



Lawson Tate Properties
03.23.2022

City of Ponderay
Stormwater Calculation Memo

Attached are the Rational Method – Bowstring spreadsheets used to calculate the critical storm runoff rates and subsequent detention volumes required when the project is completed. Some explanation of the spreadsheets is probably required. The ITD IDF curves for the 25-Year storm events were used:

The pre-developed 25-Year runoff rate was first calculated (see *Pre-Developed 25 YR*) to determine a theoretical pre-developed runoff rate from the site for each storm checked using the Rational Method.

These time-dependent (Duration) events were then used on the Post-Developed sheet (see *Post-developed 25 YR*) as a theoretical maximum release rate allowed. The soil type was also used in the Post-Developed sheet to calculate a theoretical infiltration rate using the grassed infiltration areas (GIAs) proposed. This left us with a detention requirement in the Post-Developed condition that centered on the 24-Hour 25-Year event (6,316 CF of detention would be required). The proposed stormwater detention area along the northern property boundary is has a volume of 8,095 CF at an average depth of 18-inches.

The Treatment Area required is calculated based upon the impervious area on the site. The Required Treatment Volume (the first ½” of runoff from all impervious areas) was found to be 1,691 CF. At an average depth of 8-inches, the proposed stormwater treatment area has a volume 3,596 CF.

The Operation and Maintenance Plan for the proposed erosion and stormwater control measures were included as notes on the stormwater and grading plan.

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Stormwater Management Calculations
Rational Method
Pre-Developed 25 Year

Pre-Developed

Runoff from Table 6-2 Kennedy report

		Area(ft ²)	Area(acres)	CN	Runoff C	CA
Existing Road		1377	0.04	90	0.90	0.04
Industrial Areas Light	Flat	50873	1.17	88	0.50	0.59
	Totals	52250	1.210	178	1.40	0.62

Predeveloped "C" 0.51

Time increment 5 min
 Time of concentration 10.6252886 min
 Outflow 0 cfs 1) input outflow (0.3 cfs 600 gal drywell,
 Design year 25 1.0 cfs 1000 gal drywell)
 Area (sqft) 52250 sqft 2) input surface area for basin (in sqft)
 Area (acres) 1.20 3) input the basins "C" factor
 Area x "C" 0.62
 Developed "C" factor 0.51

Time Inc. (min)	Time Inc. (sec)	Intensity (in / hr)	Q (cfs)	Volume (cf)
5	300	2.80	1.72	693
10	600	2.10	1.29	1039
11	660	2.00	1.23	1079
12	720	1.90	1.17	1096
13	780	1.85	1.14	1135
14	840	1.75	1.08	1138
15	900	1.70	1.05	1169
20	1200	1.60	0.98	1395
25	1500	1.40	0.86	1480
30	1800	1.20	0.74	1490
35	2100	1.10	0.68	1569
40	2400	0.95	0.58	1530
45	2700	0.90	0.55	1616
50	3000	0.87	0.54	1723
55	3300	0.85	0.52	1840
60	3600	0.78	0.48	1833
65	3900	0.75	0.46	1901
70	4200	0.70	0.43	1903
75	4500	0.69	0.42	2004
80	4800	0.67	0.41	2069
85	5100	0.65	0.40	2127
90	5400	0.63	0.39	2178
95	5700	0.60	0.37	2185
100	6000	0.59	0.36	2258
105	6300	0.58	0.36	2327
110	6600	0.55	0.34	2308
115	6900	0.52	0.32	2278
120	7200	0.5	0.31	2283
125	7500	0.49	0.30	2305
130	7800	0.48	0.29	2347
135	8100	0.48	0.29	2434
140	8400	0.46	0.28	2420
145	8700	0.45	0.27	2451
150	9000	0.44	0.27	2479
155	9300	0.43	0.26	2503
160	9600	0.42	0.26	2524
165	9900	0.41	0.25	2541
170	10200	0.40	0.25	2555
175	10500	0.39	0.24	2565
180	10800	0.38	0.23	2571
360	21600	0.25	0.15	3358
720	43200	0.17	0.11	4566
1440	86400	0.11	0.07	5777

24 Hr Storm

25 year design (store or discharge 25 year / 2-hour storm event)
 24-Hour Volume (pre-developed) 5777 cu ft

Time of concentration calculation

n = manning roughness(Gravel)	0.035	USDA
p=2 year, 24 hour rainfall	2	
Slope (S)	0.01	
Length (L)	250 feet	
$T_c = [0.007(nL)^{0.8}] / (((P)^{0.50}) * S^{0.4}) * 60$	10.6252886 min	



Stormwater Management Calculations
Rational Method

25-Year Storms

Post-Developed

Post-Developed Runoff and Developed "C" Factor

	Area(ft ²)	Area(acres)	Runoff	C*A	
Gravel	17500	0.41	0.90	0.37	excluded areas under roof + existing road
Building	21952	0.51	0.90	0.46	
Misc	912	0.03	0.60	0.02	Patio/ Bike Area
Landscape	11886	0.28	0.20	0.06	Greenspace and Miscellaneous Area (not under roof)
Totals	52250	1.2300	2.60	0.90	

Developed "C" 0.73

Time increment 5 min
 Time of concentration 5 min
 Outflow (infiltration) 0.0223 cfs
 Design year 25
 Area (sqft) 52250 sqft
 Area (acres) 1.20 Ac
 Area x "C" 0.88
 Developed "C" factor 0.73

Exfiltration through engineered soils
 1) input outflow (0.3 cfs 600 gal drywell, 1.0 cfs 1000 gal drywell)
 2) input surface area for basin (in sqft)
 3) input the basins "C" factor
 Weighted value

Time Inc. (min)	Time Inc. (sec)	Intensity (in /hr)	Q dev (cfs)	V in	Q pre (cfs)	V pre	Predeveloped Release		Infiltration Release		Controlled Release Combined Storage Required
							Storage No Infiltration	V infl	Storage Required Infiltration only		
5	300	2.80	2.46	990	1.72	693	297	6.69	983	290	
10	600	2.10	1.85	1297	1.29	1039	257	13.39	1283	244	
11	660	2.00	1.76	1341	1.23	1079	261	14.72	1326	246	
12	720	1.90	1.67	1374	1.17	1096	278	16.06	1358	262	
13	780	1.85	1.63	1435	1.14	1135	300	17.40	1418	283	
14	840	1.75	1.54	1450	1.08	1138	312	18.74	1431	293	
15	900	1.70	1.50	1498	1.05	1169	330	20.08	1478	310	
20	1200	1.60	1.41	1832	0.98	1395	437	26.77	1806	410	
25	1500	1.40	1.23	1973	0.86	1480	493	33.46	1939	460	
30	1800	1.20	1.06	2008	0.74	1490	518	40.16	1968	478	
35	2100	1.10	0.97	2131	0.68	1569	562	46.85	2084	515	
40	2400	0.95	0.84	2091	0.58	1530	560	53.54	2037	507	
45	2700	0.90	0.79	2218	0.55	1616	602	60.23	2158	542	
50	3000	0.87	0.77	2374	0.54	1723	651	66.93	2307	584	
55	3300	0.85	0.75	2544	0.52	1840	703	73.62	2470	630	
60	3600	0.78	0.69	2540	0.48	1833	707	80.31	2460	627	
65	3900	0.75	0.66	2640	0.46	1901	739	87.01	2553	652	
70	4200	0.70	0.62	2649	0.43	1903	746	93.70	2555	652	
75	4500	0.69	0.61	2793	0.42	2004	790	100.39	2693	689	
80	4800	0.67	0.59	2889	0.41	2069	820	107.08	2782	713	
85	5100	0.65	0.57	2974	0.40	2127	847	113.78	2861	733	
90	5400	0.63	0.55	3049	0.39	2178	871	120.47	2929	750	
95	5700	0.60	0.53	3062	0.37	2185	877	127.16	2935	750	
100	6000	0.59	0.52	3167	0.36	2258	909	133.85	3033	775	
105	6300	0.58	0.51	3266	0.36	2327	939	140.55	3126	799	
110	6600	0.55	0.48	3242	0.34	2308	934	147.24	3095	787	
115	6900	0.52	0.46	3203	0.32	2278	925	153.93	3049	771	
120	7200	0.5	0.44	3212	0.31	2283	929	160.63	3051	768	
125	7500	0.49	0.43	3244	0.30	2305	939	167.32	3077	772	
130	7800	0.48	0.42	3305	0.29	2347	958	174.01	3131	784	
135	8100	0.48	0.42	3431	0.29	2434	996	180.70	3250	815	
140	8400	0.46	0.40	3412	0.28	2420	992	187.40	3224	804	
145	8700	0.45	0.39	3458	0.27	2451	1006	194.09	3263	812	
150	9000	0.44	0.38	3498	0.27	2479	1019	200.78	3297	818	
155	9300	0.43	0.38	3534	0.26	2503	1030	207.47	3326	823	
160	9600	0.42	0.37	3564	0.26	2524	1040	214.17	3350	826	
165	9900	0.41	0.36	3590	0.25	2541	1049	220.86	3369	828	
170	10200	0.40	0.35	3610	0.25	2555	1055	227.55	3382	828	
175	10500	0.39	0.34	3625	0.24	2565	1061	234.24	3391	826	
180	10800	0.38	0.33	3635	0.23	2571	1064	240.94	3394	823	
360	21600	0.25	0.22	4772	0.15	3358	1415	481.88	4291	933	
720	43200	0.17	0.15	6507	0.11	4566	1941	963.75	5543	977	
1440	86400	0.11	0.10	8243	0.07	5777	2467	1927.50	6316	539	

25 year design (store or infiltrate 25 year peak flow and volume)
 24 Hour Storm Volume 8243 cu ft
 24 Hour Infiltration 1928 cu ft
 Peak Storm 1440.00 Min
 Peak Storm Volume 8243 cu ft

Discharge Control Structure Without Infiltration

Developed Runoff 0.10 cfs discharge control structure req
 Required Storage 2467 cu ft no infiltration

Discharge Control Structure With Infiltration

Infiltration Rate 1.3385 CFM discharge rate through infiltration
 Required Storage with Controlled Release 977 cu ft with a discharge control structure

Infiltration Only (No Discharge)

Infiltration Rate 1.3385 CFM discharge rate through infiltration Selected method
 Required storage 6316 cu ft low infiltration rate used

Overall Treatment Req and Soil Infiltration Rate

Impervious Area 39,452 SF
 Req Treatment 1,643.83 CF
 Req Treatment Area (8" depth) 2,465.75 SF
 Proposed Infiltration Area 7,710 SF
 Proposed Treatment Volume 3,598 CF
 Design Infiltration Rate 0.125 in/hr
 Infiltration Outflow Rate 0.0223 CFS

Proposed Grassed Infiltration Area for Controlled Release

7,710 Proposed Area (SF)
 0.66 Depth (ft)
 3,598 Proposed Volume (CF)
 Soil Infiltration Rate 0.125 in/hr
 Infiltration Outflow Rate 0.0223 CFS