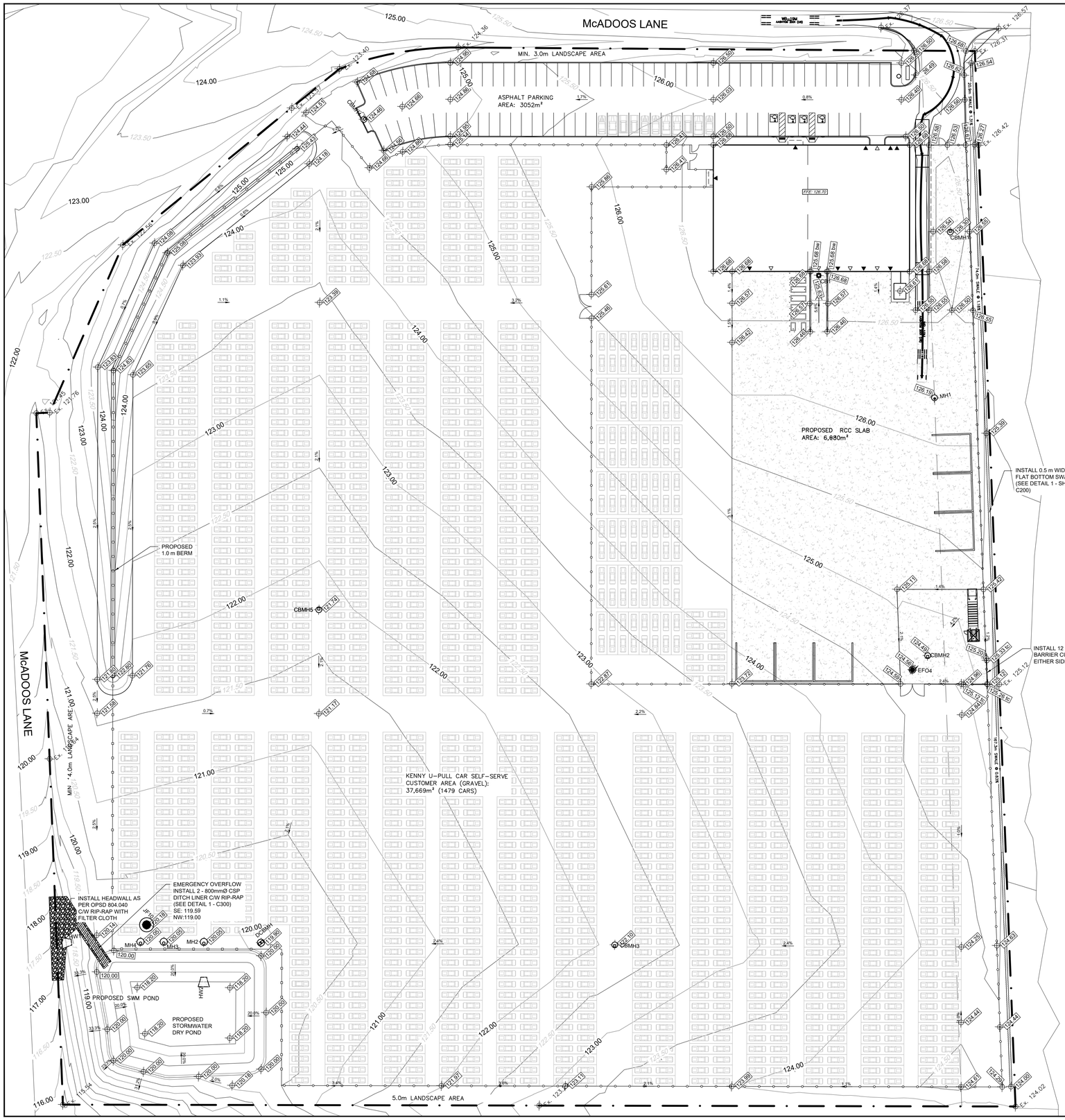
SHEET TITLE

STORMWATER SERVICING PLAN

SHEET NUMBER	ISSUE
C200	6

SCALE CHECK 1 in 10mm

File Location: \\canmast.ibigroup.com\JTO\124600_1533McAdooLN\7.0_Production\7.03_Design\04_Civil\Sheets\124600_SSP_2022-08-30.dwg Last Saved: December 7, 2022, by jasmine.leikucs Plotted: Friday, December 9, 2022 11:30:03 AM by jasmine.Leikucs



GENERAL NOTES FOR LOT GRADING

1. ALL LOTS AND BLOCKS FOR PRIVATE USE ON THE LANDS CORRESPONDING TO THIS DESIGN ARE TO BE DEVELOPED IN ACCORDANCE WITH THE PLAN DETAILS AND THESE NOTES.
2. THE DEVELOPER SHALL NOT BE CONSIDERED RESPONSIBLE TO THE CONTRACTOR IN ANY RESPECT FOR THE AMOUNT OF GRADING OR EARTHWORK REQUIRED TO BE PERFORMED BY THE CONTRACTOR DUE TO THE INFORMATION PROVIDED ON THESE DRAWINGS EXCEPT WHERE REQUIRED TO PROMOTE INTERIM DRAINAGE.
3. ALL GROUND SURFACES SHALL BE EVENLY GRADED WITHOUT PONDING AREAS AND WITHOUT LOW POINTS EXCEPT WHERE APPROVED SWALES ARE PROVIDED.
4. THE CONTRACTOR SHALL ENSURE POSITIVE DRAINAGE ALONG SIDE LOT LINES AS REQUIRED TO MAINTAIN THE INTENT OF THE GRADING PLAN. THE CONTRACTOR SHALL COMPLETE THE DRAINAGE SWALES IN THE LOCATIONS AND TO THE GRADES AND ELEVATIONS, DEPTHS AND SECTIONS SPECIFIED ON THE PLAN. PRIOR TO FINAL LANDSCAPING BY THE CONTRACTOR. THE CONTRACTOR SHALL ENSURE THAT THE REQUIRED SWALES ARE CONSTRUCTED IN ACCORDANCE WITH THE GRADING PLAN.
5. ANY EMBANKMENT REQUIRED FOR INTERNAL GRADING IS TO BE COMMENCED ALONG THE INSIDE EDGE OF THE PROPERTY.
6. THE GRADING OF ALL LOTS AND BLOCKS IS TO BE PERFORMED TO PROVIDE FINISHED PERIMETER SURFACES WHICH ARE FLUSH WITH GIVEN STREET LINE, REAR AND SIDE LINE ELEVATIONS.
7. FINAL PERIMETER GRADES FOR A LOT OR BLOCK WHERE NOT OTHERWISE SHOWN HEREON SHALL BE COINCIDENT WITH THE ADJOINING PERIMETER GRADES OF AN ADJACENT LOT OR BLOCK WHICH SHALL HAVE BEEN PREVIOUSLY ESTABLISHED BY, OR CONSTRUCTED IN ACCORDANCE WITH A MUNICIPAL SITE PLAN APPROVAL OR DEVELOPER GRADING APPROVAL.
8. MAXIMUM LOT OR BLOCK GRASS SURFACE GRADE AT ANY LOCATION SHALL BE 8.0% WITH EMBANKMENTS (3:1 MAX.) OR RETAINING STRUCTURES PROVIDED AS REQUIRED TO TAKE UP GRADE DIFFERENTIALS IN EXCESS OF SUCH SLOPES.
9. EMBANKMENTS FORMED DURING THE GRADING OF LOTS AND BLOCKS SHALL HAVE THE FOLLOWING MAXIMUM GRADES:
   (A) ADJACENT TO DRIVEWAYS OR SWALE SIDE SLOPES - 4:1 MAXIMUM
   (B) ELSEWHERE - 3:1 MAXIMUM
10. MAXIMUM DRIVEWAY GRADES TO BE 10.0%. MAXIMUM PARKING AREA PAVEMENT GRADES TO BE 5%.
11. UNLESS OTHERWISE INDICATED, THE LOT LINE AND CORNER ELEVATIONS SHOWN HEREON ARE GENERALLY THE MINIMUM ELEVATIONS FOR THE SPECIFIED DRAINAGE PATTERN. ANY ALTERATIONS REQUIRE THE WRITTEN APPROVAL OF THE DESIGN ENGINEER AND THE CITY OF KINGSTON.
12. GRADING AND SODDING OF ADJACENT ROADWAY BOULEVARDS WILL BE PERFORMED BY THE CONTRACTOR IN ACCORDANCE WITH MUNICIPAL SPECIFICATIONS.

TEMPORARY EROSION AND SEDIMENT CONTROLS

1. INSTALL SILT FENCE AT THE DOWNSLOPE SIDE OF DISTURBED AREAS AND SNOW FENCE ALONG PERIMETER OF THE DEVELOPMENT SITE, PRIOR TO THE START OF CONSTRUCTION.
2. STOCKPILE TOPSOIL AT DESIGNATED LOCATIONS OF THE SITE. STOCKPILES SHALL BE CONTAINED BY SILT FENCES ON THE DOWNSLOPE SIDES.
3. TEMPORARY SWALES WITH CHECK DAMS ARE TO BE CONSTRUCTED PRIOR TO THE BEGINNING OF SITE GRADING, AS REQUIRED.
4. THE ACCUMULATED SILT SHALL BE REMOVED FROM ALL SEDIMENT CONTROL DEVICES AS REQUIRED DURING CONSTRUCTION AND DISPOSED IN THE LOCATIONS APPROVED BY THE MUNICIPALITY.
5. ALL EXPOSED SOILS ARE TO BE STABILIZED AND VEGETATED AS SOON AS POSSIBLE USING SEED AND MULCH APPLICATION ON 100mm OF TOPSOIL, AS DIRECTED BY THE ENGINEER.
6. ADDITIONAL EROSION/SEDIMENT CONTROLS MAY BE REQUIRED ON SITE AS DETERMINED BY THE ENGINEER.
7. NO CONSTRUCTION ACTIVITY/MACHINERY SHALL INTRUDE BEYOND THE SILT/SNOW FENCE OR PROPERTY LIMIT. EXCEPT, WHERE NECESSARY TO COMPLETE WORKS ALONG McADOO'S LANE. ALL INTRUSIONS ARE TO BE KEEP TO A MINIMUM AND MUST BE APPROVED WITH THE ENGINEER PRIOR TO INTRUSION BEYOND SILT FENCE/PROPERTY LIMITS. ALL CONSTRUCTION VEHICLES SHALL ENTER AND LEAVE THE SITE VIA DESIGNATED ENTRANCES.
8. ALL REGRADED AREAS THAT ARE NOT OCCUPIED BY DWELLINGS, ROADS, SIDEWALKS, DRIVEWAYS, PARKS AND OTHER SERVICES SHALL BE COVERED BY 100mm TOPSOIL, AND SODDED/SEEDED IMMEDIATELY AFTER COMPLETION OF FINAL GRADING OPERATIONS, AS DIRECTED BY THE ENGINEER.
9. ALL TEMPORARY EROSION AND SEDIMENT CONTROLS MUST BE INSTALLED PRIOR TO THE COMMENCEMENT OF SITE GRADING, MUST BE INSPECTED ON A REGULAR BASIS AND AFTER EVERY RAINFALL EVENT, AND MUST BE CLEANED AND MAINTAINED AS REQUIRED TO PREVENT THE MIGRATION OF SEDIMENT FROM THE SITE.
10. ALL TEMPORARY EROSION AND SEDIMENT CONTROLS MUST BE REMOVED AFTER CONSTRUCTION ONCE THE DEVELOPMENT SITE HAS BEEN STABILIZED TO THE MUNICIPALITY'S SATISFACTION. ALL AREAS DISTURBED BY EROSION OR SEDIMENT CONTROL DEVICES ARE TO BE RESTORED WITH 100mm TOPSOIL AND SODDED/SEEDED AFTER CONSTRUCTION.
11. THE CONTRACTOR SHALL KEEP PUBLIC ROADWAYS FREE OF DEBRIS DURING CONSTRUCTION. ANY MATERIAL TRACKED FROM THE SITE SHALL BE PROMPTLY REMOVED FROM ROADWAYS AT THE CONTRACTOR'S EXPENSES.

CONSTRUCTION NOTES - ENVIRONMENTAL

WHILE UNDERTAKING CLEARING, DEMOLITION, EXCAVATION OR CONSTRUCTION THE OWNER AND THEIR CONTRACTORS SHALL BE VIGILANT FOR THE POTENTIAL PRESENCE OF UNDERGROUND FUEL TANKS, CONTAMINATED SOIL OR GROUNDWATER, BURIED WASTES, DESIGNATED SUBSTANCES OR ABANDONED WATER WELLS. IF ANY OF THE ABOVE ARE ENCOUNTERED OR SUSPECTED, THE OWNER SHALL ENSURE THAT:

1. THE CITY OF KINGSTON'S ENVIRONMENT DIVISION IS ADVISED THAT CONTAMINANTS OR WASTES HAVE BEEN DISCOVERED OR ARE SUSPECTED.
2. ANY SOIL OR GROUNDWATER CONTAMINATION ENCOUNTERED IS REMEDIATED TO APPLICABLE STANDARDS AS DEFINED WITHIN O.REG. 153/04 OR AS REVISED.
3. ANY WASTES GENERATED BY SITE CLEAN-UPS ARE MANAGED IN ACCORDANCE WITH APPLICABLE LAWS AND STANDARDS;
4. ANY ABANDONED FUEL TANKS ENCOUNTERED ARE DECOMMISSIONED IN ACCORDANCE WITH APPLICABLE LAWS AND STANDARDS;
5. ANY UNUSED WATER WELLS (DRILLED OR DUG) ARE PROPERLY ABANDONED IN ACCORDANCE WITH ONTARIO REGULATION 903 - WELLS OR AS REVISED ;
6. IF IT APPEARS LIKELY THAT CONTAMINATION, INCLUDING THE PRESENCE OF DESIGNATED SUBSTANCES, EXTENDS BEYOND THE BOUNDARIES OF THE SUBJECT PROPERTY, THE OWNER NOTIFIES THE LOCAL OFFICE OF THE MINISTRY OF THE ENVIRONMENT AND THE CITY OF KINGSTON'S ENVIRONMENT DIVISION;
7. CONSTRUCTION WASTES ARE NOT TO BE BURIED WITHIN THE PROPERTY THAT IS THE SUBJECT OF THIS AGREEMENT, AND
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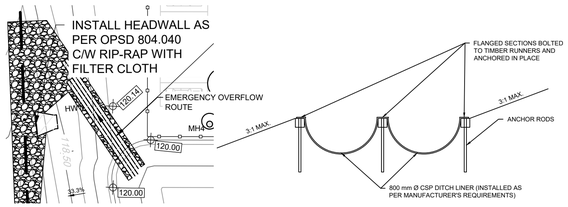
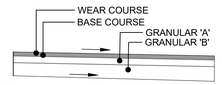


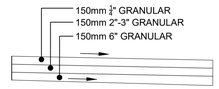
1 / C300 EMERGENCY OVERFLOW DETAIL
SCALE: NTS



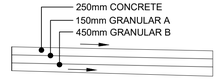
NOTES :

LIGHT DUTY PARKING	SITE ENTRANCE ON MUNICIPAL PROPERTY
40mm HL3 WEAR COURSE	50mm HL3 WEAR COURSE
50mm HL8 BASE COURSE	50mm HL4 BASE COURSE
150mm GRAN 'A'	150mm GRAN 'A'
300mm GRAN 'B'	300mm GRAN 'B'

2 / C300 PAVEMENT CROSS SECTION
SCALE: NTS



3 / C300 GRAVEL CROSS SECTION
SCALE: NTS



4 / C300 ROLLED COMPACTED CONCRETE CROSS SECTION
SCALE: NTS

1:500

5 0 5 10 15 20 25 30 35 m

True North

CLIENT

AMERICAN IRON & METAL

9100, BOUL. HENRI-BOURASSA EST
MONTREAL, QC H1E 2S4

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1	ISSUED FOR ZBA	2020-07-16
2	REISSUED FOR ZBA	2021-02-22
3	ADDED BERM	2021-08-25
4	ISSUED FOR SPC	2022-03-22
5	REISSUED FOR SPC	2022-10-11
6	REISSUED FOR SPC	2022-12-09

FOR REVIEW

KEY PLAN

LEGEND:

- PROPERTY BOUNDARY
- 123.45 PROPOSED CONTOUR ELEVATION
- XX.XX SPOT ELEVATION
- Ex. XX.XX EXISTING ELEVATION TO REMAIN
- XX.XX bw BOTTOM OF WALL ELEVATION
- FFE: XXX.XX FINISHED FLOOR ELEVATION
- X.X% PROPOSED SLOPE

LICENSED PROFESSIONAL ENGINEER
W. L. THOMAS
100528014
December 9, 2022
PROVINCE OF ONTARIO

PRIME CONSULTANT

IBI GROUP
Unit 110 - 650 Dalton Avenue
Kingston ON K7M 8N7 Canada
tel 613 531 4440 fax 613 531 7789
ibigroup.com

PROJECT

KENNY U-PULL
KINGSTON

1533 MCADOO'S LANE

PROJECT NO: 124600	SCALE: AS SHOWN
DRAWN BY: N.A.	CHECKED BY: B.T.
PROJECT MGR: B.T.	APPROVED BY: B.T.

SHEET TITLE

GRADING PLAN

SHEET NUMBER	ISSUE
C300	6

SCALE CHECK 1 in 10mm

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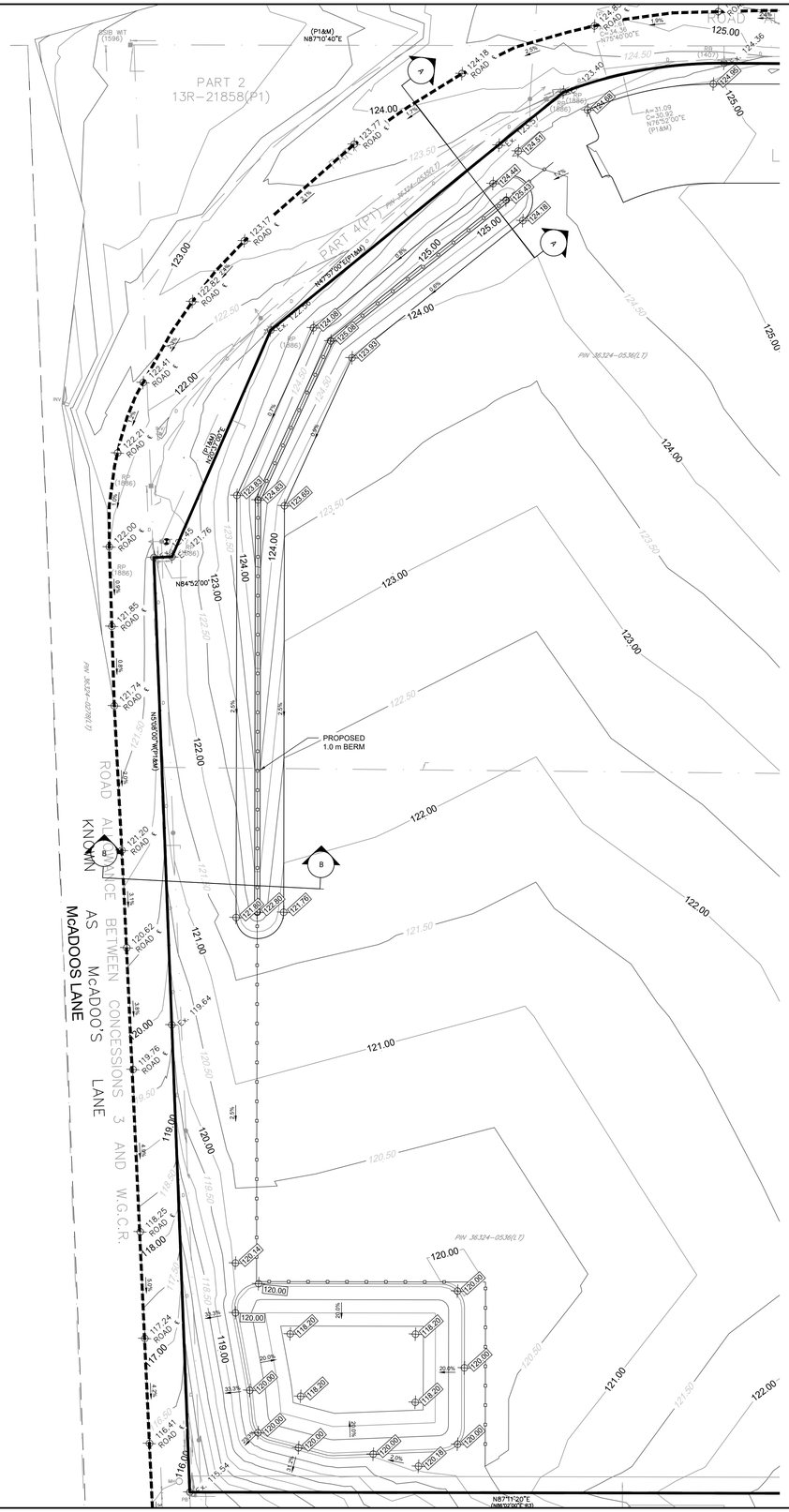
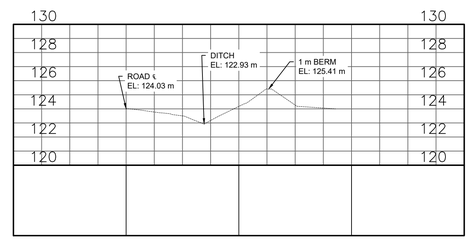


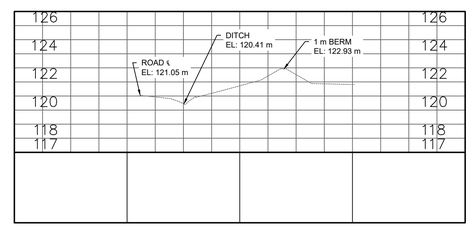
North Cross-Section PROFILE



A
C301

NORTH CROSS-SECTION
SCALE: NTS

South Cross-Section PROFILE



B
C301

SOUTH CROSS-SECTION
SCALE: NTS

1:500

5 0 5 10 15 20 25 30 35 m

True North

CLIENT

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IRON & METAL

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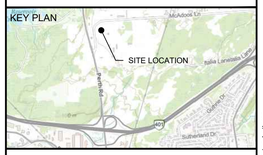
5	REISSUED FOR SPC	2022-10-11
6	REISSUED FOR SPC	2022-12-09

FOR REVIEW

KEY PLAN



LEGEND:

- PROPERTY BOUNDARY
- PROPOSED CONTOUR ELEVATION
- XX.XX — SPOT ELEVATION
- Ex. XX.XX — EXISTING ELEVATION TO REMAIN
- XX.XX bw — BOTTOM OF WALL ELEVATION
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- X.X% — PROPOSED SLOPE

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PROJECT

KENNY U-PULL
KINGSTON

1533 MCADOO'S LANE

PROJECT NO: 124600	SCALE: AS SHOWN
DRAWN BY: J.L.	CHECKED BY: B.T.
PROJECT MGR: B.T.	APPROVED BY: B.T.

SHEET TITLE

MCADOO'S LANE
ELEVATION PLAN

SHEET NUMBER	ISSUE
C301	6

SCALE CHECK
1 in
10mm

File Location: \\canmest.ibigroup.com\JTO\124600_1533McAdoo\NX7.0_Production\7.03_Design\04_Civil\Sheets\124600_CPEX_2022-10-13.dwg Last Saved: December 8, 2022, by jasmine.leikucs Plotted: Friday, December 9, 2022 1:12:29 PM by Jasmine Leikucs

Appendix B

1. Peak Flow Estimates (Rational Method): 1:2-year, 1:5-year, 1:10-year, 1:25-year, 1:50-year, 1:100-year
2. Volume Analysis (Modified Rational Method): 1:2-year, 1:5-year, 1:10-year, 1:25-year, 1:50-year, 1:100-year
3. Storm Sewer Pipe Design Sheets: 1:2-year, 1:5-year, 1:100-year
4. Environment and Climate Change Canada IDF Curves
5. Orifice Sizing
6. SWM Pond Stage Storage Discharge Table
7. Emergency Overflow Sizing
8. Stormceptor EF Sizing Report
9. Jellyfish Filter Sizing Report

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PEAK FLOW ESTIMATE UNDER 1:2-YEAR STORM

PROJECT: Kenny U-Pull
LOCATION: 1533 McAdoo's Lane
CLIENT: American Iron & Metal

LOCATION			AREA (m²)									RATIONAL DESIGN FLOW				
Concentration Point	Area ID	Area (m²)	C= 0.05	C= 0.25	C= 0.40	C= 0.50	C= 0.70	C= 0.90	Cw	Indiv. 2.78AC	Accum. 2.78AC	Inlet (min.)	Time In Pipe (min.)	Total Time (min.)	I (mm/Hr)	Peak Flow (L/s)
Existing																
Ex. CP #101	101	62528	0	40647	0	0	16465	5416	0.42	7.38	7.38	15.00	0.00	15.00	49.09	**363**
																363
Proposed																
Pr. CP #201	201	6276	0	6144	0	0	132	0	0.26	0.45	0.45	15.00	0.00	15.00	49.09	**22**
Pr. CP #202	202	3266	0	0	0	0	0	3266	0.90	0.82	0.82	15.00	0.00	15.00	49.09	**40**
Pr. CP #203	203	1806	0	0	0	0	0	1806	0.90	0.45	0.45	15.00	0.00	15.00	49.09	**22**
Pr. CP #204	204	413	0	0	0	0	0	413	0.90	0.10	0.10	15.00	0.00	15.00	49.09	**5**
Pr. CP #205	205	72	0	0	0	0	0	72	0.90	0.02	0.02	15.00	0.00	15.00	49.09	**1**
Pr. CP #206	206	9955	0	323	0	0	9632	0	0.69	1.90	1.90	15.00	0.00	15.00	49.09	**93**
Pr. CP #207	207	32333	0	490	0	0	26162	5682	0.73	6.55	6.55	15.00	0.00	15.00	49.09	**321**
Pr. CP #208	208	808	0	0	0	0	0	808	0.90	0.20	0.20	15.00	0.00	15.00	49.09	**10**
Pr. CP #209	209	5103	0	0	0	0	5103	0	0.70	0.99	0.99	15.00	0.00	15.00	49.09	**49**
Pr. CP #210	210	2498	0	1299	0	0	1200	0	0.47	0.32	0.32	15.00	0.00	15.00	49.09	**16**
																580

Designed: JL	**Revisions:**	
Checked: BT		
Dwg. Reference: SWM1 & SWM2	**Date:** 2022-12-09	**Sheet No:** 1 of 1

Q = 2.78AIC, where:
Q = Peak Flow in Litres per Second (l/s)
A = Area in Hectares (m²)
I = Rainfall Intensity in Millimeters per Hour (mm/hr)
[I=19.1*(tc)^-0.681]

#####

IBI GROUP
650 Dalton Avenue
Kingston ON K7M 8N7 Canada
tel 613 531 4440
ibigroup.com

PEAK FLOW ESTIMATE UNDER MINOR (1:5-YEAR) STORM

PROJECT: Kenny U-Pull
LOCATION: 1533 McAdoo's Lane
CLIENT: American Iron & Metal

LOCATION			AREA (m²)									RATIONAL DESIGN FLOW				
Concentration Point	Area ID	Area (m²)	C= 0.05	C= 0.25	C= 0.40	C= 0.50	C= 0.70	C= 0.90	Cw	Indiv. 2.78AC	Accum. 2.78AC	Inlet (min.)	Time In Pipe (min.)	Total Time (min.)	I (mm/Hr)	Peak Flow (L/s)
Existing																
Ex. CP #101	101	62528		40647			16465	5416	0.42	7.38	7.38	15.00	0.00	15.00	63.50	**469**
																469
Proposed																
Pr. CP #201	201	6276		6144			132		0.26	0.45	0.45	15.00	0.00	15.00	63.50	**29**
Pr. CP #202	202	3266						3266	0.90	0.82	0.82	15.00	0.00	15.00	63.50	**52**
Pr. CP #203	203	1806						1806	0.90	0.45	0.45	15.00	0.00	15.00	63.50	**29**
Pr. CP #204	204	413						413	0.90	0.10	0.10	15.00	0.00	15.00	63.50	**7**
Pr. CP #205	205	72						72	0.90	0.02	0.02	15.00	0.00	15.00	63.50	**1**
Pr. CP #206	206	9955		323			9632		0.69	1.90	1.90	15.00	0.00	15.00	63.50	**120**
Pr. CP #207	207	32333		490			26162	5682	0.73	6.55	6.55	15.00	0.00	15.00	63.50	**416**
Pr. CP #208	208	808						808	0.90	0.20	0.20	15.00	0.00	15.00	63.50	**13**
Pr. CP #209	209	5103					5103		0.70	0.99	0.99	15.00	0.00	15.00	63.50	**63**
Pr. CP #210	210	2498	0	1299			1200		0.47	0.32	0.32	15.00	0.00	15.00	63.50	**21**
																750

Designed: JL	**Revisions:**	
	2021-01-21: Increse Major Storm Runoff Coefficients	
	2021-02-05: Update Catchment Areas	
Checked: BT	2022-07-12: Update Catchment Areas	
	2022-02-22: Update Catchment Areas	
Dwg. Reference: SWM1 & SWM2	**Date:** 2022-12-09	**Sheet No:** 1 of 1

Q = 2.78AIC, where:
Q = Peak Flow in Litres per Second (l/s)
A = Area in Hectares (m²)
I = Rainfall Intensity in Millimeters per Hour (mm/hr)
$[I=1778/(t_c+13)]$

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PEAK FLOW ESTIMATE UNDER 1:10-YEAR STORM

PROJECT: Kenny U-Pull
LOCATION: 1533 McAdoo's Lane
CLIENT: American Iron & Metal

LOCATION			AREA (m²)									RATIONAL DESIGN FLOW				
Concentration Point	Area ID	Area (m²)	C= 0.05	C= 0.25	C= 0.40	C= 0.50	C= 0.70	C= 0.90	Cw	Indiv. 2.78AC	Accum. 2.78AC	Inlet (min.)	Time In Pipe (min.)	Total Time (min.)	I (mm/Hr)	Peak Flow (L/s)
Existing																
Ex. CP #101	101	62528	0	40647	0	0	16465	5416	0.42	7.38	7.38	15.00	0.00	15.00	73.52	**543**
																543
Proposed																
Pr. CP #201	201	6276	0	6144	0	0	132	0	0.26	0.45	0.45	15.00	0.00	15.00	73.52	**33**
Pr. CP #202	202	3266	0	0	0	0	0	3266	0.90	0.82	0.82	15.00	0.00	15.00	73.52	**60**
Pr. CP #203	203	1806	0	0	0	0	0	1806	0.90	0.45	0.45	15.00	0.00	15.00	73.52	**33**
Pr. CP #204	204	413	0	0	0	0	0	413	0.90	0.10	0.10	15.00	0.00	15.00	73.52	**8**
Pr. CP #205	205	72	0	0	0	0	0	72	0.90	0.02	0.02	15.00	0.00	15.00	73.52	**1**
Pr. CP #206	206	9955	0	323	0	0	9632	0	0.69	1.90	1.90	15.00	0.00	15.00	73.52	**139**
Pr. CP #207	207	32333	0	490	0	0	26162	5682	0.73	6.55	6.55	15.00	0.00	15.00	73.52	**481**
Pr. CP #208	208	808	0	0	0	0	0	808	0.90	0.20	0.20	15.00	0.00	15.00	73.52	**15**
Pr. CP #209	209	5103	0	0	0	0	5103	0	0.70	0.99	0.99	15.00	0.00	15.00	73.52	**73**
Pr. CP #210	210	2498	0	1299	0	0	1200	0	0.47	0.32	0.32	15.00	0.00	15.00	73.52	**24**
																868

Designed: JL	**Revisions:**	
Checked: BT		
Dwg. Reference: SWM1 & SWM2	**Date:** 2022-12-09	**Sheet No:** 1 of 1

Q = 2.78AIC, where:
Q = Peak Flow in Litres per Second (l/s)
A = Area in Hectares (m²)
I = Rainfall Intensity in Millimeters per Hour (mm/hr)
[I=28.8*(tc)^-0.676]

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PEAK FLOW ESTIMATE UNDER 1:25-YEAR STORM

PROJECT: Kenny U-Pull
LOCATION: 1533 McAdoo's Lane
CLIENT: American Iron & Metal

LOCATION			AREA (m²)									RATIONAL DESIGN FLOW				
Concentration Point	Area ID	Area (m²)	C= 0.05	C= 0.25	C= 0.40	C= 0.50	C= 0.70	C= 0.90	Cw	Indiv. 2.78AC	Accum. 2.78AC	Inlet (min.)	Time In Pipe (min.)	Total Time (min.)	I (mm/Hr)	Peak Flow (L/s)
Existing																
Ex. CP #101	101	62528	0	40647	0	0	16465	5416	0.42	7.38	7.38	15.00	0.00	15.00	85.53	**632**
																632
Proposed																
Pr. CP #201	201	6276	0	6144	0	0	132	0	0.26	0.45	0.45	15.00	0.00	15.00	85.53	**39**
Pr. CP #202	202	3266	0	0	0	0	0	3266	0.90	0.82	0.82	15.00	0.00	15.00	85.53	**70**
Pr. CP #203	203	1806	0	0	0	0	0	1806	0.90	0.45	0.45	15.00	0.00	15.00	85.53	**39**
Pr. CP #204	204	413	0	0	0	0	0	413	0.90	0.10	0.10	15.00	0.00	15.00	85.53	**9**
Pr. CP #205	205	72	0	0	0	0	0	72	0.90	0.02	0.02	15.00	0.00	15.00	85.53	**2**
Pr. CP #206	206	9955	0	323	0	0	9632	0	0.69	1.90	1.90	15.00	0.00	15.00	85.53	**162**
Pr. CP #207	207	32333	0	490	0	0	26162	5682	0.73	6.55	6.55	15.00	0.00	15.00	85.53	**560**
Pr. CP #208	208	808	0	0	0	0	0	808	0.90	0.20	0.20	15.00	0.00	15.00	85.53	**17**
Pr. CP #209	209	5103	0	0	0	0	5103	0	0.70	0.99	0.99	15.00	0.00	15.00	85.53	**85**
Pr. CP #210	210	2498	0	1299	0	0	1200	0	0.47	0.32	0.32	15.00	0.00	15.00	85.53	**28**
																1,010

Designed: JL	**Revisions:**		Q = 2.78AIC, where: Q = Peak Flow in Litres per Second (l/s) A = Area in Hectares (m²) I = Rainfall Intensity in Millimeters per Hour (mm/hr) [I=33.6*(tc)^-0.674]
Checked: BT			
Dwg. Reference: SWM1 & SWM2		**Date:** 2022-12-09	**Sheet No:** 1 of 1

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PEAK FLOW ESTIMATE UNDER 1:50-YEAR STORM

PROJECT: Kenny U-Pull
LOCATION: 1533 McAdoo's Lane
CLIENT: American Iron & Metal

LOCATION			AREA (m²)									RATIONAL DESIGN FLOW				
Concentration Point	Area ID	Area (m²)	C= 0.05	C= 0.25	C= 0.40	C= 0.50	C= 0.70	C= 0.90	Cw	Indiv. 2.78AC	Accum. 2.78AC	Inlet (min.)	Time In Pipe (min.)	Total Time (min.)	I (mm/Hr)	Peak Flow (L/s)
Existing																
Ex. CP #101	101	62528	0	40647	0	0	16465	5416	0.42	7.38	7.38	15.00	0.00	15.00	94.82	**700**
																700
Proposed																
Pr. CP #201	201	6276	0	6144	0	0	132	0	0.26	0.45	0.45	15.00	0.00	15.00	94.82	**43**
Pr. CP #202	202	3266	0	0	0	0	0	3266	0.90	0.82	0.82	15.00	0.00	15.00	94.82	**77**
Pr. CP #203	203	1806	0	0	0	0	0	1806	0.90	0.45	0.45	15.00	0.00	15.00	94.82	**43**
Pr. CP #204	204	413	0	0	0	0	0	413	0.90	0.10	0.10	15.00	0.00	15.00	94.82	**10**
Pr. CP #205	205	72	0	0	0	0	0	72	0.90	0.02	0.02	15.00	0.00	15.00	94.82	**2**
Pr. CP #206	206	9955	0	323	0	0	9632	0	0.69	1.90	1.90	15.00	0.00	15.00	94.82	**180**
Pr. CP #207	207	32333	0	490	0	0	26162	5682	0.73	6.55	6.55	15.00	0.00	15.00	94.82	**621**
Pr. CP #208	208	808	0	0	0	0	0	808	0.90	0.20	0.20	15.00	0.00	15.00	94.82	**19**
Pr. CP #209	209	5103	0	0	0	0	5103	0	0.70	0.99	0.99	15.00	0.00	15.00	94.82	**94**
Pr. CP #210	210	2498	0	1299	0	0	1200	0	0.47	0.32	0.32	15.00	0.00	15.00	94.82	**31**
			0	8255	0	0	42228	12045								**1,119**

Designed: JL	**Revisions:**	
Checked: BT		
Dwg. Reference: SWM1 & SWM2	**Date:** 2022-12-09	**Sheet No:** 1 of 1

Q = 2.78AIC, where:
Q = Peak Flow in Litres per Second (l/s)
A = Area in Hectares (m²)
I = Rainfall Intensity in Millimeters per Hour (mm/hr)
[I=37.3*(tc)^-0.673]

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PEAK FLOW ESTIMATE UNDER MAJOR (1:100-YEAR) STORM

PROJECT: Kenny U-Pull
LOCATION: 1533 McAdoo's Lane
CLIENT: American Iron & Metal

LOCATION			AREA (m²)									RATIONAL DESIGN FLOW				
Concentration Point	Area ID	Area (m²)	C= 0.06	C= 0.31	C= 0.50	C= 0.63	C= 0.88	C= 0.95	Cw	Indiv. 2.78AC	Accum. 2.78AC	Inlet (min.)	Time In Pipe (min.)	Total Time (min.)	I (mm/Hr)	Peak Flow (L/s)
Existing																
Ex. CP #101	101	62528	0	40647	0	0	16465	5416	0.52	8.97	8.97	15.00	0.00	15.00	103.83	**931**
																931
Proposed																
Pr. CP #201	201	6276	0	6144	0	0	132	0	0.32	0.57	0.57	15.00	0.00	15.00	103.83	**59**
Pr. CP #202	202	3266	0	0	0	0	0	3266	0.95	0.86	0.86	15.00	0.00	15.00	103.83	**90**
Pr. CP #203	203	1806	0	0	0	0	0	1806	0.95	0.48	0.48	15.00	0.00	15.00	103.83	**50**
Pr. CP #204	204	413	0	0	0	0	0	413	0.95	0.11	0.11	15.00	0.00	15.00	103.83	**11**
Pr. CP #205	205	72	0	0	0	0	0	72	0.95	0.02	0.02	15.00	0.00	15.00	103.83	**2**
Pr. CP #206	206	9955	0	323	0	0	9632	0	0.86	2.37	2.37	15.00	0.00	15.00	103.83	**246**
Pr. CP #207	207	32333	0	490	0	0	26162	5682	0.88	7.91	7.91	15.00	0.00	15.00	103.83	**821**
Pr. CP #208	208	808	0	0	0	0	0	808	0.95	0.21	0.21	15.00	0.00	15.00	103.83	**22**
Pr. CP #209	209	5103	0	0	0	0	5103	0	0.88	1.24	1.24	15.00	0.00	15.00	103.83	**129**
Pr. CP #210	210	2498	0	1299	0	0	1200	0	0.58	0.40	0.40	15.00	0.00	15.00	103.83	**42**
																1,471

Designed: JL	**Revisions:**	
	2021-01-21: Increse Major Storm Runoff Coefficients	
	2021-02-05: Update Catchment Areas	
Checked: BT	2022-07-12: Update Catchment Areas	
Dwg. Reference: SWM1 & SWM2	**Date:** 2022-12-09	**Sheet No:** 1 of 1

Q = 2.78AIC, where:
Q = Peak Flow in Litres per Second (l/s)
A = Area in Hectares (m²)
I = Rainfall Intensity in Millimeters per Hour (mm/hr)
[I=40.9*(tc)^-0.672]

Modified Rational Method (1:2 yr Event)

Project Name: AMERICAN IRON & METAL/KENNY U-PULL

Project Number: 124600

Actual Release Rate: 0.363

Allowable Release Rate: 0.363

Weighted C_{Post}

Basin	Area (ha)	Coefficient	Product
201	0.6276	0.26	0.163176
202	0.3266	0.90	0.29394
203	0.1806	0.90	0.162522
204	0.0413	0.90	0.037125
205	0.0072	0.90	0.006453
206	0.9955	0.69	0.686895
207	3.2333	0.73	2.360343
208	0.0808	0.90	0.072702
209	0.5103	0.70	0.35721
210	0.2498	0.47	0.117415
Total:	6.2529		0.68

Weighted C_{pre}

Basin	Area (ha)	Coefficient	Product
1	6.2529	0.42	2.626218
Total:	6.2529		0.42

IDF Curve (2 yr)

A	19.1
B	-0.681
C	0

Storm Duration (min)	Intensity (mm/h)	Peak Flow Pre (m^3/s)	Peak Flow Post (m^3/s)	VolumePost (m^3)	Release Volume (m^3)	Required Storage (m^3)
5	103.74	0.7568	1.225	367.59	108.90	258.69
10	64.71	0.4720	0.764	458.56	217.80	240.76
15	49.09	0.3581	0.580	521.88	326.70	195.18
20	40.36	0.2944	0.477	572.04	435.60	136.44
25	34.67	0.2529	0.409	614.24	544.50	69.74
30	30.62	0.2234	0.362	651.03	653.40	-2.37
60	19.10	0.1393	0.226	812.13	1306.80	-494.67
120	11.91	0.0869	0.141	1013.11	2613.60	-1600.49
180	9.04	0.0659	0.107	1153.00	3920.40	-2767.40
240	7.43	0.0542	0.088	1263.82	5227.20	-3963.38
300	6.38	0.0466	0.075	1357.06	6534.00	-5176.94
360	5.64	0.0411	0.067	1438.33	7840.80	-6402.47
420	5.08	0.0370	0.060	1510.82	9147.60	-7636.78
480	4.63	0.0338	0.055	1576.57	10454.40	-8877.83
540	4.28	0.0312	0.051	1636.93	11761.20	-10124.27
600	3.98	0.0290	0.047	1692.88	13068.00	-11375.12
660	3.73	0.0272	0.044	1745.14	14374.80	-12629.66
720	3.52	0.0257	0.042	1794.26	15681.60	-13887.34
780	3.33	0.0243	0.039	1840.67	16988.40	-15147.73
840	3.17	0.0231	0.037	1884.70	18295.20	-16410.50
900	3.02	0.0220	0.036	1926.64	19602.00	-17675.36
960	2.89	0.0211	0.034	1966.71	20908.80	-18942.09
1020	2.77	0.0202	0.033	2005.12	22215.60	-20210.48
1080	2.67	0.0195	0.032	2042.02	23522.40	-21480.38
1140	2.57	0.0188	0.030	2077.54	24829.20	-22751.66
1200	2.48	0.0181	0.029	2111.81	26136.00	-24024.19
1260	2.40	0.0175	0.028	2144.94	27442.80	-25297.86
1320	2.33	0.0170	0.027	2177.01	28749.60	-26572.59
1380	2.26	0.0165	0.027	2208.10	30056.40	-27848.30
1440	2.19	0.0160	0.026	2238.28	31363.20	-29124.92

Modified Rational Method (Minor 1:5 yr Event)

Project Name: AMERICAN IRON & METAL/KENNY U-PULL

Project Number: 124600

Actual Release Rate: 0.416

Allowable Release Rate: 0.469

Weighted C_{Post}

Basin	Area (ha)	Coefficient	Product
201	0.6276	0.26	0.163176
202	0.3266	0.90	0.29394
203	0.1806	0.90	0.162522
204	0.0413	0.90	0.037125
205	0.0072	0.90	0.006453
206	0.9955	0.69	0.686895
207	3.2333	0.73	2.360343
208	0.0808	0.90	0.072702
209	0.5103	0.70	0.35721
210	0.2498	0.47	0.117415
Total:	6.2529		0.68

Weighted C_{pre}

Basin	Area (ha)	Coefficient	Product
1	6.2528	0.42	2.626176
Total:	6.2528		0.42

IDF Curve (5 yr)

A	1778
B	13
C	1

Storm Duration (min)	Intensity (mm/hr)	Peak Flow Pre (m^3/s)	Peak Flow Post (m^3/s)	VolumePost (m^3)	Release Volume (m^3)	Required Storage (m^3)	
5	98.78	0.721	1.167	350.00	124.80	225.2	296.9
10	77.30	0.564	0.913	547.83	249.60	298.2	
15	63.50	0.463	0.750	675.01	374.40	300.6	
20	53.88	0.393	0.636	763.64	499.20	264.4	
25	46.79	0.341	0.553	828.95	624.00	205.0	
30	41.35	0.302	0.488	879.08	748.80	130.3	
60	24.36	0.178	0.288	1035.63	1497.60	-462.0	
120	13.37	0.098	0.158	1136.85	2995.20	-1858.3	
180	9.21	0.067	0.109	1175.14	4492.80	-3317.7	
240	7.03	0.051	0.083	1195.27	5990.40	-4795.1	
300	5.68	0.041	0.067	1207.68	7488.00	-6280.3	
360	4.77	0.035	0.056	1216.10	8985.60	-7769.5	
420	4.11	0.030	0.048	1222.18	10483.20	-9261.0	
480	3.61	0.026	0.043	1226.79	11980.80	-10754.0	
540	3.22	0.023	0.038	1230.39	13478.40	-12248.0	
600	2.90	0.021	0.034	1233.29	14976.00	-13742.7	
660	2.64	0.019	0.031	1235.67	16473.60	-15237.9	
720	2.43	0.018	0.029	1237.66	17971.20	-16733.5	
780	2.24	0.016	0.026	1239.35	19468.80	-18229.4	
840	2.08	0.015	0.025	1240.81	20966.40	-19725.6	
900	1.95	0.014	0.023	1242.07	22464.00	-21221.9	
960	1.83	0.013	0.022	1243.18	23961.60	-22718.4	
1020	1.72	0.013	0.020	1244.15	25459.20	-24215.0	
1080	1.63	0.012	0.019	1245.02	26956.80	-25711.8	
1140	1.54	0.011	0.018	1245.80	28454.40	-27208.6	
1200	1.47	0.011	0.017	1246.51	29952.00	-28705.5	
1260	1.40	0.010	0.016	1247.14	31449.60	-30202.5	

Modified Rational Method (1:10 yr Event)

Project Name: AMERICAN IRON & METAL/KENNY U-PULL

Project Number: 124600

Actual Release Rate: 0.448

Allowable Release Rate: 0.543

Weighted C_{Post}

Basin	Area (ha)	Coefficient	Product
201	0.6276	0.26	0.163176
202	0.3266	0.90	0.29394
203	0.1806	0.90	0.162522
204	0.0413	0.90	0.037125
205	0.0072	0.90	0.006453
206	0.9955	0.69	0.686895
207	3.2333	0.73	2.360343
208	0.0808	0.90	0.072702
209	0.5103	0.70	0.35721
210	0.2498	0.47	0.117415
Total:	6.2529		0.68

Weighted C_{pre}

Basin	Area (ha)	Coefficient	Product
1	6.2528	0.42	2.626176
Total:	6.2528		0.42

IDF Curve (10 yr)

A	28.8
B	-0.677
C	0

Storm Duration (min)	Intensity (mm/h)	Peak Flow Pre (m^3/s)	Peak Flow Post (m^3/s)	VolumePost (m^3)	Release Volume (m^3)	Required Storage (m^3)
5	154.88	1.1298	1.829	548.80	134.40	414.40
10	96.87	0.7067	1.144	686.50	268.80	417.70
15	73.62	0.5370	0.870	782.57	403.20	379.37
20	60.59	0.4420	0.716	858.77	537.60	321.17
25	52.09	0.3800	0.615	922.95	672.00	250.95
30	46.05	0.3359	0.544	978.93	806.40	172.53
60	28.80	0.2101	0.340	1224.58	1612.80	-388.22
120	18.01	0.1314	0.213	1531.86	3225.60	-1693.74
180	13.69	0.0999	0.162	1746.21	4838.40	-3092.19
240	11.27	0.0822	0.133	1916.25	6451.20	-4534.95
300	9.69	0.0707	0.114	2059.46	8064.00	-6004.54
360	8.56	0.0625	0.101	2184.38	9676.80	-7492.42
420	7.71	0.0563	0.091	2295.90	11289.60	-8993.70
480	7.05	0.0514	0.083	2397.09	12902.40	-10505.31
540	6.51	0.0475	0.077	2490.04	14515.20	-12025.16
600	6.06	0.0442	0.072	2576.24	16128.00	-13551.76
660	5.68	0.0414	0.067	2656.78	17740.80	-15084.02
720	5.36	0.0391	0.063	2732.51	19353.60	-16621.09
780	5.07	0.0370	0.060	2804.08	20966.40	-18162.32
840	4.82	0.0352	0.057	2872.01	22579.20	-19707.19
900	4.60	0.0336	0.054	2936.73	24192.00	-21255.27
960	4.41	0.0322	0.052	2998.59	25804.80	-22806.21
1020	4.23	0.0309	0.050	3057.89	27417.60	-24359.71
1080	4.07	0.0297	0.048	3114.86	29030.40	-25915.54
1140	3.92	0.0286	0.046	3169.74	30643.20	-27473.46
1200	3.79	0.0276	0.045	3222.69	32256.00	-29033.31
1260	3.67	0.0267	0.043	3273.88	33868.80	-30594.92
1320	3.55	0.0259	0.042	3323.45	35481.60	-32158.15
1380	3.45	0.0251	0.041	3371.51	37094.40	-33722.89
1440	3.35	0.0244	0.040	3418.18	38707.20	-35289.02

Modified Rational Method (1:25 yr Event)

Project Name: AMERICAN IRON & METAL/KENNY U-PULL

Project Number: 124600

Actual Release Rate: 0.48

Allowable Release Rate: 0.632

Weighted C_{Post}

Basin	Area (ha)	Coefficient	Product
201	0.6276	0.26	0.163176
202	0.3266	0.90	0.29394
203	0.1806	0.90	0.162522
204	0.0413	0.90	0.037125
205	0.0072	0.90	0.006453
206	0.9955	0.69	0.686895
207	3.2333	0.73	2.360343
208	0.0808	0.90	0.072702
209	0.5103	0.70	0.35721
210	0.2498	0.47	0.117415
Total:	6.2529		0.68

Weighted C_{pre}

Basin	Area (ha)	Coefficient	Product
1	6.2528	0.42	2.626176
Total:	6.2528		0.42

IDF Curve (25 yr)

A	33.6
B	-0.674
C	0

Storm Duration (min)	Intensity (mm/h)	Peak Flow Pre (m^3/s)	Peak Flow Post (m^3/s)	VolumePost (m^3)	Release Volume (m^3)	Required Storage (m^3)
5	179.35	1.3084	2.118	635.51	144.00	491.51
10	112.41	0.8200	1.328	796.63	288.00	508.63
15	85.53	0.6239	1.010	909.20	432.00	477.20
20	70.46	0.5140	0.832	998.60	576.00	422.60
25	60.62	0.4422	0.716	1073.95	720.00	353.95
30	53.61	0.3911	0.633	1139.72	864.00	275.72
60	33.60	0.2451	0.397	1428.67	1728.00	-299.33
120	21.06	0.1536	0.249	1790.89	3456.00	-1665.11
180	16.02	0.1169	0.189	2043.97	5184.00	-3140.03
240	13.20	0.0963	0.156	2244.94	6912.00	-4667.06
300	11.36	0.0828	0.134	2414.33	8640.00	-6225.67
360	10.04	0.0733	0.119	2562.18	10368.00	-7805.82
420	9.05	0.0660	0.107	2694.23	12096.00	-9401.77
480	8.27	0.0604	0.098	2814.10	13824.00	-11009.90
540	7.64	0.0557	0.090	2924.26	15552.00	-12627.74
600	7.12	0.0519	0.084	3026.45	17280.00	-14253.55
660	6.67	0.0487	0.079	3121.96	19008.00	-15886.04
720	6.29	0.0459	0.074	3211.78	20736.00	-17524.22
780	5.96	0.0435	0.070	3296.69	22464.00	-19167.31
840	5.67	0.0414	0.067	3377.31	24192.00	-20814.69
900	5.42	0.0395	0.064	3454.13	25920.00	-22465.87
960	5.19	0.0378	0.061	3527.57	27648.00	-24120.43
1020	4.98	0.0363	0.059	3597.98	29376.00	-25778.02
1080	4.79	0.0349	0.057	3665.66	31104.00	-27438.34
1140	4.62	0.0337	0.055	3730.84	32832.00	-29101.16
1200	4.46	0.0325	0.053	3793.75	34560.00	-30766.25
1260	4.32	0.0315	0.051	3854.57	36288.00	-32433.43
1320	4.18	0.0305	0.049	3913.48	38016.00	-34102.52
1380	4.06	0.0296	0.048	3970.60	39744.00	-35773.40
1440	3.95	0.0288	0.047	4026.07	41472.00	-37445.93

Modified Rational Method (1:50 yr Event)

Project Name: AMERICAN IRON & METAL/KENNY U-PULL

Project Number: 124600

Actual Release Rate: 0.502

Allowable Release Rate: 0.7

Weighted C_{Post}

Basin	Area (ha)	Coefficient	Product
201	0.6276	0.26	0.163176
202	0.3266	0.90	0.29394
203	0.1806	0.90	0.162522
204	0.0413	0.90	0.037125
205	0.0072	0.90	0.006453
206	0.9955	0.69	0.686895
207	3.2333	0.73	2.360343
208	0.0808	0.90	0.072702
209	0.5103	0.70	0.35721
210	0.2498	0.47	0.117415
Total:	6.2529		0.68

Weighted C_{pre}

Basin	Area (ha)	Coefficient	Product
1	6.2528	0.42	2.626176
Total:	6.2528		0.42

IDF Curve (50 yr)

A	37.3
B	-0.673
C	0

Storm Duration (min)	Intensity (mm/h)	Peak Flow Pre (m^3/s)	Peak Flow Post (m^3/s)	VolumePost (m^3)	Release Volume (m^3)	Required Storage (m^3)
5	198.61	1.4488	2.346	703.74	150.60	553.14
10	124.57	0.9087	1.471	882.77	301.20	581.57
15	94.82	0.6917	1.120	1007.93	451.80	556.13
20	78.13	0.5699	0.923	1107.35	602.40	504.95
25	67.23	0.4905	0.794	1191.17	753.00	438.17
30	59.47	0.4338	0.702	1264.35	903.60	360.75
60	37.30	0.2721	0.441	1586.00	1807.20	-221.20
120	23.39	0.1707	0.276	1989.48	3614.40	-1624.92
180	17.81	0.1299	0.210	2271.54	5421.60	-3150.06
240	14.67	0.1070	0.173	2495.61	7228.80	-4733.19
300	12.63	0.0921	0.149	2684.51	9036.00	-6351.49
360	11.17	0.0815	0.132	2849.43	10843.20	-7993.77
420	10.07	0.0734	0.119	2996.74	12650.40	-9653.66
480	9.20	0.0671	0.109	3130.49	14457.60	-11327.11
540	8.50	0.0620	0.100	3253.42	16264.80	-13011.38
600	7.92	0.0578	0.094	3367.46	18072.00	-14704.54
660	7.43	0.0542	0.088	3474.06	19879.20	-16405.14
720	7.01	0.0511	0.083	3574.33	21686.40	-18112.07
780	6.64	0.0484	0.078	3669.12	23493.60	-19824.48
840	6.31	0.0461	0.075	3759.12	25300.80	-21541.68
900	6.03	0.0440	0.071	3844.89	27108.00	-23263.11
960	5.77	0.0421	0.068	3926.90	28915.20	-24988.30
1020	5.54	0.0404	0.065	4005.52	30722.40	-26716.88
1080	5.33	0.0389	0.063	4081.09	32529.60	-28448.51
1140	5.14	0.0375	0.061	4153.89	34336.80	-30182.91
1200	4.97	0.0362	0.059	4224.15	36144.00	-31919.85
1260	4.81	0.0351	0.057	4292.08	37951.20	-33659.12
1320	4.66	0.0340	0.055	4357.87	39758.40	-35400.53
1380	4.52	0.0330	0.053	4421.68	41565.60	-37143.92
1440	4.39	0.0321	0.052	4483.65	43372.80	-38889.15

Modified Rational Method (Major Event)

Project Name: AMERICAN IRON & METAL/KENNY U-PULL

Project Number: 124600

Actual Release Rate: 0.57

Allowable Release Rate: 0.931

Weighted C_{Post}

Basin	Area (ha)	Coefficient	Product
201	0.6276	0.33	0.207108
202	0.3266	0.95	0.31027
203	0.1806	0.95	0.171551
204	0.0413	0.95	0.039188
205	0.0072	0.95	0.006812
206	0.9955	0.86	0.85613
207	3.2333	0.88	2.845345
208	0.0808	0.95	0.076741
209	0.5103	0.88	0.449064
210	0.2498	0.58	0.144896
Total:	6.2529		0.82

Weighted C_{pre}

Basin	Area (ha)	Coefficient	Product
1	6.2528	0.52	3.251456
Total:	6.2528		0.52

IDF Curve (100 yr)

A	40.9
B	-0.672
C	0

Storm Duration (min)	Intensity (mm/h)	Peak Flow Pre (m^3/s)	Peak Flow Post (m^3/s)	VolumePost (m^3)	Release Volume (m^3)	Required Storage (m^3)
5	217.24	1.9620	3.094	928.22	171.00	757.22
10	136.35	1.2314	1.942	1165.17	342.00	823.17
15	103.83	0.9377	1.479	1330.90	513.00	817.90
20	85.58	0.7729	1.219	1462.60	684.00	778.60
25	73.66	0.6653	1.049	1573.67	855.00	718.67
30	65.17	0.5886	0.928	1670.64	1026.00	644.64
60	40.90	0.3694	0.583	2097.11	2052.00	45.11
120	25.67	0.2318	0.366	2632.45	4104.00	-1471.55
180	19.55	0.1766	0.278	3006.89	6156.00	-3149.11
240	16.11	0.1455	0.229	3304.44	8208.00	-4903.56
300	13.87	0.1253	0.198	3555.36	10260.00	-6704.64
360	12.27	0.1108	0.175	3774.47	12312.00	-8537.53
420	11.06	0.0999	0.158	3970.22	14364.00	-10393.78
480	10.11	0.0913	0.144	4147.97	16416.00	-12268.03
540	9.34	0.0844	0.133	4311.35	18468.00	-14156.65
600	8.70	0.0786	0.124	4462.95	20520.00	-16057.05
660	8.16	0.0737	0.116	4604.67	22572.00	-17967.33
720	7.70	0.0695	0.110	4737.98	24624.00	-19886.02
780	7.30	0.0659	0.104	4864.02	26676.00	-21811.98
840	6.94	0.0627	0.099	4983.70	28728.00	-23744.30
900	6.63	0.0599	0.094	5097.77	30780.00	-25682.23
960	6.35	0.0573	0.090	5206.83	32832.00	-27625.17
1020	6.09	0.0550	0.087	5311.40	34884.00	-29572.60
1080	5.86	0.0530	0.084	5411.92	36936.00	-31524.08
1140	5.65	0.0511	0.081	5508.75	38988.00	-33479.25
1200	5.46	0.0493	0.078	5602.21	41040.00	-35437.79
1260	5.29	0.0477	0.075	5692.59	43092.00	-37399.41
1320	5.12	0.0463	0.073	5780.12	45144.00	-39363.88
1380	4.97	0.0449	0.071	5865.01	47196.00	-41330.99
1440	4.83	0.0437	0.069	5947.46	49248.00	-43300.54

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LOCATION			DRAINAGE AREA					RUNOFF			PIPE SELECTION						
Area	FROM	TO	A ha	ACCUM. A ha	Coeff. R	2.78AR	ACCUM. 2.78AR	Cummul. Tc (Ti-__) min.	i mm/h	Peak Flow Q l/s	Type Of Pipe	Pipe Dia. mm	Pipe Slope %	Pipe Length L m	Capacity (full) l/s	Velocity (full) V m/s	Time Of Flow min.
202	CBMH4	CBMH5	0.351	0.351	0.90	0.878	0.878	15.000	49.09	43.1	PVC	300	2.00%	126.0	142.7	1.955	1.074
206	CBMH5	DCBMH1	0.969	1.320	0.70	1.886	2.764	16.074	46.84	129.5	PVC	450	2.13%	86.5	434.1	2.644	0.545
203	BUILDING	CBMH1	0.181	0.181	0.90	0.452	0.452	15.000	49.09	22.2	PVC	250	1.00%	10.4	62.0	1.224	0.142
204	CBMH1	MH1	0.041	0.222	0.90	0.103	0.555	15.142	48.78	27.1	PVC	300	2.43%	42.6	157.3	2.155	0.330
205	CB1	MH1	0.007	0.007	0.90	0.018	0.018	15.000	49.09	0.9	PVC	250	1.00%	43.1	62.0	1.224	0.587
	MH1	CBMH2	0.000	0.229	0.00	0.000	0.573	15.471	48.07	27.5	PVC	300	1.22%	66.0	111.4	1.527	0.721
208	CBMH2	EFO4	0.081	0.310	0.90	0.202	0.775	16.192	46.60	36.1	PVC	300	1.00%	5.3	100.9	1.383	0.064
	EFO4	CBMH3	0.000	0.310	0.00	0.000	0.775	16.256	46.48	36.0	PVC	300	2.16%	103.8	148.3	2.032	0.851
209	CBMH3	DCBMH1	0.510	0.820	0.70	0.993	1.768	17.107	44.89	79.4	PVC	375	2.35%	90.6	280.4	2.459	0.614
207	DCBMH1	MH2	3.233	5.374	0.73	6.562	11.094	17.721	43.83	486.2	CONC.	675	2.84%	14.6	1477.8	4.001	0.061
	MH2	MH3	0.000	5.374	0.00	0.000	11.094	17.781	43.72	485.1	CONC.	675	0.50%	10.3	620.1	1.679	0.102
										*341							
	MH3	MH4	0.000	5.374	0.00	0.000	11.094	17.884	43.55	*341	CONC.	675	2.00%	6.0	1240.2	3.357	0.030
	MH4	HW1	0.000	5.374	0.00	0.000	11.094	17.913	43.51	*341	CONC.	675	0.50%	17.8	620.1	1.679	0.177
	MH3	JF10-17-4				Jellyfish Filter Treatment Flow Rate				78.9	PVC	300	1.00%	6.2	100.9	1.383	0.075
	JF10-17-4	MH4				Jellyfish Filter Treatment Flow Rate				78.9	PVC	450	0.50%	4.7	210.3	1.281	0.061

Notes: Q=2.78 AIR (l/s)

Where:
Q = Peak Flow in Litres per Second (l/s)
A = Area in Hectares (m²)
I = Rainfall Intensity in Millimeters per Hour (mm/hr)
R= run-off coefficient
* Orifice Controlled Flow

Rainfall Intensity/Duration Curve
2-year return period

I=19.1*(tc)^-0.681
Where:
I = average intensity in mm/hr
tc = storm duration (hours)

Design: JL

Checked: WT

DATE:

Friday, December 9, 2022

Project : Kenny U-Pull
1533 McAdoo's Lane
(124600)

SHEET No. 1 OF 1

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LOCATION			DRAINAGE AREA					RUNOFF			PIPE SELECTION						
Area	FROM	TO	A ha	ACCUM. A ha	Coeff. R	2.78AR	ACCUM. 2.78AR	Cummul. Tc (Ti-__) min.	i mm/h	Peak Flow Q l/s	Type Of Pipe	Pipe Dia. mm	Pipe Slope %	Pipe Length L m	Capacity (full) l/s	Velocity (full) V m/s	Time Of Flow min.
202	CBMH4	CBMH5	0.351	0.351	0.90	0.878	0.878	15.000	63.50	55.7	PVC	300	2.00%	126.0	142.7	1.955	1.074
206	CBMH5	DCBMH1	0.969	1.320	0.70	1.886	2.764	16.074	61.15	169.0	PVC	450	2.13%	86.5	434.1	2.644	0.545
203	BUILDING	CBMH1	0.181	0.181	0.90	0.452	0.452	15.000	63.50	28.7	PVC	250	1.00%	10.4	62.0	1.224	0.142
204	CBMH1	MH1	0.041	0.222	0.90	0.103	0.555	15.142	63.18	35.1	PVC	300	2.43%	42.6	157.3	2.155	0.330
205	CB1	MH1	0.007	0.007	0.90	0.018	0.018	15.000	63.50	1.1	PVC	250	1.00%	43.1	62.0	1.224	0.587
	MH1	CBMH2	0.000	0.229	0.00	0.000	0.573	15.471	62.45	35.8	PVC	300	1.22%	66.0	111.4	1.527	0.721
208	CBMH2	EFO4	0.081	0.310	0.90	0.202	0.775	16.192	60.91	47.2	PVC	300	1.00%	5.3	100.9	1.383	0.064
	EFO4	CBMH3	0.000	0.310	0.00	0.000	0.775	16.256	60.77	47.1	PVC	300	2.16%	103.8	148.3	2.032	0.851
209	CBMH3	DCBMH1	0.510	0.820	0.70	0.993	1.768	17.107	59.06	104.4	PVC	375	2.35%	90.6	280.4	2.459	0.614
207	DCBMH1	MH2	3.233	5.374	0.73	6.562	11.094	17.721	57.88	642.1	CONC.	675	2.84%	14.6	1477.8	4.001	0.061
	MH2	MH3	0.000	5.374	0.00	0.000	11.094	17.781	57.76	640.8	CONC.	675	0.50%	10.3	620.1	1.679	0.102
										*387							
	MH3	MH4	0.000	5.374	0.00	0.000	11.094	17.884	57.57	*387	CONC.	675	2.00%	6.0	1240.2	3.357	0.030
	MH4	HW1	0.000	5.374	0.00	0.000	11.094	17.913	57.52	*387	CONC.	675	0.50%	17.8	620.1	1.679	0.177

Notes: Q=2.78 AIR (l/s)

Where:
Q = Peak Flow in Litres per Second (l/s)
A = Area in Hectares (m²)
I = Rainfall Intensity in Millimeters per Hour (mm/hr)
R= run-off coefficient
* Orifice Controlled Flow

Rainfall Intensity/Duration Curve
5-year return period

I=1778/(tc+13)
Where:
I = average intensity in mm/hr
tc = time of concentration in minutes

Design: JL

Checked: WT

DATE:

Friday, December 9, 2022

Project : Kenny U-Pull
1533 McAdoo's Lane
(124600)

SHEET No. 1 OF 1

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LOCATION			DRAINAGE AREA					RUNOFF			PIPE SELECTION							
Area	FROM	TO	A ha	ACCUM. A ha	Coeff. R	2.78AR	ACCUM. 2.78AR	Cummul. Tc (Ti-__) min.	i mm/h	Peak Flow Q l/s	Type Of Pipe	Pipe Dia. mm	Pipe Slope %	Pipe Length L m	Capacity (full) l/s	Velocity (full) V m/s	Time Of Flow min.	Q/C
202	CBMH4	CBMH5	0.351	0.351	0.95	0.927	0.927	15.000	103.83	96.2	PVC	300	2.00%	126.0	142.7	1.955	1.074	67.4%
206	CBMH5	DCBMH1	0.969	1.320	0.88	2.358	3.284	16.074	99.11	325.5	PVC	450	2.13%	86.5	434.1	2.644	0.545	75.0%
203	BUILDING	CBMH1	0.181	0.181	0.95	0.477	0.477	15.000	103.83	49.5	PVC	250	1.00%	10.4	62.0	1.224	0.142	79.8%
204	CBMH1	MH1	0.041	0.222	0.95	0.109	0.586	15.142	103.17	60.4	PVC	300	2.43%	42.6	157.3	2.155	0.330	38.4%
205	CB1	MH1	0.007	0.007	0.95	0.019	0.019	15.000	103.83	2.0	PVC	250	1.00%	43.1	62.0	1.224	0.587	3.2%
	MH1	CBMH2	0.000	0.229	0.00	0.000	0.605	15.471	101.69	61.5	PVC	300	1.22%	66.0	111.4	1.527	0.721	55.2%
208	CBMH2	EFO4	0.081	0.310	0.95	0.213	0.818	16.192	98.63	80.7	PVC	300	1.00%	5.3	100.9	1.383	0.064	80.0%
	EFO4	CBMH3	0.000	0.310	0.00	0.000	0.818	16.256	98.36	80.5	PVC	300	2.16%	103.8	148.3	2.032	0.851	54.3%
209	CBMH3	DCBMH1	0.510	0.820	0.88	1.241	2.059	17.107	95.05	195.7	PVC	375	2.35%	90.6	280.4	2.459	0.614	69.8%
207	DCBMH1	MH2	3.233	5.374	0.89	7.982	13.326	17.721	92.82	1237.0	CONC.	675	2.84%	14.6	1477.8	4.001	0.061	83.7%
	MH2	MH3	0.000	5.374	0.00	0.000	13.326	17.781	92.61	1234.1	CONC.	675	0.50%	10.3	620.1	1.679	0.102	199.0%
										*511								82.4%
	MH3	MH4	0.000	5.374	0.00	0.000	0.000	17.884	92.26	*511	CONC.	675	2.00%	6.0	1240.2	3.357	0.030	41.2%
	MH4	HW1	0.000	5.374	0.00	0.000	0.000	17.913	92.15	*511	CONC.	675	0.50%	17.8	620.1	1.679	0.177	82.4%

Notes: Q=2.78 AIR (l/s)

Where:
Q = Peak Flow in Litres per Second (l/s)
A = Area in Hectares (m²)
I = Rainfall Intensity in Millimeters per Hour (mm/hr)
R= run-off coefficient
* Orifice Controlled Flow

Rainfall Intensity/Duration Curve
100 Year Return period

I=40.9*(tc)^-0.672
Where:
I = average intensity in mm/hr
tc = storm duration (hours)

Design: JL

Checked: WT

DATE:

Friday, December 9, 2022

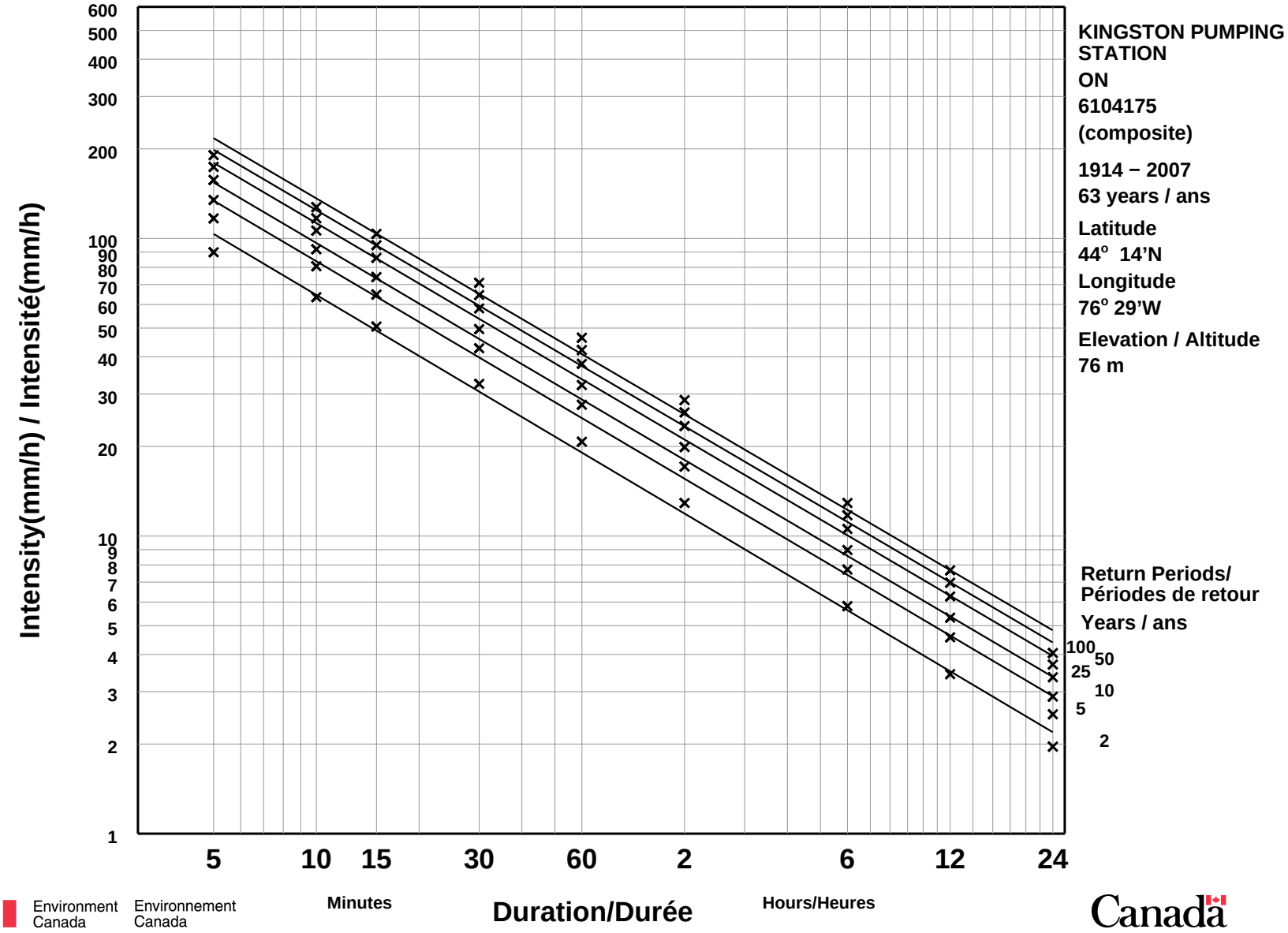
Project : Kenny U-Pull
1533 McAdoo's Lane
(124600)

SHEET No. 1 OF 1

Short Duration Rainfall Intensity−Duration−Frequency Data

2021/03/26

Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée



Environment Canada Environnement Canada

Canada

Orifice Sizing

Project #: 124600
Client: American Iron & Metal
Address: 1533 McAdoo's Lane, Kingston
Date: 2022-12-09

$$Q_{MinorAllow} = C_d A\sqrt{2gh}$$

$$A_{MinorAllow} = \frac{Q}{C_d\sqrt{2gh}}$$

$$A = \frac{0.341}{0.62\sqrt{2(9.81)(0.70)}}$$

$$A = 0.14841\ m^2$$

$$r = 0.2173\ m$$

$$d = 0.435\ m$$

$\therefore$ the diameter of the orifice shall be 435 mm.

$$Q_{MinorActual} = C_d A\sqrt{2gh}$$

$$Q_{MinorActual} = 0.62(0.14862)\sqrt{2(9.81)(0.70)}$$

$$Q_{MinorActual} = 0.34147\ m^3/s$$

$$Q_{MinorActual} = 341\ L/s$$

$$Q_{MajorActual} = C_d A\sqrt{2gh}$$

$$Q_{MajorActual} = 0.62(0.14862)\sqrt{2(9.81)(1.57)}$$

$$Q_{MajorActual} = 0.5114\ m^3/s$$

$$Q_{MajorActual} = 511\ L/s$$

Source: Computer Applications in Hydraulic Engineering 4th Ed., Haystead methods, 2001

IBI GROUP
650 Dalton Avenue
Kingston ON K7M 8N7 Canada
tel 613 531 4440
ibigroup.com

STAGE-STORAGE-DISCHARGE

LOCATION: 1533 McAdoo's Lane
CLIENT: American Iron & Metal
PROJECT #: 124600
DATE: 2022-12-09

Description	Contour Elevation (m)	Contour Area (sq.m)	Depth (m)	Incremental Volume Avg. End (cu.m)	Cumulative Volume Avg. End (cu.m)	2-yr Orifice Head (m)	2-yr Orifice Flow Rate (m^3/s)	2-yr Orifice Flow Rate (L/s)
Bottom of Pond	118.20	295.85	N/A	N/A	0.00	0.20	0.182	182
	118.25	313.79	0.05	15.24	15.24	0.25	0.204	204
	118.30	330.59	0.05	16.11	31.35	0.3	0.223	223
	118.35	349.47	0.05	17.00	48.35	0.35	0.241	241
	118.40	368.85	0.05	17.96	66.31	0.4	0.258	258
	118.45	388.72	0.05	18.94	85.25	0.45	0.273	273
	118.50	409.08	0.05	19.95	105.19	0.5	0.288	288
	118.55	427.90	0.05	20.92	126.12	0.55	0.302	302
	118.60	449.20	0.05	21.93	148.05	0.6	0.316	316
	118.65	471.00	0.05	23.00	171.05	0.65	0.329	329
2-year Water Level (118.70)	118.70	493.28	0.05	24.11	195.16	0.7	0.341	341
	118.75	516.07	0.05	25.23	220.39	0.75	0.353	353
	118.80	537.41	0.05	26.34	246.73	0.8	0.365	365
	118.85	561.13	0.05	27.46	274.19	0.85	0.376	376
5-year Water Level (118.90)	118.90	585.36	0.05	28.66	302.86	0.9	0.387	387
	118.95	610.07	0.05	29.89	332.74	0.95	0.397	397
	119.00	635.26	0.05	31.13	363.87	1	0.408	408
10-year Water Level (119.03)	119.05	660.99	0.05	32.41	396.28	1.05	0.418	418
	119.10	687.12	0.05	33.70	429.98	1.1	0.427	427
	119.15	713.65	0.05	35.02	465.00	1.15	0.437	437
25-year Water Level (119.17)	119.20	740.57	0.05	36.36	501.36	1.2	0.446	446
	119.25	767.89	0.05	37.71	539.07	1.25	0.456	456
50-year Water Level (119.27)	119.30	796.25	0.05	39.10	578.17	1.3	0.465	465
	119.35	824.51	0.05	40.52	618.69	1.35	0.474	474
	119.40	853.16	0.05	41.94	660.63	1.4	0.482	482
	119.45	882.21	0.05	43.38	704.02	1.45	0.491	491
	119.50	911.66	0.05	44.85	748.87	1.5	0.499	499
	119.55	942.45	0.05	46.35	795.22	1.55	0.507	507
100-year Water Level (119.59 - High Water Level)	119.59	966.74	0.04	38.30	833.52	1.59	0.514	514
	119.60	972.81	0.01	9.58	843.10	1.6	0.516	516
	119.65	1003.56	0.05	49.41	892.51	1.65	0.524	524
	119.70	1034.70	0.05	50.96	943.47	1.7	0.531	531
	119.75	1066.24	0.05	52.52	995.99	1.75	0.539	539
	119.80	1097.86	0.05	54.10	1050.09	1.8	0.547	547
	119.85	1130.17	0.05	55.70	1105.79	1.85	0.554	554
	119.90	1162.88	0.05	57.33	1163.12	1.9	0.562	562
	119.95	1195.98	0.05	58.97	1222.09	1.95	0.569	569
Top of Pond (0.3 m Freeboard)	120.00	1229.48	0.05	60.64	1282.73	2	0.576	576

2-yr Orifice	
Diameter (m)	0.4347
Invert	117.78
Center	118.00
Area (m^2)	0.1484

Storm	Approx Wat Elev	Approx F.R. (m^3/s)	Unattenuated	Approx F.R. (L/s)
2	118.70	0.341	0.022	363
5	118.90	0.387	0.029	416
10	119.03	0.414	0.034	448
25	119.17	0.441	0.039	480
50	119.27	0.459	0.043	502
100	119.57	0.511	0.059	570

Worksheet for Emergency Overflow (1 of 2)

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.024
Channel Slope	0.042 m/m
Normal Depth	400.0 mm
Diameter	800.0 mm

Results	
Discharge	733.96 L/s
Flow Area	0.3 m²
Wetted Perimeter	1.3 m
Hydraulic Radius	200.0 mm
Top Width	0.80 m
Critical Depth	521.7 mm
Percent Full	50.0 %
Critical Slope	0.018 m/m
Velocity	2.92 m/s
Velocity Head	0.43 m
Specific Energy	0.83 m
Froude Number	1.664
Maximum Discharge	1,579.05 L/s
Discharge Full	1,467.92 L/s
Slope Full	0.011 m/m
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	50.0 %
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	400.0 mm
Critical Depth	521.7 mm
Channel Slope	0.042 m/m
Critical Slope	0.018 m/m

Worksheet for Emergency Overflow (2 of 2)

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.024
Channel Slope	0.038 m/m
Normal Depth	400.0 mm
Diameter	800.0 mm

Results	
Discharge	693.53 L/s
Flow Area	0.3 m²
Wetted Perimeter	1.3 m
Hydraulic Radius	200.0 mm
Top Width	0.80 m
Critical Depth	506.8 mm
Percent Full	50.0 %
Critical Slope	0.018 m/m
Velocity	2.76 m/s
Velocity Head	0.39 m
Specific Energy	0.79 m
Froude Number	1.572
Maximum Discharge	1,492.07 L/s
Discharge Full	1,387.06 L/s
Slope Full	0.009 m/m
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	50.0 %
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	400.0 mm
Critical Depth	506.8 mm
Channel Slope	0.038 m/m
Critical Slope	0.018 m/m

Stormceptor®

FORTERRA

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

12/08/2022

Province:	Ontario
City:	Kingston
Nearest Rainfall Station:	KINGSTON
Climate Station Id:	6104142
Years of Rainfall Data:	20
Site Name:	
Drainage Area (ha):	0.31
Runoff Coefficient 'c':	0.90
Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	8.12
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	85.00
Peak Conveyance (maximum) Flow Rate (L/s):	85.00
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	1533 McAdoo's Ln.
Project Number:	124600
Designer Name:	Jasmine Leikucs
Designer Company:	IBI Group
Designer Email:	jasmine.leikucs@ibigroup.com
Designer Phone:	613-406-9440
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	91
EFO6	97
EFO8	99
EFO10	100
EFO12	100

Recommended Stormceptor EFO Model: EFO4

Estimated Net Annual Sediment (TSS) Load Reduction (%): 91

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

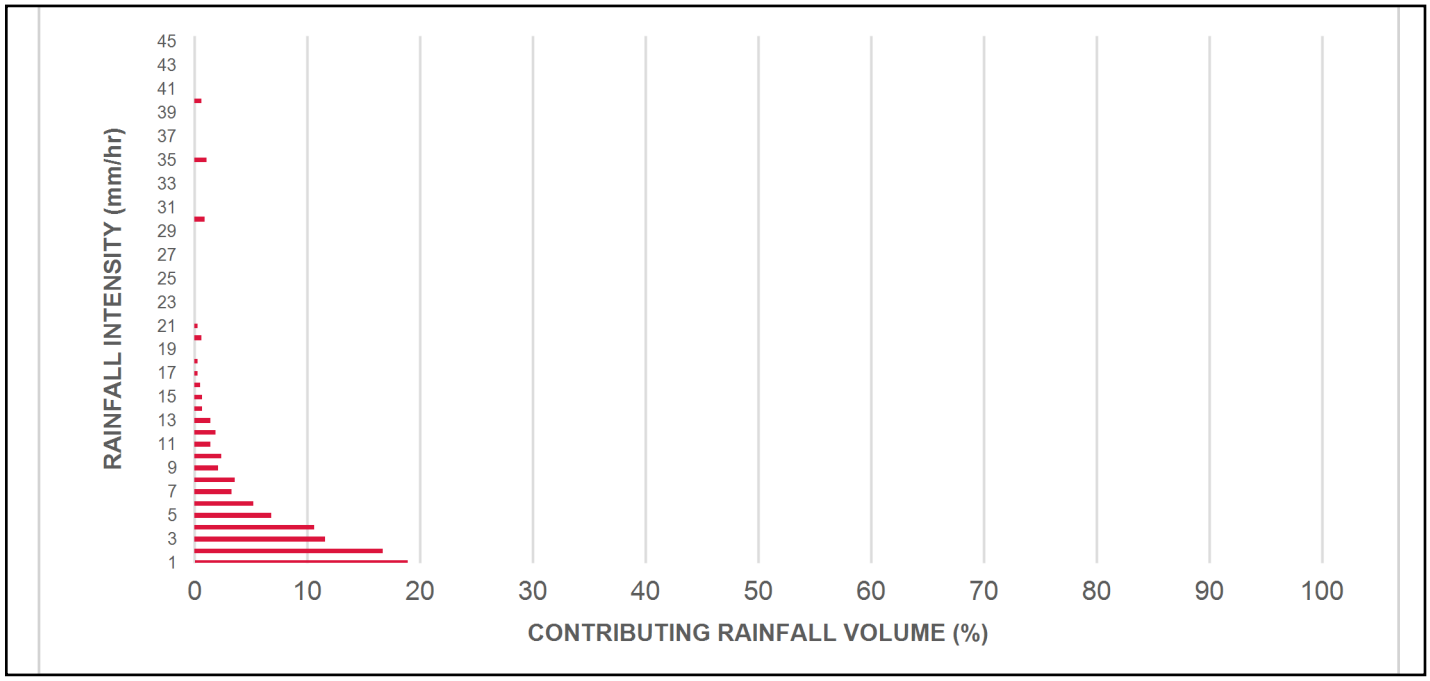
Particle Size (μm)	Percent Less Than	Particle Size Fraction (μm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Upstream Flow Controlled Results

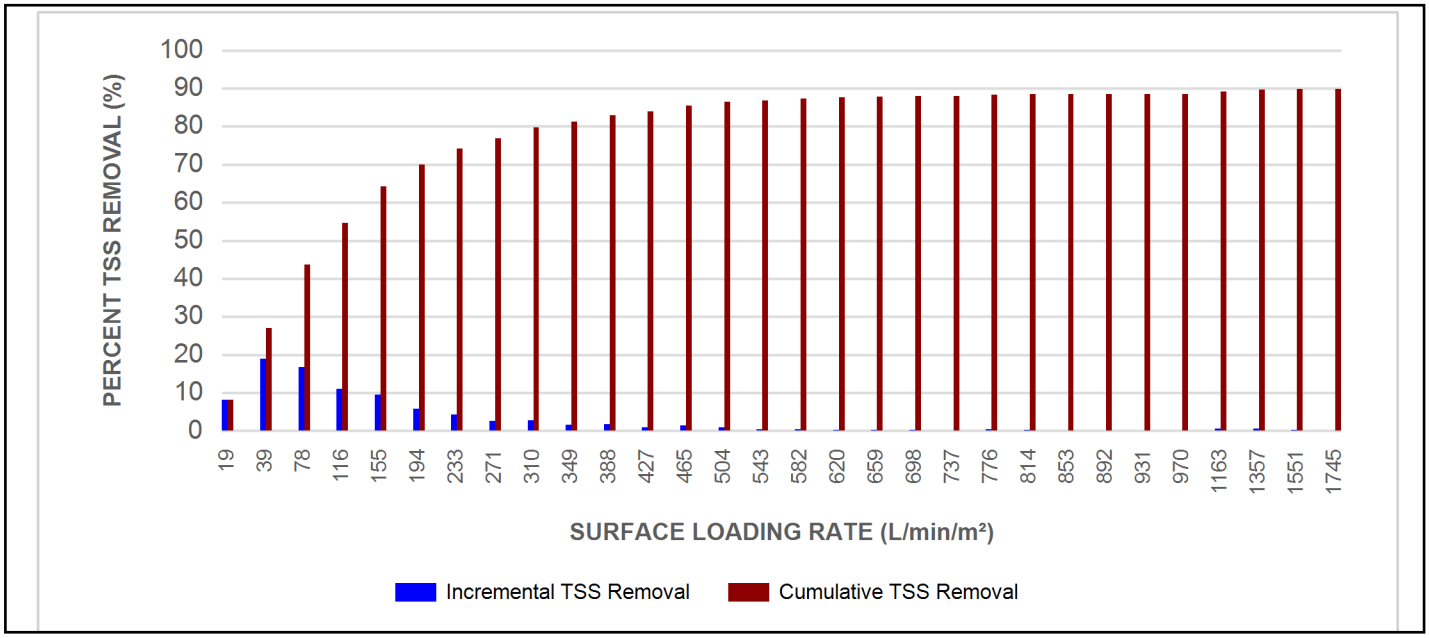
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	8.1	8.1	0.39	23.0	19.0	100	8.1	8.1
1	18.9	27.0	0.78	47.0	39.0	100	18.9	27.0
2	16.7	43.7	1.55	93.0	78.0	100	16.7	43.7
3	11.6	55.3	2.33	140.0	116.0	95	11.0	54.7
4	10.6	65.9	3.10	186.0	155.0	89	9.5	64.2
5	6.8	72.8	3.88	233.0	194.0	84	5.8	70.0
6	5.2	78.0	4.65	279.0	233.0	82	4.3	74.2
7	3.3	81.3	5.43	326.0	271.0	80	2.6	76.8
8	3.6	84.9	6.20	372.0	310.0	78	2.8	79.7
9	2.1	87.0	6.98	419.0	349.0	76	1.6	81.3
10	2.4	89.4	7.76	465.0	388.0	75	1.8	83.0
11	1.4	90.7	8.53	512.0	427.0	73	1.0	84.0
12	1.9	92.6	9.31	558.0	465.0	71	1.3	85.4
13	1.4	94.0	10.08	605.0	504.0	69	1.0	86.4
14	0.7	94.7	10.86	652.0	543.0	67	0.4	86.8
15	0.7	95.4	11.63	698.0	582.0	66	0.5	87.3
16	0.5	95.9	12.41	745.0	620.0	64	0.3	87.6
17	0.3	96.2	13.19	791.0	659.0	64	0.2	87.8
18	0.3	96.4	13.96	838.0	698.0	64	0.2	87.9
19	3.6	100.0	14.74	884.0	737.0	64	2.3	90.2
20	0.6	100.6	15.51	931.0	776.0	63	0.4	90.6
21	0.3	100.9	16.29	977.0	814.0	63	0.2	90.8
22	-0.9	100.0	17.06	1024.0	853.0	63	N/A	90.2
23	0.0	100.0	17.84	1070.0	892.0	62	0.0	90.2
24	0.0	100.0	18.61	1117.0	931.0	62	0.0	90.2
25	0.0	100.0	19.39	1163.0	970.0	62	0.0	90.2
30	0.9	100.9	23.27	1396.0	1163.0	58	0.5	90.7
35	1.1	102.0	27.15	1629.0	1357.0	53	0.6	91.3
40	0.6	102.6	31.02	1861.0	1551.0	47	0.3	91.6
45	-2.6	100.0	34.90	2094.0	1745.0	42	N/A	90.5
Estimated Net Annual Sediment (TSS) Load Reduction =								**91 %**

Climate Station ID: 6104142 *Years of Rainfall Data*: 20

RAINFALL DATA FROM KINGSTON RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

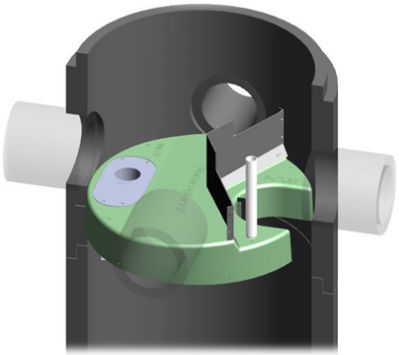
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

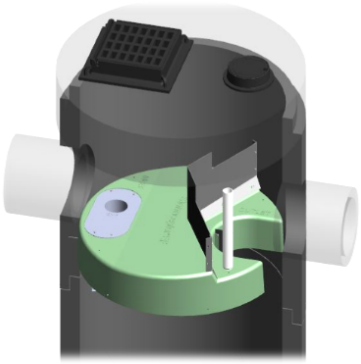
DESIGN FLEXIBILITY

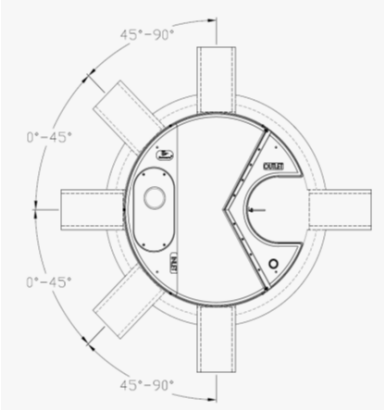
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall

remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to

assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Saturday, March 05, 2022
Project Name	1533 McAdoo's Ln. - Main Unit
Project Number	124600
Location	Kingston

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.
Please see ***www.ImbriumSystems.com*** *for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF10-17-4 is recommended to meet the water quality objective by treating a flow of 78.9 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 44 years of KINGSTON PUMPING STATION rainfall data for this site. This model has a sediment capacity of 1081 kg, which meets or exceeds the estimated average annual sediment

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF10-17-4	17	4	3.0	78.9	1081

The Jellyfish Filter System

The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

Please see ***www.ImbriumSystems.com*** *for more information.*

Thank you for the opportunity to present this information to you and your client.

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

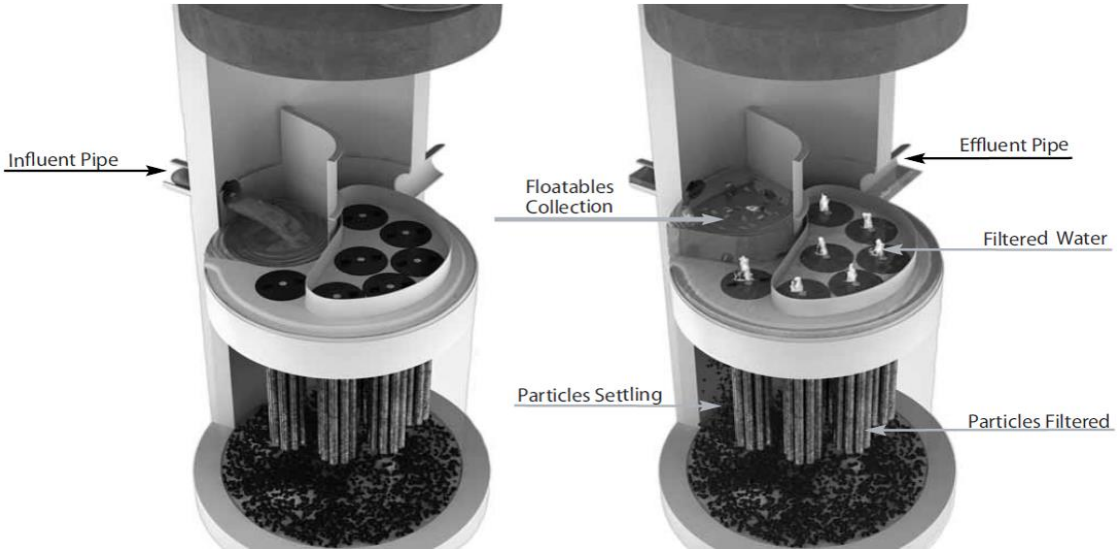
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TARP qualifying rain events and field monitored according to the TARP field test protocol, demonstrating:

- A median TSS removal efficiency of 89%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 59%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Saturday, March 05, 2022
Project Name:	1533 McAdoo's Ln. - Main Unit
Project Number:	124600
Location:	Kingston

Designer Information

Company:	IBI Group
Contact:	Corey Alderman
Phone #:	

Notes

Rainfall

Name:	KINGSTON PUMPING STATION
State:	ON
ID:	4175
Record:	1960 to 2003
Co-ords:	44°14'N, 76°29'W

Drainage Area

Total Area:	5.62 ha
Runoff Coefficient:	0.72

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 44 years of KINGSTON PUMPING STATION rainfall data:	**76 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 17282 m³, with a suspended sediment concentration of 60 mg/L.	**1037 kg**

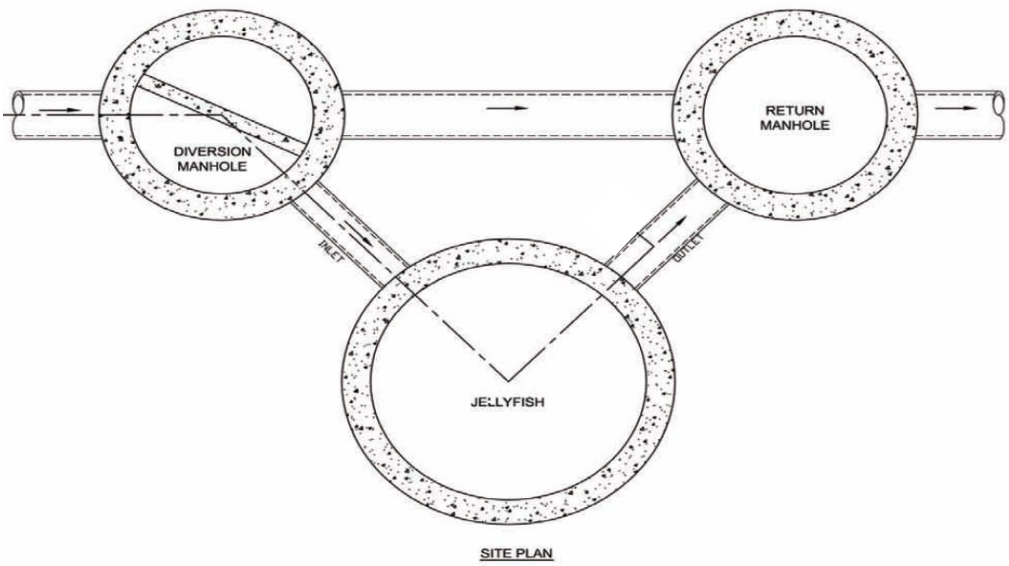
Recommendation

The Jellyfish Filter model JF10-17-4 is recommended to meet the water quality objective by treating a flow of 78.9 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 44 years of KINGSTON PUMPING STATION rainfall data for this site. This model has a sediment capacity of 1081 kg, which meets or exceeds the estimated average annual sediment

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m³)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	2313	0.34	379	7.6	85
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	4	1	1.8	5205	0.79	848	22.7	256
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	8	2	2.4	9252	1.42	1469	45.4	512
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	15	4	3.0	14456	2.21	2302	78.9	967
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	**17**	**4**	**3.0**	**14456**	**2.21**	**2302**	**78.9**	**1081**
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

Jellyfish Filter Design Notes

- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



Jellyfish Filter Typical Layout

- Typically, 18 inches (457 mm) of driving head is designed into the system, calculated as the difference in elevation between the top of the diversion structure weir and the invert of the Jellyfish Filter outlet pipe. Alternative driving head values can be designed as 12 to 24 inches (305 to 610mm) depending on specific site requirements, requiring additional sizing and design assistance.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation. However, depending on site parameters this can vary to an optional configuration of the inlet pipe entering the unit below the outlet invert elevation.
- The Jellyfish Filter can accommodate multiple inlet pipes within certain restrictions.
- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	62º	150	200
1.8	59º	200	250
2.4	52º	250	300
3.0	**48º**	**300**	**450**
3.6	40º	300	450

- The Jellyfish Filter can be built at all depths of cover generally associated with conventional stormwater conveyance systems. For sites that require minimal depth of cover for the stormwater infrastructure, the Jellyfish Filter can be applied in a shallow application using a hatch cover. The general minimum depth of cover is 36 inches (915 mm) from top of the underslab to outlet invert.
- If driving head caclulations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged condtions.
- Jellyfish Filter systems may incorporate grated inlets depending on system configuration.
- For sites with water quality treatment flow rates or mass loadings that exceed the design flow rate of the largest standard Jellyfish Filter manhole models, systems can be designed that hydraulically connect multiple Jellyfish Filters in series or alternatively Jellyfish Vault units can be designed.

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

Specifies requirements for construction and performance of an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891: Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101: Specification for Copolymer steps construction

CAN/CSA-A257.4-M92
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-M92
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft² (0.142 lps/m²).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	Minimum Filtration Membrane Surface Area (ft2 / m2)	Maximum Filter Cartridge Dry Weight (lbs / kg)
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow

event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.3 JOINTS All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER Frame and covers must be manufactured from cast-iron or other composite material tested to withstand H-20 or greater design loads, and as approved by the

local regulatory body. Frames and covers must be embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES If provided shall meet designated loading requirements or at a minimum for incidental vehicular traffic.

2.7 CONCRETE All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS The fiberglass portion of the filter device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter must be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV).

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft^2 (0.142 lps/m^2).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested and verified with a minimum 25 TARP qualifying storm events and field monitoring shall have been conducted according to the TARP 2009 NJDEP TARP field test protocol, and have received NJCAT verification.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION