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February 25, 2021

David Schaeffer Engineering Limited
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Attention: **Mr. Kevin Murphy, P.Eng.**

Subject: **Western Development Lands - Richmond / Expansion of Drainage Area to SWM Facility 1** *our file: 922-11*

As requested by your office and based on the available information as described below, we have evaluated the impact of increasing the ultimate conditions drainage area to Stormwater Management (SWM) Facility 1.

SWM Facility 1 is located within the Western Development Lands, within the City of Ottawa, and was designed to service a drainage area of 33.11 ha under interim conditions and 185.19 ha under ultimate conditions (including 99.36 ha external pre-development area), as per the March 2018 *Design Brief for Interim Stormwater Management Pond 1 Western Development Lands - Richmond* and the March 2020 *Design Brief for Stormwater Management Pond 1 Western Development Lands - Richmond*, respectively. SWM Facility 1 provides quality, erosion and quantity control and discharges to the Van Gaal / Arbuckle Drain, and ultimately to the Jock River. The remainder of the proposed development (to the southeast) and 71.80 ha of external pre-development area was designed to be serviced by SWM Facility 2, in accordance with the January 2014 *Richmond Village (South) Limited Subdivision / Preliminary Stormwater Management Plan* memo. Pond 2 discharges to the Jock River, for which only quality control is required. SWM Facility 2 was to be located in the Laffin Lands within the larger Master Drainage Plan.

We understand from your office that you wish to consider a scenario wherein SWM Facility 2 is removed from the design, and additional the development lands are serviced by ultimate SWM Facility 1, which would have an expanded drainage area of 199.72 ha at 34% imperviousness (including 99.36 ha external pre-development area) under ultimate conditions. Refer to Figure 1 for the proposed expanded drainage area. Note that Pond 1 is currently constructed to the ultimate conditions requirements of the March 2020 *Design Brief* and is operational.

The remaining 23.11 ha of the development (at 71% imperviousness) is located in the southwestern portion of the Western Development Lands on and south of Ottawa Street, and is proposed to be serviced by an oil-and-grit separator for quality control and discharge directly to the Jock River via a trunk sewer on Ottawa Street. No erosion or quantity control is required for this area. A clean water pipe servicing 71.80 ha of external pre-development area will connect to the Ottawa Street trunk sewer downstream of the oil-and-grit separator.

The ultimate conditions development and ultimate Pond 1 were modelled in DDSWMM / SWMHYMO / XPSWMM for the March 2020 *Design Brief for Stormwater Management Pond 1 Western Development Lands - Richmond*. The models were updated to reflect the information presented in Figure 1 as provided by DSEL. Note that, as the DDSWMM program is most appropriate for use in modelling small urban drainage areas, the larger undetailed drainage areas in the expanded portion of the drainage area to Pond 1 were instead modelled using SWMYHMO, and the generated minor system hydrographs then input to XPSWMM. This is also true of other large undetailed drainage areas to Pond 1, including future development north of Perth Street and external pre-development drainage areas to the south of the subject site. Note that modelling of the future development areas north of Perth Street have also been updated in accordance with the latest information provided by DSEL.

100-year capture to the trunk storm sewers on Perth Street and Ottawa Street is required for the 171.16 ha external

pre-development areas (99.36 ha + 71.80 ha).

The proposed subdivision is to be serviced by sump pumps, and as such a hydraulic gradeline in the main storm sewer up to ground level is permitted in accordance with the June 2018 *City of Ottawa Technical Bulletin ISTB-2018-04*. This elevated hydraulic gradeline reduces the differential head acting on an inlet control device (ICD) and / or catchbasin lead pipe, effectively reducing capture through these inlets. As such, no ICDs are proposed within the subdivision, and minor system inflows are controlled by the catchbasin grate capacity, lead pipe capacity, and surface storage above the catchbasin. In undetailed future development areas, where catchbasin details are not available for detailed incorporation in the XPSWMM model, 100-year capture has been modelled with surface storage available above the top of manholes to estimate surface storage above catchbasins.

A summary of drainage areas to ultimate Pond 1 is presented in Attachment A, along with target 2- to 100-year release rates for the pond. Note that the erosion and quantity control target release rates for Pond 1 are based on pre-development drainage to the Van Gaal / Arkbuckle Drain from the subject site, and are unchanged by the proposed increase in post-development drainage area to Pond 1.

The outlet controls for the pond are proposed to be modified in order to meet the target release rates for an expanded drainage area with the same pond stage-storage-area relationship. Namely, erosion control 1 has been revised from a 300 mm diameter circular orifice at an invert of 92.65 m to a 270 mm diameter circular orifice at an invert of 92.65 m. The baseflow control 1 orifice, and quality control 1 orifice, and quantity control 1 weir are unchanged from the March 2020 *Design Brief*. Refer to Calculation Sheet B-1 of Attachment B for the proposed pond outlet controls.

The operation of the SWM facility was analysed using the updated DDSWMM / SWMHYMO / XPSWMM models for the 2- to 100-year 24-hour SCS Type II design storms and the 1979, 1988 and 1996 historical events in accordance with the March 2020 *Design Brief*. Also in accordance with the March 2020 Design Brief, the operation of the SWM facility was analysed using a lumped SWMHYMO model for the 100-year 10-day spring snowmelt + rainfall event. The operating characteristics of the SWM facility are summarized below in Table 1A for free outfall conditions, and Table 1B for restrictive downstream conditions. Restrictive downstream conditions were modelled based on the following 100-year flood levels:

- 93.64 m 100-year summer flood level at the outlet from Pond 1 to the Van Gaal Drain, at cross-section 961 per the February 2016 *Richmond Village (South) Limited Subdivision / Fortune Street Culvert Improvements* memo.

- 94.11 m 100-year spring flood level at the outlet from Pond 1 to the Van Gaal Drain, at cross-section 961 per the February 2016 *Richmond Village (South) Limited Subdivision / Fortune Street Culvert Improvements* memo.

- 94.18 m 100-year regulatory flood level at the outfall to the Jock River from Ottawa Street, at cross-section 19353 per the November 2004 *Jock River Flood Risk Mapping (within the City of Ottawa) Hydraulics Report*.

Table 1A: Summary of SWM Pond 1 Operating Characteristics (Free Outfall Conditions)

Pond Component	Pond Level (m)	Allowable Release Rate [(1)] (m^3/s)	Pond Release Rate (m^3/s)	Volume Used [(2)] (m^3)
Permanent Pool	92.350	N/A	N/A	45330
Quality Control	92.619	N/A	0.083	7989
Extended Detention	93.680	N/A	0.387	43875
2yr/24hr SCS	93.312	0.330	0.313	30562
5yr/24hr SCS	93.702	4.290	0.748	44720
10yr/24hr SCS	93.736	5.348	1.890	46084
25yr/24hr SCS	93.764	6.694	3.036	47203
50yr/24hr SCS	93.777	7.749	3.685	47745
100yr/24hr SCS	93.804	8.894	5.042	48840
July 1st, 1979	93.830	N/A	6.646	49938
August 4th, 1988	93.798	N/A	4.700	48588
August 8th, 1996	93.779	N/A	3.792	47835
100yr/10day Spring	93.762	N/A	3.013	47130

[(1)] 2-year erosion control release rate of 330 L/s, and 5- to 100-yr pre-development flows (refer to Table A-3 of Appendix A)
[(2)] Volumes are active storage only for all pond components except the permanent pool.

Table 1B: Summary of SWM Pond 1 Operating Characteristics (Restrictive Downstream Conditions)

Pond Component	Pond Level (m)	Allowable Release Rate [(1)] (m^3/s)	Pond Release Rate (m^3/s)	Volume Used [(2)] (m^3)
Permanent Pool	92.350	N/A	N/A	45330
Quality Control	92.619	N/A	0.083	7989
Extended Detention	93.680	N/A	0.387	43875
2yr/24hr SCS	93.623	0.330	0.000	41689
5yr/24hr SCS	93.726	4.290	1.216	45694
10yr/24hr SCS	93.752	5.348	2.096	46706
25yr/24hr SCS	93.772	6.694	3.114	47549
50yr/24hr SCS	93.785	7.749	3.718	48046
100yr/24hr SCS	93.827	8.894	6.114	49793
July 1st, 1979	93.840	N/A	6.934	50348
August 4th, 1988	93.805	N/A	4.756	48865
August 8th, 1996	93.797	N/A	4.313	48540
100yr/10day Spring	94.202	N/A	3.010	66570

[(1)] 2-year erosion control release rate of 330 L/s, and 5- to 100-yr pre-development flows (refer to Table A-3 of Appendix A)
[(2)] Volumes are active storage only for all pond components except the permanent pool.

The above results show that the actual provided release rates do not exceed the allowable release rates for SWM Pond 1. Note that the maximum 100-year pond levels are 93.827 m for the 100-year SCS event and 94.202 m for the 100-year spring event; above the previously simulated 100-year water levels of 93.791 m and 94.198 m, respectively, from the March 2020 *Design Brief*. A 0.3 m freeboard is provided between these 100-year pond levels and the surrounding residential lots in the subdivision. The berm between the pond and the Van Gaal / Arbuckle Drain is to be raised to provide a 0.3 m freeboard above the 100-year SCS pond level, in accordance with the February 2014 *Richmond Village (South) Limited Subdivision / Hydraulic Analysis of Stormwater Management Pond 1 Berm* memo, without negatively impacting the performance of the pond or water levels on the drain.

Pond 1 has been equipped with three sediment forebays. Calculations for the minimum dispersion length, settling length and the average velocity in the forebays under these expanded conditions are presented in Calculation Sheets B-2, B-3 and B-4 of Attachment B. The forebay dimensions are sufficient to satisfy these MECP standards under the expanded drainage area conditions.

Sediment drying area calculations are also provided in Attachment B; note that the combined sediment drying area volume provided of 1960 m^3 is 212 m^3 short of the 2172 m^3 volume required to provide 10 years of sediment accumulation, but is sufficient to accommodate 9 years of sediment accumulation.

SWM Pond 1 has a permanent pool volume of 45,330 m^3, which is more than the minimum permanent pool volume the *SWMP Design Manual* requires for enhanced protection for a wet pond for the 199.723 ha drainage area at 34% imperviousness, as calculated below.

$$(140.00 - 40)\ m^3/ha \times 199.723\ ha = 19{,}972\ m^3$$

The required quality control volume of 7,989 m^3 (40 m^3/ha) for the 199.723 ha drainage area is contained within the extended detention volume at an elevation of 92.619 m.

Under 100% blockage of the outlet control structure, the 100-year pond level will be 93.828 m based on the updated modelling. The broad-crested quantity control weir set in the berm of the pond at an elevation of 93.68 m will also function as an emergency overflow weir under these conditions, and the downstream spillway will convey the 100-year outflow of 6.019 m^3/s at a velocity of 0.75 m/s and a flow depth of 17.9 cm at a slope of 0.5%, or a velocity of 2.63 m/s and a flow depth of 5.1 cm at a slope of 33.3%.

It may therefore be concluded that the operation of SWM Pond 1, with the expanded drainage area to the southeast, is in conformance with the requirements presented in the March 2020 *Design Brief for Stormwater Management Pond 1 Western Development Lands - Richmond*, with the exception of sediment drying areas, to be re-sized for a minimum of 10 years of sediment accummulation, and the 100-year SCS pond level, for which the berm between the pond and the Van Gaal / Arbuckle Drain is to be raised to provide a 0.3 m freeboard.

The impact of the proposed drainage area expansion on the 100-year hydraulic gradeline elevations within the development was also evaluated using updated DDSWMM / SWMHYMO / XPSWMM models for the 100-year 3-hour Chicago storm and the 100-year 24-hour SCS Type II storm. Table 2 presents the composite hydraulic gradeline results for the 100-year 3-hour Chicago and 100-year 24-hour SCS Type II design storms.

Table 2: Composite Hydraulic Gradeline Results for 100-Year Design Storms (Restr. Downstream Conditions)

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Freeboard [1] (m)
1	2	94.624	94.624	95.566	95.449	0.942
2	2a	94.624	94.620	95.449	95.449	0.825
2a	3	94.620	94.527	95.449	95.220	N/A
3	4	94.527	94.466	95.220	95.300	0.693
4	7	94.466	94.254	95.300	95.174	0.834
5	5a	94.544	94.543	95.298	95.378	0.754
5a	6	94.543	94.352	95.378	95.378	N/A
6	6a	94.352	94.348	95.378	95.378	1.026
6a	7	94.348	94.254	95.378	95.174	N/A
7	7a	94.254	94.182	95.174	95.174	0.920
7a	8	94.182	94.066	95.174	95.040	N/A
8	8a	94.066	94.052	95.040	95.199	0.974
8a	11	94.052	93.963	95.199	95.199	N/A
9	10	94.246	94.200	95.652	94.963	1.406
10	10a	94.200	94.199	94.963	95.199	0.763
10a	11	94.199	93.963	95.199	95.199	N/A
11	11a	93.963	93.883	95.199	95.199	1.236
11a	12	93.883	93.842	95.199	94.782	N/A
12	12a	93.842	93.836	94.782	94.964	0.940
12a	15	93.836	93.832	94.964	94.964	N/A
13	13a	93.839	93.838	95.250	95.201	1.411
13a	13b	93.838	93.836	95.201	95.201	N/A
13b	14	93.836	93.834	95.201	94.902	N/A
14	15	93.834	93.832	94.902	94.964	1.068
15	104b	93.832	93.829	94.964	94.500	1.132
16	17	94.677	94.534	94.979	95.298	0.302
17	17a	94.534	94.472	95.298	95.298	0.764
17a	18	94.472	94.434	95.298	95.030	N/A
18	19	94.434	94.399	95.030	95.094	0.596
19	23	94.398	94.261	95.094	95.383	0.696
20	20a	94.607	94.585	95.562	95.562	0.955
20	20b	94.607	94.610	95.562	95.562	0.955
20a	21	94.585	94.431	95.562	95.128	N/A
20b	24	94.610	94.418	95.562	95.243	N/A
21	21a	94.431	94.414	95.128	95.198	0.697
21a	22	94.414	94.330	95.198	95.198	N/A
22	23	94.330	94.261	95.198	95.383	0.868
23	105i	94.261	94.116	95.383	94.500	1.122
24	24a	94.418	94.415	95.243	95.320	0.825
24a	25	94.415	94.283	95.320	95.330	N/A
25	25a	94.283	94.277	95.330	95.320	1.047
25a	26	94.277	94.163	95.320	95.212	N/A
26	26a	94.163	94.125	95.212	95.352	1.049
26a	26b	94.125	94.104	95.352	95.352	N/A
26b	27	94.104	93.997	95.352	95.352	N/A
27	27a	93.997	94.019	95.352	95.352	1.355
27	27b	93.997	93.980	95.352	95.352	1.355
27a	B49	94.019	93.832	95.352	95.400	N/A
27b	107i	93.980	93.841	95.352	95.232	N/A
B49	B50	93.832	93.829	95.400	95.400	1.568
30	30a	94.213	94.254	95.372	95.372	1.159
30	31	94.213	94.136	95.372	95.212	1.159
30a	26	94.254	94.163	95.372	95.212	N/A

Table 2: Composite Hydraulic Gradeline Results for 100-Year Design Storms (Restr. Downstream Conditions)

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Freeboard [1] (m)
31	31a	94.136	94.123	95.212	95.212	1.076
31a	32	94.123	94.051	95.212	94.974	N/A
32	33	94.051	93.997	94.974	95.049	0.923
33	330	93.997	93.880	95.049	95.230	1.052
104b	Pond1	93.829	93.827	94.500	95.500	0.671
105i	106i	94.116	93.966	94.500	94.500	0.384
106i	108i	93.967	93.836	94.500	94.500	0.533
107i	1070	93.841	93.840	95.232	95.055	1.391
108i	109i	93.836	93.827	94.500	94.500	0.664
109i	Pond1	93.827	93.827	94.500	95.500	0.673
B50	Pond1	93.829	93.827	95.400	95.500	1.571
200	201	94.203	94.205	95.389	95.314	1.186
200	202	94.203	94.195	95.389	95.259	1.186
201	201a	94.205	94.206	95.314	95.314	1.109
201a	8	94.206	94.066	95.314	95.040	N/A
202	202a	94.195	94.195	95.259	95.296	1.064
202a	203	94.195	94.078	95.296	95.296	N/A
203	204	94.078	93.989	95.296	95.120	1.218
204	204a	93.989	93.984	95.120	95.250	1.131
204a	204b	93.984	93.841	95.250	95.250	N/A
204b	13	93.841	93.839	95.250	95.250	N/A
205	210	95.042	94.987	95.499	95.671	0.457
206	206a	95.072	95.071	95.476	95.499	0.404
206a	205	95.071	95.042	95.499	95.499	N/A
207	206	95.079	95.072	95.923	95.476	0.844
208	207	95.080	95.079	95.851	95.923	0.771
208	208a	95.080	95.076	95.851	95.851	0.771
208a	209	95.075	94.869	95.851	95.614	N/A
209	212	94.869	94.749	95.614	95.238	0.745
210	211	94.987	94.972	95.671	95.601	0.684
211	211a	94.972	94.960	95.601	95.614	0.629
211a	209	94.960	94.869	95.614	95.614	N/A
212	212a	94.749	94.740	95.238	95.550	0.489
212a	20	94.740	94.607	95.550	95.562	N/A
213	214	95.368	95.286	96.071	95.908	0.703
214	214a	95.286	95.276	95.908	95.918	0.622
214a	215	95.276	95.239	95.918	95.849	N/A
215	215a	95.239	95.176	95.849	95.849	0.610
215a	220	95.176	95.093	95.849	95.723	N/A
216	216a	95.319	95.335	95.972	95.972	0.653
216	217	95.319	95.315	95.972	95.900	0.653
216a	214	95.335	95.286	95.972	95.908	N/A
217	217a	95.315	95.309	95.900	95.900	0.585
217a	218	95.309	95.212	95.900	95.677	N/A
218	219	95.212	95.189	95.677	95.594	0.465
219	219a	95.189	95.178	95.594	95.733	0.405
219a	220	95.178	95.093	95.733	95.723	N/A
220	220a	95.093	94.912	95.723	95.733	0.630
220a	221	94.912	94.796	95.733	95.466	N/A
221	221a	94.796	94.730	95.466	95.515	0.670
221a	222	94.730	94.431	95.515	95.515	N/A
222	223	94.431	94.383	95.515	95.409	1.084
223	223a	94.382	94.346	95.409	95.409	1.027

Table 2: Composite Hydraulic Gradeline Results for 100-Year Design Storms (Restr. Downstream Conditions)

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Freeboard (1) (m)
223a	223b	94.346	94.299	95.409	95.409	N/A
223b	25	94.299	94.283	95.409	95.330	N/A
224	221	94.884	94.796	95.273	95.466	0.389
330	1070	93.880	93.840	95.230	95.055	1.350
1070	108i	93.840	93.836	95.055	94.500	1.215
1600	1600a	94.704	94.691	95.090	95.090	0.386
1600a	16	94.691	94.677	95.090	94.979	N/A
Pond1	Out	93.827	92.350	95.500	94.500	1.673
250	252	95.124	95.019	95.374	95.443	0.250
251	251a	95.056	95.125	95.502	95.502	0.446
251	251b	95.056	95.028	95.502	95.502	0.446
251	251c	95.056	95.061	95.502	95.502	0.446
251a	252	95.125	95.019	95.502	95.443	N/A
251b	251f	95.028	94.821	95.502	95.502	N/A
251c	251d	95.061	95.071	95.502	95.502	N/A
251e	263	95.078	95.054	95.502	95.626	N/A
252	252a	95.019	95.006	95.443	95.394	0.424
252a	252b	95.006	94.934	95.394	95.394	N/A
252b	254	94.934	94.892	95.394	95.182	N/A
254	254a	94.892	94.849	95.182	95.229	0.290
254	254c	94.892	94.922	95.182	95.180	0.290
254a	257	94.849	94.841	95.229	95.184	N/A
259a	257	94.917	94.841	95.282	95.184	N/A
254c	273	94.922	94.904	95.180	95.140	N/A
251f	256	94.821	94.764	95.502	95.262	N/A
256	256a	94.764	94.722	95.262	95.295	0.498
256a	261	94.722	94.648	95.295	95.253	N/A
251d	251e	95.071	95.078	95.502	95.502	N/A
258	258a	94.833	94.815	95.451	95.451	0.618
258a	261	94.815	94.648	95.451	95.253	N/A
259	259a	95.002	94.917	95.282	95.282	0.280
257	256	94.841	94.764	95.184	95.262	0.343
260	260a	94.717	94.716	95.319	95.319	0.602
260a	261	94.716	94.648	95.319	95.253	N/A
261	265	94.648	94.482	95.253	95.555	0.605
263	263a	95.054	94.973	95.626	95.626	0.572
263a	264	94.973	94.777	95.626	95.534	N/A
264	264a	94.777	94.669	95.534	95.534	0.757
264a	265	94.669	94.482	95.534	95.555	N/A
265	265a	94.482	94.231	95.555	95.555	1.073
265a	266	94.231	93.882	95.555	95.544	N/A
266	266a	93.882	93.875	95.544	95.550	1.662
266a	267	93.875	93.864	95.550	95.502	N/A
267	26701	93.864	93.834	95.502	95.532	1.638
270	270a	95.596	95.341	95.502	95.502	-0.094
270a	271	95.341	95.246	95.502	95.318	N/A
271	271a	95.246	95.047	95.318	95.320	0.072
271a	273	95.047	94.904	95.320	95.140	N/A
273	273a	94.904	94.779	95.140	95.140	0.236
273a	275	94.779	94.730	95.140	95.200	N/A
275	276	94.730	94.527	95.200	95.620	0.470
276	277	94.527	94.397	95.620	95.512	1.093
277	277a	94.397	94.257	95.512	95.512	1.115

Table 2: Composite Hydraulic Gradeline Results for 100-Year Design Storms (Restr. Downstream Conditions)

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Freeboard (1) (m)
277a	277b	94.257	94.126	95.512	95.512	N/A
277b	278	94.126	93.930	95.512	95.630	N/A
278	279	93.930	93.863	95.630	95.442	1.700
279	Pond1	93.863	93.827	95.442	95.500	1.579
280	266	93.922	93.882	95.452	95.544	1.530
328	263	95.147	95.054	95.697	95.626	0.550
329	329a	95.772	95.559	95.700	95.700	-0.072
329a	263	95.559	95.054	95.700	95.626	0.141
B1	B2	95.006	95.010	96.160	96.020	1.154
B1	B14	95.006	95.007	96.160	96.090	1.154
B2	B3	95.010	95.005	96.020	95.950	1.010
B3	B3a	95.005	95.000	95.950	95.950	0.945
B3a	B3b	95.000	94.929	95.950	95.950	0.950
B3b	B4	94.929	94.859	95.950	95.890	1.021
B4	B4a	94.859	94.861	95.890	95.890	1.031
B4a	B6	94.861	94.978	95.890	95.780	1.029
B5a	B6	95.059	94.978	95.780	95.780	0.721
B6	B6a	94.977	94.872	95.780	95.780	0.803
B6a	B7	94.873	94.626	95.780	95.630	0.907
B7	B7a	94.627	94.543	95.630	95.630	1.003
B7a	B13	94.542	94.425	95.630	95.490	1.088
B8	B9	95.448	95.229	95.670	95.640	0.222
B9	B11	95.229	95.043	95.640	95.620	0.411
B10	B10a	95.089	95.047	95.610	95.610	0.521
B10a	B11	95.047	95.043	95.610	95.620	0.563
B11	B11a	95.043	94.920	95.620	95.620	0.577
B11a	B12	94.920	94.715	95.620	95.550	0.700
B12	B13	94.714	94.425	95.550	95.490	0.836
B13	B13a	94.426	94.385	95.490	95.490	1.064
B13a	B20	94.385	94.270	95.490	95.400	1.105
B14	B14a	95.007	95.005	96.090	96.090	1.083
B14a	B14b	95.005	94.995	96.090	96.090	1.085
B14b	B14c	94.996	94.938	96.090	96.090	1.094
B14c	B15	94.938	94.853	96.090	95.800	1.152
B15	B15a	94.853	94.844	95.800	95.800	0.947
B15a	B15b	94.844	94.763	95.800	95.800	0.956
B15b	B17	94.763	94.740	95.800	95.600	1.037
B16	B16a	94.804	94.790	95.710	95.710	0.906
B16a	B17	94.790	94.740	95.710	95.600	0.920
B17	B17a	94.740	94.719	95.600	95.600	0.860
B17a	B18	94.719	94.532	95.600	95.430	0.881
B18	B18a	94.532	94.489	95.430	95.490	0.898
B18a	B19	94.489	94.381	95.490	95.490	1.001
B19	B20	94.380	94.270	95.490	95.400	1.110
B20	B21	94.270	94.020	95.400	95.400	1.130
B21	B49	94.020	93.832	95.400	95.400	1.380
26701	Pond1	93.834	93.827	95.532	95.500	1.698
f1	f2	98.272	98.263	98.250	98.230	-0.022
f2	f3	98.260	98.165	98.230	98.150	-0.030
f3	f4	98.165	98.140	98.150	98.130	-0.015
f4	f5	98.140	98.039	98.130	98.020	-0.010
f5	f600	98.039	97.937	98.020	97.900	-0.019
f18	f19	97.305	97.223	97.270	97.190	-0.035

Table 2: Composite Hydraulic Gradeline Results for 100-Year Design Storms (Restr. Downstream Conditions)

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Freeboard [1] (m)
f19	f200	97.223	97.124	97.190	97.120	-0.033
f23	f24	96.648	96.597	96.800	96.660	0.152
f24	f25	96.596	96.406	96.660	96.550	0.064
f25	f26	96.406	96.082	96.550	96.420	0.144
f26	f27	96.082	96.014	96.420	96.300	0.338
f27	f28	96.014	95.951	96.300	96.200	0.286
f28	f29	95.951	95.952	96.200	96.080	0.249
f29	B5a	95.952	95.059	96.080	95.780	0.128
f32	f33	96.807	96.664	96.760	96.630	-0.047
f33	f34	96.664	96.485	96.630	96.470	-0.034
f34	f35	96.485	96.355	96.470	96.300	-0.015
f35	f36	96.347	96.218	96.300	96.210	-0.047
f36	f38	96.216	96.127	96.210	96.120	-0.006
f38	f40	96.127	96.064	96.120	96.020	-0.007
f40	f41	96.056	95.896	96.020	95.890	-0.036
f41	f42	95.896	95.887	95.890	95.880	-0.006
f42	f526	95.881	95.802	95.880	95.790	-0.001
f70	f700	97.807	97.757	97.790	97.730	-0.017
f76	f125	96.085	95.906	97.020	97.020	0.935
f80	f90	97.583	97.551	97.560	97.540	-0.023
f90	f100	97.551	97.479	97.540	97.450	-0.011
f100	f110	97.479	97.345	97.450	97.340	-0.029
f110	f1200	97.345	97.263	97.340	97.240	-0.005
f120	f121	97.081	97.203	97.080	97.240	-0.001
f121	f122	97.203	96.798	97.240	97.180	0.037
f122	f123	96.798	96.579	97.180	97.100	0.382
f123	f76	96.579	96.085	97.100	97.020	0.521
f124	f1002	95.706	95.257	96.760	96.760	1.054
f125	f124	95.906	95.706	97.020	96.760	1.114
f130	f210	97.134	97.038	97.130	97.040	-0.004
f200	f210	97.125	97.038	97.120	97.040	-0.005
f210	f211	97.038	96.904	97.040	97.150	0.002
f211	f212	96.904	96.697	97.150	97.270	0.246
f212	f218	96.696	96.522	97.270	96.810	0.574
f213	f214	97.268	97.255	97.200	97.240	-0.068
f214	f215	97.251	97.150	97.240	97.150	-0.011
f215	f216	97.160	96.886	97.150	97.070	-0.010
f216	f217	96.886	96.598	97.070	96.980	0.184
f217	f218	96.598	96.522	96.980	96.810	0.382
f218	f800	96.522	96.067	96.810	96.800	0.288
f230	f23	96.824	96.648	96.840	96.800	0.016
f501	f504	96.821	96.833	96.800	96.820	-0.021
f504	f505	96.835	96.708	96.820	96.700	-0.015
f505	f507	96.708	96.678	96.700	96.670	-0.008
f507	f508	96.679	96.562	96.670	96.550	-0.009
f508	f509	96.562	96.507	96.550	96.470	-0.012
f509	f510	96.516	96.388	96.470	96.380	-0.046
f510	f511	96.388	96.299	96.380	96.280	-0.008
f511	f513	96.299	96.194	96.280	96.190	-0.019
f513	f514	96.195	96.011	96.190	96.010	-0.005
f514	f524	96.012	95.976	96.010	96.010	-0.002
f515	f516	96.572	96.427	96.560	96.420	-0.012
f516	f517	96.427	96.405	96.420	96.400	-0.007

Table 2: Composite Hydraulic Gradeline Results for 100-Year Design Storms (Restr. Downstream Conditions)

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Freeboard [1] (m)
f517	f519	96.405	96.341	96.400	96.320	-0.005
f519	f521	96.341	96.232	96.320	96.230	-0.021
f521	f522	96.233	96.148	96.230	96.210	-0.003
f522	f523	96.148	96.077	96.210	96.090	0.062
f523	f524	96.077	95.976	96.090	96.010	0.013
f524	f525	95.976	95.905	96.010	95.910	0.034
f525	f526	95.905	95.802	95.910	95.790	0.005
f526	B8	95.802	95.448	95.790	95.670	-0.012
f600	f70	97.937	97.807	97.900	97.790	-0.037
f700	f80	97.757	97.583	97.730	97.560	-0.027
f800	f124	96.067	95.706	96.800	96.760	0.733
f1002	f1003	95.256	94.873	96.760	96.760	1.504
f1003	f1007	94.873	94.628	96.760	96.760	1.887
f1007	f1008	94.628	94.180	96.760	96.760	2.132
f1200	f130	97.263	97.134	97.240	97.130	-0.023
f1800	f18	97.312	97.305	97.310	97.270	-0.002
f1801	f1800	97.417	97.312	97.410	97.310	-0.007
f1802	f1801	97.555	97.416	97.540	97.410	-0.015
f1803	f1802	97.627	97.555	97.610	97.540	-0.017

Note:

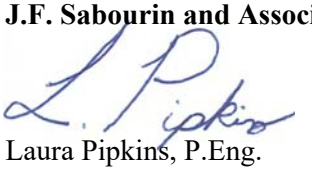
[1] Freeboard between upstream hydraulic gradeline elevation and upstream manhole cover elevation.

[3] Ponding allowed above manholes in undetailed future development areas to represent road surface storage above catchbasins.

As shown in Table 2, a minimum freeboard of 0 m between the 100-year hydraulic gradeline and the top of manhole elevations has been provided throughout the detailed areas of the subdivision, including the proposed Fox Run Phase 1 and Phase 2 subdivision, and the Mattamy Jock River Phase 1 subdivision.

As noted above, surface ponding was allowed in XPSWMM above manholes in future areas where the details of surface storage, catchbasins, etc. were not available for detailed incorporation into the XPSWMM model. The allowed surface ponding is intended to approximate road surface storage above catchbasins, to be confirmed at the detailed design stage. Less than 0 m freeboards were simulated at some future manholes as a result; however, storage used above the future manholes is within a reasonable range of what could feasibly be provided (typically less than what would be required to contain the 100-year flows in a conventional design where minor system capture is limited by inlet control devices), so it is feasible that future areas will perform well if designed similarly to Fox Run Phase 1 and Phase 2 or Mattamy Jock River Phase 1. That is, the 100-year water level would be above the surface at catchbasins, but not at manholes. For scale, a maximum 100-year unit surface storage volume of 81 m^3/ha was simulated for the 53.72 ha future development area to the south of the Moore Drain Tributary.

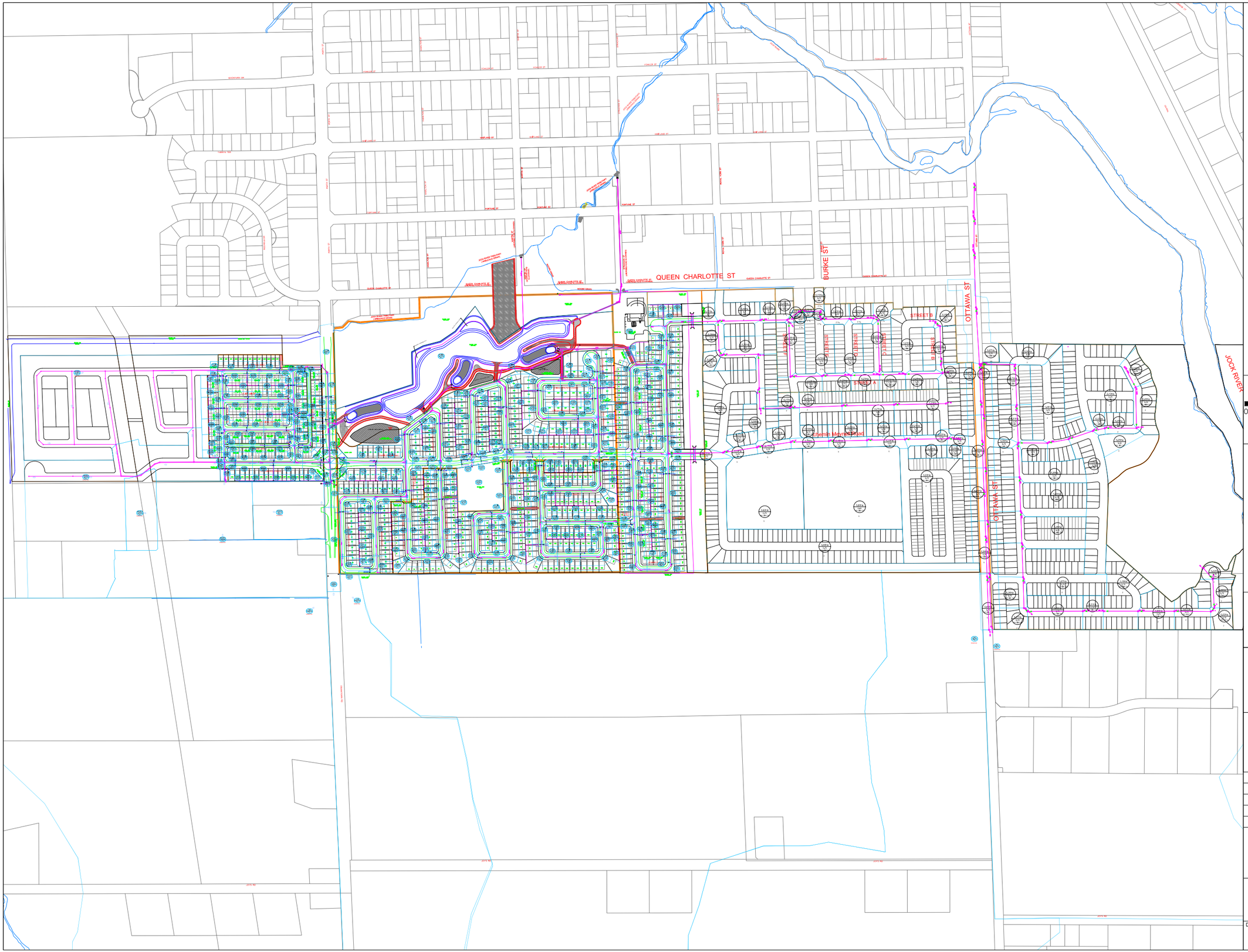
Yours truly,
J.F. Sabourin and Associates Inc.



Laura Pipkins, P.Eng.

cc: J.F. Sabourin, M.Eng, P.Eng.
Director of Water Resources Projects

Attachment A: Drainage Areas and Target Release Rates
Attachment B: Pond Controls - Quality, Extended Detention and Quantity



LEGEND :

- LIMITS OF SUBDIVISION
- MAJOR SYSTEM SUBCATCHMENT BOUNDARY TO LOW POINTS AND OTHER AREAS
- MAJOR SYSTEM FLOW DIRECTION
- FIRST DIRECTION OF EXCESS MAJOR SYSTEM FLOW AT LOW POINT
- LP009SW — LOW POINT
- A009SW / 0.063 ha / 43% — SUB-CATCHMENT ID / SUB-CATCHMENT AREA / TOTAL IMPERVIOUSNESS
- 0.32HA / 0.70 / MH1803 MH1862 — FUTURE SUB-CATCHMENT AREA / FUTURE SUB-CATCHMENT RUNOFF COEFF. / TRIBUTARY TO MANHOLE ID (U/S, D/S)

SCALE :

0 100 200 300 400 500m

J.F. Sabourin & Associates Inc.
WATER RESOURCES AND ENVIRONMENTAL CONSULTANTS
OTTAWA (613) 836-3884
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PROJECT :

WESTERN DEVELOPMENT LANDS
RICHMOND

	BY	DATE	DESCRIPTION	BY

EXPANDED DRAINAGE AREA TO SWM FACILITY

FIGURE 1

DESIGNED:
DRAWN: LP
VERIFIED: JFS
APPROVED: JFS

DRAWING REF.
922-11\202101 FSR\Design\CAD\
JFSA Figures.dwg

DATE: Feb/21
PROJECT No.: 922-11

ATTACHMENT

A

Drainage Areas and Target Release Rates

JFSA Water Resources and Environmental Consultants

Table A-1 : Drainage Area to SWM Facility

Segment ID [1]	Area (ha)	Imperviousness (%)	Area x Imp.
A002NE	0.072	61	4.392
A002NW	0.108	72	7.776
A002SE	0.198	72	14.256
A002SW	0.056	73	4.088
A005NE	0.050	74	3.700
A005NW	0.105	54	5.670
A005SE	0.090	69	6.210
A005SW	0.059	68	4.012
A006N1	0.035	43	1.505
A006NE	0.044	77	3.388
A006NW	0.046	76	3.496
A006R1	0.121	27	3.267
A006R2	0.113	26	2.938
A006R3	0.117	26	3.042
A006R4	0.087	18	1.566
A006R5	0.118	25	2.950
A006R6	0.106	24	2.544
A006R7	0.114	25	2.850
A006R8	0.042	25	1.050
A006SE	0.192	71	13.632
A006SW	0.192	69	13.248
A007NW	0.199	73	14.527
A007SE	0.094	72	6.768
A007SW	0.065	43	2.795
A008NE	0.103	74	7.622
A008NW	0.058	41	2.378
A008R1	0.113	27	3.051
A008R2	0.064	27	1.728
A008SE	0.138	70	9.660
A008SW	0.013	54	0.702
A009NW	0.047	79	3.713
A009SW	0.073	66	4.818
A010NE	0.125	74	9.250
A010NW	0.123	76	9.348
A010R1	0.135	24	3.240
A010R2	0.083	25	2.075
A010R3	0.154	21	3.234
A010SE	0.132	77	10.164
A010SW	0.147	74	10.878
A011NE	0.053	30	1.590
A011NW	0.053	53	2.809
A011SE	0.116	76	8.816
A011SW	0.053	53	2.809
A012NE	0.028	36	1.008
A012R1	0.040	19	0.760

Table A-1 : Drainage Area to SWM Facility

Segment ID [1]	Area (ha)	Imperviousness (%)	Area x Imp.
A012R2	0.138	26	3.588
A013N1	0.154	76	11.704
A013N2	0.045	38	1.710
A013NE	0.027	52	1.404
A013NW	0.052	40	2.080
A013R1	0.106	25	2.650
A013R2	0.128	24	3.072
A013R3	0.116	24	2.784
A013S1	0.155	78	12.090
A013S2	0.153	75	11.475
A013SE	0.027	48	1.296
A013SW	0.051	41	2.091
A016NE	0.087	76	6.612
A016NW	0.096	76	7.296
A017NE	0.073	36	2.628
A017NW	0.060	72	4.320
A017SE	0.172	73	12.556
A017SW	0.171	73	12.483
A020N1	0.039	72	2.808
A020N2	0.025	76	1.900
A020NE	0.049	78	3.822
A020NW	0.083	65	5.395
A020SW	0.109	78	8.502
A021NE	0.151	76	11.476
A021NW	0.087	70	6.090
A021R1	0.087	25	2.175
A021R2	0.147	24	3.528
A021R3	0.070	24	1.680
A021R4	0.052	24	1.248
A021SE	0.166	77	12.782
A021SW	0.168	71	11.928
A024NE	0.135	77	10.395
A024NW	0.122	74	9.028
A024R1	0.109	27	2.943
A024R2	0.114	28	3.192
A024R3	0.067	26	1.742
A024SE	0.127	75	9.525
A024SW	0.102	74	7.548
A025NE	0.078	71	5.538
A025NW	0.035	43	1.505
A025R1	0.156	26	4.056
A025R2	0.125	26	3.250
A025S1	0.076	46	3.496
A025SE	0.075	75	5.625
A025SW	0.066	50	3.300

Table A-1 : Drainage Area to SWM Facility

Segment ID [1]	Area (ha)	Imperviousness (%)	Area x Imp.
A026NE	0.031	74	2.294
A026R1	0.174	26	4.524
A026R2	0.195	17	3.315
A026R3	0.069	28	1.932
A026R4	0.123	28	3.444
A026R5	0.120	27	3.240
A026S1	0.041	41	1.681
A026SE	0.130	75	9.750
A026SW	0.036	42	1.512
A026WK1	0.018	59	1.062
A027N1	0.081	49	3.969
A027N2	0.140	74	10.360
A027NE	0.015	47	0.705
A027NW	0.122	64	7.808
A027S1	0.015	53	0.795
A027S2	0.042	69	2.898
A027SE	0.017	65	1.105
A027SW	0.133	74	9.842
A030NE	0.067	78	5.226
A030NW	0.142	76	10.792
A030R1	0.049	27	1.323
A030R2	0.124	27	3.348
A030R3	0.135	25	3.375
A030R4	0.087	27	2.349
A030SE	0.069	77	5.313
A030SW	0.144	70	10.080
A031NE	0.093	74	6.882
A031NW	0.105	64	6.720
A031R1	0.157	22	3.454
A031R2	0.146	26	3.796
A031R3	0.197	15	2.955
A031SE	0.082	35	2.870
A031SW	0.213	67	14.271
A1600N1	0.015	60	0.900
A1600N2	0.076	43	3.268
A1600NE	0.033	45	1.485
A1600NW	0.058	45	2.610
A1600PK1	0.963	29	27.927
A1600S1	0.018	56	1.008
A1600S2	0.054	59	3.186
A1600SE	0.028	54	1.512
A1600SW	0.055	49	2.695
A201NE	0.079	75	5.925
A201NW	0.079	75	5.925
A201R1	0.085	26	2.210

Table A-1 : Drainage Area to SWM Facility

Segment ID [1]	Area (ha)	Imperviousness (%)	Area x Imp.
A201R2	0.093	29	2.697
A201R3	0.118	26	3.068
A201R4	0.024	30	0.720
A201SE	0.082	64	5.248
A201SW	0.169	72	12.168
A202NE	0.053	76	4.028
A202NW	0.042	41	1.722
A202SE	0.109	70	7.630
A202SW	0.090	73	6.570
A204N1	0.053	80	4.240
A204N2	0.055	76	4.180
A204NE	0.088	74	6.512
A204NW	0.080	72	5.760
A204R1	0.036	28	1.008
A204R2	0.044	27	1.188
A204R3	0.017	26	0.442
A204R4	0.129	28	3.612
A204R5	0.091	26	2.366
A204R6	0.161	20	3.220
A204SE	0.180	75	13.500
A204SW	0.180	72	12.960
A206NE	0.062	40	2.480
A206NW	0.116	73	8.468
A206SE	0.134	73	9.782
A206SW	0.166	74	12.284
A208NE	0.078	73	5.694
A208NW	0.056	73	4.088
A208R1	0.106	27	2.862
A208R2	0.071	28	1.988
A208SE	0.160	72	11.520
A208SW	0.094	77	7.238
A211NE	0.024	77	1.848
A211NW	0.097	69	6.693
A211R1	0.079	28	2.212
A211R2	0.111	28	3.108
A211SE	0.033	43	1.419
A211SW	0.061	56	3.416
A212NE	0.097	63	6.111
A212NW	0.046	59	2.714
A212R1	0.134	28	3.752
A212R2	0.100	27	2.700
A212R3	0.021	28	0.588
A212SE	0.147	70	10.290
A212SW	0.052	60	3.120
A213R1	0.079	25	1.975

Table A-1 : Drainage Area to SWM Facility

Segment ID [1]	Area (ha)	Imperviousness (%)	Area x Imp.
A213R2	0.131	23	3.013
A214NE	0.151	77	11.627
A214NW	0.070	77	5.390
A214R1	0.077	27	2.079
A214R2	0.082	28	2.296
A214R3	0.111	27	2.997
A214R4	0.032	28	0.896
A214SE	0.056	75	4.200
A214SW	0.070	74	5.180
A215NW	0.108	80	8.640
A215SE	0.102	73	7.446
A216NE	0.041	39	1.599
A216NW	0.059	40	2.360
A216SE	0.096	77	7.392
A217NE	0.088	71	6.248
A217NW	0.099	74	7.326
A217SE	0.168	71	11.928
A217SW	0.099	74	7.326
A219NE	0.046	42	1.932
A219NW	0.113	74	8.362
A219R1	0.158	22	3.476
A219SE	0.070	67	4.690
A219SW	0.154	72	11.088
A220NE	0.127	74	9.398
A221N1	0.045	77	3.465
A221NE	0.119	73	8.687
A221NW	0.043	78	3.354
A221R1	0.130	27	3.510
A221R2	0.119	27	3.213
A221R3	0.125	24	3.000
A221SE	0.119	72	8.568
A221SW	0.065	40	2.600
A223N1	0.023	70	1.610
A223N2	0.076	47	3.572
A223NE	0.047	79	3.713
A223NW	0.031	44	1.364
A223R1	0.094	24	2.256
A223R2	0.120	22	2.640
A223R3	0.173	18	3.114
A223SE	0.203	70	14.210
A223SW	0.096	59	5.664
A224NE	0.018	54	0.972
A224NW	0.017	47	0.799
A224R1	0.024	26	0.624
A224SE	0.054	42	2.268

Table A-1 : Drainage Area to SWM Facility

Segment ID [1]	Area (ha)	Imperviousness (%)	Area x Imp.
A224SW	0.101	65	6.565
A250N1	0.066	76	5.016
A250NE	0.048	39	1.872
A250NW	0.018	38	0.684
A250R1	0.073	21	1.533
A250R2	0.051	21	1.071
A251E1	0.105	73	7.665
A251E2	0.114	58	6.612
A251N1	0.029	75	2.175
A251N2	0.031	44	1.364
A251N3	0.063	73	4.599
A251N4	0.046	70	3.220
A251NE	0.064	73	4.672
A251NW	0.084	75	6.300
A251R1	0.120	24	2.880
A251R2	0.088	28	2.464
A251R3	0.086	23	1.978
A251R4	0.047	19	0.893
A251S1	0.011	41	0.451
A251S3	0.062	36	2.232
A251S4	0.033	48	1.584
A251S5	0.066	70	4.620
A251S6	0.055	76	4.180
A251SE	0.075	60	4.500
A251SW	0.085	60	5.100
A251W1	0.038	88	3.344
A251W2	0.037	86	3.182
A252E1	0.014	47	0.658
A252NE	0.078	74	5.772
A252NW	0.102	68	6.936
A252R1	0.142	24	3.408
A252SE	0.078	73	5.694
A252SW	0.084	74	6.216
A252W1	0.078	76	5.928
A252W2	0.079	76	6.004
A254N2	0.016	34	0.544
A254NE	0.054	62	3.348
A254NW	0.030	40	1.200
A254R1	0.129	24	3.096
A254R2	0.029	22	0.638
A254R3	0.089	23	2.047
A254R4	0.057	24	1.368
A254S2	0.029	37	1.073
A254SE	0.103	58	5.974
A254SW	0.035	41	1.435

Table A-1 : Drainage Area to SWM Facility

Segment ID [1]	Area (ha)	Imperviousness (%)	Area x Imp.
A256NE	0.049	57	2.793
A256SE	0.031	63	1.953
A256SW	0.031	46	1.426
A258E1	0.034	47	1.598
A258NE	0.073	88	6.424
A258NW	0.074	91	6.734
A258SE	0.074	88	6.512
A258SW	0.074	91	6.734
A259N1	0.022	63	1.386
A259NE	0.058	94	5.452
A259NW	0.046	94	4.324
A259S1	0.026	63	1.638
A259SE	0.047	89	4.183
A259SW	0.039	93	3.627
A259W1	0.023	44	1.012
A259W2	0.024	43	1.032
A260NE	0.042	86	3.612
A260NW	0.049	72	3.528
A260SE	0.046	92	4.232
A260SW	0.051	57	2.907
A263NE	0.086	58	4.988
A263NW	0.038	64	2.432
A263SE	0.085	72	6.120
A263SW	0.038	69	2.622
A264NE	0.077	60	4.620
A264NW	0.110	60	6.600
A264R1	0.124	24	2.976
A264R2	0.098	24	2.352
A264R3	0.130	24	3.120
A264R4	0.080	23	1.840
A264SE	0.143	72	10.296
A264SW	0.106	66	6.996
A265NE	0.110	69	7.590
A265SW	0.117	75	8.775
A266NE	0.043	79	3.397
A266NW	0.077	63	4.851
A266SE	0.052	85	4.420
A266SW	0.060	51	3.060
A270E1	0.046	75	3.450
A270NE	0.134	73	9.782
A270NW	0.033	73	2.409
A270R1	0.158	24	3.792
A270SE	0.045	76	3.420
A270SW	0.084	74	6.216
A271NE	0.049	51	2.499

Table A-1 : Drainage Area to SWM Facility

Segment ID [1]	Area (ha)	Imperviousness (%)	Area x Imp.
A271NW	0.092	70	6.440
A271S2	0.082	73	5.986
A271SW	0.031	78	2.418
A273NE	0.112	70	7.840
A273NW	0.016	47	0.752
A273SE	0.071	91	6.461
A273SW	0.013	35	0.455
A277N1	0.323	69	22.287
A277N2	0.071	63	4.473
A277N3	0.129	61	7.869
A277NE	0.036	67	2.412
A277NW	0.066	68	4.488
A277S1	0.039	69	2.691
A277S2	0.072	66	4.752
A277SE	0.047	70	3.290
A277SW	0.086	64	5.504
A280N1	0.047	51	2.397
A280NW	0.046	80	3.680
A280R1	0.099	23	2.277
A280R2	0.032	7	0.224
A280S1	0.533	62	33.046
A280S2	0.087	61	5.307
A280SW	0.086	81	6.966
A329NE	0.037	76	2.812
A329NW	0.038	76	2.888
APOND1	6.472	56	362.432
APONDR1	0.138	24	3.312
APONDR2	0.043	19	0.817
APONDR3	0.167	23	3.841
APONDR4	0.022	7	0.154
B003N1	0.101	58	5.858
B003NE	0.106	74	7.844
B003NW	0.106	67	7.102
B003S1	0.075	63	4.725
B003SE	0.115	72	8.280
B003SW	0.087	73	6.351
B004NE	0.180	74	13.320
B004NW	0.060	47	2.820
B004SE	0.180	74	13.320
B004SW	0.067	75	5.025
B005NE	0.061	51	3.111
B005NW	0.061	52	3.172
B006NE	0.095	76	7.220
B006NW	0.099	74	7.326
B006SE	0.069	71	4.899

Table A-1 : Drainage Area to SWM Facility

Segment ID [1]	Area (ha)	Imperviousness (%)	Area x Imp.
B006SW	0.051	47	2.397
B007NE	0.109	73	7.957
B007NW	0.093	72	6.696
B007SE	0.113	72	8.136
B007SW	0.119	72	8.568
B010NE	0.107	70	7.490
B010NW	0.105	37	3.885
B010R1	0.024	28	0.672
B010R2	0.082	27	2.214
B011NE	0.122	63	7.686
B011NW	0.097	58	5.626
B011SE	0.109	70	7.630
B011SW	0.090	74	6.660
B013NE	0.050	54	2.700
B013NW	0.130	68	8.840
B013R1	0.048	29	1.392
B013R2	0.100	26	2.600
B013SE	0.043	41	1.763
B013SW	0.054	54	2.916
B014N1	0.036	62	2.232
B014N2	0.034	70	2.380
B014N3	0.069	72	4.968
B014NE	0.141	64	9.024
B014NW	0.030	42	1.260
B014R1	0.043	26	1.118
B014R2	0.090	26	2.340
B014R3	0.111	23	2.553
B014SE	0.096	69	6.624
B014SW	0.093	74	6.882
B014WK1	0.031	50	1.550
B015NE	0.072	56	4.032
B015NW	0.100	70	7.000
B015R1	0.079	25	1.975
B015R2	0.087	26	2.262
B015R3	0.104	26	2.704
B015R4	0.048	25	1.200
B015S1	0.070	77	5.390
B015S2	0.074	74	5.476
B015SE	0.094	77	7.238
B015SW	0.099	73	7.227
B016NW	0.129	75	9.675
B016SE	0.129	75	9.675
B017NE	0.059	51	3.009
B017SW	0.092	71	6.532
B018NE	0.111	78	8.658

Table A-1 : Drainage Area to SWM Facility

Segment ID [1]	Area (ha)	Imperviousness (%)	Area x Imp.
B018NW	0.115	76	8.740
B018R1	0.104	27	2.808
B018R2	0.108	27	2.916
B018R3	0.105	27	2.835
B018SE	0.130	76	9.880
B018SW	0.131	78	10.218
B018WK1	0.016	50	0.800
B020R1	0.024	7	0.168
B020R2	0.157	20	3.140
B020WK1	0.043	23	0.989
B021PS1	0.837	64	53.568
Undeveloped Areas			
VG-2	64.366	7	450.562
VG-5	34.992	7	244.944
Future Development Areas			
A270RE1	7.813	64	500.032
A328RE1	7.421	64	474.944
A329CM1	1.861	86	160.046
A329PK1	1.078	29	31.262
A329RE1	7.865	64	503.360
f23a	0.220	71	15.620
f23b	0.210	71	14.910
f23c	0.220	71	15.620
f24a	3.330	71	236.430
f24b	0.190	71	13.490
f24c	0.210	71	14.910
f25a	0.180	71	12.780
f25b	0.220	71	15.620
f26a	0.160	71	11.360
f26b	0.180	71	12.780
f26c	3.600	29	104.400
f27a	0.170	71	12.070
f27b	2.620	79	206.980
f27c	0.360	71	25.560
f28a	0.140	71	9.940
f28b	0.170	71	12.070
f29a	0.130	71	9.230
f29b	3.680	71	261.280
f32	1.230	71	87.330
f33	0.770	71	54.670
f34	0.630	71	44.730
f35	0.170	71	12.070
f36	0.580	71	41.180
f38	1.830	71	129.930
f40	0.700	71	49.700

Table A-1 : Drainage Area to SWM Facility

Segment ID [1]	Area (ha)	Imperviousness (%)	Area x Imp.
f41	0.150	71	10.650
f42	0.260	71	18.460
f230a	0.090	71	6.390
f230b	0.100	71	7.100
f501	0.180	71	12.780
f504	0.580	71	41.180
f505	0.340	71	24.140
f507	0.270	71	19.170
f508a	1.010	71	71.710
f508b	0.210	71	14.910
f509	0.230	71	16.330
f510	0.230	71	16.330
f511	0.350	71	24.850
f513	0.680	71	48.280
f514	0.050	71	3.550
f515	0.650	71	46.150
f516	0.150	71	10.650
f517	0.210	71	14.910
f519a	0.640	71	45.440
f519b	0.230	71	16.330
f521a	0.050	71	3.550
f521b	0.700	71	49.700
f522a	0.020	71	1.420
f522b	0.100	71	7.100
f523	0.020	71	1.420
f524a	0.150	71	10.650
f524b	0.250	71	17.750
f525	0.640	71	45.440
f526	0.170	71	12.070
Total	**199.723**	**34**	**6806.124**

[1] Refer to Figure 2

Weighted Average Imperviousness = S(Area x Imp) / Total Area = 6806.124 / 199.723 = 34 %

Table A-2 : Summary of Total Drainage Area

Land Use [1]	Area (ha)	Imperviousness (%)	Area x Imp.
to Pond 1	199.723	34	6806.124

[1] Refer to Figure 2.

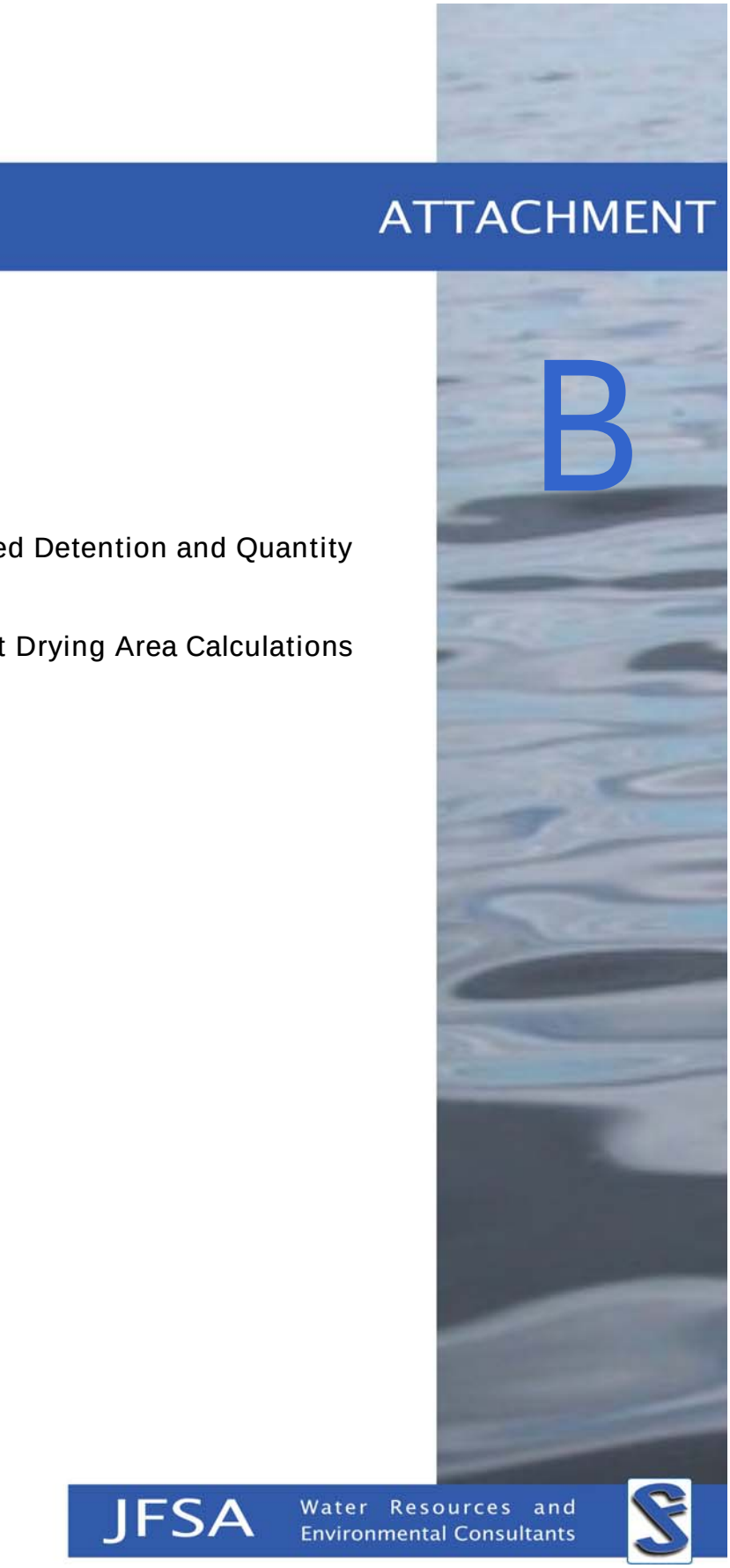
Weighted Average Imperviousness = S(Area x Imp) / Total Area = 6806.124 / 199.723 = 34 %

Table A-3: Target Release Rates for SWM Facility

Event	Pre-Development Release Rate [1] ($m^3/s/ha$)	Target Release Rate (m^3/s)
2-Year, 24-Hour SCS [2]	2.767	0.330
5-Year, 24-Hour SCS	4.290	4.290
10-Year, 24-Hour SCS	5.348	5.348
25-Year, 24-Hour SCS	6.694	6.694
50-Year, 24-Hour SCS	7.749	7.749
100-Year, 24-Hour SCS	8.894	8.894

[1] As per pre-development flows modelled in the January 2014 "*Richmond Village (South) Limited Subdivision / Preliminary Stormwater Management Plan*" memo.

[2] Target release rate based on erosion control of 2-year release rate to 330 L/s (per Parish Geomorphic erosion threshold; refer to January 2014 memo).



ATTACHMENT

B

Pond Controls – Quality, Extended Detention and Quantity

Sediment Drying Area Calculations

JFSA Water Resources and Environmental Consultants

Table B-1: Criteria for Required Storage Volumes

Pond	Area [1] (ha)	Imperviousness (%)	Storage Volume for Impervious Level [2] (m^3/ha)
N/A	N/A	35	140
Pond 1	199.723	34	140.00
N/A	N/A	55	190

[1] Refer to Appendix C for drainage areas to SWM Facility.

[2] Protection Level for Wet Pond: Enhanced 80% long-term S.S. removal. SWM Planning & Design Manual, Table 3.2, p.3-10 (March 2003).

Table B-2: Required Storage Volumes for SWM Facility

Pond Component	Required Volume (m^3)	Provided Volume [4] (m^3)	Volume Ratio	Provided Area [5] (m^2)	Provided Elevation (m)
Permanent Pool (PP) [1]	19972	45330	2.27	28938	92.350
Quality Control [2]	7989	7989	1.00	N/A	92.619
Extended Detention [3]	N/A	43875	N/A	N/A	93.680
Forebay (20% PP)	3994	N/A	N/A	6199	92.350
PP - Forebay	15978	N/A	N/A	22739	92.350
			Area Ratio (%) [6] =	21	

[1] Required PP volume based on Table B-1 (140.00 - 40 = 100.00 m^3/ha).

[2] Required quality control volume based on 40 m^3/ha.

[3] Extended detention based on 100-year summer flood level at the pond outfall.

[4] Provided volume based on stage-storage curve and extended detention (refer to Tables B-8 and B-9 of Appendix B).

[5] Based on grading plan provided by DSEL (refer to Figure 2).

[6] As per MOE, Maximum Forebay Area: 33% of Total Permanent Pool.

Table B-3: Extended Detention Parameters for SWM Facility

Permanent Pool Parameters			Baseflow Orifice Parameters			Quality Orifice Parameters		
Area (C3)	28938.05	m^2	Diameter	0.100	m	Diameter	0.300	m
Volume	45330.01	m^3						
PP Elev	92.350	m	Area	0.008	m^2	Area	0.071	m^2
QC Elev	92.619	m	Invert	92.100	m	Invert	92.350	m
h (m)	0.269	m	C_o	0.62		C_o	0.62	

Notes:
- C3 is the intercept from the area-depth linear regression.
- PP Elev indicates the elevation of the permanent pool.
- QC Elev indicates the elevation of the storage volume required by MOE for quality control.
- h is the maximum water elevation above the orifice (m).

Table B-4: Extended Detention Drawdown Time for SWM Facility

Elev.	Active Storage			C2	Drawdown Time	Drawdown Time	Flow	Demarkation
(m)	V (m^3)	A (m^2)	depth (m)	(m^2/m)	(h)	(days)	(m^3/s)	Point
92.35	**0.00**	**28938.05**	**0.00**				**0.011**	**PP Elev**
92.40	1447.42	28966.93	0.05	578	16.65	0.69	0.024	
92.45	2921.35	29497.69	0.10	5596	23.69	0.99	0.038	
92.50	4404.39	29790.67	0.15	5684	29.11	1.21	0.051	
92.55	5905.87	30117.00	0.20	5895	33.74	1.41	0.065	
92.60	7419.40	30403.23	0.25	5861	37.84	1.58	0.078	
92.619	**7989.00**	**30511.44**	**0.27**	**5857**	**39.27**	**1.64**	**0.083**	**QC Elev**
92.65	**8946.63**	**30693.36**	**0.30**	**5851**	**41.59**	**1.73**	**0.091**	
92.70	10489.71	30979.41	0.35	5832	45.06	1.88	0.114	
92.75	12047.14	31272.39	0.40	5836	48.33	2.01	0.136	
92.80	13618.54	31567.55	0.45	5843	51.43	2.14	0.156	
92.85	15204.56	31862.53	0.50	5849	54.39	2.27	0.176	
92.90	16806.83	32161.21	0.55	5860	57.23	2.38	0.196	
92.95	18424.87	32459.98	0.60	5870	59.97	2.50	0.214	
93.00	20054.22	32758.57	0.65	5878	62.63	2.61	0.231	
93.05	21698.57	33052.02	0.70	5877	65.20	2.72	0.246	
93.10	23361.36	33349.09	0.75	5881	67.70	2.82	0.260	
93.15	25037.25	33654.51	0.80	5896	70.16	2.92	0.274	
93.20	26728.92	33957.94	0.85	5906	72.55	3.02	0.286	
93.25	28425.62	34260.52	0.90	5914	74.90	3.12	0.298	
93.30	30162.12	34566.80	0.95	5925	77.21	3.22	0.310	
93.35	31900.53	34869.18	1.00	5931	79.47	3.31	0.321	
93.40	33804.14	35199.40	1.05	5963	81.72	3.40	0.332	
93.45	35591.37	35493.24	1.10	5959	83.90	3.50	0.342	
93.50	37203.33	35906.87	1.15	6060	86.17	3.59	0.353	
93.55	39003.77	36110.83	1.20	5977	88.21	3.68	0.362	
93.60	40793.68	38015.11	1.25	7262	91.83	3.83	0.372	
93.640	***42324.77***	***38434.78***	***1.29***	***7362***	***93.70***	***3.90***	***0.379***	***Summer FL***
93.65	42707.55	38539.70	1.30	7386	94.16	3.92	0.381	
93.680	**43874.50**	**38970.27**	**1.33**	**7543**	**95.66**	**3.99**	**0.387**	**Ext. Det.**
93.70	44652.47	39257.33	1.35	7644	96.66	4.03	0.690	
93.75	46640.54	40265.56	1.40	8091	99.45	4.14	2.359	
93.80	48678.10	41236.84	1.45	8482	102.20	4.26	4.807	
93.85	50750.08	41642.21	1.50	8469	104.37	4.35	7.833	
93.90	52847.68	42261.61	1.55	8596	106.75	4.45	11.341	
93.95	54989.42	43408.35	1.60	9044	109.69	4.57	15.273	
94.00	57180.79	44246.16	1.65	9278	112.30	4.68	19.585	

Notes:
- C2 is the slope coefficient from the area-depth linear regression.
- PP Elev indicates the elevation of the permanent pool.
- QC Elev indicates the elevation of the storage volume required by MOE for quality control, with a 24 to 48 hour drawdown time.

Table B-4: Extended Detention Drawdown Time for SWM Facility

Elev.	Active Storage			C2	Drawdown Time	Drawdown Time	Flow	Demarkation
(m)	V (m^3)	A (m^2)	depth (m)	(m^2/m)	(h)	(days)	(m^3/s)	Point

- Ext. Det. indicates the elevation of extended detention provided above the 100-year summer flood level at the pond outfall.
- Summer FL indicates the elevation of the 100-year summer flood level at the pond outfall.

Table B-5: Stage-Storage-Outflow Curve for Ultimate SWM Facility (Free Outfall Conditions)

			Baseflow Control 1		Quality Control 1		Erosion Control 1		Quantity Control 1			
			Vertical Orifice		Vertical Orifice		Vertical Orifice		Rectangular Weir			
			Dia (m)	0.100	Dia (m)	0.300	Dia (m)	0.270	L (m)	67.000		
									88.5 with 90° angle			
			Area (m^2)	0.008	Area (m^2)	0.071	Area (m^2)	0.057	C_w	1.58		
			Invert (m)	92.10	Invert (m)	92.35	Invert (m)	92.65	Invert (m)	93.68		
			C_o	0.62	C_o	0.62	C_o	0.62	n contr.	2		
			Q @ D	0.005	Q @ D	0.075	Q @ D	0.058				
Elevation	Active Sto.	Notes	Head	Outflow	Head	Outflow	Head	Outflow	Head	Outflow	Outflow	Storage
(m)	(m^3)		(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m^3/s)	(ha·m)
92.35	**0**	**PP Elev**	**0.250**	**0.011**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.011**	**0.000**
92.40	1447		0.300	0.012	0.050	0.013	0.000	0.000	0.000	0.000	0.024	0.145
92.45	2921		0.350	0.013	0.100	0.025	0.000	0.000	0.000	0.000	0.038	0.292
92.50	4404		0.400	0.014	0.150	0.038	0.000	0.000	0.000	0.000	0.051	0.440
92.55	5906		0.450	0.014	0.200	0.050	0.000	0.000	0.000	0.000	0.065	0.591
92.60	7419		0.500	0.015	0.250	0.063	0.000	0.000	0.000	0.000	0.078	0.742
92.619	**7989**	**QC Elev**	**0.519**	**0.016**	**0.269**	**0.067**	**0.000**	**0.000**	**0.000**	**0.000**	**0.083**	**0.799**
92.65	**8947**		**0.550**	**0.016**	**0.300**	**0.075**	**0.000**	**0.000**	**0.000**	**0.000**	**0.091**	**0.895**
92.70	10490		0.600	0.017	0.350	0.087	0.050	0.011	0.000	0.000	0.114	1.049
92.75	12047		0.650	0.017	0.400	0.097	0.100	0.021	0.000	0.000	0.136	1.205
92.80	13619		0.700	0.018	0.450	0.106	0.150	0.032	0.000	0.000	0.156	1.362
92.85	15205		0.750	0.019	0.500	0.115	0.200	0.043	0.000	0.000	0.176	1.520
92.90	16807		0.800	0.019	0.550	0.123	0.250	0.053	0.000	0.000	0.196	1.681
92.95	18425		0.850	0.020	0.600	0.130	0.300	0.064	0.000	0.000	0.214	1.842
93.00	20054		0.900	0.020	0.650	0.137	0.350	0.073	0.000	0.000	0.231	2.005
93.05	21699		0.950	0.021	0.700	0.144	0.400	0.081	0.000	0.000	0.246	2.170
93.10	23361		1.000	0.022	0.750	0.150	0.450	0.088	0.000	0.000	0.260	2.336
93.15	25037		1.050	0.022	0.800	0.157	0.500	0.095	0.000	0.000	0.274	2.504
93.20	26729		1.100	0.023	0.850	0.162	0.550	0.101	0.000	0.000	0.286	2.673
93.25	28426		1.150	0.023	0.900	0.168	0.600	0.107	0.000	0.000	0.298	2.843
93.30	30162		1.200	0.024	0.950	0.174	0.650	0.113	0.000	0.000	0.310	3.016
93.35	31901		1.250	0.024	1.000	0.179	0.700	0.118	0.000	0.000	0.321	3.190
93.40	33804		1.300	0.025	1.050	0.184	0.750	0.123	0.000	0.000	0.332	3.380
93.45	35591		1.350	0.025	1.100	0.189	0.800	0.128	0.000	0.000	0.342	3.559
93.50	37203		1.400	0.026	1.150	0.194	0.850	0.133	0.000	0.000	0.353	3.720
93.55	39004		1.450	0.026	1.200	0.199	0.900	0.138	0.000	0.000	0.362	3.900
93.60	40794		1.500	0.026	1.250	0.204	0.950	0.142	0.000	0.000	0.372	4.079
93.64	***42325***	***Summer FL***	***1.540***	***0.027***	***1.290***	***0.207***	***0.990***	***0.145***	***0.000***	***0.000***	***0.379***	***4.232***
93.65	42708		1.550	0.027	1.300	0.208	1.000	0.146	0.000	0.000	0.381	4.271
93.68	**43875**	**Ext. Det.**	**1.580**	**0.027**	**1.330**	**0.211**	**1.030**	**0.149**	**0.000**	**0.000**	**0.387**	**4.387**
93.70	44652		1.600	0.027	1.350	0.213	1.050	0.150	0.020	0.299	0.690	4.465
93.75	46641		1.650	0.028	1.400	0.217	1.100	0.154	0.070	1.960	2.359	4.664
93.80	48678		1.700	0.028	1.450	0.221	1.150	0.158	0.120	4.399	4.807	4.868
93.85	50750		1.750	0.029	1.500	0.226	1.200	0.162	0.170	7.416	7.833	5.075
93.90	52848		1.800	0.029	1.550	0.230	1.250	0.166	0.220	10.916	11.341	5.285
93.95	54989		1.850	0.029	1.600	0.234	1.300	0.170	0.270	14.840	15.273	5.499
94.00	57181		1.900	0.030	1.650	0.238	1.350	0.173	0.320	19.144	19.585	5.718
94.05	59423		1.950	0.030	1.700	0.242	1.400	0.177	0.370	23.799	24.247	5.942
94.10	61714		2.000	0.031	1.750	0.246	1.450	0.180	0.420	28.778	29.234	6.171
94.11	***62185***	***Spring FL***	***2.010***	***0.031***	***1.760***	***0.246***	***1.460***	***0.181***	***0.430***	***29.811***	***30.269***	***6.218***
94.15	64066		2.050	0.031	1.800	0.249	1.500	0.184	0.470	34.062	34.526	6.407
94.20	66471		2.100	0.031	1.850	0.253	1.550	0.187	0.520	39.633	40.105	6.647
94.25	68904		2.150	0.032	1.900	0.257	1.600	0.190	0.570	45.478	45.957	6.890
94.30	71364		2.200	0.032	1.950	0.260	1.650	0.194	0.620	51.584	52.070	7.136
94.35	73853		2.250	0.032	2.000	0.264	1.700	0.197	0.670	57.939	58.433	7.385
94.40	76369		2.300	0.033	2.050	0.268	1.750	0.200	0.720	64.535	65.035	7.637
94.45	78916		2.350	0.033	2.100	0.271	1.800	0.203	0.770	71.362	71.869	7.892
94.50	81485		2.400	0.033	2.150	0.275	1.850	0.206	0.820	78.413	78.927	8.148

Notes : - PP Elev indicates the elevation of the permanent pool.

- QC Elev indicates the elevation of the storage volume required by MOE for quality control.

- Ext. Det. indicates the elevation of extended detention provided above the 100-year summer flood level at the pond outfall.

Table B-5: Stage-Storage-Outflow Curve for Ultimate SWM Facility (Free Outfall Conditions)

			Baseflow Control 1		Quality Control 1		Erosion Control 1		Quantity Control 1			
			Vertical Orifice		Vertical Orifice		Vertical Orifice		Rectangular Weir			
			Dia (m)	0.100	Dia (m)	0.300	Dia (m)	0.270	L (m)	67.000		
									88.5 with 90° angle			
			Area (m^2)	0.008	Area (m^2)	0.071	Area (m^2)	0.057	C_w	1.58		
			Invert (m)	92.10	Invert (m)	92.35	Invert (m)	92.65	Invert (m)	93.68		
			C_o	0.62	C_o	0.62	C_o	0.62	n contr.	2		
			Q @ D	0.005	Q @ D	0.075	Q @ D	0.058				
Elevation	Active Sto.	Notes	Head	Outflow	Head	Outflow	Head	Outflow	Head	Outflow	Outflow	Storage
(m)	(m^3)		(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m^3/s)	(ha·m)

- Summer and Spring FL indicate the elevations of the 100-year summer and spring flood levels, respectively, at the pond outfall.

Table B-6: Stage-Storage-Outflow Curve for SWM Facility (Restrictive D/S Conditions; Summer Flood Level = 93.64 m)

			Baseflow Control 1		Quality Control 1		Erosion Control 1		Quantity Control 1			
			Vertical Orifice		Vertical Orifice		Vertical Orifice		Rectangular Weir			
			Dia (m)	0.100	Dia (m)	0.300	Dia (m)	0.270	L (m)	67.000		
									88.5 with 90° angle			
			Area (m^2)	0.008	Area (m^2)	0.071	Area (m^2)	0.057	C_w	1.58		
			Invert (m)	93.64	Invert (m)	93.64	Invert (m)	93.64	Invert (m)	93.68		
			C_o	0.62	C_o	0.62	C_o	0.62	n contr.	2		
			Q @ D	0.005	Q @ D	0.075	Q @ D	0.058				
Elevation	Active Sto.	Notes	Head	Outflow	Head	Outflow	Head	Outflow	Head	Outflow	Outflow	Storage
(m)	(m^3)		(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m^3/s)	(ha·m)
92.35	**0**	**PP Elev**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
92.40	1447		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.145
92.45	2921		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.292
92.50	4404		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.440
92.55	5906		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.591
92.60	7419		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.742
92.619	**7989**	**QC Elev**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.799**
92.65	**8947**		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.895**
92.70	10490		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.049
92.75	12047		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.205
92.80	13619		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.362
92.85	15205		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.520
92.90	16807		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.681
92.95	18425		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.842
93.00	20054		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.005
93.05	21699		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.170
93.10	23361		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.336
93.15	25037		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.504
93.20	26729		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.673
93.25	28426		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.843
93.30	30162		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.016
93.35	31901		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.190
93.40	33804		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.380
93.45	35591		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.559
93.50	37203		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.720
93.55	39004		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.900
93.60	40794		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.079
93.64	***42325***	***Summer FL***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***4.232***
93.65	42708		0.010	0.000	0.010	0.003	0.010	0.002	0.000	0.000	0.005	4.271
93.68	**43875**	**Ext. Det.**	**0.040**	**0.002**	**0.040**	**0.010**	**0.040**	**0.009**	**0.000**	**0.000**	**0.021**	**4.387**
93.70	44652		0.060	0.003	0.060	0.015	0.060	0.013	0.020	0.299	0.330	4.465
93.75	46641		0.110	0.005	0.110	0.028	0.110	0.024	0.070	1.960	2.017	4.664
93.80	48678		0.160	0.007	0.160	0.040	0.160	0.034	0.120	4.399	4.480	4.868
93.85	50750		0.210	0.009	0.210	0.053	0.210	0.045	0.170	7.416	7.522	5.075
93.90	52848		0.260	0.010	0.260	0.065	0.260	0.056	0.220	10.916	11.047	5.285
93.95	54989		0.310	0.011	0.310	0.078	0.310	0.066	0.270	14.840	14.994	5.499
94.00	57181		0.360	0.012	0.360	0.089	0.360	0.075	0.320	19.144	19.320	5.718
94.05	59423		0.410	0.013	0.410	0.099	0.410	0.082	0.370	23.799	23.993	5.942
94.10	61714		0.460	0.014	0.460	0.108	0.460	0.090	0.420	28.778	28.990	6.171
94.11	***62185***	***Spring FL***	***0.470***	***0.014***	***0.470***	***0.110***	***0.470***	***0.091***	***0.430***	***29.811***	***30.026***	***6.218***
94.15	64066		0.510	0.015	0.510	0.116	0.510	0.096	0.470	34.062	34.289	6.407
94.20	66471		0.560	0.015	0.560	0.124	0.560	0.103	0.520	39.633	39.876	6.647
94.25	68904		0.610	0.016	0.610	0.132	0.610	0.108	0.570	45.478	45.735	6.890
94.30	71364		0.660	0.017	0.660	0.139	0.660	0.114	0.620	51.584	51.853	7.136
94.35	73853		0.710	0.018	0.710	0.145	0.710	0.119	0.670	57.939	58.222	7.385
94.40	76369		0.760	0.018	0.760	0.152	0.760	0.124	0.720	64.535	64.829	7.637
94.45	78916		0.810	0.019	0.810	0.158	0.810	0.129	0.770	71.362	71.668	7.892
94.50	81485		0.860	0.019	0.860	0.164	0.860	0.134	0.820	78.413	78.730	8.148

Notes : - PP Elev indicates the elevation of the permanent pool.

- QC Elev indicates the elevation of the storage volume required by MOE for quality control.

- Ext. Det. indicates the elevation of extended detention provided above the 100-year summer flood level at the pond outfall.

Table B-6: Stage-Storage-Outflow Curve for SWM Facility (Restrictive D/S Conditions; Summer Flood Level = 93.64 m)

			Baseflow Control 1		Quality Control 1		Erosion Control 1		Quantity Control 1			
			Vertical Orifice		Vertical Orifice		Vertical Orifice		Rectangular Weir			
			Dia (m)	0.100	Dia (m)	0.300	Dia (m)	0.270	L (m)	67.000		
									88.5 with 90° angle			
			Area (m^2)	0.008	Area (m^2)	0.071	Area (m^2)	0.057	C_w	1.58		
			Invert (m)	93.64	Invert (m)	93.64	Invert (m)	93.64	Invert (m)	93.68		
			C_o	0.62	C_o	0.62	C_o	0.62	n contr.	2		
			Q @ D	0.005	Q @ D	0.075	Q @ D	0.058				
Elevation	Active Sto.	Notes	Head	Outflow	Head	Outflow	Head	Outflow	Head	Outflow	Outflow	Storage
(m)	(m^3)		(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m^3/s)	(ha·m)

- Summer and Spring FL indicate the elevations of the 100-year summer and spring flood levels, respectively, at the pond outfall.

Table B-7: Stage-Storage-Outflow Curve for SWM Facility (Restrictive D/S Conditions; Spring Flood Level = 94.11 m)

			Baseflow Control 1		Quality Control 1		Erosion Control 1		Quantity Control 1			
			Vertical Orifice		Vertical Orifice		Vertical Orifice		Rectangular Weir			
			Dia (m)	0.100	Dia (m)	0.300	Dia (m)	0.270	L (m)	67.000		
									88.5 with 90° angle			
			Area (m^2)	0.008	Area (m^2)	0.071	Area (m^2)	0.057	C_w	1.58		
			Invert (m)	94.11	Invert (m)	94.11	Invert (m)	94.11	Invert (m)	94.11		
			C_o	0.62	C_o	0.62	C_o	0.62	n contr.	2		
			Q @ D	0.005	Q @ D	0.075	Q @ D	0.058				
Elevation	Active Sto.	Notes	Head	Outflow	Head	Outflow	Head	Outflow	Head	Outflow	Outflow	Storage
(m)	(m^3)		(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m^3/s)	(ha·m)
92.35	**0**	**PP Elev**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
92.40	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
92.45	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
92.50	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
92.55	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
92.60	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
92.619	**0**	**QC Elev**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
92.65	**0**		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
92.70	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
92.75	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
92.80	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
92.85	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
92.90	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
92.95	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.00	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.05	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.10	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.15	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.20	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.25	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.30	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.35	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.40	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.45	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.50	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.55	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.60	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.64	***0***	***Summer FL***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***
93.65	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.68	**0**	**Ext. Det.**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
93.70	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.75	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.80	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.85	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.90	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93.95	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
94.00	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
94.05	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
94.10	0		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
94.11	***0***	***Spring FL***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***
94.15	1881		0.040	0.002	0.040	0.010	0.040	0.009	0.040	0.847	0.867	0.188
94.20	4286		0.090	0.004	0.090	0.023	0.090	0.019	0.090	2.857	2.904	0.429
94.25	6719		0.140	0.006	0.140	0.035	0.140	0.030	0.140	5.543	5.614	0.672
94.30	9180		0.190	0.008	0.190	0.048	0.190	0.041	0.190	8.762	8.859	0.918
94.35	11668		0.240	0.009	0.240	0.060	0.240	0.051	0.240	12.438	12.559	1.167
94.40	14184		0.290	0.011	0.290	0.073	0.290	0.062	0.290	16.518	16.663	1.418
94.45	16731		0.340	0.012	0.340	0.085	0.340	0.071	0.340	20.966	21.133	1.673
94.50	19300		0.390	0.013	0.390	0.095	0.390	0.079	0.390	25.753	25.940	1.930

Notes : - PP Elev indicates the elevation of the permanent pool. Volume below the elevation of the 100-year spring flood level treated as dead storage.

- QC Elev indicates the elevation of the storage volume required by MOE for quality control.

- Ext. Det. indicates the elevation of extended detention provided above the 100-year summer flood level at the pond outfall.

Table B-7: Stage-Storage-Outflow Curve for SWM Facility (Restrictive D/S Conditions; Spring Flood Level = 94.11 m)

			Baseflow Control 1		Quality Control 1		Erosion Control 1		Quantity Control 1			
			Vertical Orifice		Vertical Orifice		Vertical Orifice		Rectangular Weir			
			Dia (m)	0.100	Dia (m)	0.300	Dia (m)	0.270	L (m)	67.000		
									88.5 with 90° angle			
			Area (m^2)	0.008	Area (m^2)	0.071	Area (m^2)	0.057	C_w	1.58		
			Invert (m)	94.11	Invert (m)	94.11	Invert (m)	94.11	Invert (m)	94.11		
			C_o	0.62	C_o	0.62	C_o	0.62	n contr.	2		
			Q @ D	0.005	Q @ D	0.075	Q @ D	0.058				
Elevation	Active Sto.	Notes	Head	Outflow	Head	Outflow	Head	Outflow	Head	Outflow	Outflow	Storage
(m)	(m^3)		(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m^3/s)	(ha·m)

- Summer and Spring FL indicate the elevations of the 100-year summer and spring flood levels, respectively, at the pond outfall.

CALCULATION SHEET B-1: CONTROLS

Baseflow Control 1		
Vertical Circular Orifice		
Diameter	(m)	0.100
A_o	(m^2)	0.008
invert	(m)	92.10
C_o		0.62
100yr Water Level	(m)	93.827
Head of Water	(m)	1.727
Q_0	(m^3/s)	0.028
Orifice Equation:		
$Q_o = C_o A_o (2gh)^{0.5}$		
Not including reverse pipe losses		
Q_o *is the orifice flow*		
C_o *is the orifice coefficient*		
A_o *is the orifice flow area*		
g is the gravitational constant		
h is the head of water		

Quality Control 1		
Vertical Circular Orifice		
Diameter	(m)	0.300
A_o	(m^2)	0.071
invert	(m)	92.35
C_o		0.62
100yr Water Level	(m)	93.827
Head of Water	(m)	1.477
Q_0	(m^3/s)	0.224
Orifice Equation:		
$Q_o = C_o A_o (2gh)^{0.5}$		
Not including reverse pipe losses		
Q_o *is the orifice flow*		
C_o *is the orifice coefficient*		
A_o *is the orifice flow area*		
g is the gravitational constant		
h is the head of water		

Erosion Control 1		
Vertical Circular Orifice		
Diameter	(m)	0.270
A_o	(m^2)	0.057
Invert	(m)	92.65
C_o		0.62
100yr Water Level	(m)	93.827
Head of Water	(m)	1.177
Q_0	(m^3/s)	0.160
Orifice Equation:		
$Q_o = C_o A_o (2gh)^{0.5}$		
Q_o *is the orifice flow*		
C_o *is the orifice coefficient*		
A_o *is the orifice flow area*		
g is the gravitational constant		
h is the head of water		

Quantity Control 1		
Rectangular Weir		
L	(m)	67.000
C_w		1.58
Invert	(m)	93.680
n		2
Max Water Level	(m)	93.828
Head of Water	(m)	0.148
$Q_{w\ (100\%\ Blockage)}$	(m^3/s)	6.019
Note: Sloping Sides of weir are not considered in weir capacity (underestimated capacity)		
Weir Equation:		
$Qw = C_w (L-0.1nh) h^{1.5}$		
Qw is the weir flow		
Cw is the weir coefficient		
L is the weir length		
h is the weir height		
n is the # of side contractions		

Spillway Velocity - Minimum Slope		
Restangular Channel Equation: $Q = 1/n \times AR^{2/3}S^{1/2}$		
normal depth	(m)	0.179
n (roughness coef.)		0.03
W (width)	(m)	45.000
A (area of flow)	(m^2)	8.071
p (wetted perimeter)	(m)	45.359
R (hydraulic radius)	(m)	0.178
S (assumed slope)	(m/m)	0.005
Q (flow)	(m^3/s)	6.019
v (velocity)	(m/s)	0.75

Spillway Velocity - Maximum Slope		
Restangular Channel Equation: $Q = 1/n \times AR^{2/3}S^{1/2}$		
normal depth	(m)	0.051
n (roughness coef.)		0.03
W (width)	(m)	45.000
A (area of flow)	(m^2)	2.285
p (wetted perimeter)	(m)	45.102
R (hydraulic radius)	(m)	0.051
S (assumed slope)	(m/m)	0.333
Q (flow)	(m^3/s)	6.019
v (velocity)	(m/s)	2.63

CALCULATION SHEET B-2: FOREBAY SIZING FOR SWM FACILITY

WESTERN DEVELOPMENT LANDS - RICHMOND
SWM Pond 1
City of Ottawa
Calculation of Forebay Size
South Forebay

Settling Criteria

From the SWMP Manual, the required length for settling is as follows:

$$L_{min} = \left(\frac{r\,Q_p}{V_s}\right)^{0.5}$$

where:
- r = length to width ratio, at the invert of the inlet pipe.
- Q_p = peak outflow during design quality storm
- V_s = settling velocity

Input:

r =	3.07		(83 m / 27 m)
Q_p =	0.387	m^3/s	(at elevation 93.68 m)
V_s =	0.0003	m/s	

L_{min} = 62.95 m

The peak flow rate from the pond during the quality storm is taken as the flow that would occur just below the quantity controls (Refer to Table B-5 of Appendix B)

Dispersion Criteria

From the SWMP Manual, the required length for dispersion is as follows:

$$L_{min} = \frac{8\,Q}{d\,V_f}$$

where:
- Q = Inlet flowrate (10-Year, 24-Hour SCS Storm)
- d = depth of permanent pool (forebay)
- V_f = desired final velocity

Input:

Q =	7.762	m^3/s
d =	2.0	m
Vf =	0.5	m/s

L_{min} = 62.09 m

The minimum forebay length is determined by the larger of the settling or dispersion criteria.

Minimum Length of Forebay Required	62.95 m	
Length of Forebay Provided	**83.00 m**	(at elevation 92.35 m)

Average Forebay Velocity

From the SWMP Manual, the maximum allowable average velocity is 0.15 m/s:

$$V_{avg} = \frac{Q}{d\,W_{avg}}$$

where:
- Q = Inlet flowrate (10-Year, 24-Hour SCS Storm)
- d = depth of pond during peak 10-year inflow (12h:00min)
- W_{avg} = average width of forebay

Input:

Q =	7.762	m^3/s	
d =	2.58	m	
W_{avg} =	21	m	(15 m bottom, 27 m permanent pool)

V = 0.14 m/s < 0.15 m/s

CALCULATION SHEET B-3: FOREBAY SIZING FOR SWM FACILITY

WESTERN DEVELOPMENT LANDS - RICHMOND
SWM Pond 1
City of Ottawa
Calculation of Forebay Size
West Forebay

Settling Criteria

From the SWMP Manual, the required length for settling is as follows:

$$L_{min} = \left(\frac{r\,Q_p}{V_s}\right)^{0.5}$$

where:
- r = length to width ratio, at the invert of the inlet pipe.
- Q_p = peak outflow during design quality storm
- V_s = settling velocity

Input:

r =	2.39		(67 m / 28 m)
Q_p =	0.387	m^3/s	(at elevation 93.68 m)
V_s =	0.0003	m/s	

L_{min} = 55.54 m

The peak flow rate from the pond during the quality storm is taken as the flow that would occur just below the quantity controls (Refer to Table B-5 of Appendix B)

Dispersion Criteria

From the SWMP Manual, the required length for dispersion is as follows:

$$L_{min} = \frac{8\,Q}{d\,V_f}$$

where:
- Q = Inlet flowrate (10-Year, 24-Hour SCS Storm)
- d = depth of permanent pool (forebay)
- V_f = desired final velocity

Input:

Q =	1.094	m^3/s
d =	2.0	m
Vf =	0.5	m/s

L_{min} = 8.75 m

The minimum forebay length is determined by the larger of the settling or dispersion criteria.

Minimum Length of Forebay Required	55.54 m	
Length of Forebay Provided	**67.00 m**	(at elevation 92.35 m)

Average Forebay Velocity

From the SWMP Manual, the maximum allowable average velocity is 0.15 m/s:

$$V_{avg} = \frac{Q}{d\,W_{avg}}$$

where:
- Q = Inlet flowrate (10-Year, 24-Hour SCS Storm)
- d = depth of pond during peak 10-year inflow (12h:00min)
- W_{avg} = average width of forebay

Input:

Q =	1.094	m^3/s	
d =	2.58	m	
W_{avg} =	22	m	(16 m bottom, 28 m permanent pool)

V = 0.02 m/s < 0.15 m/s

CALCULATION SHEET B-4: FOREBAY SIZING FOR SWM FACILITY

WESTERN DEVELOPMENT LANDS - RICHMOND
SWM Pond 1
City of Ottawa
Calculation of Forebay Size
North Forebay

Settling Criteria

From the SWMP Manual, the required length for settling is as follows:

$$L_{min} = \left(\frac{r\,Q_p}{V_s}\right)^{0.5}$$

where:
- r = length to width ratio, at the invert of the inlet pipe.
- Q_p = peak outflow during design quality storm
- V_s = settling velocity

Input:

r =	3.04		(85 m / 28 m)
Q_p =	0.387	m^3/s	(at elevation 93.68 m)
V_s =	0.0003	m/s	

L_{min} = 62.56 m

The peak flow rate from the pond during the quality storm is taken as the flow that would occur just below the quantity controls (Refer to Table B-5 of Appendix B)

Dispersion Criteria

From the SWMP Manual, the required length for dispersion is as follows:

$$L_{min} = \frac{8\,Q}{d\,V_f}$$

where:
- Q = Inlet flowrate (10-Year, 24-Hour SCS Storm)
- d = depth of permanent pool (forebay)
- V_f = desired final velocity

Input:

Q =	5.071	m^3/s
d =	2.0	m
Vf =	0.5	m/s

L_{min} = 40.57 m

The minimum forebay length is determined by the larger of the settling or dispersion criteria.

Minimum Length of Forebay Required	62.56 m	
Length of Forebay Provided	**85.00 m**	(at elevation 92.35 m)

Average Forebay Velocity

From the SWMP Manual, the maximum allowable average velocity is 0.15 m/s:

$$V_{avg} = \frac{Q}{d\,W_{avg}}$$

where:
- Q = Inlet flowrate (10-Year, 24-Hour SCS Storm)
- d = depth of pond during peak 10-year inflow (12h:00min)
- W_{avg} = average width of forebay

Input:

Q =	5.071	m^3/s	
d =	2.58	m	
W_{avg} =	22	m	(16 m bottom, 28 m permanent pool)

V = 0.09 m/s < 0.15 m/s

Date: Feb 2021
File: 15-764BB

WESTERN DEVELOPMENT LANDS - RICHMOND
City of Ottawa
SWM Pond 1
North Sediment Drying Area

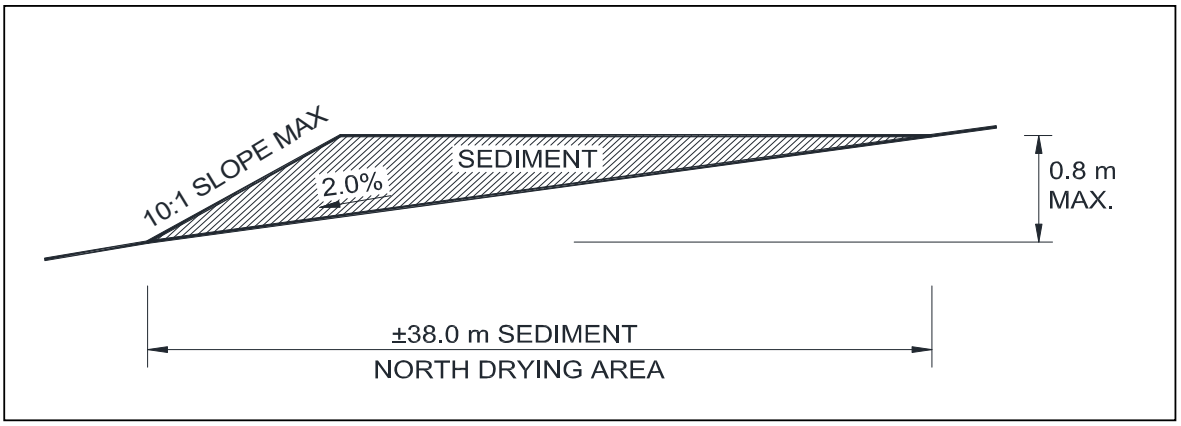
As per Table 6.3 in the MOE SWMP Manual, the annual sediment loading for this catchments will be 0.60 m^3/ha

Table 6.3 Annual Sediment Loadings

Catchement Imperviousness	Annual Loading (kg/ha)	Wet Density (kg/m^3)	Annual Loading (m^3/ha)
35%	770	1230	0.6
55%	2300	1230	1.9
70%	3495	1230	2.8
85%	4680	1230	3.8

Interpolate for Catchment Imperviousness of 22% - Annual Loading = 0.60 m^3/ha
Total Drainage Area = 140.386 ha

Sediment Drying Volume = min 10 yrs accumulation x annual loading x drainage area
Sediment Drying Volume = (10)*(0.6)*(140.386)
= 842 m^3



Provided Sediment Drying Area Capacity = 1155 m^3

BaseArea= 3800 m^2

Date: Feb 2021
File: 15-764BB

WESTERN DEVELOPMENT LANDS - RICHMOND
City of Ottawa
SWM Pond 1
West Sediment Drying Area

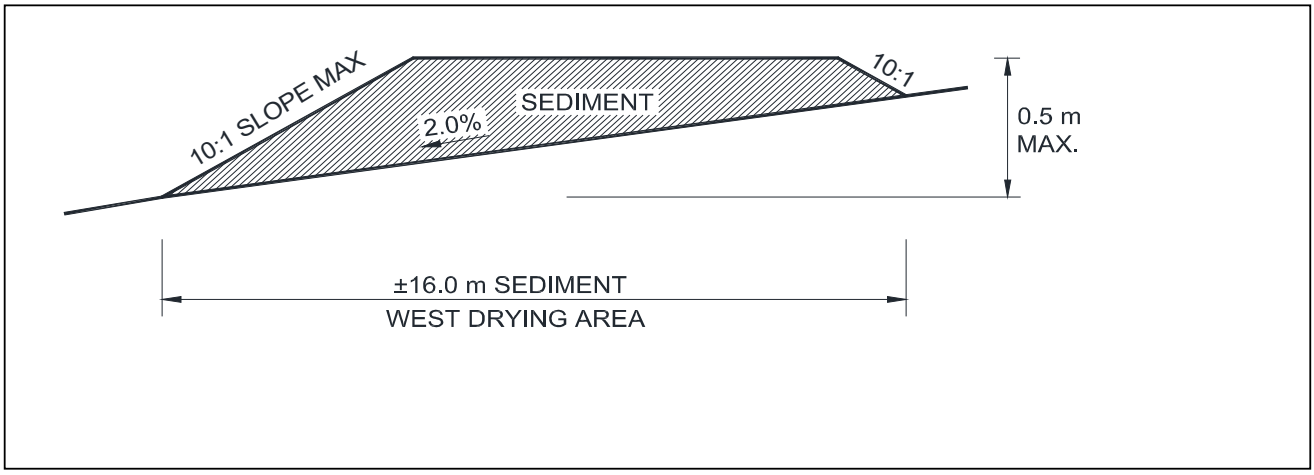
As per Table 6.3 in the MOE SWMP Manual, the annual sediment loading for this catchments will be 1.71 m^3/ha

Table 6.3 Annual Sediment Loadings

Catchement Imperviousness	Annual Loading (kg/ha)	Wet Density (kg/m^3)	Annual Loading (m^3/ha)
35%	770	1230	0.6
55%	2300	1230	1.9
70%	3495	1230	2.8
85%	4680	1230	3.8

Interpolate for Catchment Imperviousness of 52% - Annual Loading = 1.71 m^3/ha
Total Drainage Area = 7.701 ha

Sediment Drying Volume = min10 yrs accumulation x annual loading x drainage area
Sediment Drying Volume = (10)*(1.71)*(7.701)
= 132 m^3



Provided Sediment Drying Area Capacity = 177 m^3

BaseArea= 704 m^2

Date: Feb 2021
File: 15-764BB

WESTERN DEVELOPMENT LANDS - RICHMOND
City of Ottawa
SWM Pond 1
South Sediment Drying Area

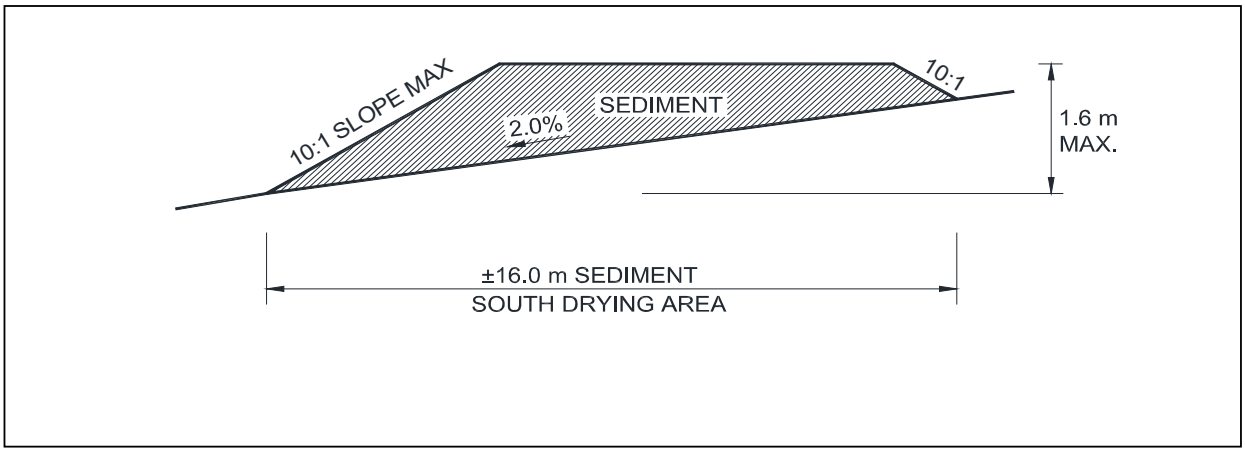
As per Table 6.3 in the MOE SWMP Manual, the annual sediment loading for this catchments will be 2.32 m^3/ha

Table 6.3 Annual Sediment Loadings

Catchement Imperviousness	Annual Loading (kg/ha)	Wet Density (kg/m^3)	Annual Loading (m^3/ha)
35%	770	1230	0.6
55%	2300	1230	1.9
70%	3495	1230	2.8
85%	4680	1230	3.8

Interpolate for Catchment Imperviousness of 62% - Annual Loading = 2.32 m^3/ha
Total Drainage Area = 51.636 ha

Sediment Drying Volume = min 10 yrs accumulation x annual loading x drainage area
Sediment Drying Volume = (10)*(2.32)*(51.636)
= 1198 m^3



Provided Sediment Drying Area Capacity = 628 m^3

BaseArea= 960 m^2