



CASTLE ROCK CITY COUNCIL AGENDA

Regular Meeting: Monday, June 23, 2025
7:30 PM

Location

Castle Rock Senior Center
222 Second Ave SW
Castle Rock, WA 98611

AGENDA

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1. CALL TO ORDER

- a. Pledge of Allegiance
- b. Roll Call
- c. Changes to Agenda

2. PROCLAMATIONS & PRESENTATIONS

3. CITIZEN COMMENTS - maximum 3 minutes

4. DEPARTMENT REPORTS

- City Attorney Nikki Thompson
- Police Chief Charlie Worley
- Public Works Director Dave Vorse / Assistant Director Tyler Stone
- City Engineer Tom Gower
- Clerk-Treasurer Carie Cuttonaro

1. Expenditure, Revenue, Cash & Investments Reports (page 3-6)

5. COUNCIL AND AD HOC COMMITTEE REPORTS

- Mayor / Mayor Pro-Tempore / Councilmembers
- CRCDA Representative

6. PUBLIC HEARINGS

- a. To take public testimony on the City's Six-Year Transportation Plan for fiscal years 2026-2031. (page 7-18)

7. CONSENT AGENDA

- a. June 9, 2025 Regular Council Meeting Minutes (page 19-20)

8. OLD BUSINESS

9. NEW BUSINESS

- a. Resolution No. 2025-04, a resolution relating to the Six-Year Transportation Improvement Plan. (page 21)
- b. Estimated budget for Cathodic Protection Engineering, Materials & Installation on water reservoir, with a range of \$41,954 - \$44,954. Additional estimate for installation without tank drained is \$6,093. (page 22-23)

c. Request approval to purchase two dump trucks from Cowlitz County Department of Public Works. (page 24-25)

d. Staff Report: Substantial Shoreline Development Permit to Construct Stormwater Outfall (page 26-1,116)

e. Special Event Permit #2025-0007; Castle Rock Fair Parade; July 17, 2025 at 6:00 PM. Insurance will be provided. Street closure request includes: (page 1,117-1,122)

- Huntington Ave S
- Cowlitz St W
- 2nd Ave SW
- B St SW
- Front Ave S

10. OTHER BUSINESS

11. ADJOURNMENT

NEXT REGULAR COUNCIL MEETINGS:

<u>3Q25</u>	<u>4Q25</u>	<u>1Q26</u>	<u>2Q26</u>
July 14	October 13	January 12	April 13
July 28	October 27	January 26	April 27
August 11	November 10	February 09	May 11
August 25	November 24	February 23	Tuesday, May 26
September 08	December 08	March 09	June 08
September 22	December 22	March 23	June 22

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Title VI: The City of Castle Rock ensures compliance with Title VI of the Civil Rights Act of 1964 and American Disabilities Act of 1990 by prohibiting discrimination against any person on the basis of race, color, national origin, sex or disabilities in the provision of benefits and services from its federal assisted programs and activities. If you need special accommodations to participate in this meeting, please contact Carie Cuttonaro at 360.274.8181 by 9:00 a.m. three days prior to the meeting.

City Council may add and take action on other items not listed on this Agenda.

2025 Expenditures

<u>Fund</u>	<u>Sub</u>	<u>#</u>	<u>January</u>	<u>February</u>	<u>March</u>	<u>April</u>	<u>May</u>	<u>Total</u>	<u>Budget</u>	<u>Remaining</u>	<u>% Expended</u>
General											
	Legislative	010 0 010	7,310.07	5,959.47	6,670.09	5,012.29	5,040.22	29,992.14	87,158.00	57,165.86	34.41%
	Municipal	010 0 020	9,012.76	4,444.58	9,591.98	7,850.03	5,712.08	36,611.43	95,510.00	58,898.57	38.33%
	Financial	010 0 030	20,019.85	11,837.31	12,018.13	12,353.85	12,087.99	68,317.13	165,355.00	97,037.87	41.32%
	Law Enforcement	010 0 040	212,753.20	75,339.50	110,745.90	105,260.17	93,049.39	597,148.16	1,335,759.00	738,610.84	44.70%
	Parks	010 0 060	4,223.17	449.58	125.84	478.20	294.60	5,571.39	23,863.00	18,291.61	23.35%
	Building/Planning	010 0 070	15,841.22	11,569.55	32,109.44	22,298.18	11,557.93	93,376.32	150,030.00	56,653.68	62.24%
	Non-Departmental	010 0 099	35,248.67	13,216.31	234,363.18	5,898.74	5,390.48	294,117.38	480,423.00	186,305.62	61.22%
General Total		010	304,408.94	122,816.30	405,624.56	159,151.46	133,132.69	1,125,133.95	2,338,098.00	1,212,964.05	48.12%
Streets		100	17,328.39	21,781.84	33,492.81	10,201.42	8,729.64	91,534.10	326,053.00	234,518.90	28.07%
Building Code		115	2,476.37	2,000.91	3,841.89	2,015.73	2,056.23	12,391.13	48,590.00	36,198.87	25.50%
Visitor Center		120	2,365.12	634.41	597.81	2,255.57	637.12	6,490.03	20,689.00	14,198.97	31.37%
Library		130	8,057.56	1,288.47	650.75	366.13	537.52	10,900.43	17,090.00	6,189.57	63.78%
Criminal Justice		140	-	-	-	142.50	-	142.50	1,667.00	1,524.50	8.55%
Local Criminal Justice		145	5,486.00	13,430.45	119.19	7,046.20	67.02	26,148.86	76,300.00	50,151.14	34.27%
Accumulative Reserve		150	-	-	-	-	-	-	-	-	0.00%
CDBG Grant/Home Rehab Proj		160	-	-	-	-	-	-	1,000.00	1,000.00	0.00%
DOT Spoils Site		170	7,294.75	10,086.39	2,699.92	5,001.99	2,644.65	27,727.70	126,645.00	98,917.30	21.89%
Public Works Vehicle Replacement		180	-	-	-	-	-	-	45,000.00	45,000.00	0.00%
Police Vehicle Replacement		185	-	-	-	-	-	-	-	-	0.00%
Drug Enforcement		190	-	-	-	-	-	-	-	-	0.00%
Low Income Housing		195	-	-	-	-	-	-	-	-	0.00%
Swimming Pool Construction		300	-	-	-	-	-	-	-	-	0.00%
REET Construction		310	-	-	-	-	-	-	93,600.00	93,600.00	0.00%
Street Construction		320	-	7,599.80	18,559.20	6,186.40	19,796.48	52,141.88	3,790,464.00	3,738,322.12	1.38%
Water/Sewer Operating		400	217,698.48	154,624.16	301,639.27	179,072.20	203,731.88	1,056,765.99	2,235,472.00	1,178,706.01	47.27%
Regional Water System		410	72,160.83	32,044.14	87,595.36	44,048.65	36,249.48	272,098.46	710,186.00	438,087.54	38.31%
Stormwater Management		420	17,636.77	13,376.07	19,170.94	12,678.66	12,253.27	75,115.71	197,139.00	122,023.29	38.10%
Stormwater Capital		425	-	-	-	-	-	-	256,500.00	256,500.00	0.00%
Regional Water Capital		430	18.38	525.00	-	18.38	-	561.76	135,225.00	134,663.24	0.42%
Muni Water Capital Improvement		435	55,802.02	105,429.10	203,230.80	10,705.45	34,058.74	409,226.11	1,618,200.00	1,208,973.89	25.29%
Water Bond Reserve		440	-	-	-	-	-	-	-	-	0.00%
Sewer Bond Reserve		450	-	-	-	-	-	-	-	-	0.00%
Sewer Loan Reserve Fund		460	-	-	-	-	-	-	-	-	0.00%
Short Lived Asset Reserve Fund		463	-	-	-	-	-	-	-	-	0.00%
Emerg Repair/Replace Res Fund		465	-	-	-	-	-	-	-	-	0.00%
Muni Sewer Cap Impr Reserve		470	-	-	1,404.08	8,884.18	281.95	10,570.21	118,100.00	107,529.79	8.95%
Boat Launch Facility		475	4,817.52	7,225.03	4,079.49	10,824.94	1,364.24	28,311.22	46,389.00	18,077.78	61.03%
Utility Deposit		631	320.00	283.76	411.60	280.00	640.00	1,935.36	12,000.00	10,064.64	16.13%
Transportation Benefit District		632	4,837.00	32,000.00	-	-	-	36,837.00	279,147.00	242,310.00	13.20%
TBD Capital Project		633	-	-	-	-	-	-	-	-	0.00%
State Custodial Pass-Thru Fund		634	903.07	833.20	1,184.31	819.32	1,147.62	4,887.52	24,980.00	20,092.48	19.57%
Totals			721,611.20	525,979.03	1,084,301.98	459,699.18	457,328.53	3,248,919.92	12,518,534.00	9,269,614.08	25.95%

2025 Revenue

<u>Fund</u>	<u>#</u>	<u>January</u>	<u>February</u>	<u>March</u>	<u>April</u>	<u>May</u>	<u>Total</u>	<u>Budget</u>	<u>Remaining</u>	<u>% Received</u>
General	010	159,050.72	123,861.34	189,789.03	140,906.61	319,284.96	932,892.66	2,128,098.00	1,195,205.34	43.84%
Streets	100	3,438.32	3,141.66	127,324.54	2,508.71	1,244.39	137,657.62	314,860.00	177,202.38	43.72%
Building Code	115	4,352.49	301.48	1,306.54	7,994.30	896.95	14,851.76	55,000.00	40,148.24	27.00%
Visitor Center	120	1,598.87	835.27	825.44	765.53	927.34	4,952.45	17,000.00	12,047.55	29.13%
Library	130	693.75	380.36	508.42	215.99	1,088.99	2,887.51	2,450.00	(437.51)	117.86%
Criminal Justice	140	1,201.30	109.30	117.87	1,209.16	110.05	2,747.68	4,451.00	1,703.32	61.73%
Local Criminal Justice	145	5,307.37	6,315.24	5,078.24	4,700.57	5,563.31	26,964.73	58,000.00	31,035.27	46.49%
Accumulative Reserve	150	51.56	49.90	56.38	55.51	51.52	264.87	-	(264.87)	0.00%
CDBG Grant/Home Rehab Proj	160	532.85	520.38	561.19	555.10	517.51	2,687.03	-	(2,687.03)	0.00%
DOT Spoils Site	170	180.13	356.54	10,079.44	9,395.57	83,074.54	103,086.22	93,000.00	(10,086.22)	110.85%
Public Works Vehicle Replacement	180	-	-	45,115.32	113.55	107.72	45,336.59	45,000.00	(336.59)	100.75%
Police Vehicle Replacement	185	78.58	76.03	10,107.63	105.98	98.35	10,466.57	10,000.00	(466.57)	104.67%
Drug Enforcement	190	7.37	7.13	7.69	7.57	7.02	36.78	200.00	163.22	18.39%
Low Income Housing	195	169.43	3,166.33	304.94	184.19	173.28	3,998.17	3,000.00	(998.17)	133.27%
Swimming Pool Construction	300	424.81	413.46	448.44	441.55	412.13	2,140.39	-	(2,140.39)	0.00%
REET Capital Fund	310	2,619.38	228.11	233.19	996.86	4,764.22	8,841.76	30,000.00	21,158.24	29.47%
Street Construction	320	-	4.75	30,000.00	4,251.79	(2,015.40)	32,241.14	3,790,464.00	3,758,222.86	0.85%
Water/Sewer Operating	400	163,565.54	179,772.88	168,735.44	160,303.46	185,333.81	857,711.13	2,141,669.00	1,283,957.87	40.05%
Regional Water System	410	30,267.45	88,046.32	62,667.98	60,651.43	33,032.33	274,665.51	710,186.00	435,520.49	38.68%
Stormwater Management	420	13,576.23	13,915.37	14,248.10	15,426.97	14,328.47	71,495.14	174,900.00	103,404.86	40.88%
Stormwater Capital	425	61.39	26.14	105.06	103.45	96.01	392.05	238,500.00	238,107.95	0.16%
Regional Water Capital	430	3,326.58	327.92	39,726.00	446.61	416.81	44,243.92	43,225.00	(1,018.92)	102.36%
Muni Water Capital Improvement	435	2,828.78	2,350.03	92,119.59	3,015.19	2,779.55	103,093.14	107,500.00	4,406.86	95.90%
Water Bond Reserve	440	540.22	527.50	568.88	562.67	524.53	2,723.80	-	(2,723.80)	0.00%
Sewer Bond Reserve	450	837.34	817.40	884.07	870.49	810.21	4,219.51	-	(4,219.51)	0.00%
Sewer Loan Reserve Fund	460	51.56	49.90	53.81	52.99	49.18	257.44	-	(257.44)	0.00%
Short Lived Asset Reserve Fund	463	122.77	118.81	130.69	128.68	119.42	620.37	-	(620.37)	0.00%
Muni Sewer Cap Impr Reserve	470	248.00	216.23	50,361.31	2,353.24	313.78	53,492.56	52,500.00	(992.56)	101.89%
Boat Launch Facility	475	850.68	402.92	1,039.31	1,305.60	674.81	4,273.32	11,600.00	7,326.68	36.84%
Utility Deposit	631	446.27	761.97	827.81	774.47	841.38	3,651.90	12,000.00	8,348.10	30.43%
Transportation Benefit District	632	13,288.45	15,391.54	15,072.24	11,971.09	14,621.73	70,345.05	150,285.00	79,939.95	46.81%
State Custodial Pass-Through Fund	634	606.07	893.20	1,238.31	853.32	1,205.12	4,796.02	24,980.00	20,183.98	19.20%
Totals		410,324.26	443,385.41	869,642.90	433,228.20	671,454.02	2,828,034.79	10,218,868.00	7,390,833.21	27.67%

2025 Expense/Revenue Comparison

Expenses					Revenue						
<u>Fund</u>	<u>#</u>	<u>Actuals</u>	<u>Budget</u>	<u>% Expended</u>	<u>Actuals</u>	<u>Budget</u>	<u>% Received</u>	<u>Budget Revenue Less</u> <u>Actual Expenses</u>	<u>% of Budget</u> <u>Expended</u>	<u>Actual Revenue Less</u> <u>Actual Expenses</u>	<u>% of Actual</u> <u>Revenue</u> <u>Expended</u>
General Total	010	1,125,133.95	2,338,098.00	48.12%	932,892.66	2,128,098.00	43.84%	1,002,964.05	52.87%	(192,241.29)	120.61%
Streets	100	91,534.10	326,053.00	28.07%	137,657.62	314,860.00	43.72%	223,325.90	29.07%	46,123.52	66.49%
Building Code	115	12,391.13	48,590.00	25.50%	14,851.76	55,000.00	27.00%	42,608.87	22.53%	2,460.63	83.43%
Visitor Center	120	6,490.03	20,689.00	31.37%	4,952.45	17,000.00	29.13%	10,509.97	38.18%	(1,537.58)	131.05%
Library	130	10,900.43	17,090.00	63.78%	2,887.51	2,450.00	117.86%	(8,450.43)	444.92%	(8,012.92)	377.50%
Criminal Justice	140	142.50	1,667.00	8.55%	2,747.68	4,451.00	61.73%	4,308.50	3.20%	2,605.18	5.19%
Local Criminal Justice	145	26,148.86	76,300.00	34.27%	26,964.73	58,000.00	46.49%	31,851.14	45.08%	815.87	96.97%
Accumulative Reserve	150	-	-		264.87	-		-		264.87	0.00%
CDBG Grant/Home Rehab Proj	160	-	1,000.00	0.00%	2,687.03	-		-		2,687.03	0.00%
DOT Spoils Site	170	27,727.70	126,645.00	21.89%	103,086.22	93,000.00	110.85%	65,272.30	29.81%	75,358.52	26.90%
Public Works Vehicle Replacement	180	-	45,000.00	0.00%	45,336.59	45,000.00	100.75%	45,000.00	0.00%	45,336.59	0.00%
Police Vehicle Replacement	185	-	-		10,466.57	10,000.00	104.67%	10,000.00	0.00%	10,466.57	0.00%
Drug Enforcement	190	-	-		36.78	200.00	18.39%	200.00	0.00%	36.78	0.00%
Low Income Housing	195	-	-		3,998.17	3,000.00	133.27%	3,000.00	0.00%	3,998.17	0.00%
Swimming Pool Construction	300	-	-		2,140.39	-		-		2,140.39	0.00%
REET Construction	310	-	93,600.00	0.00%	8,841.76	30,000.00	29.47%	30,000.00	0.00%	8,841.76	0.00%
Street Construction	320	52,141.88	3,790,464.00	1.38%	32,241.14	3,790,464.00	0.85%	3,738,322.12	1.38%	(19,900.74)	161.72%
Water/Sewer Operating	400	1,056,765.99	2,235,472.00	47.27%	857,711.13	2,141,669.00	40.05%	1,084,903.01	49.34%	(199,054.86)	123.21%
Regional Water System	410	272,098.46	710,186.00	38.31%	274,665.51	710,186.00	38.68%	438,087.54	38.31%	2,567.05	99.07%
Stormwater Management	420	75,115.71	197,139.00	38.10%	71,495.14	174,900.00	40.88%	99,784.29	42.95%	(3,620.57)	105.06%
Stormwater Capital	425	-	256,500.00	0.00%	392.05	238,500.00	0.16%	238,500.00	0.00%	392.05	0.00%
Regional Water Capital	430	561.76	135,225.00	0.42%	44,243.92	43,225.00	102.36%	42,663.24	1.30%	43,682.16	1.27%
Muni Water Capital Improvement	435	409,226.11	1,618,200.00	25.29%	103,093.14	107,500.00	95.90%	(301,726.11)	380.68%	(306,132.97)	396.95%
Water Bond Reserve	440	-	-		2,723.80	-		-		2,723.80	0.00%
Sewer Bond Reserve	450	-	-		4,219.51	-		-		4,219.51	0.00%
Sewer Loan Reserve Fund	460	-	-		257.44	-		-		257.44	0.00%
Short Lived Asset Reserve Fund	463	-	-		620.37	-		-		620.37	0.00%
Muni Sewer Cap Impr Reserve	470	10,570.21	118,100.00	8.95%	53,492.56	52,500.00	101.89%	41,929.79	20.13%	42,922.35	19.76%
Boat Launch Facility	475	28,311.22	46,389.00	61.03%	4,273.32	11,600.00	36.84%	(16,711.22)	244.06%	(24,037.90)	662.51%
Utility Deposit	631	1,935.36	12,000.00	16.13%	3,651.90	12,000.00	30.43%	10,064.64	16.13%	1,716.54	53.00%
Transportation Benefit District	632	36,837.00	279,147.00	13.20%	70,345.05	150,285.00	46.81%	113,448.00	24.51%	33,508.05	52.37%
State Custodial Pass-Thru Fund	634	4,887.52	24,980.00	19.57%	4,796.02	24,980.00	19.20%	20,092.48	19.57%	(91.50)	101.91%
		3,248,919.92	12,518,534.00	25.95%	2,828,034.79	10,218,868.00	27.67%	6,969,948.08	31.79%	(420,885.13)	114.88%

Cash and Investment Activity

Period: 2025 - May
Period Totals

Fund		Cash Balance				Investments					Total Ending Balance
		Beginning	Activity In	Out	Ending	Beginning	Acquired	Activity Interest	Liquidated	Ending	
010	General Fund	\$211,735.24	\$327,616.88	\$133,134.49	\$406,217.63	\$394,661.47	\$0.00	\$1,414.35	\$9,744.47	\$386,331.35	\$792,548.98
011	Petty Cash/Change Fund	\$760.00	\$0.00	\$0.00	\$760.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$760.00
100	Street Fund	\$21,488.00	\$7,338.05	\$9,631.89	\$19,194.16	\$49,965.33	\$0.00	\$163.92	\$5,355.33	\$44,773.92	\$63,968.08
115	Building Code Account Fund	\$37,847.32	\$683.85	\$6,288.76	\$32,242.41	\$53,760.47	\$4,232.53	\$213.10	\$0.00	\$58,206.10	\$90,448.51
120	Visitor Center Fund	\$5,442.68	\$1,445.77	\$637.12	\$6,251.33	\$10,751.89	\$0.00	\$37.46	\$555.89	\$10,233.46	\$16,484.79
130	Library Fund	\$2,637.34	\$1,072.75	\$1,203.53	\$2,506.56	\$3,795.14	\$665.86	\$16.39	\$0.00	\$4,477.39	\$6,983.95
140	Criminal Justice Fund	\$18,569.97	\$0.00	\$857.94	\$17,712.03	\$29,094.06	\$857.94	\$110.05	\$0.00	\$30,062.05	\$47,774.08
145	Local Criminal Justice Fund	\$53,615.98	\$5,769.22	\$67.02	\$59,318.18	\$94,870.48	\$0.00	\$346.57	\$552.48	\$94,664.57	\$153,982.75
150	Accumulative Reserve Fund	\$8,237.85	\$0.00	\$105.49	\$8,132.36	\$13,914.51	\$105.49	\$51.52	\$0.00	\$14,071.52	\$22,203.88
160	CDBG Grant/Home Rehab Project	\$81,885.01	\$0.00	\$1,694.90	\$80,190.11	\$139,144.10	\$1,694.90	\$517.51	\$0.00	\$141,356.51	\$221,546.62
170	DOT Spoil Site Fund	\$15,540.63	\$82,807.65	\$58,224.40	\$40,123.88	\$17,709.65	\$55,577.35	\$269.29	\$0.00	\$73,556.29	\$113,680.17
180	Public Works Vehicle Replacement	\$17,613.85	\$0.00	\$853.45	\$16,760.40	\$28,461.55	\$853.45	\$107.72	\$0.00	\$29,422.72	\$46,183.12
185	Police Vehicle Replacement Fund	\$16,194.37	\$0.00	\$202.02	\$15,992.35	\$26,563.98	\$202.02	\$98.35	\$0.00	\$26,864.35	\$42,856.70
190	Drug Enforcement Fund	\$1,539.89	\$0.00	\$14.43	\$1,525.46	\$1,897.57	\$14.43	\$7.02	\$0.00	\$1,919.02	\$3,444.48
195	Low Income Housing Fund	\$27,888.89	\$0.00	\$988.81	\$26,900.08	\$46,170.19	\$988.81	\$173.28	\$0.00	\$47,332.28	\$74,232.36
300	Swimming Pool Const Fund, 1987	\$65,423.04	\$0.00	\$1,478.45	\$63,944.59	\$110,682.55	\$1,478.45	\$412.13	\$0.00	\$112,573.13	\$176,517.72
310	REET Capital Fund	\$34,979.92	\$4,548.79	\$1,075.39	\$38,453.32	\$57,554.61	\$1,075.39	\$215.43	\$0.00	\$58,845.43	\$97,298.75
320	Street Construction Capital Fund	\$811.68	\$1,250.61	\$21,818.90	(\$19,756.61)	\$3,162.61	\$0.00	\$7.02	\$1,250.61	\$1,919.02	(\$17,837.59)
400	Water/Sewer Operating Fund	\$300,918.65	\$183,264.84	\$218,102.81	\$266,080.68	\$548,986.12	\$14,369.88	\$2,070.02	\$0.00	\$565,426.02	\$831,506.70
410	Regional Water System Fund	\$256,017.46	\$31,452.16	\$54,675.34	\$232,794.28	\$411,739.59	\$18,425.41	\$1,580.62	\$0.00	\$431,745.62	\$664,539.90
420	Stormwater Management Fund	\$11,829.19	\$14,265.45	\$16,185.31	\$9,909.33	\$13,914.51	\$3,929.49	\$65.57	\$0.00	\$17,909.57	\$27,818.90
425	Stormwater Capital Reserve Fund	\$15,387.97	\$0.00	\$197.55	\$15,190.42	\$25,931.45	\$197.55	\$96.01	\$0.00	\$26,225.01	\$41,415.43
430	Regional Water Capital Improvement	\$66,406.08	\$0.00	\$1,488.39	\$64,917.69	\$111,947.61	\$1,488.39	\$416.81	\$0.00	\$113,852.81	\$178,770.50
435	Muni Water Capital Improvement	\$431,864.28	\$0.00	\$34,705.55	\$397,158.73	\$755,805.19	\$646.81	\$2,779.55	\$0.00	\$759,231.55	\$1,156,390.28
440	Water Bond Reserve Fund	\$83,053.39	\$0.00	\$1,709.33	\$81,344.06	\$141,041.67	\$1,709.33	\$524.53	\$0.00	\$143,275.53	\$224,619.59
450	Sewer Bond Reserve Fund	\$128,557.43	\$0.00	\$2,295.51	\$126,261.92	\$218,203.49	\$2,295.51	\$810.21	\$0.00	\$221,309.21	\$347,571.13
460	Sewer Loan Reserve Fund	\$8,441.33	\$0.00	\$101.01	\$8,340.32	\$13,281.99	\$101.01	\$49.18	\$0.00	\$13,432.18	\$21,772.50
463	Short Lived Asset Reserve Fund	\$19,043.18	\$0.00	\$245.32	\$18,797.86	\$32,255.68	\$245.32	\$119.42	\$0.00	\$32,620.42	\$51,418.28
470	Muni Sewer Capital Imprv Reserve	\$45,595.24	\$3,150.24	\$281.95	\$48,463.53	\$88,546.24	\$0.00	\$313.78	\$3,150.24	\$85,709.78	\$134,173.31
475	Boat Launch Facility Fund	\$714.58	\$6,245.90	\$1,364.54	\$5,595.94	\$16,444.60	\$0.00	\$39.81	\$5,610.60	\$10,873.81	\$16,469.75
631	Utility Deposit Fund	\$32,726.78	\$0.00	\$1,045.53	\$31,681.25	\$53,760.47	\$1,045.53	\$201.38	\$0.00	\$55,007.38	\$86,688.63
632	Transportation Benefit District Fund	\$184,760.96	\$14,621.73	\$0.00	\$199,382.69	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$199,382.69
633	TBD Capital Project Fund	\$3,456.17	\$0.00	\$0.00	\$3,456.17	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$3,456.17
634	State Custodial Pass-Thru Fund	\$1,514.07	\$1,205.12	\$1,147.62	\$1,571.57	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$1,571.57
		\$2,212,498.42	\$686,739.01	\$571,822.75	\$2,327,414.68	\$3,514,018.77	\$112,200.85	\$13,228.00	\$26,219.62	\$3,613,228.00	\$5,940,642.68

CITY OF CASTLE ROCK
Notice of Public Hearing
Six-Year Transportation Plan

The Castle Rock City Council will hold a public hearing during the regular meeting of the Castle Rock City Council on Monday, June 23, 2025 starting at 7:30 PM, located at the Castle Rock Senior Center, 222 Second Ave SW, Castle Rock, Washington. Virtual connection information will be included on the agenda and posted online. Public comment can be submitted in advance to ccuttonaro@ci.castle-rock.wa.us.

The purpose of this meeting is to take testimony on the proposed Six-Year Transportation Plan for 2026 - 2031. Please contact the Clerk-Treasurer's Office to request a copy of the proposed transportation plan.

Anyone interested may appear and be heard in regard to this public hearing at the above-mentioned time and place. Any testimony will be taken into consideration when the City Council discusses the issue during regular session. City Council action may be taken at this meeting.

For more information, please contact Clerk-Treasurer Carie Cuttonaro at City Hall, 360.274.8181, email ccuttonaro@ci.castle-rock.wa.us, or Public Works Director David Vorse 360.274.7478, email crpwd@ci.castle-rock.wa.us.

Posted by June 7, 2025

Published in The Daily News on June 7, 2025

Six Year Transportation Improvement Program

From 2026 to 2031

Agency: Castle Rock

County: Cowlitz

MPO/RTPO: CWCG

Y Inside

N Outside

Functional Class	Priority Number	A. PIN/Project No. C. Project Title D. Road Name or Number E. Begin & End Termini F. Project Description	B. STIP ID G. Structure ID	Hearing	Adopted	Amendment	Resolution No.	Improvement Type	Utility Codes	Total Length	Environmental Type	RW Required
04	1	/ 08C1(002) Huntington Avenue - River Front Trail Pedestrian Lighting - SRRTS Phase 2 Huntington Avenue - SR 411 Larsen Lane to Lions Pride Park This project will install pedestrian friendly lights along Castle Rock's Riverfront trail, which is an identified section of the SRRTS, install an HMA path from Lion's Pride Park to connect to Huntington Avenue, and provide a pedestrian crossing near the intersection of Huntington Avenue with Larsen Lane.	WA-14408	06/23/25				28		0.300	CE	No

Funding								
Status	Phase	Phase Start Year (YYYY)	Federal Fund Code	Federal Funds	State Fund Code	State Funds	Local Funds	Total Funds
S	CN	2026	TA(UM)	330,688		0	51,611	382,299
Totals				330,688		0	51,611	382,299

Expenditure Schedule					
Phase	1st	2nd	3rd	4th	5th & 6th
CN	382,299	0	0	0	0
Totals	382,299	0	0	0	0

Six Year Transportation Improvement Program

From 2026 to 2031

Agency: Castle Rock

County: Cowlitz

MPO/RTPO: CWCG

Y Inside

N Outside

Functional Class	Priority Number	A. PIN/Project No. C. Project Title D. Road Name or Number E. Begin & End Termini F. Project Description	B. STIP ID G. Structure ID	Hearing	Adopted	Amendment	Resolution No.	Improvement Type	Utility Codes	Total Length	Environmental Type	RW Required
06	2	/ Z908(004) City Wide Pedestrian Improvements City Wide to City Wide The first part of this project includes flush mount barrier lights, wiring, conduit and wiring from an existing power source and capacity for future pedestrian lights on SR 411 (PH-10) Bridge over the Cowlitz River to the west. The second part includes updating school zone lights, adding speed read out displays and the construction of bulb-outs at key intersections where pedestrian activity is high and visibility of pedestrians is needed. The third part of this project includes installing a pedestrian activated crosswalk signal at the intersection of SR 411 (A Street SW) and Huntington Ave. South and the continuation of a sidewalk section from this same location, along SR 411 (Huntington Ave.) to Cowlitz Street to fill in a missing gap of sidewalk along this arterial street that connects to the downtown business and service area. *** Project is fully funded with federal funds using Toll Credits as local match.****	WA-14434	06/23/25				28			CE	No

Funding								
Status	Phase	Phase Start Year (YYYY)	Federal Fund Code	Federal Funds	State Fund Code	State Funds	Local Funds	Total Funds
S	CN	2026	CRP(UM)	560,636		0	0	560,636
S	CN	2026	STBG(UM)	328,214		0	0	328,214
Totals				888,850		0	0	888,850

Expenditure Schedule					
Phase	1st	2nd	3rd	4th	5th & 6th
CN	888,850	0	0	0	0
Totals	888,850	0	0	0	0

Six Year Transportation Improvement Program

From 2026 to 2031

Agency: Castle Rock

County: Cowlitz

MPO/RTPO: CWCG

Y Inside

N Outside

Functional Class	Priority Number	A. PIN/Project No. C. Project Title D. Road Name or Number E. Begin & End Termini F. Project Description	B. STIP ID G. Structure ID	Hearing	Adopted	Amendment	Resolution No.	Improvement Type	Utility Codes	Total Length	Environmental Type	RW Required
04	4	Huntington Avenue S. Roundabout Huntington Avenue S. 500' N of 1955 Huntington Ave S to 500' S of 1955 Huntington Ave S An intersection improvement along Huntington Avenue S. at the future entrance into the Landing on the Cowlitz development. The conceptual roundabout will require additional right-of-way from neighboring properties for construction. The proposed improvements include a single-lane roundabout with center landscape island and a concrete truck apron to accommodate maneuvering of large truck traffic through the intersection from the Landing on the Cowlitz development. Widening of Huntington Avenue S. including asphalt, curb and gutter, concrete sidewalk, signing, striping, stormwater management, and landscaping improvements are proposed with this project. Project is fully funded with federal funds using Toll Credits as local match.	WA-15119	06/23/25				04	C G P S T W	0.200	CE	Yes

Funding								
Status	Phase	Phase Start Year (YYYY)	Federal Fund Code	Federal Funds	State Fund Code	State Funds	Local Funds	Total Funds
S	PE	2026	STBG(UM)	589,300		0	0	589,300
S	PE	2027	STBG(UM)	589,300		0	0	589,300
S	RW	2028	STBG(UM)	80,000		0	0	80,000
P	CN	2028	STBG(R)	4,706,850	WSDOT	734,600	2,680,100	8,121,550
Totals				5,965,450		734,600	2,680,100	9,380,150

Six Year Transportation Improvement Program
From 2026 to 2031

Agency: Castle Rock

County: Cowlitz

MPO/RTPO: CWCG

Y Inside

N Outside

Expenditure Schedule					
Phase	1st	2nd	3rd	4th	5th & 6th
PE	589,300	589,300	0	0	0
RW	0	0	80,000	0	0
CN	0	0	8,121,550	0	0
Totals	589,300	589,300	8,201,550	0	0

Six Year Transportation Improvement Program
From 2026 to 2031

Agency: Castle Rock

County: Cowlitz

MPO/RTPO: CWCG

Y Inside

N Outside

Functional Class	Priority Number	A. PIN/Project No. C. Project Title D. Road Name or Number E. Begin & End Termini F. Project Description	B. STIP ID G. Structure ID	Hearing	Adopted	Amendment	Resolution No.	Improvement Type	Utility Codes	Total Length	Environmental Type	RW Required
06	5	Pleasant Hill Road Reconstruction Pleasant Hill Road Huntington Avenue South to South City Limits Full depth reclamation, hot mix asphalt overlay and adjustment or replacement of guardrail between Huntington Avenue South and the South City Limits.	WA-12807	06/23/25				04	C P T	0.360	CE	No

Funding								
Status	Phase	Phase Start Year (YYYY)	Federal Fund Code	Federal Funds	State Fund Code	State Funds	Local Funds	Total Funds
P	PE	2027	STBG	58,800	TIB	57,950	12,250	129,000
P	CN	2028	STBG	449,550	TIB	446,000	93,650	989,200
Totals				508,350		503,950	105,900	1,118,200

Expenditure Schedule					
Phase	1st	2nd	3rd	4th	5th & 6th
PE	0	129,000	0	0	0
CN	0	0	989,200	0	0
Totals	0	129,000	989,200	0	0

Six Year Transportation Improvement Program

From 2026 to 2031

Agency: Castle Rock

County: Cowlitz

MPO/RTPO: CWCG

Y Inside

N Outside

Functional Class	Priority Number	A. PIN/Project No. C. Project Title D. Road Name or Number E. Begin & End Termini F. Project Description	B. STIP ID G. Structure ID	Hearing	Adopted	Amendment	Resolution No.	Improvement Type	Utility Codes	Total Length	Environmental Type	RW Required
07	6	Bond Road Overlay Bond Road South City Limits to North City Limits Spot repair and grinding of existing roadway surface, followed by 0.20' asphalt overlay.	WA-12039	06/23/25				05		0.700	CE	No

Funding								
Status	Phase	Phase Start Year (YYYY)	Federal Fund Code	Federal Funds	State Fund Code	State Funds	Local Funds	Total Funds
P	PE	2029		0	TIB	56,950	3,000	59,950
P	CN	2029		0	TIB	434,900	22,850	457,750
Totals				0		491,850	25,850	517,700

Expenditure Schedule					
Phase	1st	2nd	3rd	4th	5th & 6th
PE	0	0	0	59,950	0
CN	0	0	0	457,750	0
Totals	0	0	0	517,700	0

Six Year Transportation Improvement Program
From 2026 to 2031

Agency: Castle Rock

County: Cowlitz

MPO/RTPO: CWCG

Y Inside

N Outside

Functional Class	Priority Number	A. PIN/Project No. C. Project Title D. Road Name or Number E. Begin & End Termini F. Project Description	B. STIP ID G. Structure ID	Hearing	Adopted	Amendment	Resolution No.	Improvement Type	Utility Codes	Total Length	Environmental Type	RW Required
06	7	PH 10 Hwy Improvements PH 10 Highway Cowlitz River Bridge to West Side Highway Reconstruction of PH 10 Highway from the west side of the bridge over the Cowlitz River to the intersection with West Side Highway. Raise the road elevation to provide access during high water conditions. Provide new sidewalk and illumination on one side.	WA-11257	06/23/25				04		0.360	EA	No

Funding								
Status	Phase	Phase Start Year (YYYY)	Federal Fund Code	Federal Funds	State Fund Code	State Funds	Local Funds	Total Funds
P	ALL	2030	STBG(R)	6,705,950		0	0	6,705,950
Totals				6,705,950		0	0	6,705,950

Expenditure Schedule					
Phase	1st	2nd	3rd	4th	5th & 6th
ALL	0	0	0	6,705,950	0
Totals	0	0	0	6,705,950	0

Six Year Transportation Improvement Program
From 2026 to 2031

Agency: Castle Rock

County: Cowlitz

MPO/RTPO: CWCG

Y Inside

N Outside

Functional Class	Priority Number	A. PIN/Project No. C. Project Title D. Road Name or Number E. Begin & End Termini F. Project Description	B. STIP ID G. Structure ID	Hearing	Adopted	Amendment	Resolution No.	Improvement Type	Utility Codes	Total Length	Environmental Type	RW Required
08	8	3rd Avenue Overlay Cowlitz Street West to Dike Road SW Spot repairs and grinding of existing pavement, followed by 0.2' asphalt overlay.	WA-12028	06/23/25				05		0.500	CE	No

Funding								
Status	Phase	Phase Start Year (YYYY)	Federal Fund Code	Federal Funds	State Fund Code	State Funds	Local Funds	Total Funds
P	PE	2030		0	TIB	29,350	1,550	30,900
P	CN	2030		0	TIB	225,050	11,850	236,900
Totals				0		254,400	13,400	267,800

Expenditure Schedule					
Phase	1st	2nd	3rd	4th	5th & 6th
PE	0	0	0	0	31,850
CN	0	0	0	0	244,000
Totals	0	0	0	0	275,850

Six Year Transportation Improvement Program
From 2026 to 2031

Agency: Castle Rock

County: Cowlitz

MPO/RTPO: CWCG

Y Inside

N Outside

Functional Class	Priority Number	A. PIN/Project No. C. Project Title D. Road Name or Number E. Begin & End Termini F. Project Description	B. STIP ID G. Structure ID	Hearing	Adopted	Amendment	Resolution No.	Improvement Type	Utility Codes	Total Length	Environmental Type	RW Required
05	9	Dougherty Drive Chip Seal Dougherty Drive SR 504 to City Limits Chip seal road and replace striping.	WA-16480	06/23/25				05		0.470	CE	No

Funding								
Status	Phase	Phase Start Year (YYYY)	Federal Fund Code	Federal Funds	State Fund Code	State Funds	Local Funds	Total Funds
P	ALL	2031		0	TIB	127,775	6,725	134,500
Totals				0		127,775	6,725	134,500

Expenditure Schedule					
Phase	1st	2nd	3rd	4th	5th & 6th
ALL	0	0	0	0	134,500
Totals	0	0	0	0	134,500

Six Year Transportation Improvement Program
From 2026 to 2031

Agency: Castle Rock

County: Cowlitz

MPO/RTPO: CWCG

Y Inside

N Outside

Functional Class	Priority Number	A. PIN/Project No. C. Project Title D. Road Name or Number E. Begin & End Termini F. Project Description	B. STIP ID G. Structure ID	Hearing	Adopted	Amendment	Resolution No.	Improvement Type	Utility Codes	Total Length	Environmental Type	RW Required
04	10	Huntington Avenue Chip Seal Huntington Avenue S Front Avenue to Kalmbach Road Chip seal road and restripe.		06/23/25				05		1.200	CE	No

Funding								
Status	Phase	Phase Start Year (YYYY)	Federal Fund Code	Federal Funds	State Fund Code	State Funds	Local Funds	Total Funds
P	ALL	2030		0	TIB	382,470	20,130	402,600
Totals				0		382,470	20,130	402,600

Expenditure Schedule					
Phase	1st	2nd	3rd	4th	5th & 6th
ALL	0	0	0	0	402,600
Totals	0	0	0	0	402,600

	Federal Funds		State Funds	Local Funds	Total Funds
Grand Totals for Castle Rock	14,399,288		2,495,045	2,903,716	19,798,049

Six Year Transportation Improvement Program

From 2026 to 2031

Agency: Castle Rock

County: Cowlitz

MPO/RTPO: SWW RTPO

N Inside

Y Outside

Functional Class	Priority Number	A. PIN/Project No. C. Project Title D. Road Name or Number E. Begin & End Termini F. Project Description	B. STIP ID G. Structure ID	Hearing	Adopted	Amendment	Resolution No.	Improvement Type	Utility Codes	Total Length	Environmental Type	RW Required
00	3	2025 ADA Improvements Downtown to Install 22 ADA ramps and add two new sidewalk sections. The additional sidewalks include 420 of new sidewalks, creating safer access for pedestrians of all ages and abilities.	WA-16362	06/23/25				28		0.000	CE	No

Funding								
Status	Phase	Phase Start Year (YYYY)	Federal Fund Code	Federal Funds	State Fund Code	State Funds	Local Funds	Total Funds
S	ALL	2026		0	TIB	536,170	28,220	564,390
Totals				0		536,170	28,220	564,390

Expenditure Schedule						
Phase	1st	2nd	3rd	4th	5th & 6th	
ALL	564,390	0	0	0	0	
Totals	564,390	0	0	0	0	

	Federal Funds		State Funds	Local Funds	Total Funds
Grand Totals for Castle Rock	0		536,170	28,220	564,390

1. CALL TO ORDER

Mayor Paul Helenberg called the regular meeting of the Castle Rock City Council to order at 7:30 PM.

a. Pledge of Allegiance

Mayor Helenberg led the Pledge of Allegiance.

b. Roll Call

Councilmembers present: Art Lee, Lee Kessler, John Whalen, Paul Simonsen, and Ellen Rose.

Staff present: Police Chief Charlie Worley, City Attorney Nikki Thompson, Public Works Senior Operator Tyler Stone, and Clerk-Treasurer Carie Cuttonaro.

c. Changes to Agenda

2. PROCLAMATIONS & PRESENTATIONS

3. CITIZEN COMMENTS - maximum 3 minutes

4. DEPARTMENT REPORTS

- City Attorney Nikki Thompson

City Attorney Nikki Thompson gave a verbal report.

- Police Chief Charlie Worley

Police Chief Charlie Worley gave a verbal report.

- Public Works Director Dave Vorse

- City Engineer Tom Gower

- Clerk-Treasurer Carie Cuttonaro

5. COUNCIL AND AD HOC COMMITTEE REPORTS

- Mayor / Mayor Pro-Tempore / Councilmembers

- CRCDA Representative

6. PUBLIC HEARINGS

7. CONSENT AGENDA

Councilmember Kessler made a motion, seconded by Rose, to approve the Consent Agenda as presented. Motion carried by roll call vote. Councilmembers Lee, Kessler, Whalen, Simonsen, and Rose voted 'Aye'.

a. May 27, 2025 Regular Council Meeting Minutes

b. May 2025 invoices as described in the Fund Transaction Summary Report in the amount of

\$458,680.75.

8. OLD BUSINESS

9. NEW BUSINESS

10. OTHER BUSINESS

Cowlitz County Commissioner Rick Dahl gave an update on the monitoring of the river levels and an update on the Sediment Retention Structure on the North Fork Toutle River.

Amber MacLaren, City resident, inquired about the recently passed ordinance regarding noise.

11. ADJOURNMENT

There being no further business, Mayor Helenberg adjourned the meeting at 7:44 PM.

Mayor Paul Helenberg

Clerk-Treasurer Carie Cuttonaro

**CITY OF CASTLE ROCK
RESOLUTION NO. 2025-04**

**A RESOLUTION RELATING TO THE SIX-YEAR TRANSPORTATION
IMPROVEMENT PLAN.**

WHEREAS, pursuant to the requirements of RCW 35.77.010, Laws of the State of Washington, the City of Castle Rock has prepared the annual update to its Six-Year Transportation Improvement Program for the ensuing calendar year 2026 – 2031; and

WHEREAS, pursuant to said law, the City Council of the City of Castle Rock, being the legislative body of said City did hold a public hearing on said plan at 7:30 PM in the Senior Center of said City Hall on the 23rd day of June 2025.

NOW, THEREFORE BE IT RESOLVED, that a copy of said revised Six-Year Transportation Improvement Program for the ensuing six calendar years 2026 through 2031, together with a copy of this resolution, be filed with the Director of Highways of the State of Washington.

ADOPTED (unanimously/majority) on this _____ day of _____, 2025.

CITY OF CASTLE ROCK

APPROVED:

Paul Helenberg, Mayor

APPROVED AS TO FORM:

ATTEST:

Nikki Thompson, City Attorney

Carie Cuttonaro, City Clerk



Norton Corrosion Limited, LLC

8820 222nd Street SE, Woodinville, WA 98077

Phone (425) 483-1616

Email: mhickey@nortoncorrosion.com

www.nortoncorrosion.com

June 9, 2025

City of Castle Rock

Mr. Tyler Stone

PO Box 370

Castle Rock, WA 98611

Email: tstone@ci.castle-rock.wa.us

(360) 751-8197

Subject: **CATHODIC PROTECTION ENGINEERING, MATERIALS & INSTALLATION
WATER RESERVOIR – 516,000 GALLON, 24' HEIGHT
CITY OF CASTLE ROCK
CASTLE ROCK, WA**

Dear Tyler

Norton Corrosion Limited (NCL) is pleased to provide you with this estimated budget for the design, materials, and installation for a cathodic protection system in your 516K gallon water reservoir. This system will protect interior submerged metallic components. The design assumes the submerged metallic components are coated.

We note the following regarding this scope of work:

CP Engineering/Design

1. CP system is based on an impressed current cathodic protection (ICCP) system. This system will require AC power (ground level).
2. The CP system will be designed/engineered by an NCL licensed P.E. and/or a NACE CP Specialist. Design will include site specific CAD CP installation drawings and a bill of materials (no specification). The design budget is based on a one step design submittal. If a CP specification or additional submittal steps are needed, NCL can accommodate at an additional cost.

Materials and Installation

1. CP material budget includes such items as anodes, wire, handhole covers, hanging system, reference electrode, junction boxes, rectifier, and miscellaneous hardware such as rope, thermite weld material, splice kits and PVC conduit.
2. Materials are based on NCL's NSF 61 approved system.
3. The installation proposal is for the CP system only. System to be installed by a two person NCL NACE certified team. We estimated up to 4 days onsite **with the tank drained**. Time onsite includes cutting holes in the roof for anodes and reference electrodes. It also includes welding negative structure wire to the tank. An electrician will be required to run AC power to the rectifier. The electrician would be by others.

Please consider the following:

Item	Quantity	Description	Rate	Ext. Rate
1	1 lot	CP Engineering/Design: Includes site specific CAD CP installation drawings and a bill of materials. Design is based on a one step design submittal. If a specification or additional submittal steps are needed, NCL can accommodate at an additional cost.	\$2,618.00	\$2,618.00



Norton Corrosion Limited, LLC

City of Castle Rock
Water Storage Tank CP
June 9, 2025
Page 2

2	1 lot	CP Materials: (NSF 61): Anodes, rectifier, reference electrodes, security mounting assembly's w/ driver, internal DC wiring, handhole cover assemblies, pull box, junction box, conduit, DC wiring. Amount depending on design results (number of anodes).	\$25,000.00 - \$28,000.00
3	1 lot	CP System Installation: CP installation as noted above. We estimated up to 4 days onsite site for two person NCL NACE certified installation team assuming the tank is drained. Budget includes mob/demob and all travel expenses.	\$12,855.00
4	1 lot	Post Installation: Commissioning/Testing and Written Report	\$1,481.00
Total Estimated Budget Range-All Items			\$41,954.00 - \$44,954.00

**Optional Add: Estimated additional installation without tank
drained - \$6,093.00**

No taxes are included in the above pricing. NCL Terms: Net 30 days. Due to extraordinary market volatility, NCL reserves the right to verify materials pricing at the time of project approval. NCL maintains \$3M/\$5M professional liability insurance; higher limits are available at additional cost. Lead time on design is 3 weeks from authorization. Lead time on materials is 8-9 weeks from approved design submittals.

Thank you for the opportunity to present this estimated budget. We look forward to your positive response.

Sincerely,

Miles VC Hickey
Technical Sales

Authorized by

Date

SC\PBC\Castle_Rock_Reservoir_Proposal

City of Castle Rock

Agenda Item Summary

Item Title

Request to purchase two used dump trucks from Cowlitz County Department of Public Works.

Recommended Action

Recommend approval.

City Attorney Review

Not Required

Summary Statement

Public Works request purchase of two dump trucks from Cowlitz County Department of Public Works.

- (2) 2004 Sterling 10-yard dump trucks
- Includes snowplow and sander
- Purchase Price: \$10,000 each (\$20,000 total)

Fund 180 – PW Vehicle Replacement has \$45,000 budgeted and is sufficient to cover purchase cost and necessary repairs. Both trucks need repairs to be operable. One truck will be used to replace the 1985 International 5-yard dump truck that has a blown head gasket, and the other would be an addition to the fleet.

Staff Contact

Tyler Stone, Public Works

Attachments

1. Photo





STAFF REPORT

Substantial Shoreline Development Permit Landing on the Cowlitz

To: Mayor Helenberg and Members of the City Council
From: Rachel Granrath, Contract Planner
Date: June 23, 2025
Subject: Substantial Shoreline Development Permit to Construct Stormwater Outfall

Summary of Request and Recommendation

Project Description: The applicant has submitted a Substantial Shoreline Development Permit (SSDP) and SEPA Checklist to the City of Castle Rock to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOT) Master Plan. The project consists of installing a stormwater outfall within a portion of the Cowlitz River's shoreline buffer and shoreline jurisdiction.

- **Stormwater Outfall Installation:** Phase 1a of the LOTC Master Plan includes constructing a stormwater outfall within the Cowlitz River's shoreline buffer to discharge treated runoff from onsite and offsite systems using 30" and 48" pipes.
- **Treatment and Conveyance Systems:** Runoff will be treated with devices such as bioretention planters, mechanical filtration (e.g., catch basins) and biofiltration swales before being conveyed to the outfall using a combination of closed pipe networks and a ditch system for both the onsite and offsite basins.
- **Construction Methods and Access:** Trenching will be used for pipeline installation; outfall construction begins landward from the river's ordinary high-water mark (OHWM), and construction traffic will access the site via Huntington Avenue S, avoiding Larson Lane SW.
- **Floodplain Impacts:** Minimal impact to the floodway and 100-year floodplain is anticipated, with a net cut of 8 cubic yards and overall grading roughly balanced.
- **Future Phases:** A future permit will address installation of a temporary gravel road and storm pipe (outside critical areas) to support later phases; the road will be removed after construction and mitigation are complete.

Planning Commission Recommendation: On June 17, 2025, the Planning Commission held a public hearing and recommended approval without incorporating staff conditions.

Staff Recommendation: Staff recommends approval of this application, with conditions.

General Information

Proponent: CT6, LLC

Project Representative: Ingrid Friedberg, Special Projects Manager

Project Location: The site is located within the Recreation designated portion of the approved LOTC Master Plan, formally Parcel 3 (#6143802), adjusted per Boundary Line Adjustment (CR-BLA-24-01 – AFN#3762029). The Castle

Rock Landing on the Cowlitz Master Planned Mixed Use Development site is accessed from I-5 at Exit #48 and is located on the south side of Huntington Avenue S, approximately 0.5 mile west of the exit. The site is located within the Recreation designated portion of the approved Landing on the Cowlitz Master Plan.

Vicinity Map

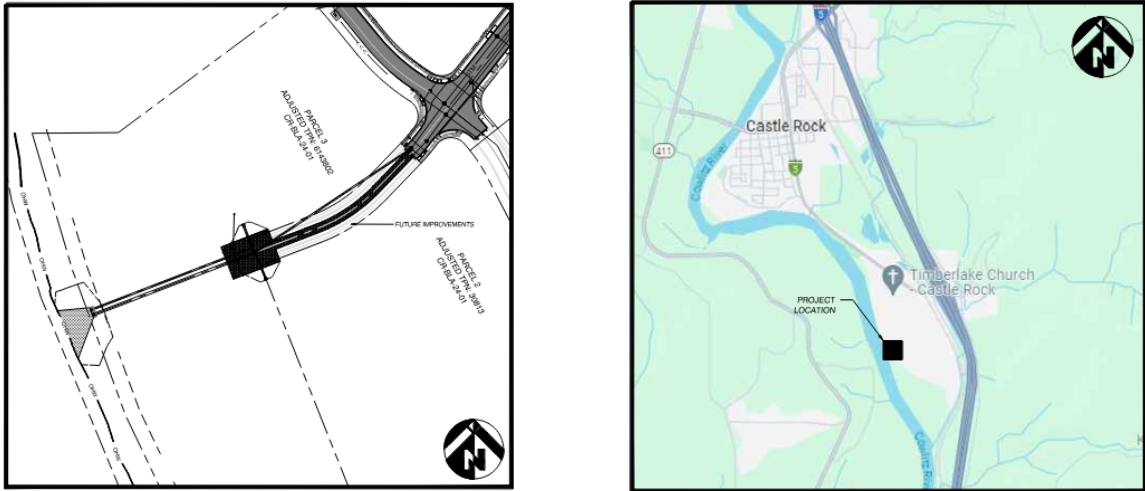


Figure 2: Vicinity Map

SITE MAP

VICINITY MAP

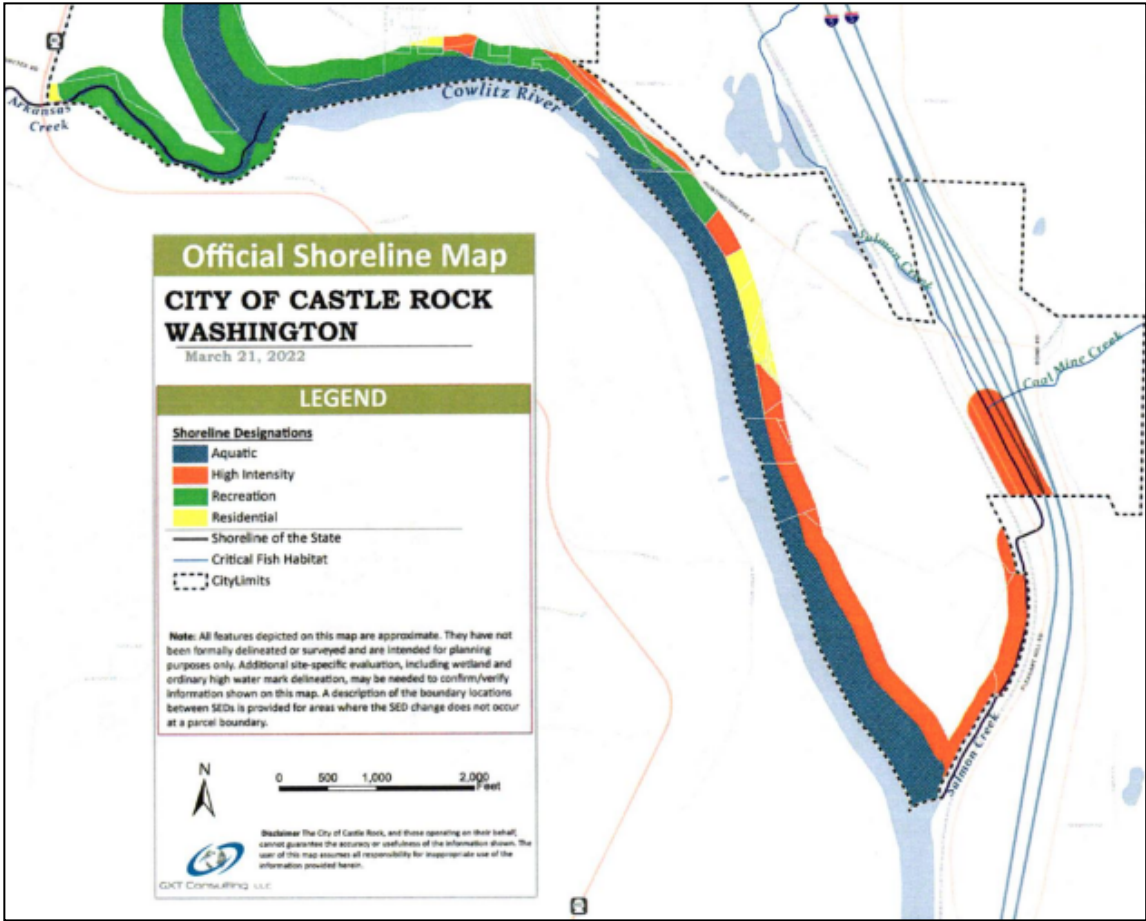


Figure 1: Shoreline Master Program Map

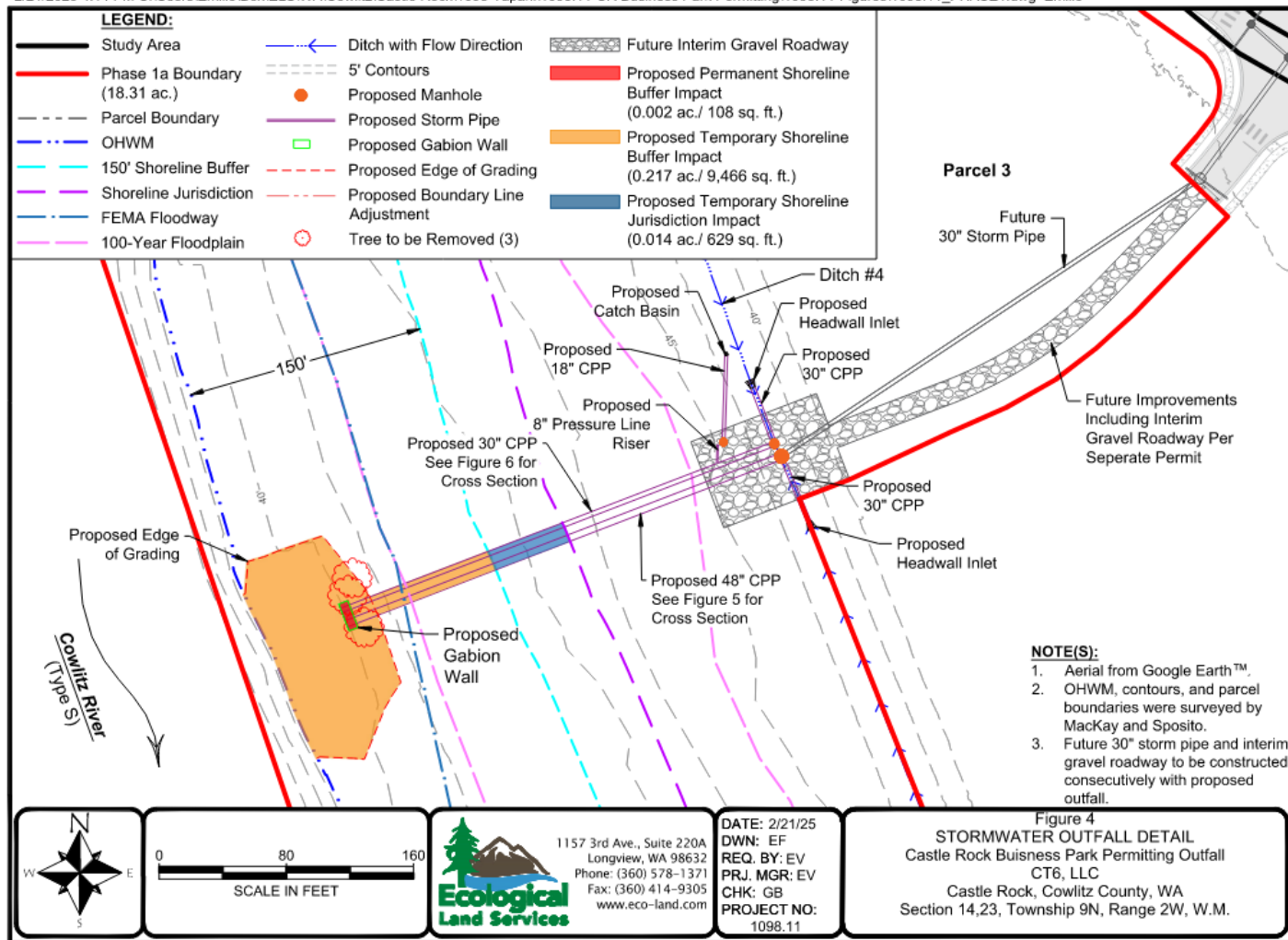


Figure 3: Stormwater Outfall Detail

Shoreline Master Program (SMP) Consistency

Section 5.4.1 defines and classifies the purpose and policies of the high intensity environment, which the subject site is designated.

Purpose

The purpose of the high-intensity shoreline environment designation is to provide for high intensity, water-oriented commercial, transportation, and industrial uses while protecting existing ecological functions and seeking to restore ecological functions in areas that have been previously degraded.

Management Policies

- Priority should be given to water-dependent, water-related, and water-enjoyment uses in that order of preference. Non-water-oriented uses within the High-Intensity shoreline environment designation are appropriate on sites where there is no direct access to the shoreline because of another property separating it from the shoreline or an intervening public right-of-way.
- Non-water-oriented uses on sites adjacent to the water should provide public benefit in the form of ecological enhancement and/or public access in compliance with the provisions of this Program.

- C. Where unavoidable impacts to ecological functions occur, appropriate mitigation should be provided in accordance with this Program to achieve no-net-loss. Where applicable, development should include environmental cleanup and restoration of the shoreline in accordance with relevant state and federal law.
- D. Visual and/or physical public access should be provided, where feasible.
- E. Aesthetic objectives of this Program should be in character with high intensity development and include height limits, screening, and other standards consistent with the primary purpose of accommodating high intensity uses.
- F. Existing urban areas appropriate for intensive development should be fully utilized before expanding intensive development into other areas.

Utilities is a permitted use in the high intensity through a Substantial Shoreline Development Permit (SSDP).

Shoreline Substantial Development Permit

As identified in the Shoreline Master Program, applications for an SSDP will be reviewed against the following criteria that the “Proposed use or development on shorelines of the state must be consistent with the policy and provisions of the Act and this Program.” Per Section 1-5 of Castle Rock Shoreline Master Program, no separate critical areas permit is required for a development proposal that requires a shoreline development permit. All applicable critical areas requirements in CRMC 18.10 have been incorporated into the conditions for the Shoreline Substantial Development Permit associated with this staff report. Staff has outlined the standards in the table below, along with referenced chapters.

Table 1: General Shoreline Regulations: Section 6 of Castle Rock SMP

Standard	Site Design	Reference	Requirement Met
No net loss of ecological function	Onsite mitigation to ensure no net loss of ecological functions meet the vegetation conservation standards in the SMP and include both permanent impact mitigation and temporary impacts mitigation along with tree removal and mitigation at a 4:1 ratio.	SMP Chapter 6.1	Yes, as conditioned
Archaeological, Cultural, and Historic Resources	An inadvertent discovery is required as a condition of approval and is required as part of the Master Plan Development Agreement	SMP Chapter 6.2	Yes, as conditioned
Critical Areas Protection	See flood prevention below, the only critical area impacted by this proposal is the floodplain.	SMP Chapter 6.3	Yes, as conditioned
Flood Prevention and Flood Damage Minimization	The floodplain and floodway are noted on the plans and will be disturbed as part of the stormwater outfall construction. The physical outfall and gravel road is out of the floodplain, but the pipe outfall is in the floodplain.	SMP Chapter 6.4	Yes, as conditioned
Public Access	This application does not prevent public access and is part of a larger master planned development with various phases including	SMP Chapter 6.5	N/A

	recreation, housing, and commercial/industrial mixed uses		
Vegetation Conservation	2:1 permanent mitigation ratio 1:1 temporary mitigation ratio 4:1 tree removal and replacement Combination of restoration and enhancement with native grass, seed, shrubs and trees.	SMP Chapter 6.6	Yes, as conditioned
Water Quality and Quantity	Stormwater management structures are located outside of the floodplain and mitigation/buffers are proposed to minimize the disturbance and enhance the site accordingly	SMP Chapter 6.7	Yes, as conditioned

Procedural Requirements

The process is outlined by the following steps in accordance with the Castle Rock Municipal Code CRMC 18.08, CRMC 18.04, Castle Rock Shoreline Master Program.

Table 2: Shoreline Substantial Development Permit: Key Dates and Milestones

Procedure Action Item	Date
Pre-Application Meeting	November 6, 2024
Application Submittal	March 31, 2025
Letter of Complete	March 13, 2025
Agency Notice	May 20, 2025
SEPA/Public Notice	May 20, 2025 – Comment period ended June 10, 2025
Planning Commission Public Hearing	Tuesday, June 17, 2025
City Council Meeting	Monday, June 23, 2025

Agency and Public Comment

Comments from the City Engineer and City Public Works are summarized below and included in the conditions of approval. Agency comment was issued on May 20th, no agency comments were received.

Public comment was issued on June 3rd and comment period ends the date of the public hearing. At the time of this report, staff has received two public comments, summarized below.

Table 4: Pubic and Agency Comments Received

Commenter	Nature of Comment(s)
Tom Gower, Gibbs & Olson – City Engineer	Various Comments on plan set, Stormwater Master Plan TIR and in letter on engineering approach and design
Dave Vorse, Castle Rock Public Works	April 7, 2025, letter detailing TIR and Stormwater Outfall revisions for city approval
Sheryl Adams – Public Comment	Concern on habitat and animal impact of development
Roy Henson – Public Comment	Concern on stormwater design, drainage, and encroachment

Conclusions

Staff finds that the application materials, as conditioned have met the requirements outlined in CRMC 18.08, CRMC 18.04, Castle Rock Shoreline Master Program and Castle Rock Engineering Standards for Public Works Construction.

Planning Commission Action

CRMC 17.77.040 (8) describes this action as a Type VIII – Environmental Permit. A Type VIII development review process is used for critical areas permits (CRMC [18.10.080](#)), shoreline permits and decisions (Chapter [18.08](#) CRMC), and SEPA (Chapter [18.04](#) CRMC) reviews required in conjunction with the review of an underlying development activity. Substantial reports will be required and so a preapplication meeting is recommended to help understand the challenges and define the scope of the reports. Public notice and/or a public hearing is required.

Planning Commission shall hold the public hearing, and make a recommendation to City Council to approve, approve with conditions, or deny the substantial development permit.

Planning Commission Recommendation

On Tuesday, June 17, 2025, the Castle Rock Planning Commission held a public hearing on the Substantial Shoreline Development Permit (SSDP) for the stormwater outfall. There was testimony from the applicant to address public comments on the stormwater design, habitat mitigation, and flooding management. The Commission unanimously recommended approval to the City Council as submitted by applicant not including staff recommended conditions.

Staff Recommendation

As conditioned below, the application does not appear to be detrimental to the general public health, safety or welfare and meets the basic intent and criteria in Castle Rock Municipal Code, City Engineering and Public Works Standards, and the Master Planned Development Agreement.

Staff Recommended Conditions of Approval

1. **Cultural Resources:** Should ground disturbing or other activities related to the proposed subdivision result in the inadvertent discovery of cultural resources or archaeological materials, work shall be stopped in the immediate area and contact be made with the Washington State Department of Archaeology and Historic Preservation (DAHP) and the Cowlitz Indian Tribe. Work shall remain suspended until the findings are assessed, and appropriate consultation is conducted. Should human remains be inadvertently discovered, as dictated by Washington State RCW 27.44.055, work shall be immediately halted in the area and contact made with the coroner and local law enforcement in the most expeditious manner possible.
2. **Dedication of Improvements:** Upon completion of construction, all site improvements and associated rights-of-way and easements shall be dedicated to the City.
3. **Storm Event Mitigation:** Due to the location of the improvements, the applicant shall implement mitigation measures to address impacts during peak storm events and periods of high water as required by stormwater regulations, standards, codes and subject to approval by the City.

4. **General Construction Stormwater Permit Compliance:** The applicant shall either amend the existing General Construction Stormwater Permit (GCSP) for the mass grading project or obtain a new permit to cover construction activities related to site access, utilities, and the stormwater outfall. Compliance with this requirement may be included as a condition of the Mitigated Determination of Nonsignificance (MDNS).
5. Applicant will comply with provisions in the Castle Rock Shoreline Master Program (SMP) and WAC 173-27-090.
 - a. Construction activities shall commence, or where no construction activities are involved, the use or activity shall commence within two (2) years of the effective date of an SSDP.
 - b. The period for commencement of construction or use may be extended once for a one (1)-year period if a request based on reasonable factors is filed before the expiration date and notice of the proposed extension is given to parties of record.
 - c. The authorization to conduct certain development activities (see WAC 173-27-090) shall terminate five (5) years after the effective date of an SSDP.
 - d. The authorization period to conduct development activities may be extended once for a one (1)-year period if a request based on reasonable factors is filed before the expiration date and notice of the proposed extension is given to parties of record and the department.
 - e. The time periods in Sections 1 through 4, above, do not include the time during which a use or activity was not actually pursued due to the pendency of administrative appeals or legal actions or due to the need to obtain any other government permits and approvals for the development that authorize the development to proceed, including all reasonably related administrative or legal actions on any such permits or approvals.
6. The applicant will remain compliant with the Master Planned Development Agreement and conditions associated.
7. Comments from Tom Gower, Gibbs & Olson— City Engineer and David Vorse – Castle Rock Public Works Director, dated April 7, 2025, on the “Landing on the Cowlitz Stormwater Outfall” dated 2/12/2025 consisting of 12 drawings and the “Landing on the Cowlitz Stormwater Master Plan Technical Information Report” dated 3/10/2025 consisting of 757 pages and associated redlines.

Stormwater Pump Agreement: The City and the Applicant shall engage in good faith negotiations to establish the terms of the agreement.

8. The applicant is responsible for compliance with all applicable local, state, and federal rules and regulations, and must obtain all appropriate permits and approvals.
9. All conditions of the SEPA MDNS issued on June 20, 2025, shall be met.

Exhibits:

- Exhibit A: Application Materials**
- Exhibit B: Noticing Materials**
- Exhibit C: SEPA MDNS**
- Exhibit D: Comments Received**

Exhibit A: Application Materials

1. Stormwater Outfall SSDP Application Submittals Overview
2. Signed Master Application Forms (CRP-25-007/CRP-25-008 & CR-24-051)
3. Application Narratives (CRP-25-007/CRP-25-008 & CR-24-051)
4. SEPA Checklist
5. Stormwater Outfall Plans
6. Stormwater Pollution Prevention Plan (SWPPP) - CR-24-051
7. Stormwater Drainage Report (TIR) – CR-24-051
8. Habitat Management – Mitigation & Monitoring Plan (CRP-25-007/CRP-25-008)
9. Ordinary High Water Mark Memo
10. Excavation & Grade Addendum – LOTC Stormwater Outfall (CR-24-051)
11. Letter of Completeness (CRP-25-007/CRP-25-008)



SUBMITTAL OVERVIEW

CT6, LLC

DATE: March 5, 2025

PROJECT NO.: 163.2

CITY PROJECT NO.:

RECEIVED BY:

SUBMITTAL TITLE: Landing on the Cowlitz Stormwater Outfall
Shoreline Substantial Development Permit Application

SUBMITTED BY: Ingrid Friedberg, Special Projects Manager
CT6, LLC
P.O. Box 1419
Battle Ground, WA 98604

SUBMITTED VIA: Online Share Drive

SUBMITTED TO: **City of Castle Rock**
Attn. Karlene Akesson, Building/Planning Clerk
P.O. Box 370
Castle Rock, WA 98611

SUBMITTAL CONTENTS:	ITEM DESCRIPTION	RECEIVED
1.	Application Submittal Overview	☐
2.	Signed Master Application Form	☐
3.	Narrative	☐
4.	SEPA Checklist	☐
5.	Habitat Management, Mitigation and Monitoring Plan dated February 19, 2025, by Ecological Land Services	☐
6.	Ordinary High Water Mark Memo dated December 4, 2024, by Ecological Land Services	☐
7.	Check in the amount of \$1,500.00 made payable to the City of Castle Rock (to be hand delivered).	☐



City of Castle Rock

Department Of Building and Planning

City Hall, PO Box 370 / 141 'A' St SW, Castle Rock, WA 98611
Phone: 360.274.8181 / Email: finance@ci.castle-rock.wa.us

CR

PLEASE PRINT IN INK OR
TYPE

MASTER APPLICATION

PROPERTY INFORMATION

Project Address: N/A City: Castle Rock Parcel #: 308120500
Short Plat/Subdivision: _____ Block: _____ Lot: _____

OWNER/APPLICANT INFORMATION

Applicant/Authorized Agent: Shane Tapani on behalf of CT6, LLC Phone: 360.687.1148
Mailing Address: PO Box 1419 City: Battle Ground State: WA Zip: 98604
Property Owner: Same as Applicant Phone: _____
Mailing Address: _____ City: _____ State: _____ Zip: _____
Contractor: Tapani Inc. Lic #: TAPANI*88OE Phone: 360.907.7615
Mailing Address: PO Box 1419 City: Battle Ground State: WA Zip: 98604
Lender Name: N/A Phone: _____
Lender's Address: _____

PROJECT INFORMATION

Building/Construction	Planning	Environmental
☐ Building Permit	☐ Critical Areas	☐ Critical Areas
☐ Excavation & Grading Permit	☐ Flood Plain	☐ Flood Plain Permits
☐ Manufactured/Structure Placement	☐ Master Plan	☐ SEPA
☐ Mechanical Permit	☐ Mobile Home Park	☐ Surface Mining
☐ Plumbing Permit	☐ Plat (Preliminary)	☒ Other <u>Shoreline</u>
☐ Roofing Permit	☐ Plat (Final)	Substantial
☐ Signage Permit	☐ Short Plat	Development
☐ Other _____	☐ Site Plan (Preliminary)	Permit
	☐ Site Plan (Final)	SEPA Checklist

PROJECT DESCRIPTION

Occupancy Group: N/A **Type of Construction:** N/A **Sq. Ft.** N/A **No. of Stories:** N/A **No. of Bedrooms:** N/A
Is there any grading, filling, or excavation associated with this project? Yes Quantity (cubic yards): 121 cubic yard (cy) cut & 113 cy fill
(Including grading for road construction, site preparation, and landscaping.) **NO SITE WORK MAY BE DONE PRIOR TO CRITICAL AREAS DETERMINATION.**
Water Supply: N/A **Sewage Disposal:** N/A **Type of Heat:** N/A **Fair Market Value:** N/A

Does project involve Asbestos? ☐ YES ☒ NO

PLEASE PROVIDE A BASIC DESCRIPTION OF THE PROPOSED PROJECT:

Stormwater outfall for the Phase 1 infrastructure of the Landing on the Cowlitz Master Plan (ref. CR-24-051).

I hereby certify that I am the owner or duly authorized agent of the owner for the purposes of this application. Further, I grant permission from the owner to any and all employees and representatives of the City of Castle Rock and other governmental agencies to enter upon and inspect said property as reasonably necessary to process this application. I further certify that I have read and examined this application and know the same to be true and correct. If any of the information provided on this application is incorrect, the permit or approval may be revoked.

APPLICANT'S SIGNATURE: Shane Tapani

DATE: 3/6/2025 | 1:01 PM PST

APPLICATION ACCEPTED BY: _____ DATE: _____

APPLICATION APPROVED BY: _____ DATE: _____

PERMIT NUMBER
CR _____



City of Castle Rock

Building & Planning Department

General Land Use Application

141 A St SW / PO Box 370
Castle Rock, WA 98611
Phone: (360) 274-8181
finance@ci.castle-rock.wa.us

OFFICIAL USE ONLY

Case # _____ Related File # _____ Received By: _____

One or more of the following **Supplements** must be attached to this **General Land Use Application**:

TITLE 16 SUBDIVISIONS

- ☐ Binding Site Plan
- ☐ Boundary Line Adjustment
- ☐ Condominium Subdivision
- ☐ Final Plat (Subdivision)
- ☐ Final Short Plat
- ☐ Preliminary Plat (Subdivision)
- ☐ Preliminary Short Plat

TITLE 18 ENVIRONMENTAL PROTECTION

- ☐ Critical Areas Determination
- ☐ Critical Areas Permit
- ☐ Environmental Questionnaire
- ☒ SEPA Checklist
- ☐ Shorelines Conditional Use
- ☒ Shorelines Substantial Development
- ☐ Shorelines Variance

TITLE 17 ZONING

- ☐ Annexation
- ☐ Bed & Breakfast – (CUP)
- ☐ Comprehensive Plan Amendment
- ☐ Conditional Use Permit = (CUP)
- ☐ Home Occupancy Business License
- ☐ Home Occupancy in an Accessory Building – (CUP)
- ☐ Manufactured Home Park
- ☐ Recreational Vehicle Park – (CUP)
- ☐ Request for Clarification
- ☐ Rezone
- ☐ Similar Use Authorization
- ☐ Special Use Permit
- ☐ Variance

OTHER

- ☐ Request for Pre-Application Meeting
- ☐ Wireless Communications Facilities - (CUP)
- ☐ Other _____

Project Name: Landing on the Cowlitz (LOTC)
Stormwater Outfall

Project Address: No site address.
Location is within the approved LOTC Master Plan.

Applicant: CT6, LLC
Phone : PO Box 1419
E-mail Address: shanet@tapani.com; ingridf@tapani.com

Mailing Address: Same as Applicant.

Owner: Same as Applicant.
(If other than applicant)
Phone : _____
E-mail Address: _____

Mailing Address: Same as Applicant.

Other Authorized Representative (if any): Not Applicable.

Mailing Address: _____

Phone: _____

E-mail Address: _____

Project Description: This proposal includes a stormwater outfall for the Phase 1 infrastructure for the approved Landing on the Cowlitz Master Plan.Size of Project Site: Parcel Size is approximately 15.37 acres.Assessor Tax Parcel Number(s): 308120500Full Legal Description of Subject Property (Attached ☐):Zoning: Industrial (City); Recreation and Open Space (LOT Master Plan)

Special Areas On or Near Site (show areas on site plan):

☒ Creek, Stream or River (name): Cowlitz River☐ Wetland☐ Steep Slopes/Draw/Gully/Ravine☒ Flood Hazard Area _____☐ None**Water Service**

Existing pipe size and material: _____

Proposed pipe size and material: _____

Sewage Disposal

Existing: _____

Proposed: _____

AccessName of Street(s) from which access will be gained: Access shall be via the temporary site access gravel road, later replaced by the Phase 1 access roadway which shall connect to a temporary access easement & road.**Owner's Consent and Authorization**

I affirm that I am the owner of the subject site and all answers, statements, and information submitted with this application are correct and accurate to the best of my knowledge. Further, I grant permission from the owner to any and all employees and representatives of the City of Castle Rock and other governmental agencies to enter upon and inspect said property as reasonably necessary to process this application.

I agree to pay all fees of the City that apply to this application.

Shane Tapani

Owner's Name (Print Name)

DocuSigned by:

Shane Tapani

8ADCFO136DTB439..

Owner's Signature

3/6/2025 | 4:46 PM PST

Date

EXHIBIT "A"
Legal Description

For APN/Parcel ID(s): 308120500

A PARCEL OF PROPERTY LOCATED IN A PORTION OF THE BENJAMIN HUNTINGTON D.L.C. AND THE NORTH HALF OF SECTION 23, TOWNSHIP 9 NORTH, RANGE 2 WEST OF THE WILLAMETTE MERIDIAN IN THE CITY OF CASTLE ROCK, COWLITZ COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE CORNER COMMON TO SECTION 13, 14, 23 AND 24, TOWNSHIP 9 NORTH, RANGE 2 WEST, AS SHOWN ON RECORD-OF-SURVEY RECORDED IN VOLUME 43, PAGES 120-121 OF THE WILLAMETTE MERIDIAN, COWLITZ COUNTY, WASHINGTON;

THENCE NORTH 88°18'41" WEST ALONG THE NORTH LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23, A DISTANCE OF 1956.09 FEET;

THENCE SOUTH 01°41'19" WEST 24.09 FEET TO THE INTERSECTION OF THE NORTH LINE OF "PARCEL II" AS CONVEYED TO CT6, LLC BY DEED RECORDED UNDER AUDITOR'S FILE NUMBER 3682681, COWLITZ COUNTY RECORDS AND A POINT 30.00 FEET SOUTHWESTERLY OF, WHEN MEASURED PERPENDICULAR TO, THE CENTERLINE OF LARSEN LANE AND TO THE TRUE POINT OF BEGINNING;

THENCE SOUTH 53°23'25" WEST, ALONG SAID NORTH LINE 394.16 FEET;
THENCE SOUTH 89°35'00" WEST, ALONG SAID NORTH LINE 145.25 FEET TO THAT BOUNDARY AGREEMENT LINE AS DESCRIBED IN EXHIBIT A OF THAT BOUNDARY LINE AGREEMENT DOCUMENT RECORDED UNDER AUDITOR'S FILE NUMBER 3597924, COWLITZ COUNTY RECORDS:

THENCE ALONG SAID BOUNDARY AGREEMENT LINE AND THE ORDINARY HIGH WATER LINE ON THE LEFT BANK OF THE COWLITZ RIVER LINE APPROXIMATED BY THE FOLLOWING FOUR (4) COURSES:

THENCE SOUTH 16°25'08" EAST 239.13 FEET;
THENCE SOUTH 20°06'11" EAST 262.43 FEET;
THENCE SOUTH 25°28'57" EAST 218.98 FEET;
THENCE SOUTH 20°33'29" EAST 229.50 FEET;

THENCE LEAVING SAID ORDINARY HIGH WATER LINE AND CONTINUING ALONG SAID BOUNDARY AGREEMENT LINE THE FOLLOWING FOUR (4) COURSES;

THENCE NORTH 74°55'34" EAST 13.28 FEET

THENCE SOUTH 50°34'51" EAST 735.65 FEET TO A 1000.00 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 1000.00 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 23°12'02" AN ARC DISTANCE OF 404.92 FEET:

THENCE SOUTH 73°46'53" EAST 380.03 FEET TO A POINT WHICH BEARS NORTH 88°25'11" WEST 732.00 FEET FROM A POINT ON THE EAST LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23 THAT IS SOUTH 01°34'49" WEST, 1869.34 FEET FROM THE NORTHEAST CORNER OF SAID NORTHEAST QUARTER ;

THENCE NORTH 27°09'34" WEST LEAVING SAID BOUNDARY AGREEMENT LINE 473.65 FEET TO A NON-TANGENT 68.00 FOOT RADIUS CURVE TO THE RIGHT, FROM WHICH THE RADIUS POINT BEARS NORTH 44°16'29" WEST;



City of Castle Rock

Department Of Building and Planning

City Hall, PO Box 370 / 141 'A' St SW, Castle Rock, WA 98611
Phone: 360.274.8181 / Email: finance@ci.castle-rock.wa.us

CR

PLEASE PRINT IN INK OR
TYPE

MASTER APPLICATION

PROPERTY INFORMATION

Project Address: See property sheet attached City: Castle Rock Parcel #: See property sheet
Short Plat/Subdivision: N/A Block: _____ Lot: _____

OWNER/APPLICANT INFORMATION

Applicant/Authorized Agent: Shane Tapani, CT6, LLC Phone: (360) 687-1148
Mailing Address: PO Box 1419 City: Battle Ground State: WA Zip: 98604
Property Owner: See property sheet attached Phone: _____
Mailing Address: _____ City: _____ State: _____ Zip: _____
Contractor: Tapani, Inc. Lic #: TAPANI*883OE Phone: (360) 687-1148
Mailing Address: PO Box 1900 City: Battle Ground State: WA Zip: 98604
Lender Name: _____ Phone: _____
Lender's Address: _____

PROJECT INFORMATION

Building/Construction

- ☐ Building Permit
☒ Excavation & Grading Permit
☐ Manufactured/Structure Placement
☐ Mechanical Permit
☐ Plumbing Permit
☐ Roofing Permit
☐ Signage Permit
☒ Other Engineering Plan Review

Planning

- ☐ Critical Areas
☐ Flood Plain
☐ Master Plan
☐ Mobile Home Park
☐ Plat (Preliminary)
☐ Plat (Final)
☐ Short Plat
☐ Site Plan (Preliminary)
☐ Site Plan (Final)

Environmental

- ☐ Critical Areas
☐ Flood Plain Permits
☐ SEPA
☐ Surface Mining
☐ Other _____

NOTE: WE'VE SUBMITTED THREE
COPIES OF THE PERMIT, SIGNED BY
EACH PROPERTY OWNER INVOLVED

PROJECT DESCRIPTION

Occupancy Group: N/A Type of Construction: N/A Sq. Ft. N/A No. of Stories: N/A No. of Bedrooms: N/A

Is there any grading, filling, or excavation associated with this project? Yes Quantity (cubic yards): 1,100 cubic yards
(Including grading for road construction, site preparation, and landscaping.) **NO SITE WORK MAY BE DONE PRIOR TO CRITICAL AREAS DETERMINATION.**

Water Supply: N/A Sewage Disposal: N/A Type of Heat: N/A Fair Market Value: N/A

Does project involve Asbestos? ☐ YES ☒ NO

PLEASE PROVIDE A BASIC DESCRIPTION OF THE PROPOSED PROJECT:

Constructing a stormwater outfall to the Cowlitz River

I hereby certify that I am the owner or duly authorized agent of the owner for the purposes of this application. Further, I grant permission from the owner to any and all employees and representatives of the City of Castle Rock and other governmental agencies to enter upon and inspect said property as reasonably necessary to process this application. I further certify that I have read and examined this application and know the same to be true and correct. If any of the information provided on this application is incorrect, the permit or approval may be revoked.

APPLICANT'S SIGNATURE: Shane Tapani
8ADCFO136D1B439...

DATE: 11/13/2024 | 4:04 PM PST

APPLICATION ACCEPTED BY: _____ DATE: _____

APPLICATION APPROVED BY: _____ DATE: _____

PERMIT NUMBER
CR _____



City of Castle Rock

Department Of Building and Planning

City Hall, PO Box 370 / 141 'A' St SW, Castle Rock, WA 98611
Phone: 360.274.8181 / Email: finance@ci.castle-rock.wa.us

CR

PLEASE PRINT IN INK OR
TYPE

MASTER APPLICATION

PROPERTY INFORMATION

Project Address: See property sheet attached City: Castle Rock Parcel #: See property sheet
Short Plat/Subdivision: N/A Block: _____ Lot: _____

OWNER/APPLICANT INFORMATION

Applicant/Authorized Agent: Shane Tapani, CT6, LLC Phone: (360) 687-1148
Mailing Address: PO Box 1419 City: Battle Ground State: WA Zip: 98604
Property Owner: See property sheet attached Phone: _____
Mailing Address: _____ City: _____ State: _____ Zip: _____
Contractor: Tapani, Inc. Lic #: TAPANI*883OE Phone: (360) 687-1148
Mailing Address: PO Box 1900 City: Battle Ground State: WA Zip: 98604
Lender Name: _____ Phone: _____
Lender's Address: _____

PROJECT INFORMATION

Building/Construction

- ☐ Building Permit
☒ Excavation & Grading Permit
☐ Manufactured/Structure Placement
☐ Mechanical Permit
☐ Plumbing Permit
☐ Roofing Permit
☐ Signage Permit
☒ Other Engineering Plan Review

Planning

- ☐ Critical Areas
☐ Flood Plain
☐ Master Plan
☐ Mobile Home Park
☐ Plat (Preliminary)
☐ Plat (Final)
☐ Short Plat
☐ Site Plan (Preliminary)
☐ Site Plan (Final)

Environmental

- ☐ Critical Areas
☐ Flood Plain Permits
☐ SEPA
☐ Surface Mining
☐ Other _____

PROJECT DESCRIPTION

Occupancy Group: N/A Type of Construction: N/A Sq. Ft. N/A No. of Stories: N/A No. of Bedrooms: N/A

Is there any grading, filling, or excavation associated with this project? Yes Quantity (cubic yards): 1,100 cubic yards
(Including grading for road construction, site preparation, and landscaping.) **NO SITE WORK MAY BE DONE PRIOR TO CRITICAL AREAS DETERMINATION.**

Water Supply: N/A Sewage Disposal: N/A Type of Heat: N/A Fair Market Value: N/A

Does project involve Asbestos? ☐ YES ☒ NO

PLEASE PROVIDE A BASIC DESCRIPTION OF THE PROPOSED PROJECT:

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APPLICANT'S SIGNATURE: DocuSigned by: Mike Canton DATE: 11/13/2024 | 5:16 PM PST
APPLICATION ACCEPTED BY: _____ DATE: _____
APPLICATION APPROVED BY: _____ DATE: _____

PERMIT NUMBER
CR _____



City of Castle Rock

Department Of Building and Planning

City Hall, PO Box 370 / 141 'A' St SW, Castle Rock, WA 98611
Phone: 360.274.8181 / Email: finance@ci.castle-rock.wa.us

CR

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TYPE

MASTER APPLICATION

PROPERTY INFORMATION

Project Address: See property sheet attached City: Castle Rock Parcel #: See property sheet
Short Plat/Subdivision: N/A Block: _____ Lot: _____

OWNER/APPLICANT INFORMATION

Applicant/Authorized Agent: Shane Tapani, CT6, LLC Phone: (360) 687-1148
Mailing Address: PO Box 1419 City: Battle Ground State: WA Zip: 98604
Property Owner: See property sheet attached Phone: _____
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Lender Name: _____ Phone: _____
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Building/Construction

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☐ Plat (Preliminary)
☐ Plat (Final)
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Environmental

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☐ Flood Plain Permits
☐ SEPA
☐ Surface Mining
☐ Other _____

PROJECT DESCRIPTION

Occupancy Group: N/A Type of Construction: N/A Sq. Ft. N/A No. of Stories: N/A No. of Bedrooms: N/A

Is there any grading, filling, or excavation associated with this project? Yes Quantity (cubic yards): 1,100 cubic yards
(Including grading for road construction, site preparation, and landscaping.) **NO SITE WORK MAY BE DONE PRIOR TO CRITICAL AREAS DETERMINATION.**

Water Supply: N/A Sewage Disposal: N/A Type of Heat: N/A Fair Market Value: N/A

Does project involve Asbestos? ☐ YES ☒ NO

PLEASE PROVIDE A BASIC DESCRIPTION OF THE PROPOSED PROJECT:

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I hereby certify that I am the owner or duly authorized agent of the owner for the purposes of this application. Further, I grant permission from the owner to any and all employees and representatives of the City of Castle Rock and other governmental agencies to enter upon and inspect said property as reasonably necessary to process this application. I further certify that I have read and examined this application and know the same to be true and correct. If any of the information provided on this application is incorrect, the permit or approval may be revoked.

APPLICANT'S SIGNATURE: _____ DATE: _____

APPLICATION ACCEPTED BY: DocuSigned by: _____ DATE: _____

APPLICATION APPROVED BY: Raymond Pieren DATE: 11/13/2024 | 5:31 PM PST

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PERMIT NUMBER
CR

Castle Rock Landing on the Cowlitz Property Information

BLA Parcel Number	Proposed Adjusted TPN	Property Owner
1	308640100	CT6, LLC
2	30813	CT6, LLC
3	6143802	CT6, LLC
4	308100100	MLC Ventures LLC
5	30812	Pieren Raymond
6	308640200	Pieren Raymond
7	30864	Pieren Raymond

**CITY OF CASTLE ROCK
SUBSTANTIAL SHORELINE DEVELOPMENT PERMIT APPLICATION**

LANDING ON THE COWLITZ STORMWATER OUTFALL

**PARCEL NO. 308120500
LANDING ON THE COWLITZ**

APPLICANT:

CT6, LLC

P.O. Box 1419

Battle Ground, WA 98604-1419

Contact: Ingrid Friedberg, Special Projects Manager

Email: ingridf@tapani.com

Phone: 360.907.553.9144

ENVIRONMENTAL CONSULTANT:

Ecological Land Solutions

1157 3rd Avenue, Suite 220A

Longview, WA 98632

Contact: Elizabeth Vaughn, Biologist

Email: elizabeth@eco-land.com

Phone: 360.578.1371



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I. DEVELOPMENT SUMMARY INFORMATION

Property Owner & Applicant:	CT6, LLC P.O. Box 1419 Battle Ground, WA 98604-1419 Contact: Ingrid Friedberg, Special Projects Manager Email: ingridf@tapani.com Phone: 360.553.9144
Request:	Shoreline Substantial Development Permit Application Approval
Anticipated Applications Required:	Binding Site Plan Application and Shoreline Permit Application
Location:	The existing property is adjacent to Parcel 6143801, 3081501 and 308140200 (privately owned property outside of the Landing on the Cowlitz (LOTIC) Master Plan) and Larsen Lane SW, LOTIC BLA Parcel 7 (Parcel 30684), State of Washington Department of Land and Natural Resources (DNR) property, and the Cowlitz River.
Parcel ID:	308120500 (ref. Boundary Line Adjustment (BLA) Survey Parcel No. 3, recorded on December 5, 2024, Auditor's File No. (AFN) 3762029)
Area:	Parcel Size: 15.37 Acres (669,622 Square Feet)
Approximate Grading Volumes:	It is anticipated that this proposal will require approximately 113 cubic yards (cy) of fill, 121 cy of cut, resulting in 8 cy of net cut within the shoreline jurisdiction.
Zoning Designation:	Industrial (I)
Landing on the Cowlitz Land Use Area Designation:	Recreation and Open Space
Shoreline Environmental Designation (SED):	High-Intensity

II. PROJECT DESCRIPTION

This project involves the construction of a stormwater outfall and associated infrastructure within the shoreline buffer, shoreline jurisdiction, and the regulatory floodway and the 100-year floodplain of the Cowlitz River to facilitate a centralized discharge location for the Landing on the Cowlitz (LOT) Master Plan. The stormwater outfall and conveyance pipes have been sized sufficiently to accommodate for the full build out of the LOT Master Plan and have been designed to include corrugated polypropylene pipe (CPP) which range in size from shall include one (1) thirty- (30) inch to 48-inch CPP. Runoff intercepted from roadway surfaces will undergo preliminary water quality treatment through bioretention planters positioned along the roadways outside of the shoreline area. For each individual phase of the LOT Master Plan, final treatment methodologies will be specified at the development stage integrating bioretention systems and mechanical filtration via catch basins to achieve regulatory compliance. The treated stormwater will be directed into an onsite conveyance system, channeling flows towards the outfall and facilitating discharge into the shoreline buffer of the Cowlitz River for infiltration. Additionally, an integrated infiltration strategy will be implemented at each capture point, optimizing upland infiltration and minimizing runoff volumes entering the conveyance system.

CONSTRUCTION METHODS

Stormwater infrastructure will be installed primarily through trenching for accurate pipeline placement. All onsite runoff will receive treatment through roadside bioretention rain gardens before discharge. Outfall construction will be completed with landward-based excavation, beginning at the OHWM of the Cowlitz River and moving progressively away from the river. Biodegradable jute erosion matting will be placed within the proposed restoration and enhancement area to stabilize soils prior to habitat features such as rootwads and rootwad logs are installed reducing the need for further equipment access for final planting. Construction traffic will use the existing gravel road connection to Huntington Avenue S., avoiding access from Larson Lane SW.

To construct the proposed stormwater outfall conveyance system, equipment to be used may include, but is not limited to, excavators, bull dozers, dump trucks, concrete trucks, compacting equipment, and hand tools. All staging and stockpile areas will be located outside of critical areas and buffers, and all project construction is proposed to be completed in a single phase during the dry season. All plant installation will be conducted during the appropriate planting windows as specified in this report.

The following details the general construction sequence:

1. All work limits will be clearly demarcated with silt fencing or construction fencing.
2. All appropriate best management practices (BMPs) will be installed.
3. Topsoil will be cleared and grubbed.
4. Infiltration areas will be marked to avoid heavy equipment from compacting soils and affecting infiltration.
5. Stormwater outfall will be graded to designed elevations.
6. Install signage prohibiting access to mitigation area.
7. Install biodegradable erosion control jute matting.
8. Install habitat features in shoreline jurisdiction.
9. Install riparian habitat and shoreline vegetation enhancement and restoration plantings.

IMPACT AVOIDANCE AND MINIMIZATION METHODS

This proposal involves the construction of water-dependent critical infrastructure and as such avoidance is not possible. Impacts associated with the construction of the stormwater infrastructure are unavoidable even if they were to be sited elsewhere. Therefore, this proposal includes minimization measures to the greatest extent practicable the inclusion of mitigation for this proposal which is described in greater detail within the onsite mitigation section included below.

The following construction best management practices (BMPs) are recommended by the Habitat Management, Mitigation and Monitoring Plan:

1. Construction will occur mainly during the dry season (May-October) as feasible.
2. Native vegetation will be retained to the greatest extent possible within shoreline jurisdiction where improvements are not proposed.
3. Only three trees within the project area will be removed to accommodate the installation of the outfall system.
4. Clearly demarcate the job site and critical areas that must be avoided prior to ground disturbing activities.
5. Install silt fencing on the waterward side of land disturbing activities in shoreline jurisdiction.
6. No equipment will enter below the OHWM of the Cowlitz River.
7. Vehicle and equipment maintenance, repair, and/or service will be performed at designated repair facilities whenever possible.
8. All equipment will be maintained or fueled up, a minimum of 200 feet from the Cowlitz River.
9. All bare soils within shoreline jurisdiction will be mulched with certified weed-free straw after ground disturbing activities.
10. Signage will be installed along the boundary of Area 1 and Area 3 to notify the public of mitigation locations and access restrictions (Figure 7).
11. Install large woody material rootwads and horizontal logs to deter entrance from the public to the stormwater outfall.

PROJECT IMPACT SUMMARY

All impacts have been minimized to the greatest extent possible. All mitigation for impacts to the shoreline buffer and shoreline jurisdiction of the Cowlitz River is proposed onsite. Most project impacts come from the proposed grading and fill, and the installation of the proposed dual outfall piping system. Proposed impacts to critical areas onsite are included in the table below.

Shoreline Buffer Impacts		
Habitat Area	Proposed Impact	Size of Impact
Shoreline Buffer for Cowlitz River (RHA)	Permanent Shoreline Buffer Impact	0.002 acres/108 square feet
	Temporary Shoreline Buffer Impact	0.217 acres/9,444 square feet
Shoreline Impacts		
Habitat Area	Proposed Impact	Size of Impact
Shoreline Jurisdiction for the Cowlitz River (outside of RHAs)	Temporary Shoreline Jurisdiction Impact	0.014 acres/629 square feet

ONSITE MITIGATION

The applicant is proposing project impacts be compensated for through onsite, in-kind mitigation. The goal of onsite mitigation is to ensure no net loss of ecological functions and meet vegetation conservation standards established in the SMP. The generally accepted mitigation ratio for permanent impacts and temporary impacts to shoreline buffers and shoreline jurisdiction impacts, in ELS experience, has been generally accepted at 1:1 mitigation ratio. CT6, LLC proposes a comprehensive onsite mitigation plan to address project impacts within the shoreline buffer and shoreline jurisdiction of the Cowlitz River. The plan includes:

- Permanent Impacts: Mitigation at a 2:1 ratio for permanent impacts to the shoreline buffer resulting from the installation of a gabion wall.
- Temporary Impacts: Mitigation at a 1:1 ratio for temporary impacts to the shoreline buffer and shoreline jurisdiction caused by grading and the installation of an outfall pipe system.
- Tree Removal: Mitigation at a 4:1 stem count ratio for the removal of three black cottonwood trees within the shoreline buffer to accommodate the outfall system installation.

Mitigation includes a combination of restoration and enhancement with an upland native grass seed application and installing native trees and shrubs. In addition to these measures, CT6, LLC will install habitat features within the shoreline buffer of the Cowlitz River to ensure no net loss of ecological function. Performance standards, monitoring, maintenance, and contingency methods will be discussed in subsequent sections of this report to ensure the mitigation areas are successful.

III. EXISTING SITE CONDITIONS

The site consists of undeveloped area within the recreation land use designated for recreation use in the approved Landing on the Cowlitz (LOT) Master Plan and subsequent minor modification (Ordinance No. 2021-10 and Resolution No. 2024-03) (Master Plan). The site is further identified as Parcel 308120500 (BLA Parcel No. 3, CR-BLA-24-01 - AFN3762029 and AFN 3763318).

The site primarily consists of mudflow derived from the 1980 eruption of Mount St. Helen's or by dredge from the Cowlitz River. The site features sporadic vegetation consisting of deciduous native trees, herbaceous grasses and weeds, and non-native invasive species including scotch broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus armeniacus*). The site itself requires the removal of three (3) black cottonwood (*Populus trichocarpa*) trees in order to facilitate the grading and installation of the stormwater outfall system. Existing site slopes are less than 2:1. For more information, see the Habitat Management, Mitigation and Monitoring Plan dated December 4, 2024, prepared by Ecological Land Services, Inc.

IV. CONFORMANCE WITH THE CITY OF CASTLE ROCK SHORELINE MASTER PROGRAM (ORD. 2022-03, MAY 9, 2022)

The following narrative addresses the way in which the proposed stormwater outfall has been designed in compliance with the City of Castle Rock Shoreline Master Program (SMP). Only applicable Sections of the SMP are included below and text appearing in italics denotes information contained within the SMP. Response text follows each SMP section. Ellipses ([...]) that appear to denote a truncation of SMP code text which does not apply.

[...]

5. Shoreline Environment Designations and Shorelines of Statewide Significance

[...]

5.4 Shoreline Environment Designations

The City classification system consists of shoreline environment designations that are consistent with and implement the Act, the Program, and the City of Castle Rock Comprehensive Plan.

These designations have been assigned consistent with the corresponding criteria provided for each shoreline environment designation. In delineating shoreline environment designations, the City aims to ensure that existing shoreline ecological functions are protected with the proposed pattern and intensity of development. Such designations should be consistent with the policies for restoration of degraded shorelines. The shoreline environment designations are, High-Intensity, Residential, Aquatic, and Recreation.

5.4.1 High-Intensity Environment

[...]

Management Policies

- A. *Priority should be given to water-dependent, water-related, and water-enjoyment uses in that order of preference. Non-water-oriented uses within the High-Intensity shoreline environment designation are appropriate on sites where there is no direct access to the shoreline because of another property separating it from the shoreline or an intervening public right-of-way.*

Response: This proposal involves a water-dependent use within the High-intensity shoreline buffer. The purpose of the stormwater project is to facilitate the inclusion of critical infrastructure and does not include the provision of direct vehicular or pedestrian access to the shoreline. This proposal has been designed to enhance the ecological functions of the site. Existing undeveloped site conditions deciduous native trees, herbaceous grasses and weeds, and non-native, invasive species including sporadic scotch broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus armeniacus*). Site conditions are not resultant from previous degradation.

- B. *Non-water-oriented uses on sites adjacent to the water should provide public benefit in the form of ecological enhancement and/or public access in compliance with the provisions of this Program.*

Response: Not applicable. This proposal involves a water-dependent use and as such the criteria for non-water-oriented uses does not apply.

- c. *Where unavoidable impacts to ecological functions occur, appropriate mitigation should be provided in accordance with this Program to achieve no-net-loss. Where applicable, development should include environmental cleanup and restoration of the shoreline in accordance with relevant state and federal law.*

Response: This proposal involves unavoidable impacts to a portion of the Cowlitz River shoreline buffer area and the regulatory floodplain and as such, is required to include mitigation measures to ensure no-net-loss is achievable for the area.

This proposal has been designed to include onsite compensatory mitigation in order to achieve no net loss of habitat function:

- 2:1 ratio for permanent impacts associated with the installation of the gabion wall for the stormwater outfall;
- 1:1 ratio for temporary impacts associated with the installation of a stormwater outfall gabion wall, and;
- 4:1 stem count ratio for permanent impacts associated with tree removal

The mitigation that has been designed for this proposal exceed the 1:1 ratio which is generally accepted for permanent and temporary impacts within critical areas.

C. Visual and/or physical public access should be provided, where feasible.

Response: Not applicable. This proposal involves the construction of stormwater infrastructure on a privately owned site devoid of public access roads.

D. Aesthetic objectives of this Program should be in character with high intensity development and include height limits, screening, and other standards consistent with the primary purpose of accommodating high-intensity uses.

Response: This proposal has been designed in conformance with the aesthetic objectives of this Program. While topography renders the proposed stormwater outfall imperceivable from the nearest development located adjacent to Larsen Lane SW, the mitigation plan includes plantings which shall obstruct visibility of the stormwater outfall. The proposed plantings will further shield the Cowlitz River from any upland development in the vicinity of the outfall.

E. Existing urban areas appropriate for intensive development should be fully utilized before expanding intensive development into other areas.

Response: Not applicable. The site is not located within an existing urban area nor does the installation of essential stormwater infrastructure constitute an expansion of an existing intensive development into other areas.

Designation Criteria

The High-Intensity environment designation is given to shoreline areas within the City of Castle Rock if they currently support or are planned for high-intensity uses related to commercial, industrial, or transportation.

Response: The site is planned for adjacent high intensity uses in the future.

6. General Shoreline Regulations

This Chapter describes general regulations which apply to all shorelines of the state that are located in the City of Castle Rock. The general regulations Section is used in conjunction with the use and modification regulations found in Chapter 7.

6.1 No Net Loss of Ecological Function

- A. All shoreline use and development, including preferred uses and uses that are exempt from permit requirements, shall be located, designed, constructed, conducted, and maintained in a manner that maintains shoreline ecological functions, in accordance with the mitigation sequencing provisions of the Program.*

Response: This proposal has been designed to avoid and minimize impacts to the buffer by limiting the area of impact to the shoreline buffer involving 108 square feet (0.002 acres) of permanent impact and 9,444 square feet (0.217 acres) of temporary impact, and 629 square feet (0.014 acres) outside of the shoreline buffer but within shoreline jurisdiction. In addition, this proposal includes compensatory mitigation of 2:1 for permanent impacts, exceeding the generally accepted ratio of 1:1. Furthermore, non-native invasive species shall be cleared from the project area which shall enhance environmental conditions and result in no net loss of ecological function onsite within the area of impact. The small project footprint, BMPs, and proposed mitigation measures will maintain ecological functions.

- B. *Shoreline ecological functions that shall be protected include, but are not limited to, fish and wildlife habitat, food web support, and water quality maintenance.*

Response: This proposal involves the installation of a stormwater system landward of the ordinary high water mark (OHWM) which shall avoid direct impacts to aquatic life. The native plantings included as part of the proposed mitigation plan shall provide an enhanced environmental quality within an area which currently features non-native, invasive plant species. Furthermore, this proposal includes a stormwater system with water quality treatment outside of the regulatory shoreline wherein which only treated and controlled stormwater runoff shall be discharged within the shoreline buffer of the Cowlitz River. The installed vegetation will slow surface runoff, reduce the potential for erosion, and promote infiltration, which protects water quality functions of the shoreline buffer. Additionally, the proposed vegetation and habitat features will provide nesting, roosting, and foraging opportunities.

- C. *Shoreline processes that shall be protected include, but are not limited to, water flow; erosion and accretion; infiltration; groundwater recharge and discharge; sediment delivery, transport, and storage; large woody debris recruitment; organic matter input; nutrient and pathogen removal; and stream channel formation/maintenance.*

Response: This proposal has been designed to minimize impacts to shoreline processes by including a stormwater outfall above the OHWM with a permanent impact area limited to 108 square feet (0.002 acres) within the Cowlitz River shoreline buffer. The limited area of impact along with the proposed shoreline stabilization associated with the onsite mitigation shall reduce interruption to the shoreline processes. Erosion control and stabilization measures for the onsite restoration and enhancement shall include the installation of biodegradable jute matting prior to the installation of habitat features such as rootwads and rootwad logs. The area proposed for the outfall is not significantly downcut and does not appear to have frequent erosion. Sediment transport and accretion will be maintained. Groundwater recharge will be supported through stormwater discharge to the riparian buffer. Because the proposed outfall is located landward of the OHWM, large woody material recruitment will not be impacted.

- D. *In-water work shall be scheduled to protect biological productivity (including but not limited to fish runs, spawning, and benthic productivity). In-water work shall not occur in areas used for commercial fishing during a fishing season unless specifically addressed and mitigated for in the permit.*

Response: Not applicable. This proposal does not include or require in-water work.

- E. *An application for any permit or approval shall demonstrate all reasonable efforts have been taken to provide sufficient mitigation such that the activity does not result in net loss of ecological functions. Mitigation shall occur in the following prioritized order:*

1. *Avoid the adverse impact altogether by not taking a certain action or parts of an action or by moving the action.*

Response: The project has been designed to avoid impacts to the shoreline buffer and shoreline jurisdiction to the greatest extent practicable. Due to the landscape position of the Phase 1a boundary and the water-related/water orientated nature of the stormwater outfall, complete avoidance of impacts to shorelines was not possible.

2. *Minimize adverse impacts by limiting the degree or magnitude of the action and its implementation by using appropriate technology and engineering, or by taking affirmative steps to avoid or reduce adverse impacts.*

Response: Permanent impacts from the proposed gabion wall are limited to 0.002 acres (108 sq. ft.) and will be offset with a 2:1 onsite mitigation ratio. Additionally, permanent impacts from grading and installation of the outfall system within the shoreline buffer necessitates the proposed removal of three black cottonwood (*Populus trichocarpa*) trees. Neither of these permanent impacts could be avoided to accommodate project design. Alternative locations for the outfall would result in the same amount of vegetation removal or more.

3. *Rectify the adverse impact by repairing, rehabilitating, or restoring the affected environment.*

Response: The affected environmental shall be restored to pre-project conditions and further enhanced with the inclusion of erosion control measures including jutte matting and hydroseeding of all disturbed areas. Native trees and shrubs as well as habitat features will be installed to result in no net loss of ecological functions. A total of 0.268 acres of the shoreline will be restored and enhanced with native trees and shrubs. Furthermore, the habitat mitigation plan includes the removal of non-native invasive species. For more details about the proposed onsite restoration and enhancement, see Table 2 and 5 within the Habitat Management, Mitigation and Monitoring Plan by Ecological Land Services.

4. *Reduce or eliminate the adverse impact over time by preservation and maintenance operations during the life of the action.*

Response: This proposal has been designed to include a monitoring and maintenance plan for three (1) restoration areas over the course of five (5) years to ensure the mitigation goals, objective, and performance standards are being met. Native vegetation will be monitored for overall success including survival and percent cover. Maintenance to the mitigation areas will include invasive vegetation removal, competing vegetation removal, and irrigation. Over the long term, the stormwater outfall and associated facility will be maintained for the life of the project to ensure proper function and to avoid impacts to the shoreline buffer and water quality.

5. *Compensate for the adverse impact by replacing, enhancing, or providing similar substitute resources or environments. Preference shall be given to measures that replace the impacted functions on site or in the immediate vicinity of the impact. However, alternative compensatory mitigation within the watershed that addresses limiting factors or identified critical needs for shoreline resource conservation based on watershed or comprehensive resource management plans may be authorized.*

Response: The compensatory mitigation included in the Habitat Management, Mitigation and Monitoring Plan serves to replace and enhance the impacted environment within the area of temporary and permanent impact associated with the installation of the stormwater outfall. Onsite mitigation will ensure the impacted functions are replaced onsite and will result in no net loss of ecological function.

6. *Monitor the adverse impact and take appropriate corrective measures.*

Response: This proposal includes a five- (5) year monitoring plan and includes corrective measures, if they are needed. The outfall will be monitored regularly to ensure proper function.

- F. *Applicants for permits have the burden of proving that the proposed development is consistent with the criteria set forth in this Program and the Act, including demonstrating all reasonable efforts have been taken to provide sufficient mitigation such that the activity does not result in net loss of ecological functions.*

Response: This proposal includes a Habitat Management and Mitigation Plan (Plan) and Monitoring Plan which details the proposed mitigation for anticipated permanent impacts in exceedance of the generally accepted mitigation ratio of 1:1. The Plan also includes 1:1 restoration and enhancement for temporary impacts.

- G. *Uses and development activities that comply with the provisions of the Castle Rock Comprehensive Plan and the Castle Rock Municipal Code may be permitted landward of levees, dikes, revetments, roads, railways, and rights-of-way, in accordance with the provisions of the Shoreline Management Act and this Program, including but not limited to the provisions requiring no net loss of ecological function and mitigation sequencing.*

Response: This proposal includes the provision of critical infrastructure and includes no net loss of ecological function and mitigation sequencing in conformance with the different City- and State-level regulatory requirements of the Comprehensive Plan, Castle Rock Municipal Code, City's SMP and the State Shoreline Management Act. The mitigation plan developed in conjunction with the proposed stormwater outfall includes an overall lift in ecological function within the existing riparian and shoreline habitat through the proposed plantings and habitat features, removal of non-native and invasive plant species, and the proposed compensatory mitigation ratios meeting and exceeding the generally accepted mitigation ratio.

6.2 Archaeological, Cultural, and Historic Resources

- A. *If historic, cultural, or archaeological sites or artifacts are discovered in the process of development, work shall be stopped immediately in accordance with the provisions of federal, state, and local laws, the site secured, and the find reported as soon as possible to the City. The property owner also shall notify the Washington State*

Department of Archaeology and Historic Preservation (DAHP) and affected tribes. The City may provide for a site investigation by a qualified professional and may provide for avoidance or conservation of the resources in coordination with appropriate agencies. All shoreline permits shall contain a special provision notifying permittees of this requirement. Failure to comply with this requirement shall be considered a violation of the shoreline permit and shall subject the permittee to legal action.

Response: The Applicant acknowledges that adherence to federal, state and local laws. Pursuant to the Developer's Agreement Exhibit C, Notice of Modifications to the Mitigated Determination of Non-Significance, Item 13, requires consultation between the City and Project Sponsor and the Cowlitz Tribe prior to the initiation of any ground disturbing activities. Consultation took place prior to the initiation of the approved Landing on the Cowlitz Master Plan mass grading.

This proposal is subject to the Inadvertent Discovery Plan (Report No. 4820) dated July 18, 2022, by the Archaeological Investigations Northwest, Inc. for the Landing on the Cowlitz Master Plan. Refer to the Inadvertent Discovery Plan for more details.

- B. Prior to approval of development in an area of known or probable cultural resources, the City shall require a site assessment by a qualified professional archaeologist in coordination with affected tribes. Conditions of approval may require preservation or conservation of cultural resources as provided by applicable federal, state, and local statutes. All permits issued for development in areas known to be archaeologically significant shall provide for monitoring of any development activity for previously unidentified cultural resources.*

Response: The Applicant has satisfied this site assessment requirement with the approved Master Plan and involved a scope inclusive of the overall site. Should any cultural resources or archaeological items of significance be discovered with any ground disturbing activities, all work shall be required to immediately cease and protocol included in the Inadvertent Discovery be adhered to.

6.3 Critical Areas Protection

Critical Areas Regulations are in Appendix B.

6.3.1 Applicable Critical Areas

For purposes of this Program, the following critical areas, as defined in Appendix B, will be protected under this Program: Wetlands; Critical Aquifer Recharge Areas; Frequently Flooded Areas; Geologically Hazardous Areas; and Fish and Wildlife Habitat Conservation Areas.

Response: The site is located within frequently flooded areas including the regulatory floodway and the 100-year floodplain of the Cowlitz River, and within fish and wildlife habitat conservation areas in the shoreline buffer. As such, the Critical Areas Regulations contained within the City of Castle Rock Municipal Code (CRMC) Chapter 15.24, Chapter 18.10.130, and Chapter 18.10.140 apply to this proposal.

6.3.2 General Provisions

- A. Shoreline uses, activities, developments and their associated structures and equipment shall be located, designed and operated to protect the ecological processes and functions of critical areas. Provide a level of protection to critical areas located within shoreline jurisdiction that assures no*

net loss of shoreline ecological functions necessary to sustain shoreline natural resources.

Response: This proposal involves the inclusion of critical infrastructure and has met mitigation sequencing, including proposed mitigation measures which are designed to result in no net loss of shoreline ecological functions necessary to sustain shoreline natural resources.

- B. New and/or expanded development proposals shall integrate protection of wetlands, fish and wildlife habitat, and flood hazard reduction with other stream management provisions to ensure no net loss of ecological functions.*

Response: This proposal includes the construction of stormwater infrastructure and integrates enhancement and long-term protection measures to result in a no net loss of ecological functions.

- C. Critical areas within the shoreline jurisdiction shall be regulated for any use, development, or activity as provided in accordance with this Program and Appendix B.*

Response: The Applicant acknowledges that the proposed stormwater outfall is subject to shoreline and critical areas regulations.

- D. If provisions of Appendix B and other parts of this Program conflict, the provisions most protective of ecological resources shall apply, as determined by the City.*

Response: The Applicant acknowledges that should any provisions of the Appendix B and other parts of this Program conflict, the provisions of the most protective ecological resources shall apply, as determined by the City. Ecological resources have been protected and enhanced to the greatest extent practicable.

- E. Unless otherwise stated, critical area buffers associated with jurisdictional shoreline areas shall be regulated in accordance with this Program and Appendix B, including but not limited to, Section 2.5, Table 7, and Table 8.*

Response: The Applicant acknowledges that the critical areas associated with jurisdictional shoreline areas shall be regulated in accordance with this Program and Appendix B, including but not limited to, Section 2.5, Table 7, and Table 8. No wetlands are present within the project area. Shoreline buffers have been established according to Table 7, which refers to Table 8. The shoreline buffer for this reach code is 150 feet.

- F. These provisions do not extend the shoreline jurisdiction beyond the limits specified in this Program as defined in Section 3.1, Applicability.*

Response: The Applicant acknowledges that these provisions shall not extend the shoreline jurisdiction beyond the limits specified in this Program as defined in Section 3.1, Applicability.

- G. All critical areas and critical areas buffers located outside of the jurisdiction of the Shoreline Management Act shall be subject to the provisions of the Castle Rock Municipal Code and the Washington State Growth Management Act.*

Response: The Applicant acknowledges that all critical areas and critical areas buffers located outside of the jurisdiction of the Shoreline Management Act shall be subject to the provisions of the Castle Rock Municipal Code and the Washington State Growth Management Act. This proposal involves work within area designated as frequently flooded and as such must comply with all applicable regulations.

6.4 Flood Prevention and Flood Damage Minimization

This Program addresses flooding in two different ways. This Section includes flood hazard reduction measures, including flood control works, intended to avoid increasing hazards and minimize damage. Section 6.3 includes flood hazard protections through the Critical Areas Regulations.

- A *Development or uses in floodplains shall avoid significantly or cumulatively increasing flood hazards, and shall be consistent with Chapter 15.24 of the CRMC.*

Response: This proposal has been designed to reduce site flood hazards by facilitating appropriate drainage of the overall master plan site. In addition, the outfall has been designed to include an inline check valve outside of the outfall pipe which in the event of side flooding, shall facilitate the utilization of an existing on-site ditch on the western side of the property for emergency storage. This proposal has been designed to include a parallel thirty- (30) inch system which shall separately handle off-site flows captured.

- B *New residential, commercial, or industrial development and uses, including subdivision of land, within shoreline jurisdiction are prohibited if it would be reasonably foreseeable that the development or use would require structural flood hazard reduction measures in the channel migration zone or floodway over the life of the development.*

Response: Not applicable. This proposal includes a stormwater outfall and does not comprise new residential, commercial or industrial development and uses.

- C *The following uses and activities may be authorized in floodways or channel migration zones when otherwise permitted by this Program:*

1. *Actions and development with a primary purpose of protecting or restoring ecological functions and ecosystem-wide processes.*

Response: Not applicable. This proposal does not include a use with a primary purpose of protecting or restoring ecological functions and ecosystem-wide processes.

2. *Forest practices in compliance with the Washington State Forest Practices Act and its implementing rules.*

Response: Not applicable. The site is not located within a forested area and does not include forest practice uses.

3. *Existing and ongoing agricultural practices, provided that no new restrictions to channel movement occur.*

Response: Not applicable. This proposal does not involve existing or ongoing agricultural practices.

4. *Bridges, utility lines, public stormwater and wastewater facilities and their outfalls, and other public utility and transportation structures where no other feasible alternative exists, or where the alternative would result in unreasonable and disproportionate costs. Where such structures are allowed, mitigation shall address impacted functions and processes in the affected shoreline.*

Response: This proposal involves the construction of stormwater utility lines and a stormwater outfall which shall be dedicated to the City of Castle Rock. There is no other feasible alternative for locating this infrastructure elsewhere as no other location could accommodate stormwater from both on- and off-site flows for the master plan.

5. *Repair and maintenance of an existing legally established use, provided flood hazards to other uses are not increased and that the activity does not cause significant ecological impacts that cannot be mitigated.*

Response: Not applicable. This proposal does not involve an existing use.

6. *Development in Castle Rock, where structures exist that prevent active channel movement and flooding.*

Response: Not applicable. The site is devoid of development.

7. *Modifications or additions to an existing nonagricultural legal use, provided that channel migration is not further limited and that the new development includes appropriate protection of ecological functions.*

Response: Not applicable. This proposal does not involve modifications or additions to an existing nonagricultural legal use.

8. *Measures to reduce shoreline erosion provided that it is demonstrated that the erosion rate exceeds that which would normally occur in a natural condition, that the measures do not interfere with fluvial hydrological and geomorphological processes normally acting in natural conditions, and that the measures include appropriate mitigation of impacts to ecological functions associated with the river or stream.*

Response: The proposed outfall is located landward of the OHWM and will not interfere with fluvial hydrological and geomorphological processes. This section of the Cowlitz River is linear and there is extremely minimal aggradation or degradation occurring in the area of the outfall. The proposed enhancements will not interfere with natural processes. This proposal has been designed to further include erosion control measures involving the installation of:

- (1) A gabion wall wherein which stormwater shall be discharged;
- (2) Biodegradable jute matting
- (3) Large woody material for habitat enhancement and riparian bank stabilization
- (4) Native shrubs, and spreading native seed mix

In addition, the Erosion Control Notes as included in the Phase 1 Access and Utilities Plan (Sheet C0.1) shall be adhered to:

1. The contractor shall ensure that all erosion control measures are intact and in working condition prior commencement of drainage facility construction.
2. A high-visibility fence shall be installed and composed of a high-density polyethylene material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stinger to prevent sagging between posts. The fence color shall be high-visibility orange. The fence tensile strength shall be 360 lbs/ft using the ASTM D4595 testing method. If appropriate install fabric silt fence in accordance with BMP C233: Silt fence to act as high-visibility fence. Silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP. Metal fences shall be designated and installed according to the manufacturer's specifications. Metal fences shall be at least 3 feet high and must be highly visible. Fences shall not be wired or stapled to trees. If

the fence has been damaged or visibly reduced, it shall be repaired or replaced immediately and visibly restored.

3. Approval of this Erosion/Sedimentation Control (ESC) Plan does not constitute an approval of permanent road or drainage design (e.g. size and location of roads, pipes, restrictors, channels, retention facilities, utilities).
4. The implementation of this ESC Plan and the construction, maintenance, replacement, and upgrading of these ESC BMPs is the responsibility of the Applicant until all construction is completed and approved and vegetation/landscaping is established.
5. Clearly flag the boundaries of the clearing limits shown on this plan in the field prior to construction. During the construction period, no disturbance beyond the flagged clearing limits shall be permitted. The flagging shall be maintained by the Applicant for the duration of construction.
6. Construct the ESC BMPs shown on this Plan in conjunction with all clearing and grading activities, and in such a manner as to ensure that sediment and sediment laden water do not enter the drainage system, roadways, or violate applicable water standards.
7. The ESC BMPs shown on this plan are the minimum requirement for anticipated site conditions. During the construction period, upgrade these ESCP BMPs as needed for unexpected storm events and to ensure that sediment and sediment-laden water do not leave the site.
8. The Applicant shall inspect the ESC BMPs daily and maintain them as necessary to ensure their continued functioning. Inspect and maintain the ESC BMPs on inactive sites a minimum of once a month or within the 48 hours following a major storm event (i.e. a 24-hour storm event with a 10-yr or greater recurrence interval).
9. At no time shall the sediment exceed 60-percent of the sump depth or have less than 6-inches of clearance from the sediment surface to the invert of the lowest pipe. All catch basins and conveyance lines shall be cleaned prior to paving. The cleaning operation shall not flush sediment laden water into the downstream system.
10. Install stabilized construction entrances at the beginning of construction and maintain for the duration of the project. Additional measures may be required to ensure that all paved areas are kept clean for the duration of the project.

D. Removal of materials for flood management purposes shall be consistent with an adopted flood hazard reduction plan in accordance with the mitigation sequencing provisions of this Program and shall only be allowed if a biological and geomorphological study demonstrates a long-term benefit to flood hazard reduction.

Response: This proposal does not include the removal of materials for flood management purposes.

E. Channel Migration Zones:

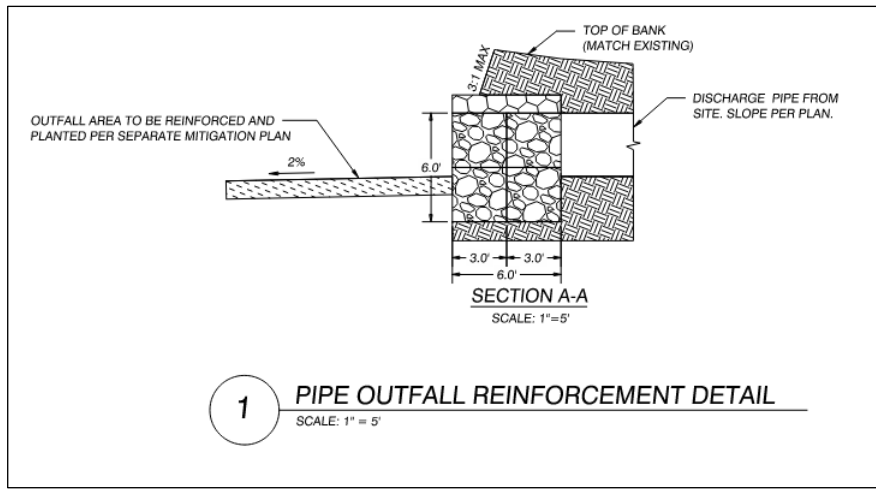
[...]

Response: Not applicable. Pursuant to the State of Washington Department of Ecology mapping, the site is not located in the Channel Migration Zones.

F. Flood Control Works:

[...]

Response: This proposal does not involve the inclusion of structural flood hazard reduction measures.



[Source: Landing on the Cowlitz Stormwater Outfall Plan Set – Sheet C6.0, Outfall Enlargement]

- C. *Vegetation conservation standards of this Program shall not apply retroactively in a way which requires lawfully existing uses and developments, including residential landscaping and gardens, to be removed, except as required as mitigation for new and expanded development. Routine maintenance of existing landscaping and gardens is allowed.*

Response: Not applicable. This proposal does not include the request to approve of vegetation conservation in response to retroactive removal of vegetation within the shoreline and associated buffer.

- D. *Vegetation may be removed or altered landward of shoreline buffers described in this Program provided that there is no net loss of ecological function.*

Response: It is not anticipated that this proposal will require the removal or alteration of vegetation landward of shoreline buffers described in this Program. Temporary impacts to herbaceous vegetation will occur to install the underground pipers. This area will be restored through native seed installation.

- E. *Shoreline landowners are encouraged to preserve and enhance sustainable woody vegetation and sustainable groundcovers to stabilize soils and provide habitat. When shoreline uses or modifications require a planting plan (i.e., uses or modifications that require a mitigation plan), maintaining sustainable plant communities, replacing noxious weeds and avoiding installation of ornamental plants are preferred. Non- native vegetation requiring use of fertilizers, herbicides/pesticides, or summer watering is discouraged.*

Response: This proposal includes a shoreline use which necessitates mitigation plantings. The mitigation included with this proposal includes the enhancement of the shoreline area with the installation of large woody material rootwads and horizontal logs to deter entrance from the public to the stormwater outfall. Proposed native trees and shrubs are woody vegetation that will provide additional bank stability.

- F. *Mitigation plans shall be approved before initiation of other permitted activities, unless a phased schedule that ensures completion prior to occupancy has been approved.*

Response: The Applicant acknowledges that the mitigation plan must be approved by the City of Castle Rock prior to the initiation of activities within the jurisdictional shoreline and associated buffer.

- G. *Aquatic weed control shall only occur to protect sustainable plant communities and associated habitats or where an existing water-dependent use is restricted by the presence of weeds. Aquatic weed control shall occur in compliance with all other applicable laws and standards and shall be done by a qualified professional.*

Response: Not applicable. This proposal does not include or require alteration of aquatic weeds.

- H. *Limbing or crown thinning shall comply with the Tree Care Industry Association pruning standards, unless the tree is a hazard tree as defined by this SMP. No more than 25 percent of the limbs of any single tree may be removed and no more than 20 percent of the canopy cover in any single stand of trees may be removed for view preservation.*

Response: Not applicable. This proposal does not involve the limbing or crowning of trees and instead necessitates the removal of three cottonwood trees.

- I. *The clearing of non-native vegetation is allowed as is routine landscape maintenance and family gardening, when conducted using hand-held equipment.*

Response: While this proposal shall require the clearing of non-native vegetation it shall not be undertaken as part of routine maintenance and family gardening. The site is devoid of an existing garden.

- J. *Vegetation may be removed or altered landward of shoreline buffers described in this Program provided that there is no net loss of ecological function.*

Response: It is not currently anticipated that this proposal will necessitate permanent vegetation removal landward of the shoreline buffers for the installation of the stormwater outfall.

6.7 Water Quality and Quantity

- A. *All shoreline development shall comply with the applicable requirements of the Castle Rock Comprehensive Plan, which identifies the 1992 Puget Sound Stormwater Management Manual, as approved by the City, as the guidance for the City's program, and best management practices to prevent impacts to water quality and stormwater quantity that would result in a net loss of shoreline ecological functions and/or a significant impact to aesthetic qualities or recreational opportunities.*

Response: This proposal has been designed in conformance with the applicable requirements of the Castle Rock Comprehensive Plan, the 1992 Puget Sound Stormwater Management Manual.

- B. *Stormwater management structures including ponds, basins, and vaults shall be located outside of shoreline jurisdiction where possible, as far from the water's edge as feasible, and shall minimize disturbance of vegetation conservation buffers. Low impact development facilities (which do not substantially change the character of the shoreline) such as vegetation filter strips, grass-lined swales, and vegetated bioretention and infiltration facilities, are encouraged in association with development allowed in shoreline jurisdiction.*

Response: This proposal involves the installation of a stormwater outfall within the shoreline jurisdiction as no other location alternative is practicable which would avoid vegetation removal or impacts to the buffer associated with waterbodies. This proposal has been designed to minimize the disturbance of vegetation to the shoreline and associated buffer with anticipated total impacts of 0.22 acres (9,552 square feet) which is comprised of permanent impacts of 0.002 acres (108 square feet), 0.217 acres (9,444 square feet) of temporary impacts and the removal of three (3) black cottonwood trees. The proposed enhancements with native vegetation and habitat features will not substantially change the character of the shoreline, and will blend in with surrounding habitat.

C. *Sewage management. To avoid water quality degradation, sewer service is subject to the requirements outlined below.*

1. *Any existing septic system or other on-site system that fails or malfunctions will be required to connect to an existing municipal sewer service system infeasible, or make system corrections approved by the Cowlitz County Environmental Health Unit.*
2. *Any new development, business, single-family or multi-family unit will be required to connect to an existing municipal sewer service system if feasible, or install an on-site septic system approved by Cowlitz County Environmental Health Unit.*

Response: Not applicable. This proposal does not involve sewage management facilities.

7. Specific Shoreline Use Regulations

The regulations in this Chapter apply to specific uses within shoreline jurisdiction. In many circumstances, more than one Section of use regulations will apply to a specific proposal. Guiding policies for uses and modifications are located in Chapter 4.

7.1 Shoreline Use, Modification, and Standards Tables

- A. *Table 7-1 Shoreline Use, Modification, Setbacks, and Heights, shall be used to determine which uses may be permitted (P), approved with conditions through the issuance of a Shoreline Conditional Use Permit (SCUP), or prohibited (X) in each shoreline environment. Specific regulations for each corresponding Use and Modification can be found in Chapters 7 of the SMP.*

Response: This proposal includes utilities and is permissible through an approved Shoreline Substantial Development Permit (SSDP).

- B. *All uses and development activities proposed for jurisdictional shoreline areas must comply with all provisions of the Castle Rock Municipal Code, as determined by the City.*

Response: This proposal has been designed in conformance with all applicable provisions of the City of Castle Rock Municipal Code. The Habitat Management, Mitigation and Monitoring Plan details the project compliance with critical areas regulations.

- C. *Setbacks shall be measured on a horizontal plane landward from the required feature described in Table 7-1 below.*

[NOTE: Excerpted portions of Table 7-1 is included herein:]

Table Key: P = May be permitted through SSDP or SLE	Shoreline Environmental Designations			
Shoreline Use	High-Intensity	Residential	Recreation	Aquatic
Utilities	P	P	P	P
Dimensional Standards				
Buffer ⁽²³⁾	See Table 8, Appendix B [NOTE: High-Intensity Buffer for the Cowlitz River is 150 feet]			
Building setback from Buffer in Table 8, Appendix B, or Landward Toe of Levee Where Present ⁽²³⁾	10'	10'	10'	N/A
Maximum Height ⁽²¹⁾	35'	35'	35'	35'
Minimum River Frontage ⁽²²⁾	N/A	60'	N/A	N/A

Response: This proposal will result in impacts to the 150-foot shoreline buffer. As such, an evaluation of the proposed impacts along with mitigation to result in no net loss of ecological function is required.

This proposal has been designed in conformance with the thirty-five- (35) foot maximum height with the provision of a two- (2) foot high gabion wall and the top of bank shall be reestablished minimizing the protrusion of the installed gabion wall. In addition, there are no river frontage requirements applicable to a high-intensity use included in Table 7-1.

7.2 Shoreline Use

7.2.1 Commercial

[...]

Response: Not applicable.

7.2.2 Forest Practices

[...]

Response: Not applicable.

7.2.3 Industrial

[...]

Response: Not applicable.

7.2.4 In-stream Structures

[...]

Response: Not applicable. This proposal has been designed outside of the Cowlitz Stream and is located above the ordinary high water mark (OHWM).

7.2.5 Mining

[...]

Response: Not applicable. This proposal does not include mining related uses.

7.2.6 Recreational Development

[...]

Response: Not applicable. This proposal does not include recreational development.

7.2.7 Residential Development

[...]

Response: Not applicable.

7.2.8 Transportation Facilities

[...]

Response: Not applicable.

7.2.9 Utilities Uses

These provisions apply to services and facilities that produce, convey, store, or process power, water, sewage, stormwater, gas, communications, oil, waste, and similar services and functions. On-site utility features serving a primary use, such as a water, sewer, or gas line to a residence or other approved use, are accessory utilities and shall be considered a part of the primary use.

- A. *New or expanded non-water dependent utilities or parts thereof may be located within shoreline jurisdiction only when the applicant demonstrates based on analysis of alternative locations and technologies that:*

[...]

Response: Not applicable. This proposal involves the provision of a non-water-dependent use.

- B. *Overhead electrical transmission lines should be located outside of shoreline jurisdictional areas, unless infeasible due to site constraints, including but not limited to topography or safety, as determined by the City.*

Response: Not applicable. This proposal does not involve overhead electrical transmission lines.

- C. *Transmission, distribution and conveyance facilities shall be located in existing rights of way and corridors or shall cross shoreline jurisdictional areas by the shortest, most direct route feasible, unless such route would cause significant environmental damage.*

Response: This proposal includes the provision of a stormwater conveyance and discharge facility which crosses the shoreline jurisdiction area by the shortest, most direct route feasible. Additionally, the majority of the facility in shoreline jurisdiction is below ground, which further avoids environmental impacts.

- D. *Utility crossings of waterbodies shall be attached to bridges where feasible. Where attachment to a bridge is not feasible, underground construction methods that avoid surface disturbance are preferred.*

Response: Not applicable. This proposal does not include utility crossings of water bodies.

- E. *All underwater pipelines transporting liquids intrinsically harmful to aquatic life or potentially harmful to water quality shall be equipped with automatic shut off valves.*

Response: Not applicable. This proposal does not include the provision of underwater pipelines.

- F. *Structural utility buildings, such as pump stations, electrical substations, waste facilities, or other facilities shall be located outside of jurisdictional shoreline areas, unless no other feasible location exists, in which case they shall be visually compatible in scale with surrounding development and landscape to provide compatibility with natural features and adjacent uses.*

Response: Not applicable. This proposal does not include the provision of a structural utility building.

- G. *Stormwater outfalls may be placed below the OHWM to reduce scouring. New outfalls and modifications to existing outfalls shall be designed and constructed to avoid impacts to existing native aquatic vegetation attached to or rooted in substrate.*

Response: Not applicable. This proposal involves the provision of a stormwater outfall above the ordinary high water mark (OHWM).

- H. *The presence of existing utilities shall not justify more intense development. Rather, the development shall be consistent with the City Comprehensive Plan, Development Regulations, and this SMP, and shall be supported by adequate utilities.*

1. *Existing facilities such as the City's Municipal Water System and Sewer System, that are located landward of a levee, may be improved in accordance with the mitigation sequencing provisions contained in this Program.*

Response: Not applicable. The site is devoid of existing utilities.

7.3.1 Fill and Excavation

- A. *Fill may be placed in flood hazard areas only when otherwise allowed by the Frequently Flooded Areas Regulations in this Program (Appendix 8) and where it is demonstrated in a hydrogeological report prepared by a qualified professional that adverse impacts to hydrogeologic processes will be avoided.*

Response: This proposal has been prepared by a licensed professional Engineer in the State of Washington. Included with this proposal is a stormwater report which evaluated the potential impacts of the proposed fill. No habitable structures exist or are proposed near the proposed outfall; therefore, the evaluation of a hydrogeological professional is not anticipated to be required. Furthermore, the proposed fill is limited to a small area and shall not cause a change in flood hazard conditions.

B. *Fill placed below the OHWM for any other use besides ecological restoration requires a Shoreline Conditional Use Permit.*

1. *Accomplish an aquatic habitat restoration plan.*
2. *Support a mitigation action, environmental restoration, beach nourishment or other enhancement project.*
3. *Correct the adverse results of past shoreline modification that have disrupted natural stream geomorphic conditions and adversely affected aquatic or terrestrial habitat.*
4. *Support a water-dependent use.*
5. *Serve as part of a public access proposal.*
6. *Support cleanup of contaminated sediments as part of an interagency environmental clean-up plan, or permitted under MTCA or CERCLA.*
7. *Expand or alter transportation facilities of statewide significance currently located on the shoreline only when demonstrated that alternatives to fill are not feasible.*

Response: Not applicable. This proposal does not include fill placed below the ordinary high water mark (OHWM).

C. *Fill is restricted in wetlands or fish and wildlife habitat conservation areas in accordance with the critical areas standards in this Program, Section 6.3, and Appendix B.*

Response: Not applicable. This proposal does not include or require fill in restricted wetlands or fish and wildlife habitat conservation areas.

D. *Excavation of previously deposited dredge spoils above the OHWM may be permitted if the spoils site is part of a dredge materials management plan and the spoils were not originally placed as part of a beach nourishment or other shoreline restoration project.*

Response: Not applicable. This proposal does not involve the excavation of previously deposited dredge spoils.

E. *Excavation below the OHWM is considered dredging and is subject to provisions in Section 7.3.5, Dredging and Dredge Material Stockpiling.*

Response: Not applicable. This proposal does not include excavation below the ordinary high water mark (OHWM).

7.3.2 Dredging and Dredge Material Stockpiling

[...]

Response: Not applicable. This proposal does not involve dredging or in-water disposal of material.

7.3.3 Shoreline Habitat and Ecological Enhancement Projects

[...]

Response: Not applicable.

V. CONCLUSION

This Shoreline Substantial Development Permit (SSDP) application narrative along with accompanying information has successfully met the burden of proof demonstrating compliance with the City of Castle Rock Shoreline Master Program (SMP). The Applicant respectfully requests the City's approval of the SSDP application.

Landing on the Cowlitz – Stormwater Outfall Submittal

SUMMARY NARRATIVE

11/13/2024

CT6, LLC, applicant

The applicant requests review of the proposed **Excavation & Grading Permit** and **Engineering Plan Review** for the Stormwater Outfall design of the Landing on the Cowlitz mixed-use master planned development.

Located at the southernmost end of the City of Castle Rock, the Landing on the Cowlitz property is accessed from I-5 at exit #48. The property is situated west of the BNSF line and Salmon Creek, and south of Huntington Ave. South of the property is DNR-owned property that contains a dredge spoils site. The property is currently accessed via a temporary access road from Huntington Avenue.

The Landing on the Cowlitz property is comprised of seven parcels, totaling approximately 118 acres. Those parcels are currently in the process of a Boundary Line Adjustment (CR-BLA-24-01), which includes a right of way dedication for the proposed roadway included in this design. The proposed stormwater outfall will serve as the primary stormwater outlet for the entire project. The Cowlitz River is a flow control exempt water body per the Washington State Department of Ecology, making this option an ideal choice for the development. The outfall design consists of two pipe systems to keep offsite flows and onsite runoff separate. This will ensure that the developed site does not have an adverse impact on the neighboring residential properties and visa versa.

In order to size the conveyance pipes in the two systems, an in-depth stormwater master plan was created. The logic, calculations, and intended use of the system are thoroughly described in the included Technical Information Report. The impacts of grading for the construction of the outfall system should have minimal impacts on the existing conditions of the site. While future development of the onsite parcels was factored into the calculations, no development outside of the outfall piping is being proposed with this application. The proposed Phase 1 Access & Utilities design shows the first connection to this stormwater outfall, but that project has been submitted for a separate review.

Wherever possible, this project will retain existing drainage patterns on. Drainage channels that have been created from previous onsite grading operations will continue to be used at this time and will lead to this new outfall. The construction of this stormwater outfall will have temporary and permanent impacts on buffer areas along the Cowlitz River. These impacts will require a Mitigation Plan and a Shoreline Permit, which are currently being prepared by Ecological Land Services and CT6, LLC. The engineering plans and stormwater analysis are being submitted in advance of these documents to begin the review of the engineering design, but they will be submitted to the City as soon as they are completed.

City of Castle Rock

P.O. Box 370
CASTLE ROCK, WA 98611
(360) 274-8181



SEPA ENVIRONMENTAL CHECKLIST

What is this for?

The City and other governmental agencies use this checklist to help determine whether the environmental impacts of your proposal are significant. This information will also help determine if it's possible to avoid, minimize, or compensate (mitigate) for the probable significant impacts; or whether an environmental impact statement needs to be prepared to further analyze the proposal.

How to fill this out:

This environmental checklist asks you to describe some basic information about your proposal. Please answer each question accurately and carefully, to the best of your knowledge. You may need to consult with an agency specialist or private consultant for some questions. You may use "not applicable" or "does not apply" only when you can explain why it does not apply and not when the answer is unknown. You may also attach, excerpt, or refer to additional studies or reports. Complete and accurate answers to these questions often avoid delays with the SEPA process as well as later in the decisionmaking process.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The City or other agencies may ask you to explain your answers or provide additional information to determine if there may be a significant adverse impact.

If you're using this checklist for a nonproject proposal (such as an ordinance, regulations, plans, or programs), complete the applicable parts of Parts A and B plus the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (Part D). Please completely answer all questions that apply and note that the words "project," "applicant," and "property or site" should be read as "proposal," "proponent," and "affected geographic area," respectively. For nonproject actions, the lead agency may exclude questions in Part B that do not contribute meaningfully to the analysis of the proposal.

This form is set up as a Word table. Except for a few questions that ask for you to select options, each question is followed by a blank field in which you can type your answer. Type in the shaded box. Check boxes will fill in when you click them. Each field will expand to accommodate your text, and the overall form will expand to additional pages as you fill in answers.

A. BACKGROUND

1. Name of proposed project, if applicable:

Landing on the Cowlitz Stormwater Outfall

2. Name of applicant:

CT6, LLC

3. Address and phone number of applicant or contact person:

PO Box 1419, Battle Ground, WA 98604 | Ingrid Friedberg,
Special Projects Manager

4. Date checklist prepared:

3/5/2025

5. Agency requesting checklist:

City of Castle Rock

6. Proposed timing or schedule (including phasing, if applicable):

It is anticipated that construction will commence upon the receipt of the necessary permits and approvals.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? ☐ Yes ☒ No

If yes, explain.

Click or tap here to enter text.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

Specific to this stormwater outfall, the following items have been prepared:

Preliminary Technical Information Report | MacKay Sposito | November 13, 2024 and subsequent updates

Habitat Management and Mitigation and Monitoring Plan | Ecological Land Services, Inc. | December 4, 2024

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? ☐ Yes ☒ No

If yes, explain.

Click or tap here to enter text.

10. List any government approvals or permits that will be needed for your proposal, if known.

Landing on the Cowlitz Phase 1 Access and Utilities and Stormwater Outfall Engineering Approval (CR-24-051)

Prior to Construction:

Shoreline Substantial Development Permit

Critical Areas Permit

General Construction Stormwater Permit

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. (There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers here.)

The Applicant, CT6, LLC, is requesting to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOT) Master Plan and subsequent minor modification (Ordinance No. 2021-10 and Resolution No. 2024-03) (Master Plan).

The project includes installing a stormwater outfall within a portion of the Cowlitz River's shoreline buffer, shoreline jurisdiction, and the regulatory floodway. Stormwater will be conveyed to the outfall through two separate pipes; a 30-inch corrugated polypropylene pipe (CPP) for the offsite system and a 48-inch CPP for the onsite system. Runoff from the neighboring properties will flow through the study area via a portion of Ditch 4, before being conveyed to the outfall. The existing Ditch 4 will be separated by a berm to keep the onsite and offsite systems separated. All remaining onsite flows will be conveyed to the remainder of Ditch 4 and the outfall structure. Outfall profiles can be seen on Figures 5 and 6. The primary outfall is designated as the centralized discharge point for all stormwater within the project scope. Runoff intercepted from roadway surfaces will undergo preliminary water quality treatment through bioretention planters positioned along the roadways. For each individual phase of the LOT Master Plan, final treatment methodologies will be specified at the development stage integrating bioretention systems and mechanical filtration via catch basins to achieve regulatory compliance. The treated stormwater will be directed into an onsite conveyance system, channeling flows towards the outfall and facilitating discharge into the shoreline buffer of the Cowlitz River. Additionally, an integrated infiltration strategy will be implemented at each capture point, optimizing upland infiltration and minimizing runoff volumes entering the conveyance system.

A single Residential Local Access roadway intersection is included in this proposal serving as the connection to the Standard Collector road included in Phase 1 of the Master Plan infrastructure.

Project impacts to critical areas are limited to the proposed outfall. The project will result in 0.002 acres of permanent shoreline buffer impacts, 0.217 acres of temporary shoreline buffer impacts, and 0.014 acres of temporary impacts to shoreline jurisdiction outside buffers. All mitigation is proposed onsite and consists of

0.268 acres of enhancement with native trees and shrubs to result in no net loss of ecological function.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description and, if you haven't already done so with the permit application to which this checklist is related, a site plan, vicinity map, and topographic map, if reasonably available.

The site is included within the Recreation designated portion of the approved LOTC Master Plan and was recently adjusted as Boundary Line Adjustment (CR-BLA-24-01) Parcel 3 and is now designated by the County as 308110100.

B. ENVIRONMENTAL ELEMENTS

1. Earth

- a. General description of the site:

☐ Flat ☐ Rolling ☐ Hilly ☒ Steep slopes ☐ Mountainous

☐ Other (specify): Insert text here.

- b. What is the steepest slope on the site (approximate percent slope)?

The existing slope area is no steeper than 2:1. The proposed maximum slope area shall be limited to 3:1.

- c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils.

The existing soil type at the site includes Cowlitz extremely gravelly sand, disturbed, 0 to 5 percent slopes.

- d. Are there surface indications or history of unstable soils in the immediate vicinity? ☐ Yes ☒ No
If so, describe.

Insert text here.

- e. Describe the purpose, type, total area, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill.

This proposal includes 121 cubic yards (cy) of cut and 113cy of fill, resulting in a net export of 8 cy in the regulatory floodway. The source of the fill shall be from the onsite stockpiles consisting of dredged material from the Cowlitz River.

- f. Could erosion occur as a result of clearing, construction, or use? ☒ Yes ☐ No
If so, generally describe.

As with any clearing or other types of earth-disturbing construction activity, there is potential for erosion to occur. Site-specific best management practices will be used

to mitigate erosion during the construction of the proposal. Site-specific erosion control measures will be implemented per the approved Grading Plan. Further, all sediment and erosion control design work will be completed in accordance with the requirements of the Construction Stormwater General Permit and City standards.

- g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

Approximately 0.002 acres (108 square feet) shall be covered by impervious surfaces after project construction and is associated with the stormwater outfall gabion wall. Of the total 15.37 acre-parcel, this consists of a nominal amount of additional impervious surface area.

- h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Proposed measures to reduce or control erosion, or other impacts to the earth include treating and detaining stormwater, installing silt fencing, and other standard erosion control best management practices. Stormwater and erosion control plans have been prepared by MacKay Sposito in compliance with the City's regulatory requirements and in conformance with the Washington State Department of Transportation (WSDOT) Standards.

2. Air

- a. What types of emissions to the air would result from the proposal during construction, operation, and maintenance when the project is completed? If any, generally describe and give approximate quantities if known:

During Construction, Operation, and Maintenance:
Equipment and vehicles required for construction activities will generate dust and particulate emissions during the construction period.

After Project Completion:

Delivery trucks, mail delivery, solid waste, recycling vehicles and residence's automobiles will generate some particulate emissions in the long-term. Other emission sources include those typical to residential areas, e.g. small power tools including, heating, air conditioning, fireplaces, gas appliances, small gas-powered equipment used for site and landscape maintenance and emissions that are typical of a residential area are anticipated.

- b. Are there any off-site sources of emissions or odor that may affect your proposal? ☐ Yes ☒ No
If so, generally describe.

Insert text here.

- c. Proposed measures to reduce or control emissions or other impacts to air, if any:

If necessary, water will be utilized for dust control as needed during construction of on- and off-site improvements. Emissions control measures for vehicles and equipment are regulated under the Washington State Department of Ecology and U.S. Environmental Protection Agency. It is anticipated that all construction vehicles and equipment will be in compliance with these regulations.

3. Water

- a. Surface Water

- 1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? ☒ Yes ☐ No
If yes, describe type and provide names. If applicable, state what stream or river it flows into.

The Cowlitz River, a Type S water, a shoreline of statewide significance, is located in the immediate vicinity of the site.

- 2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? ☒ Yes ☐ No
If yes, please describe, and attach available plans.

This proposal shall involve work adjacent to (within 200 feet) of the Cowlitz River.

- 3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

None.

- 4) Will the proposal require surface water withdrawals or diversions? ☐ Yes ☒ No
Give general description, purpose, and approximate quantities if known.

Insert text here.

- 5) Does the proposal lie within a 100-year floodplain? ☒ Yes ☐ No
If so, note location on the site plan.

- 6) Does the proposal involve any discharges of waste materials to surface waters? ☐ Yes ☒ No
If so, describe the type of waste and anticipated volume of discharge.

Insert text here.

- b. Ground Water

- 1) Will groundwater be withdrawn from a well for drinking water or other purposes? ☐ Yes ☒ No
If so, give a general description of the well, proposed uses, and approximate quantities withdrawn from the well.

Insert text here.

Will water be discharged to groundwater? ☐ Yes ☒ No
Give general description, purpose, and approximate quantities if known.

Insert text here.

- 2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: domestic sewage; industrial, containing the following chemicals...; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

Not applicable. This proposal shall not involve the discharge of wastewater into the ground.

c. Water runoff (including stormwater)

- 1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

This proposal includes a stormwater outfall that will discharge treated stormwater from both on- and off-site areas into the riparian buffer of the Cowlitz River. The outfall and surrounding improvements have been designed to promote infiltration of treated stormwater in the buffer.

The sources of the off-site runoff shall be limited to capturing, conveying and treating runoff from Larsen Lane SW and the adjacent residential and Timberlake Church properties, which overall consist predominantly of vegetated, pervious area.

The sources of the stormwater generated on-site are anticipated to be attributed to the Phase 1 roadway and the impervious surfaces associated with the future development of the residential, commercial, and industrial land use designated areas of the approved Landing on the Cowlitz Master Plan.

The Phase 1 roadway has been designed to include first line treatment consisting of bioretention treatment planters with subsequent infiltration into catchment locations or conveyance to the outfall. For the future development adjacent to the Phase 1 roadway, each site shall be required to include some form of City-approved treatment and infiltration prior to quantity controlled discharge to the outfall.

- 2) Could waste materials enter ground or surface waters? ☐ Yes ☒ No
If so, generally describe.

Insert text here.

- 3) Does the proposal alter or otherwise affect drainage patterns in the vicinity of the site?
☒ Yes ☐ No
If so, describe.

This proposal has been designed to enhance treatment and control discharge quantity of stormwater. The current drainage pattern entails drainage into a large drainage ditch that transects the site and eventually discharges to Salmon Creek and the Cowlitz River. This proposal has been designed to utilize the existing onsite ditch for

conveyance directly to the Cowlitz River buffer. A secondary option is contemplated to include retaining a portion of the existing conveyance for temporary or future overflow. Due to the hydraulic connectivity of the Salmon Creek and Cowlitz River, these proposed and potential modifications are not anticipated to result in significant or adverse impacts to the existing on-site drainage patterns.

- d. Proposed measures to reduce or control surface, ground, and runoff water, and drainage pattern impacts, if any:

This proposal includes catchment points featuring infiltration to the maximum extent practicable on-site within the approved Landing on the Cowlitz Master Plan which shall result in quality and quantity control prior to discharge to the Cowlitz River.

4. Plants

- a. Check the types of vegetation found on the site:

☐ alder ☐ maple ☐ aspen ☐ fir ☐ cedar ☐ pine ☒ other tree(s) (specify):

Black cottonwood, bigleaf maple

☐ shrubs ☒ grass ☐ pasture ☐ crop or grain ☐ orchards, vineyards or other permanent crops

☐ cattail ☐ buttercup ☐ bulrush ☐ skunk cabbage ☐ other wet soil plant(s) (specify): Insert text here.

☐ water lily ☐ eelgrass ☐ milfoil ☐ other water plant(s) (specify): Insert text here.

☐ other types of vegetation Insert text here.

- b. What kind and amount of vegetation will be removed or altered?

All vegetation within the areas of the site proposed for development will be removed. The site is presently sparsely vegetated. Vegetation to be removed for the outfall includes mainly non-native and invasive Scot's broom. Three cottonwood trees will need to be removed to accommodate the outfall design. These trees will be mitigated onsite through the installation of native trees.

- c. List threatened and endangered species known to be on or near the site.

No listed plants are known to be on or near the site.

- d. List all noxious weeds and invasive species known to be on or near the site.

Class B

Scot's broom

Class C

Himalayan blackberry

Canada thistle

Reed canarygrass

5. Animals

- a. Check any birds and other animals which have been observed on or near the site or are known to be on or near the site.

☒ hawk ☒ heron ☒ eagle ☒ songbirds, ☐ other bird(s) (specify): Insert text here.

☒ deer ☐ bear ☐ elk ☐ beaver ☒ other mammal(s) (specify): Small mammals

☐ bass ☒ salmon ☒ trout ☐ herring ☐ shellfish ☐ other fish (specify): Insert text here.

- b. List any threatened and endangered species known to be on or near the site.

The proposed outfall is located adjacent to the Cowlitz River. The Cowlitz River provides habitat for the following federally listed species:

Columbia River Chum Salmon ESU - Threatened

Lower Columbia River Chinook ESU - Threatened

Lower Columbia River Coho Salmon ESU - Threatened

Lower Columbia River Steelhead DPS - Threatened

Eulachon (Columbia River Smelt) Southern DPS - Threatened

- c. Washington as whole lies within the Pacific Flyway. Is the site part of any other migration route?

☐ Yes ☒ No

If so, explain.

No. The site is only part of the Pacific Flyway.

- d. Proposed measures to preserve or enhance wildlife, if any:

Landscaping included in the final condition of the finished subdivision may provide some habitat for wildlife typical for urban environments. Enhancements to the riparian habitat onsite as mitigation for riparian habitat impacts and tree removal will provide nesting, roosting, and forage opportunities for wildlife.

- e. List any invasive animal species known to be on or near the site.

None known.

6. Energy and Natural Resources

- a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

The completed project's energy needs shall be met by electric and natural gas.

- b. Would your project affect the potential use of solar energy by adjacent properties?

☐ Yes ☒ No

If so, generally describe.

Insert text here.

- c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

This proposal does not include the construction of buildings. Future building applications shall be required to demonstrate compliance with the State of Washington Energy Code and the adopted version of the International Building Code.

7. Environmental Health

- a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur as a result of this proposal?

☐ Yes ☒ No

If so, describe.

Insert text here.

- 1) Describe any known or possible contamination at the site from present or past uses.

Unknown.

- 2) Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity.

There are no known existing hazardous chemicals/conditions that might affect the project development and design. The Applicant shall be required to comply with all applicable local, state and federal regulations during the construction of this proposal.

- 3) Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project.

Construction equipment will require the use of various petroleum products for fuel, hydraulics and lubrication. Spill kits will be located onsite for use in case of a spill.

- 4) Describe special emergency services that might be required.

Special emergency services are not anticipated for this proposal. However, State-compliant protocol shall be followed should any unforeseen complications arise with the spillage of hazardous or otherwise toxic chemicals. A spill prevention and/or response plan shall be on site at all times during construction.

- 5) Proposed measures to reduce or control environmental health hazards, if any:

Spill kits will be available onsite in case of any leaks from construction equipment. Other BMPs will be in place to protect critical areas in the project vicinity. Project construction will follow all conditions of permits upon receipt to help further avoid environmental health hazards.

- b. Noise

- 1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?

Some traffic noise from the Interstate 5 (I-5) Highway, may be heard currently at the site, but it not expected to adversely affect the proposal as it involves the provision of critical infrastructure required to facilitate the first phase of development within the approved Landing on the Cowlitz (LOTC) Master Plan.

- 2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

Construction on the site will create short-term noise and shall not be allowed after 7 p.m. or before 7 a.m. Visitor, resident, mail and parcel deliveries, solid waste and recycling vehicles, and HVAC equipment will be associated on a long-term basis. Other long-term noise sources which may be created include small power tools associated with landscaping maintenance and upkeep typical to residential life.

- 3) Proposed measures to reduce or control noise impacts, if any:

Construction activities shall be limited between 7 a.m. and 7 p.m.

8. Land and Shoreline Use

- a. What is the current use of the site and adjacent properties? Will the proposal affect current land uses on nearby or adjacent properties? ☐ Yes ☒ No
If so, describe.

The site is vacant and undeveloped. Surrounding areas include undeveloped Department of Natural Resources property, Timberlake Church, and established single-family residential areas.

- b. Has the project site been used as working farmland or working forest land?
☐ Yes ☒ No
If so, describe.

Insert text here.

How much agricultural or forest land of long-term commercial significance will be converted to other uses as a result of the proposal, if any?

None. The site is not designated as agricultural or forest land of long-term commercial significance.

If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or nonforest use?

Not applicable. The site is not eligible for designation for resource lands.

- 1) Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling, and harvesting? ☐ Yes ☒ No

If so, how?

Insert text here.

- c. Describe any structures on the site.

The site is devoid of existing structures.

- d. Will any structures be demolished? ☐ Yes ☒ No

If so, what?

Not applicable. There are no existing structures at the site.

- e. What is the current zoning classification of the site?

The site is located within the Light Industrial zoning classification. The site is also designated as part of the recreation land use designated area within the approved Landing on the Cowlitz (LOTC) Master Plan.

- f. What is the current comprehensive plan designation of the site?

The current comprehensive plan designation of the site is Industrial.

- g. If applicable, what is the current shoreline master program designation of the site?

Shoreline Environmental Designation (SED) is High-Intensity.

- h. Has any part of the site been classified as a critical area by the city or county?

☒ Yes ☐ No

If so, specify.

A portion of the site is located within frequently flooded areas including the 100-year floodplain and the regulatory floodway of the Cowlitz River. Fish and wildlife habitat conservation areas onsite include the Cowlitz River and its associated shoreline buffer. The Cowlitz River is also a shoreline of statewide significance.

- i. Approximately how many people would reside or work in the completed project?

None. This proposal involves the construction of critical infrastructure and does not include the provision of housing or workforce area.

- j. Approximately how many people would the completed project displace?

None. This proposal involves the construction of a stormwater outfall within an undeveloped site devoid of residential structures.

- k. Proposed measures to avoid or reduce displacement impacts, if any:

None. This proposal does not involve displacement of residential housing.

- l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

This proposal is compatible with the projected land uses as it will help facilitate the first phase of the Landing on the Cowlitz Master Plan.

- m. Proposed measures to reduce or control impacts to agricultural and forest lands of long-term commercial significance, if any:

None. The site is not on or near agricultural and forest lands of long-term commercial significance.

9. Housing

- a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

None. This proposal does not involve the provision of residential housing.

- b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

None. The site does not feature housing development.

- c. Proposed measures to reduce or control housing impacts, if any:

None. This proposal will not impact housing.

10. Aesthetics

- a. What is the tallest height of any proposed structure(s), not including antennas? What is the principal exterior building material(s) proposed?

This proposal involves the installation of a stormwater outfall which shall be located at or beneath grade.

- b. What views in the immediate vicinity would be altered or obstructed?

No views will be altered as part of this proposal.

- c. Proposed measures to reduce or control aesthetic impacts, if any:

None. This proposal shall not impact aesthetics.

11. Light and Glare

- a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

None. This proposal does not include the provision of lighting fixtures.

- b. Could light or glare from the finished project be a safety hazard or interfere with views?

Light or glare shall not result from the constructed stormwater outfall.

- c. What existing off-site sources of light or glare may affect your proposal?

None. The nearest off-site sources of light or glare are not visible from the proposed stormwater outfall location.

- d. Proposed measures to reduce or control light and glare impacts, if any:

None. This proposal does not include or require reduction or control for light or glare impacts.

12. Recreation

- a. What designated and informal recreational opportunities are in the immediate vicinity?

While there are no designated or informal recreational opportunities in the near vicinity, the site itself is designated as a recreation land use area within the approved Landing on the Cowlitz (LOT) Master Plan.

- b. Would the proposed project displace any existing recreational uses? ☐ Yes ☒ No
If so, describe.

No. The site is not presently used for recreational purposes nor does it have access roadways.

- c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

None. This proposal does not include or require mitigation for recreational areas.

13. Historic and cultural preservation

- a. Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers? ☐ Yes ☒ No
If so, specifically describe.

Click or tap here to enter text.

- b. Are there any landmarks, features, or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. ☐ Yes ☒ No
Are there any material evidence, artifacts, or areas of cultural importance on or near the site?
☐ Yes ☒ No
Please list any professional studies conducted at the site to identify such resources.

Click or tap here to enter text.

- c. Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with local tribe(s) and the state Department of Archeology and Historic Preservation, archaeological surveys, historic maps, GIS data, etc.

This proposal is located within the approved Landing on the Cowlitz Master Plan and was evaluated by Archaeological Investigations Northwest, Inc. in an archaeological survey report. Methods used to assess the potential impacts to cultural and historic resources on or near the project site included a review of historical records, recently completed surveys and a site reconnaissance inspection.

- d. Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required.

This proposal does not include avoidance, minimization or compensatory measures as no cultural or historic resources were discovered at the site and none are anticipated. Archaeological Investigations Northwest, Inc. developed an inadvertent discovery plan which shall be adhered to in the unlikely event cultural or archaeological resources are

encountered during the site preparation, construction and site stabilization for the stormwater outfall.

14. **Transportation**

- a. Identify public streets and highways serving the site or affected geographic area and describe proposed access to the existing street system. If any, show on site plan.

None. This proposal is not presently served by public street access. A temporary twenty- (20) foot-wide gravel access road shall provide access to the shoreline for construction of the outfall.

- b. Is the site or affected geographic area currently served by public transit? ☐ Yes ☒ No
If so, generally describe. If not, what is the approximate distance to the nearest transit stop?

Insert text here.

- c. How many additional parking spaces would the completed project or non-project proposal have? How many would the project or proposal eliminate?

None. This proposal involves the construction of a stormwater outfall and as such does not necessitate the provision of parking spaces.

- d. Will the proposal require any new or improvements to existing roads, streets, pedestrian, bicycle or state transportation facilities, not including driveways? ☐ Yes ☒ No
If so, generally describe (indicate whether public or private).

Insert text here.

- e. Will the project or proposal use (or occur in the immediate vicinity of) water, rail, or air transportation? ☐ Yes ☒ No
If so, generally describe.

Insert text here.

- f. How many vehicle trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would be trucks (such as commercial and nonpassenger vehicles). What data or transportation models were used to make these estimates?

None. Following the completion of construction, it is anticipated that occasional maintenance will be required for the outfall. The vehicular trips associated with that shall be too infrequent to quantify and is not anticipated to adversely impact traffic in the vicinity of the site.

- g. Will the proposal interfere with, affect or be affected by the movement of agricultural and forest products on roads or streets in the area? ☐ Yes ☒ No
If so, generally describe.

Insert text here.

- h. Proposed measures to reduce or control transportation impacts, if any:

None. This proposal is not anticipated to result in transportation impacts.

15. **Public Services**

- a. Would the project result in an increased need for public services (for example: fire protection, police protection, public transit, health care, schools, other)? ☐ Yes ☒ No

If so, generally describe.

Insert text here.

- b. Proposed measures to reduce or control direct impacts on public services, if any.

None proposed, as the proposed outfall does not require public services and will not impact existing public services.

16. Utilities

- a. Check utilities currently available at the site:

☐ electricity ☐ natural gas ☐ potable water ☐ irrigation water ☐ refuse service ☐ telephone ☐ sanitary sewer ☐ septic system ☐ other (specify): ☒ None available.

- b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

None. This proposal includes the provision of stormwater utilities. The site is otherwise not served by utilities nor does this proposal necessitate the provision of additional utilities.

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature:

Signed by:

Ingrid Friedberg

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Manually sign above, print, & scan; or insert electronic signature here.

Name:

Ingrid Friedberg

Position:

Special Projects Manager

Agency/Organization:

CT6, LLC

Date Submitted:

March 5, 2025

D. SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS

(Do NOT use this sheet for project actions)

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment. When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?

Insert text here.

Proposed measures to avoid or reduce such increases are:

Insert text here.

2. How would the proposal be likely to affect plants, animals, fish, or marine life?

Insert text here.

Proposed measures to protect or conserve plants, animals, fish, or marine life are:

Insert text here.

3. How would the proposal be likely to deplete energy or natural resources?

Insert text here.

Proposed measures to protect or conserve energy and natural resources are:

Insert text here.

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection; such as parks, wilderness, wild and scenic rivers, threatened or endangered species' habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

Insert text here.

Proposed measures to protect such resources or to avoid or reduce impacts are:

Insert text heret.

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

Insert text here.

Proposed measures to avoid or reduce shoreline and land use impacts are:

Insert text here.

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

Insert text here.

Proposed measures to reduce or respond to such demand(s) are:

Insert text here.

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

Insert text here.

LANDING ON THE COWLITZ STORMWATER OUTFALL

NW QTR, SECTION 14
TOWNSHIP T9N, RANGE R2W W.M.



VICINITY MAP
N.T.S.

PROJECT PARCEL # 6143802
CR-BLA-24-01, PARCEL 3

OWNER

CT6, LLC

SHANE TAPANI
PO BOX 1419
BATTLE GROUND, WA 98604
PHONE: 360-687-1148

DEVELOPER

TAPANI, INC.

1705 SE 9TH AVE
BATTLE GROUND, WA 98604
JEROME SARKINEN
PHONE: 360-907-7615

PROJECT ENGINEER

MackKay Sposito

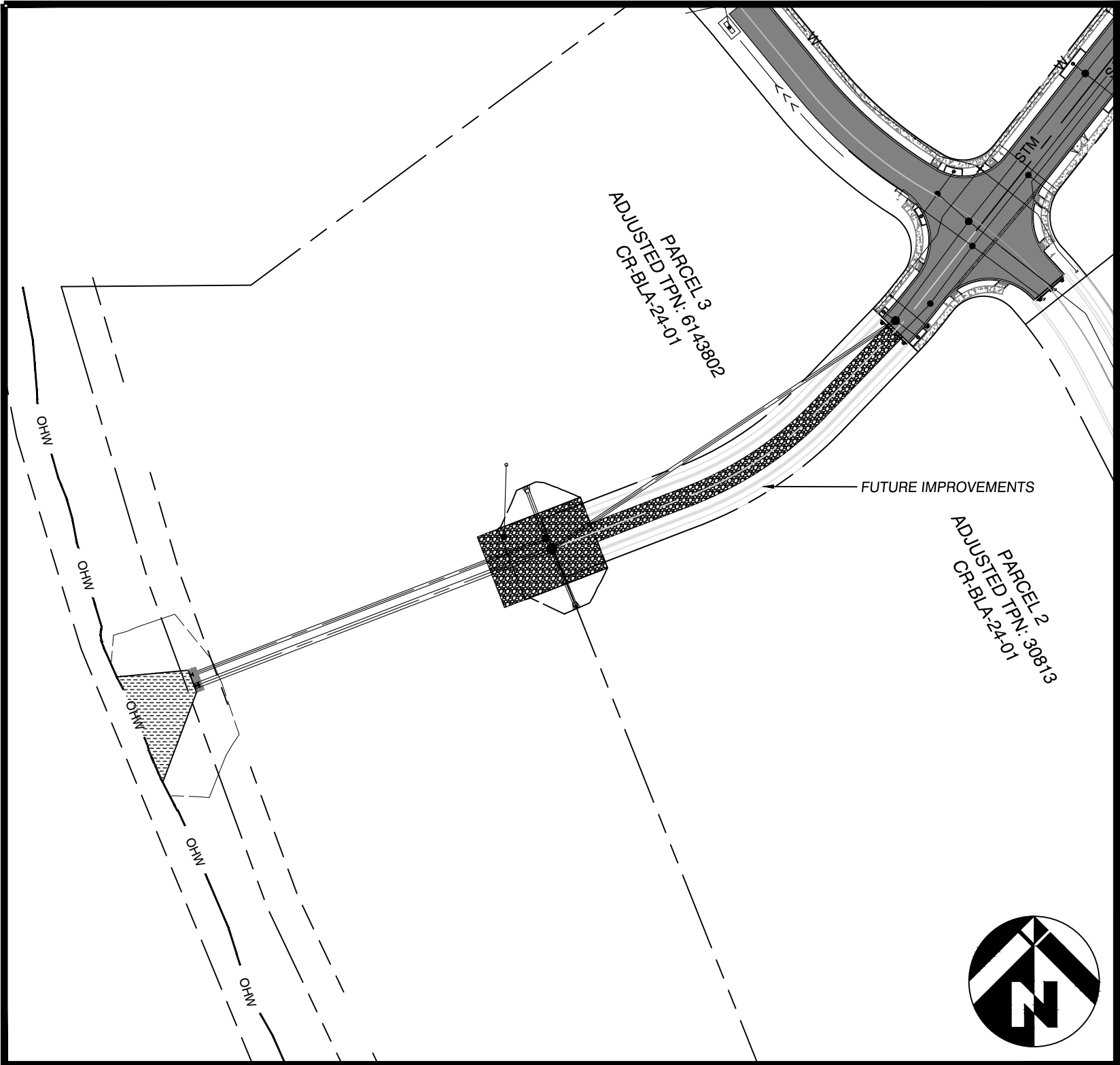
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VERTICAL DATUM

THE ELEVATIONS SHOWN ON THIS MAP ARE BASED ON AN
OPUS SOLUTION AT CP 1 WITH A DERIVED NAVD88
ORTHOMETRIC ELEVATION OF 46.26 FEET.

HORIZONTAL DATUM

WASHINGTON STATE PLANE COORDINATE SYSTEM, SOUTH
ZONE (4602), NAD83(2011)(EPOCH: 2010.0000), US SURVEY
FOOT. DISTANCES SHOWN HEREON ARE GROUND
DISTANCES. TO CONVERT TO GRID MULTIPLY BY THE
COMBINED SCALE FACTOR OF 0.99899321353 ABOUT CP1



SITE MAP
1" = 100'

LEGEND

---	PERIMETER OF SITE	W	WATER SERVICE METER
---	RIGHT-OF-WAY LINE	T	TELEPHONE RISER
---	CENTERLINE OF ROAD	G	GAS RISER
---	FACE OF CURB	E	ELECTRIC RISER
---	LOT LINE	U	UTILITY POLE
---	EASEMENT LINE	U/L	UTILITY POLE W/ LIGHT
STM	STORM SEWER LINE	S	SIGN POST
STM	EXIST STORM SEWER		
SAN	SANITARY SEWER LINE		
SAN	EXIST SANITARY SEWER		
W	WATER SERVICE LINE		
W	EXIST WATER LINE		
123	GRADED CONTOUR LINE		
123	EXIST CONTOUR LINE		
MANHOLE			
WATER VALVE AND BOX			
FIRE HYDRANT ASSEMBLY			
CLEAN OUT			
CATCH BASIN			
THRUST BLOCK			

Sheet List Table

Sheet Title	Sheet Number
COVER SHEET	C1.0
NOTES	C1.1
EXISTING CONDITIONS	C2.0
EXISTING CONDITIONS	C2.1
GRADING AND EROSION CONTROL PLAN	C3.0
STORMWATER LAYOUT PLAN	C4.0
48-INCH STORMWATER OUTFALL PROFILE	C5.0
30-INCH STORMWATER OUTFALL PROFILE	C5.1
OUTFALL ENLARGEMENT	C6.0
DETAILS	C7.0
DETAILS	C7.1
DETAILS	C7.2

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON
COVER SHEET
STORMWATER OUTFALL

REVISIONS:

JOB NO.: 18591
DATE: 2/12/2025
SCALE: H: N/A V: N/A
DESIGNED BY: PJM
DRAWN BY: PJM
CHECKED BY: TAW

FINAL

C1.0



GENERAL NOTES:

- ALL WORK SHALL FOLLOW THE CITY OF CASTLE ROCK DEVELOPMENT POLICIES AND PUBLIC WORKS STANDARDS, AND CONDUCTED USING CURRENT WISHA/OSHA REGULATIONS.
- ALL WORK WITHIN THE CITY ROW SHALL COMPLY WITH CITY REQUIREMENTS AS OUTLINED IN THE CITY OF CASTLE ROCK ENGINEERING STANDARDS, DEVELOPMENT POLICIES AND PUBLIC WORKS STANDARDS.THE PUBLIC WORKS DIRECTORS OFFICE MUST BE CONTACTED 24 HOURS BEFORE BACKFILLING TRENCHES OR REPAIRING PAVEMENT AT 360-274-7478.
- TRENCH BACKFILL AND PAVEMENT RESTORATION SHALL BE PER CHAPTER 4, SECTION 4.17 TABLE 4.3

GENERAL STORMWATER NOTES:

- ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH CITY STANDARDS AND THE MOST CURRENT COPY OF THE STATE OF WASHINGTON STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION (WSDOT).
- TEMPORARY EROSION/WATER POLLUTION MEASURES SHALL BE REQUIRED IN ACCORDANCE WITH SECTION 1-07.15 OF THE STANDARD SPECIFICATIONS. JULY 2020 STORM DRAINAGE STANDARDS 5-3
- CONTRACTOR SHALL BE RESPONSIBLE FOR COMPLYING WITH ALL OTHER PERMITS AND OTHER REQUIREMENTS BY THE CITY OR OTHER GOVERNING AUTHORITY OR AGENCY AS MAY BE APPLICABLE.
- A PRECONSTRUCTION MEETING SHALL BE HELD WITH THE CITY PRIOR TO THE START OF CONSTRUCTION.
- ALL STORM MAINS AND RETENTION/DETENTION AREAS SHALL BE STAKED FOR GRADE AND ALIGNMENT BY AN ENGINEERING OR SURVEYING FIRM CAPABLE OF PERFORMING SUCH WORK, AND CURRENTLY LICENSED IN THE STATE OF WASHINGTON TO DO SO.
- CONTRACTOR SHALL PROVIDE TRAFFIC CONTROL PLAN(S) AS REQUIRED IN ACCORDANCE WITH MUTCD.
- CALL UNDERGROUND LOCATE LINE AT 811 A MINIMUM OF 72 HOURS PRIOR TO ANY EXCAVATIONS.
- WHERE CONNECTIONS REQUIRE "FIELD VERIFICATIONS," CONNECTION POINTS WILL BE EXPOSED BY CONTRACTOR AND FITTINGS VERIFIED 48 HOURS PRIOR TO DISTRIBUTING SHUT-DOWN NOTICES
- PROPOSED CPP STORM DRAIN PIPE SHALL CONFORM WITH WSDOT STANDARDS FOR CORRUGATED POLYETHYLENE PIPE (PER CITY OF CASTLE ROCK ENGINEERING STANDARDS).

EROSION CONTROL NOTES:

- THE CONTRACTOR SHALL ENSURE THAT ALL EROSION CONTROL MEASURES ARE INTACT AND IN WORKING CONDITION PRIOR TO COMMENCEMENT OF DRAINAGE FACILITY CONSTRUCTION.
- A HIGH-VISIBILITY FENCE SHALL BE INSTALLED AND COMPOSED OF A HIGH-DENSITY POLYETHYLENE MATERIAL AND SHALL BE AT LEAST FOUR FEET IN HEIGHT. POSTS FOR THE FENCING SHALL BE STEEL OR WOOD AND PLACED EVERY 6 FEET ON CENTER (MAXIMUM) OR AS NEEDED TO ENSURE RIGIDITY. THE FENCING SHALL BE FASTENED TO THE POST EVERY SIX INCHES WITH A POLYETHYLENE TIE. ON LONG CONTINUOUS LENGTHS OF FENCING, A TENSION WIRE OR ROPE SHALL BE USED AS A TOP STRINGER TO PREVENT SAGGING BETWEEN POSTS. THE FENCE COLOR SHALL BE HIGH-VISIBILITY ORANGE. THE FENCE TENSILE STRENGTH SHALL BE 360 LBS/FT USING THE ASTM D4595 TESTING METHOD. IF APPROPRIATE INSTALL FABRIC SILT FENCE IN ACCORDANCE WITH BMP C233: SILT FENCE TO ACT AS HIGH-VISIBILITY FENCE. SILT FENCE SHALL BE AT LEAST 3 FEET HIGH AND MUST BE HIGHLY VISIBLE TO MEET THE REQUIREMENTS OF THIS BMP. METAL FENCES SHALL BE DESIGNED AND INSTALLED ACCORDING TO THE MANUFACTURERS SPECIFICATIONS. METAL FENCES SHALL BE AT LEAST 3 FEET HIGH AND MUST BE HIGHLY VISIBLE. FENCES SHALL NOT BE WIRED OR STAPLED TO TREES. IF THE FENCE HAS BEEN DAMAGED OR VISIBILITY REDUCED, IT SHALL BE REPAIRED OR REPLACED IMMEDIATELY AND VISIBILITY RESTORED.
- APPROVAL OF THIS EROSION/SEDIMENTATION CONTROL (ESC) PLAN DOES NOT CONSTITUTE AN APPROVAL OF PERMANENT ROAD OR DRAINAGE DESIGN (E.G. SIZE AND LOCATION OF ROADS, PIPES, RESTRICTORS, CHANNELS, RETENTION FACILITIES, UTILITIES).
- THE IMPLEMENTATION OF THIS ESC PLAN AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT, AND UPGRADING OF THESE ESC BMPS IS THE RESPONSIBILITY OF THE APPLICANT UNTIL ALL CONSTRUCTION IS COMPLETED AND APPROVED AND VEGETATION/LANDSCAPING IS ESTABLISHED.
- CLEARLY FLAG THE BOUNDARIES OF THE CLEARING LIMITS SHOWN ON THIS PLAN IN THE FIELD PRIOR TO CONSTRUCTION. DURING THE CONSTRUCTION PERIOD, NO DISTURBANCE BEYOND THE FLAGGED CLEARING LIMITS SHALL BE PERMITTED. THE FLAGGING SHALL BE MAINTAINED BY THE APPLICANT FOR THE DURATION OF CONSTRUCTION.
- CONSTRUCT THE ESC BMPS SHOWN ON THIS PLAN IN CONJUNCTION WITH ALL CLEARING AND GRADING ACTIVITIES, AND IN SUCH A MANNER AS TO ENSURE THAT SEDIMENT AND SEDIMENT LADEN WATER DO NOT ENTER THE DRAIN-AGE SYSTEM, ROADWAYS, OR VIOLATE APPLICABLE WATER STANDARDS.
- THE ESC BMPS SHOWN ON THIS PLAN ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. DURING THE CONSTRUCTION PERIOD, UPGRADE THESE ESC BMPS AS NEEDED FOR UNEXPECTED STORM EVENTS AND TO ENSURE THAT SEDIMENT AND SEDIMENT-LADEN WATER DO NOT LEAVE THE SITE.
- THE APPLICANT SHALL INSPECT THE ESC BMPS DAILY AND MAINTAIN THEM AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONING. INSPECT AND MAINTAIN THE ESC BMPS ON INACTIVE SITES A MINIMUM OF ONCE A MONTH OR WITHIN THE 48 HOURS FOLLOWING A MAJOR STORM EVENT (I.E. A 24-HOUR STORM EVENT WITH A 10-YR OR GREATER RECURRENCE INTERVAL).
- AT NO TIME SHALL THE SEDIMENT EXCEED 60-PERCENT OF THE SUMP DEPTH OR HAVE LESS THAN 6-INCHES OF CLEARANCE FROM THE SEDIMENT SURFACE TO THE INVERT OF THE LOWEST PIPE. ALL CATCH BASINS AND CONVEYANCE LINES SHALL BE CLEANED PRIOR TO PAVING. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT LADEN WATER INTO THE DOWNSTREAM SYSTEM.
- INSTALL STABILIZED CONSTRUCTION ENTRANCES AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES MAY BE REQUIRED TO ENSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.

CHECKMATE ULTRAFLEX SLIP-IN INLINE CHECK VALVES
SPECIFICATION TT-CMUF-SL

PART 1: GENERAL

1.01 SUBMITTALS

- A. SUBMIT PRODUCT LITERATURE THAT INCLUDES INFORMATION ON THE PERFORMANCE AND OPERATION OF THE VALVE, MATERIALS OF CONSTRUCTION, DIMENSIONS AND WEIGHTS, ELASTOMER CHARACTERISTICS, HEADLOSS, FLOW DATA AND PRESSURE RATINGS.

B. UPON REQUEST, PROVIDE SHOP DRAWINGS THAT CLEARLY IDENTIFY THE VALVE MATERIALS OF CONSTRUCTION AND DIMENSIONS.

1.02 QUALITY ASSURANCE

A. SUPPLIER SHALL HAVE AT LEAST TWELVE (12) YEARS EXPERIENCE IN THE DESIGN AND MANUFACTURE OF "CHECKMATE"™ STYLE ELASTOMERIC CHECK VALVES.

B. MANUFACTURER SHALL HAVE DESIGNED, FABRICATED AND HAVE AT LEAST FIVE (5) CURRENT INSTALLATION OF A "CHECKMATE" STYLE ELASTOMERIC CHECK VALVES IN THE 72" (1800MM) SIZE. MANUFACTURER MUST PROVIDE DOCUMENTATION, INCLUDING PROJECT NAME, LOCATION, AND REFERENCES.

C. MANUFACTURER SHALL HAVE CONDUCTED INDEPENDENT HYDRAULIC TESTING TO DETERMINE HEADLOSS, JET VELOCITY AND VERTICAL OPENING HEIGHT CHARACTERISTICS ON A MINIMUM OF THREE (3) SIZES OF CHECKMATE VALVES RANGING FROM 6" (150MM) THROUGH 24" (600MM). THE TESTING MUST HAVE BEEN CONDUCTED FOR FREE DISCHARGE (PRESSURIZED AND OPEN CHANNEL FLOW DISCHARGING TO ATMOSPHERE) AND SUBMERGED CONDITIONS.

PART 2: PRODUCTS

2.01 CHECKMATE ULTRAFLEX ELASTOMERIC CHECK VALVES

A. CHECK VALVES ARE TO BE ALL RUBBER AND THE FLOW OPERATED CHECK TYPE WITH SLIP-IN CUFF CONNECTION. THE ENTIRE CHECKMATE ULTRAFLEX VALVE SHALL BE PLY REINFORCED THROUGHOUT THE BODY, SADDLE AND BILL, WHICH IS CURED AND VULCANIZED INTO A ONE-PIECE UNIBODY CONSTRUCTION. A SEPARATE VALVE BODY OR PIPE USED AS THE HOUSING IS NOT ACCEPTABLE. THE VALVE SHALL BE MANUFACTURED WITH NO METAL, MECHANICAL HINGES OR FASTENERS, WHICH WOULD BE USED TO SECURE ANY COMPONENT OF THE VALVE TO A VALVE HOUSING. THE PORT AREA OF THE SADDLE SHALL CONTOUR INTO A CIRCUMFERENTIAL SEALING AREA (THE "BILL") THAT IS CONCENTRIC WITH THE PIPE WHICH SHALL ALLOW PASSAGE OF FLOW IN ONE DIRECTION WHILE PREVENTING REVERSE FLOW. THE ENTIRE VALVE SHALL FIT WITHIN THE PIPE INSIDE DIAMETER. THE SADDLE AREA OF THE VALVE MUST BE FLAT, NOT CONICAL, AND INTEGRAL WITH THE RUBBER BODY ABOVE CENTERLINE IN ORDER TO NOT PRODUCE ANY AREAS OR VOIDS THAT CAN COLLECT OR TRAP DEBRIS. THE VALVE MUST BE EASILY INSTALLED IN PIPES WITH POOR END CONDITION WITHOUT THE NEED TO MODIFY OR UTILIZE THE HEADWALL OR STRUCTURE TO SEAL AND ANCHOR THE VALVE. ONCE INSTALLED, THE CHECKMATE ULTRAFLEX VALVE SHALL NOT PROTRUDE BEYOND THE FACE OF THE STRUCTURE OR END OF THE PIPE.

B. THE CHECKMATE ULTRAFLEX VALVE SHALL INCORPORATE MULTIPLE CONCAVE GROOVES MOLDED INTEGRALLY INTO THE FLAT SADDLE WALL THICKNESS EXTENDING LONGITUDINALLY A MINIMUM OF 80% OF THE LENGTH OF THE SADDLE TO REDUCE OPENING RESISTANCE AND REDUCE HEADLOSS.

C. THE CHECKMATE ULTRAFLEX VALVE SHALL INCORPORATE A CUSTOM SHAPED NOTCH IN THE END OF THE BILL TO REDUCE CRACKING PRESSURE. THE NOTCH SHALL BE AT THE INVERT/BOTTOM OF THE BILL AND SYMMETRICAL ABOUT THE VALVE CENTERLINE. THE LONGITUDINAL LENGTH OF THE NOTCH SHALL BE NO GREATER THAN HALF THE LENGTH OF THE BILL.

D. THE OUTSIDE DIAMETER OF THE UPSTREAM AND DOWNSTREAM SECTIONS OF THE VALVE MUST BE CIRCUMFERENTIALLY IN CONTACT WITH THE INSIDE DIAMETER OF THE PIPE.

E. SLIP-IN STYLE CHECKMATE ULTRAFLEX VALVES WILL BE FURNISHED WITH A SET OF STAINLESS STEEL EXPANSION CLAMPS. THE CLAMPS, WHICH WILL SECURE THE VALVE IN PLACE, SHALL BE INSTALLED IN THE UPSTREAM OR DOWNSTREAM CUFF OF THE VALVE, DEPENDING ON INSTALLATION ORIENTATION, AND SHALL EXPAND OUTWARDS BY MEANS OF A TURNBUCKLE. EACH BAND SHALL BE PRE-DRILLED ALLOWING FOR THE VALVE TO BE PINNED AND SECURED INTO POSITION IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.

F. MANUFACTURER MUST HAVE FLOW TEST DATA FROM AN ACCREDITED HYDRAULICS LABORATORY TO CONFIRM PRESSURE DROP AND HYDRAULIC DATA.

E. COMPANY NAME, PLANT LOCATION, VALVE SIZE PATENT NUMBER, AND SERIAL NUMBER SHALL BE BONDED TO THE CHECK VALVE.

2.02 FUNCTION

A. WHEN LINE PRESSURE EXCEEDS THE BACKPRESSURE, THE LINE PRESSURE FORCES THE BILL AND SADDLE OF THE VALVE OPEN, ALLOWING FLOW TO PASS. WHEN THE BACKPRESSURE EXCEEDS THE LINE PRESSURE, OR IN THE ABSENCE OF ANY UPSTREAM OR DOWNSTREAM PRESSURE, THE BILL AND SADDLE OF THE VALVE IS FORCED CLOSED, PREVENTING BACKFLOW.

2.03 MANUFACTURER

A. ALL VALVES SHALL BE SERIES CMUF-SL SLIP-IN CHECKMATE ULTRAFLEX VALVES AS MANUFACTURED BY TIDEFLEX TECHNOLOGIES, A DIVISION OF RED VALVE COMPANY, CARNEGIE, PA 15106. ALL VALVES SHALL BE MANUFACTURED IN THE U.S.A.

PART 3: EXECUTION

3.01 INSTALLATION

A. VALVE SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTALLATION AND OPERATION MANUAL AND APPROVED SUBMITTALS.

3.02 MANUFACTURER'S CUSTOMER SERVICE

A. MANUFACTURER'S AUTHORIZED REPRESENTATIVE SHALL BE AVAILABLE FOR CUSTOMER SERVICE DURING INSTALLATION AND START-UP, AND TO TRAIN PERSONNEL IN THE OPERATION, MAINTENANCE AND TROUBLESHOOTING OF THE VALVE.

B. IF SPECIFIED, THE MANUFACTURER SHALL ALSO MAKE CUSTOMER SERVICE AVAILABLE DIRECTLY FROM THE FACTORY IN ADDITION TO AUTHORIZED REPRESENTATIVES FOR ASSISTANCE DURING INSTALLATION AND START-UP, AND TO TRAIN PERSONNEL IN THE PERATION, MAINTENANCE AND TROUBLESHOOTING OF THE VALVE.

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

NOTES
STORMWATER OUTFALL



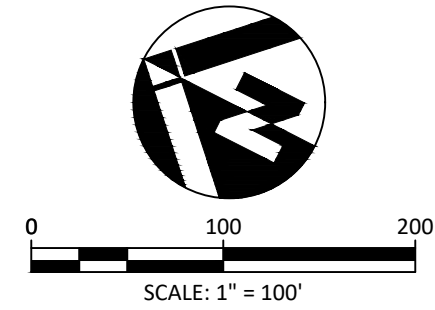
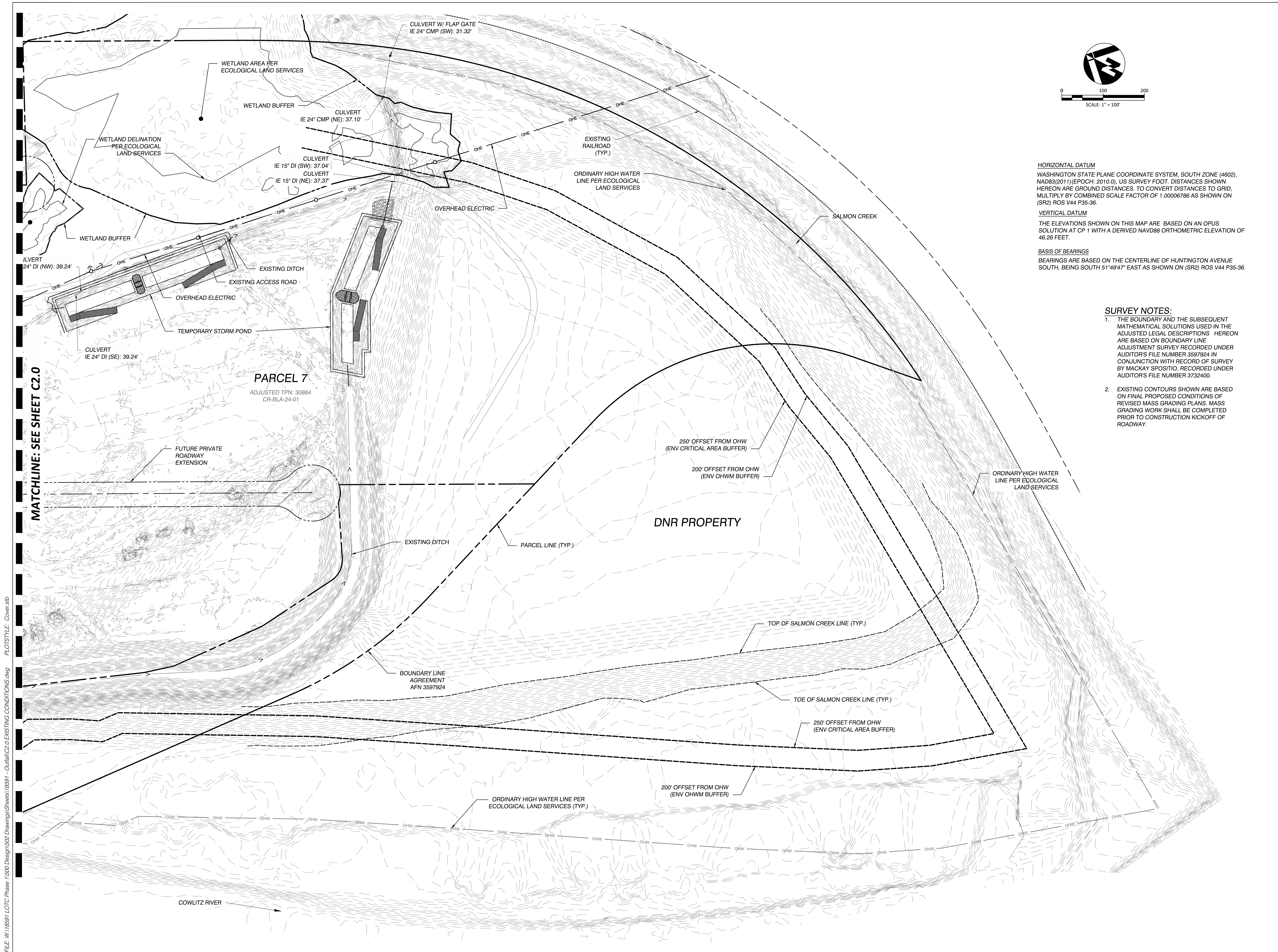
2/12/2025

REVISIONS:

JOB NO.: 18591
DATE: 2/12/2025
SCALE: H: N/A V: N/A
DESIGNED BY: PJM
DRAWN BY: PJM
CHECKED BY: TAW

FINAL

C1.1



HORIZONTAL DATUM

WASHINGTON STATE PLANE COORDINATE SYSTEM, SOUTH ZONE (4602).
NAD83(2011) (EPOCH: 2010.0), US SURVEY FOOT. DISTANCES SHOWN
HEREON ARE GROUND DISTANCES. TO CONVERT DISTANCES TO GRID,
MULTIPLY BY COMBINED SCALE FACTOR OF 1.00006786 AS SHOWN ON
(SR2) ROS V44 P35-36.

VERTICAL DATUM

THE ELEVATIONS SHOWN ON THIS MAP ARE BASED ON AN OPUS
SOLUTION AT CP 1 WITH A DERIVED NAVD88 ORTHOMETRIC ELEVATION OF
46.26 FEET.

BASIS OF BEARINGS

BEARINGS ARE BASED ON THE CENTERLINE OF HUNTINGTON AVENUE
SOUTH, BEING SOUTH 51°49'47" EAST AS SHOWN ON (SR2) ROS V44 P35-36.

SURVEY NOTES:

1. THE BOUNDARY AND THE SUBSEQUENT MATHEMATICAL SOLUTIONS USED IN THE ADJUSTED LEGAL DESCRIPTIONS HEREON ARE BASED ON BOUNDARY LINE ADJUSTMENT SURVEY RECORDED UNDER AUDITOR'S FILE NUMBER 3597924 IN CONJUNCTION WITH RECORD OF SURVEY BY MACKAY SPOSITO, RECORDED UNDER AUDITOR'S FILE NUMBER 3732400.
2. EXISTING CONTOURS SHOWN ARE BASED ON FINAL PROPOSED CONDITIONS OF REVISED MASS GRADING PLANS. MASS GRADING WORK SHALL BE COMPLETED PRIOR TO CONSTRUCTION KICKOFF OF ROADWAY.

'LANDING ON THE COWLITZ' CASTLE ROCK, WASHINGTON

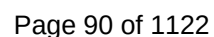
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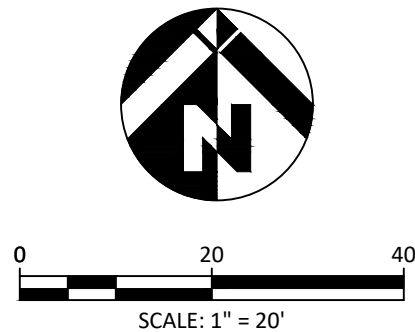
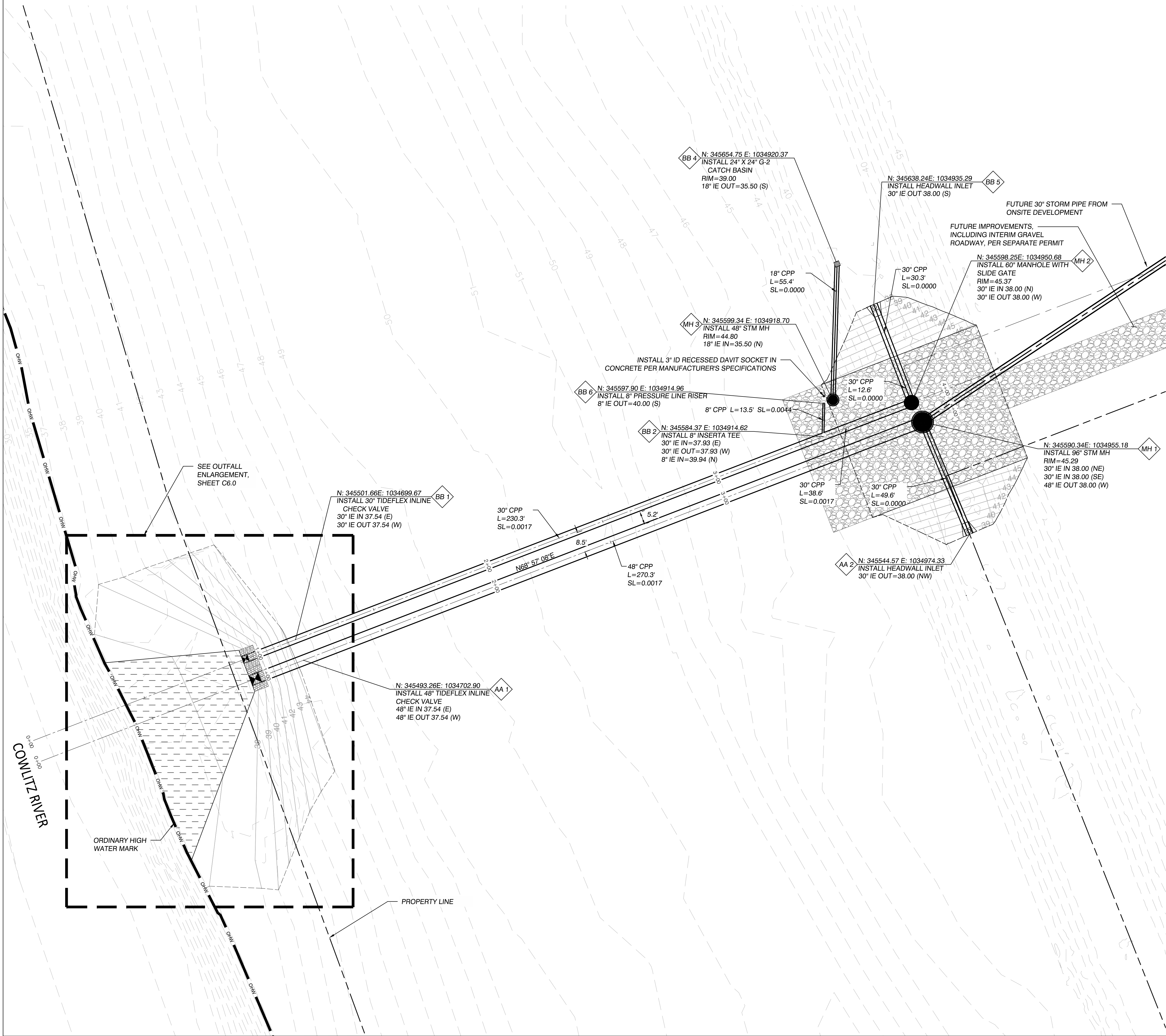
JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: 1"= 100'	V: N/A
DESIGNED BY:	PJM
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C2.1







STORM DRAINAGE CONSTRUCTION NOTES:

1. THE 30" OUTFALL PIPING SYSTEM IS DEDICATED TO OFFSITE FLOWS THAT ARE CURRENTLY CONTRIBUTING TO THE ONSITE DRAINAGE DITCH. FOR MORE INFORMATION ON THE OPERATING PROCEDURE DURING FLOOD CONDITIONS, SEE DETAIL 7 ON SHEET C7.0.
2. THE 48" OUTFALL PIPING SYSTEM IS DEDICATED TO ONSITE DEVELOPMENT FLOWS.
3. ALL PIPING TO BE INSTALLED PER DETAIL 2, SHEET C7.1
4. 96" STORM MANHOLE TO BE CONSTRUCTED PER DETAILS 1 AND 2, SHEET C7.0.
5. 48" STANDARD STORM MANHOLE TO BE CONSTRUCTED PER DETAILS 4, 5, AND 7, SHEET C7.0.
6. 60" SUMP STORM MANHOLE TO BE CONSTRUCTED PER DETAILS 3 AND 5, SHEET C7.0.
7. HEADWALL STRUCTURES TO BE CONSTRUCTED PER DETAIL 1, SHEET C7.1.
8. TIDEFLEX INLINE CHECK VALVES (SIZE PER PLAN) TO BE CONSTRUCTED PER DETAIL 2, SHEET C7.2.
9. INSERTA TEE PIPE CONNECTION TO BE CONSTRUCTED PER DETAIL 6, SHEET C7.0.
10. SLUICE GATE IN MH 2 TO BE INSTALLED PER DETAIL 3 ON SHEET C7.0 AND DETAIL 1 ON SHEET C7.2

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

STORMWATER LAYOUT PLAN
STORMWATER OUTFALL

REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
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C4.0



2/12/2025

48-INCH STORMWATER OUTFALL PROFILE
LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON
STORMWATER OUTFALL

DB NO.:	18591
DATE:	2/12/2025
SCALE: H: N/A	V: N/A
DESIGNED BY:	PJM
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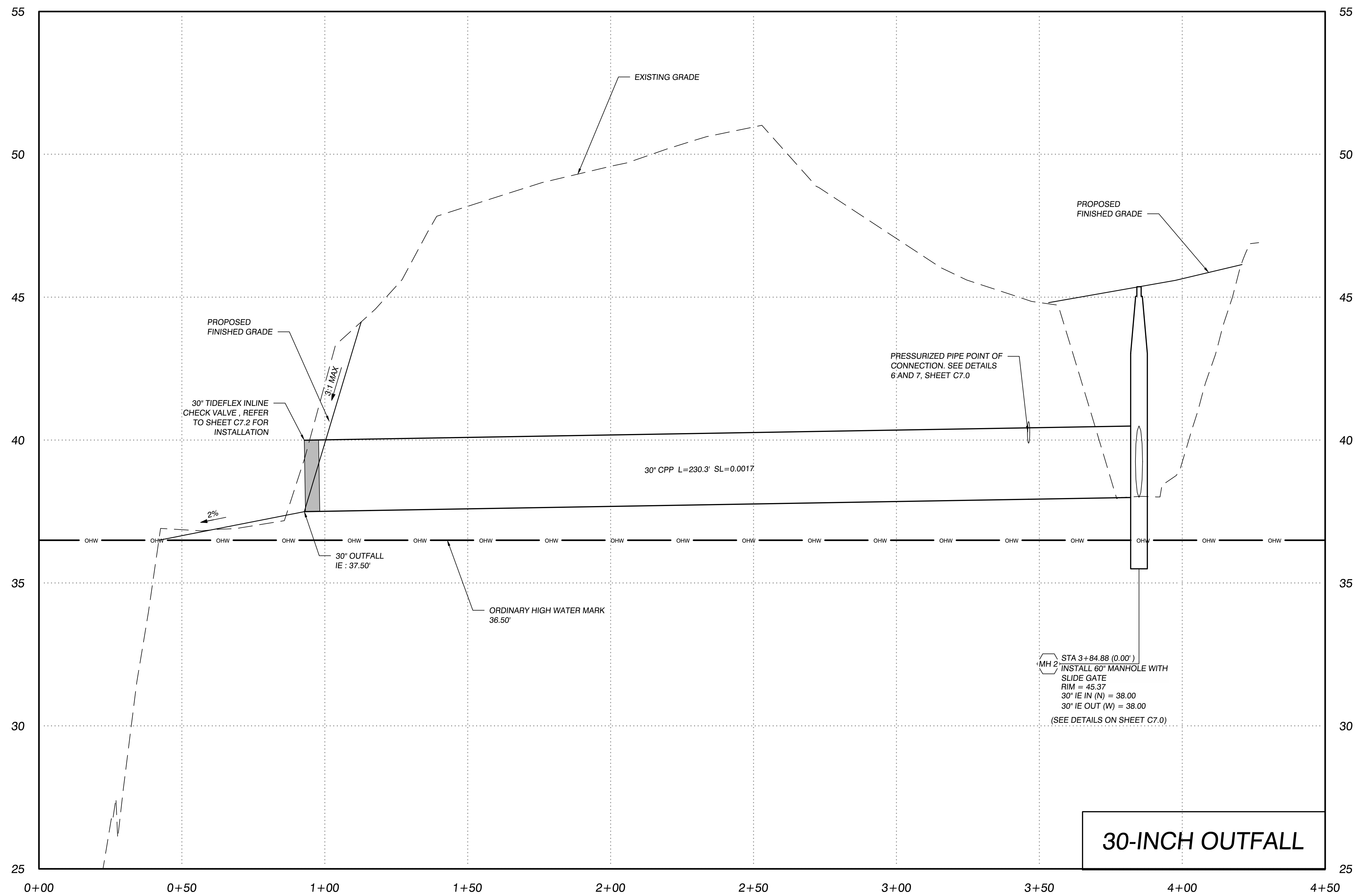
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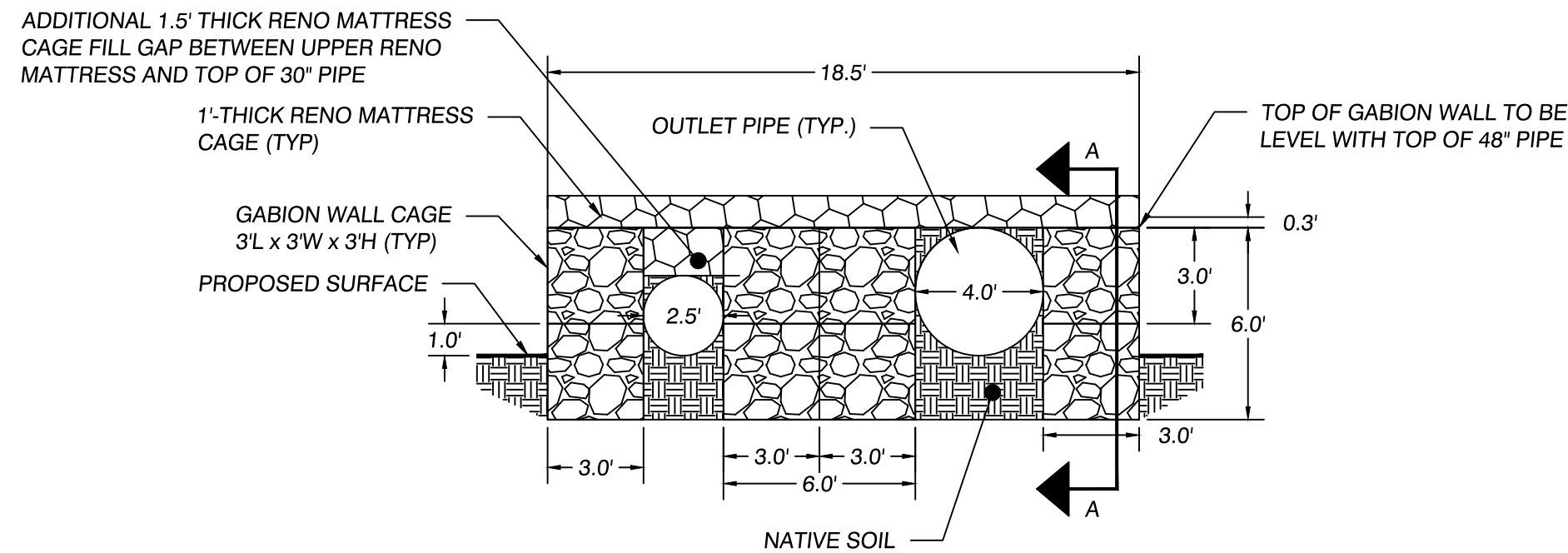
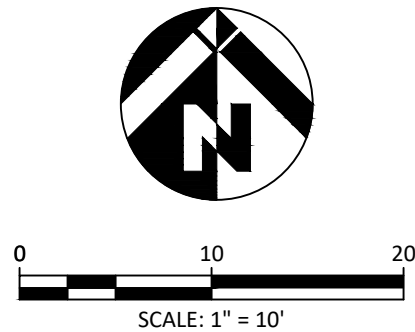
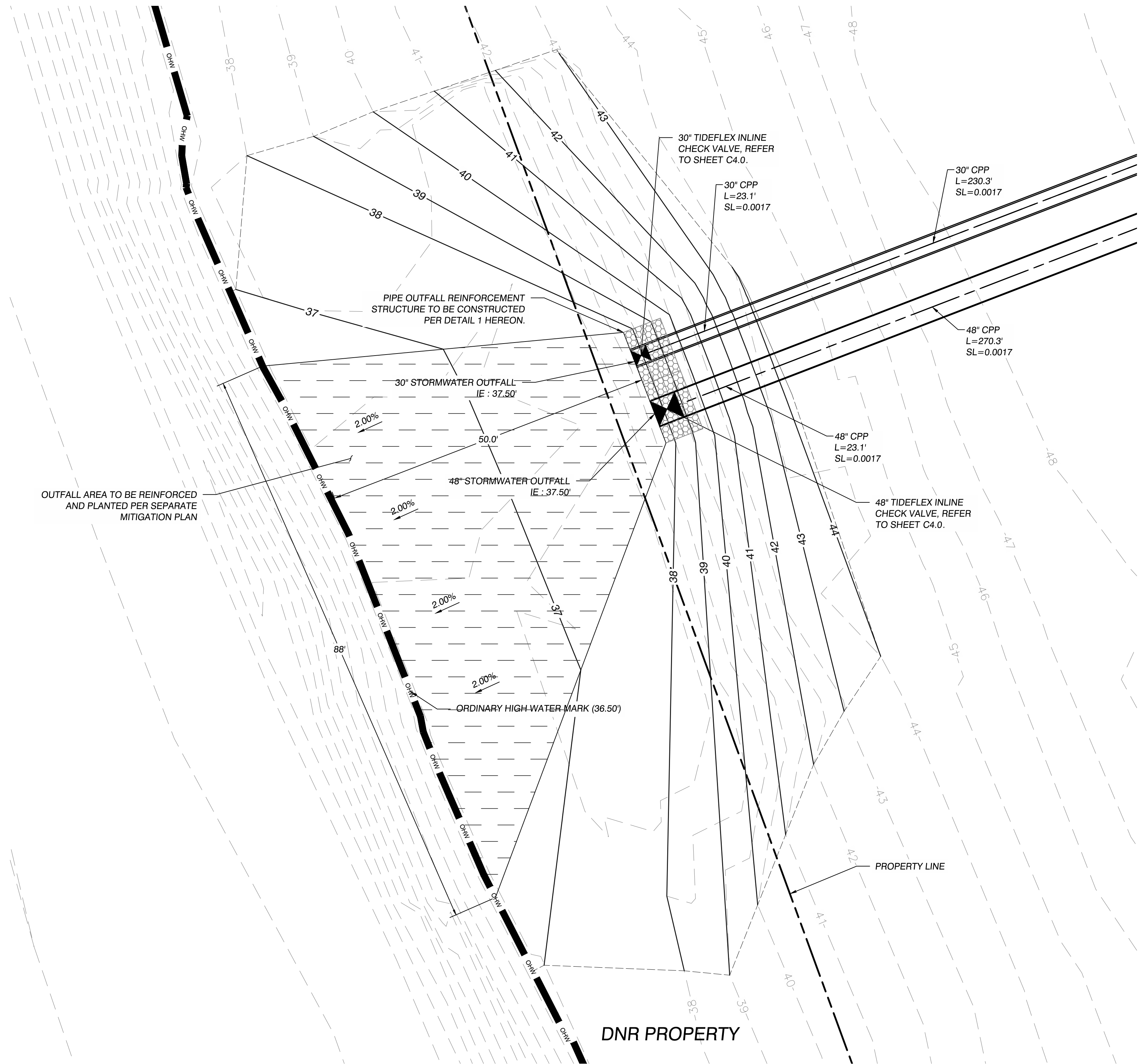


30-INCH STORMWATER OUTFALL PROFILE STORMWATER OUTFALL

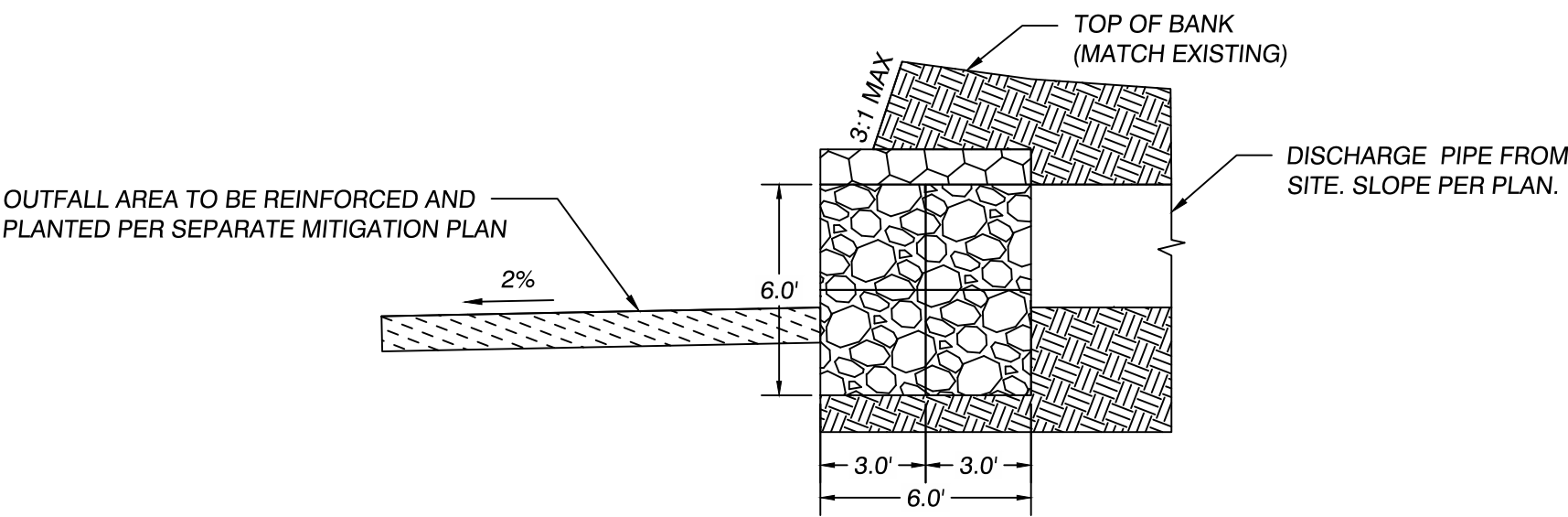
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C5.1





ELEVATION VIEW
SCALE: 1"=5'



SECTION A-A
SCALE: 1"=5'

1 PIPE OUTFALL REINFORCEMENT DETAIL
SCALE: 1" = 5'

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON
OUTFALL ENLARGEMENT
STORMWATER OUTFALL

REVISIONS:

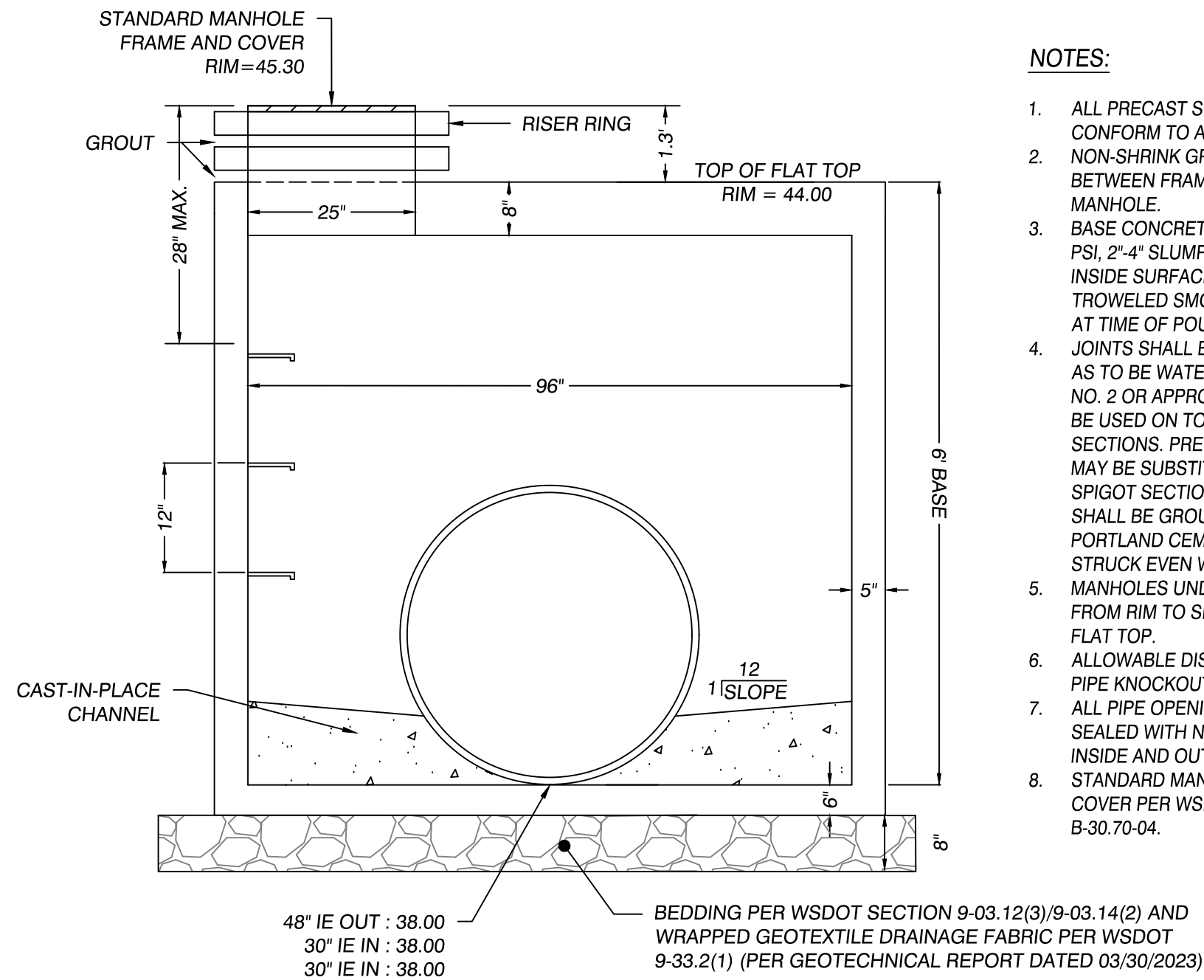
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DESIGNED BY:	PJM
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CHECKED BY:	TAW

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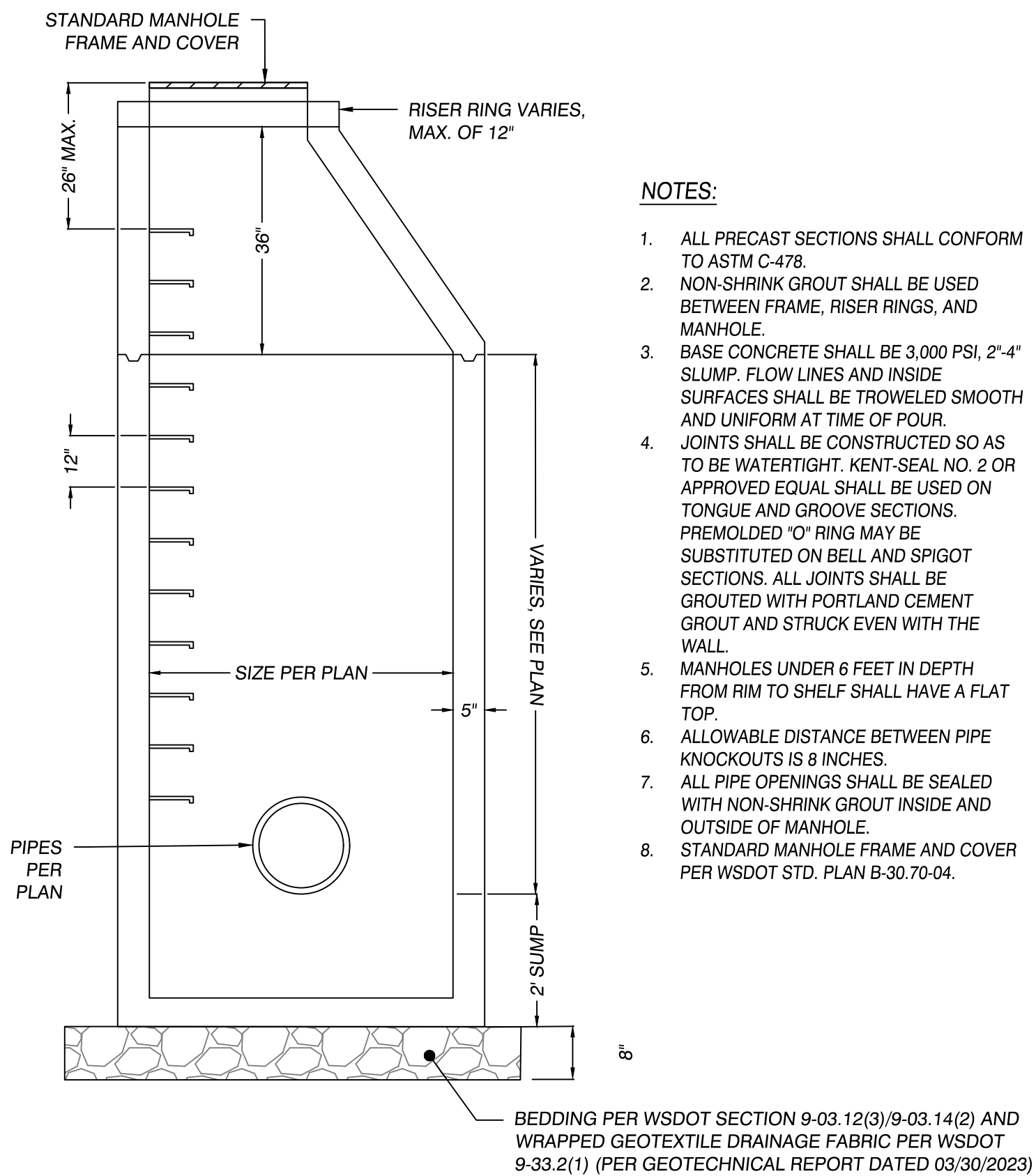
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2/12/2025

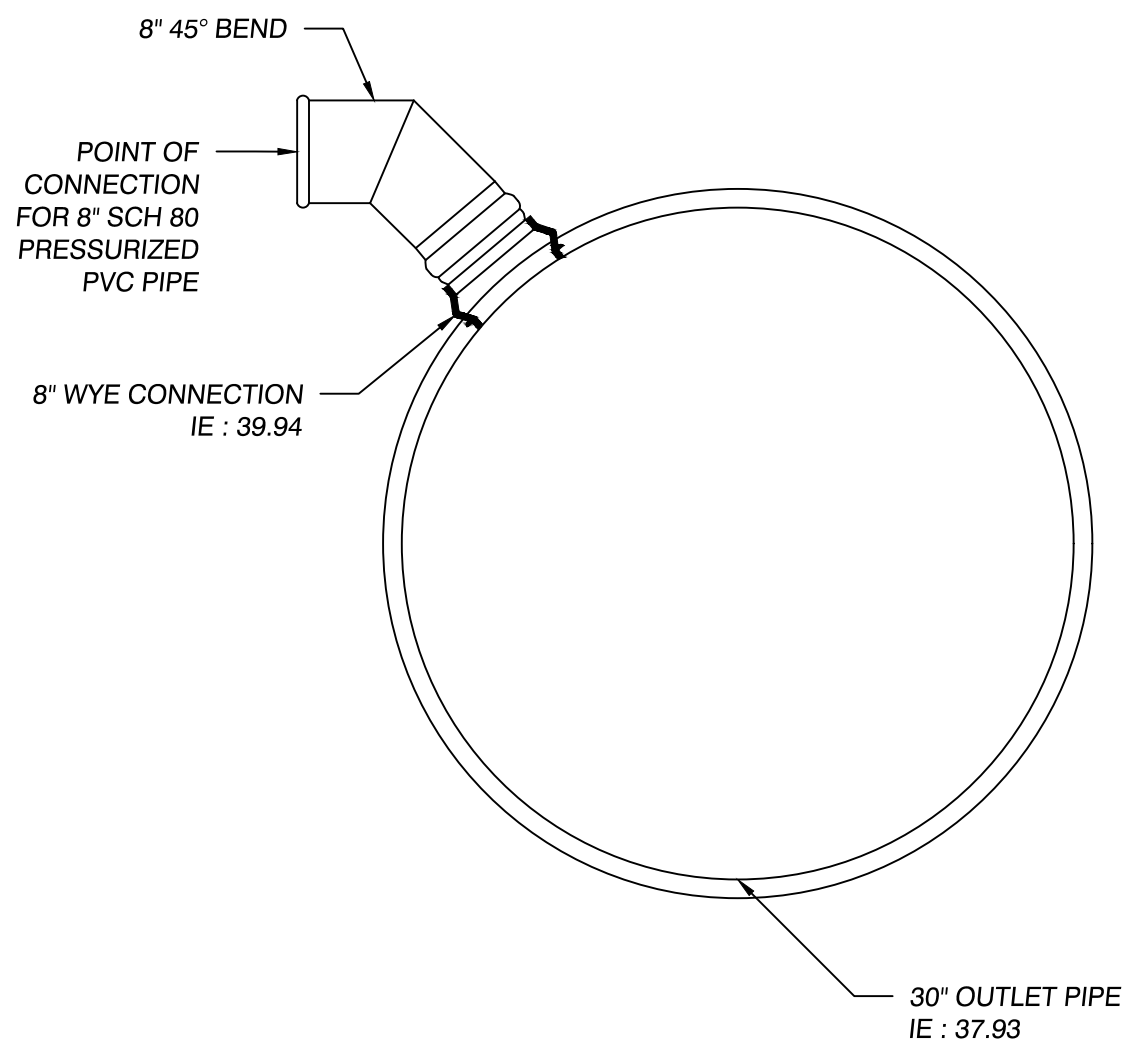
FILE: W\18591 LOTC Phase 1500 Design\502 Drawings\Sheets\18591 - Outfall\C7.0 DETAILS.dwg PLOTSTYLE: Cover.ctb



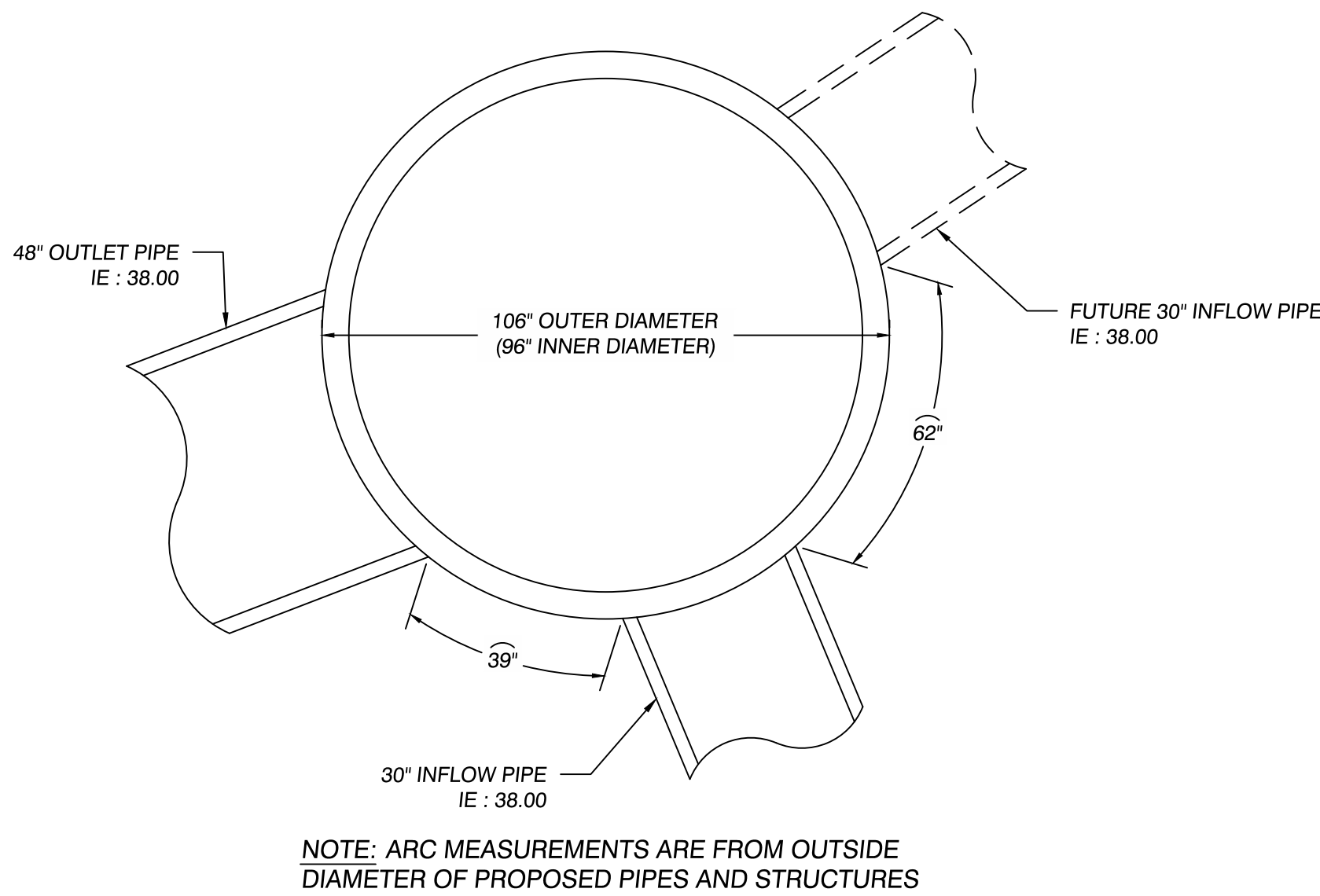
1 96" STORM DRAINAGE MANHOLE (MH 1)
NO SCALE



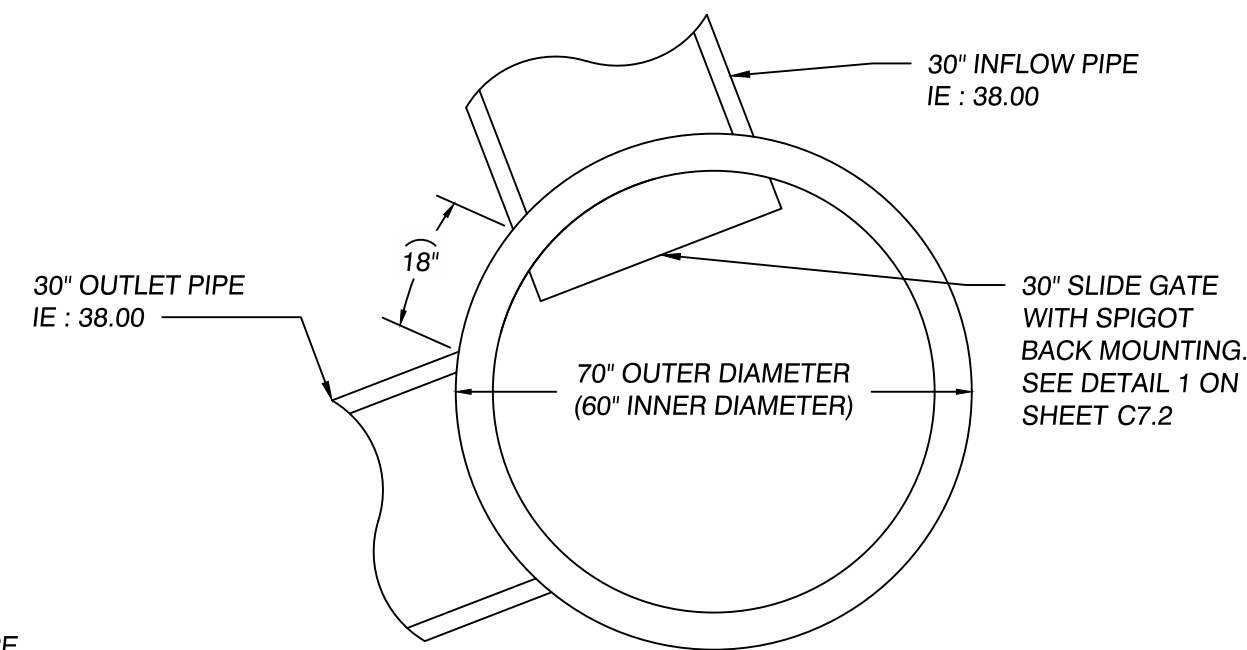
5 STANDARD STORM DRAINAGE MANHOLE
NO SCALE



6 PRESSURE PIPE CONNECTION
NO SCALE

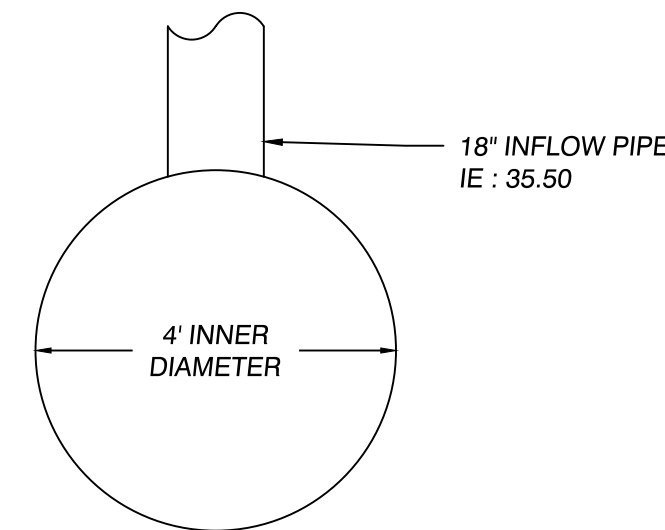


2 STORM DRAINAGE MANHOLE (MH 1) CONFIGURATION
NO SCALE

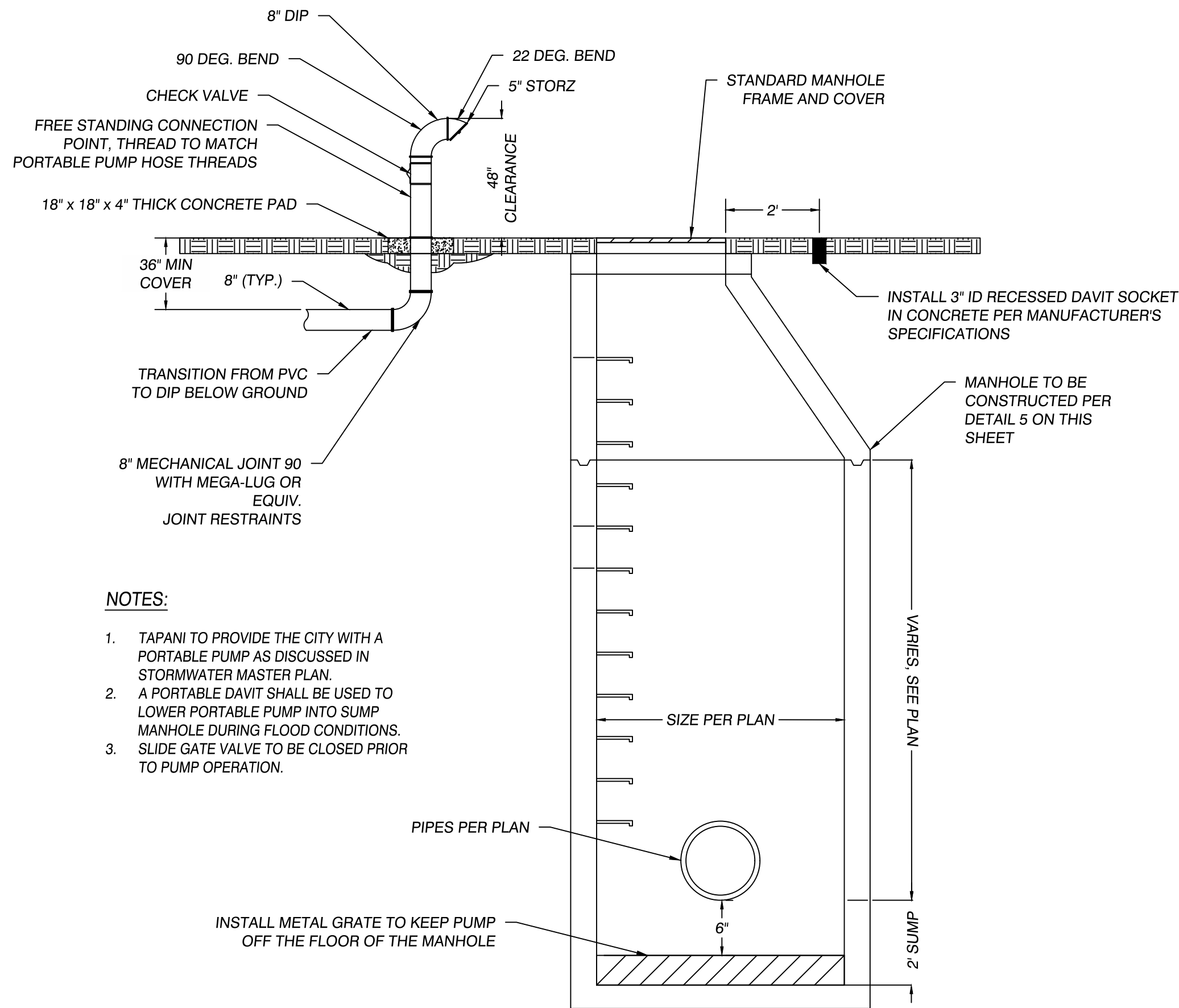


NOTE: ARC MEASUREMENTS ARE FROM OUTSIDE DIAMETER OF PROPOSED PIPES AND STRUCTURES

3 SUMP MANHOLE (MH 2) CONFIGURATION
NO SCALE



4 SUMP MANHOLE (MH 3) CONFIGURATION
NO SCALE



7 SUMP MANHOLE (MH 3) PUMP CONFIGURATION
NO SCALE

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

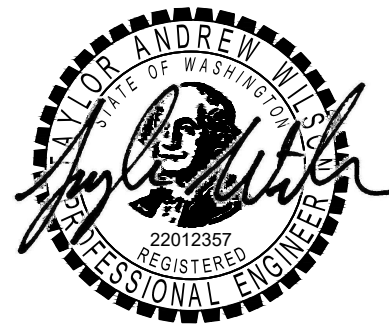
DETAILS
STORMWATER OUTFALL

REVISIONS:

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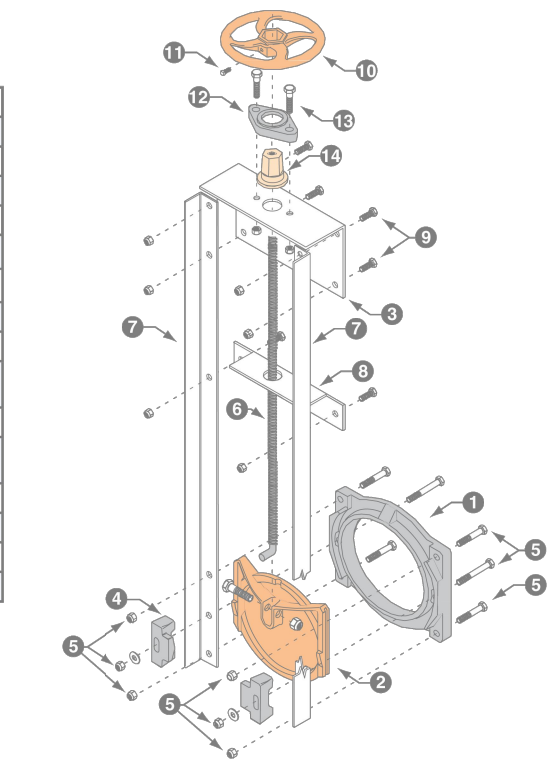
SERIES 6600 MODEL 101C SLIDE GATE



Series 6600 Slide Gate

Material Specifications

Item	Description	Material	Specification
1	Seat	Cast Iron	ASTM A128, Class B
2	Slide	Cast Iron	ASTM A128, Class B
3	Head Bar	Steel, Galvanized	ASTM A36
4	Wedge	Cast Iron	ASTM A128, Class B
5	Wedge Bolt/Nuts	Steel, Plated	ASTM A307, A164
6	Stem	Steel	ASTM A108, Grade 1045
7	Side Angles	Steel, Galvanized	ASTM A36
8	Stem Support	Steel, Galvanized	ASTM A36
9	Handwheel Bolt/Nuts	Steel, Plated	ASTM A307, A164
10	Handwheel Set Screw	Steel, Plated	ASTM A307, A164
11	Keeper	Cast Iron	ASTM A128, Class B
12	Keeper Bolt/Nuts	Steel, Plated	ASTM A307, A164
13	Lift Nut	Brass	ASTM B16
14	Stem Bolt/Nut	Plated	ASTM A307, A164



- Features**
- One-piece adjustable wedges ensure uniform wedging action.
 - Roll threaded rising stem provides ease of operation and extended stem life.
 - Rugged Cast Iron seat and cover.
 - Available for mounting to headwalls or corrugated pipe.
 - Precision machined seating surfaces.

Applications

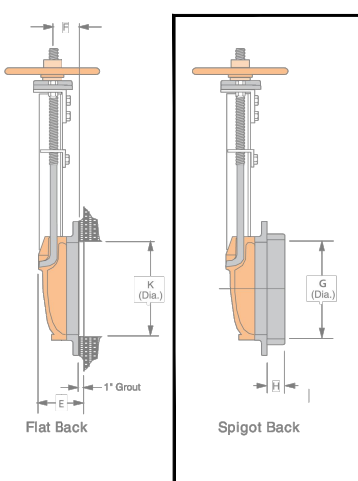
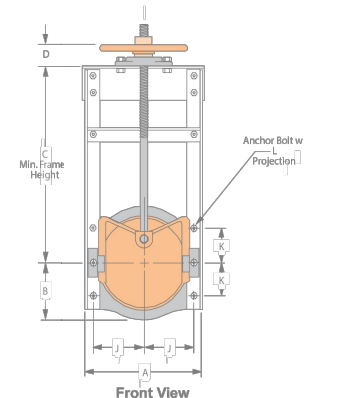
The Series 6600 Slide Gate is designed for use in canals and ditches, on corrugated pipe, flood control systems, oil refineries, fish hatcheries and various low head industrial water control applications where pressure is in seating direction only.

1 SLIDE GATE (30") FOR MH 2

NO SCALE

NOTE: CONTRACTOR MAY USE APPROVED EQUAL IN LIEU OF THIS PRODUCT.

SPECIFICATIONS



Pressure Rating

Gate Size:	
6"-24"	23 ft.
30"-36"	11 ft.
42"-48"	9 ft.
54"-60"	6 ft.

Installation

The Series 6600 Slide Gate is normally installed on corrugated steel pipe or bolted to a concrete head wall. When attaching to corrugated pipe, you may either bolt directly to the spigot back seat, or use a rod and harness assembly.

Options

- Frame angles available painted, galvanized or Stainless Steel.
- Cast Iron or Bronze seating faces.
- Stainless Steel stem and fasteners.
- Flat back for headwall or flange mounting.
- Spigot back for mounting to corrugated pipe.
- Square bottom slide in select sizes.
- Rising stem and non-projecting stem extensions.
- Tapered setting collars for concrete pipe installations.

Dimensional Information

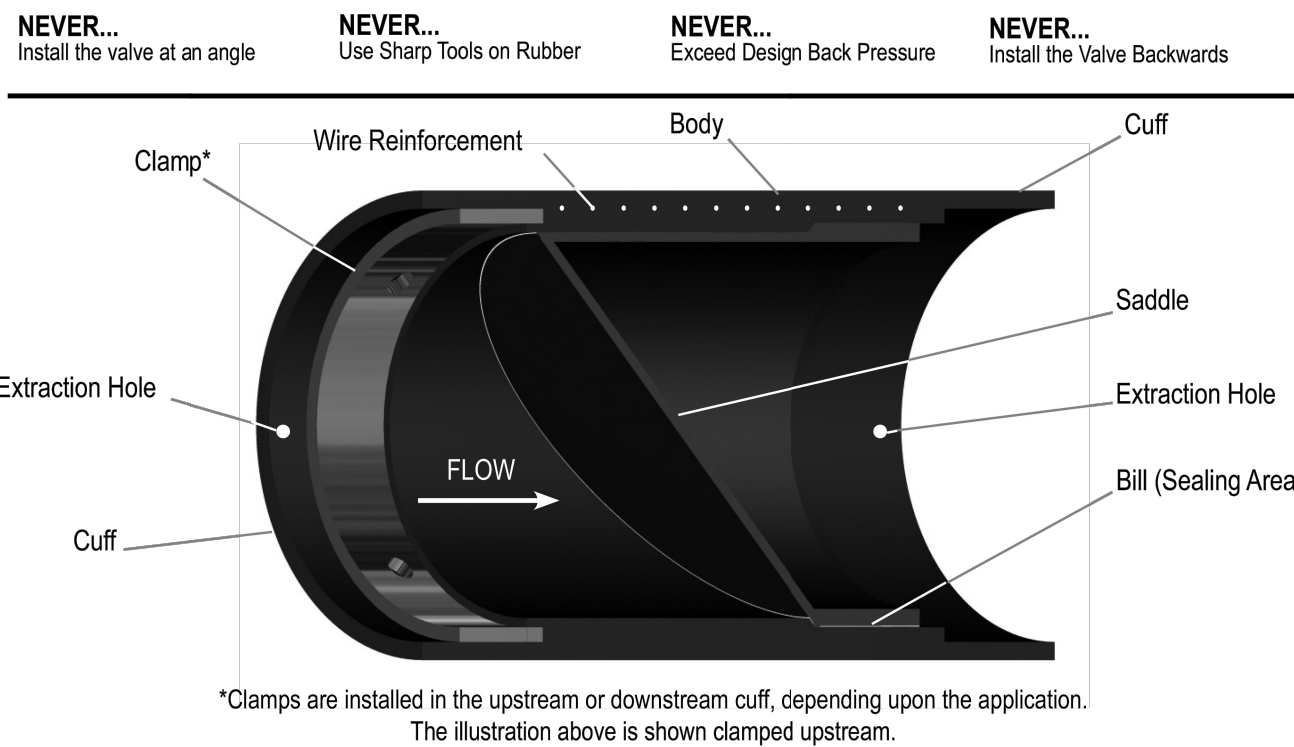
Gate Size (Inches)	Dimensions (Inches)											Anchor Bolt Data			Lift Data	
	A	B	C	D	E	F	G	H	J	K	Qty.	Size	Qty.	Lift H/Wheel Dia.	Stem Dia.	
6	9.3	4.0	15.50	2.88	3.88	2.25	6.75	1.50	4.00	2.50	4.0	1/2 x 12	4.00	H1	10.0	7/8
8	11.3	5.0	18.00	2.88	3.88	2.25	8.75	1.50	5.00	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
10	13.3	6.0	21.00	2.88	3.88	2.25	10.75	1.50	6.00	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
12	15.3	7.3	24.00	2.88	3.88	2.25	13.25	1.50	7.00	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
14	17.3	8.3	27.25	2.88	3.88	2.25	15.25	1.50	8.00	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
15	18.3	8.8	28.50	2.88	3.88	2.25	16.25	1.50	8.50	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
16	19.3	9.3	30.00	2.88	3.88	2.25	17.25	1.50	9.00	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
18	23.0	10.6	33.25	2.88	4.88	2.88	19.25	1.50	10.50	7.00	4.0	5/8 x 12	4.50	H1	14.0	1-1/8
20	25.0	11.6	36.75	2.88	4.88	2.88	21.25	1.50	11.50	7.00	4.0	5/8 x 12	4.50	H1	14.0	1-1/8
21	26.0	12.1	37.25	2.88	4.88	2.88	22.25	1.50	12.00	7.00	4.0	5/8 x 12	4.50	H1	14.0	1-1/8
24	29.0	13.6	42.25	2.88	4.88	2.88	25.25	1.50	13.50	7.00	4.0	5/8 x 12	4.50	H1	14.0	1-1/8
30	35.9	17.1	51.50	2.88	5.88	3.75	31.25	2.00	16.88	12.00	4.0	3/4 x 12	5.25	H1	14.0	1-1/2
36	41.9	20.1	60.50	3.50	6.50	3.75	37.25	2.00	19.88	12.00	4.0	3/4 x 12	5.25	H1	24.0	1-1/2
42	47.9	23.1	69.50	3.50	6.88	4.12	43.38	2.00	22.88	16.00	6.0	3/4 x 12	5.50	H2	24.0	1-1/2
48	53.9	26.1	78.50	6.12	6.88	4.12	49.38	2.00	25.88	16.00	6.0	3/4 x 12	5.50	H2B	24.0	1-1/2
54	61.3	29.3	87.75	6.12	7.75	4.62	55.38	2.00	29.25	18.00	6.0	1 x 12	5.50	H2B	30.0	2.00
60	66.0	32.3	97.25	6.12	9.00	5.12	61.38	2.00	32.50	20.00	6.0	1 x 12	5.50	H2B	30.0	2.00



Specifications subject to change without notice. Fresno Valves & Castings, Inc. Printed in USA

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P.O. Box 40, Selma, CA 93662, U.S.A.
(800) 333-1658
www.fresnovalves.com

CheckMate® Installation Procedure



*Clamps are installed in the upstream or downstream cuff, depending upon the application. The illustration above is shown clamped upstream.

CHECKMATE® INSTALLATION

1. Product Shipping

Valve sizes 3" - 18" are furnished with one clamp. Valves 20" - 60" ship with two clamps. 72" valves ship with three clamps.

NOTE: A clamp is installed on each end of the valve to keep the valve's shape during transit and storage. Once the installation orientation is determined the CheckMate® valve will be clamped from either the upstream or downstream side. For valves with two or three clamps, they can be installed onto the same side of the valve and offset from each other, as illustrated in Figure 1.

2. Unpacking & Lifting

Do not use sharp tools when unpacking this product as it may damage the valve.

For larger CheckMate® valves, the valve should be lifted with either a sling or with supports around the O.D. at each side of the valve to ease the installation procedure. Do not place an object through the valve in order to lift.

CAUTION: Do not try to bend, collapse or fold the valve in order to facilitate the installation as this will cause permanent damage and will not allow the valve to return to a fully round shape.

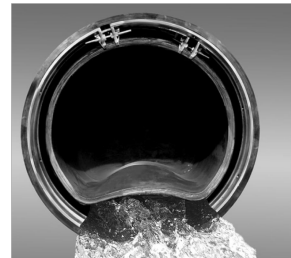


Figure 1 - Clamps shown installed on the same side of valve

2 TIDEFLEX INLINE CHECK VALVE

NO SCALE

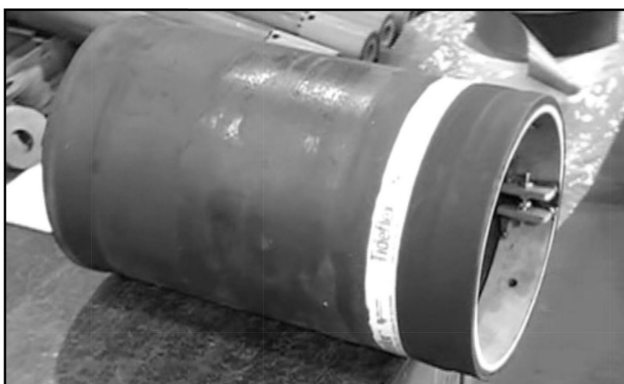
NOTE: SEE MANUFACTURER'S STANDARD SPECIFICATIONS ON SHEET C1.1.

CheckMate® Rubber Adhesive Strip Build Up Procedure

5. Rubber Adhesive Strip Build up

When valve O.D. is smaller than the pipe I.D., one-sided rubber adhesive strip is used to build up the O.D. of both CheckMate® cuffs to the actual pipe I.D.

NOTICE: Clean and dry the exterior of the valve prior to beginning rubber adhesive strip build up procedure.



STEP A: Place the valve on a solid, flat surface with the clamped end hanging slightly over the edge of the surface.



STEP B: Slowly rotate the valve while firmly pressing the rubber adhesive strip onto itself in concentric layers until valve O.D. is equal to or a fraction smaller than pipe I.D.



STEP C: Repeat steps A and B on the opposite side of the valve to ensure uniformity of the CheckMate® O.D. is consistent and matches the pipe I.D.



STEP D: Lubricate the valve and rubber adhesive strip surface. Slide valve into pipe. Ensure the area marked TOP is in the 12:00 position.



STEP E: Check O.D. of the valve to ensure it fits snugly into the I.D. of the pipe. If loose, add another layer(s) of the rubber adhesive strip.



STEP F: Once in place, tighten the clamp to secure it against the pipe and compress the rubber adhesive strip.

CheckMate® Installation Notes

1. It is important that the CheckMate® is installed level within the pipe. The CheckMate® may "gap open" if installed improperly.

2. The sealing area of the CheckMate® must have room to expand outwards, while bottom of the sealing area rises. The area around the sealing area must be kept free of debris to allow the bill to close in order for the valve to seal properly.

3. The CheckMate® effectively reduces the inside diameter of the pipe in which it is installed, creating a restriction. It may also create a "ledge" inside the pipe, causing standing water.

4. Back pressure in excess of the back pressure rating may cause valve failure.

5. Should the conditions that the CheckMate® was designed for change, (line pressure, back pressure, chemical compatibility) the performance of the valve may suffer.

6. CheckMate® Valves must be installed in true round pipe which is concentric across the entire length. Out of round pipe may cause the sealing area of the valve to distort and gap, which will cause the valve to leak.

MAINTENANCE

Inspection

Valves should occasionally be inspected for damage, wear, and buildup of debris. The frequency of the inspections should be determined by the severity of the service and the environment in which it operates.

The clamps should be checked for proper tension, and be sure that the inside of the valve is free of debris. Soft marine growth is normal on valves in submerged applications. Because hard marine growth such as barnacles will not bond well to the CheckMate® they can be easily removed. Also insert pins to ensure they are tight.

STORAGE

If your CheckMate® is to be stored for a period of time prior to installation, the following storage guidelines will help to preserve the valve and assure a trouble-free installation:

- Store in a clean, cool, dry location. Avoid exposure to light, electric motors, dirt, or chemicals.
- Store valve vertically on floor or pallet.
- Store valve to prevent other items from contacting check sleeve to prevent possible damage.
- Store this manual with the valve, so that it is readily available at time of installation.

TROUBLESHOOTING GUIDE

Sleeve Inverted or Distorted

- Excessive back pressure, water surge, or water hammer.

Leaking Around Perimeter of Valve

- Tighten clamp.
- Check for cracks and holes in surface of pipe.
- If taped, check tape to ensure the pipe I.D. has been fully sealed.

Backflow

- Debris lodged inside bill.

2 TIDEFLEX INLINE CHECK VALVE (continued)

NO SCALE

NOTE: SEE MANUFACTURER'S STANDARD SPECIFICATIONS ON SHEET C1.1.

2/12/2025

REVISIONS:

JOB NO.: 18591
DATE: 2/12/2025
SCALE: H: N/A V: N/A
DESIGNED BY: PJM
DRAWN BY: PJM
CHECKED BY: TAW

FINAL

Construction Stormwater General Permit (CSWGP)

Stormwater Pollution Prevention Plan (SWPPP)

for

Landing on the Cowlitz – Phase 1 Access and Utilities & Stormwater Outfall

Prepared for:

**Department of Ecology
Southwest Regional Office**

Permittee / Owner	Developer	Operator / Contractor
CT6, LLC	CT6, LLC	TBD

Parcels 308640100, 30813, 6143802, 308100100, 30812, 308640200, 30864

Certified Erosion and Sediment Control Lead (CESCL)

Name	Organization	Contact Phone Number
TBD	TBD	TBD

SWPPP Prepared By

Name	Organization	Contact Phone Number
Taylor Wilson, PE	MacKay Sposito, Inc.	(360) 823-1344

SWPPP Preparation Date

11/7/2024

Project Construction Dates

Activity / Phase	Start Date	End Date
Grading & Construction	01/01/2025	01/01/2030

GENERAL INSTRUCTIONS AND CAVEATS

This template presents the recommended structure and content for preparation of a Construction Stormwater General Permit (CSWGP) Stormwater Pollution Prevention Plan (SWPPP).

The Department of Ecology's (Ecology) CSWGP requirements inform the structure and content of this SWPPP template; however, **you must customize this template to reflect the conditions of your site.**

A Construction Stormwater Site Inspection Form can be found on Ecology's website.
<https://www.ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Construction-stormwater-permit>

Using the SWPPP Template

Each section will include instructions and space for information specific to your project. Please read the instructions for each section and provide the necessary information when prompted. This Word template can be modified electronically. You may add/delete text, copy and paste, edit tables, etc. Some sections may be completed with brief answers while others may require several pages of explanation.

Follow this link to a copy of the Construction Stormwater General Permit:
<https://www.ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Construction-stormwater-permit>

List of Acronyms and Abbreviations

Acronym / Abbreviation	Explanation
303(d)	Section of the Clean Water Act pertaining to Impaired Waterbodies
BFO	Bellingham Field Office of the Department of Ecology
BMP(s)	Best Management Practice(s)
CESCL	Certified Erosion and Sediment Control Lead
CO₂	Carbon Dioxide
CRO	Central Regional Office of the Department of Ecology
CSWGP	Construction Stormwater General Permit
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ERO	Eastern Regional Office of the Department of Ecology
ERTS	Environmental Report Tracking System
ESC	Erosion and Sediment Control
GULD	General Use Level Designation
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
NWRO	Northwest Regional Office of the Department of Ecology
pH	Power of Hydrogen
RCW	Revised Code of Washington
SPCC	Spill Prevention, Control, and Countermeasure
su	Standard Units
SWMMEW	Stormwater Management Manual for Eastern Washington
SWMMWW	Stormwater Management Manual for Western Washington
SWPPP	Stormwater Pollution Prevention Plan
TESC	Temporary Erosion and Sediment Control
SWRO	Southwest Regional Office of the Department of Ecology
TMDL	Total Maximum Daily Load
VFO	Vancouver Field Office of the Department of Ecology
WAC	Washington Administrative Code
WSDOT	Washington Department of Transportation
WWHM	Western Washington Hydrology Model

Project Information (1.0)

Project/Site Name: Landing on the Cowlitz – Phase 1 Access and Utilities & Stormwater Outfall
Parcel Numbers (1-7): 308640100, 30813, 6143802, 308100100, 30812, 308640200, 30864
City: Caste Rock State: WA Zip code: 98611
Subdivision: CR08080, Lot 2
Receiving waterbody: Salmon Creek/Cowlitz River

Existing Conditions (1.1)

Total acreage (including support activities such as off-site equipment staging yards, material storage areas, and borrow areas).

Total acreage: 118 acres

Disturbed acreage: 100 acres

Existing structures: There is one unoccupied single family home located on the site, as well as additional existing structures utilized for agricultural purposes.

Landscape topography: The site was mass graded for future development. The very southern portion of the site contains a plateau that is owned by the Department of Natural Resources (DNR). This plateau is a dredged material disposal area that contains sand dredge from the Cowlitz River after the 1980 Eruption of Mount Saint Helens.

Drainage patterns: Offsite and onsite drainage is captured by localized depressions and/or existing ditches that convey stormwater south, towards an existing outlet that discharges to Salmon Creek.

Existing Vegetation: The majority of the site is comprised of grass fields and dredge pile areas. There are some forested areas near the river and stream, and a line of trees at the toe of the slope between the farm field and dredge material pile.

Critical Areas (wetlands, streams, high erosion risk, steep or difficult to stabilize slopes): Three (3) existing wetlands have been identified onsite and are located near the southwest portion of the site. All 3 wetlands will be avoided with this phase of construction.

List of known impairments for 303(d) listed or Total Maximum Daily Load (TMDL) for the receiving waterbody: Cowlitz River has been on the 303(d) list for the following tested results with a current listing of Category 5: Temperature, Polychlorinated Biphenyls (PCBs), (2,3,7,8)-TCDD (Dioxin), Methyl mercury

Table 1 includes a list of suspected and/or known contaminants associated with the construction activity.

Table 1 – Summary of Site Pollutant Constituents

Constituent (Pollutant)	Location	Depth	Concentration
Refer to Element 9, Table 2	NA	NA	NA

Proposed Construction Activities (1.2)

Description of site development (example: subdivision):

The approved uses on the site include light industrial, flex/office space, commercial, single-family residential, and recreational. Approximately 53.5 acres have been identified for light industrial use, 12.5 acres for flex/office space, 9.9 acres for commercial uses, 10.3 acres for residential, and 13.9 acres for recreational use (which will include an RV park, recreational trails and other recreational amenities)

Description of construction activities (example: site preparation, demolition, excavation):

Land disturbing activities will include the demolition of existing hardscape and buildings, clearing, grading, and excavation. Upon grading completion, the construction will consist of infrastructure improvements, including: street, stormwater, sanitary sewer (both gravity and force main), water, and various other improvements.

Description of site drainage including flow from and onto adjacent properties. Must be consistent with Site Map in Appendix A: Runoff on the proposed Roadway will be directed to bioretention facilities for treatment before ultimately being conveyed through an onsite storm drain system.

The parcels adjacent to the road corridor will be graded to flat pads in anticipation of future development. Stormwater runoff for these flat pads is expected to be negligible due to onsite soil types. Onsite ditches that were graded during the phase 1 mass grading (previous project) will be used to store and convey stormwater until the new system is in place.

Description of final stabilization (example: extent of revegetation, paving, landscaping):

The proposed project involves the construction of new roadways for the proposed Landing on the Cowlitz development, including associated sewer and water systems, stormwater treatment and conveyance systems, site signing and striping, and landscaping. This project includes a road connection to the existing Huntington Ave and a proposed storm outfall to the Cowlitz River for the entire Landing on the Cowlitz development.

Contaminated Site Information:

Proposed activities regarding contaminated soils or groundwater (example: on-site treatment system, authorized sanitary sewer discharge):
There are no known contaminants.

Construction Stormwater Best Management Practices (BMPs) (2.0)

The SWPPP is a living document reflecting current conditions and changes throughout the life of the project. These changes may be informal (i.e. hand-written notes and deletions). Update the SWPPP when the CESCL has noted a deficiency in BMPs or deviation from original design.

The 13 Elements (2.1)

Element 1: Preserve Vegetation / Mark Clearing Limits (2.1.1)

To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction will be clearly marked before land-disturbing activities begin.

List and describe BMPs:

- BMP C103: High Visibility Plastic or Metal Fence
- BMP C233: Silt Fence

Installation Schedules:

- Prior to Site Clearing

Inspection and Maintenance plan:

- Silt fence and clearing limits shall be maintained until the final site development.

Responsible Staff: CESCL

Element 2: Establish Construction Access (2.1.2)

Construction vehicle access and exit shall be limited to the construction entrance being built off the existing driveway from Huntington Ave South. Access points shall be stabilized to minimize tracking of sediment onto public roads. A wheel wash and tire bath shall be located on site if the stabilized construction entrance is not effective in preventing sediment from being tracked onto public roads.

If sediment is being tracked offsite, roads shall be cleaned thoroughly at the end of each day, or more frequently during wet weather conditions. Sediment shall be removed from roads by shoveling or pick-up sweeping and shall be transported to a controlled sediment disposal area.

Street washing is allowed only after sediment is removed in accordance with the above-mentioned methods. Street wash wastewater shall be controlled by pumping back on site or otherwise be prevented from discharging onto systems tributary to waters of the state.

List and describe BMPs:

- BMP C105: Stabilized Construction Entrance/Exit
- BMP C107: Construction Road/Parking Area Stabilization. To be constructed if the stabilized construction entrance/exit does not effectively remove sediment from the construction vehicle tires.

To avoid potential erosion and sediment control issues, the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

Installation Schedules:

- Prior to ground disturbing activities.

Inspection and Maintenance plan:

- Inspect construction access weekly, replace or clean once rock is full of sediment.

Responsible Staff: CESCL

Element 3: Control Flow Rates (2.1.3)

Stormwater runoff will be collected in grass-lined channels that slope towards 2 onsite temporary sediment ponds. The sediment ponds will have riser pipes to handle overflows during large storm events. Pond 2 will also have an emergency overflow spillway in the event both the dewatering orifice and riser become clogged. The surface area at the top of Pond 1 (riser elevation) was significantly increased due to shallow slope and low elevations surrounding the ditches that convey flows to sediment Pond 1. This was needed in order to contain flows below an elevation of 42 in the event of a 100 year storm event, and not allow flows to bypass the sediment pond. Due to those and other various constraints of the existing site, pond 1 will only be able to accommodate a riser pipe for emergency overflows. However the riser for Pond 1 has been sized to pass the 100 year flood event. Any overflows from Ponds 1 or 2 will be contained and channelized through the grass lined ditches, and drain to Salmon Creek via the outlet pipe.

The proposed final storm system will capture and infiltrate the majority of the runoff onsite. The remaining runoff will drain offsite, mimicking the existing conditions.

Will you construct stormwater retention and/or detention facilities?

☒ Yes ☐ No

Ditch 8 (labeled on the proposed basin map) will be constructed with a 10' wide flat bottom for storing any excess stormwater in the drainage basin that overflows towards the site.

Will you use permanent infiltration ponds or other low impact development (example: rain gardens, bio-retention, porous pavement) to control flow during construction?

☒ Yes ☐ No

List and describe BMPs:

- BMP C241: Temporary Sediment Pond
- BMP C231: Brush Barrier (Outfall – Biofilter bag check dam)

Installation Schedules:

- Beginning of grading operations.

Inspection and Maintenance plan:

- Inspect weekly, clean or remove debris as necessary

Responsible Staff: CESCL

Element 4: Install Sediment Controls (2.1.4)

Stormwater runoff from disturbed areas shall pass through the appropriate sediment removal BMP prior to infiltration. Additional BMPs listed below shall be installed for runoff that will drain offsite.

Sediment control BMPs shall be constructed as one of the first steps in grading. These BMPs should be functional before other land disturbing activities take place. To avoid potential erosion and sediment control issues, the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing

List and describe BMPs:

- BMP C220, Storm Drain Inlet Protection
- BMP C233: Silt Fence
- BMP C231: Brush Barrier

Installation Schedules:

- To be constructed as one of the first steps in grading

Inspection and Maintenance plan:

- Weekly and after rain events.

Responsible Staff: CESCL

Element 5: Stabilize Soils (2.1.5)

All disturbed soil on the site shall be stabilized upon completion of the grading activities. No soils should remain exposed or unworked for longer than the periods outlined in the table below to prevent erosion.

West of the Cascade Mountains Crest

Season	Dates	Number of Days Soils Can be Left Exposed
During the Dry Season	May 1 – September 30	7 days
During the Wet Season	October 1 – April 30	2 days

Soils must be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast.

Anticipated project dates: Start date: 01/01/2025 End date: 01/01/2030

Will you construct during the wet season?

☒ Yes ☐ No

List and describe BMPs:

- BMP C120: Temporary and Permanent Seeding- Temporary EC seed mixes from table II-3.54 of the 2019 SWMMWW are recommended to be used for all onsite areas. Proposed ditches, sediment ponds and others disturbed areas onsite that contain or convey stormwater shall use a wet area seed mix from the table.
- BMP C122: Nets and Blankets (as needed)
- BMP C123: Plastic Covering (as needed)
- BMP C130: Surfacing Roughening (as needed)
- BMP C140: Dust Control

Installation Schedules:

- Soil stabilization BMPs shall be used as needed by the contractor. Soil stabilization shall be in conformance with the table above. During the dry season, dust control shall be implemented as needed to control wind-blown dust. If plastic covering is not placed on stockpiles, then the surface of the stockpiles shall be roughened, and a cutoff ditch shall be constructed at the base of the stockpile.

Inspection and Maintenance plan:

- Cover soils per the table above.

Responsible Staff: CESCL

Element 6: Protect Slopes (2.1.6)

All slopes onsite will be roughened and seeded within the required timeline depending on the time of year. Slopes toward the property lines will have silt fence installed around the perimeter. Other slopes onsite drain towards the grass-lined ditches and to the sediment pond onsite.

Will steep slopes be present at the site during construction?

☒ Yes ☐ No

List and describe BMPs:

- BMP C120: Temporary and Permanent Seeding
- BMP C130: Surface Roughening

Installation Schedules:

- During dry season, slopes will be roughened or seeded within 7 days of final cut. During wet season, slopes will be roughened or seeded within 2 days of final cut.

Inspection and Maintenance plan:

- Inspect weekly and after rain events.

Responsible Staff: CESCL

Element 7: Protect Drain Inlets (2.1.7)

Inlet protection devices shall be cleaned or removed and replaced when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

List and describe BMPs:

- BMP C220: Storm Drain Inlet Protection

Installation Schedules:

- Prior to ground disturbing activities per the Grading, Drainage, and Erosion Control Plans.

Inspection and Maintenance plan:

- Inlets will be inspected weekly at a minimum and daily during storm events. Inlet protection devices will be cleaned (or removed and replaced), when sediment has filled the device by 1/3 or as specified by the manufacturer.

Responsible Staff: CESCL

Element 8: Stabilize Channels and Outlets (2.1.8)

The channels and ponds on the site will be seeded to limit any sediment travel onsite.

Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches, will be installed at the outlets of all conveyance systems.

List and describe BMPs:

- BMP C201: Grass-Lined Channels
- BMP C241: Sediment Pond (Temporary)

Installation Schedules:

- The channels and ponds will be constructed in the first phases of grading.

Inspection and Maintenance plan:

- Inspect weekly and after rain events.

Responsible Staff: CESCL

Element 9: Control Pollutants (2.1.9)

The following pollutants are anticipated to be present on-site:

Table 2 – Pollutants

Pollutant (and source, if applicable)
Construction Debris
Waste Materials

Waste materials will be stored onsite in a large dumpster and the dumpster will be hauled off before it reaches full capacity and replaced with an empty dumpster. Chemicals shall not be stored directly on the ground. Secondary containment shall be implemented. A spill kit shall be always retained onsite. All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of

stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well-organized, and free of debris. If required, BMPs to be implemented to control specific sources of pollutants are discussed below.

Vehicles, construction equipment, and/or petroleum product storage/dispensing:

- All vehicles, equipment, and petroleum product storage/dispensing areas will be inspected regularly to detect any leaks or spills, and to identify maintenance needs to prevent leaks or spills.
- On-site fueling tanks and petroleum product storage containers shall include secondary containment.
- Spill prevention measures, such as drip pans, will be used when conducting maintenance and repair of vehicles or equipment.
- In order to perform emergency repairs on site, temporary plastic will be placed beneath and, if raining, over the vehicle.
- Contaminated surfaces shall be cleaned immediately following any discharge or spill incident.

Excavation and tunneling spoils dewatering waste:

- Dewatering BMPs and BMPs specific to the excavation and tunneling (including handling of contaminated soils) are discussed under Element 10.

Demolition:

- Dust released from demolished sidewalks, buildings, or structures will be controlled using Dust Control measures (BMP C140).
- Storm drain inlets vulnerable to stormwater discharge carrying dust, soil, or debris will be protected using Storm Drain Inlet Protection (BMP C220 as described above for Element 7).

Process water and slurry resulting from sawcutting and surfacing operations will be prevented from entering the waters of the State by implementing Sawcutting and Surfacing Pollution Prevention measures (BMP C152).

Concrete and grout:

- Process water and slurry resulting from concrete work will be prevented from entering the waters of the State by implementing Concrete Handling measures (BMP C151).

Sanitary wastewater:

- Portable sanitation facilities will be firmly secured, regularly maintained, and emptied when necessary.

Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system or to the sanitary sewer as part of Wheel Wash implementation (BMP C106).

This project does not require a Spill Prevention, Control, and Countermeasure (SPCC) Plan under the Federal regulations of the Clean Water Act (CWA).

No storage of potential pollutants is expected. Vehicle maintenance will be performed using equipment maintenance vehicles utilizing required BMPs to control pollutants.

List and describe BMPs:

- BMP C153: Material Delivery, Storage, & Containment

Installation Schedules:

- Installed prior to any grading activity.

Inspection and Maintenance plan:

- Inspect weekly and after rain events.

Responsible Staff: CESCL

Will maintenance, fueling, and/or repair of heavy equipment and vehicles occur on-site?

☒Yes ☐No

List and describe BMPs:

- BMP C153: Material Delivery, Storage, & Containment – The recommendations of BMP C153 shall be followed. Chemicals shall not be stored directly on the ground. Secondary containment shall be implemented. A spill kit shall be retained onsite.

Installation Schedules:

- Prior to performing refueling onsite.

Inspection and Maintenance plan:

- After any use of the spill kit, the kit shall be restocked.
- Inspect with each fueling/maintenance entry to the site

Responsible Staff: CESCL

Will wheel wash or tire bath system BMPs be used during construction?

☐Yes ☒No

List and describe BMPs: N/A

Installation Schedules: N/A

Inspection and Maintenance plan: N/A

Responsible Staff: N/A

Will pH-modifying sources be present on-site?

☒ Yes ☐ No

Table 3 – pH-Modifying Sources

	None
X	Bulk cement
X	Cement kiln dust
X	Fly ash
	Other cementitious materials
	New concrete washing or curing waters
	Waste streams generated from concrete grinding and sawing
	Exposed aggregate processes
	Dewatering concrete vaults
	Concrete pumping and mixer washout waters
	Recycled concrete
	Other (i.e. calcium lignosulfate) [please describe]

List and describe BMPs:

- The recommendations of BMP C151 shall be followed. Concrete trucks shall not be washed out on the ground. Hand tools shall be washed off into formed areas only. A concrete washout shall be used if needed to control concrete wash water.
- The recommendations of BMP C153 shall be followed. Chemicals shall not be stored directly on the ground. Secondary containment shall be implemented. A spill kit shall be retained onsite.
- The recommendations of BMP C154 shall be followed. If it is not possible to dispose of concrete wastewater and truck washout water off-site, then a concrete washout shall be constructed.

Installation Schedules:

- Concrete handline protocols and recommendations shall be implemented as soon as concrete is delivered to the site. A concrete washout shall be constructed prior to concrete deliveries if concrete trucks are to be washout out on-site. A spill kit shall be prepared and stored on-site prior to any chemicals or fuel being delivered or transferred on-site.

Inspection and Maintenance plan:

- Inspect concrete washouts after rain events and after use. Inspect secondary containment weekly.

Responsible Staff: CESCL

Concrete trucks must not be washed out onto the ground, or into storm drains, open ditches, streets, or streams. Excess concrete must not be dumped on-site, except in designated concrete washout areas with appropriate BMPs installed.

Element 10: Control Dewatering (2.1.10)

Dewatering may be required for excavations at the site taking place during the wet season. If seepage or groundwater is encountered, a sump pump may be used to dewater the area. Any water pumped from these areas will be pumped into a sediment trap.

Table 4 – Dewatering BMPs

X	Infiltration
	Transport off-site in a vehicle (vacuum truck for legal disposal)
	Ecology-approved on-site chemical treatment or other suitable treatment technologies
	Sanitary or combined sewer discharge with local sewer district approval (last resort)
X	Use of sedimentation bag with discharge to ditch or swale (small volumes of localized dewatering)

List and describe BMPs:

BMP C240: Sediment Trap

Installation Schedules: Construct prior to grading activities.

Inspection and Maintenance plan: Inspect weekly and after any rain event. Sediment shall be removed from the trap when it reaches 1' in depth.

Responsible Staff: CESCL

Element 11: Maintain BMPs (2.1.11)

All temporary and permanent Erosion and Sediment Control (ESC) BMPs shall be maintained and repaired as needed to ensure continued performance of their intended function.

Maintenance and repair shall be conducted in accordance with each particular BMP specification (see *Volume II of the SWMMWW* or *Chapter 7 of the SWMMEW*).

Visual monitoring of all BMPs installed at the site will be conducted at least once every calendar week and within 24 hours of any stormwater or non-stormwater discharge from the site. If the site becomes inactive and is temporarily stabilized, the inspection frequency may be reduced to once every calendar month.

All temporary ESC BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed.

Trapped sediment shall be stabilized on-site or removed. Disturbed soil resulting from removal of either BMPs or vegetation shall be permanently stabilized.

Additionally, protection must be provided for all BMPs installed for the permanent control of stormwater from sediment and compaction. BMPs that are to remain in place following completion of construction shall be examined and restored to full operating condition. If sediment enters these BMPs during construction, the sediment shall be removed and the facility shall be returned to conditions specified in the construction documents.

Element 12: Manage the Project (2.1.12)

The project will be managed based on the following principles:

- Projects will be phased to the maximum extent practicable and seasonal work limitations will be taken into account.
- Inspection and monitoring:
 - Inspection, maintenance and repair of all BMPs will occur as needed to ensure performance of their intended function.
 - Site inspections and monitoring will be conducted in accordance with Special Condition S4 of the CSWGP. Sampling locations are indicated on the [Site Map](#). Sampling station(s) are located in accordance with applicable requirements of the CSWGP.
- Maintain an updated SWPPP.
 - The SWPPP will be updated, maintained, and implemented in accordance with Special Conditions S3, S4, and S9 of the CSWGP.

As site work progresses the SWPPP will be modified routinely to reflect changing site conditions. The SWPPP will be reviewed monthly to ensure the content is current.

Check all the management BMPs that apply at your site:

Table 5 – Management

X	Design the project to fit the existing topography, soils, and drainage patterns
X	Emphasize erosion control rather than sediment control
X	Minimize the extent and duration of the area exposed
X	Keep runoff velocities low
X	Retain sediment on-site
X	Thoroughly monitor site and maintain all ESC measures
	Schedule major earthwork during the dry season
	Other (please describe)

Table 6 – BMP Implementation Schedule

[illegible]

Element 13: Protect Low Impact Development (LID) BMPs (2.1.13)

No impervious areas are proposed for this phase of the project, therefore no LID facilities will be constructed.

Pollution Prevention Team (3.0)

Table 7 – Team Information

Title	Name(s)	Phone Number
Certified Erosion and Sediment Control Lead (CESCL)	TBD	TBD
Resident Engineer	Taylor Wilson, PE MacKay Sposito, Inc.	(360) 823-1334
Emergency Ecology Contact	TBD	TBD
Emergency Permittee/ Owner Contact	Shane Tapani	360-687-1148
Non-Emergency Owner Contact	Jerome Sarkinen	360-907-7615
Monitoring Personnel	TBD	TBD
Ecology Regional Office	Southwest Region	(360) 407-6300

Monitoring and Sampling Requirements (4.0)

Monitoring includes visual inspection, sampling for water quality parameters of concern, and documentation of the inspection and sampling findings in a site log book. A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements
- Site inspections
- Stormwater sampling data

Create your own Site Inspection Form or use the Construction Stormwater Site Inspection Form found on Ecology's website. <https://www.ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Construction-stormwater-permit>

File a blank form under Appendix D.

The site log book must be maintained on-site within reasonable access to the site and be made available upon request to Ecology or the local jurisdiction.

Numeric effluent limits may be required for certain discharges to 303(d) listed waterbodies. See CSWGP Special Condition S8 and Section 5 of this template.

Complete the following paragraph for sites that discharge to impaired waterbodies for fine sediment, turbidity, phosphorus, or pH:

The receiving waterbody, Salmon Creek, is impaired for: no impairments. All stormwater and dewatering discharges from the site are subject to an **effluent limit** of 8.5 su for pH and/or 25 NTU for turbidity.

Site Inspection (4.1)

Site inspections will be conducted at least once every calendar week and within 24 hours following any discharge from the site. For sites that are temporarily stabilized and inactive, the required frequency is reduced to once per calendar month.

The discharge point(s) are indicated on the Site Map (see Appendix A) and in accordance with the applicable requirements of the CSWGP.

Stormwater Quality Sampling (4.2)

Turbidity Sampling (4.2.1)

Requirements include calibrated turbidity meter or transparency tube to sample site discharges for compliance with the CSWGP. Sampling will be conducted at all discharge points at least once per calendar week.

Method for sampling turbidity:

Table 8 – Turbidity Sampling Method

x	Turbidity Meter/Turbidimeter (required for disturbances 5 acres or greater in size)
	Transparency Tube (option for disturbances less than 1 acre and up to 5 acres in size)

The benchmark for turbidity value is 25 nephelometric turbidity units (NTU) and a transparency less than 33 centimeters.

If the discharge's turbidity is 26 to 249 NTU or the transparency is less than 33 cm but equal to or greater than 6 cm, the following steps will be conducted:

1. Review the SWPPP for compliance with Special Condition S9. Make appropriate revisions within 7 days of the date the discharge exceeded the benchmark.
2. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible. Address the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.
3. Document BMP implementation and maintenance in the site log book.

If the turbidity exceeds 250 NTU or the transparency is 6 cm or less at any time, the following steps will be conducted:

1. Telephone or submit an electronic report to the applicable Ecology Region's Environmental Report Tracking System (ERTS) within 24 hours.
<https://www.ecology.wa.gov/About-us/Get-involved/Report-an-environmental-issue>
 - Central Region (Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima): (509) 575-2490
 - Eastern Region (Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman): (509) 329-3400
 - Northwest Region (King, Kitsap, Island, San Juan, Skagit, Snohomish, Whatcom): (425) 649-7000
 - Southwest Region (Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Lewis, Mason, Pacific, Pierce, Skamania, Thurston, Wahkiakum,): (360) 407-6300
2. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible. Address the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period
3. Document BMP implementation and maintenance in the site log book.
4. Continue to sample discharges daily until one of the following is true:
 - Turbidity is 25 NTU (or lower).
 - Transparency is 33 cm (or greater).

- Compliance with the water quality limit for turbidity is achieved.
 - 1 - 5 NTU over background turbidity, if background is less than 50 NTU
 - 1% - 10% over background turbidity, if background is 50 NTU or greater
- The discharge stops or is eliminated.

pH Sampling (4.2.2)

pH monitoring is required for “Significant concrete work” (i.e. greater than 1000 cubic yards poured concrete or recycled concrete over the life of the project). The use of engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD] or fly ash) also requires pH monitoring.

For significant concrete work, pH sampling will start the first day concrete is poured and continue until it is cured, typically three (3) weeks after the last pour.

For engineered soils and recycled concrete, pH sampling begins when engineered soils or recycled concrete are first exposed to precipitation and continues until the area is fully stabilized.

If the measured pH is 8.5 or greater, the following measures will be taken:

1. Prevent high pH water from entering storm sewer systems or surface water.
2. Adjust or neutralize the high pH water to the range of 6.5 to 8.5 su using appropriate technology such as carbon dioxide (CO₂) sparging (liquid or dry ice).
3. Written approval will be obtained from Ecology prior to the use of chemical treatment other than CO₂ sparging or dry ice.

Method for sampling pH:

Table 8 – pH Sampling Method

	pH meter
X	pH test kit
	Wide range pH indicator paper

Discharges to 303(d) or Total Maximum Daily Load (TMDL) Waterbodies (5.0)

303(d) Listed Waterbodies (5.1)

The 303(d) status is listed on the Water Quality Atlas: <https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Assessment-of-state-waters-303d>

Circle the applicable answer, if necessary:

Is the receiving water 303(d) (Category 5) listed for turbidity, fine sediment, phosphorus, or pH?

☐ Yes ☒ No

List the impairment(s):

N/A

The receiving waterbody, Cowlitz River, is impaired for: no impairments. All stormwater and dewatering discharges from the site are subject to an **effluent limit** of 8.5 su for pH and/or 25 NTU for turbidity.

If yes, discharges must comply with applicable effluent limitations in S8.C and S8.D of the CSWGP.

Describe the method(s) for 303(d) compliance:

List and describe BMPs:

N/A

TMDL Waterbodies (5.2)

Waste Load Allocation for CWSGP discharges:

N/A

Describe the method(s) for TMDL compliance:

List and describe BMPs:

N/A

Discharges to TMDL receiving waterbodies will meet in-stream water quality criteria at the point of discharge.

The Construction Stormwater General Permit Proposed New Discharge to an Impaired Water Body form is included in Appendix F.

Reporting and Record Keeping (6.0)

Record Keeping (6.1)

Site Log Book (6.1.1)

A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements
- Site inspections
- Sample logs

Records Retention (6.1.2)

Records will be retained during the life of the project and for a minimum of three (3) years following the termination of permit coverage in accordance with Special Condition S5.C of the CSWGP.

Permit documentation to be retained on-site:

- CSWGP
- Permit Coverage Letter
- SWPPP
- Site Log Book

Permit documentation will be provided within 14 days of receipt of a written request from Ecology. A copy of the SWPPP or access to the SWPPP will be provided to the public when requested in writing in accordance with Special Condition S5.G.2.b of the CSWGP.

Updating the SWPPP (6.1.3)

The SWPPP will be modified if:

- Found ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site.
- There is a change in design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the State.

The SWPPP will be modified within seven (7) days if inspection(s) or investigation(s) determine additional or modified BMPs are necessary for compliance. An updated timeline for BMP implementation will be prepared.

Reporting (6.2)

Discharge Monitoring Reports (6.2.1)

Cumulative soil disturbance is one (1) acre or larger; therefore, Discharge Monitoring Reports (DMRs) will be submitted to Ecology monthly. If there was no discharge during a given monitoring period the DMR will be submitted as required, reporting “No Discharge”. The DMR due date is fifteen (15) days following the end of each calendar month.

DMRs will be reported online through Ecology’s WQWebDMR System.

To sign up for WQWebDMR go to:

<https://www.ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Water-quality-permits-guidance/WQWebPortal-guidance>

Notification of Noncompliance (6.2.2)

If any of the terms and conditions of the permit is not met, and the resulting noncompliance may cause a threat to human health or the environment, the following actions will be taken:

1. Ecology will be notified within 24-hours of the failure to comply by calling the applicable Regional office ERTS phone number (Regional office numbers listed below).
2. Immediate action will be taken to prevent the discharge/pollution or otherwise stop or correct the noncompliance. If applicable, sampling and analysis of any noncompliance will be repeated immediately and the results submitted to Ecology within five (5) days of becoming aware of the violation.
3. A detailed written report describing the noncompliance will be submitted to Ecology within five (5) days, unless requested earlier by Ecology.

Specific information to be included in the noncompliance report is found in Special Condition S5.F.3 of the CSWGP.

Anytime turbidity sampling indicates turbidity is 250 NTUs or greater, or water transparency is 6 cm or less, the Ecology Regional office will be notified by phone within 24 hours of analysis as required by Special Condition S5.A of the CSWGP.

- Central Region at (509) 575-2490 for Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, or Yakima County
- Eastern Region at (509) 329-3400 for Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, or Whitman County
- Northwest Region at (425) 649-7000 for Island, King, Kitsap, San Juan, Skagit, Snohomish, or Whatcom County

- Southwest Region at (360) 407-6300 for Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Lewis, Mason, Pacific, Pierce, Skamania, Thurston, or Wahkiakum

Include the following information:

1. Your name and / Phone number
2. Permit number
3. City / County of project
4. Sample results
5. Date / Time of call
6. Date / Time of sample
7. Project name

In accordance with Special Condition S4.D.5.b of the CSWGP, the Ecology Regional office will be notified if chemical treatment other than CO₂ sparging is planned for adjustment of high pH water.

Appendix/Glossary

A. Vicinity Map

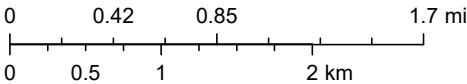
Vicinity Map



11/1/2024, 10:40:00 AM

 County Boundary

1:72,224



Oregon State Parks, State of Oregon GEO, WA State Parks GIS, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS

B. BMP Details

permitting authority. These should not be disturbed and must be protected with sediment control BMPs to prevent impacts. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

- Vegetative Buffer Zones - areas that may be identified in undisturbed vegetation areas or managed vegetation areas that are outside any Designated Critical Area Buffer. They may be utilized to provide an additional sediment control area and/or reduce runoff velocities. If being used for preservation of natural vegetation, they should be arranged in clumps or strips. They can be used to protect natural swales and incorporated into the natural landscaping area.

Design and Installation Specifications

- Preserving natural vegetation or plantings in clumps, blocks, or strips is generally the easiest and most successful method.
- Leave all unstable steep slopes in natural vegetation.
- Mark clearing limits and keep all equipment and construction debris out of the natural areas and buffer zones. Steel construction fencing is the most effective method to protect sensitive areas and buffers. Alternatively, wire-backed silt fence on steel posts is marginally effective. Flagging alone is typically not effective.
- Keep all excavations outside the dripline of trees and shrubs.
- Do not push debris or extra soil into the buffer zone area because it will cause damage by burying and smothering vegetation.
- Vegetative buffer zones for streams, lakes or other waterways shall be established by the local permitting authority or other state or federal permits or approvals.

Maintenance Standards

Inspect the area frequently to make sure flagging remains in place and the area remains undisturbed. Replace all damaged flagging immediately. Remove all materials located in the buffer area that may impede the ability of the vegetation to act as a filter.

BMP C103: High-Visibility Fence

Purpose

High-visibility fencing is intended to:

- Restrict clearing to approved limits.
- Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed.
- Limit construction traffic to designated construction entrances, exits, or internal roads.
- Protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use

To establish clearing limits, plastic, fabric, or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.
- As necessary to control vehicle access to and on the site.

Design and Installation Specifications

High-visibility plastic fence shall be composed of a high-density polyethylene (HDPE) material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high-visibility orange. The fence tensile strength shall be 360 lbs/ft using the ASTM D4595 testing method.

If appropriate, install fabric silt fence in accordance with [BMP C233: Silt Fence](#) to act as high-visibility fence. Silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP.

Metal fences shall be designed and installed according to the manufacturer's specifications.

Metal fences shall be at least 3 feet high and must be highly visible.

Fences shall not be wired or stapled to trees.

Maintenance Standards

If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

BMP C105: Stabilized Construction Access

Purpose

Stabilized construction accesses are established to reduce the amount of sediment transported onto paved roads outside the project site by vehicles or equipment. This is done by constructing a stabilized pad of quarry spalls at entrances and exits for project sites.

Conditions of Use

Construction accesses shall be stabilized wherever traffic will be entering or leaving a construction site if paved roads or other paved areas are within 1,000 feet of the site.

For residential subdivision construction sites, provide a stabilized construction access for each residence, rather than only at the main subdivision entrance. Stabilized surfaces shall be of sufficient length/width to provide vehicle access/parking, based on lot size and configuration.

On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized accesses not shown in the initial Construction SWPPP. It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

Design and Installation Specifications

- See [Figure II-4.1: Stabilized Construction Access](#) for details. Note: the 100' minimum length of the access shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100').
- Construct stabilized construction accesses with a 12-inch thick pad of 4-inch to 8-inch quarry spalls, a 4-inch course of asphalt treated base (ATB), or use existing pavement. Do not use crushed concrete, cement, or calcium chloride for construction access stabilization because these products raise pH levels in stormwater and concrete discharge to waters of the State is prohibited.
- A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the standards listed in [Table II-4.2: Stabilized Construction Access Geotextile Standards](#).

Table II-4.2: Stabilized Construction Access Geotextile Standards

Geotextile Property	Required Value
Grab Tensile Strength (ASTM D4751)	200 psi min.
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	No. 20 to No. 45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt in areas that will be paved; this can be used as a stabilized access. Also consider the installation of excess concrete as a stabilized access. During large concrete pours, excess concrete is often available for this purpose.
- Fencing (see [BMP C103: High-Visibility Fence](#)) shall be installed as necessary to restrict traffic to the construction access.
- Whenever possible, the access shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.
- Construction accesses should avoid crossing existing sidewalks and back of walk drains if at all possible. If a construction access must cross a sidewalk or back of walk drain, the full length of the sidewalk and back of walk drain must be covered and protected from sediment leaving the site.

Alternative Material Specification

WSDOT has raised safety concerns about the quarry spall rock specified above. WSDOT observes that the 4-inch to 8-inch rock sizes can become trapped between dually truck tires, and then released off-site at highway speeds. WSDOT has chosen to use a modified specification for the rock while continuously verifying that the stabilized construction access remains effective. To remain effective, the BMP must prevent sediment from migrating off site. To date, there has been no performance testing to verify operation of this new specification. Local jurisdictions may use the alternative specification, but must perform increased off-site inspection if they use, or allow others to use, it.

Stabilized construction accesses may use material that meets the requirements of WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Section 9-03.9(1) ([WSDOT, 2016](#)) for ballast except for the following special requirements.

The grading and quality requirements are listed in [Table II-4.3: Stabilized Construction Access Alternative Material Requirements](#).

Table II-4.3: Stabilized Construction Access Alternative Material Requirements

Sieve Size	Percent Passing
2½"	99 to 100
2"	65 to 100
¾"	40 to 80
No. 4	5 max.
No. 100	0 to 2
% Fracture	75 min.
Notes: 1. All percentages are by weight. 2. The sand equivalent value and dust ratio requirements do not apply. 3. The fracture requirement shall be at least one fractured face and will apply the combined aggregate retained on the No. 4 sieve in accordance with FOP for AASHTO T 335.	

Maintenance Standards

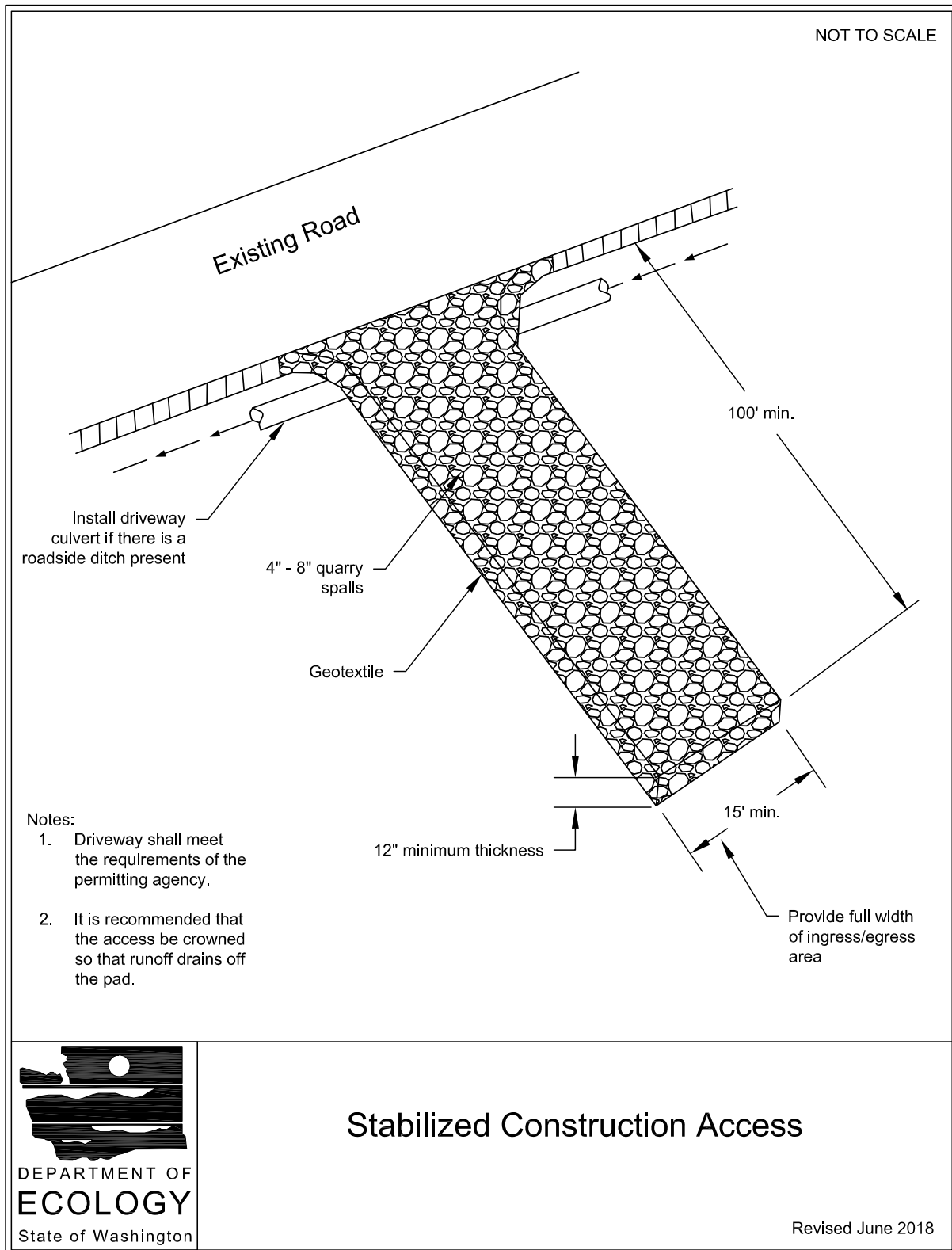
Quarry spalls shall be added if the pad is no longer in accordance with the specifications.

- If the access is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include replacement/cleaning of the existing quarry spalls, street sweeping, an increase in the dimensions

of the access, or the installation of [BMP C106: Wheel Wash](#).

- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a small sump to contain the wash water shall be considered. The sediment would then be washed into the sump where it can be controlled.
- Perform street sweeping by hand or with a high efficiency sweeper. Do not use a non-high efficiency mechanical sweeper because this creates dust and throws soils into storm systems or conveyance ditches.
- Any quarry spalls that are loosened from the pad, which end up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the construction access(es), [BMP C103: High-Visibility Fence](#) shall be installed to control traffic.
- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

Figure II-4.1: Stabilized Construction Access



Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

<https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies>

BMP C106: Wheel Wash

Purpose

Wheel washes reduce the amount of sediment transported onto paved roads by washing dirt from the wheels of motor vehicles prior to the motor vehicles leaving the construction site.

Conditions of Use

- Use a wheel wash when [BMP C105: Stabilized Construction Access](#) is not preventing sediment from being tracked off site.
- Wheel washing is generally an effective BMP when installed with careful attention to topography. For example, a wheel wash can be detrimental if installed at the top of a slope abutting a right-of-way where the water from the dripping truck can run unimpeded into the street.
- Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10-foot x 10-foot sump can be very effective.
- Wheel wash wastewater is not stormwater. It is commonly called process water, and must be discharged to a separate on-site treatment system that prevents discharge to waters of the State, or to the sanitary sewer with local sewer district approval.
- Wheel washes may use closed-loop recirculation systems to conserve water use.
- Wheel wash wastewater shall not include wastewater from concrete washout areas.
- When practical, the wheel wash should be placed in sequence with [BMP C105: Stabilized Construction Access](#). Locate the wheel wash such that vehicles exiting the wheel wash will enter directly onto [BMP C105: Stabilized Construction Access](#). In order to achieve this, [BMP C105: Stabilized Construction Access](#) may need to be extended beyond the standard installation to meet the exit of the wheel wash.

Design and Installation Specifications

Suggested details are shown in [Figure II-4.2: Wheel Wash](#). The local permitting authority may allow other designs. A minimum of 6 inches of asphalt treated base (ATB) over crushed base

material or 8 inches over a good subgrade is recommended to pave the wheel wash.

Use a low clearance truck to test the wheel wash before paving. Either a belly dump or lowboy will work well to test clearance.

Keep the water level from 12 to 14 inches deep to avoid damage to truck hubs and filling the truck tongues with water.

Midpoint spray nozzles are only needed in extremely muddy conditions.

Wheel wash systems should be designed with a small grade change, 6- to 12-inches for a 10-foot-wide pond, to allow sediment to flow to the low side of pond to help prevent re-suspension of sediment. A drainpipe with a 2- to 3-foot riser should be installed on the low side of the pond to allow for easy cleaning and refilling. Polymers may be used to promote coagulation and flocculation in a closed-loop system. Polyacrylamide (PAM) added to the wheel wash water at a rate of 0.25 to 0.5 pounds per 1,000 gallons of water increases effectiveness and reduces cleanup time. If PAM is already being used for dust or erosion control and is being applied by a water truck, the same truck can be used to change the wash water. PAM use shall be reviewed and approved by the local permitting authority. Discharge of PAM may be a basis for penalties per [RCW 90.48.080](#).

Maintenance Standards

The wheel wash should start out each day with fresh water.

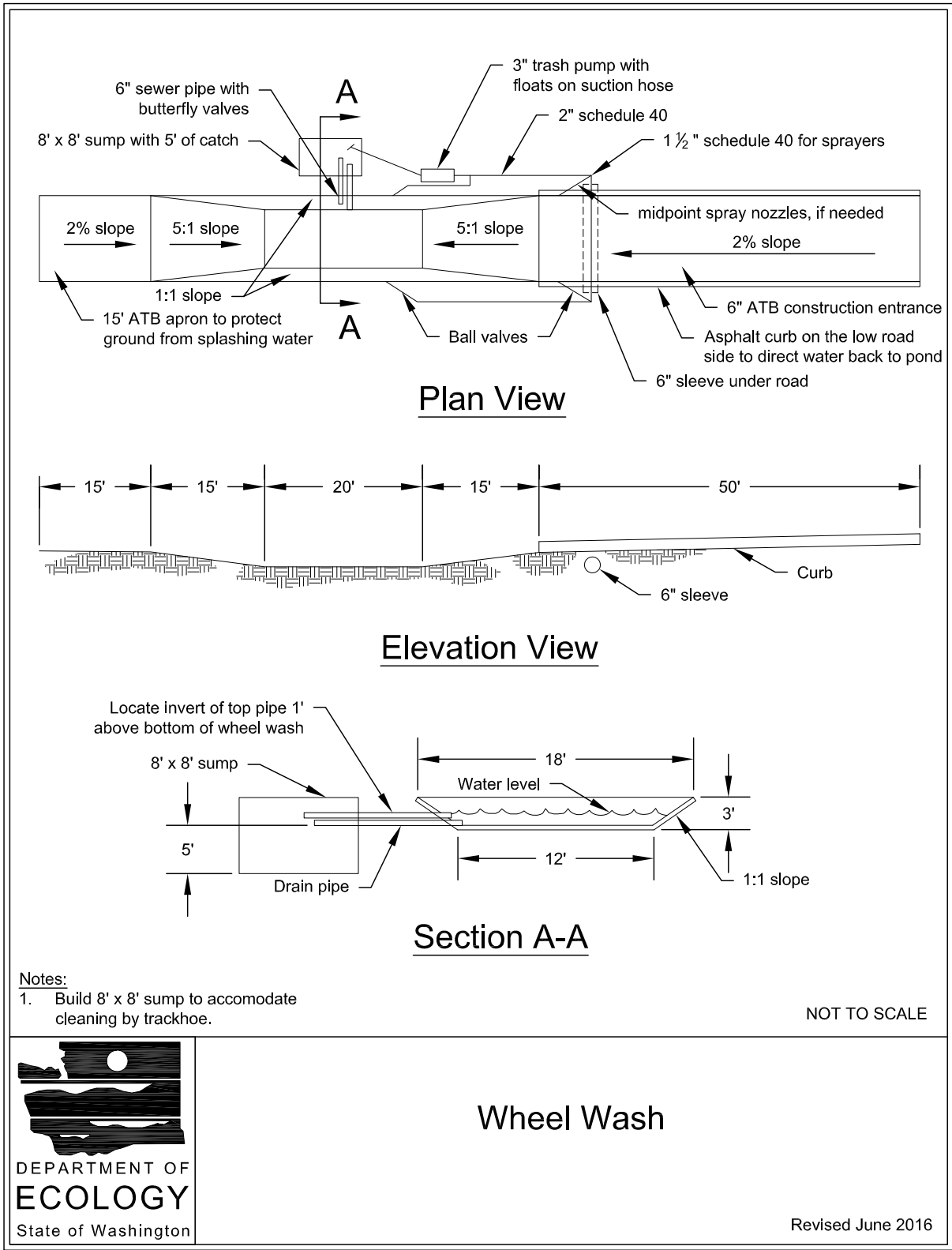
The wheel wash water should be changed a minimum of once per day. On large earthwork jobs where more than 10 to 20 trucks per hour are expected, the wheel wash water will need to be changed more often.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

<https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies>

Figure II-4.2: Wheel Wash



BMP C107: Construction Road / Parking Area Stabilization

Purpose

Stabilizing roads, parking areas, and other on-site vehicle transportation routes immediately after grading reduces erosion caused by construction traffic or stormwater runoff.

Conditions of Use

Roads and parking areas shall be stabilized wherever they are constructed, whether permanent or temporary, for use by construction traffic.

[BMP C103: High-Visibility Fence](#) shall be installed, if necessary, to limit the access of vehicles to only those roads and parking areas that are stabilized.

Design and Installation Specifications

- On areas that will receive asphalt as part of the project, install the first lift as soon as possible.
- A 6-inch depth of 2- to 4-inch crushed rock, gravel base, or crushed surfacing base course shall be applied immediately after grading or utility installation. A 4-inch course of asphalt treated base (ATB) may also be used, or the road/parking area may be paved. It may also be possible to use cement or calcium chloride for soil stabilization. If cement or cement kiln dust is used for road base stabilization, pH monitoring and [BMP C252: Treating and Disposing of High pH Water](#) is necessary to evaluate and minimize the effects on stormwater. If the area will not be used for permanent roads, parking areas, or structures, a 6-inch depth of hog fuel may also be used, but this is likely to require more maintenance. Whenever possible, construction roads and parking areas shall be placed on a firm, compacted subgrade.
- Temporary road gradients shall not exceed 15 percent. Roadways shall be carefully graded to drain. Drainage ditches shall be provided on each side of the roadway in the case of a crowned section, or on one side in the case of a super-elevated section. Drainage ditches shall be directed to a sediment control BMP.
- Rather than relying on ditches, it may also be possible to grade the road so that runoff sheet flows into a heavily vegetated area with a well-developed topsoil. Landscaped areas are not adequate. If this area has at least 50 feet of vegetation that water can flow through, then it is generally preferable to use the vegetation to treat runoff, rather than a sediment pond or trap. The 50 feet shall not include wetlands or their buffers. If runoff is allowed to sheet flow through adjacent vegetated areas, it is vital to design the roadways and parking areas so that no concentrated runoff is created.
- Storm drain inlets shall be protected to prevent sediment-laden water entering the drainage system (see [BMP C220: Inlet Protection](#)).

Maintenance Standards

Inspect stabilized areas regularly, especially after large storm events.

Crushed rock, gravel base, etc., shall be added as required to maintain a stable driving surface and to stabilize any areas that have eroded.

Following construction, these areas shall be restored to pre-construction condition or better to prevent future erosion.

Perform street cleaning at the end of each day or more often if necessary.

BMP C120: Temporary and Permanent Seeding

Purpose

Seeding reduces erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

- Use seeding throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days. See [II-2.5 Element 5: Stabilize Soils](#) for specific timelines for stabilizing exposed soils.
- See [Table II-4.4: Seeding Windows in Western Washington \(continued\)](#) for appropriate seeding windows.
- Review all disturbed areas in late August to early September and complete all seeding by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.
- Mulch is required at all times for seeding because it protects seeds from heat, moisture loss, and transport due to runoff. Mulch can be applied on top of the seed or simultaneously by hydroseeding. See [BMP C121: Mulching](#) for specifications.
- Seed and mulch all disturbed areas not otherwise vegetated at final site stabilization. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions, or geotextiles) which will prevent erosion. See [BMP T5.13: Post-Construction Soil Quality and Depth](#).

Table II-4.4: Seeding Windows in Western Washington

Month	Seeding Recommendations
January	Seeding requires a cover of mulch or an erosion control blanket until 75% grass cover is established
February	
March	

Table II-4.4: Seeding Windows in Western Washington (continued)

Month	Seeding Recommendations
April	Optimum seeding window
May	
June	
July	Seeding requires irrigation until 75% grass cover is established
August	
September	Optimum seeding window
October	Seeding requires a cover of mulch or an erosion control blanket until 75 percent grass cover is established
November	
December	

Design and Installation Specifications

General

- Install channels intended for vegetation before starting major earthwork and hydroseed with a Bonded Fiber Matrix (BFM). For vegetated channels that will have high flows, install erosion control blankets over the top of hydroseed. Before allowing water to flow in vegetated channels, establish a 75% vegetation cover. If vegetated channels cannot be established by seed before water flow, install sod or prevegetated mats in the channel bottom over top of hydromulch and erosion control blankets.
- Confirm the installation of all required stormwater control measures to prevent seed from washing away.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre (lb/acre) of mulch with 3% tackifier. See [BMP C121: Mulching](#) for specifications.
- Areas that will have seeding only, and not landscaping, may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Re-install native topsoil on the disturbed soil surface before application. See [BMP T5.13: Post-Construction Soil Quality and Depth](#).
- When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. To overcome this, consider increasing seed quantities by up to 50 percent.
- Vegetation establishment can be enhanced by one of the following two approaches:
 - Approach 1: Enhance vegetation establishment by dividing the hydromulch operation into two phases:

- Phase 1 – Install all seed and fertilizer with 25% to 30% mulch and tackifier onto the soil in the first lift.
- Phase 2 – Install the remaining mulch and tackifier over the first lift.
- Approach 2: Vegetation can also be enhanced by:
 - Installing the mulch, seed, fertilizer, and tackifier in one lift;
 - Spreading or blowing straw over the top of the hydromulch at a rate of about 800 to 1,000 lb/acre; or
 - Holding straw in place with a standard tackifier.

Both of these approaches (Approach 1 and Approach 2) will increase cost moderately but will greatly improve and enhance vegetative establishment. The increased cost may be offset by the reduced need for:

- Irrigation,
- Reapplication of mulch, and
- Repair of failed slope surfaces.

Either of these approaches can use standard hydromulch (1,500 lb/acre minimum) and BFM/mechanically bonded fiber matrix (MBFM) (3,000 lb/acre minimum).

- Seed may be installed by hand if it is:
 - Temporary and covered by straw, mulch, or topsoil; or
 - Permanent in small areas (usually less than 1 acre) and covered with mulch, topsoil, or erosion blankets.
- Consult the local suppliers and/or the local conservation district for their recommendations for appropriate seed mixes and application rates. The appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic.
- In addition to meeting erosion control functions and not hindering maintenance operations, selection of long-lived, successional growth native vegetation that can compete against or exclude weeds and grow with minimal maintenance after plant establishment is preferred. Provide diversity to the greatest extent possible and plan for a succession of flowering times to improve pollinator habitat.
- The seed mixes listed in [Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington \(continued\)](#) include recommended mixes for both temporary and permanent seeding. Alternative seed mixes approved by the local jurisdiction may also be used.
- Apply the mixes in [Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington \(continued\)](#), with the exception of the wet area seed mix, at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used. Apply the wet area seed mix at a rate of 60 pounds per acre.

Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington

Common Name	Latin Name	% Weight	% Purity	% Germination
Temporary Erosion Control Seed Mix				
A standard mix for areas requiring a temporary vegetative cover.				
Chewings or annual blue grass	<i>Festuca rubra</i> var. <i>commutata</i> or <i>Poa annua</i>	40	98	90
Perennial rye	<i>Lolium perenne</i>	50	98	90
Redtop or colonial bentgrass	<i>Agrostis alba</i> or <i>Agrostis tenuis</i>	5	92	85
White dutch clover	<i>Trifolium repens</i>	5	98	90
Landscaping Seed Mix				
A recommended mix for landscaping seed.				
Perennial rye blend	<i>Lolium perenne</i>	70	98	90
Chewings and red fescue blend	<i>Festuca rubra</i> var. <i>commutata</i> or <i>Festuca rubra</i>	30	98	90
Low-Growing Turf Seed Mix				
A turf seed mix for dry situations where there is no need for watering. This mix requires very little maintenance.				
Dwarf tall fescue (several varieties)	<i>Festuca arundinacea</i> var.	45	98	90
Dwarf perennial rye (Barclay)	<i>Lolium perenne</i> var. <i>barclay</i>	30	98	90
Red fescue	<i>Festuca rubra</i>	20	98	90
Colonial bentgrass	<i>Agrostis tenuis</i>	5	98	90
Bioswale Seed Mix				
A seed mix for bioswales and other intermittently wet areas.				
Tall or meadow fescue	<i>Festuca arundinacea</i> or <i>Festuca elatior</i>	75-80	98	90
Seaside/Creeping bentgrass	<i>Agrostis palustris</i>	10-15	92	85
Redtop bentgrass	<i>Agrostis alba</i> or <i>Agrostis gigantea</i>	5-10	90	80
Wet Area Seed Mix				

Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington (continued)

Common Name	Latin Name	% Weight	% Purity	% Germination
A low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Consult Hydraulic Permit Authority (HPA) for seed mixes if applicable.				
Tall or meadow fescue	<i>Festuca arundinacea</i> or <i>Festuca elatior</i>	60-70	98	90
Seaside/Creeping bentgrass	<i>Agrostis palustris</i>	10-15	98	85
Meadow foxtail	<i>Alepocurus pratensis</i>	10-15	90	80
Alsike clover	<i>Trifolium hybridum</i>	1-6	98	90
Redtop bentgrass	<i>Agrostis alba</i>	1-6	92	85
Meadow Seed Mix A recommended meadow seed mix for infrequently maintained areas or non-maintained areas where colonization by native plants is desirable. Likely applications include rural road and utility right-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. Consider the appropriateness of clover, a fairly invasive species, in the mix. Amending the soil can reduce the need for clover.				
Redtop or Oregon bentgrass	<i>Agrostis alba</i> or <i>Agrostis oregonensis</i>	20	92	85
Red fescue	<i>Festuca rubra</i>	70	98	90
White dutch clover	<i>Trifolium repens</i>	10	98	90

Roughening and Rototilling

- The seedbed should be firm and rough. Roughen all soil no matter what the slope. Track walk slopes before seeding if engineering purposes require compaction. Backblading or smoothing of slopes greater than 4H:1V is not allowed if they are to be seeded.
- Restoration-based landscape practices require deeper incorporation than that provided by a simple, single-pass rototilling treatment. Wherever practical, initially rip the subgrade to improve long-term permeability, infiltration, and water inflow qualities. At a minimum, permanent areas shall receive soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches, complete the rototilling process in multiple lifts, or prepare the soil amendments per the specifications and place to achieve the specified depth.

Fertilizers

- Conducting soil tests to determine the exact type and quantity of fertilizer needed is recommended. This will prevent the overapplication of fertilizer.
- Organic matter is the most appropriate form of fertilizer because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form.
- In general, use 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer at a rate of 90 pounds per acre.
- Always use slow-release fertilizers because they are more efficient and have fewer environmental impacts. Do not add fertilizer to the hydromulch machine, or agitate, more than 20 minutes before use. Too much agitation destroys the slow-release coating.
- There are numerous products available to take the place of chemical fertilizers, including several with seaweed extracts that are beneficial to soil microbes and organisms. If 100% cottonseed meal is used as the mulch in hydroseed, chemical fertilizer may not be necessary. Cottonseed meal provides a good source of long-term, slow-release, available nitrogen.

Bonded Fiber Matrix and Mechanically Bonded Fiber Matrix

- On steep slopes, use Bonded Fiber Matrix (BFM) or Mechanically Bonded Fiber Matrix (MBFM) products. Apply BFM/MBFM products at a minimum rate of 3,000 pounds per acre with approximately 10% tackifier. Achieve a minimum of 95% soil coverage during application. Numerous products are available commercially. Most products require 24-36 hours to cure before rainfall, and cannot be installed on wet or saturated soils. Generally, products come in 40-50 pound bags and include all necessary ingredients except for seed and fertilizer.
- Install products per manufacturer's instructions.
- BFMs and MBFMs provide good alternatives to blankets in most areas requiring vegetation establishment. Advantages over blankets include the following:
 - BFM and MBFMs do not require surface preparation.
 - Helicopters can assist in installing BFM and MBFMs in remote areas.
 - On slopes steeper than 2.5H:1V, blanket installers may require ropes and harnesses for safety.
 - Installing BFM and MBFMs can save at least \$1,000 per acre compared to blankets.

Maintenance Standards

- Reseed any seeded areas that fail to establish at least 75% cover (100% cover for areas that receive sheet or concentrated flows) of all seeded areas after 3 months of active growth following germination during the growing season. If reseeding is ineffective, use an alternate method, such as sodding, mulching, or nets/blankets. If winter weather prevents

adequate grass growth, this time limit may be relaxed at the discretion of the local authority when sensitive areas would otherwise be protected.

- Reseed and protect by mulch any areas that experience erosion after achieving adequate cover. If the erosion problem is drainage related, the problem shall be fixed and the eroded area reseeded and protected by mulch.
- Supply seeded areas with adequate moisture, but do not water to the extent that it causes runoff.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

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BMP C121: Mulching

Purpose

Mulching soils provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There are a variety of mulches that can be used. This section discusses only the most common types of mulch.

Conditions of Use

As a temporary cover measure, mulch should be used:

- For less than 30 days on disturbed areas that require cover.
- At all times for seeded areas, especially during the wet season and during the hot summer months.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.

Mulch may be applied at any time of the year and must be refreshed periodically.

For seeded areas, mulch may be made up of 100 percent:

- Cottonseed meal;
- Fibers made of wood, recycled cellulose, hemp, or kenaf;

Any areas that experience erosion shall be remulched and/or protected with a net or blanket. If the erosion problem is drainage related, then the problem shall be fixed and the eroded area remulched.

BMP C122: Nets and Blankets

Purpose

Erosion control nets and blankets are intended to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. In addition, some nets and blankets can be used to permanently reinforce turf to protect drainage systems during high flows.

Nets (commonly called matting) are strands of material woven into an open, but high-tensile strength net (e.g. coconut fiber matting). Blankets are strands of material that are not tightly woven, but instead form a layer of interlocking fibers, typically held together by a biodegradable or photodegradable netting (for example, excelsior or straw blankets). They generally have lower tensile strength than nets, but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Conditions of Use

Erosion control netting and blankets shall be made of natural plant fibers unaltered by synthetic materials.

Erosion control nets and blankets should be used:

- To aid permanent vegetated stabilization of slopes 2H:1V or greater and with more than 10 feet of vertical relief.
- For drainage ditches and swales (highly recommended). The application of appropriate netting or blanket to drainage ditches and swales can protect bare soil from channelized runoff while vegetation is established. Nets and blankets also can capture a great deal of sediment due to their open, porous structure. Nets and blankets can be used to permanently stabilize channels and may provide a cost-effective, environmentally preferable alternative to riprap.

Disadvantages of nets and blankets include:

- Surface preparation is required.
- On slopes steeper than 2.5H:1V, net and blanket installers may need to be roped and harnessed for safety.
- They cost at least \$4,000 - \$6,000 per acre installed.

Advantages of nets and blankets include:

- Installation without mobilizing special equipment.
- Installation by anyone with minimal training

- Installation in stages or phases as the project progresses.
- Installers can hand place seed and fertilizer as they progress down the slope.
- Installation in any weather.
- There are numerous types of nets and blankets that can be designed with various parameters in mind. Those parameters include: fiber blend, mesh strength, longevity, biodegradability, cost, and availability.

An alternative to nets and blankets in some limited conditions is [BMP C202: Riprap Channel Lining](#). Ensure that [BMP C202: Riprap Channel Lining](#) is appropriate before using it as a substitute for nets and blankets.

Design and Installation Specifications

- See [Figure II-4.3: Channel Installation \(Clackamas County et al., 2008\)](#) and [Figure II-4.4: Slope Installation](#) for typical orientation and installation of nets and blankets used in channels and as slope protection. Note: these are typical only; all nets and blankets must be installed per manufacturer's installation instructions.
- Installation is critical to the effectiveness of these products. If good ground contact is not achieved, runoff can concentrate under the product, resulting in significant erosion.
- Install nets and blankets on slopes per the following steps:

1. Complete final grade and track walk up and down the slope. Soils should be raked and uniform prior to installing nets or blankets. To be effective, nets and blankets must have good adhesion to the soil.
2. Install hydromulch with seed and fertilizer.
3. Dig a small trench, approximately 12 inches wide by 6 inches deep along the top of the slope.
4. Install the leading edge of the net/blanket into the small trench and staple approximately every 18 inches.

NOTE: Staples are metal, "U"-shaped, and a minimum of 6 inches long. Longer staples are used in sandy soils. Biodegradable stakes are also available.

5. Roll the net/blanket slowly down the slope as the installer walks backward.

NOTE: The net/blanket rests against the installer's legs. Staples are installed as the net/blanket is unrolled. It is critical that the proper staple pattern is used for the net/blanket being installed. The net/blanket is not to be allowed to roll down the slope on its own as this stretches the net/blanket, making it impossible to maintain soil contact. In addition, no one is allowed to walk on the net/blanket after it is in place.

6. If the net/blanket is not long enough to cover the entire slope length, the trailing edge of the upper net/blanket should overlap the leading edge of the lower net/blanket and be stapled. On steeper slopes, this overlap should be installed in a small trench, stapled, and covered with soil.

- With the variety of products available, it is impossible to cover all the details of appropriate use and installation. Therefore, it is critical that the designer consult the manufacturer's information and that a site visit takes place in order to ensure that the product specified is appropriate. Information is also available in WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Division 8-01 and Division 9-14 ([WSDOT, 2016](#)).
- Use jute matting in conjunction with mulch ([BMP C121: Mulching](#)). Excelsior, woven straw blankets and coir (coconut fiber) blankets may be installed without mulch. There are many other types of erosion control nets and blankets on the market that may be appropriate in certain circumstances.
- In general, most nets (e.g., jute matting) require mulch in order to prevent erosion because they have a fairly open structure. Blankets typically do not require mulch because they usually provide complete protection of the surface.
- Extremely steep, unstable, wet, or rocky slopes are often appropriate candidates for use of synthetic blankets, as are riverbanks, beaches and other high-energy environments. If synthetic blankets are used, the soil should be hydromulched first.
- 100 percent biodegradable blankets are available for use in sensitive areas. These organic blankets are usually held together with a paper or fiber mesh and stitching which may last up to a year.
- Most netting used with blankets is photodegradable, meaning it breaks down under sunlight (not UV stabilized). However, this process can take months or years even under bright sun. Once vegetation is established, sunlight does not reach the mesh. It is not uncommon to find non-degraded netting still in place several years after installation. This can be a problem if maintenance requires the use of mowers or ditch cleaning equipment. In addition, birds and small animals can become trapped in the netting.

Maintenance Standards

- Maintain good contact with the ground. Erosion must not occur beneath the net or blanket.
- Repair and staple any areas of the net or blanket that are damaged or not in close contact with the ground.
- Fix and protect eroded areas if erosion occurs due to poorly controlled drainage.

Figure II-4.3: Channel Installation

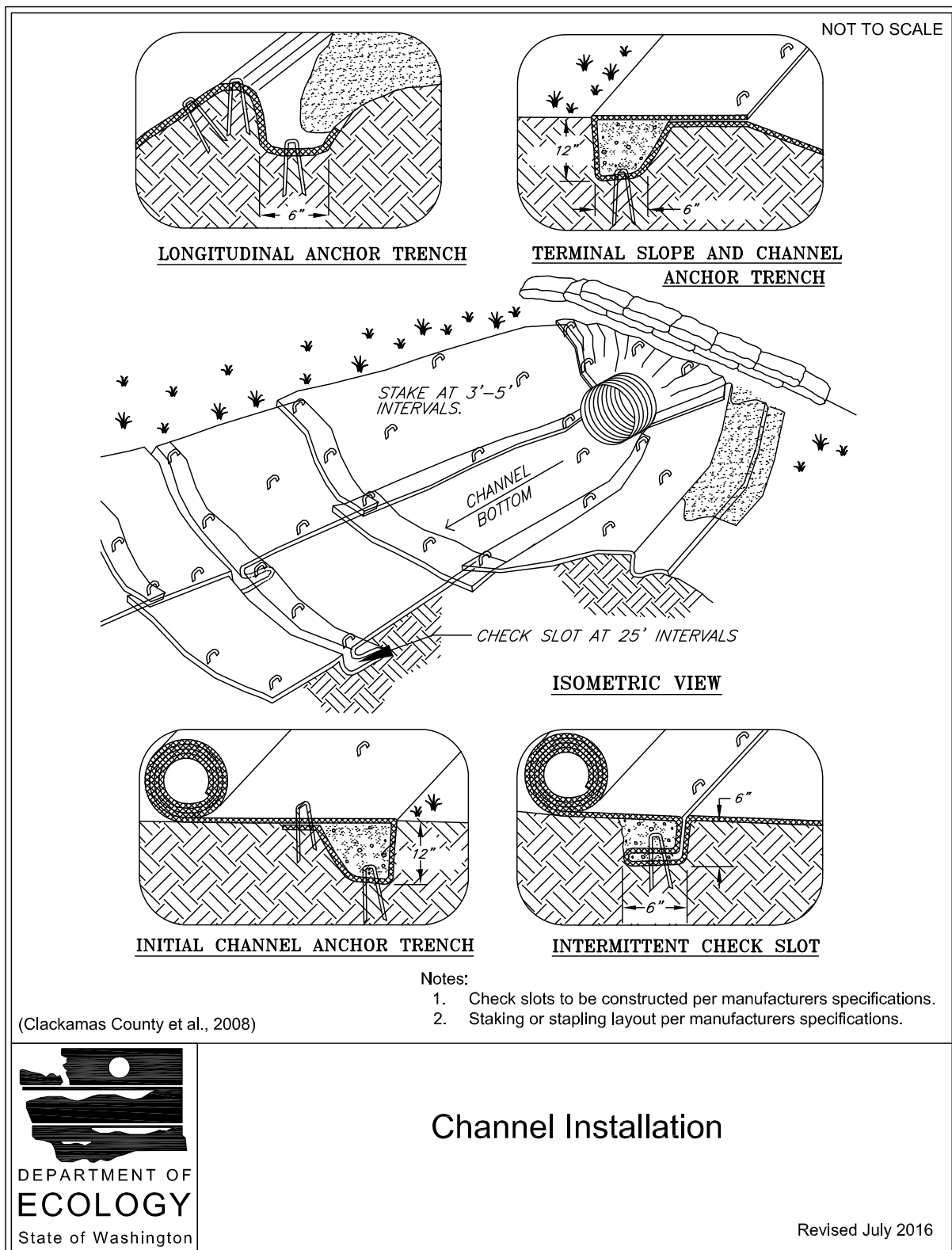
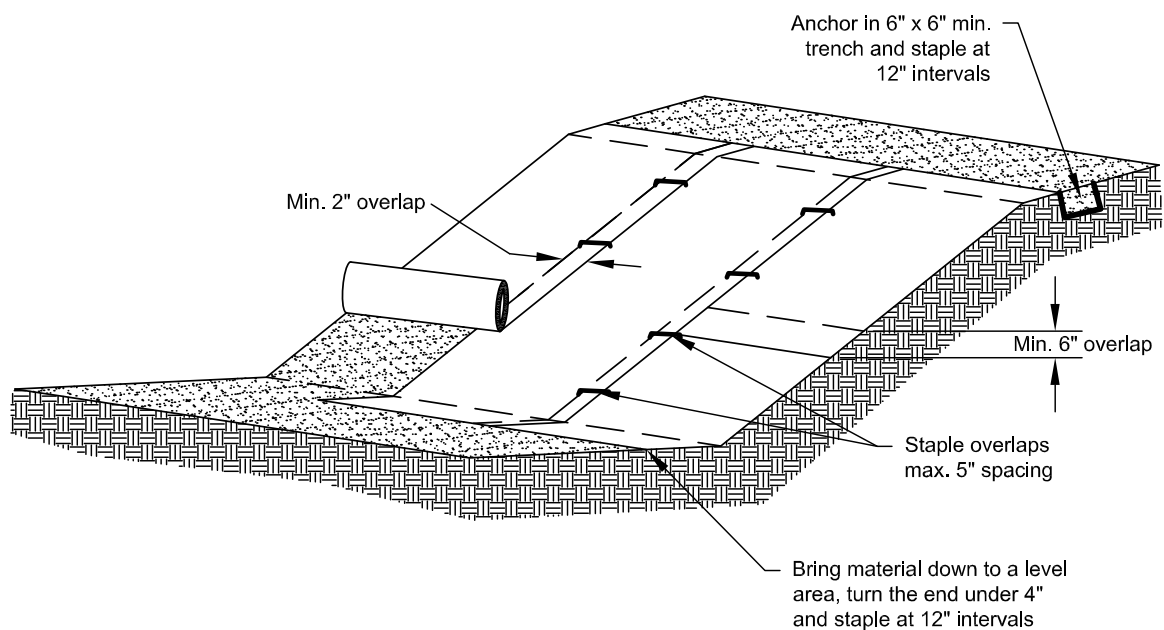


Figure II-4.4: Slope Installation



Notes:

1. Slope surface shall be smooth before placement for proper soil contact.
2. Stapling pattern as per manufacturer's recommendations.
3. Do not stretch blankets/matting tight - allow the rolls to mold to any irregularities.
4. For slopes less than 3H:1V, rolls may be placed in horizontal strips.
5. If there is a berm at the top of the slope, anchor upslope of the berm.
6. Lime, fertilize, and seed before installation. Planting of shrubs, trees, etc. should occur after installation.

NOT TO SCALE



Slope Installation

Revised June 2016

BMP C123: Plastic Covering

Purpose

Plastic covering provides immediate, short-term erosion protection to slopes and disturbed areas.

Conditions of Use

Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.

- Plastic is particularly useful for protecting cut and fill slopes and stockpiles. However, the relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for applications greater than six months.
- Due to rapid runoff caused by plastic covering, do not use this method upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Plastic sheeting may result in increased runoff volumes and velocities, requiring additional on-site measures to counteract the increases. Creating a trough with wattles or other material can convey clean water away from these areas.
- To prevent undercutting, trench and backfill rolled plastic covering products.
- Although the plastic material is inexpensive to purchase, the cost of installation, maintenance, removal, and disposal add to the total costs of this BMP.
- Whenever plastic is used to protect slopes, install water collection measures at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to convey clean rainwater away from bare soil and disturbed areas. Do not mix clean runoff from a plastic covered slope with dirty runoff from a project.
- Other uses for plastic include:
 - Temporary ditch liner.
 - Pond liner in temporary sediment pond.
 - Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored.
 - Emergency slope protection during heavy rains.
 - Temporary drainpipe ("elephant trunk") used to direct water.

Design and Installation Specifications

- Plastic slope cover must be installed as follows:
 1. Run plastic up and down the slope, not across the slope.
 2. Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet.
 3. Provide a minimum of 8-inch overlap at the seams.
 4. On long or wide slopes, or slopes subject to wind, tape all seams.
 5. Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath.
 6. Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and tie them together with twine to hold them in place.
 7. Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil, which causes extreme erosion.
 8. Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.
- Plastic sheeting shall have a minimum thickness of 6 mil.
- If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

- Torn sheets must be replaced and open seams repaired.
- Completely remove and replace the plastic if it begins to deteriorate due to ultraviolet radiation.
- Completely remove plastic when no longer needed.
- Dispose of old tires used to weight down plastic sheeting appropriately.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

<https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies>

steep slopes, silty and clayey soils (USDA Classification Type "C" and "D" soils), long grades, and high precipitation areas. When PAM is applied first to bare soil and then covered with straw, a reapplication may not be necessary for several months.

- PAM may affect the treatment efficiency of chitosan flocculent systems.

BMP C130: Surface Roughening

Purpose

Surface roughening aids in the establishment of vegetative cover, reduces runoff velocity, increases infiltration, and provides for sediment trapping through the provision of a rough soil surface. Horizontal depressions are created by operating a tiller or other suitable equipment on the contour or by leaving slopes in a roughened condition by not fine grading them.

Use this BMP in conjunction with other BMPs such as [BMP C120: Temporary and Permanent Seeding](#), [BMP C121: Mulching](#), or [BMP C124: Sodding](#).

Conditions for Use

- All slopes steeper than 3H:1V and greater than 5 vertical feet require surface roughening to a depth of 2 to 4 inches prior to seeding.
- Areas that will not be stabilized immediately may be roughened to reduce runoff velocity until seeding takes place.
- Slopes with a stable rock face do not require roughening.
- Slopes where mowing is planned should not be excessively roughened.

Design and Installation Specifications

There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends on the type of slope. Roughening methods include stair-step grading, grooving, contour furrows, and tracking. See [Figure II-4.5: Surface Roughening by Tracking and Contour Furrows](#). Factors to be considered in choosing a roughening method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.

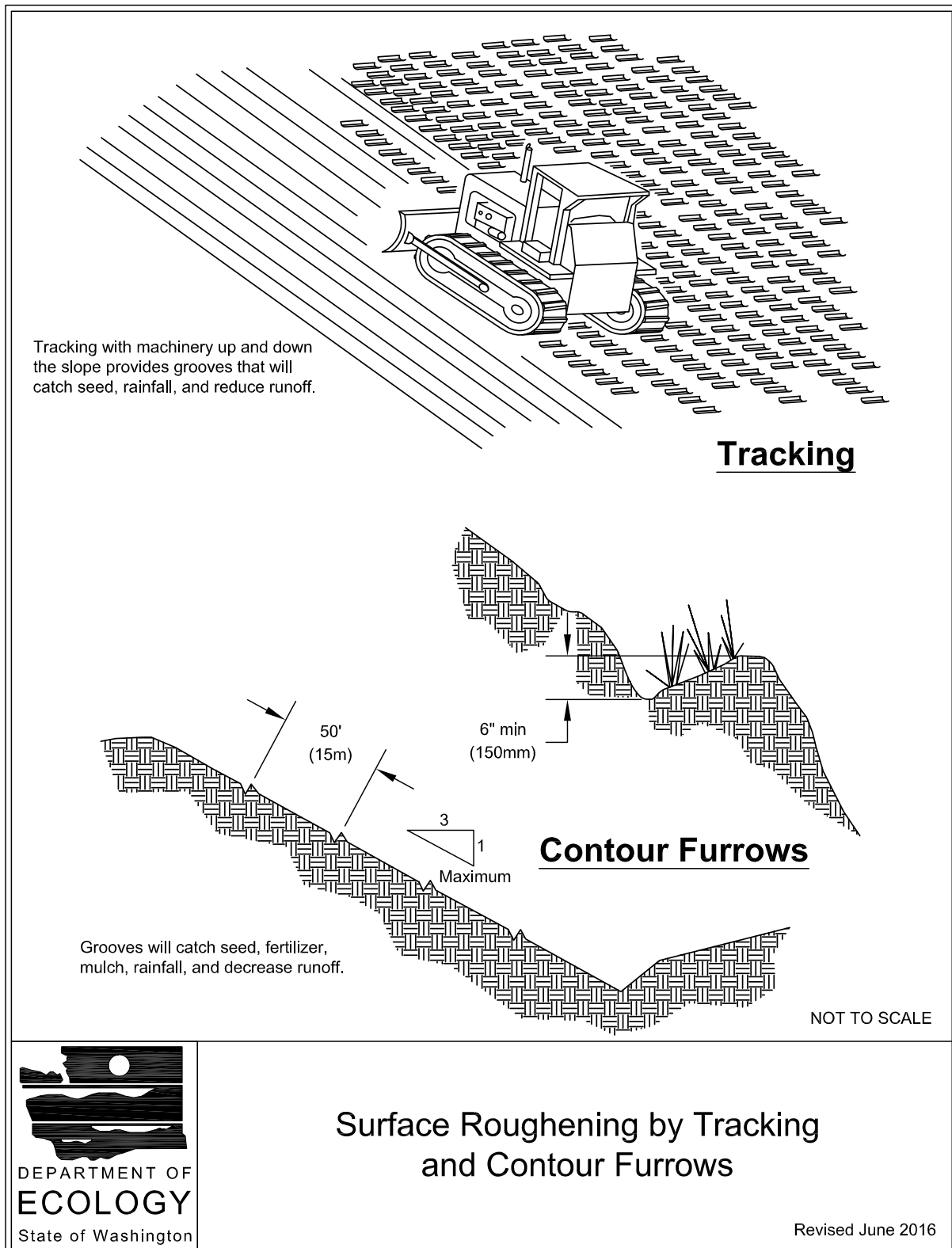
- Disturbed areas that will not require mowing may be stair-step graded, grooved, or left rough after filling.
- Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each "step" catches material that sloughs from above, and provides a level site where vegetation can become established. Stairs should be wide enough to work with standard earth moving equipment. Stair steps must be on contour or gullies will form on the slope.
- Areas that will be mowed (these areas should have slopes less steep than 3H:1V) may have small furrows left by disking, harrowing, raking, or seed-planting machinery operated on the contour.

- Graded areas with slopes steeper than 3H:1V but less than 2H:1V should be roughened before seeding. This can be accomplished in a variety of ways, including "track walking", or driving a crawler tractor up and down the slope, leaving a pattern of cleat imprints parallel to slope contours.
- Tracking is done by operating equipment up and down the slope to leave horizontal depressions in the soil.

Maintenance Standards

- Areas that are surface roughened should be seeded as quickly as possible.
- Regular inspections should be made of the area. If rills appear, they should be re-roughened and re-seeded immediately.

Figure II-4.5: Surface Roughening by Tracking and Contour Furrows



BMP C140: Dust Control

Purpose

Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, into drainage systems, and into surface waters.

Conditions of Use

Use dust control in areas (including roadways) subject to surface and air movement of dust where on-site or off-site impacts to roadways, drainage systems, or surface waters are likely.

Design and Installation Specifications

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition. Maintain the original ground cover as long as practical.
- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- Sprinkle the site with water until the surface is wet. Repeat as needed. To prevent carryout of mud onto the street, refer to [BMP C105: Stabilized Construction Access](#) and [BMP C106: Wheel Wash](#).
- Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.
- Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local jurisdictions may approve other dust palliatives such as calcium chloride or PAM.
- PAM ([BMP C126: Polyacrylamide \(PAM\) for Soil Erosion Protection](#)) added to water at a rate of 0.5 pounds per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to the increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may reduce the quantity of water needed for dust control.

Note that the application rate specified here applies to this BMP, and is not the same application rate that is specified in [BMP C126: Polyacrylamide \(PAM\) for Soil Erosion Protection](#), but the downstream protections still apply.

Refer to [BMP C126: Polyacrylamide \(PAM\) for Soil Erosion Protection](#) for conditions of use. PAM shall not be directly applied to water or allowed to enter a water body. PAM use shall

be reviewed and approved by the local permitting authority and discharge of PAM may be a basis for penalties per [RCW 90.48.080](#).

- Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes compliance with this BMP. See the following website for more information:

<https://ecology.wa.gov/About-us/Our-role-in-the-community/Partnerships-committees/Clean-air-agencies>

- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Techniques that can be used for unpaved roads and lots include:
 - Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.
 - Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
 - Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than .075 mm) to 10 to 20 percent.
 - Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
 - Encourage the use of alternate, paved routes, if available.
 - Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
 - Limit dust-generating work on windy days.
 - Pave unpaved permanent roads and other trafficked areas.

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

BMP C150: Materials on Hand

Purpose

Keep quantities of erosion prevention and sediment control materials on the project site at all times to be used for regular maintenance and emergency situations such as unexpected heavy rains. Having these materials on-site reduces the time needed to replace existing or implement new BMPs when inspections indicate that existing BMPs are not meeting the Construction SWPPP requirements. In addition, contractors can save money by buying some materials in bulk and storing them at their office or yard.

Conditions of Use

- Construction projects of any size or type can benefit from having materials on hand. A small commercial development project could have a roll of plastic and some gravel available for immediate protection of bare soil and temporary berm construction. A large earthwork project, such as highway construction, might have several tons of straw, several rolls of plastic, flexible pipe, sandbags, geotextile fabric and steel “T” posts.
- Materials should be stockpiled and readily available before any site clearing, grubbing, or earthwork begins. A large contractor or project proponent could keep a stockpile of materials that are available for use on several projects.
- If storage space at the project site is at a premium, the contractor could maintain the materials at their office or yard. The office or yard must be less than an hour from the project site.

Design and Installation Specifications

Depending on project type, size, complexity, and length, materials and quantities will vary. A good minimum list of items that will cover numerous situations includes:

- Clear plastic, 6 mil
- Drainpipe, 6 or 8 inch diameter
- Sandbags, filled
- Straw bales for mulching
- Quarry spalls
- Washed gravel
- Geotextile fabric
- Catch basin inserts
- Steel “T” posts
- Silt fence material
- Straw wattles

Maintenance Standards

- All materials with the exception of the quarry spalls, steel “T” posts, and gravel should be kept covered and out of both sun and rain.
- Re-stock materials as needed.

BMP C151: Concrete Handling

Purpose

Concrete work can generate process water and slurry that contain fine particles and high pH, both of which can violate water quality standards in the receiving water. Concrete spillage or concrete discharge to waters of the State is prohibited. Use this BMP to minimize and eliminate concrete, concrete process water, and concrete slurry from entering waters of the State.

Conditions of Use

Any time concrete is used, utilize these management practices. Concrete construction project components include, but are not limited to:

- Curbs
- Sidewalks
- Roads
- Bridges
- Foundations
- Floors
- Runways

Disposal options for concrete, in order of preference are:

1. Off-site disposal
2. Concrete wash-out areas (see [BMP C154: Concrete Washout Area](#))
3. De minimus washout to formed areas awaiting concrete

Design and Installation Specifications

- Wash concrete truck drums at an approved off-site location or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground (including formed areas awaiting concrete), or into storm drains, open ditches, streets, or streams. Refer to [BMP C154: Concrete Washout Area](#) for information on concrete washout areas.
 - Return unused concrete remaining in the truck and pump to the originating batch plant for recycling. Do not dump excess concrete on site, except in designated concrete washout areas as allowed in [BMP C154: Concrete Washout Area](#).
- Wash small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheelbarrows) into designated concrete washout areas or into formed areas awaiting concrete pour.

- At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly drain to natural or constructed stormwater conveyance or potential infiltration areas.
- Do not allow washwater from areas, such as concrete aggregate driveways, to drain directly (without detention or treatment) to natural or constructed stormwater conveyances.
- Contain washwater and leftover product in a lined container when no designated concrete washout areas (or formed areas, allowed as described above) are available. Dispose of contained concrete and concrete washwater (process water) properly.
- Always use forms or solid barriers for concrete pours, such as pilings, within 15-feet of surface waters.
- Refer to [BMP C252: Treating and Disposing of High pH Water](#) for pH adjustment requirements.
- Refer to the Construction Stormwater General Permit (CSWGP) for pH monitoring requirements if the project involves one of the following activities:
 - Significant concrete work (as defined in the CSWGP).
 - The use of soils amended with (but not limited to) Portland cement-treated base, cement kiln dust or fly ash.
 - Discharging stormwater to segments of water bodies on the 303(d) list (Category 5) for high pH.

Maintenance Standards

Check containers for holes in the liner daily during concrete pours and repair the same day.

BMP C152: Sawcutting and Surfacing Pollution Prevention

Purpose

Sawcutting and surfacing operations generate slurry and process water that contain fine particles and have a high pH (concrete cutting), both of which can violate the water quality standards in the receiving water. Concrete spillage or concrete discharge to waters of the State is prohibited. Use this BMP to minimize and eliminate process water and slurry created by sawcutting or surfacing from entering waters of the State.

Conditions of Use

Utilize these management practices anytime sawcutting or surfacing operations take place. Sawcutting and surfacing operations include, but are not limited to:

- Sawing
- Coring
- Grinding
- Roughening
- Hydro-demolition
- Bridge and road surfacing

Design and Installation Specifications

- Vacuum slurry and cuttings during cutting and surfacing operations.
- Slurry and cuttings shall not remain on permanent concrete or asphalt pavement overnight.
- Slurry and cuttings shall not drain to any natural or constructed drainage conveyance including stormwater systems. This may require temporarily blocking catch basins.
- Dispose of collected slurry and cuttings in a manner that does not violate groundwater or surface water quality standards.
- Do not allow process water generated during hydro-demolition, surface roughening, or similar operations to drain to any natural or constructed drainage conveyance including stormwater systems. Dispose of process water in a manner that does not violate groundwater or surface water quality standards.
- Handle and dispose of cleaning waste material and demolition debris in a manner that does not cause contamination of water. Dispose of sweeping material from a pick-up sweeper at an appropriate disposal site.

Maintenance Standards

Continually monitor operations to determine whether slurry, cuttings, or process water could enter waters of the state. If inspections show that a violation of water quality standards could occur, stop operations and immediately implement preventive measures such as berms, barriers, secondary containment, and/or vacuum trucks.

BMP C153: Material Delivery, Storage, and Containment

Purpose

Prevent, reduce, or eliminate the discharge of pollutants to the stormwater system or watercourses from material delivery and storage. Minimize the storage of hazardous materials on-site, store materials in a designated area, and install secondary containment.

Conditions of Use

Use at construction sites with delivery and storage of the following materials:

- Petroleum products such as fuel, oil and grease
- Soil stabilizers and binders (e.g., polyacrylamide)
- Fertilizers, pesticides, and herbicides
- Detergents
- Asphalt and concrete compounds
- Hazardous chemicals such as acids, lime, adhesives, paints, solvents, and curing compounds
- Any other material that may be detrimental if released to the environment

Design and Installation Specifications

- The temporary storage area should be located away from vehicular traffic, near the construction entrance(s), and away from waterways or storm drains.
- Safety Data Sheets (SDS) should be supplied for all materials stored. Chemicals should be kept in their original labeled containers.
- Hazardous material storage on-site should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- During the wet weather season (October 1 – April 30), consider storing materials in a covered area.
- Materials should be stored in secondary containments, such as an earthen dike, horse trough, or even a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, within secondary containment.
- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rain-water on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.
- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 shall be stored in approved containers and drums and shall not be overfilled. Containers and drums shall be stored in temporary secondary containment facilities.
- Temporary secondary containment facilities shall provide for a spill containment volume able to contain 10% of the total enclosed container volume of all containers, or 110% of the capacity of the largest container within its boundary, whichever is greater.

- Secondary containment facilities shall be impervious to the materials stored therein for a minimum contact time of 72 hours.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- During the wet weather season (Oct 1 – April 30), each secondary containment facility shall be covered during non-working days.
- Secondary containment facilities shall be covered at all times, except when in active use.
- Keep material storage areas clean, organized, and equipped with an ample supply of appropriate spill clean-up material (spill kit).
- The spill kit should include, at a minimum:
 - 1 - Water resistant nylon bag
 - 3 - Oil absorbent socks 3"x 4'
 - 2 - Oil absorbent socks 3"x 10'
 - 12 - Oil absorbent pads 17"x19"
 - 1 - Pair splash resistant goggles
 - 3 - Pairs nitrile gloves
 - 10 - Disposable bags with ties
 - Instructions

Maintenance Standards

- Secondary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills shall be collected and placed into drums. These liquids shall be handled as hazardous waste unless testing determines them to be non-hazardous.
- Re-stock spill kit materials as needed.

BMP C154: Concrete Washout Area

Purpose

Prevent or reduce the discharge of pollutants from concrete waste to stormwater by conducting washout off-site, or performing on-site washout in a designated area.

Conditions of Use

Concrete washout areas are implemented on construction projects where:

- Concrete is used as a construction material
- It is not possible to dispose of all concrete wastewater and washout off-site (ready mix plant, etc.).
- Concrete truck drums are washed on-site.

Note that auxiliary concrete truck components (e.g. chutes and hoses) and small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheelbarrows) may be washed into formed areas awaiting concrete pour.

At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.

Design and Installation Specifications

Implementation

- Perform washout of concrete truck drums at an approved off-site location or in designated concrete washout areas only.
- Do not wash out concrete onto non-formed areas, or into storm drains, open ditches, streets, or streams.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly drain to natural or constructed stormwater conveyance or potential infiltration areas.
- Do not allow excess concrete to be dumped on-site, except in designated concrete washout areas as allowed above.
- Concrete washout areas may be prefabricated concrete washout containers, or self-installed structures (above-grade or below-grade).
- Prefabricated containers are most resistant to damage and protect against spills and leaks. Companies may offer delivery service and provide regular maintenance and disposal of solid and liquid waste.
- If self-installed concrete washout areas are used, below-grade structures are preferred over above-grade structures because they are less prone to spills and leaks.
- Self-installed above-grade structures should only be used if excavation is not practical.
- Concrete washout areas shall be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

Education

- Discuss the concrete management techniques described in this BMP with the ready-mix concrete supplier before any deliveries are made.
- Educate employees and subcontractors on the concrete waste management techniques described in this BMP.

- Arrange for the contractor's superintendent or Certified Erosion and Sediment Control Lead (CESCL) to oversee and enforce concrete waste management procedures.
- A sign should be installed adjacent to each concrete washout area to inform concrete equipment operators to utilize the proper facilities.

Contracts

Incorporate requirements for concrete waste management into concrete supplier and sub-contractor agreements.

Location and Placement

- Locate concrete washout areas at least 50 feet from sensitive areas such as storm drains, open ditches, water bodies, or wetlands.
- Allow convenient access to the concrete washout area for concrete trucks, preferably near the area where the concrete is being poured.
- If trucks need to leave a paved area to access the concrete washout area, prevent track-out with a pad of rock or quarry spalls (see [BMP C105: Stabilized Construction Access](#)). These areas should be far enough away from other construction traffic to reduce the likelihood of accidental damage and spills.
- The number of concrete washout areas you install should depend on the expected demand for storage capacity.
- On large sites with extensive concrete work, concrete washout areas should be placed in multiple locations for ease of use by concrete truck drivers.

Concrete Truck Washout Procedures

- Washout of concrete truck drums shall be performed in designated concrete washout areas only.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated concrete washout areas or properly disposed of off-site.

Concrete Washout Area Installation

- Concrete washout areas should be constructed as shown in the figures below, with a recommended minimum length and minimum width of 10 ft, but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.
- Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.
- Lath and flagging should be commercial type.
- Liner seams shall be installed in accordance with manufacturers' recommendations.

- Soil base shall be prepared free of rocks or other debris that may cause tears or holes in the plastic lining material.

Maintenance Standards

Inspection and Maintenance

- Inspect and verify that concrete washout areas are in place prior to the commencement of concrete work.
- Once concrete wastes are washed into the designated washout area and allowed to harden, the concrete should be broken up, removed, and disposed of per applicable solid waste regulations. Dispose of hardened concrete on a regular basis.
- During periods of concrete work, inspect the concrete washout areas daily to verify continued performance.
 - Check overall condition and performance.
 - Check remaining capacity (% full).
 - If using self-installed concrete washout areas, verify plastic liners are intact and side-walls are not damaged.
 - If using prefabricated containers, check for leaks.
- Maintain the concrete washout areas to provide adequate holding capacity with a minimum freeboard of 12 inches.
- Concrete washout areas must be cleaned, or new concrete washout areas must be constructed and ready for use once the concrete washout area is 75% full.
- If the concrete washout area is nearing capacity, vacuum and dispose of the waste material in an approved manner.
 - Do not discharge liquid or slurry to waterways, storm drains or directly onto ground.
 - Do not discharge to the sanitary sewer without local approval.
 - Place a secure, non-collapsing, non-water collecting cover over the concrete washout area prior to predicted wet weather to prevent accumulation and overflow of precipitation.
 - Remove and dispose of hardened concrete and return the structure to a functional condition. Concrete may be reused on-site or hauled away for disposal or recycling.
- When you remove materials from a self-installed concrete washout area, build a new structure; or, if the previous structure is still intact, inspect for signs of weakening or damage, and make any necessary repairs. Re-line the structure with new plastic after each cleaning.

Removal of Concrete Washout Areas

- When concrete washout areas are no longer required for the work, the hardened concrete, slurries and liquids shall be removed and properly disposed of.
- Materials used to construct concrete washout areas shall be removed from the site of the work and disposed of or recycled.
- Holes, depressions or other ground disturbance caused by the removal of the concrete washout areas shall be backfilled, repaired, and stabilized to prevent erosion.

Figure II-4.7: Concrete Washout Area with Wood Planks

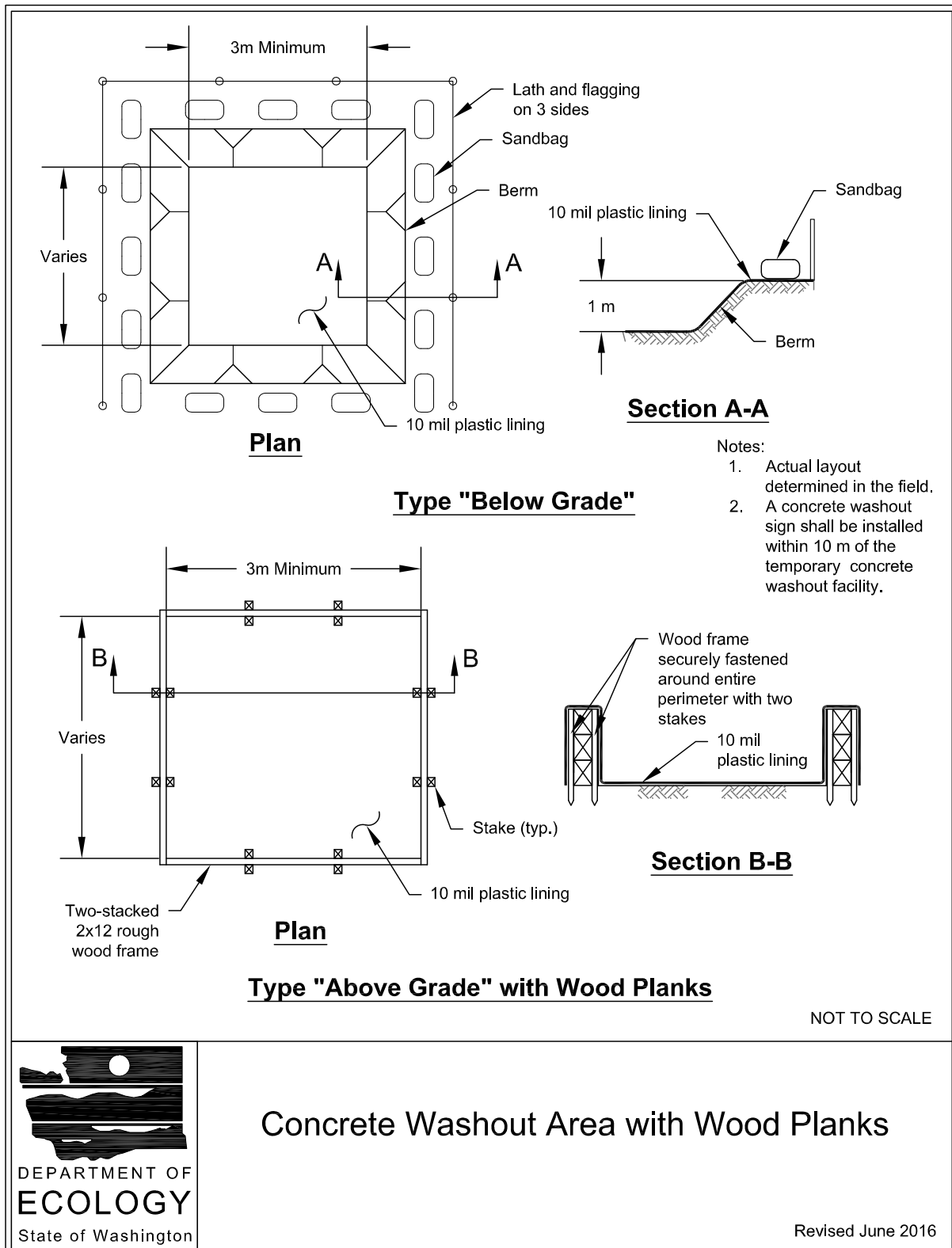


Figure II-4.8: Concrete Washout Area with Straw Bales

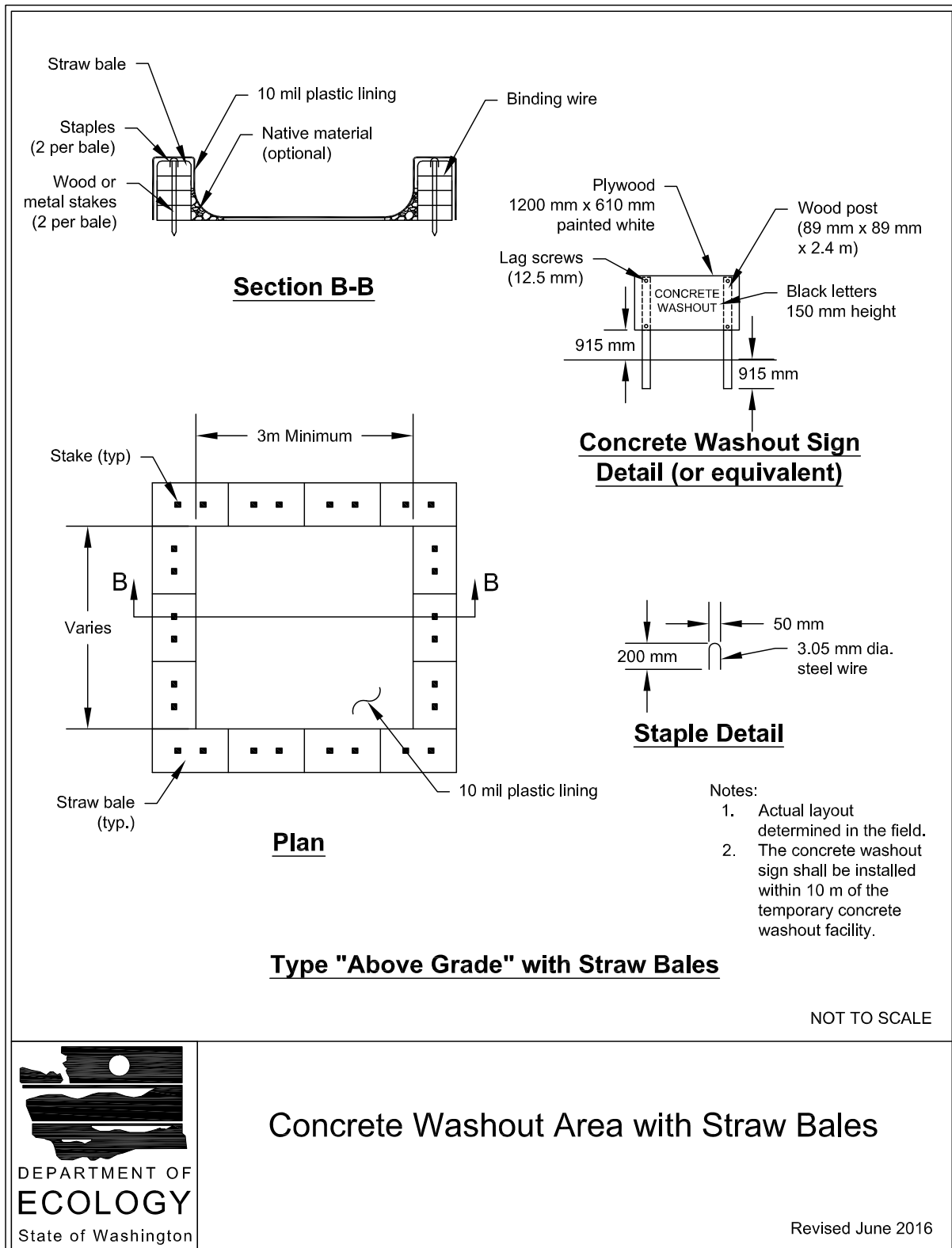
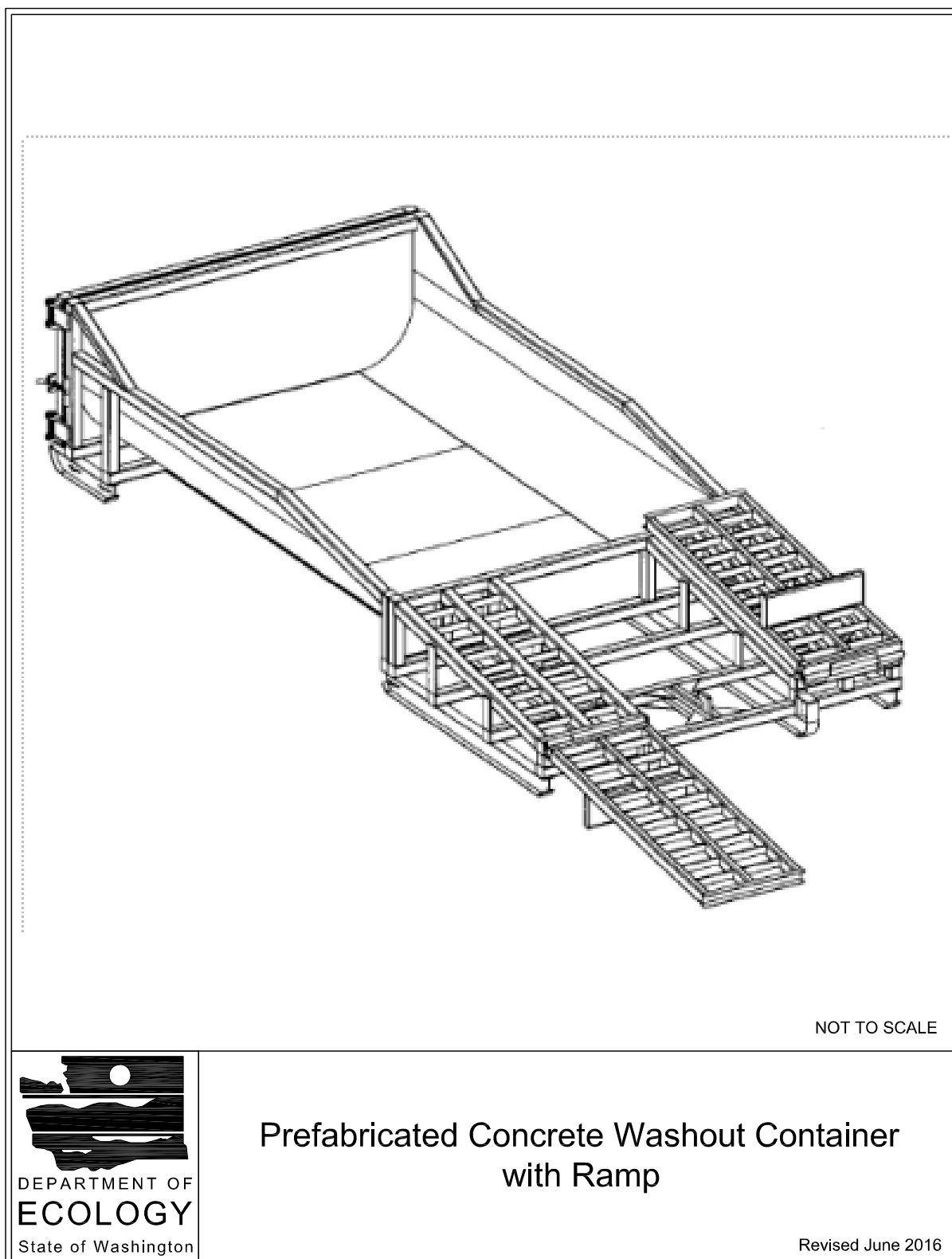


Figure II-4.9: Prefabricated Concrete Washout Container with Ramp



- See [Table II-4.9: Horizontal Spacing of Interceptor Dikes Along Ground Slope](#) for recommended horizontal spacing between dikes.

Table II-4.9: Horizontal Spacing of Interceptor Dikes Along Ground Slope

Average Slope	Slope Percent	Flowpath Length
20H:1V or less	3 - 5%	300 feet
(10 to 20)H:1V	5 - 10%	200 feet
(4 to 10)H:1V	10 - 25%	100 feet
(2 to 4)H:1V	25 - 50%	50 feet

Interceptor Swales

Interceptor swales shall meet the following criteria:

- Bottom Width: 2 feet minimum; the cross-section bottom shall be level.
- Depth: 1 foot minimum.
- Side Slope: 2H:1V or flatter.
- Grade: Maximum 5%, with positive drainage to a suitable outlet (such as [BMP C241: Sediment Pond \(Temporary\)](#)).
- Stabilization: Seed per [BMP C120: Temporary and Permanent Seeding](#), or [BMP C202: Riprap Channel Lining](#), 12 inches thick riprap pressed into the bank and extending at least 8 inches vertical from the bottom.

Maintenance Standards

- Inspect diversion dikes and interceptor swales once a week and after every rainfall. Immediately remove sediment from the flow area.
- Damage caused by construction traffic or other activity must be repaired before the end of each working day.
- Check outlets and make timely repairs as needed to avoid gully formation. When the area below the temporary diversion dike is permanently stabilized, remove the dike and fill and stabilize the channel to blend with the natural surface.

BMP C201: Grass-Lined Channels

Purpose

To provide a channel with a vegetative lining for conveyance of runoff. The purpose of the vegetative lining is to prevent transport of sediment and erosion.

Conditions of Use

This practice applies to construction sites where concentrated runoff needs to be directed to prevent erosion or flooding.

- Use this BMP when a vegetative lining can provide sufficient stability for the channel cross section and at lower velocities of water (normally dependent on grade). This means that the channel slopes are generally less than 5% and space is available for a relatively large cross section.
- Typical uses include roadside ditches, channels at property boundaries, outlets for diversions, and other channels and drainage ditches in low areas.
- Channels that will be vegetated should be installed before major earthwork and hydroseeded with a bonded fiber matrix (BFM). The vegetation should be well established (i.e. 75% cover) before water is allowed to flow in the ditch unless [BMP C122: Nets and Blankets](#) is used to protect the channel. With channels that will have high flows, erosion control blankets should be installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the bottom of the ditch in lieu of hydromulch and blankets.

Design and Installation Specifications

See [Figure II-4.10: Typical Grass-Lined Channels](#)

Locate channels where they can conform to the topography and other features such as roads. Use natural drainage systems to the greatest extent possible

- Avoid sharp changes in alignment or bends and changes in grade.
 - Do not reshape the landscape to fit the drainage channel.
 - The maximum design velocity shall be based on soil conditions, type of vegetation, and method of revegetation, but at no time shall velocity exceed 5 feet/second. The channel shall not be overtopped by the peak volumetric flow rate calculated by one of the following methods:
 - Single Event Hydrograph Method: The peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the worst-case land cover condition.
- OR
- Continuous Simulation Method: The 10-year peak flow rate, as determined by an approved continuous runoff model with a 15-minute time step for the worst-case land cover condition.

Worst-case land cover conditions (i.e. producing the most runoff) should be used for analysis (in most cases, this would be the land cover conditions just prior to final landscaping).

- Where the grass-lined channel will also function as a permanent stormwater conveyance facility, consult the drainage conveyance requirements of the local jurisdiction.

- An established grass or vegetated lining is required before the channel can be used to convey stormwater, unless stabilized with nets or blankets (see [BMP C122: Nets and Blankets](#)).
- If design velocity of a channel to be vegetated by seeding exceeds 2 ft/sec, a temporary channel liner is required. Geotextile or special mulch protection such as fiberglass roving or straw and netting provides stability until the vegetation is fully established. See [Figure II-4.11: Temporary Channel Liners](#).
- Check dams shall be removed when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4%. The area beneath the check dams shall be seeded and mulched immediately after dam removal.
- If vegetation is established by sodding, the permissible velocity for established vegetation may be used and no temporary liner is needed.
- Do not subject the grass-lined channel to sedimentation from disturbed areas. Use sediment-trapping BMPs upstream of the channel.
- V-shaped grass channels generally apply where the quantity of water is small, such as in short reaches along roadsides. The V-shaped cross section is least desirable because it is difficult to stabilize the bottom where velocities may be high.
- Trapezoidal grass channels are used where runoff volumes are large and slope is low so that velocities are nonerosive to vegetated linings.

Note: it is difficult to construct small parabolic shaped channels.

- Subsurface drainage or riprap channel bottoms may be necessary on sites that are subject to prolonged wet conditions due to long duration flows or a high water table.
- Provide outlet protection at culvert ends and at channel intersections.
- Grass channels, at a minimum, should carry peak runoff for temporary construction drainage facilities from the 10-year, 24-hour storm for the worst case land cover condition without eroding. Where flood hazard exists, increase the capacity according to the potential damage.
- Grassed channel side slopes generally are constructed 3H:1V or flatter to aid in the establishment of vegetation and for maintenance.
- Construct channels a minimum of 0.2 foot larger around the periphery to allow for soil bulking during seedbed preparations and sod buildup.

Maintenance Standards

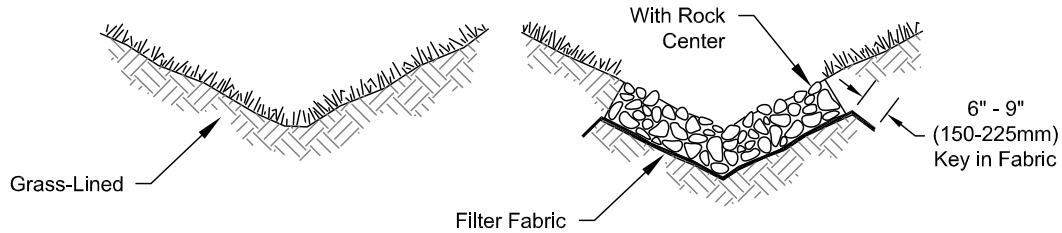
During the establishment period, check grass-lined channels after every rainfall.

- After grass is established, periodically check the channel; check it after every heavy rainfall event. Immediately make repairs.
- Check the channel outlet and all road crossings for bank stability and evidence of piping or scour holes.

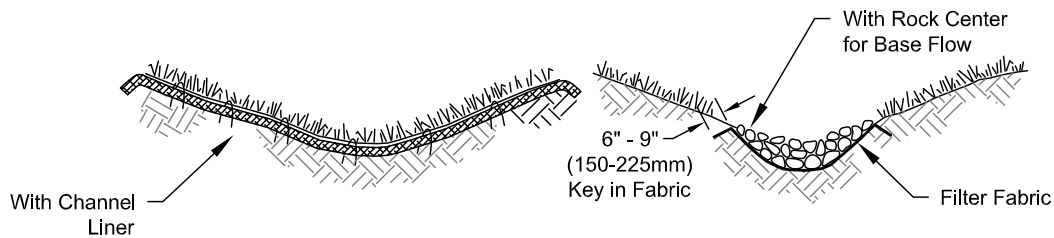
- Remove all significant sediment accumulations to maintain the designed carrying capacity. Keep the grass in a healthy, vigorous condition at all times, since it is the primary erosion protection for the channel.

Figure II-4.10: Typical Grass-Lined Channels

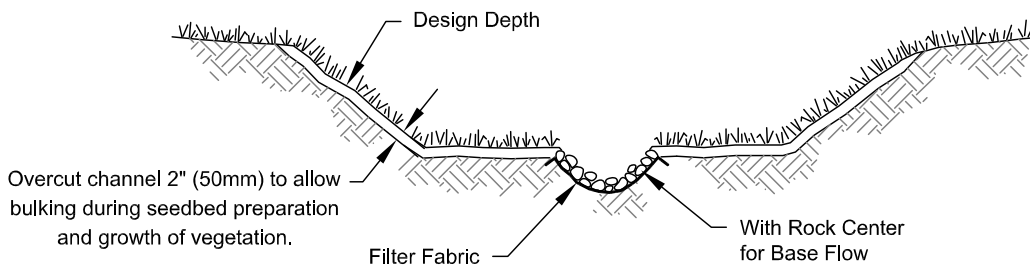
Typical V-Shaped Channel Cross-Section



Typical Parabolic Channel Cross-Section



Typical Trapezoidal Channel Cross-Section



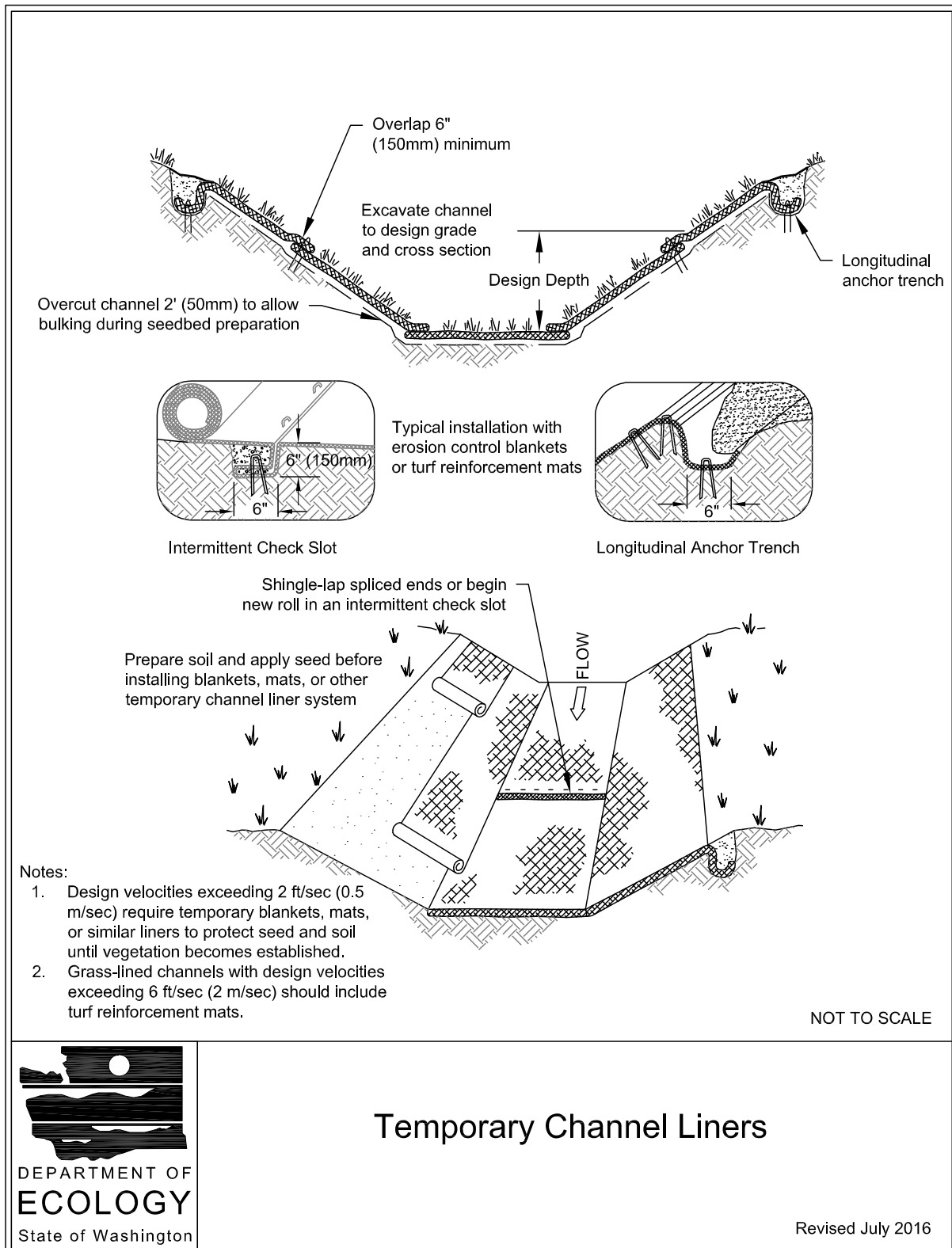
NOT TO SCALE



Typical Grass-Lined Channels

Revised June 2016

Figure II-4.11: Temporary Channel Liners



Maintenance Standards

- Monitor the spray field on a daily basis to ensure that over saturation of any portion of the field does not occur at any time. The presence of standing puddles of water or creation of concentrated flows visually signify that over saturation of the field has occurred.
- Monitor the vegetated spray field all the way down to the nearest surface water, or farthest spray area, to ensure that the water has not caused overland or concentrated flows, and has not created erosion around the spray nozzle(s).
- Do not exceed water quality standards for turbidity.
- Ecology recommends that a separate inspection log be developed, maintained, and kept with the existing site logbook to aid the operator conducting inspections. This separate “Field Filtration Logbook” can also aid in demonstrating compliance with permit conditions.
- Inspect the spray nozzles daily, at a minimum, for leaks and plugging from sediment particles.
- If erosion, concentrated flows, or over saturation of the field occurs, rotate the use of branches or spray heads or move the branches to a new field location.
- Check all branches and the manifold for unintended leaks.

BMP C240: Sediment Trap

Purpose

A sediment trap is a small temporary ponding area with a gravel outlet used to collect and store sediment from sites during construction. Sediment traps, along with other perimeter controls, shall be installed before any land disturbance takes place in the contributing drainage area.

Conditions of Use

- Sediment traps are intended for use on sites where the contributing drainage area is less than 3 acres, with no unusual drainage features, and a projected build-out time of 6 months or less. The sediment trap is a temporary measure (with a design life of approximately 6 months) and shall be maintained until the contributing drainage area is permanently protected against erosion by vegetation and/or structures.
- Sediment traps are only effective in removing sediment down to about the medium silt size fraction. Runoff with sediment of finer grades (fine silt and clay) will pass through untreated, emphasizing the need to control erosion to the maximum extent first.
- Projects that are constructing permanent Flow Control BMPs, or permanent Runoff Treatment BMPs that use ponding for treatment, may use the rough-graded or final-graded permanent BMP footprint for the temporary sediment trap. When permanent BMP footprints are used as temporary sediment traps, the surface area requirement of the sediment trap must be met. If the surface area requirement of the sediment trap is larger than the surface area of the permanent BMP, then the sediment trap shall be enlarged beyond the

permanent BMP footprint to comply with the surface area requirement.

- A floating pond skimmer may be used for the sediment trap outlet if approved by the Local Permitting Authority.
- Sediment traps may not be feasible on utility projects due to the limited work space or the short-term nature of the work. Portable tanks may be used in place of sediment traps for utility projects.

Design and Installation Specifications

- See [Figure II-4.26: Cross Section of Sediment Trap](#) and [Figure II-4.27: Sediment Trap Outlet](#) for details.
- To determine the sediment trap geometry, first calculate the design surface area (SA) of the trap, measured at the invert of the weir. Use the following equation:

$$SA = FS * (Q_2/V_s)$$

where:

SA = Design surface area of the trap (square feet)

FS = A safety factor of 2 to account for non-ideal settling.

Q_2 = The peak volumetric flow rate (cubic feet per second), calculated using one of the following options:

- Option 1 - Single Event Hydrograph Method

The peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 2-year, 24-hour frequency storm for the developed condition. The 10-year peak volumetric flow rate shall be used if the project size, expected timing and duration of construction, or downstream conditions warrant a higher level of protection.

- Option 2 - The Rational Method

For construction sites that are less than 1 acre, the peak volumetric flow rate calculated using the Rational Method.

V_s = The settling velocity of the soil particle of interest. The 0.02 mm (medium silt) particle with an assumed density of 2.65 g/cm³ has been selected as the particle of interest and has a settling velocity (V_s) of 0.00096 ft/sec.

Therefore, the equation for computing sediment trap surface area becomes:

$$SA = 2 \times Q_2 / 0.00096$$

or

2080 square feet per cfs of inflow

- Sediment trap depth shall be 3.5 feet minimum from the bottom of the trap to the top of the overflow weir.
- To aid in determining sediment depth, all sediment traps shall have a staff gauge with a prominent mark 1 foot above the bottom of the trap.
- Design the discharge from the sediment trap by using the guidance for discharge from temporary sediment ponds in [BMP C241: Sediment Pond \(Temporary\)](#).

Maintenance Standards

- Sediment shall be removed from the trap when it reaches 1 foot in depth.
- Any damage to the trap embankments or slopes shall be repaired.

Figure II-4.26: Cross Section of Sediment Trap

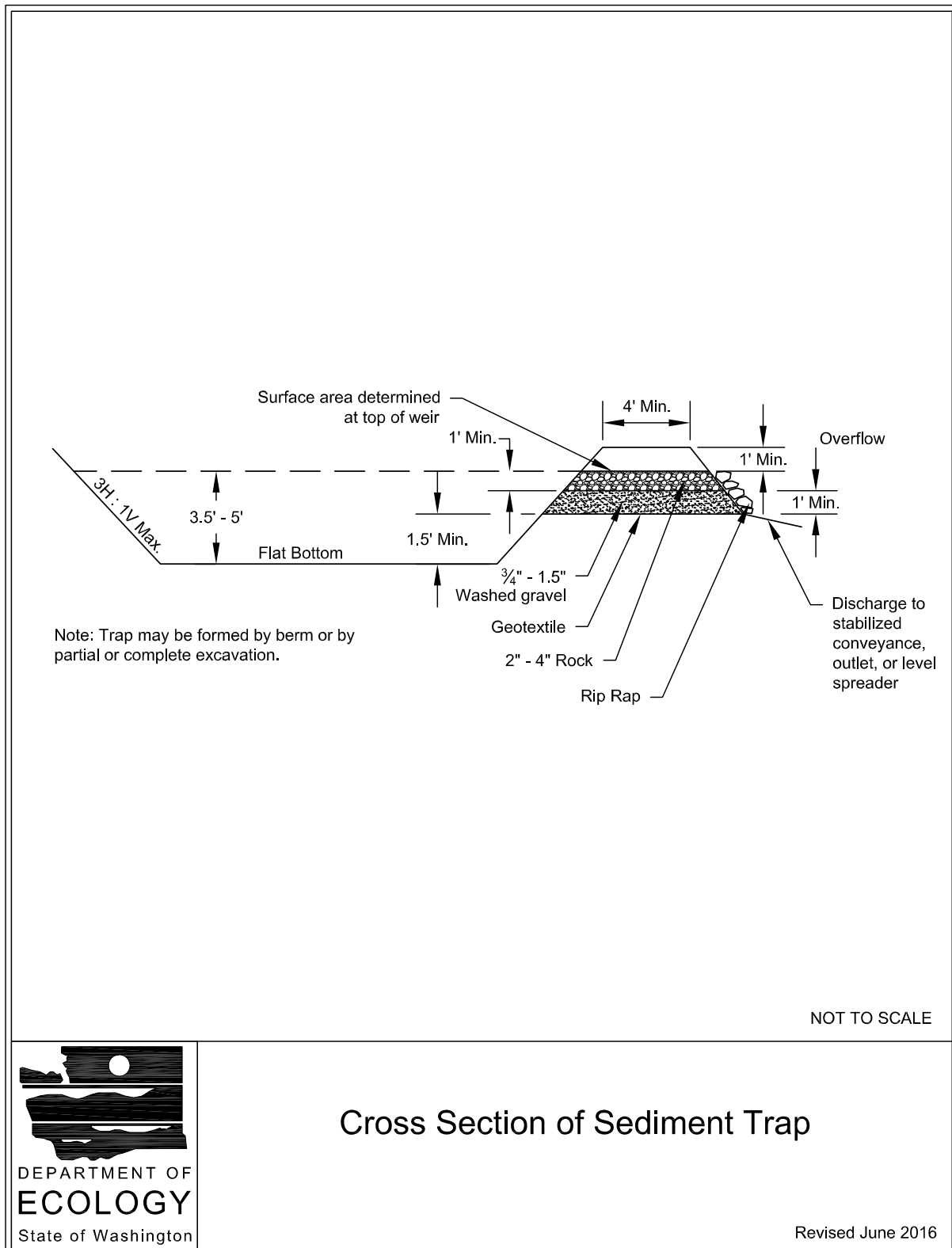
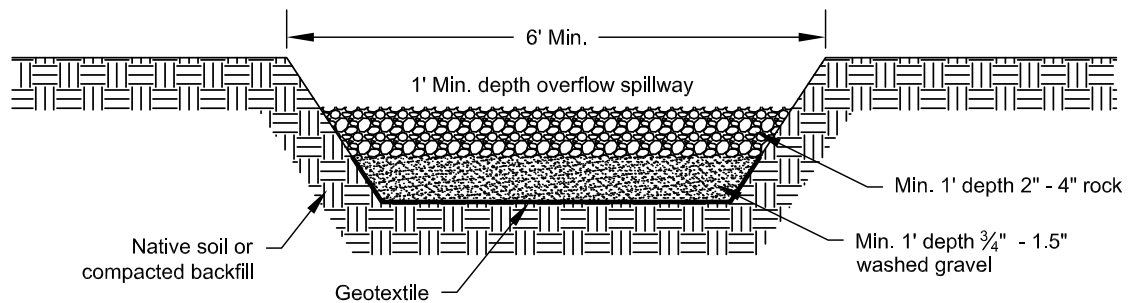


Figure II-4.27: Sediment Trap Outlet



NOT TO SCALE



Sediment Trap Outlet

Revised June 2016

BMP C241: Sediment Pond (Temporary)

Purpose

Sediment ponds are temporary ponds used during construction to remove sediment from runoff originating from disturbed areas of the project site. Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). Consequently, they usually reduce turbidity only slightly.

Conditions of Use

- Use a sediment pond where the contributing drainage area to the pond is 3 acres or more. Ponds must be used in conjunction with other Construction Stormwater BMPs to reduce the amount of sediment flowing into the pond. For drainage areas smaller than 3 acres, use the guidance in [BMP C240: Sediment Trap](#).
- Do not install sediment ponds on sites where failure of the BMP would result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities. Also, sediment ponds are attractive to children and can be dangerous. Compliance with local ordinances regarding health and safety must be addressed. If fencing of the pond is required, show the type of fence and its location on the drawings in the Construction SWPPP.
- Sediment ponds that can impound 10 acre-ft (435,600 cu-ft, or 3.26 million gallons) or more are subject to the Washington Dam Safety Regulations ([Chapter 173-175 WAC](#)). See [BMP D.1: Detention Ponds](#) for more information regarding dam safety considerations for detention ponds.
- Projects that are constructing permanent Flow Control BMPs or Runoff Treatment BMPs that use ponding for treatment may use the rough-graded or final-graded permanent BMP footprint for the temporary sediment pond. When permanent BMP footprints are used as temporary sediment ponds, the surface area requirement of the temporary sediment pond must be met. If the surface area requirement of the sediment pond is larger than the surface area of the permanent BMP, then the sediment pond shall be enlarged beyond the permanent BMP footprint to comply with the surface area requirement.

The permanent control structure must be temporarily replaced with a control structure that only allows water to leave the temporary sediment pond from the surface or by pumping. Alternatively, the permanent control structure may be used if it is temporarily modified by plugging any outlet holes below the riser. The permanent control structure must be installed as part of the permanent BMP after the site is fully stabilized.

Design and Installation Specifications

General

- See [Figure II-4.28: Sediment Pond Plan View](#), [Figure II-4.29: Sediment Pond Cross Section](#), and [Figure II-4.30: Sediment Pond Riser Detail](#) for details.

- Use of permanent infiltration BMP footprints for temporary sediment ponds during construction tends to clog the soils and reduce their capacity to infiltrate. If permanent infiltration BMP footprints are used, the sides and bottom of the temporary sediment pond must only be rough excavated to a minimum of 2 feet above final grade of the permanent infiltration BMP. Final grading of the permanent infiltration BMP shall occur only when all contributing drainage areas are fully stabilized. Any proposed permanent pretreatment BMP prior to the infiltration BMP should be fully constructed and used with the temporary sediment pond to help prevent clogging of the soils.

See [II-2.13 Element 13: Protect Infiltration BMPs](#) for more information about protecting permanent infiltration BMPs.

- The pond shall be divided into two roughly equal volume cells by a permeable divider that will reduce turbulence while allowing movement of water between the cells. The divider shall be at least one-half the height of the riser, and at least one foot below the top of the riser. Wire-backed, 2 to 3 foot high, high strength geotextile fabric supported by treated 4x4s can be used as a divider. Alternatively, staked straw bales wrapped with geotextile fabric may be used. If the pond is more than 6 feet deep, a different divider design must be proposed. A riprap embankment is one acceptable method of separation for deeper ponds. Other designs that satisfy the intent of this provision are allowed as long as the divider is permeable, structurally sound, and designed to prevent erosion under and around the divider.
- The most common structural failure of sediment ponds is caused by piping. Piping refers to two phenomena:
 1. Water seeping through fine-grained soil, eroding the soil grain by grain and forming pipes or tunnels; and,
 2. Water under pressure flowing upward through a granular soil with a head of sufficient magnitude to cause soil grains to lose contact and capability for support.

The most critical construction practices to prevent piping are:

- Tight connections between the riser and outlet pipe, and other pipe connections.
- Adequate anchoring of the riser.
- Proper soil compaction of the embankment and riser footing.
- Proper construction of anti-seep devices.

Sediment Pond Geometry

To determine the sediment pond geometry, first calculate the design surface area (SA) of the pond, measured at the top of the riser pipe. Use the following equation:

$$SA = 2 \times Q_2 / 0.00096$$

or

$$2,080 \text{ square feet per cfs of inflow}$$

where:

SA = design surface area of the pond (sf)

Q_2 = Peak volumetric flow rate (cfs)

See [BMP C240: Sediment Trap](#) for more information on the above equation.

The basic geometry of the pond can now be determined using the following design criteria:

- Required surface area SA (from the equation above) at the top of the riser.
- Minimum 3.5 foot depth from the top of the riser to the bottom of the pond.
- Maximum 3H:1V interior side slopes and maximum 2H:1V exterior slopes. The interior slopes can be increased to a maximum of 2H:1V if fencing is provided at or above the maximum water surface.
- One foot of freeboard between the top of the riser and the crest of the emergency spillway.
- Flat bottom.
- Minimum 1 foot deep spillway.
- Length-to-width ratio between 3:1 and 6:1.

Sediment Pond Discharge

The outlet for the pond consists of a combination of principal and emergency spillways. These outlets must pass the peak runoff expected from the contributing drainage area for a 100-year storm. If, due to site conditions and basin geometry, a separate emergency spillway is not feasible, the principal spillway must pass the entire peak runoff expected from the 100-year storm. However, an attempt to provide a separate emergency spillway should always be made. Base the runoff calculations on the site conditions during construction. The flow through the dewatering orifice cannot be utilized when calculating the 100-year storm elevation because of its potential to become clogged; therefore, available spillway storage must begin at the principal spillway riser crest.

The principal spillway designed by the procedures described below will result in some reduction in the peak rate of runoff. However, the design will not control the discharge flow rates to the extent required to comply with [I-3.4.7 MR7: Flow Control](#). The size of the contributing basin, the expected life of the construction project, the anticipated downstream effects, and the anticipated weather conditions during construction should be considered to determine the need for additional discharge control.

Principal Spillway: Determine the required diameter for the principal spillway (riser pipe). The diameter shall be the minimum necessary to pass the peak volumetric flow rate using a 15-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Use [Figure II-4.31: Riser Inflow Curves](#) to determine the riser diameter.

To aid in determining sediment depth, 1 foot intervals shall be prominently marked on the riser.

Emergency Overflow Spillway: Size the emergency overflow spillway for the peak volumetric flow rate using a 10-minute time step from a Type 1A, 100-year, 24-hour frequency storm for the

developed condition. See [BMP D.1: Detention Ponds](#) for additional guidance for Emergency Overflow Spillway design

Dewatering Orifice: Size the dewatering orifice(s) (minimum 1-inch diameter) using a modified version of the discharge equation for a vertical orifice and a basic equation for the area of a circular orifice. Determine the required area of the orifice with the following equation:

$$A_o = \frac{A_s * (2h)^{0.5}}{0.6 * 3600 * T * g^{0.5}}$$

where:

A_o = orifice area (square feet)

A_s = pond surface area (square feet)

h = head of water above orifice (height of riser in feet)

T = dewatering time (24 hours)

g = acceleration of gravity (32.2 feet/second²)

Convert the orifice area (in square feet) to the orifice diameter D (in inches):

$$D = 24 \times \sqrt{\frac{A_o}{\pi}} = 13.54 \times \sqrt{A_o}$$

where:

D = orifice diameter (inches)

A_o = orifice area (sf)

The vertical, perforated tubing connected to the dewatering orifice must be at least 2 inches larger in diameter than the orifice to improve flow characteristics. The size and number of perforations in the tubing should be large enough so that the tubing does not restrict flow. The orifice should control the flow rate.

Figure II-4.28: Sediment Pond Plan View

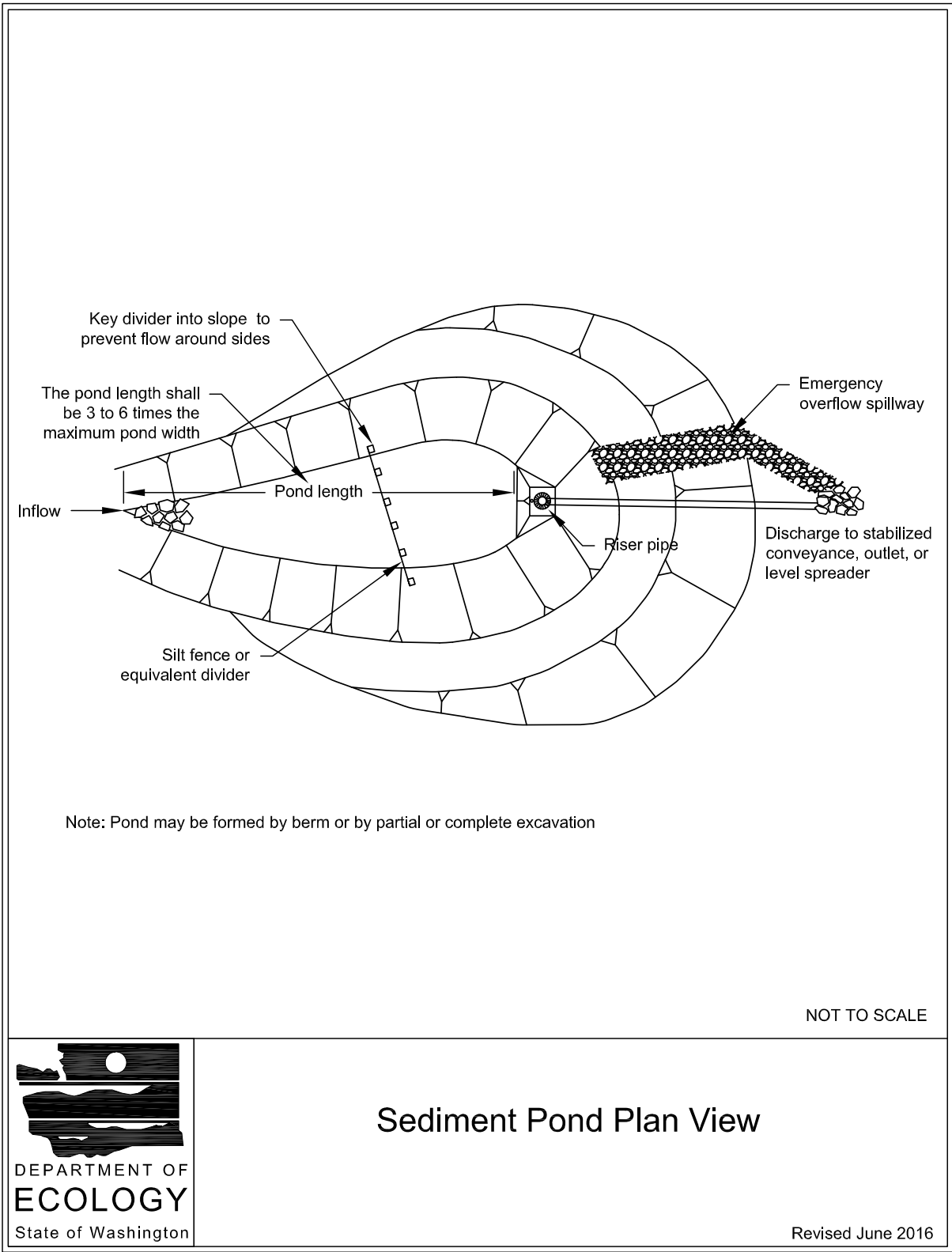


Figure II-4.29: Sediment Pond Cross Section

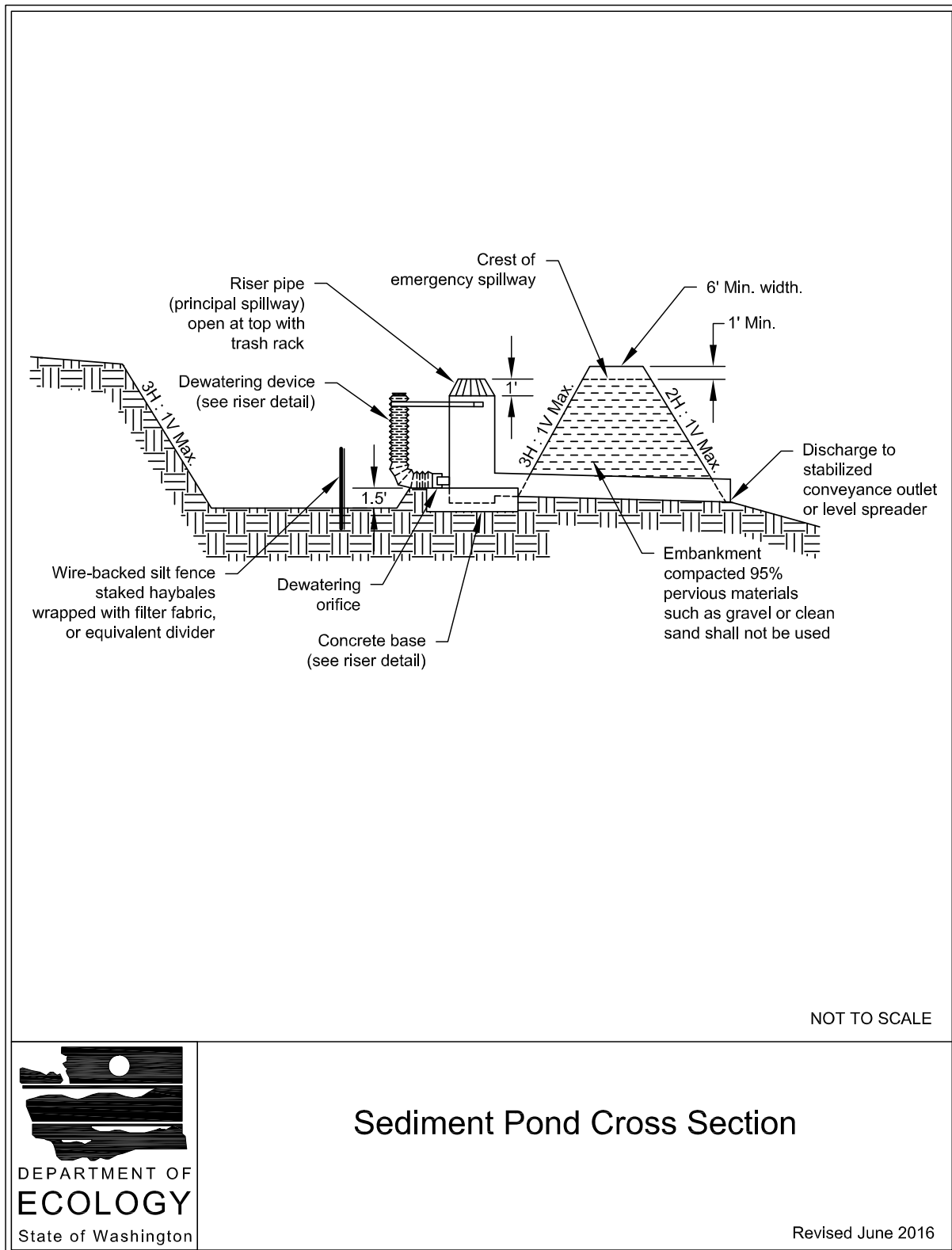


Figure II-4.30: Sediment Pond Riser Detail

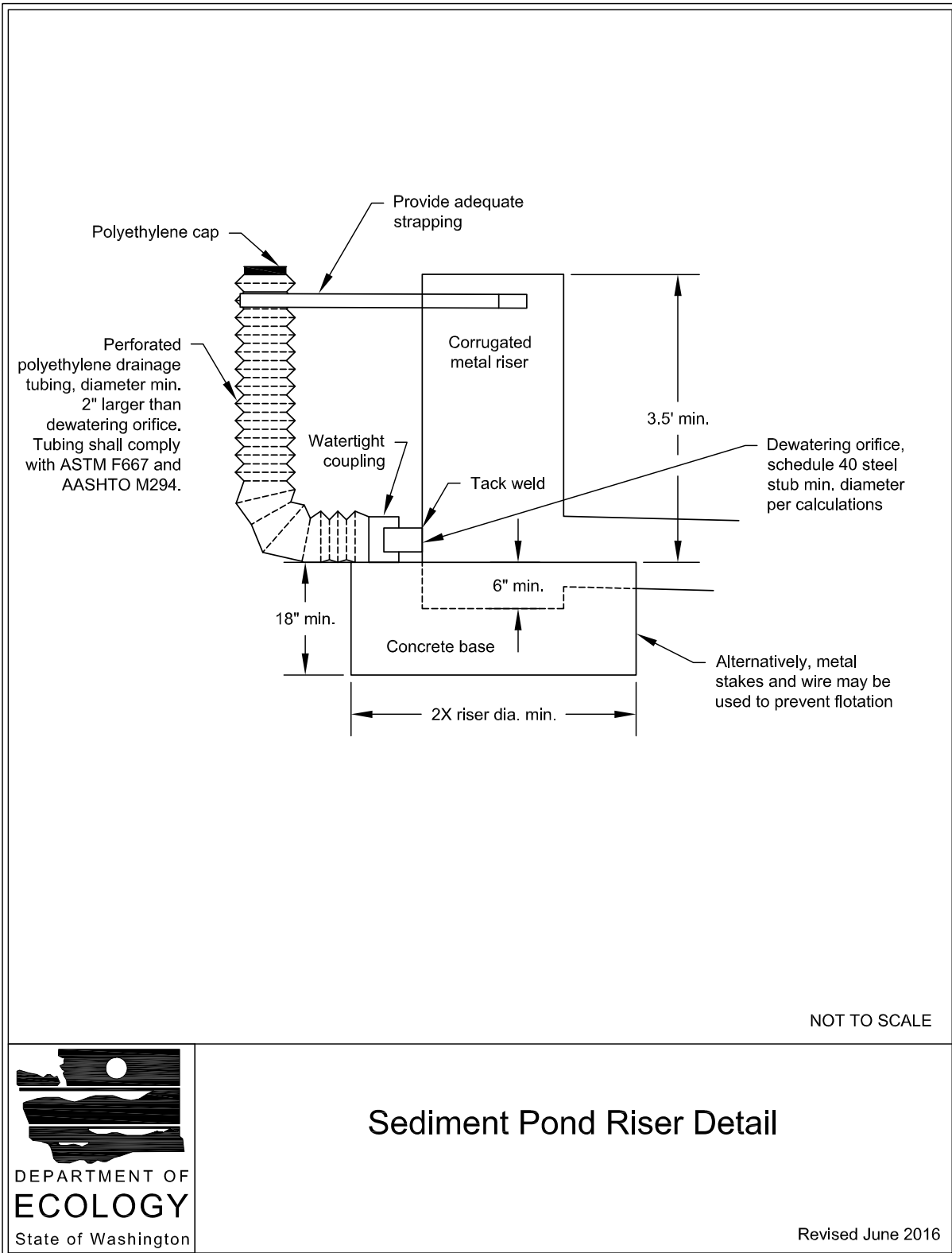
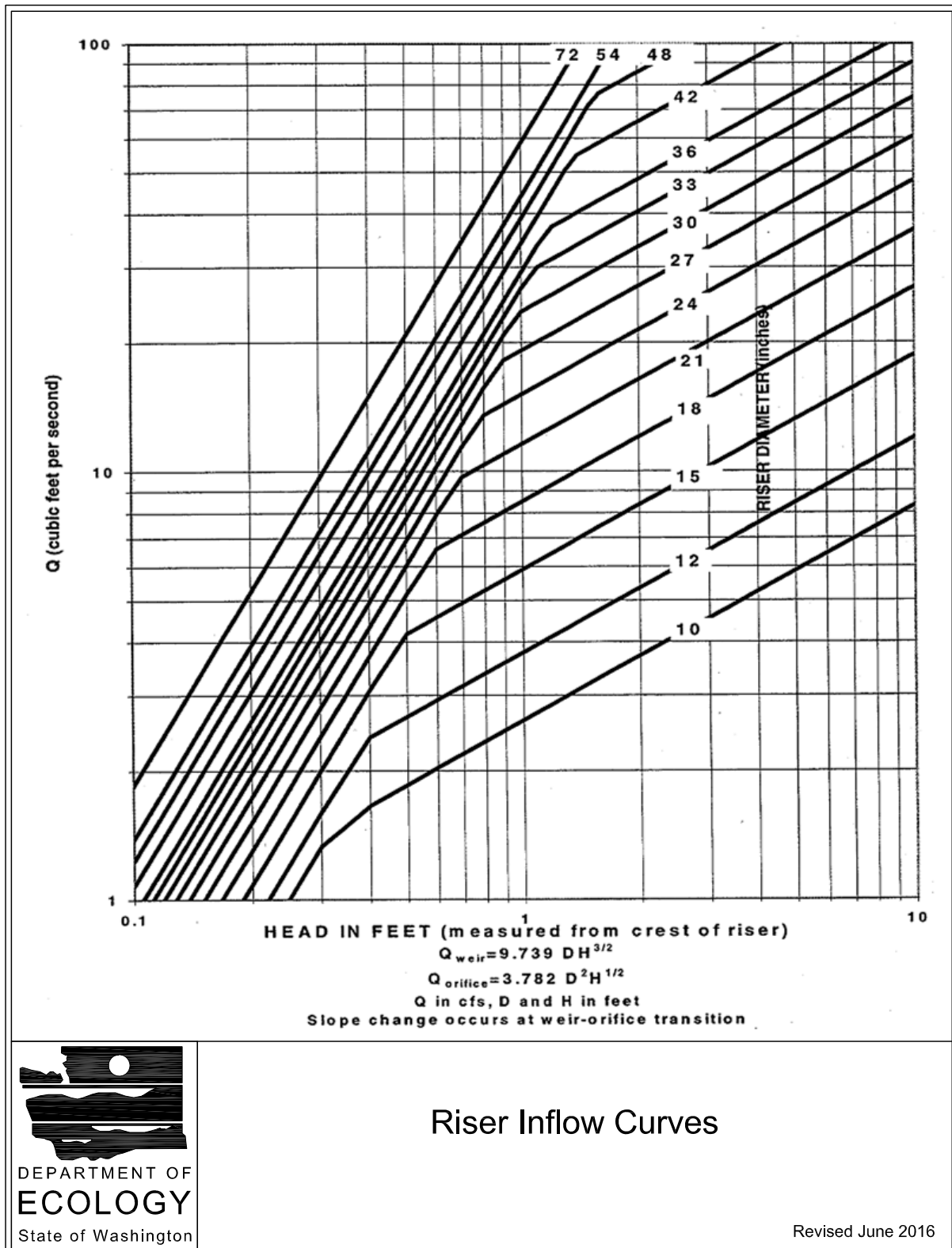


Figure II-4.31: Riser Inflow Curves



C. Correspondence
N/A

D. Site Inspection Form

Construction Stormwater Site Inspection Form

Project Name _____ Permit # _____ Inspection Date _____ Time _____

Name of Certified Erosion Sediment Control Lead (CESCL) or qualified inspector if *less than one acre*

Print Name: _____

Approximate rainfall amount since the last inspection (in inches): _____

Approximate rainfall amount in the last 24 hours (in inches): _____

Current Weather Clear ☐ Cloudy ☐ Mist ☐ Rain ☐ Wind ☐ Fog ☐

A. Type of inspection: Weekly ☐ Post Storm Event ☐ Other ☐

B. Phase of Active Construction (check all that apply):

Pre Construction/installation of erosion/sediment controls	☐	Clearing/Demo/Grading	☐	Infrastructure/storm/roads	☐
Concrete pours	☐	Vertical Construction/buildings	☐	Utilities	☐
Offsite improvements	☐	Site temporary stabilized	☐	Final stabilization	☐

C. Questions:

- | | | | | |
|--|-----|-------|----|-------|
| 1. Were all areas of construction and discharge points inspected? | Yes | _____ | No | _____ |
| 2. Did you observe the presence of suspended sediment, turbidity, discoloration, or oil sheen | Yes | _____ | No | _____ |
| 3. Was a water quality sample taken during inspection? (<i>refer to permit conditions S4 & S5</i>) | Yes | _____ | No | _____ |
| 4. Was there a turbid discharge 250 NTU or greater, or Transparency 6 cm or less?* | Yes | _____ | No | _____ |
| 5. If yes to #4 was it reported to Ecology? | Yes | _____ | No | _____ |
| 6. Is pH sampling required? pH range required is 6.5 to 8.5. | Yes | _____ | No | _____ |

If answering yes to a discharge, describe the event. Include when, where, and why it happened; what action was taken, and when.

*If answering yes to # 4 record NTU/Transparency with continual sampling daily until turbidity is 25 NTU or less/ transparency is 33 cm or greater.

Sampling Results: _____ Date: _____

Parameter	Method (circle one)	Result			Other/Note
		NTU	cm	pH	
Turbidity	tube, meter, laboratory				
pH	Paper, kit, meter				

Construction Stormwater Site Inspection Form

D. Check the observed status of all items. Provide "Action Required" details and dates.

Element #	Inspection	BMPs Inspected			BMP needs maintenance	BMP failed	Action required (describe in section F)
		yes	no	n/a			
1 Clearing Limits	Before beginning land disturbing activities are all clearing limits, natural resource areas (streams, wetlands, buffers, trees) protected with barriers or similar BMPs? (high visibility recommended)						
2 Construction Access	Construction access is stabilized with quarry spalls or equivalent BMP to prevent sediment from being tracked onto roads?						
	Sediment tracked onto the road way was cleaned thoroughly at the end of the day or more frequent as necessary.						
3 Control Flow Rates	Are flow control measures installed to control stormwater volumes and velocity during construction and do they protect downstream properties and waterways from erosion?						
	If permanent infiltration ponds are used for flow control during construction, are they protected from siltation?						
4 Sediment Controls	All perimeter sediment controls (e.g. silt fence, wattles, compost socks, berms, etc.) installed, and maintained in accordance with the Stormwater Pollution Prevention Plan (SWPPP).						
	Sediment control BMPs (sediment ponds, traps, filters etc.) have been constructed and functional as the first step of grading.						
	Stormwater runoff from disturbed areas is directed to sediment removal BMP.						
5 Stabilize Soils	Have exposed un-worked soils been stabilized with effective BMP to prevent erosion and sediment deposition?						

Construction Stormwater Site Inspection Form

Element #	Inspection	BMPs Inspected			BMP needs maintenance	BMP failed	Action required (describe in section F)
		yes	no	n/a			
5 Stabilize Soils Cont.	Are stockpiles stabilized from erosion, protected with sediment trapping measures and located away from drain inlet, waterways, and drainage channels?						
	Have soils been stabilized at the end of the shift, before a holiday or weekend if needed based on the weather forecast?						
6 Protect Slopes	Has stormwater and ground water been diverted away from slopes and disturbed areas with interceptor dikes, pipes and or swales?						
	Is off-site storm water managed separately from stormwater generated on the site?						
	Is excavated material placed on uphill side of trenches consistent with safety and space considerations?						
	Have check dams been placed at regular intervals within constructed channels that are cut down a slope?						
7 Drain Inlets	Storm drain inlets made operable during construction are protected.						
	Are existing storm drains within the influence of the project protected?						
8 Stabilize Channel and Outlets	Have all on-site conveyance channels been designed, constructed and stabilized to prevent erosion from expected peak flows?						
	Is stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream conveyance systems?						
9 Control Pollutants	Are waste materials and demolition debris handled and disposed of to prevent contamination of stormwater?						
	Has cover been provided for all chemicals, liquid products, petroleum products, and other material?						
	Has secondary containment been provided capable of containing 110% of the volume?						
	Were contaminated surfaces cleaned immediately after a spill incident?						
	Were BMPs used to prevent contamination of stormwater by a pH modifying sources?						

Construction Stormwater Site Inspection Form

Element #	Inspection	BMPs Inspected			BMP needs maintenance	BMP failed	Action required (describe in section F)
		yes	no	n/a			
9 Cont.	Wheel wash wastewater is handled and disposed of properly.						
10 Control Dewatering	Concrete washout in designated areas. No washout or excess concrete on the ground.						
	Dewatering has been done to an approved source and in compliance with the SWPPP.						
	Were there any clean non turbid dewatering discharges?						
11 Maintain BMP	Are all temporary and permanent erosion and sediment control BMPs maintained to perform as intended?						
12 Manage the Project	Has the project been phased to the maximum degree practicable?						
	Has regular inspection, monitoring and maintenance been performed as required by the permit?						
	Has the SWPPP been updated, implemented and records maintained?						
13 Protect LID	Is all Bioretention and Rain Garden Facilities protected from sedimentation with appropriate BMPs?						
	Is the Bioretention and Rain Garden protected against over compaction of construction equipment and foot traffic to retain its infiltration capabilities?						
	Permeable pavements are clean and free of sediment and sediment laden-water runoff. Muddy construction equipment has not been on the base material or pavement.						
	Have soiled permeable pavements been cleaned of sediments and pass infiltration test as required by stormwater manual methodology?						
	Heavy equipment has been kept off existing soils under LID facilities to retain infiltration rate.						

E. Check all areas that have been inspected. ✓

All in place BMPs ☐ All disturbed soils ☐ All concrete wash out area ☐ All material storage areas ☐
 All discharge locations ☐ All equipment storage areas ☐ All construction entrances/exits ☐

Construction Stormwater Site Inspection Form

F. Elements checked "Action Required" (section D) describe corrective action to be taken. List the element number; be specific on location and work needed. Document, initial, and date when the corrective action has been completed and inspected.

Element #	Description and Location	Action Required	Completion Date	Initials

Attach additional page if needed

Sign the following certification:

"I certify that this report is true, accurate, and complete, to the best of my knowledge and belief"

Inspected by: (print) _____ (Signature) _____ Date: _____

Title/Qualification of Inspector: _____

E. Construction Stormwater General Permit (CSWGP)

Issuance Date: November 18, 2020
Effective Date: January 1, 2021
Expiration Date: December 31, 2025

CONSTRUCTION STORMWATER GENERAL PERMIT

National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge
General Permit for Stormwater Discharges Associated with Construction Activity

State of Washington
Department of Ecology
Olympia, Washington 98504

In compliance with the provisions of
Chapter 90.48 Revised Code of Washington
(State of Washington Water Pollution Control Act)
and
Title 33 United States Code, Section 1251 et seq.
The Federal Water Pollution Control Act (The Clean Water Act)

Until this permit expires, is modified, or revoked, Permittees that have properly
obtained coverage under this general permit are authorized to discharge in accordance
with the special and general conditions that follow.



Vincent McGowan, P.E.
Water Quality Program Manager
Washington State Department of Ecology

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SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions within this permit for additional submittal requirements. Appendix A provides a list of definitions. Appendix B provides a list of acronyms.

Table 1 Summary of Required Submittals

Permit Section	Submittal	Frequency	First Submittal Date
S5.A and S8	High Turbidity/Transparency Phone Reporting	As Necessary	Within 24 hours
S5.B	Discharge Monitoring Report	Monthly*	Within 15 days following the end of each month
S5.F and S8	Noncompliance Notification – Telephone Notification	As necessary	Within 24 hours
S5.F	Noncompliance Notification – Written Report	As necessary	Within 5 Days of non-compliance
S9.D	Request for Chemical Treatment Form	As necessary	Written approval from Ecology is required prior to using chemical treatment (with the exception of dry ice, CO ₂ or food grade vinegar to adjust pH)
G2	Notice of Change in Authorization	As necessary	
G6	Permit Application for Substantive Changes to the Discharge	As necessary	
G8	Application for Permit Renewal	1/permit cycle	No later than 180 days before expiration
S2.A	Notice of Permit Transfer	As necessary	
G19	Notice of Planned Changes	As necessary	
G21	Reporting Anticipated Non-compliance	As necessary	

NOTE: *Permittees must submit electronic Discharge Monitoring Reports (DMRs) to the Washington State Department of Ecology monthly, regardless of site discharge, for the full duration of permit coverage. Refer to Section S5.B of this General Permit for more specific information regarding DMRs.

Table 2 Summary of Required On-site Documentation

Document Title	Permit Conditions
Permit Coverage Letter	See Conditions S2, S5
Construction Stormwater General Permit (CSWGP)	See Conditions S2, S5
Site Log Book	See Conditions S4, S5
Stormwater Pollution Prevention Plan (SWPPP)	See Conditions S5, S9
Site Map	See Conditions S5, S9

SPECIAL CONDITIONS

S1. PERMIT COVERAGE

A. Permit Area

This Construction Stormwater General Permit (CSWGP) covers all areas of Washington State, except for federal operators and Indian Country as specified in Special Condition S1.E.3 and 4.

B. Operators Required to Seek Coverage Under this General Permit

1. Operators of the following construction activities are required to seek coverage under this CSWGP:
 - a. Clearing, grading and/or excavation that results in the disturbance of one or more acres (including off-site disturbance acreage related to construction-support activity as authorized in S1.C.2) and discharges stormwater to surface waters of the State; and clearing, grading and/or excavation on sites smaller than one acre that are part of a larger common plan of development or sale, if the common plan of development or sale will ultimately disturb one acre or more and discharge stormwater to surface waters of the State.
 - i. This category includes forest practices (including, but not limited to, class IV conversions) that are part of a construction activity that will result in the disturbance of one or more acres, and discharge to surface waters of the State (that is, forest practices that prepare a site for construction activities); and
 - b. Any size construction activity discharging stormwater to waters of the State that the Washington State Department of Ecology (Ecology):
 - i. Determines to be a significant contributor of pollutants to waters of the State of Washington.
 - ii. Reasonably expects to cause a violation of any water quality standard.
2. Operators of the following activities are not required to seek coverage under this CSWGP (unless specifically required under Special Condition S1.B.1.b, above):
 - a. Construction activities that discharge all stormwater and non-stormwater to groundwater, sanitary sewer, or combined sewer, and have no point source discharge to either surface water or a storm sewer system that drains to surface waters of the State.
 - b. Construction activities covered under an Erosivity Waiver (Special Condition S1.F).
 - c. Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility.

C. Authorized Discharges

1. ***Stormwater Associated with Construction Activity.*** Subject to compliance with the terms and conditions of this permit, Permittees are authorized to discharge stormwater associated with construction activity to surface waters of the State or to a storm sewer system that drains to surface waters of the State. (Note that “surface waters of the

State” may exist on a construction site as well as off site; for example, a creek running through a site.)

2. ***Stormwater Associated with Construction Support Activity.*** This permit also authorizes stormwater discharge from support activities related to the permitted construction site (for example, an on-site portable rock crusher, off-site equipment staging yards, material storage areas, borrow areas, etc.) provided:
 - a. The support activity relates directly to the permitted construction site that is required to have an NPDES permit; and
 - b. The support activity is not a commercial operation serving multiple unrelated construction projects, and does not operate beyond the completion of the construction activity; and
 - c. Appropriate controls and measures are identified in the Stormwater Pollution Prevention Plan (SWPPP) for the discharges from the support activity areas.
3. ***Non-Stormwater Discharges.*** The categories and sources of non-stormwater discharges identified below are authorized conditionally, provided the discharge is consistent with the terms and conditions of this permit:
 - a. Discharges from fire-fighting activities.
 - b. Fire hydrant system flushing.
 - c. Potable water, including uncontaminated water line flushing.
 - d. Hydrostatic test water.
 - e. Uncontaminated air conditioning or compressor condensate.
 - f. Uncontaminated groundwater or spring water.
 - g. Uncontaminated excavation dewatering water (in accordance with S9.D.10).
 - h. Uncontaminated discharges from foundation or footing drains.
 - i. Uncontaminated or potable water used to control dust. Permittees must minimize the amount of dust control water used.
 - j. Routine external building wash down that does not use detergents.
 - k. Landscape irrigation water.

The SWPPP must adequately address all authorized non-stormwater discharges, except for discharges from fire-fighting activities, and must comply with Special Condition S3. At a minimum, discharges from potable water (including water line flushing), fire hydrant system flushing, and pipeline hydrostatic test water must undergo the following: dechlorination to a concentration of 0.1 parts per million (ppm) or less, and pH adjustment to within 6.5 – 8.5 standard units (su), if necessary.

D. Prohibited Discharges

The following discharges to waters of the State, including groundwater, are prohibited:

1. Concrete wastewater
2. Wastewater from washout and clean-up of stucco, paint, form release oils, curing compounds and other construction materials.
3. Process wastewater as defined by 40 Code of Federal Regulations (CFR) 122.2 (See Appendix A of this permit).
4. Slurry materials and waste from shaft drilling, including process wastewater from shaft drilling for construction of building, road, and bridge foundations unless managed according to Special Condition S9.D.9.j.
5. Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance.
6. Soaps or solvents used in vehicle and equipment washing.
7. Wheel wash wastewater, unless managed according to Special Condition S9.D.9.
8. Discharges from dewatering activities, including discharges from dewatering of trenches and excavations, unless managed according to Special Condition S9.D.10.

E. Limits on Coverage

Ecology may require any discharger to apply for and obtain coverage under an individual permit or another more specific general permit. Such alternative coverage will be required when Ecology determines that this CSWGP does not provide adequate assurance that water quality will be protected, or there is a reasonable potential for the project to cause or contribute to a violation of water quality standards.

The following stormwater discharges are not covered by this permit:

1. Post-construction stormwater discharges that originate from the site after completion of construction activities and the site has undergone final stabilization.
2. Non-point source silvicultural activities such as nursery operations, site preparation, reforestation and subsequent cultural treatment, thinning, prescribed burning, pest and fire control, harvesting operations, surface drainage, or road construction and maintenance, from which there is natural runoff as excluded in 40 CFR Subpart 122.
3. Stormwater from any federal operator.
4. Stormwater from facilities located on **Indian Country** as defined in 18 U.S.C. §1151, except portions of the Puyallup Reservation as noted below.

Indian Country includes:

- a. All land within any Indian Reservation notwithstanding the issuance of any patent, and, including rights-of-way running through the reservation. This includes all federal, tribal, and Indian and non-Indian privately owned land within the reservation.
- b. All off-reservation Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same.
- c. All off-reservation federal trust lands held for Native American Tribes.

Puyallup Exception: Following the *Puyallup Tribes of Indians Land Settlement Act of 1989*, 25 U.S.C. §1773; the permit does apply to land within the Puyallup Reservation except for discharges to surface water on land held in trust by the federal government.

5. Stormwater from any site covered under an existing NPDES individual permit in which stormwater management and/or treatment requirements are included for all stormwater discharges associated with construction activity.
6. Stormwater from a site where an applicable Total Maximum Daily Load (TMDL) requirement specifically precludes or prohibits discharges from construction activity.

F. Erosivity Waiver

Construction site operators may qualify for an Erosivity Waiver from the CSWGP if the following conditions are met:

1. The site will result in the disturbance of fewer than five (5) acres and the site is not a portion of a common plan of development or sale that will disturb five (5) acres or greater.
2. Calculation of Erosivity “R” Factor and Regional Timeframe:
 - a. The project’s calculated rainfall erosivity factor (“R” Factor) must be less than five (5) during the period of construction activity, (See the CSWGP homepage <http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html> for a link to the EPA’s calculator and step by step instructions on computing the “R” Factor in the *EPA Erosivity Waiver Fact Sheet*). The period of construction activity starts when the land is first disturbed and ends with final stabilization. In addition:
 - b. The entire period of construction activity must fall within the following timeframes:
 - i. For sites west of the Cascades Crest: June 15 – September 15.
 - ii. For sites east of the Cascades Crest, excluding the Central Basin: June 15 – October 15.
 - iii. For sites east of the Cascades Crest, within the Central Basin: no timeframe restrictions apply. The Central Basin is defined as the portions of Eastern Washington with mean annual precipitation of less than 12 inches. For a map of the Central Basin (Average Annual Precipitation Region 2), refer to: <http://www.ecy.wa.gov/programs/wq/stormwater/construction/resourcesguidance.html>.
3. Construction site operators must submit a complete Erosivity Waiver certification form at least one week before disturbing the land. Certification must include statements that the operator will:
 - a. Comply with applicable local stormwater requirements; and
 - b. Implement appropriate erosion and sediment control BMPs to prevent violations of water quality standards.
4. This waiver is not available for facilities declared significant contributors of pollutants as defined in Special Condition S1.B.1.b or for any size construction activity that could

reasonably expect to cause a violation of any water quality standard as defined in Special Condition S1.B.1.b.ii.

5. This waiver does not apply to construction activities which include non-stormwater discharges listed in Special Condition S1.C.3.
6. If construction activity extends beyond the certified waiver period for any reason, the operator must either:
 - a. Recalculate the rainfall erosivity “R” factor using the original start date and a new projected ending date and, if the “R” factor is still under 5 *and* the entire project falls within the applicable regional timeframe in Special Condition S1.F.2.b, complete and submit an amended waiver certification form before the original waiver expires; *or*
 - b. Submit a complete permit application to Ecology in accordance with Special Condition S2.A and B before the end of the certified waiver period.

S2. APPLICATION REQUIREMENTS

A. Permit Application Forms

1. *Notice of Intent Form*

- a. Operators of new or previously unpermitted construction activities must submit a complete and accurate permit application (Notice of Intent, or NOI) to Ecology.
- b. Operators must apply using the electronic application form (NOI) available on Ecology’s website (<http://ecy.wa.gov/programs/wq/stormwater/construction/index.html>). Permittees unable to submit electronically (for example, those who do not have an internet connection) must contact Ecology to request a waiver and obtain instructions on how to obtain a paper NOI.

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Olympia, Washington 98504-7696

- c. The operator must submit the NOI at least 60 days before discharging stormwater from construction activities and must submit it prior to the date of the first public notice (See Special Condition S2.B, below, for details). The 30-day public comment period begins on the publication date of the second public notice. Unless Ecology responds to the complete application in writing, coverage under the general permit will automatically commence on the 31st day following receipt by Ecology of a *completed* NOI, or the issuance date of this permit, whichever is later; unless Ecology specifies a later date in writing as required by WAC173-226-200(2). See S8.B for Limits on Coverage for New Discharges to TMDL or 303(d)-Listed Waters.
- d. If an applicant intends to use a Best Management Practice (BMP) selected on the basis of Special Condition S9.C.4 (“demonstrably equivalent” BMPs), the applicant must notify Ecology of its selection as part of the NOI. In the event the applicant selects BMPs after submission of the NOI, the applicant must provide notice of the

selection of an equivalent BMP to Ecology at least 60 days before intended use of the equivalent BMP.

- e. Applicants must notify Ecology if they are aware of contaminated soils and/or groundwater associated with the construction activity. Provide detailed information with the NOI (as known and readily available) on the nature and extent of the contamination (concentrations, locations, and depth), as well as pollution prevention and/or treatment BMPs proposed to control the discharge of soil and/or groundwater contaminants in stormwater. Examples of such detail may include, but are not limited to:
 - i. List or table of all known contaminants with laboratory test results showing concentration and depth,
 - ii. Map with sample locations,
 - iii. Related portions of the Stormwater Pollution Prevention Plan (SWPPP) that address the management of contaminated and potentially contaminated construction stormwater and dewatering water,
 - iv. Dewatering plan and/or dewatering contingency plan.

2. *Transfer of Coverage Form*

The Permittee can transfer current coverage under this permit to one or more new operators, including operators of sites within a Common Plan of Development, provided:

- i. The Permittee submits a complete Transfer of Coverage Form to Ecology, signed by the current and new discharger and containing a specific date for transfer of permit responsibility, coverage and liability (including any Administrative Orders associated with the permit); and
- ii. Ecology does not notify the current discharger and new discharger of intent to revoke coverage under the general permit. If this notice is not given, the transfer is effective on the date specified in the written agreement.

When a current discharger (Permittee) transfers a portion of a permitted site, the current discharger must also indicate the remaining permitted acreage after the transfer. Transfers do not require public notice.

3. *Modification of Coverage Form*

Permittees must notify Ecology regarding any changes to the information provided on the NOI by submitting an Update/Modification of Permit Coverage form in accordance with General Conditions G6 and G19. Examples of such changes include, but are not limited to:

- i. Changes to the Permittee's mailing address,
- ii. Changes to the on-site contact person information, and
- iii. Changes to the area/acreage affected by construction activity.

B. Public Notice

For new or previously unpermitted construction activities, the applicant must publish a public notice at least one time each week for two consecutive weeks, at least 7 days apart, in a newspaper with general circulation in the county where the construction is to take place. The notice must be run after the NOI has been submitted and must contain:

1. A statement that *“The applicant is seeking coverage under the Washington State Department of Ecology’s Construction Stormwater NPDES and State Waste Discharge General Permit.”*
2. The name, address, and location of the construction site.
3. The name and address of the applicant.
4. The type of construction activity that will result in a discharge (for example, residential construction, commercial construction, etc.), and the total number of acres to be disturbed over the lifetime of the project.
5. The name of the receiving water(s) (that is, the surface water(s) to which the site will discharge), or, if the discharge is through a storm sewer system, the name of the operator of the system and the receiving water(s) the system discharges to.
6. The statement: *Any persons desiring to present their views to the Washington State Department of Ecology regarding this application, or interested in Ecology’s action on this application, may notify Ecology in writing no later than 30 days of the last date of publication of this notice. Ecology reviews public comments and considers whether discharges from this project would cause a measurable change in receiving water quality, and, if so, whether the project is necessary and in the overriding public interest according to Tier II antidegradation requirements under WAC 173-201A-320. Comments can be submitted to: Department of Ecology, PO Box 47696, Olympia, Washington 98504-7696 Attn: Water Quality Program, Construction Stormwater.*

S3. COMPLIANCE WITH STANDARDS

- A. Discharges must not** cause or contribute to a violation of surface water quality standards (Chapter 173-201A WAC), groundwater quality standards (Chapter 173-200 WAC), sediment management standards (Chapter 173-204 WAC), and human health-based criteria in the Federal water quality criteria applicable to Washington. (40 CFR Part 131.45) Discharges that are not in compliance with these standards are prohibited.
- B. Prior to the discharge** of stormwater and non-stormwater to waters of the State, the Permittee must apply All Known, Available, and Reasonable methods of prevention, control, and Treatment (AKART). This includes the preparation and implementation of an adequate SWPPP, with all appropriate BMPs installed and maintained in accordance with the SWPPP and the terms and conditions of this permit.
- C. Ecology presumes** that a Permittee complies with water quality standards unless discharge monitoring data or other site-specific information demonstrates that a discharge causes or contributes to a violation of water quality standards, when the Permittee complies with the following conditions. The Permittee must fully:

1. Comply with all permit conditions, including; planning, sampling, monitoring, reporting, and recordkeeping conditions.
 2. Implement stormwater BMPs contained in stormwater management manuals published or approved by Ecology, or BMPs that are demonstrably equivalent to BMPs contained in stormwater management manuals published or approved by Ecology, including the proper selection, implementation, and maintenance of all applicable and appropriate BMPs for on-site pollution control. (For purposes of this section, the stormwater manuals listed in Appendix 10 of the *Phase I Municipal Stormwater Permit* are approved by Ecology.)
- D. Where construction sites** also discharge to groundwater, the groundwater discharges must also meet the terms and conditions of this CSWGP. Permittees who discharge to groundwater through an injection well must also comply with any applicable requirements of the Underground Injection Control (UIC) regulations, Chapter 173-218 WAC.

S4. MONITORING REQUIREMENTS, BENCHMARKS, AND REPORTING TRIGGERS

A. Site Log Book

The Permittee must maintain a site log book that contains a record of the implementation of the SWPPP and other permit requirements, including the installation and maintenance of BMPs, site inspections, and stormwater monitoring.

B. Site Inspections

Construction sites one (1) acre or larger that discharge stormwater to surface waters of the State must have site inspections conducted by a Certified Erosion and Sediment Control Lead (CESCL). Sites less than one (1) acre may have a person without CESCL certification conduct inspections. (See Special Conditions S4.B.3 and B.4, below, for detailed requirements of the Permittee's CESCL.)

Site inspections must include all areas disturbed by construction activities, all BMPs, and all stormwater discharge points under the Permittee's operational control.

1. The Permittee must have staff knowledgeable in the principles and practices of erosion and sediment control. The CESCL (sites one acre or more) or inspector (sites less than one acre) must have the skills to assess the:
 - a. Site conditions and construction activities that could impact the quality of stormwater; and
 - b. Effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges. The SWPPP must identify the CESCL or inspector, who must be present on site or on-call at all times. The CESCL (sites one (1) acre or more) must obtain this certification through an approved erosion and sediment control training program that meets the minimum training standards established by Ecology. (See BMP C160 in the manual, referred to in Special Condition S9.C.1 and 2.)
2. The CESCL or inspector must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. BMP effectiveness must be evaluated to

determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges.

Based on the results of the inspection, the Permittee must correct the problems identified, by:

- a. Reviewing the SWPPP for compliance with Special Condition S9 and making appropriate revisions within 7 days of the inspection.
 - b. Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs, within 10 days of the inspection. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when an extension is requested by a Permittee within the initial 10-day response period.
 - c. Documenting BMP implementation and maintenance in the site log book.
3. The CESCL or inspector must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one (1) day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one (1) inspection is required that week.) Inspection frequency may be reduced to once every calendar month for inactive sites that are temporarily stabilized.
4. The Permittee must summarize the results of each inspection in an inspection report or checklist and enter the report/checklist into, or attach it to, the site log book. At a minimum, each inspection report or checklist must include:
 - a. Inspection date and time.
 - b. Weather information.
 - c. The general conditions during inspection.
 - d. The approximate amount of precipitation since the last inspection.
 - e. The approximate amount of precipitation within the last 24 hours.
 - f. A summary or list of all implemented BMPs, including observations of all erosion/sediment control structures or practices.
 - g. A description of:
 - i. BMPs inspected (including location).
 - ii. BMPs that need maintenance and why.
 - iii. BMPs that failed to operate as designed or intended, and
 - iv. Where additional or different BMPs are needed, and why.
 - h. A description of stormwater discharged from the site. The Permittee must note the presence of suspended sediment, turbidity, discoloration, and oil sheen, as applicable.

- i. Any water quality monitoring performed during inspection.
- j. General comments and notes, including a brief description of any BMP repairs, maintenance, or installations made following the inspection.
- k. An implementation schedule for the remedial actions that the Permittee plans to take if the site inspection indicates that the site is out of compliance. The remedial actions taken must meet the requirements of the SWPPP and the permit.
- l. A summary report of the inspection.
- m. The name, title, and signature of the person conducting the site inspection, a phone number or other reliable method to reach this person, and the following statement:
I certify that this report is true, accurate, and complete to the best of my knowledge and belief.

Table 3 Summary of Primary Monitoring Requirements

Size of Soil Disturbance ¹	Weekly Site Inspections	Weekly Sampling w/ Turbidity Meter	Weekly Sampling w/ Transparency Tube	Weekly pH Sampling ²	CESCL Required for Inspections?
Sites that disturb less than 1 acre, but are part of a larger Common Plan of Development	Required	Not Required	Not Required	Not Required	No
Sites that disturb 1 acre or more, but fewer than 5 acres	Required	Sampling Required – either method ³		Required	Yes
Sites that disturb 5 acres or more	Required	Required	Not Required ⁴	Required	Yes

¹ Soil disturbance is calculated by adding together all areas that will be affected by construction activity. Construction activity means clearing, grading, excavation, and any other activity that disturbs the surface of the land, including ingress/egress from the site.

² If construction activity results in the disturbance of 1 acre or more, and involves significant concrete work (1,000 cubic yards of concrete or recycled concrete placed or poured over the life of a project) or the use of engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD], or fly ash), and stormwater from the affected area drains to surface waters of the State or to a storm sewer stormwater collection system that drains to other surface waters of the State, the Permittee must conduct pH sampling in accordance with Special Condition S4.D.

³ Sites with one or more acres, but fewer than 5 acres of soil disturbance, must conduct turbidity or transparency sampling in accordance with Special Condition S4.C.4.a or b.

⁴ Sites equal to or greater than 5 acres of soil disturbance must conduct turbidity sampling using a turbidity meter in accordance with Special Condition S4.C.4.a.

C. Turbidity/Transparency Sampling Requirements

1. Sampling Methods

- a. If construction activity involves the disturbance of five (5) acres or more, the Permittee must conduct turbidity sampling per Special Condition S4.C.4.a, below.
- b. If construction activity involves one (1) acre or more but fewer than five (5) acres of soil disturbance, the Permittee must conduct either transparency sampling *or* turbidity sampling per Special Condition S4.C.4.a or b, below.

2. Sampling Frequency

- a. The Permittee must sample all discharge points at least once every calendar week when stormwater (or authorized non-stormwater) discharges from the site or enters any on-site surface waters of the state (for example, a creek running through a site); sampling is not required on sites that disturb less than an acre.
- b. Samples must be representative of the flow and characteristics of the discharge.
- c. Sampling is not required when there is no discharge during a calendar week.
- d. Sampling is not required outside of normal working hours or during unsafe conditions.
- e. If the Permittee is unable to sample during a monitoring period, the Permittee must include a brief explanation in the monthly Discharge Monitoring Report (DMR).
- f. Sampling is not required before construction activity begins.
- g. The Permittee may reduce the sampling frequency for temporarily stabilized, inactive sites to once every calendar month.

3. Sampling Locations

- a. Sampling is required at all points where stormwater associated with construction activity (or authorized non-stormwater) is discharged off site, including where it enters any on-site surface waters of the state (for example, a creek running through a site).
- b. The Permittee may discontinue sampling at discharge points that drain areas of the project that are fully stabilized to prevent erosion.
- c. The Permittee must identify all sampling point(s) in the SWPPP and on the site map and clearly mark these points in the field with a flag, tape, stake or other visible marker.
- d. Sampling is not required for discharge that is sent directly to sanitary or combined sewer systems.
- e. The Permittee may discontinue sampling at discharge points in areas of the project where the Permittee no longer has operational control of the construction activity.

4. Sampling and Analysis Methods

- a. The Permittee performs turbidity analysis with a calibrated turbidity meter (turbidimeter) either on site or at an accredited lab. The Permittee must record the results in the site log book in nephelometric turbidity units (NTUs).
- b. The Permittee performs transparency analysis on site with a 1¾ inch diameter, 60 centimeter (cm)-long transparency tube. The Permittee will record the results in the site log book in centimeters (cm).

Table 4 Monitoring and Reporting Requirements

Parameter	Unit	Analytical Method	Sampling Frequency	Benchmark Value
Turbidity	NTU	SM2130	Weekly, if discharging	25 NTUs
Transparency	Cm	Manufacturer instructions, or Ecology guidance	Weekly, if discharging	33 cm

5. Turbidity/Transparency Benchmark Values and Reporting Triggers

The benchmark value for turbidity is 25 NTUs. The benchmark value for transparency is 33 centimeters (cm). Note: Benchmark values do not apply to discharges to segments of water bodies on Washington State's 303(d) list (Category 5) for turbidity, fine sediment, or phosphorus; these discharges are subject to a numeric effluent limit for turbidity. Refer to Special Condition S8 for more information and follow S5.F – Noncompliance Notification for reporting requirements applicable to discharges which exceed the numeric effluent limit for turbidity.

- a. Turbidity 26 – 249 NTUs, or Transparency 32 – 7 cm:

If the discharge turbidity is 26 to 249 NTUs; or if discharge transparency is 32 to 7 cm, the Permittee must:

- i. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs, and no later than 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.
- ii. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within 7 days of the date the discharge exceeded the benchmark.
- iii. Document BMP implementation and maintenance in the site log book.

- b. Turbidity 250 NTUs or greater, or Transparency 6 cm or less:

If a discharge point's turbidity is 250 NTUs or greater, or if discharge transparency is less than or equal to 6 cm, the Permittee must complete the reporting and adaptive

management process described below. For discharges which are subject to a numeric effluent limit for turbidity, see S5.F – Noncompliance Notification.

- i. Within 24 hours, telephone or submit an electronic report to the applicable Ecology Region's Environmental Report Tracking System (ERTS) number (or through Ecology's Water Quality Permitting Portal [WQWebPortal] – Permit Submittals when the form is available), in accordance with Special Condition S5.A.
 - **Central Region** (Okanogan, Chelan, Douglas, Kittitas, Yakima, Klickitat, Benton): (509) 575-2490
 - **Eastern Region** (Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman): (509) 329-3400
 - **Northwest Region** (Kitsap, Snohomish, Island, King, San Juan, Skagit, Whatcom): (425) 649-7000
 - **Southwest Region** (Grays Harbor, Lewis, Mason, Thurston, Pierce, Clark, Cowlitz, Skamania, Wahkiakum, Clallam, Jefferson, Pacific): (360) 407-6300

These numbers and a link to the ERTS reporting page are also listed at the following website: <http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html>.

- ii. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible, addressing the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.
- iii. Sample discharges daily until:
 - a) Turbidity is 25 NTUs (or lower); or
 - b) Transparency is 33 cm (or greater); or
 - c) The Permittee has demonstrated compliance with the water quality standard for turbidity:
 - 1) No more than 5 NTUs over background turbidity, if background is less than 50 NTUs, or
 - 2) No more than 10% over background turbidity, if background is 50 NTUs or greater; or

*Note: background turbidity in the receiving water must be measured immediately upstream (upgradient) or outside of the area of influence of the discharge.
 - d) The discharge stops or is eliminated.
- iv. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within seven (7) days of the date the discharge exceeded the benchmark.

- v. Document BMP implementation and maintenance in the site log book.

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with permit benchmarks.

D. pH Sampling Requirements – Significant Concrete Work or Engineered Soils

If construction activity results in the disturbance of 1 acre or more, *and* involves significant concrete work (significant concrete work means greater than 1000 cubic yards placed or poured concrete or recycled concrete used over the life of a project) or the use of engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD], or fly ash), and stormwater from the affected area drains to surface waters of the State or to a storm sewer system that drains to surface waters of the State, the Permittee must conduct pH sampling as set forth below. Note: In addition, discharges to segments of water bodies on Washington State's 303(d) list (Category 5) for high pH are subject to a numeric effluent limit for pH; refer to Special Condition S8.

1. The Permittee must perform pH analysis on site with a calibrated pH meter, pH test kit, or wide range pH indicator paper. The Permittee must record pH sampling results in the site log book.
2. During the applicable pH monitoring period defined below, the Permittee must obtain a representative sample of stormwater and conduct pH analysis at least once per week.
 - a. For sites with significant concrete work, the Permittee must begin the pH sampling period when the concrete is first placed or poured and exposed to precipitation, and continue weekly throughout and after the concrete placement, pour and curing period, until stormwater pH is in the range of 6.5 to 8.5 (su).
 - b. For sites with recycled concrete where monitoring is required, the Permittee must begin the weekly pH sampling period when the recycled concrete is first exposed to precipitation and must continue until the recycled concrete is fully stabilized with the stormwater pH in the range of 6.5 to 8.5 (su).
 - c. For sites with engineered soils, the Permittee must begin the pH sampling period when the soil amendments are first exposed to precipitation and must continue until the area of engineered soils is fully stabilized.
3. The Permittee must sample pH in the sediment trap/pond(s) or other locations that receive stormwater runoff from the area of significant concrete work or engineered soils before the stormwater discharges to surface waters.
4. The benchmark value for pH is 8.5 standard units. Anytime sampling indicates that pH is 8.5 or greater, the Permittee must either:
 - a. Prevent the high pH water (8.5 or above) from entering storm sewer systems or surface waters of the state; *or*
 - b. If necessary, adjust or neutralize the high pH water until it is in the range of pH 6.5 to 8.5 (su) using an appropriate treatment BMP such as carbon dioxide (CO₂) sparging, dry ice or food grade vinegar. The Permittee must obtain written approval from Ecology before using any form of chemical treatment other than CO₂ sparging, dry ice or food grade vinegar.

S5. REPORTING AND RECORDKEEPING REQUIREMENTS

A. High Turbidity Reporting

Anytime sampling performed in accordance with Special Condition S4.C indicates turbidity has reached the 250 NTUs or more (or transparency less than or equal to 6 cm), high turbidity reporting level, the Permittee must notify Ecology within 24 hours of analysis either by calling the applicable Ecology Region's Environmental Report Tracking System (ERTS) number by phone or by submitting an electronic ERTS report (through Ecology's Water Quality Permitting Portal (WQWebPortal) – Permit Submittals when the form is available). See the CSWGP website for links to ERTS and the WQWebPortal. (<http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html>) Also, see phone numbers in Special Condition S4.C.5.b.i.

B. Discharge Monitoring Reports (DMRs)

Permittees required to conduct water quality sampling in accordance with Special Conditions S4.C (Turbidity/Transparency), S4.D (pH), S8 (303[d]/TMDL sampling), and/or G12 (Additional Sampling) must submit the results to Ecology.

Permittees must submit monitoring data using Ecology's WQWebDMR web application accessed through Ecology's Water Quality Permitting Portal.

Permittees unable to submit electronically (for example, those who do not have an internet connection) must contact Ecology to request a waiver and obtain instructions on how to obtain a paper copy DMR at:

Department of Ecology
Water Quality Program - Construction Stormwater
PO Box 47696
Olympia, WA 98504-7696

Permittees who obtain a waiver not to use WQWebDMR must use the forms provided to them by Ecology; submittals must be mailed to the address above. Permittees must submit DMR forms to be received by Ecology within 15 days following the end of each month.

If there was no discharge during a given monitoring period, all Permittees must submit a DMR as required with "no discharge" entered in place of the monitoring results. DMRs are required for the full duration of permit coverage (from the first full month following the effective date of permit coverage up until Ecology has approved termination of the coverage). For more information, contact Ecology staff using information provided at the following website: www.ecy.wa.gov/programs/wq/permits/paris/contacts.html.

C. Records Retention

The Permittee must retain records of all monitoring information (site log book, sampling results, inspection reports/checklists, etc.), Stormwater Pollution Prevention Plan, copy of the permit coverage letter (including Transfer of Coverage documentation) and any other documentation of compliance with permit requirements for the entire life of the construction project and for a minimum of five (5) years following the termination of permit coverage. Such information must include all calibration and maintenance records, and records of all data used to complete the application for this permit. This period of retention must be extended during

the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology.

D. Recording Results

For each measurement or sample taken, the Permittee must record the following information:

1. Date, place, method, and time of sampling or measurement.
2. The first and last name of the individual who performed the sampling or measurement.
3. The date(s) the analyses were performed.
4. The first and last name of the individual who performed the analyses.
5. The analytical techniques or methods used.
6. The results of all analyses.

E. Additional Monitoring by the Permittee

If the Permittee samples or monitors any pollutant more frequently than required by this permit using test procedures specified by Special Condition S4 of this permit, the sampling results for this monitoring must be included in the calculation and reporting of the data submitted in the Permittee's DMR.

F. Noncompliance Notification

In the event the Permittee is unable to comply with any part of the terms and conditions of this permit, and the resulting noncompliance may cause a threat to human health or the environment (such as but not limited to spills or fuels or other materials, catastrophic pond or slope failure, and discharges that violate water quality standards), or exceed numeric effluent limitations (see S8 – Discharges to 303(d) or TMDL Waterbodies), the Permittee must, upon becoming aware of the circumstance:

1. Notify Ecology within 24 hours of the failure to comply by calling the applicable Regional office ERTS phone number (refer to Special Condition S4.C.5.b.i, or go to <https://ecology.wa.gov/About-us/Get-involved/Report-an-environmental-issue> to find contact information for the regional offices.)
2. Immediately take action to prevent the discharge/pollution, or otherwise stop or correct the noncompliance, and, if applicable, repeat sampling and analysis of any noncompliance immediately and submit the results to Ecology within five (5) days of becoming aware of the violation (See S5.F.3, below, for details on submitting results in a report).
3. Submit a detailed written report to Ecology within five (5) days of the time the Permittee becomes aware of the circumstances, unless requested earlier by Ecology. The report must be submitted using Ecology's Water Quality Permitting Portal (WQWebPortal) – Permit Submittals, unless a waiver from electronic reporting has been granted according to S5.B. The report must contain a description of the noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

The Permittee must report any unanticipated bypass and/or upset that exceeds any effluent limit in the permit in accordance with the 24-hour reporting requirement contained in 40 C.F.R. 122.41(l)(6).

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply. Upon request of the Permittee, Ecology may waive the requirement for a written report on a case-by-case basis, if the immediate notification is received by Ecology within 24 hours.

G. Access to Plans and Records

1. The Permittee must retain the following permit documentation (plans and records) on site, or within reasonable access to the site, for use by the operator or for on-site review by Ecology or the local jurisdiction:
 - a. General Permit
 - b. Permit Coverage Letter
 - c. Stormwater Pollution Prevention Plan (SWPPP)
 - d. Site Log Book
 - e. Erosivity Waiver (if applicable)
2. The Permittee must address written requests for plans and records listed above (Special Condition S5.G.1) as follows:
 - a. The Permittee must provide a copy of plans and records to Ecology within 14 days of receipt of a written request from Ecology.
 - b. The Permittee must provide a copy of plans and records to the public when requested in writing. Upon receiving a written request from the public for the Permittee's plans and records, the Permittee must either:
 - i. Provide a copy of the plans and records to the requester within 14 days of a receipt of the written request; *or*
 - ii. Notify the requester within 10 days of receipt of the written request of the location and times within normal business hours when the plans and records may be viewed; and provide access to the plans and records within 14 days of receipt of the written request; *or*

Within 14 days of receipt of the written request, the Permittee may submit a copy of the plans and records to Ecology for viewing and/or copying by the requester at an Ecology office, or a mutually agreed location. If plans and records are viewed and/or copied at a location other than at an Ecology office, the Permittee will provide reasonable access to copying services for which a reasonable fee may be charged. The Permittee must notify the requester within 10 days of receipt of the request where the plans and records may be viewed and/or copied.

S6. PERMIT FEES

The Permittee must pay permit fees assessed by Ecology. Fees for stormwater discharges covered under this permit are established by Chapter 173-224 WAC. Ecology continues to assess permit fees until the permit is terminated in accordance with Special Condition S10 or revoked in accordance with General Condition G5.

S7. SOLID AND LIQUID WASTE DISPOSAL

The Permittee must handle and dispose of solid and liquid wastes generated by construction activity, such as demolition debris, construction materials, contaminated materials, and waste materials from maintenance activities, including liquids and solids from cleaning catch basins and other stormwater facilities, in accordance with:

- A. Special Condition S3, Compliance with Standards.
- B. WAC 173-216-110.
- C. Other applicable regulations.

S8. DISCHARGES TO 303(d) OR TMDL WATERBODIES

A. Sampling and Numeric Effluent Limits For Certain Discharges to 303(d)-Listed Water Bodies

1. Permittees who discharge to segments of water bodies listed as impaired by the State of Washington under Section 303(d) of the Clean Water Act for turbidity, fine sediment, high pH, or phosphorus, must conduct water quality sampling according to the requirements of this section, and Special Conditions S4.C.2.b-f and S4.C.3.b-d, and must comply with the applicable numeric effluent limitations in S8.C and S8.D.
2. All references and requirements associated with Section 303(d) of the Clean Water Act mean the most current listing by Ecology of impaired waters (Category 5) that exists on January 1, 2021, or the date when the operator's complete permit application is received by Ecology, whichever is later.

B. Limits on Coverage for New Discharges to TMDL or 303(d)-Listed Waters

Construction sites that discharge to a TMDL or 303(d)-listed waterbody are not eligible for coverage under this permit *unless* the operator:

1. Prevents exposing stormwater to pollutants for which the waterbody is impaired, and retains documentation in the SWPPP that details procedures taken to prevent exposure on site; *or*
2. Documents that the pollutants for which the waterbody is impaired are not present at the site, and retains documentation of this finding within the SWPPP; *or*
3. Provides Ecology with data indicating the discharge is not expected to cause or contribute to an exceedance of a water quality standard, and retains such data on site with the SWPPP. The operator must provide data and other technical information to Ecology that sufficiently demonstrate:
 - a. For discharges to waters without an EPA-approved or -established TMDL, that the discharge of the pollutant for which the water is impaired will meet in-stream water quality criteria at the point of discharge to the waterbody; *or*
 - b. For discharges to waters with an EPA-approved or -established TMDL, that there is sufficient remaining wasteload allocation in the TMDL to allow construction stormwater discharge and that existing dischargers to the waterbody are subject to compliance schedules designed to bring the waterbody into attainment with water quality standards.

Operators of construction sites are eligible for coverage under this permit only after Ecology makes an affirmative determination that the *discharge will not cause or contribute to the existing impairment or exceed the TMDL*.

C. Sampling and Numeric Effluent Limits for Discharges to Water Bodies on the 303(d) List for Turbidity, Fine Sediment, or Phosphorus

1. Permittees who discharge to segments of water bodies on the 303(d) list (Category 5) for turbidity, fine sediment, or phosphorus must conduct turbidity sampling in accordance with Special Condition S4.C.2 and comply with either of the numeric effluent limits noted in Table 5 below.
2. As an alternative to the 25 NTUs effluent limit noted in Table 5 below (applied at the point where stormwater [or authorized non-stormwater] is discharged off-site), Permittees may choose to comply with the surface water quality standard for turbidity. The standard is: no more than 5 NTUs over background turbidity when the background turbidity is 50 NTUs or less, or no more than a 10% increase in turbidity when the background turbidity is more than 50 NTUs. In order to use the water quality standard requirement, the sampling must take place at the following locations:
 - a. Background turbidity in the 303(d)-listed receiving water immediately upstream (upgradient) or outside the area of influence of the discharge.
 - b. Turbidity at the point of discharge into the 303(d)-listed receiving water, inside the area of influence of the discharge.
3. Discharges that exceed the numeric effluent limit for turbidity constitute a violation of this permit.
4. Permittees whose discharges exceed the numeric effluent limit must sample discharges daily until the violation is corrected and comply with the non-compliance notification requirements in Special Condition S5.F.

Table 5 Turbidity, Fine Sediment & Phosphorus Sampling and Limits for 303(d)-Listed Waters

Parameter identified in 303(d) listing	Parameter Sampled	Unit	Analytical Method	Sampling Frequency	Numeric Effluent Limit ¹
- Turbidity - Fine Sediment - Phosphorus	Turbidity	NTU	SM2130	Weekly, if discharging	25 NTUs, at the point where stormwater is discharged from the site; OR In compliance with the surface water quality standard for turbidity (S8.C.2.a)

¹ Permittees subject to a numeric effluent limit for turbidity may, at their discretion, choose either numeric effluent limitation based on site-specific considerations including, but not limited to, safety, access and convenience.

D. Discharges to Water Bodies on the 303(d) List for High pH

1. Permittees who discharge to segments of water bodies on the 303(d) list (Category 5) for high pH must conduct pH sampling in accordance with the table below, and comply with the numeric effluent limit of pH 6.5 to 8.5 su (Table 6).

Table 6 pH Sampling and Limits for 303(d)-Listed Waters

Parameter identified in 303(d) listing	Parameter Sampled/Units	Analytical Method	Sampling Frequency	Numeric Effluent Limit
High pH	pH /Standard Units	pH meter	Weekly, if discharging	In the range of 6.5 – 8.5 su

2. At the Permittee's discretion, compliance with the limit shall be assessed at one of the following locations:
 - a. Directly in the 303(d)-listed waterbody segment, inside the immediate area of influence of the discharge; *or*
 - b. Alternatively, the Permittee may measure pH at the point where the discharge leaves the construction site, rather than in the receiving water.
3. Discharges that exceed the numeric effluent limit for pH (outside the range of 6.5 – 8.5 su) constitute a violation of this permit.
4. Permittees whose discharges exceed the numeric effluent limit must sample discharges daily until the violation is corrected and comply with the non-compliance notification requirements in Special Condition S5.F.

E. Sampling and Limits for Sites Discharging to Waters Covered by a TMDL or another Pollution Control Plan

1. Discharges to a waterbody that is subject to a Total Maximum Daily Load (TMDL) for turbidity, fine sediment, high pH, or phosphorus must be consistent with the TMDL. Refer to <http://www.ecy.wa.gov/programs/wq/tmdl/TMDLsbyWria/TMDLbyWria.html> for more information on TMDLs.
 - a. Where an applicable TMDL sets specific waste load allocations or requirements for discharges covered by this permit, discharges must be consistent with any specific waste load allocations or requirements established by the applicable TMDL.
 - i. The Permittee must sample discharges weekly, unless otherwise specified by the TMDL, to evaluate compliance with the specific waste load allocations or requirements.
 - ii. Analytical methods used to meet the monitoring requirements must conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136.
 - iii. Turbidity and pH methods need not be accredited or registered unless conducted at a laboratory which must otherwise be accredited or registered.
 - b. Where an applicable TMDL has established a general waste load allocation for construction stormwater discharges, but has not identified specific requirements, compliance with Special Conditions S4 (Monitoring) and S9 (SWPPPs) will constitute compliance with the approved TMDL.
 - c. Where an applicable TMDL has not specified a waste load allocation for construction stormwater discharges, but has not excluded these discharges, compliance with Special Conditions S4 (Monitoring) and S9 (SWPPPs) will constitute compliance with the approved TMDL.
 - d. Where an applicable TMDL specifically precludes or prohibits discharges from construction activity, the operator is not eligible for coverage under this permit.

S9. STORMWATER POLLUTION PREVENTION PLAN

The Permittee must prepare and properly implement an adequate Stormwater Pollution Prevention Plan (SWPPP) for construction activity in accordance with the requirements of this permit beginning with initial soil disturbance and until final stabilization.

A. The Permittee's SWPPP must meet the following objectives:

1. To identify best management practices (BMPs) which prevent erosion and sedimentation, and to reduce, eliminate or prevent stormwater contamination and water pollution from construction activity.
2. To prevent violations of surface water quality, groundwater quality, or sediment management standards.
3. To control peak volumetric flow rates and velocities of stormwater discharges.

B. General Requirements

1. The SWPPP must include a narrative and drawings. All BMPs must be clearly referenced in the narrative and marked on the drawings. The SWPPP narrative must include documentation to explain and justify the pollution prevention decisions made for the project. Documentation must include:
 - a. Information about existing site conditions (topography, drainage, soils, vegetation, etc.).
 - b. Potential erosion problem areas.
 - c. The 13 elements of a SWPPP in Special Condition S9.D.1-13, including BMPs used to address each element.
 - d. Construction phasing/sequence and general BMP implementation schedule.
 - e. The actions to be taken if BMP performance goals are not achieved—for example, a contingency plan for additional treatment and/or storage of stormwater that would violate the water quality standards if discharged.
 - f. Engineering calculations for ponds, treatment systems, and any other designed structures. When a treatment system requires engineering calculations, these calculations must be included in the SWPPP. Engineering calculations do not need to be included in the SWPPP for treatment systems that do not require such calculations.
2. The Permittee must modify the SWPPP if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is, or would be, ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The Permittee must then:
 - a. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within 7 days of the inspection or investigation.
 - b. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible, addressing the problems no later than 10 days from the inspection or investigation. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when an extension is requested by a Permittee within the initial 10-day response period.
 - c. Document BMP implementation and maintenance in the site log book.

The Permittee must modify the SWPPP whenever there is a change in design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the State.

C. Stormwater Best Management Practices (BMPs)

BMPs must be consistent with:

1. *Stormwater Management Manual for Western Washington* (most current approved edition at the time this permit was issued), for sites west of the crest of the Cascade Mountains; or

2. *Stormwater Management Manual for Eastern Washington* (most current approved edition at the time this permit was issued), for sites east of the crest of the Cascade Mountains; *or*
3. Revisions to the manuals listed in Special Condition S9.C.1 & 2, or other stormwater management guidance documents or manuals which provide an equivalent level of pollution prevention, that are approved by Ecology and incorporated into this permit in accordance with the permit modification requirements of WAC 173-226-230; *or*
4. Documentation in the SWPPP that the BMPs selected provide an equivalent level of pollution prevention, compared to the applicable stormwater management manuals, including:
 - a. The technical basis for the selection of all stormwater BMPs (scientific, technical studies, and/or modeling) that support the performance claims for the BMPs being selected.
 - b. An assessment of how the selected BMP will satisfy AKART requirements and the applicable federal technology-based treatment requirements under 40 CFR part 125.3.

D. SWPPP – Narrative Contents and Requirements

The Permittee must include each of the 13 elements below in Special Condition S9.D.1-13 in the narrative of the SWPPP and implement them unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the SWPPP.

1. Preserve Vegetation/Mark Clearing Limits
 - a. Before beginning land-disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area.
 - b. Retain the duff layer, native topsoil, and natural vegetation in an undisturbed state to the maximum degree practicable.
2. Establish Construction Access
 - a. Limit construction vehicle access and exit to one route, if possible.
 - b. Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMPs, to minimize tracking sediment onto roads.
 - c. Locate wheel wash or tire baths on site, if the stabilized construction entrance is not effective in preventing tracking sediment onto roads.
 - d. If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (for example, during wet weather). Remove sediment from roads by shoveling, sweeping, or pickup and transport of the sediment to a controlled sediment disposal area.
 - e. Conduct street washing only after sediment removal in accordance with Special Condition S9.D.2.d.
 - f. Control street wash wastewater by pumping back on site or otherwise preventing it from discharging into systems tributary to waters of the State.

3. Control Flow Rates

- a. Protect properties and waterways downstream of construction sites from erosion and the associated discharge of turbid waters due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site, as required by local plan approval authority.
- b. Where necessary to comply with Special Condition S9.D.3.a, construct stormwater infiltration or detention BMPs as one of the first steps in grading. Assure that detention BMPs function properly before constructing site improvements (for example, impervious surfaces).
- c. If permanent infiltration ponds are used for flow control during construction, protect these facilities from sedimentation during the construction phase.

4. Install Sediment Controls

The Permittee must design, install and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants. At a minimum, the Permittee must:

- a. Construct sediment control BMPs (sediment ponds, traps, filters, infiltration facilities, etc.) as one of the first steps in grading. These BMPs must be functional before other land disturbing activities take place.
- b. Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.
- c. Direct stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Special Condition S9.D.3.a.
- d. Locate BMPs intended to trap sediment on site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.
- e. Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration, unless infeasible.
- f. Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.

5. Stabilize Soils

- a. The Permittee must stabilize exposed and unworked soils by application of effective BMPs that prevent erosion. Applicable BMPs include, but are not limited to: temporary and permanent seeding, sodding, mulching, plastic covering, erosion

control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.

- b. The Permittee must control stormwater volume and velocity within the site to minimize soil erosion.
- c. The Permittee must control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- d. Depending on the geographic location of the project, the Permittee must not allow soils to remain exposed and unworked for more than the time periods set forth below to prevent erosion.

West of the Cascade Mountains Crest

During the dry season (May 1 - September 30): 7 days

During the wet season (October 1 - April 30): 2 days

East of the Cascade Mountains Crest, except for Central Basin*

During the dry season (July 1 - September 30): 10 days

During the wet season (October 1 - June 30): 5 days

The Central Basin*, East of the Cascade Mountains Crest

During the dry Season (July 1 - September 30): 30 days

During the wet season (October 1 - June 30): 15 days

***Note: The Central Basin** is defined as the portions of Eastern Washington with mean annual precipitation of less than 12 inches.

- e. The Permittee must stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- f. The Permittee must stabilize soil stockpiles from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways, and drainage channels.
- g. The Permittee must minimize the amount of soil exposed during construction activity.
- h. The Permittee must minimize the disturbance of steep slopes.
- i. The Permittee must minimize soil compaction and, unless infeasible, preserve topsoil.

6. Protect Slopes

- a. The Permittee must design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).
- b. The Permittee must divert off-site stormwater (run-on) or groundwater away from slopes and disturbed areas with interceptor dikes, pipes, and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.
- c. At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.

- i. West of the Cascade Mountains Crest: Temporary pipe slope drains must handle the peak 10-minute flow rate from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas should be modeled as "landscaped area."
 - ii. East of the Cascade Mountains Crest: Temporary pipe slope drains must handle the expected peak flow rate from a 6-month, 3-hour storm for the developed condition, referred to as the short duration storm.
- d. Place excavated material on the uphill side of trenches, consistent with safety and space considerations.
- e. Place check dams at regular intervals within constructed channels that are cut down a slope.
- 7. Protect Drain Inlets
 - a. Protect all storm drain inlets made operable during construction so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.
 - b. Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).
- 8. Stabilize Channels and Outlets
 - a. Design, construct and stabilize all on-site conveyance channels to prevent erosion from the following expected peak flows:
 - i. West of the Cascade Mountains Crest: Channels must handle the peak 10-minute flow rate from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the WWHM to predict flows, bare soil areas should be modeled as "landscaped area."
 - ii. East of the Cascade Mountains Crest: Channels must handle the expected peak flow rate from a 6-month, 3-hour storm for the developed condition, referred to as the short duration storm.
 - b. Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches at the outlets of all conveyance systems.

9. Control Pollutants

Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants. The Permittee must:

- a. Handle and dispose of all pollutants, including waste materials and demolition debris that occur on site in a manner that does not cause contamination of stormwater.
- b. Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. Minimize storage of hazardous materials on-site. Safety Data Sheets (SDS) should be supplied for all materials stored. Chemicals should be kept in their original labeled containers. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume of the largest tank within the containment structure. Double-walled tanks do not require additional secondary containment.
- c. Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.
- d. Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland land application, or to the sanitary sewer with local sewer district approval.
- e. Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.
- f. Use BMPs to prevent contamination of stormwater runoff by pH-modifying sources. The sources for this contamination include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, recycled concrete stockpiles, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters. (Also refer to the definition for "concrete wastewater" in Appendix A – Definitions.)
- g. Adjust the pH of stormwater or authorized non-stormwater if necessary to prevent an exceedance of groundwater and/or surface water quality standards.
- h. Assure that washout of concrete trucks is performed off-site or in designated concrete washout areas only. Do not wash out concrete truck drums onto the ground, or into storm drains, open ditches, streets, or streams. Washout of small concrete handling equipment may be disposed of in a formed area awaiting concrete where it will not contaminate surface or groundwater. Do not dump excess concrete on site, except in designated concrete washout areas. Concrete spillage or concrete discharge directly to groundwater or surface waters of the State is

prohibited. At no time shall concrete be washed off into the footprint of an area where an infiltration BMP will be installed.

- i. Obtain written approval from Ecology before using any chemical treatment, with the exception of CO₂, dry ice or food grade vinegar, to adjust pH.
- j. Uncontaminated water from water-only based shaft drilling for construction of building, road, and bridge foundations may be infiltrated provided the wastewater is managed in a way that prohibits discharge to surface waters. Prior to infiltration, water from water-only based shaft drilling that comes into contact with curing concrete must be neutralized until pH is in the range of 6.5 to 8.5 (su).

10. Control Dewatering

- a. Permittees must discharge foundation, vault, and trench dewatering water, which have characteristics similar to stormwater runoff at the site, in conjunction with BMPs to reduce sedimentation before discharge to a sediment trap or sediment pond.
- b. Permittees may discharge clean, non-turbid dewatering water, such as well-point groundwater, to systems tributary to, or directly into surface waters of the State, as specified in Special Condition S9.D.8, provided the dewatering flow does not cause erosion or flooding of receiving waters. Do not route clean dewatering water through stormwater sediment ponds. Note that “surface waters of the State” may exist on a construction site as well as off site; for example, a creek running through a site.
- c. Other dewatering treatment or disposal options may include:
 - i. Infiltration
 - ii. Transport off site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.
 - iii. Ecology-approved on-site chemical treatment or other suitable treatment technologies (See S9.D.9.i, regarding chemical treatment written approval).
 - iv. Sanitary or combined sewer discharge with local sewer district approval, if there is no other option.
 - v. Use of a sedimentation bag with discharge to a ditch or swale for small volumes of localized dewatering.
- d. Permittees must handle highly turbid or contaminated dewatering water separately from stormwater.

11. Maintain BMPs

- a. Permittees must maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function in accordance with BMP specifications.
- b. Permittees must remove all temporary erosion and sediment control BMPs within 30 days after achieving final site stabilization or after the temporary BMPs are no longer needed.

12. Manage the Project

- a. Phase development projects to the maximum degree practicable and take into account seasonal work limitations.
- b. Inspect, maintain and repair all BMPs as needed to assure continued performance of their intended function. Conduct site inspections and monitoring in accordance with Special Condition S4.
- c. Maintain, update, and implement the SWPPP in accordance with Special Conditions S3, S4, and S9.

13. Protect Low Impact Development (LID) BMPs

The primary purpose of on-site LID Stormwater Management is to reduce the disruption of the natural site hydrology through infiltration. LID BMPs are permanent facilities.

- a. Permittees must protect all LID BMPs (including, but not limited to, Bioretention and Rain Garden facilities) from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the Bioretention and/or Rain Garden facilities. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the facility must include removal of sediment and any sediment-laden bioretention/ rain garden soils, and replacing the removed soils with soils meeting the design specification.
- b. Permittees must maintain the infiltration capabilities of LID BMPs by protecting against compaction by construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.
- c. Permittees must control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements or base materials.
- d. Permittees must clean permeable pavements fouled with sediments or no longer passing an initial infiltration test using local stormwater manual methodology or the manufacturer's procedures.
- e. Permittees must keep all heavy equipment off existing soils under LID BMPs that have been excavated to final grade to retain the infiltration rate of the soils.

E. SWPPP – Map Contents and Requirements

The Permittee's SWPPP must also include a vicinity map or general location map (for example, a USGS quadrangle map, a portion of a county or city map, or other appropriate map) with enough detail to identify the location of the construction site and receiving waters within one mile of the site.

The SWPPP must also include a legible site map (or maps) showing the entire construction site. The following features must be identified, unless not applicable due to site conditions.

1. The direction of north, property lines, and existing structures and roads.
2. Cut and fill slopes indicating the top and bottom of slope catch lines.

3. Approximate slopes, contours, and direction of stormwater flow before and after major grading activities.
4. Areas of soil disturbance and areas that will not be disturbed.
5. Locations of structural and nonstructural controls (BMPs) identified in the SWPPP.
6. Locations of off-site material, stockpiles, waste storage, borrow areas, and vehicle/equipment storage areas.
7. Locations of all surface water bodies, including wetlands.
8. Locations where stormwater or non-stormwater discharges off-site and/or to a surface waterbody, including wetlands.
9. Location of water quality sampling station(s), if sampling is required by state or local permitting authority.
10. Areas where final stabilization has been accomplished and no further construction-phase permit requirements apply.
11. Location or proposed location of LID facilities.

S10. NOTICE OF TERMINATION

Partial terminations of permit coverage are not authorized.

A. The site is eligible for termination of coverage when it has met any of the following conditions:

1. The site has undergone final stabilization, the Permittee has removed all temporary BMPs (except biodegradable BMPs clearly manufactured with the intention for the material to be left in place and not interfere with maintenance or land use), and all stormwater discharges associated with construction activity have been eliminated; *or*
2. All portions of the site that have not undergone final stabilization per Special Condition S10.A.1 have been sold and/or transferred (per Special Condition S2.A), and the Permittee no longer has operational control of the construction activity; *or*
3. For residential construction only, the Permittee has completed temporary stabilization and the homeowners have taken possession of the residences.

B. When the site is eligible for termination, the Permittee must submit a complete and accurate Notice of Termination (NOT) form, signed in accordance with General Condition G2, to:

Department of Ecology
Water Quality Program - Construction Stormwater
PO Box 47696
Olympia, WA 98504-7696

When an electronic termination form is available, the Permittee may choose to submit a complete and accurate Notice of Termination (NOT) form through the Water Quality Permitting Portal rather than mailing a hardcopy as noted above.

The termination is effective on the 31st calendar day following the date Ecology receives a complete NOT form, unless Ecology notifies the Permittee that termination request is denied because the Permittee has not met the eligibility requirements in Special Condition S10.A.

Permittees are required to comply with all conditions and effluent limitations in the permit until the permit has been terminated.

Permittees transferring the property to a new property owner or operator/Permittee are required to complete and submit the Notice of Transfer form to Ecology, but are not required to submit a Notice of Termination form for this type of transaction.

GENERAL CONDITIONS

G1. DISCHARGE VIOLATIONS

All discharges and activities authorized by this general permit must be consistent with the terms and conditions of this general permit. Any discharge of any pollutant more frequent than or at a level in excess of that identified and authorized by the general permit must constitute a violation of the terms and conditions of this permit.

G2. SIGNATORY REQUIREMENTS

- A. All permit applications must bear a certification of correctness to be signed:
 - 1. In the case of corporations, by a responsible corporate officer.
 - 2. In the case of a partnership, by a general partner of a partnership.
 - 3. In the case of sole proprietorship, by the proprietor.
 - 4. In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official.
- B. All reports required by this permit and other information requested by Ecology (including NOIs, NOTs, and Transfer of Coverage forms) must be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:
 - 1. The authorization is made in writing by a person described above and submitted to Ecology.
 - 2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters.
- C. Changes to authorization. If an authorization under paragraph G2.B.2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph G2.B.2 above must be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative.
- D. Certification. Any person signing a document under this section must make the following certification:

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

G3. RIGHT OF INSPECTION AND ENTRY

The Permittee must allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law:

- A.** To enter upon the premises where a discharge is located or where any records are kept under the terms and conditions of this permit.
- B.** To have access to and copy, at reasonable times and at reasonable cost, any records required to be kept under the terms and conditions of this permit.
- C.** To inspect, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.
- D.** To sample or monitor, at reasonable times, any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G4. GENERAL PERMIT MODIFICATION AND REVOCATION

This permit may be modified, revoked and reissued, or terminated in accordance with the provisions of Chapter 173-226 WAC. Grounds for modification, revocation and reissuance, or termination include, but are not limited to, the following:

- A.** When a change occurs in the technology or practices for control or abatement of pollutants applicable to the category of dischargers covered under this permit.
- B.** When effluent limitation guidelines or standards are promulgated pursuant to the CWA or Chapter 90.48 RCW, for the category of dischargers covered under this permit.
- C.** When a water quality management plan containing requirements applicable to the category of dischargers covered under this permit is approved, or
- D.** When information is obtained that indicates cumulative effects on the environment from dischargers covered under this permit are unacceptable.

G5. REVOCATION OF COVERAGE UNDER THE PERMIT

Pursuant to Chapter 43.21B RCW and Chapter 173-226 WAC, the Director may terminate coverage for any discharger under this permit for cause. Cases where coverage may be terminated include, but are not limited to, the following:

- A.** Violation of any term or condition of this permit.
- B.** Obtaining coverage under this permit by misrepresentation or failure to disclose fully all relevant facts.
- C.** A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.
- D.** Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.
- E.** A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations.
- F.** Nonpayment of permit fees or penalties assessed pursuant to RCW 90.48.465 and Chapter 173-224 WAC.

- G.** Failure of the Permittee to satisfy the public notice requirements of WAC 173-226-130(5), when applicable.

The Director may require any discharger under this permit to apply for and obtain coverage under an individual permit or another more specific general permit. Permittees who have their coverage revoked for cause according to WAC 173-226-240 may request temporary coverage under this permit during the time an individual permit is being developed, provided the request is made within ninety (90) days from the time of revocation and is submitted along with a complete individual permit application form.

G6. REPORTING A CAUSE FOR MODIFICATION

The Permittee must submit a new application, or a supplement to the previous application, whenever a material change to the construction activity or in the quantity or type of discharge is anticipated which is not specifically authorized by this permit. This application must be submitted at least sixty (60) days prior to any proposed changes. Filing a request for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not relieve the Permittee of the duty to comply with the existing permit until it is modified or reissued.

G7. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in this permit will be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G8. DUTY TO REAPPLY

The Permittee must apply for permit renewal at least 180 days prior to the specified expiration date of this permit. The Permittee must reapply using the electronic application form (NOI) available on Ecology's website. Permittees unable to submit electronically (for example, those who do not have an internet connection) must contact Ecology to request a waiver and obtain instructions on how to obtain a paper NOI.

Department of Ecology
Water Quality Program - Construction Stormwater
PO Box 47696
Olympia, WA 98504-7696

G9. REMOVED SUBSTANCE

The Permittee must not re-suspend or reintroduce collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of stormwater to the final effluent stream for discharge to state waters.

G10. DUTY TO PROVIDE INFORMATION

The Permittee must submit to Ecology, within a reasonable time, all information that Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee must also submit to Ecology, upon request, copies of records required to be kept by this permit [40 CFR 122.41(h)].

G11. OTHER REQUIREMENTS OF 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G12. ADDITIONAL MONITORING

Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G13. PENALTIES FOR VIOLATING PERMIT CONDITIONS

Any person who is found guilty of willfully violating the terms and conditions of this permit shall be deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to ten thousand dollars (\$10,000) and costs of prosecution, or by imprisonment at the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit shall incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars (\$10,000) for every such violation. Each and every such violation shall be a separate and distinct offense, and in case of a continuing violation, every day's continuance shall be deemed to be a separate and distinct violation.

G14. UPSET

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs or other relevant evidence that: 1) an upset occurred and that the Permittee can identify the cause(s) of the upset; 2) the permitted facility was being properly operated at the time of the upset; 3) the Permittee submitted notice of the upset as required in Special Condition S5.F, and; 4) the Permittee complied with any remedial measures required under this permit.

In any enforcement proceeding, the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G15. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

G16. DUTY TO COMPLY

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G17. TOXIC POLLUTANTS

The Permittee must comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G18. PENALTIES FOR TAMPERING

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than two years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this condition, punishment shall be a fine of not more than \$20,000 per day of violation, or imprisonment of not more than four (4) years, or both.

G19. REPORTING PLANNED CHANGES

The Permittee must, as soon as possible, give notice to Ecology of planned physical alterations, modifications or additions to the permitted construction activity. The Permittee should be aware that, depending on the nature and size of the changes to the original permit, a new public notice and other permit process requirements may be required. Changes in activities that require reporting to Ecology include those that will result in:

- A.** The permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b).
- B.** A significant change in the nature or an increase in quantity of pollutants discharged, including but not limited to: a 20% or greater increase in acreage disturbed by construction activity.
- C.** A change in or addition of surface water(s) receiving stormwater or non-stormwater from the construction activity.
- D.** A change in the construction plans and/or activity that affects the Permittee's monitoring requirements in Special Condition S4.

Following such notice, permit coverage may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation.

G20. REPORTING OTHER INFORMATION

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to Ecology, it must promptly submit such facts or information.

G21. REPORTING ANTICIPATED NON-COMPLIANCE

The Permittee must give advance notice to Ecology by submission of a new application or supplement thereto at least forty-five (45) days prior to commencement of such discharges, of any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility or activity which may result in noncompliance with permit limits or conditions. Any maintenance of facilities, which might necessitate unavoidable interruption of

operation and degradation of effluent quality, must be scheduled during non-critical water quality periods and carried out in a manner approved by Ecology.

G22. REQUESTS TO BE EXCLUDED FROM COVERAGE UNDER THE PERMIT

Any discharger authorized by this permit may request to be excluded from coverage under the general permit by applying for an individual permit. The discharger must submit to the Director an application as described in WAC 173-220-040 or WAC 173-216-070, whichever is applicable, with reasons supporting the request. These reasons will fully document how an individual permit will apply to the applicant in a way that the general permit cannot. Ecology may make specific requests for information to support the request. The Director will either issue an individual permit or deny the request with a statement explaining the reason for the denial. When an individual permit is issued to a discharger otherwise subject to the construction stormwater general permit, the applicability of the construction stormwater general permit to that Permittee is automatically terminated on the effective date of the individual permit.

G23. APPEALS

- A.** The terms and conditions of this general permit, as they apply to the appropriate class of dischargers, are subject to appeal by any person within 30 days of issuance of this general permit, in accordance with Chapter 43.21B RCW, and Chapter 173-226 WAC.
- B.** The terms and conditions of this general permit, as they apply to an individual discharger, are appealable in accordance with Chapter 43.21B RCW within 30 days of the effective date of coverage of that discharger. Consideration of an appeal of general permit coverage of an individual discharger is limited to the general permit's applicability or nonapplicability to that individual discharger.
- C.** The appeal of general permit coverage of an individual discharger does not affect any other dischargers covered under this general permit. If the terms and conditions of this general permit are found to be inapplicable to any individual discharger(s), the matter shall be remanded to Ecology for consideration of issuance of an individual permit or permits.

G24. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit, or application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

G25. BYPASS PROHIBITED

A. Bypass Procedures

Bypass, which is the intentional diversion of waste streams from any portion of a treatment facility, is prohibited for stormwater events below the design criteria for stormwater management. Ecology may take enforcement action against a Permittee for bypass unless one of the following circumstances (1, 2, 3 or 4) is applicable.

- 1. Bypass of stormwater is consistent with the design criteria and part of an approved management practice in the applicable stormwater management manual.
- 2. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

Bypass is authorized if it is for essential maintenance and does not have the potential to cause violations of limitations or other conditions of this permit, or adversely impact public health.

3. Bypass of stormwater is unavoidable, unanticipated, and results in noncompliance of this permit.

This bypass is permitted only if:

- a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.
 - b. There are no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, maintenance during normal periods of equipment downtime (but not if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance), or transport of untreated wastes to another treatment facility.
 - c. Ecology is properly notified of the bypass as required in Special Condition S5.F of this permit.
4. A planned action that would cause bypass of stormwater and has the potential to result in noncompliance of this permit during a storm event.

The Permittee must notify Ecology at least thirty (30) days before the planned date of bypass. The notice must contain:

- a. A description of the bypass and its cause
 - b. An analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing.
 - c. A cost-effectiveness analysis of alternatives including comparative resource damage assessment.
 - d. The minimum and maximum duration of bypass under each alternative.
 - e. A recommendation as to the preferred alternative for conducting the bypass.
 - f. The projected date of bypass initiation.
 - g. A statement of compliance with SEPA.
 - h. A request for modification of water quality standards as provided for in WAC 173-201A-110, if an exceedance of any water quality standard is anticipated.
 - i. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.
5. For probable construction bypasses, the need to bypass is to be identified as early in the planning process as possible. The analysis required above must be considered during

preparation of the Stormwater Pollution Prevention Plan (SWPPP) and must be included to the extent practical. In cases where the probable need to bypass is determined early, continued analysis is necessary up to and including the construction period in an effort to minimize or eliminate the bypass.

Ecology will consider the following before issuing an administrative order for this type bypass:

- a. If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.
- b. If there are feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.
- c. If the bypass is planned and scheduled to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, Ecology will approve, conditionally approve, or deny the request. The public must be notified and given an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Approval of a request to bypass will be by administrative order issued by Ecology under RCW 90.48.120.

B. Duty to Mitigate

The Permittee is required to take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

APPENDIX A – DEFINITIONS

AKART is an acronym for “All Known, Available, and Reasonable methods of prevention, control, and Treatment.” AKART represents the most current methodology that can be reasonably required for preventing, controlling, or abating the pollutants and controlling pollution associated with a discharge.

Applicable TMDL means a TMDL for turbidity, fine sediment, high pH, or phosphorus, which was completed and approved by EPA before January 1, 2021, or before the date the operator’s complete permit application is received by Ecology, whichever is later. TMDLs completed after a complete permit application is received by Ecology become applicable to the Permittee only if they are imposed through an administrative order by Ecology, or through a modification of permit coverage.

Applicant means an *operator* seeking coverage under this permit.

Benchmark means a pollutant concentration used as a permit threshold, below which a pollutant is considered unlikely to cause a water quality violation, and above which it may. When pollutant concentrations exceed benchmarks, corrective action requirements take effect. Benchmark values are not water quality standards and are not numeric effluent limitations; they are indicator values.

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the State. BMPs include treatment systems, operating procedures, and practices to control stormwater associated with construction activity, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Buffer means an area designated by a local jurisdiction that is contiguous to and intended to protect a sensitive area.

Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

Calendar Day A period of 24 consecutive hours starting at 12:00 midnight and ending the following 12:00 midnight.

Calendar Week (same as **Week**) means a period of seven consecutive days starting at 12:01 a.m. (0:01 hours) on Sunday.

Certified Erosion and Sediment Control Lead (CESCL) means a person who has current certification through an approved erosion and sediment control training program that meets the minimum training standards established by Ecology (See BMP C160 in the SWMM).

Chemical Treatment means the addition of chemicals to stormwater and/or authorized non-stormwater prior to filtration and discharge to surface waters.

Clean Water Act (CWA) means the Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, and 97-117; USC 1251 et seq.

Combined Sewer means a sewer which has been designed to serve as a sanitary sewer and a storm sewer, and into which inflow is allowed by local ordinance.

Common Plan of Development or Sale means a site where multiple separate and distinct construction activities may be taking place at different times on different schedules and/or by different contractors, but still under a single plan. Examples include: 1) phased projects and projects with multiple filings or lots, even if the separate phases or filings/lots will be constructed under separate contract or by separate owners (e.g., a development where lots are sold to separate builders); 2) a development plan that may be phased over multiple years, but is still under a consistent plan for long-term development; 3) projects in a contiguous area that may be unrelated but still under the same contract, such as construction of a building extension and a new parking lot at the same facility; and 4) linear projects such as roads, pipelines, or utilities. If the project is part of a common plan of development or sale, the disturbed area of the entire plan must be used in determining permit requirements.

Composite Sample means a mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing discrete samples. May be "time-composite" (collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increases while maintaining a constant time interval between the aliquots).

Concrete Wastewater means any water used in the production, pouring and/or clean-up of concrete or concrete products, and any water used to cut, grind, wash, or otherwise modify concrete or concrete products. Examples include water used for or resulting from concrete truck/mixer/pumper/tool/chute rinsing or washing, concrete saw cutting and surfacing (sawing, coring, grinding, roughening, hydro-demolition, bridge and road surfacing). When stormwater comes in contact with concrete wastewater, the resulting water is considered concrete wastewater and must be managed to prevent discharge to waters of the State, including groundwater.

Construction Activity means land disturbing operations including clearing, grading or excavation which disturbs the surface of the land (including off-site disturbance acreage related to construction-support activity). Such activities may include road construction, construction of residential houses, office buildings, or industrial buildings, site preparation, soil compaction, movement and stockpiling of topsoils, and demolition activity.

Construction Support Activity means off-site acreage that will be disturbed as a direct result of the construction project and will discharge stormwater. For example, off-site equipment staging yards, material storage areas, borrow areas, and parking areas.

Contaminant means any hazardous substance that does not occur naturally or occurs at greater than natural background levels. See definition of "hazardous substance" and WAC 173-340-200.

Contaminated soil means soil which contains contaminants, pollutants, or hazardous substances that do not occur naturally or occur at levels greater than natural background.

Contaminated groundwater means groundwater which contains contaminants, pollutants, or hazardous substances that do not occur naturally or occur at levels greater than natural background.

Demonstrably Equivalent means that the technical basis for the selection of all stormwater BMPs is documented within a SWPPP, including:

1. The method and reasons for choosing the stormwater BMPs selected.
2. The pollutant removal performance expected from the BMPs selected.

3. The technical basis supporting the performance claims for the BMPs selected, including any available data concerning field performance of the BMPs selected.
4. An assessment of how the selected BMPs will comply with state water quality standards.
5. An assessment of how the selected BMPs will satisfy both applicable federal technology-based treatment requirements and state requirements to use all known, available, and reasonable methods of prevention, control, and treatment (AKART).

Department means the Washington State Department of Ecology.

Detention means the temporary storage of stormwater to improve quality and/or to reduce the mass flow rate of discharge.

Dewatering means the act of pumping groundwater or stormwater away from an active construction site.

Director means the Director of the Washington State Department of Ecology or his/her authorized representative.

Discharger means an owner or operator of any facility or activity subject to regulation under Chapter 90.48 RCW or the Federal Clean Water Act.

Domestic Wastewater means water carrying human wastes, including kitchen, bath, and laundry wastes from residences, buildings, industrial establishments, or other places, together with such groundwater infiltration or surface waters as may be present.

Ecology means the Washington State Department of Ecology.

Engineered Soils means the use of soil amendments including, but not limited, to Portland cement treated base (CTB), cement kiln dust (CKD), or fly ash to achieve certain desirable soil characteristics.

Equivalent BMPs means operational, source control, treatment, or innovative BMPs which result in equal or better quality of stormwater discharge to surface water or to groundwater than BMPs selected from the SWMM.

Erosion means the wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

Erosion and Sediment Control BMPs means BMPs intended to prevent erosion and sedimentation, such as preserving natural vegetation, seeding, mulching and matting, plastic covering, filter fences, sediment traps, and ponds. Erosion and sediment control BMPs are synonymous with stabilization and structural BMPs.

Federal Operator is an entity that meets the definition of "Operator" in this permit and is either any department, agency or instrumentality of the executive, legislative, and judicial branches of the Federal government of the United States, or another entity, such as a private contractor, performing construction activity for any such department, agency, or instrumentality.

Final Stabilization (same as **fully stabilized** or **full stabilization**) means the completion of all soil disturbing activities at the site and the establishment of permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions, or geotextiles) which will prevent erosion. See the applicable Stormwater Management Manual for more information on vegetative cover expectations and equivalent permanent stabilization measures.

Groundwater means water in a saturated zone or stratum beneath the land surface or a surface waterbody.

Hazardous Substance means any dangerous or extremely hazardous waste as defined in RCW 70.105.010 (5) and (6), or any dangerous or extremely dangerous waste as designated by rule under chapter 70.105 RCW; any hazardous sub-stance as defined in RCW 70.105.010(14) or any hazardous substance as defined by rule under chapter 70.105 RCW; any substance that, on the effective date of this section, is a hazardous substance under section 101(14) of the federal cleanup law, 42U.S.C., Sec. 9601(14); petroleum or petroleum products; and any substance or category of substances, including solid waste decomposition products, determined by the director by rule to present a threat to human health or the environment if released into the environment. The term hazardous substance does not include any of the following when contained in an underground storage tank from which there is not a release: crude oil or any fraction thereof or petroleum, if the tank is in compliance with all applicable federal, state, and local law.

Injection Well means a well that is used for the subsurface emplacement of fluids. (See **Well**.)

Jurisdiction means a political unit such as a city, town or county; incorporated for local self-government.

National Pollutant Discharge Elimination System (NPDES) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the State from point sources. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington State Department of Ecology.

Notice of Intent (NOI) means the application for, or a request for coverage under this general permit pursuant to WAC 173-226-200.

Notice of Termination (NOT) means a request for termination of coverage under this general permit as specified by Special Condition S10 of this permit.

Operator means any party associated with a construction project that meets either of the following two criteria:

- The party has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications; or
- The party has day-to-day operational control of those activities at a project that are necessary to ensure compliance with a SWPPP for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWPPP or comply with other permit conditions).

Permittee means individual or entity that receives notice of coverage under this general permit.

pH means a liquid's measure of acidity or alkalinity. A pH of 7 is defined as neutral. Large variations above or below this value are considered harmful to most aquatic life.

pH Monitoring Period means the time period in which the pH of stormwater runoff from a site must be tested a minimum of once every seven days to determine if stormwater pH is between 6.5 and 8.5.

Point Source means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, and container from which pollutants are or may be discharged to surface waters of the State. This term does not include return flows from irrigated agriculture. (See the Fact Sheet for further explanation)

Pollutant means dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, domestic sewage sludge (biosolids), munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste. This term does not include sewage from vessels within the meaning of section 312 of the CWA, nor does it include dredged or fill material discharged in accordance with a permit issued under section 404 of the CWA.

Pollution means contamination or other alteration of the physical, chemical, or biological properties of waters of the State; including change in temperature, taste, color, turbidity, or odor of the waters; or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the State as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare; or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses; or to livestock, wild animals, birds, fish or other aquatic life.

Process Wastewater means any non-stormwater which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product. If stormwater commingles with process wastewater, the commingled water is considered process wastewater.

Receiving Water means the waterbody at the point of discharge. If the discharge is to a storm sewer system, either surface or subsurface, the receiving water is the waterbody to which the storm system discharges. Systems designed primarily for other purposes such as for groundwater drainage, redirecting stream natural flows, or for conveyance of irrigation water/return flows that coincidentally convey stormwater are considered the receiving water.

Representative means a stormwater or wastewater sample which represents the flow and characteristics of the discharge. Representative samples may be a grab sample, a time-proportionate *composite sample*, or a flow proportionate sample. Ecology's Construction Stormwater Monitoring Manual provides guidance on representative sampling.

Responsible Corporate Officer for the purpose of signatory authority means: (i) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures (40 CFR 122.22).

Sanitary Sewer means a sewer which is designed to convey domestic wastewater.

Sediment means the fragmented material that originates from the weathering and erosion of rocks or unconsolidated deposits, and is transported by, suspended in, or deposited by water.

Sedimentation means the depositing or formation of sediment.

Sensitive Area means a waterbody, wetland, stream, aquifer recharge area, or channel migration zone.

SEPA (State Environmental Policy Act) means the Washington State Law, RCW 43.21C.020, intended to prevent or eliminate damage to the environment.

Significant Amount means an amount of a pollutant in a discharge that is amenable to available and reasonable methods of prevention or treatment; or an amount of a pollutant that has a reasonable potential to cause a violation of surface or groundwater quality or sediment management standards.

Significant Concrete Work means greater than 1000 cubic yards placed or poured concrete or recycled concrete used over the life of a project.

Significant Contributor of Pollutants means a facility determined by Ecology to be a contributor of a significant amount(s) of a pollutant(s) to waters of the State of Washington.

Site means the land or water area where any "facility or activity" is physically located or conducted.

Source Control BMPs means physical, structural or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. A few examples of source control BMPs are erosion control practices, maintenance of stormwater facilities, constructing roofs over storage and working areas, and directing wash water and similar discharges to the sanitary sewer or a dead end sump.

Stabilization means the application of appropriate BMPs to prevent the erosion of soils, such as, temporary and permanent seeding, vegetative covers, mulching and matting, plastic covering and sodding. See also the definition of Erosion and Sediment Control BMPs.

Storm Drain means any drain which drains directly into a *storm sewer system*, usually found along roadways or in parking lots.

Storm Sewer System means a means a conveyance, or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains designed or used for collecting or conveying stormwater. This does not include systems which are part of a *combined sewer* or Publicly Owned Treatment Works (POTW), as defined at 40 CFR 122.2.

Stormwater means that portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a stormwater drainage system into a defined surface waterbody, or a constructed infiltration facility.

Stormwater Management Manual (SWMM) or Manual means the technical Manual published by Ecology for use by local governments that contain descriptions of and design criteria for BMPs to prevent, control, or treat pollutants in stormwater.

Stormwater Pollution Prevention Plan (SWPPP) means a documented plan to implement measures to identify, prevent, and control the contamination of point source discharges of stormwater.

Surface Waters of the State includes lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Temporary Stabilization means the exposed ground surface has been covered with appropriate materials to provide temporary stabilization of the surface from water or wind erosion. Materials include, but are not limited to, mulch, riprap, erosion control mats or blankets and temporary cover crops. Seeding alone is not considered stabilization. Temporary stabilization is not a substitute for the more permanent "final stabilization."

Total Maximum Daily Load (TMDL) means a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet state water quality standards. Percentages of the total maximum daily load are allocated to the various pollutant sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The TMDL calculations must include a "margin of safety" to ensure that the waterbody can be protected in case there are unforeseen events or unknown sources of the pollutant. The calculation must also account for seasonable variation in water quality.

Transfer of Coverage (TOC) means a request for transfer of coverage under this general permit as specified by Special Condition S2.A of this permit.

Treatment BMPs means BMPs that are intended to remove pollutants from stormwater. A few examples of treatment BMPs are detention ponds, oil/water separators, biofiltration, and constructed wetlands.

Transparency means a measurement of water clarity in centimeters (cm), using a 60 cm transparency tube. The transparency tube is used to estimate the relative clarity or transparency of water by noting the depth at which a black and white Secchi disc becomes visible when water is released from a value in the bottom of the tube. A transparency tube is sometimes referred to as a "turbidity tube."

Turbidity means the clarity of water expressed as nephelometric turbidity units (NTUs) and measured with a calibrated turbidimeter.

Uncontaminated means free from any contaminant. See definition of "contaminant" and WAC 173-340-200.

Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

Waste Load Allocation (WLA) means the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality based effluent limitation (40 CFR 130.2[h]).

Water-Only Based Shaft Drilling is a shaft drilling process that uses water only and no additives are involved in the drilling of shafts for construction of building, road, or bridge foundations.

Water Quality means the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Waters of the State includes those waters as defined as "waters of the United States" in 40 CFR Subpart 122.2 within the geographic boundaries of Washington State and "waters of the State" as defined in Chapter 90.48 RCW, which include lakes, rivers, ponds, streams, inland waters, underground waters, salt

waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Well means a bored, drilled or driven shaft, or dug hole whose depth is greater than the largest surface dimension. (See **Injection Well**.)

Wheel Wash Wastewater means any water used in, or resulting from the operation of, a tire bath or wheel wash (BMP C106: Wheel Wash), or other structure or practice that uses water to physically remove mud and debris from vehicles leaving a construction site and prevent track-out onto roads. When stormwater comes in contact with wheel wash wastewater, the resulting water is considered wheel wash wastewater and must be managed according to Special Condition S9.D.9.

APPENDIX B – ACRONYMS

AKART	All Known, Available, and Reasonable Methods of Prevention, Control, and Treatment
BMP	Best Management Practice
CESCL	Certified Erosion and Sediment Control Lead
CFR	Code of Federal Regulations
CKD	Cement Kiln Dust
cm	Centimeters
CPD	Common Plan of Development
CTB	Cement-Treated Base
CWA	Clean Water Act
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
ERTS	Environmental Report Tracking System
ESC	Erosion and Sediment Control
FR	Federal Register
LID	Low Impact Development
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
SWMM	Stormwater Management Manual
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
UIC	Underground Injection Control
USC	United States Code
USEPA	United States Environmental Protection Agency
WAC	Washington Administrative Code
WQ	Water Quality
WWHM	Western Washington Hydrology Model

F. 303(d) List Waterbodies / TMDL Waterbodies Information

Search Results - 12 Matched Listings							
Listing ID	AU ID	Medium	Parameter	Category	Waterbody Name	WRIA	WQ Improvement Project
6586	17080005000053_001_001	Water	Temperature	5	COWLITZ RIVER	26-Cowlitz	
17164	17080005000220_001_001	Tissue	Polychlorinated Biphenyls (PCBs)	5	COWLITZ RIVER	26-Cowlitz	
51552	17080005000220_001_001	Tissue	2,3,7,8-TCDD (Dioxin)	5	COWLITZ RIVER	26-Cowlitz	
86610	17080004000212_001_001	Tissue	Polychlorinated Biphenyls (PCBs)	5	COWLITZ RIVER	26-Cowlitz	
86614	17080005000069_001_001	Tissue	Polychlorinated Biphenyls (PCBs)	5	COWLITZ RIVER	26-Cowlitz	
86615	17080005000221_001_001	Tissue	Polychlorinated Biphenyls (PCBs)	5	COWLITZ RIVER	26-Cowlitz	
86616	17080005000222_001_001	Tissue	Polychlorinated Biphenyls (PCBs)	5	COWLITZ RIVER	26-Cowlitz	
88562	17080004000293_001_001	Tissue	Methyl mercury	5	COWLITZ RIVER	26-Cowlitz	
88565	17080005000069_001_001	Tissue	Methyl mercury	5	COWLITZ RIVER	26-Cowlitz	
88566	17080005000220_001_001	Tissue	Methyl mercury	5	COWLITZ RIVER	26-Cowlitz	
88567	17080005000221_001_001	Tissue	Methyl mercury	5	COWLITZ RIVER	26-Cowlitz	
88568	17080005000222_001_001	Tissue	Methyl mercury	5	COWLITZ RIVER	26-Cowlitz	

G. Contaminated Site Information
N/A

H. Engineering Calculations

N/A

Landing on the Cowlitz

Stormwater Master Plan

Technical Information Report

Landing on the Cowlitz – Stormwater Master Plan

March 10, 2025

PREPARED FOR :

City of Castle Rock

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03/10/2025



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March 10, 2025

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Technical Information Report (TIR)
LOTC – Stormwater Master Plan

Engineer's Certification

March 10, 2025
City of Castle Rock
Development Engineer

"I hereby state this Technical Information Report (TIR) has been prepared under my supervision and meets the standards of care and expertise which is usual and customary in this community for professional engineers. The TIR includes the required information per City of Castle Rock's Storm Drainage Standards and complies with the 1992 Stormwater Management Manual for the Puget Sound Basin. The proposed stormwater design is feasible."



03/10/2025

Taylor Wilson, PE
Project Manager

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1. Project Overview

The Landing on the Cowlitz is an approved mixed-use master plan development with a site area of approximately 118 acres.

The approved uses on the site include light industrial, flex/office space, commercial, single-family residential, and recreational. Approximately 53.5 acres have been identified for light industrial use, 12.5 acres for flex/office space, 9.9 acres for commercial uses, 10.3 acres for residential, and 13.9 acres for recreational use (which will include an RV park, recreational trails and other recreational amenities). The remaining acreage consists of public/private roadways and undevelopable shoreline along the Cowlitz River.

This report is being prepared to analyze the future stormwater demands of the site, as well as sizing the storm drain main lines for the site's stormwater outfall and Phase 1 access road (connecting the site to Huntington Ave).

Site Location and Topography

The project is located in the City of Castle Rock, Cowlitz County, WA. The site consists of seven parcels (currently being adjusted per CR-BLA-24-01): Parcel 1 (308640100), Parcel 2 (30813), Parcel 3 (6143802), Parcel 4 (308100200), Parcel 5 (30812), Parcel 6 (308640200), and Parcel 7 (30864). Also, there is an adjacent DNR-owned property to the south that is expected to contribute to the site's runoff in the future and has been included in the contributing area (bounded by the Cowlitz River and Salmon Creek). The project site is accessed from I-5 at exit #48 and is located south of Huntington Avenue S. The property is situated between the BNSF line and Salmon Creek to the east and south, and the Cowlitz River to the west. North of the property is the Timberlake Church and some residential uses along Larsen Lane.

The site is mostly flat, with several closed depressions. Along the western and southern ends of the site, there is a berm that separates the site from Salmon Creek and the Cowlitz River. Towards the southern end of the site there is an approximately 33% slope at the dredge pile that is partially located on the Landing site, with the other part of the pile being located on the DNR parcel.

Existing and Proposed Storm Systems for Early Grading

Prior to any onsite grading, the existing site contained two private ditches to convey stormwater. The main ditch generally runs north-south through the center of the site and utilizes 3 culverts (ranging in size from 15"-24" diam.) to cross existing access roads. The existing secondary ditch is located at the toe of the dredge pile slope located near the southern portion of the site. Both ditches convey stormwater drainage to an existing 24" diameter outfall culvert which discharges to Salmon Creek.

With the initial grading to fill the site above the 100-year flood elevation, the existing primary ditch was widened in its existing alignment. New ditches were installed along the west perimeter of the site to capture and convey onsite runoff and allow neighboring properties to drain in the event of a large storm or flood event. The perimeter ditches are conveyed to a large, flat ditch which acts as a detention pond for the Phase 1 mass grading prior to discharging to Salmon Creek. Temporary sediment and detention ponds were installed near the downstream end of the new ditches while keeping clear of the wetland buffers.

Drainage to and From Adjacent Properties

The overall project site is surrounded by residential lots and a church to the north, the Cowlitz River to the west, the BNSF railroad to the east, Huntington Avenue to the northeast, and Salmon Creek to the south.

Currently there are approximately 5.3 acres of offsite stormwater that flows onto the site from the BNSF railroad to the east and 2.1 acres that flow onto the site from Huntington Ave. In large storm events, it is anticipated that runoff can occur from the adjacent lots to the northwest that are primarily single-family homes on larger lots (along Larsen Lane) and also a Church directly adjacent to the site with paved parking (roughly 32 acres of mostly pervious area). However, this offsite area has many intermediate low points that would need to fill and overflow before making its way onsite.

Environmental Impacts

The FEMA flood map for the project site shows flooding for the 100-year storm event at an elevation of 48' (See appendix A for details). There is an existing wetland that has been mapped near the southeast portion of the property. There is a 200 ft Shoreline Buffer and a 250 ft Critical Habit Buffer that extends onto the site from the ordinary high water mark (OHWM) of both the Cowlitz River and Salmon Creek.

2. Minimum Requirements Overview

The stormwater management design for this project is required to comply with Section 5 of the City of Castle Rock Development Policies and Public Works Standards, and the 1992 Stormwater Management Manual for the Puget Sound Basin. Per section I-2.4.1 of the 1992 Stormwater Management Manual for the Puget Sound Basin and figure I-2.1 "Flowchart for determining Minimum Requirements" (see Appendix A), minimum requirements 1-11 will apply to the site development. The site results in over an acre of land disturbing area. See the Stormwater Master Plan Basin and Conveyance Exhibit, attached in Appendix A, for a more detailed summary of basin areas and conveyance assumptions. For a summary of the basin areas used in all stormwater models, reference the tables below.

Table 1 – Proposed Onsite Basin Summary

Basin	Pervious Area (AC)	Impervious Area (AC)	Total Area (AC)
Road 1	1.160	1.684	2.844
Basin 1	1.210	10.889	12.099
Road 2	0.091	0.250	0.341
Basin 2	4.645	4.276	8.921
Road 3	0.239	0.710	0.949
Basin 3	0.306	2.757	3.063
Basin 4	9.462	66.396	75.858
Total	17.113	86.962	104.075

Table 2 – Proposed Offsite Basin Summary

Basin	Pervious Area (AC)	Impervious Area (AC)	Total Area (AC)
Offsite	25.386	6.346	31.732
Road 4	0.107	0.156	0.263
Total	25.493	6.502	31.995

Below is the summary of the requirements and a brief description of how each applies.

I-2.5 Minimum Requirement #1: Erosion and Sediment Control

For each phase of the project, an Erosion Control Plan and Stormwater Pollution Prevention Plan (SWPPP) will be prepared in accordance with the city requirements.

I-2.6 Minimum Requirement #2: Preservation of Natural Drainage Systems

Natural drainage patterns will be maintained as feasible.

I-2.7 Minimum Requirement #3: Source Control of Pollution

Each phase of the development will implement applicable Source Control BMP's based on the proposed land use.

I-2.8 Minimum Requirement #4: Runoff Treatment BMPs

As each phase is developed, Treatment BMP's will be designed to meet quality control requirements for each land use.

I-2.9 Minimum Requirement #5: Streambank Erosion Control

See Section 3 below for further details.

I-2.10 Minimum Requirement #6: Wetlands

No hydrologic modifications to the existing conditions are proposed for the wetland areas on the site.

I-2.11 Minimum Requirement #7: Water Quality Sensitive Areas

There are no sensitive areas that will be impacted by the current development.

I-2.12 Minimum Requirement #8: Off-site Analysis and Mitigation

See Section 5 below for further discussion.

I-2.13 Minimum Requirement #9: Basin Planning

No watershed-based basin plans are intended to be used to modify any of the minimum requirements at this time.

I-2.14 Minimum Requirement #10: Operation and Maintenance

All onsite stormwater treatment systems will be privately maintained by an HOA. The City of Castle Rock will own, operate, and maintain the proposed offsite stormwater facilities and the two proposed stormwater outfalls to the Cowlitz River. Pages from the 1992 SWMMPSB are attached in Appendix E detailing maintenance requirements for applicable components onsite. The site will be inspected for defects and maintained as needed at least once every season, as well as after all major storm events (including and in excess of the 100-year storm event).

I-2.15 Minimum Requirement #11: Financial Liability

A performance bond or other appropriate financial instruments (as approved by the City) shall be provided to ensure compliance with these standards.

3. Streambank Erosion Control

Per Section 5 of the City of Castle Rock Development Policies and Public Works Standards and the 1992 Stormwater Management Manual for the Puget Sound Basin, the project is required to limit the peak rate of runoff from the developed site to:

- 50% of the existing 2-year, 24-hour design storm
- the 10 year, 24-hour design storm.
- the 25 year, 24-hour design storm.
- the 100 year, 24-hour design storm.

Since the different onsite soils are all classified as Hydrologic Soil Group A, management of runoff is generally through infiltration due to the limited runoff experienced from Group A soils.

Review of the onsite soils for infiltration potential was completed by Columbia West Engineering (CWE) in March 2023 with follow up exploration in March 2024. See Appendix C for the CWE Geotechnical Report and Exploration Map showing locations and tested infiltration rates. Tested infiltration rates ranged from a high of 200 in/hr. to negligible. The test pits identified hardpan layers and strata with very high silt content resulting in very variable rates across the site. Groundwater was also encountered between 9ft and 35ft with the likelihood of perched groundwater at even shallower depths being encountered. Due to the issues related to infiltration rates identified in CWE's original investigation, further investigation was completed in March 2024. The follow up investigations confirmed CWE's recommendations that infiltration should only be used to address Low Impact Development (LID) Best Management Practices (BMP's) rather than as the mechanism to remove all runoff from the site.

Discussions were had with CWE to reclassify the onsite soil from a Group A to a tighter soil type with higher historical runoff. However, due to the high rates tested, a reclassification was not possible. Due to the issues related to both detention and infiltration, direct discharge from the site was explored.

Per the 2024 Stormwater Management Manual for Western Washington Section 1-3.4.7: Flow Control, under TDA Exemption, it states: Flow Control is not required for TDAs that discharge directly to, or

indirectly through an MS4 to a water listed in Appendix 1-A: Flow Control Exempt Receiving Waters. Based on Appendix 1-A, the Cowlitz River is Flow Control Exempt Downstream of confluence of the Ohanapecosh River and the Clear Fork Cowlitz River. Since the confluence of the Ohanapecosh is approximately 85 miles upstream of the site, the project is well within the Flow Control Exempt reaches of the Cowlitz River.

Applying the latest Stormwater Manual for Western Washington (SWMMWW) and thus the Flow Control Exemption rather than the 1992 Puget Sound Manual was discussed with the city. Based on the above site issues, City staff supported using the SWMMWW due to the afore mentioned issues. By applying the flow control exemption, the project also takes on the responsibility to apply the Minimum Requirements (MR) from the manual. The only MR that really differs between the two manuals is the requirement in the SWMMWW to address LID standards. Therefore, future development on the site will meet the LID standards per the requirements.

4. Direct Discharge to the Cowlitz River

Since the site is predominantly located within a 100-year flood zone of the Cowlitz River, any design has to address the ability of a system to remove stormwater from the site in all situations without impacting any buildings or creating any safety issues to the public. There are two distinct areas associated with the project drainage:

- Onsite Areas that will be raised to or above the 100-year flood elevation
- Offsite Areas that will stay at the existing elevation between 42ft and 55ft

The development of the project site will be creating a significant amount of impervious surface that will create a large increase in both runoff flow and volume. To convey this flow from the different parts of the site creates a hydraulic grade line that exceeds the offsite elevation. To address this difference in flow elevation and flow rate/volume, two systems are being proposed for the project; an offsite system and an onsite system, both with their own direct discharge to the Cowlitz River. These systems will be kept hydraulically disconnected so the onsite flow elevation will not impact the elevation of the offsite storm.

Since the offsite area is well below the 100-year flood elevation of 48 ft, this project is proposing several measures to prevent the offsite area from being adversely impacted by not only this development, but also from flooding of the Cowlitz River. The paths that stormwater runoff take to get to the site will remain largely unchanged. The existing culverts from neighboring properties and the series of smaller ditches along the norther boundary that lead to the large drainage ditch onsite will remain in place, with minor modifications to their grades/depths. To keep the offsite and onsite stormwater runoff hydraulically disconnected, an earthen berm will be constructed that separates the existing drainage ditch into two separate detention ponds. The northern most portion of the ditch will be tied to the offsite system while the remaining portion will be used for the onsite system. A 30" storm pipe will be used to convey water from the offsite system to a new outfall along the Cowlitz River. To prevent backflow into the offsite system during flood events in the Cowlitz River, an internal check valve will be installed in the 30" pipe. As a secondary measure, a manhole with a manual slide gate valve will also be installed so that the City can manually isolate the offsite detention pond if the primary valve fails.

If either (or both) of the valves are closed, the offsite system will require a pumping system to ensure that offsite runoff doesn't flood the basin. Since the need for pumping is anticipated to be infrequent

the development is not proposing a permanent pump station at this time. Instead, a dry sump manhole will be constructed in close proximity to the proposed slide gate manhole in which a portable pump can be utilized. Tapani/CT6 is currently in possession of a 2,290 GPM portable pump to maintain the existing drainage system and has agreed to donate that pump to the City upon completion of construction for use on this offsite system. Please see Section 5 for more information on pumping frequency and anticipated performance of the offsite system.

For the onsite area, the conveyance system is being sized to minimize localized flooding even when the Cowlitz River reaches flood stage. Roads and parking will be designed through site development to provide flow routes and ponding locations to ensure that no buildings are impacted if there was ever a 100-year storm event. Onsite conveyance will consist of both underground piping and above ground drainage channels that lead to a second (and separate) outfall at the Cowlitz River. A manhole will be constructed within the earthen berm described above to combine the underground flows with the above ground flows in remaining portion of the onsite ditch. From that point, a 48" storm pipe will convey runoff to the discharge point at the Cowlitz River. This 48" line will also have an internal check valve to prevent backflow onto the site during flood conditions in the Cowlitz River. However, due to the higher hydraulic grade of the onsite system, we do not anticipate that the internal check valve on the onsite system will close as frequently as the valve on the offsite system. In the rare occasions that the internal check valve does close, the remaining portion of the onsite ditch will act as onsite detention until river levels subside. As a measure of extreme precaution, the Phase 1 roadway has been designed so that the surface elevations gradually cascade down towards the river. Runoff can surface flow down the roadway towards the existing ditch until it spills over the edge towards the river. Please see Section 5 for more information on the capabilities and expected operation of the onsite storm system.

5. Conveyance System Analysis and Design

Determination of Ordinary Highwater Mark

In the early stages of the stormwater master planning process, we walked the project frontage along the Cowlitz River with the client and their environmental consultant (Ecological Land Services) to better understand the flow patterns of the river before setting a location and elevation for a potential outfall. Based on observations in the field and the ordinary highwater mark (OHWM) shown on preliminary design documents, it became evident that the OHWM may not have been accurately represented on the preliminary plans. To more clearly define it, we studied the available data for the Cowlitz River at a nearby gauging station and compared it to survey information gathered at various locations along the project frontage on the river.

The nearest gauging station for the Cowlitz River is located at the bridge crossing the river just north of the project site in Castle Rock. On April 25, 2024, surveyors collected the water elevation under the bridge and then captured the water elevation at the location of the proposed outfall location. The water elevation at the bridge gauging station was 33.501 feet at 11:22 am. The water elevation at the north property line of the project was 27.205 feet at 11:51 am. This shows a drop of 6.3 feet from the bridge to the site.

Next, we compared this to the readings at the gauging station from the USGS Gauging Station Web Site. On April 25, 2024, the reading for the water elevation at the bridge was listed as 34.17 feet (at 11:15 am, 11:30 am, and 11:45 am). This shows a difference in datum of 0.7 feet.

Water elevations of the Cowlitz at the gauging station for the previous 4 winters were then downloaded (See Appendix B). Based on the graphs of these flows, a river elevation was estimated that would cover the extended higher flow river surfaces for all the four years. A line at this elevation has been added the graphs. The estimated elevation was 37.2 feet. Based on the difference in datum between the gauging station and the surveyed readings of 0.7 feet, the resulting ordinary high water elevation at the site is 36.5 feet.

Determination of Flood Stage Elevation

The USGS River Gaging Station website lists four classes of flood stages for the Cowlitz River at the Castle Rock Gaging Station: Action Stage (46 ft), Minor Flood Stage (48 ft), Moderate Flood Stage (54 ft), and Major Flood Stage (57 ft). Based on these classifications, a flood event at this site would be any event resulting in a water elevation of 48 feet or higher. Using the same methodology that we used to assume the OHWM at our site in relation to the reading at the gaging station, we were able to determine that any river water level above 41 feet in elevation at the project site should be considered a flood event. More specifically, the flood stages in relation to our site are as follows: Minor Flood Stage (41 ft), Moderate Flood Stage (47 ft), and Major Flood Stage (50 ft).

The USGS Gaging Station website has data for this location dating back to 2007. Since 2007, there have been a total of three events that have reached flood stages (2 minor and 1 moderate). See Appendix B for more information on these events.

Hydraulic Analysis

The stormwater master plan breaks the development into four (4) distinct drainage basins to be drained by either a piped system or ditch in addition to the one (1) offsite drainage basin (See Master Storm Conveyance Plan in Appendix A). In order to simplify the calculations, additional basins were created for the portions of the proposed Phase 1 roadway adjacent to those basins. In accordance with the SWMMWW, the onsite flows to be used in the analysis of the storm system were calculated using WSDOE's WWHM model.

Overall, the stormwater master plan conveyance model for the site is comprised of five (5) nodes. Four of those nodes are tied to the onsite system, while the last node represents the offsite system. A summary of the nodes is shown below:

- Node A – Captures Drainage from Basin 1 (commercial and flex properties) and the adjacent public roadway. Runoff leaves this node in a 24" pipe.
- Node B – Runoff from Basin 2 (residential) and the adjacent public roadway enters the storm main and continues downstream in a 24" pipe.
- Node C – Runoff from Basin 3 (flex) and the adjacent public roadway enters the storm main and the storm pipe is upsized to 30".
- Node D – Runoff from the rest of the onsite area is conveyed to the large onsite drainage ditch/detention pond through a combination of roadside swales, ditches, and culverts. This ditch is tied into a manhole (by 30" pipe) where it converges with the rest of the runoff from Nodes A-C. Runoff leaves this node in a 48" pipe where it continued towards the ultimate discharge point at the proposed Cowlitz River outfall.
- Node E – Any onsite runoff that makes its way to the northern limits of the project area will be collected via ditches along the property lines or culverts to the remaining portion of the existing

ditch that has been preserved for the offsite system. A short stretch of the roadway improvements on Larsen Lane will also be conveyed to this offsite system due to the transitioning grade from our raised site to the lower existing elevations.

To determine the flow from each of the basin areas, a separate WWHM model was developed for the basins leading to each node. Due to the requirements of this project including stormwater treatment and infiltration (to meet the LID Standard), preliminary bioretention planters and infiltration trenches were designed for each basin. These facilities do assist in reducing the amount of runoff being generated by the parcels and help reduce the pipe sizes in our conveyance system. While these designs are not final, preliminary sizing as completed for this report should be a close approximation. These models provide the necessary design flows for each storm event in each basin (See Appendix C for WWHM models). Based on the models, the flows associated with the 2-year, 10-year, 25-year and 100-year storm events for each basin are as follows:

Table 3 - WWHM Flow Rates for the 2-, 10-, 25- and 100-year storm events

	Flow (CFS)				
Storm	Node A	Node B	Node C	Node D	Node E (Offsite)
2 Yr	3.504	2.939	1.112	16.233	10.287
10 Yr	8.044	6.235	2.689	25.643	21.126
25 Yr	10.575	7.928	3.607	29.385	26.397
100 Yr	14.402	10.369	5.016	34.011	33.741

Since conveyance is generally sized to convey the 25-year storm, the table below shows the cumulative flow that can be expected at each node for both the 25-year and 100-year storm events.

Table 4 – Cumulative WWHM Flow Rates at each node for the 25 and 100-year storm events

Node	25-Year	100-Year
A	10.575 CFS	14.402 CFS
B	18.503 CFS	24.771 CFS
C	22.110 CFS	29.787 CFS
D	51.495 CFS	63.798 CFS
E (Offsite)*	26.397 CFS	33.741 CFS

*Offsite system is completely disconnected from the onsite system.

Due to the size of the site, limited vertical elevation available, and the impact from the Cowlitz River, head losses within the conveyance system become the key factor in sizing pipes within the storm system. To offset the project size and losses within the last pipe from the site to the Cowlitz River, a ponded area is being proposed. This ponded area will act as overflow of the open channel ditch that

provides conveyance for Basin 4. The detention provided in this area reduces the peak flow within the pipe thus reducing head losses.

Assumptions and Basis for Conveyance Modeling

HydroCAD was used to model the conveyance since it has the capacity to model detention, change tailwater elevations to determine hydraulic grades through the system, and add pump flows. For the standard 2-, 10-, 25-, and 100-year storm events, the lowest downstream nodes were set to open flow conditions. To hydraulically connect the nodes within HydroCAD, we utilized catch basin ponds instead of reaches. The furthest downstream nodes (D & E) were set with storage areas to match the volumes of the ditches/detention ponds that they're attached to. The offsite system pond storage was designed to match the volume of the remaining ditch, plus a 2' deep area adjacent on the offsite area where any overflow would collect (should that be necessary). This elevation would still be at least 2-3 feet below the finished floor elevations of the nearest structures on the property. The onsite pond was modeled to reflect a future relocation/realignment of the existing onsite drainage ditch. For these models, it was assumed that the end of the pond will end near the end of the future Phase 2 Road cul-de-sac. In the interim condition, the existing onsite ditch actually has more storage than we've accounted for in these calculations. We also included a large overflow extending from the top of the ditch, as described earlier in this report. Outlet pipes matching the outfall design and free discharge conditions were also modeled. The peak water elevation at a node was then applied to the next node upstream of it as tailwater, to represent the hydraulic grade line in the pipe at that node.

For the onsite system, the pipe diameter was reduced by one pipe size to represent the potential head loss within the outfall pipe to compensate for the backflow device. This approach was not applied to the offsite drainage system due to the smaller size and flatter hydraulic grade. While an effort was made to represent the head loss due to these valves, it should be noted that the Tideflex CheckMate UltraFlex Inline Check Valve is known for causing extremely low headloss. For more information, please reference the product brochure in Appendix D.

For the offsite system, it should be noted that no storm system exists on the neighboring properties. Therefore, the majority of runoff is sheet flow over vegetated areas with little to no concentration of the flow with the exception of the Church parking lot. It should also be noted that the ditches constructed along the west property line of the site do not currently see flow even in large storm events. The above flows associated with the offsite area assume the runoff reaches the outfall area. Based on visual observations, it is likely the offsite flows will be significantly less than what was calculated using the hydrologic modelling.

HydroCAD Reports for all the scenarios that were run for this site are provided in Appendix D.

To properly evaluate the performance of the proposed drainage systems, we modeled a variety of scenarios combining different storm events with various potential flood events of the Cowlitz River. Those scenarios include an analysis of the 25- and 100-year storm events (both on- and offsite) when the Cowlitz River is at or Below the OHWM, at the Minor Flood Stage, at the Moderate Flood Stage, at the FEMA 100-year flood plain elevation, and at Major Flood Stage.

Cowlitz River Elevation at/or below OHWM

The first scenario modeled reflects the ideal scenario for the site in which the Cowlitz elevation is at or below the OHWM. In this condition, we see the typical free discharge system with no initial tailwater applied to Node D or E (the furthest downstream nodes). The following results for the proposed system when the river levels were at the OHWM or below were calculated:

Table 5 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	A	B	C	D	E (Offsite)
Water Elevation	50.24	48.56	44.32	42.27	40.30
Rim Elevation	50.41	49.52	48.83	45.29	42.00*
Free-Board	0.17	0.96	4.51	3.02	1.70

*Approximate elevation at which water could overflow ditch into offsite area.

Table 6 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D	E (Offsite)
Water Elevation	50.56	49.68	46.40	43.12	40.85
Rim Elevation	50.41	49.52	48.83	45.29	42.00*
Free-Board	-0.15	-0.16	2.43	2.17	1.15

*Approximate elevation at which water could overflow ditch into offsite area.

Only two nodes on the model are shown exceeding the rim elevation (by less than 3”) during the 100-year storm event. Both the onsite and offsite systems show adequate capacity to convey these storm events in this condition. The development should have no adverse impacts on the neighboring offsite areas when the Cowlitz River is at or below the OHWM. Additionally, no pumping assistance will be needed in these conditions.

Cowlitz River Elevation at Minor Flood Stage

With the onsite and offsite storm systems performing more than adequately while the Cowlitz River is at or below the OHWM, we then updated the models to test the condition in which the flood stages are reached. As previously explained in this report, minor flood events in the Cowlitz would be equal to an elevation of 41 feet at our site. The inline backflow valve will automatically close when the flood stage exceeds the outfall IE by a few inches and the upstream water elevation is at or lower than this elevation. By closing, any onsite stormwater storage is preserved for use by an onsite storm event. For the following onsite analysis, the most conservative approach has been taken by assuming the onsite storage is already full to the elevation of the flood stage in the Cowlitz River being studied. As the onsite ponded elevation exceeds that of the Cowlitz River, the check valve will open to allow flow into the river. For the onsite model, we’ve assigned a tailwater elevation of 41 feet as the basis for Node D. The results for the onsite system during a flood event on the Cowlitz are shown below.

Table 7 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	A	B	C	D
Water Elevation	50.45	48.77	44.53	42.48
Rim Elevation	50.41	49.52	48.83	45.29
Free-Board	-0.04	0.75	4.30	2.81

Table 8 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D
Water Elevation	50.56	49.68	46.47	43.19
Rim Elevation	50.41	49.52	48.83	45.29
Free-Board	-0.15	-0.16	2.36	2.10

With the data shown above, our onsite system shows it can handle the 25-year storm while maintaining a hydraulic grade line just above the surface elevation at the high point of the storm main when the river is experiencing a minor flood stage. During the 100-year storm, only the two upper nodes on the are shown exceeding the rim elevation and by less than 3”.

For the offsite system, a flood stage of 41 will almost certainly close the internal check valve due to the lack of head behind the offsite flows. If for some reason the internal check valve doesn’t close, we would recommend that the City close the manual slide gate valve to ensure that the offsite area is protected from flooding. With the valves closed, the offsite system is essentially an isolated detention pond with no gravity outlet. In this condition, the temporary pump should be used to drain the pond and force water out towards the river. As mentioned above, the City would need to use the Tapani-provided pump (capable of pumping 5.0 CFS) to lower the water level in the detention pond. Whenever the pump is to be operated, the City should manually close the slide valve to ensure that none of the pump water makes its way back into the pond. This pump has been modeled in HydroCAD as a Skimmer outlet at elevation 40.

Table 9 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	E
Water Elevation	42.45**
Rim Elevation	42.00*
Overflow Depth	0.45

*Approximate elevation at which water could overflow ditch into offsite area.

**Assumes use of pump, operating at 5.0 CFS outflow

Table 10 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A
Water Elevation	43.65**
Rim Elevation	42.00*
Overflow Depth	1.65

*Approximate elevation at which water could overflow ditch into offsite area.

**Assumes use of pump, operating at 5.0 CFS outflow

As shown above, minor overflowing of the stormwater detention pond is possible when flood elevations force the valves to close and a 25-year or greater storm event occurs. However, the proposed pump should minimize that to less than 2' of ponding within the existing localized depression adjacent to the detention pond. Topographic surveys of the area show that none of the existing structures adjacent to the property line are below a finished floor elevation of 46 feet, more than 2' above the peak elevation of the 100-year design storm. It's also important to note that the models that have been prepared show a simplified offsite system with a single point of confluence and do not factor in the numerous local depressions, conveyance systems, or infiltration facilities that exist on the adjacent properties. Actual surface conditions will likely result in much less surface runoff than the models show.

Cowlitz River Elevation at Moderate Flood Stage

When the Cowlitz River reaches major flood stages, the equivalent elevation at our site would be 47 feet. As described above in the Minor Flood section, the inline check valve for the onsite system will likely remain closed until the ponded elevation of water on the site exceeds the level of water in the river. In this model, we have made the same conservative assumption that the water elevation onsite will be matching the river elevation prior to the valve closing and therefore reducing the available storage in the detention pond. To test the capacity of the system at this elevation, we've assigned a tailwater elevation of 47 feet as the basis for Node D. In addition to the 48" outlet pipe, this scenario also includes a weir at elevation 48. With the tailwater elevation being so high, the weir was provided as an emergency overflow. The proposed weir would be approximately 30'-wide and the location is yet to be determined, but it would need to lead directly to the Cowlitz River or Salmon Creek. In the interim condition, additional flooding within Basin 4 should have no impact on the site as the existing ditch has an existing spillway to Salmon Creek. In the final condition, a relocated/realigned ditch would likely also provide an emergency overflow to Salmon Creek. The results for the onsite system during a flood event on the Cowlitz are shown below.

Table 11 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	A	B	C	D
Water Elevation	50.51	49.73	48.92	47.56
Rim Elevation	50.41	49.52	48.83	48.00*
Free-Board	-0.10	-0.21	-0.09	0.44

*Elevation of the proposed weir.

Table 12 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D
Water Elevation	50.57	49.80	49.06	48.12
Rim Elevation	50.41	49.52	48.83	48.00*
Free-Board	-0.16	-0.28	-0.23	-0.12

*Elevation of the proposed weir.

With the Cowlitz River in moderate flood stages, we start seeing the impact of the flooding on the onsite system. The 25-year design storm event maintain an HGL just above the proposed roadway elevation without reaching an elevation where the emergency overflow weir is utilized. However, we start to see some water making its way over the spillway during the 100-year storm. In this condition, we also see runoff at a surface level at depths up to 3.5". Due to the design of the road profile for Phase 1, surface runoff that backs up into the roadway will eventually spill down to the existing pond and over the weir (if necessary). Please note that this scenario was modeled with the assumption that the elevation of ponder water in the onsite detention pond was already equivalent to the river flood elevation prior to the event beginning. In actuality, the available storage in the detention pond will likely be much greater and the resulting water elevations at each node would likely come down below the surface elevation of the roadway.

For the offsite system, a flood stage of 47 will certainly close the internal check valve and it is likely that the City would choose to manually close the slide gate valve if the river reached moderate flood stages. In this scenario, the offsite system will operate in exactly the same fashion as it does during the minor flood stage. The offsite storm system has shown adequate capacity up to the 100-year storm event when the system is totally isolated from the river outfall. As long as the river elevation stays below the highest point of the bank, the offsite storm pond can still handle the full 100-year storm event with the pump is running at full capacity.

Cowlitz River Elevation at FEMA 100-year Flood Plain Elevation of 48

As previously mentioned, the inline check valve will close once the river elevation exceeds the IE of the outflow pipe by a few inches and the upstream water elevation is at or less than the river elevation. As the river floods to an elevation of 48ft, it is highly likely that considerable onsite detention volume will still be available for an onsite storm event. However, to analyze the most conservative option, it is assumed that all onsite storage volume is already at an elevation of 48ft and flow through the outfall pipe is negligible. In this scenario, the volume available to store any onsite runoff is restricted to the area adjacent to the onsite ditch/detention pond. The plan is to have a low area of parking along the ditch to provide this volume. For this study, the volume in the model for node D is assumed as approximately 200ft wide parking at 2% slope to ditch for the length of the ditch. Total depth of this volume is 2ft. With the 30ft overflow to Salmon creek at the south end of the property. The maximum depth for this pond was found to be 0.61ft or 48.61ft. At this time, we anticipate the minimum building elevations onsite to be 50ft. Therefore, all buildings will be over 1ft above the highest 100yr onsite flood elevation under the most conservative assumptions. To simplify the calculations for this scenario, we started directly with the 100-year storm event. The results for the onsite system during a flood event on the Cowlitz are shown below.

Table 13 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D
Water Elevation	50.49	49.71	49.02	48.61
Rim Elevation	50.41	49.52	48.83	48.00*
Free-Board	-0.08	-0.19	-0.19	N/A

*Elevation of the proposed weir.

As shown above, the system is capable of passing the 100-year storm event even if the river elevation reaches the 100-year flood plain elevation of 48. In this scenario, water will fill the entire onsite conveyance system and then surface flow down the proposed Phase 1 road towards the ditch (less than 3" deep). At the weir, water could reach a peak elevation of 48.61 feet and spill into Salmon Creek or the Cowlitz directly, depending on the location chosen. It is important to note that even in this condition, we do not anticipate any surface runoff on the roadway to run towards the existing Larsen Lane. The elevations of Node C consistently stay below the high point on our proposed extension of Larsen Lane. This scenario was also tested for the actual isopluvial rainfall and the results were very similar to the data above. In that report, a peak elevation of 48.85 feet is shown at the weir which is still more than 1' lower than the minimum finish floor of 50ft.

Once again, the offsite system would be fully isolated in this condition and no additional analysis was required.

Cowlitz River at Major Flood Stage

If the Cowlitz River ever reaches Major Flood Stages (elevation 50 or higher per USGS), the river elevation would likely breach the banks along the project frontage and cause flooding in both the onsite and offsite systems. This level of flooding exceeds even the FEMA 100-year flood elevation and is beyond what is required for our analysis. But as river elevations subside below the bank elevation for the proposed systems, flooding should dissipate much faster than it would in current conditions.

Frequency of Large Storm Events, Flooding, and Need for Pumping

The impact to the site when the Cowlitz River is in flood stages depends on the local weather during the period in which the river levels are high. The Cowlitz River has two major dams upriver from the site. The impact of the dams is that the peaks in flow are modulated and peak flows are generally short in nature. Reviewing the gauging data from 2007 to present, there have only been three events that are considered within flood stage. Between the three events, the river was considered above flood stage for a total of 3 days. Since elevated water elevation in the Cowlitz River is based on extreme weather in its upper reaches rather than local weather, a severe local event occurring at the same time is very unlikely.

In addition to the river flood elevation available on the USGS website, we were also provided with actual rainfall data by the City of Castle Rock Public Works Department. After reviewing their records (which go back to January of 2007), we identified 11 storm events in that time period that would be considered a significant storm event. Nine of those events qualified as 2-year storm events, one as a 10-year storm,

and one as a 100-year storm. Of those nine events in the past 17 years, only two of them occurred on a day in which the river elevation was also at a flood stage elevation.

In the past 17 years, it appears that there were only two (2) occasions in which the offsite system would have required pumping (1/8/2009 and 12/9/2015). In both cases, the inline check valve would have closed, the City would have closed the manual slide gate valve, and pumping would have been needed for no more than 24 hours. While the data suggests that pumping was needed approximately once every ten years, it should be assumed that the pump should be prepared for use any time that the river gage shows flood conditions and a significant storm event is forecasted. Based on historic data, this may occur only every few years. Over time, City staff should become educated on the likely events and conditions that may require the use of the pump. The City could also opt to operate the pump more frequently to ease the concerns of the neighbors if they deem it necessary.

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Appendix A: Maps & Figures

USDA Soil Map

Isopluvial Maps- Figures III-A.1 through A.3

1992 Stormwater Manual “Figure I-2.1 Flowchart for Determining Minimum Requirements”

FEMA Flood Map

Stormwater Master Plan Basin and Conveyance Exhibit



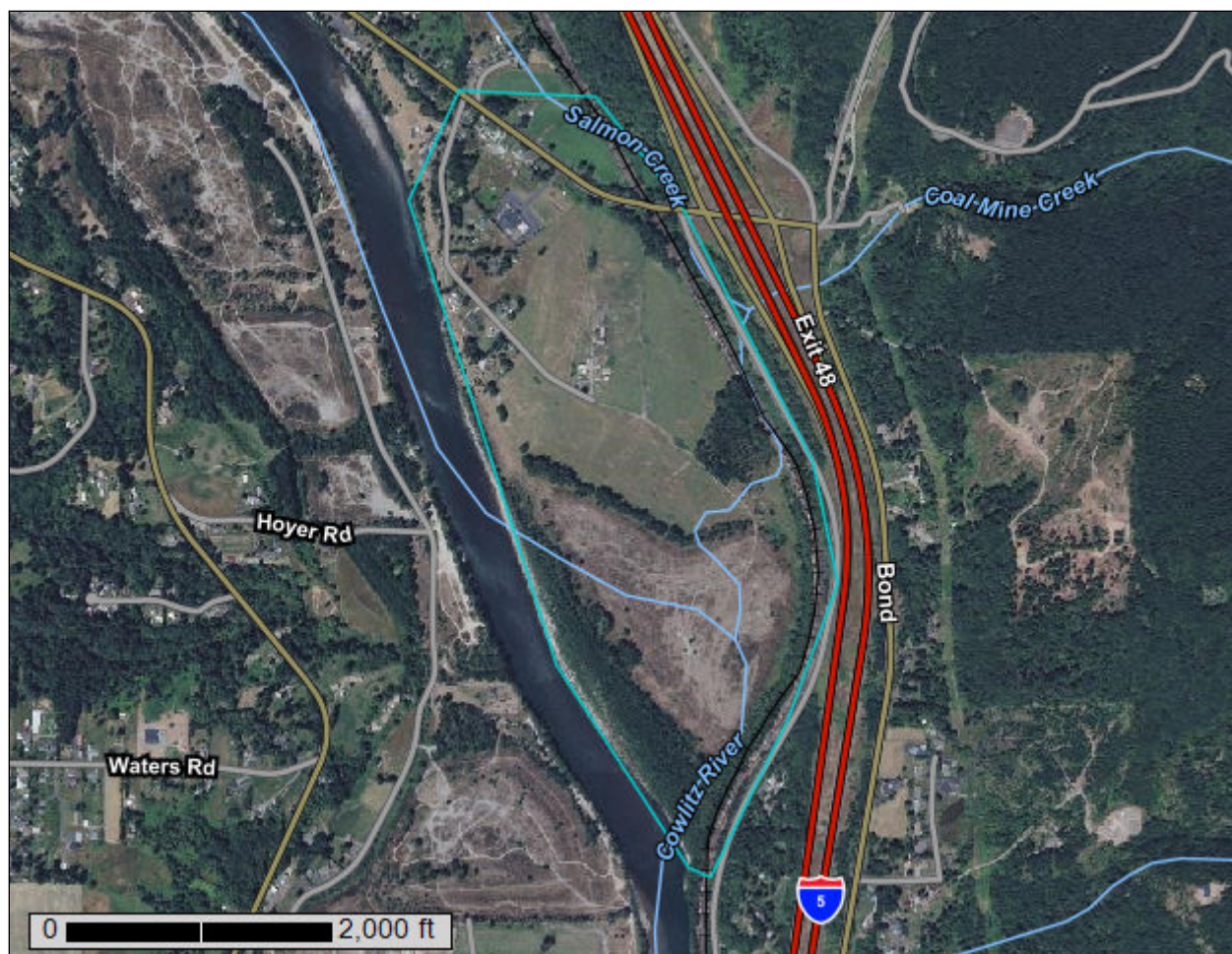
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Stations, and local
participants

Custom Soil Resource Report for **Cowlitz County, Washington**



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

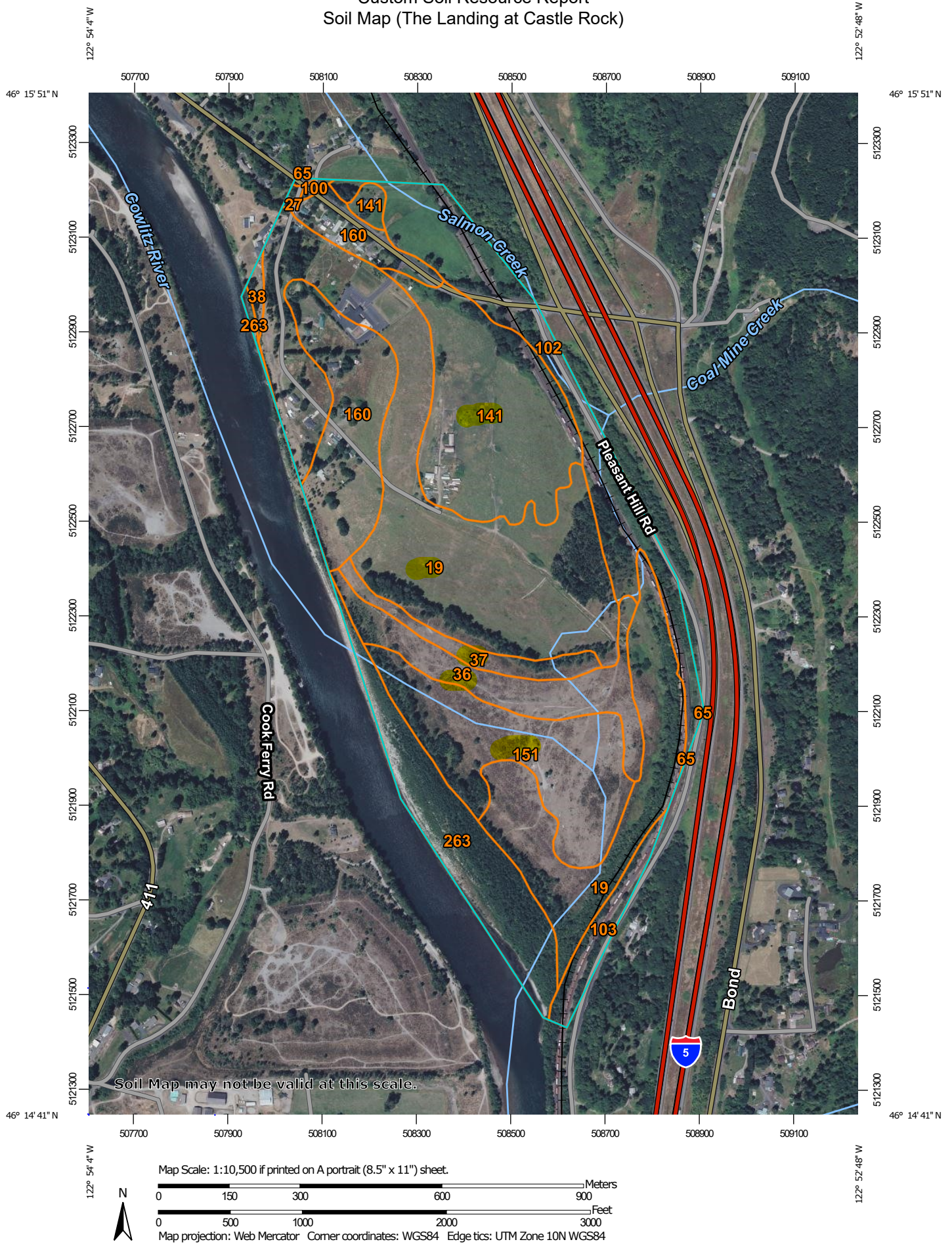
Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map (The Landing at Castle Rock)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cowlitz County, Washington
Survey Area Data: Version 22, Aug 23, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 21, 2021—Nov 22, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (The Landing at Castle Rock)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Carrolls loamy sand, 0 to 2 percent slopes	87.9	35.9%
27	Cinebar silt loam, 20 to 30 percent slopes	0.3	0.1%
36	Cowlitz extremely gravelly sand, disturbed, 0 to 5 percent slopes	14.4	5.9%
37	Cowlitz extremely gravelly sand, disturbed, 5 to 15 percent slopes	5.2	2.1%
38	Cowlitz extremely gravelly sand, disturbed, 15 to 30 percent slopes	0.9	0.4%
65	Godfrey silt loam, 0 to 3 percent slopes	0.2	0.1%
100	Kelso silt loam, 0 to 8 percent slopes	0.4	0.2%
102	Kelso silt loam, 15 to 30 percent slopes	26.4	10.8%
103	Kelso silt loam, 30 to 50 percent slopes	5.2	2.1%
141	Newberg fine sandy loam, 0 to 3 percent slopes	32.5	13.3%
151	Panamaker gravelly sand, 0 to 3 percent slopes	25.9	10.6%
160	Pilchuck loamy fine sand, 0 to 8 percent slopes	25.0	10.2%
263	Water	20.2	8.3%
Totals for Area of Interest		244.4	100.0%

Map Unit Descriptions (The Landing at Castle Rock)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the

landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present

or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Cowlitz County, Washington

19—Carrolls loamy sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2f5r
Elevation: 10 to 100 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Carrolls and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carrolls

Setting

Landform: Flood plains
Parent material: Sandy alluvium over mudflow deposits

Typical profile

H1 - 0 to 7 inches: loamy sand
H2 - 7 to 10 inches: very fine sandy loam
H3 - 10 to 60 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F002XB007WA - Portland Basin Wet Forest
Forage suitability group: Wet Soils (G002XV102WA)
Other vegetative classification: Wet Soils (G002XV102WA)
Hydric soil rating: Yes

Minor Components

Mountsolo

Percent of map unit: 10 percent
Landform: Terraces
Hydric soil rating: Yes

Unnamed, poorly drained

Percent of map unit: 5 percent

Hydric soil rating: No

27—Cinebar silt loam, 20 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2fbd

Elevation: 50 to 2,000 feet

Mean annual precipitation: 50 to 75 inches

Mean annual air temperature: 48 to 52 degrees F

Frost-free period: 160 to 250 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Cinebar and similar soils: 80 percent

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cinebar

Setting

Landform: Hillslopes

Parent material: Volcanic ash over glaciofluvial deposits

Typical profile

H1 - 0 to 10 inches: silt loam

H2 - 10 to 23 inches: silt loam

H3 - 23 to 60 inches: silt loam

Properties and qualities

Slope: 20 to 30 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.57 to 1.98 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Very high (about 16.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Ecological site: F002XB004WA - Portland Basin Forest

Forage suitability group: Sloping to Steep Soils (G002XV702WA)

Other vegetative classification: Sloping to Steep Soils (G002XV702WA)

Hydric soil rating: No

Minor Components

Zynbar

Percent of map unit: 10 percent
Hydric soil rating: No

Newaukum

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, moderately well drained

Percent of map unit: 5 percent
Hydric soil rating: No

36—Cowlitz extremely gravelly sand, disturbed, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2fd1
Elevation: 10 to 200 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Cowlitz and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cowlitz

Setting

Landform: Terraces, flood plains
Parent material: Alluvium over mudflow deposits

Typical profile

H1 - 0 to 11 inches: extremely gravelly sand
H2 - 11 to 60 inches: very gravelly sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: A

Ecological site: F002XA004WA - Puget Lowlands Forest

Forage suitability group: Droughty Soils (G002XV402WA)

Other vegetative classification: Droughty Soils (G002XV402WA)

Hydric soil rating: No

Minor Components

Panamaker

Percent of map unit: 5 percent

Hydric soil rating: No

37—Cowlitz extremely gravelly sand, disturbed, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2fd5

Elevation: 10 to 200 feet

Mean annual precipitation: 45 to 60 inches

Mean annual air temperature: 48 to 50 degrees F

Frost-free period: 150 to 200 days

Farmland classification: Not prime farmland

Map Unit Composition

Cowlitz and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cowlitz

Setting

Landform: Terraces, flood plains

Parent material: Alluvium over mudflow deposits

Typical profile

H1 - 0 to 11 inches: extremely gravelly sand

H2 - 11 to 60 inches: very gravelly sand

Properties and qualities

Slope: 5 to 15 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Droughty Soils (G002XV402WA)
Other vegetative classification: Droughty Soils (G002XV402WA)
Hydric soil rating: No

Minor Components

Panamaker

Percent of map unit: 15 percent
Hydric soil rating: No

38—Cowlitz extremely gravelly sand, disturbed, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2fdb
Elevation: 10 to 200 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Cowlitz and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cowlitz

Setting

Landform: Terraces, flood plains
Parent material: Alluvium over mudflow deposits

Typical profile

H1 - 0 to 11 inches: extremely gravelly sand
H2 - 11 to 60 inches: very gravelly sand

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Droughty Soils (G003XF403WA)
Other vegetative classification: Droughty Soils (G003XF403WA)
Hydric soil rating: No

Minor Components

Panamaker

Percent of map unit: 15 percent
Hydric soil rating: No

65—Godfrey silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2flz
Elevation: 20 to 300 feet
Mean annual precipitation: 40 to 65 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Godfrey and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Godfrey

Setting

Landform: Flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 27 inches: silty clay loam
H3 - 27 to 60 inches: sandy clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 59 inches to abrupt textural change
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4w

Hydrologic Soil Group: D

Ecological site: F002XA008WA - Puget Lowlands Riparian Forest

Forage suitability group: Seasonally Wet Soils (G002XV202WA)

Other vegetative classification: Seasonally Wet Soils (G002XV202WA)

Hydric soil rating: Yes

Minor Components

Godfrey, drained

Percent of map unit: 10 percent

Hydric soil rating: Yes

Caples

Percent of map unit: 5 percent

Landform: Flood plains

Hydric soil rating: Yes

100—Kelso silt loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2f11

Elevation: 50 to 200 feet

Mean annual precipitation: 40 to 60 inches

Mean annual air temperature: 50 to 52 degrees F

Frost-free period: 165 to 180 days

Farmland classification: All areas are prime farmland

Map Unit Composition

Kelso and similar soils: 80 percent

Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kelso

Setting

Landform: Terraces

Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: silt loam

H2 - 11 to 34 inches: silt loam

H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained

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Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: About 24 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2w

Hydrologic Soil Group: C

Ecological site: F002XA004WA - Puget Lowlands Forest

Forage suitability group: Seasonally Wet Soils (G002XV202WA)

Other vegetative classification: Seasonally Wet Soils (G002XV202WA)

Hydric soil rating: No

Minor Components

Hazeldell

Percent of map unit: 5 percent

Hydric soil rating: No

Olympic

Percent of map unit: 5 percent

Hydric soil rating: No

102—Kelso silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2f18

Elevation: 50 to 200 feet

Mean annual precipitation: 40 to 60 inches

Mean annual air temperature: 50 to 52 degrees F

Frost-free period: 165 to 180 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Kelso and similar soils: 80 percent

Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kelso

Setting

Landform: Escarpments, terraces

Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: silt loam

H2 - 11 to 34 inches: silt loam

H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Sloping to Steep Soils (G002XV702WA)
Other vegetative classification: Sloping to Steep Soils (G002XV702WA)
Hydric soil rating: No

Minor Components

Hazeldell

Percent of map unit: 5 percent
Hydric soil rating: No

Olympic

Percent of map unit: 5 percent
Hydric soil rating: No

103—Kelso silt loam, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: 2f19
Elevation: 50 to 200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 165 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Kelso and similar soils: 80 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kelso

Setting

Landform: Escarpments, terraces
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: silt loam
H2 - 11 to 34 inches: silt loam
H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: F002XA004WA - Puget Lowlands Forest
Hydric soil rating: No

Minor Components

Olympic

Percent of map unit: 5 percent
Hydric soil rating: No

Hazeldell

Percent of map unit: 5 percent
Hydric soil rating: No

141—Newberg fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2f3d
Elevation: 10 to 1,500 feet
Mean annual precipitation: 18 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Newberg and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Newberg

Setting

Landform: Flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 10 inches: fine sandy loam
H2 - 10 to 28 inches: very fine sandy loam
H3 - 28 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A
Ecological site: F002XA008WA - Puget Lowlands Riparian Forest
Forage suitability group: Soils with Few Limitations (G002XV502WA)
Other vegetative classification: Soils with Few Limitations (G002XV502WA)
Hydric soil rating: No

Minor Components

Chehalis

Percent of map unit: 5 percent
Hydric soil rating: No

151—Panamaker gravelly sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2f3s
Elevation: 200 to 600 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Panamaker and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Panamaker

Setting

Landform: Flood plains, terraces

Parent material: Sandy drege material from mudflow deposits

Typical profile

H1 - 0 to 3 inches: gravelly sand

H2 - 3 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: NoneRare

Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3s

Hydrologic Soil Group: A

Ecological site: F002XA005WA - Puget Lowlands Moist Forest

Forage suitability group: Droughty Soils (G002XV402WA)

Other vegetative classification: Droughty Soils (G002XV402WA)

Hydric soil rating: No

160—Pilchuck loamy fine sand, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2f45

Elevation: 10 to 50 feet

Mean annual precipitation: 40 to 60 inches

Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 165 to 195 days

Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pilchuck and similar soils: 85 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pilchuck

Setting

Landform: Flood plains

Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: loamy fine sand

Custom Soil Resource Report

H2 - 12 to 36 inches: fine sand

H3 - 36 to 60 inches: gravelly sand

Properties and qualities

Slope: 0 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: NoneRare

Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4s

Hydrologic Soil Group: A

Ecological site: F002XA005WA - Puget Lowlands Moist Forest

Forage suitability group: Droughty Soils (G002XV402WA)

Other vegetative classification: Droughty Soils (G002XV402WA)

Hydric soil rating: No

263—Water

Map Unit Composition

Water: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Setting

Landform: Alluvial cones

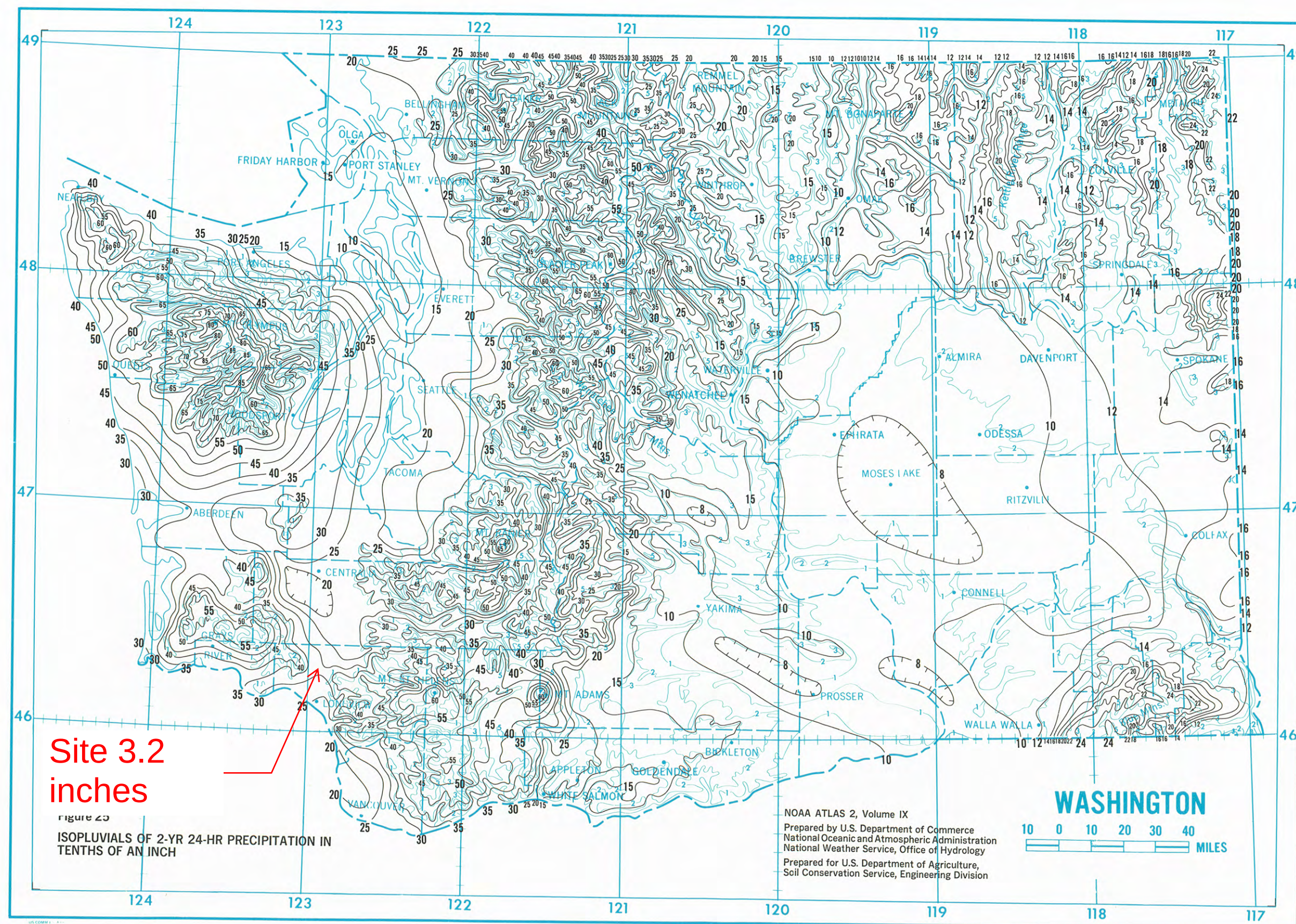
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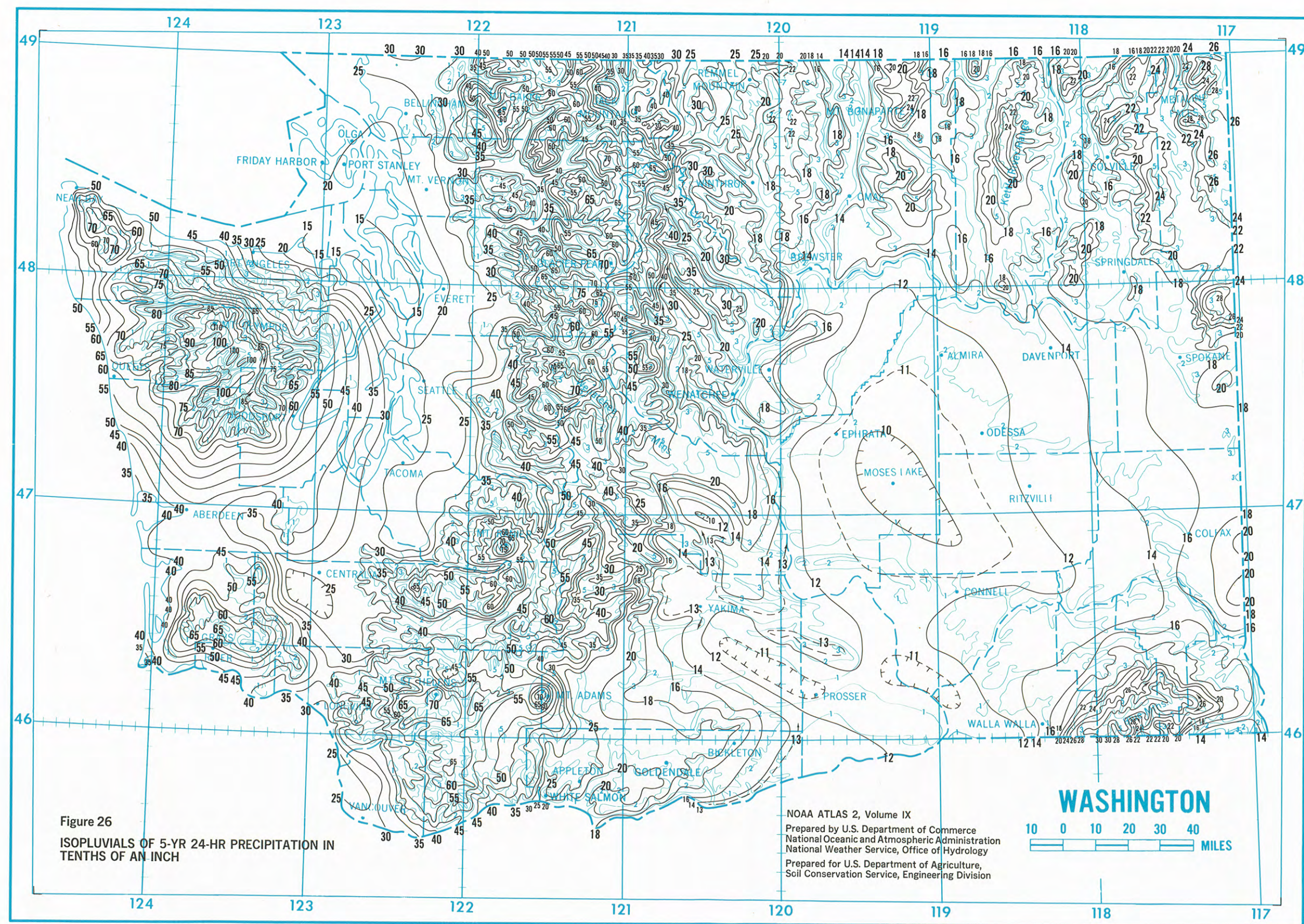
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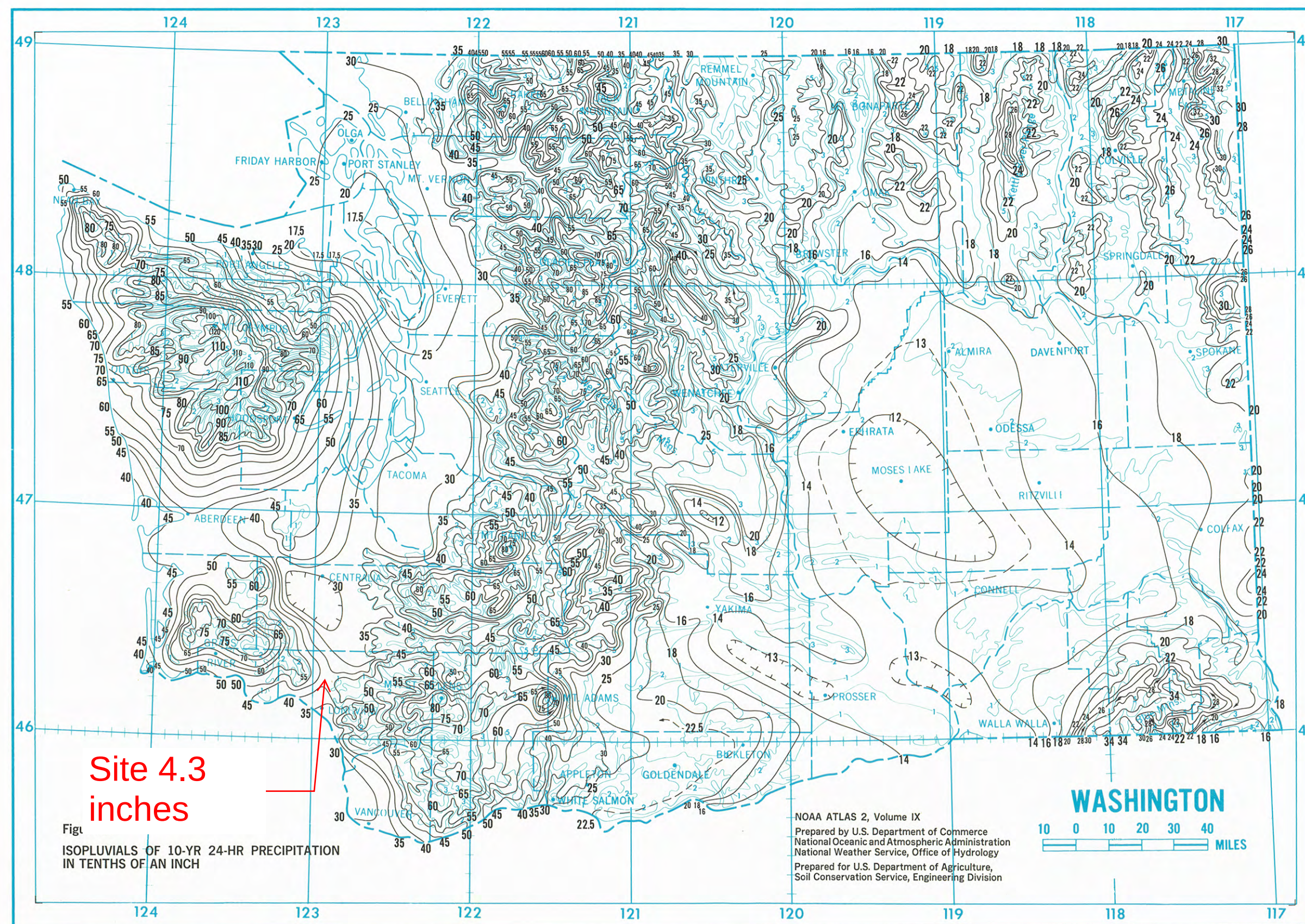
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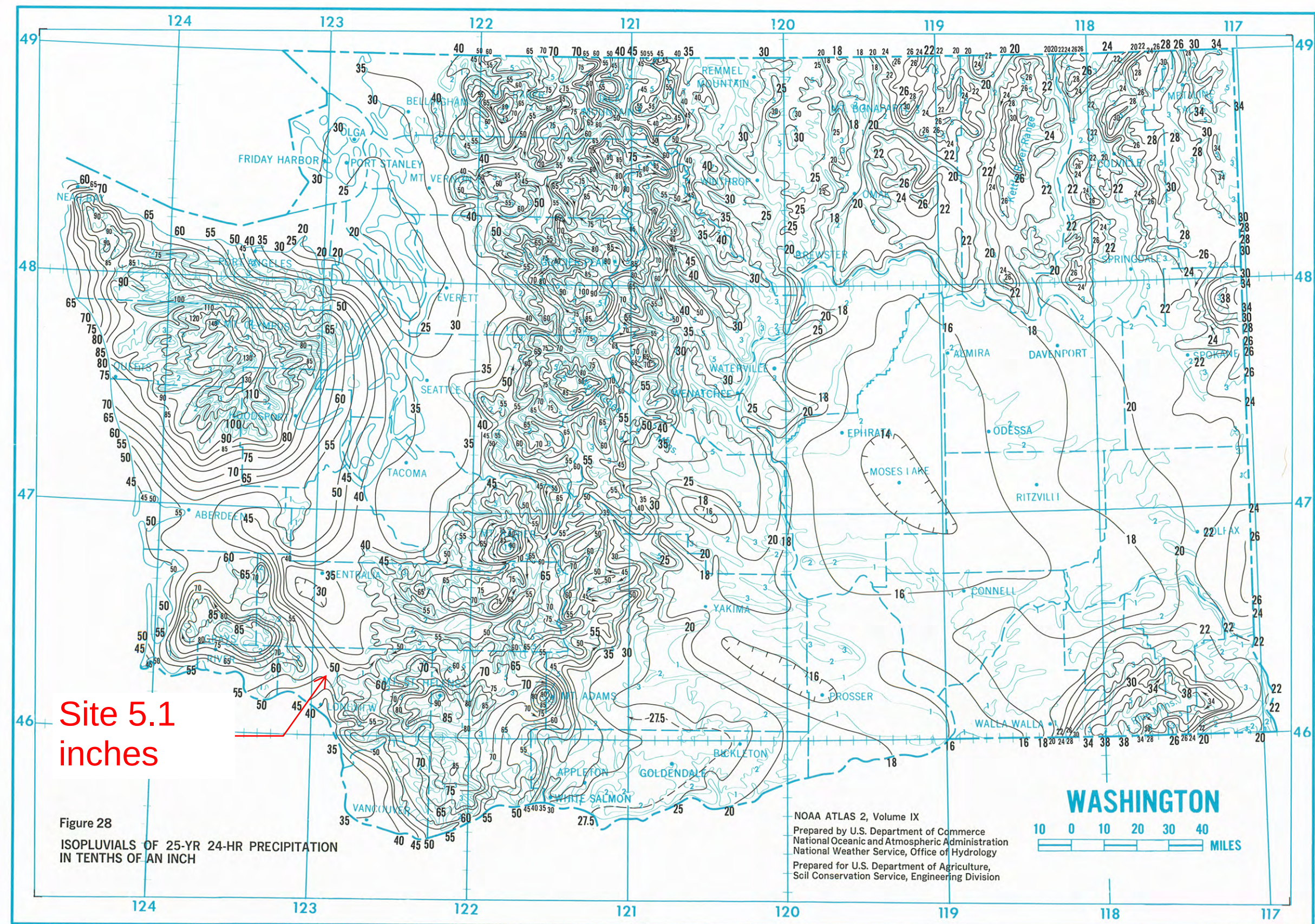
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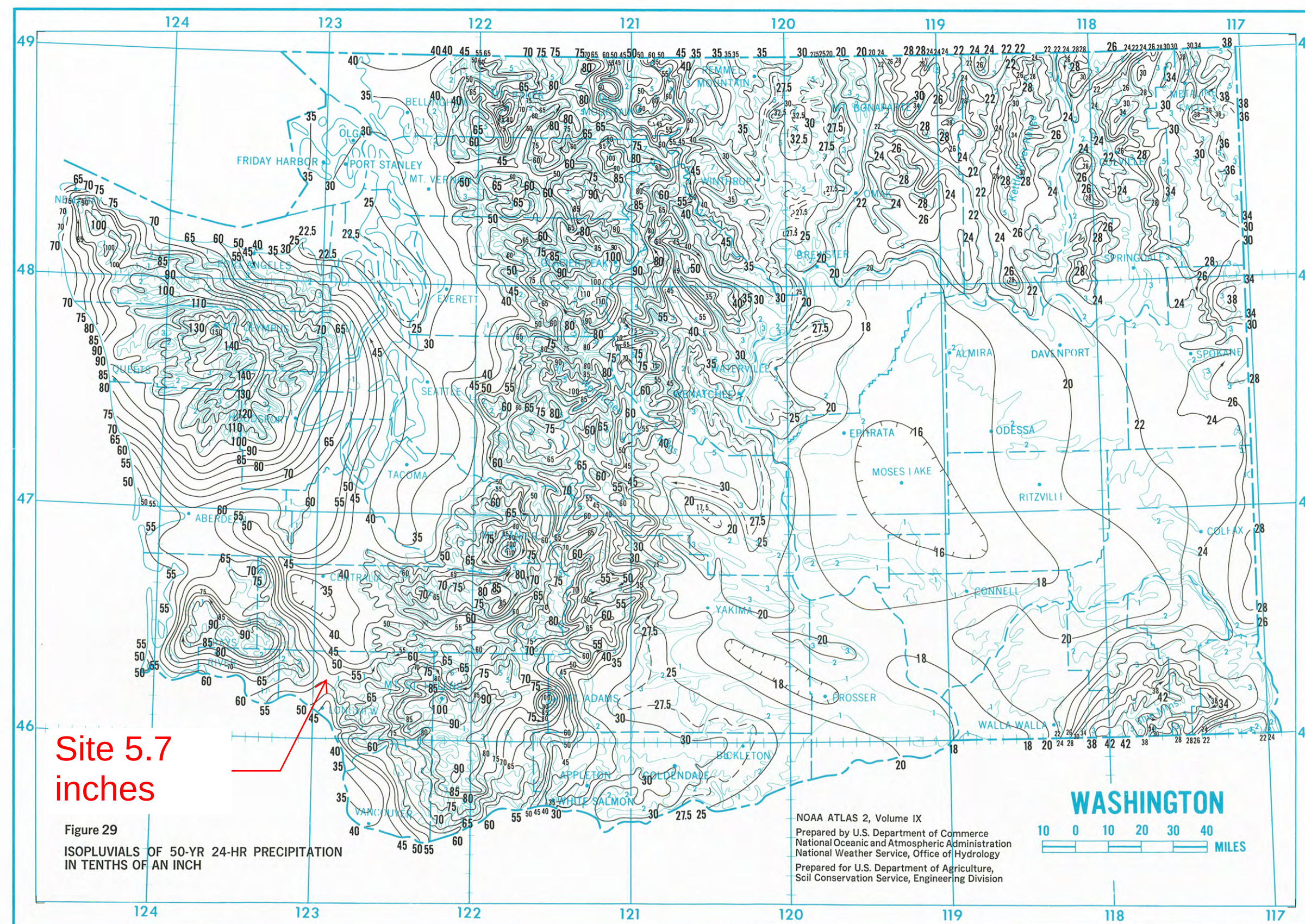
United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf











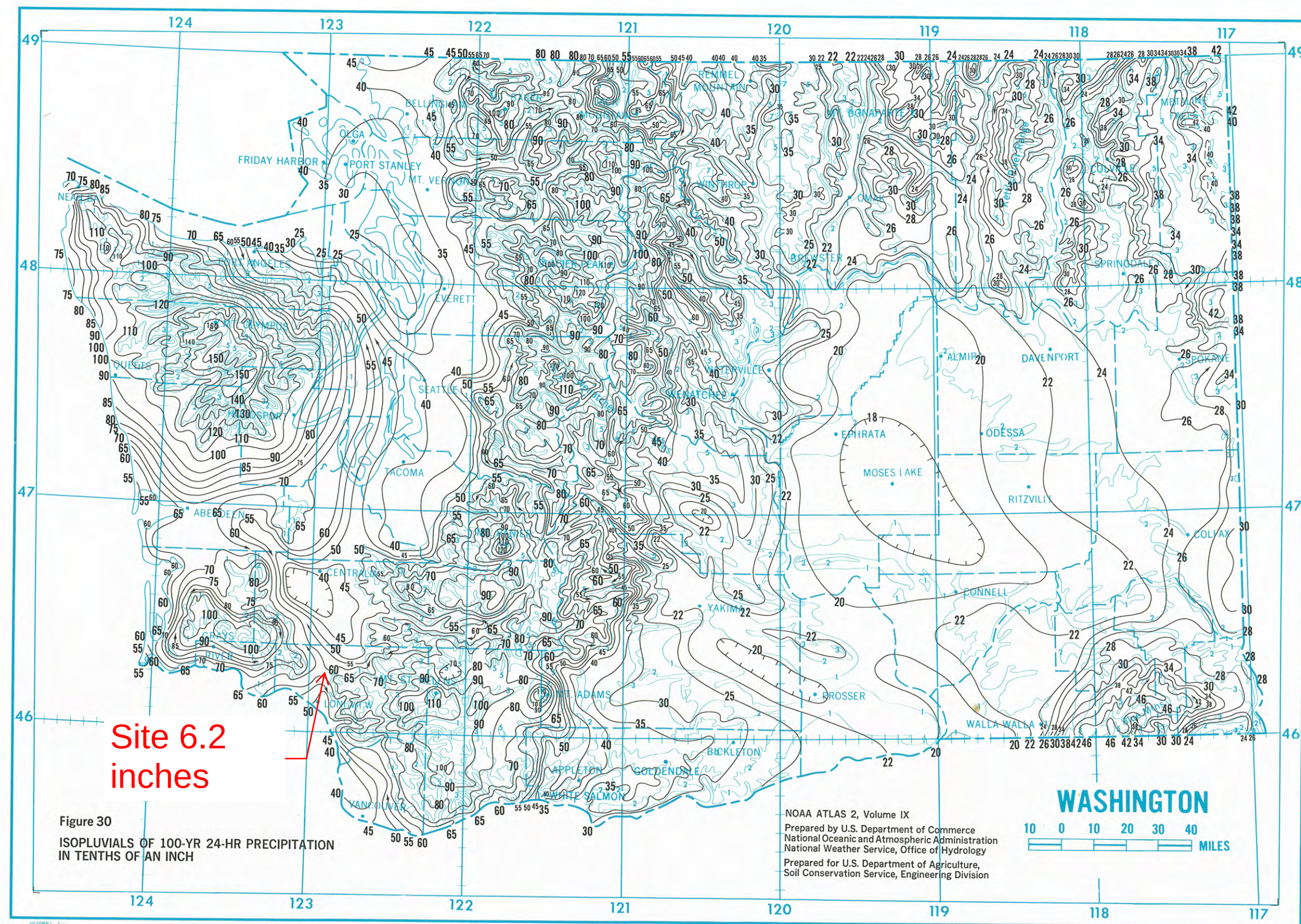
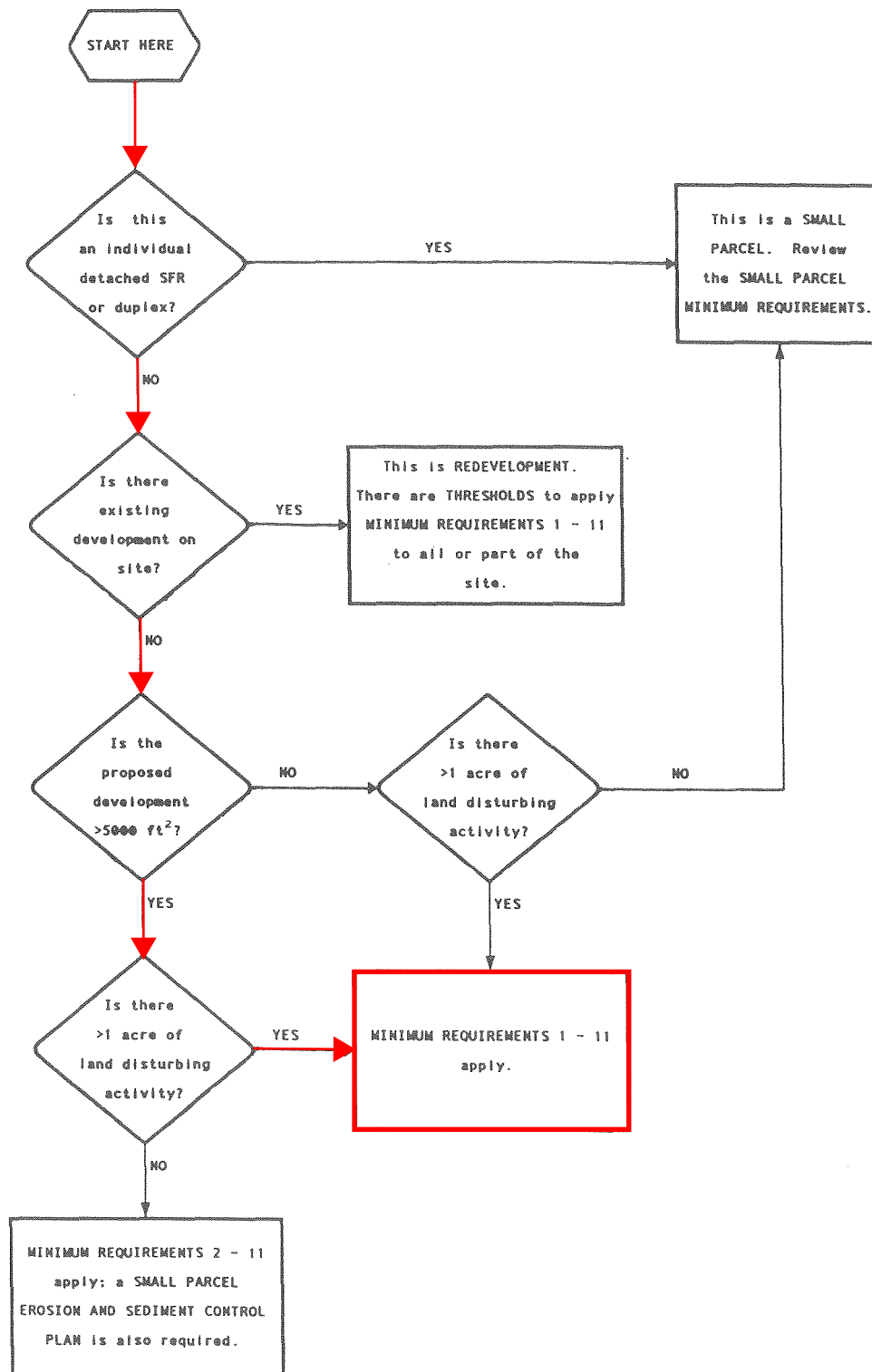


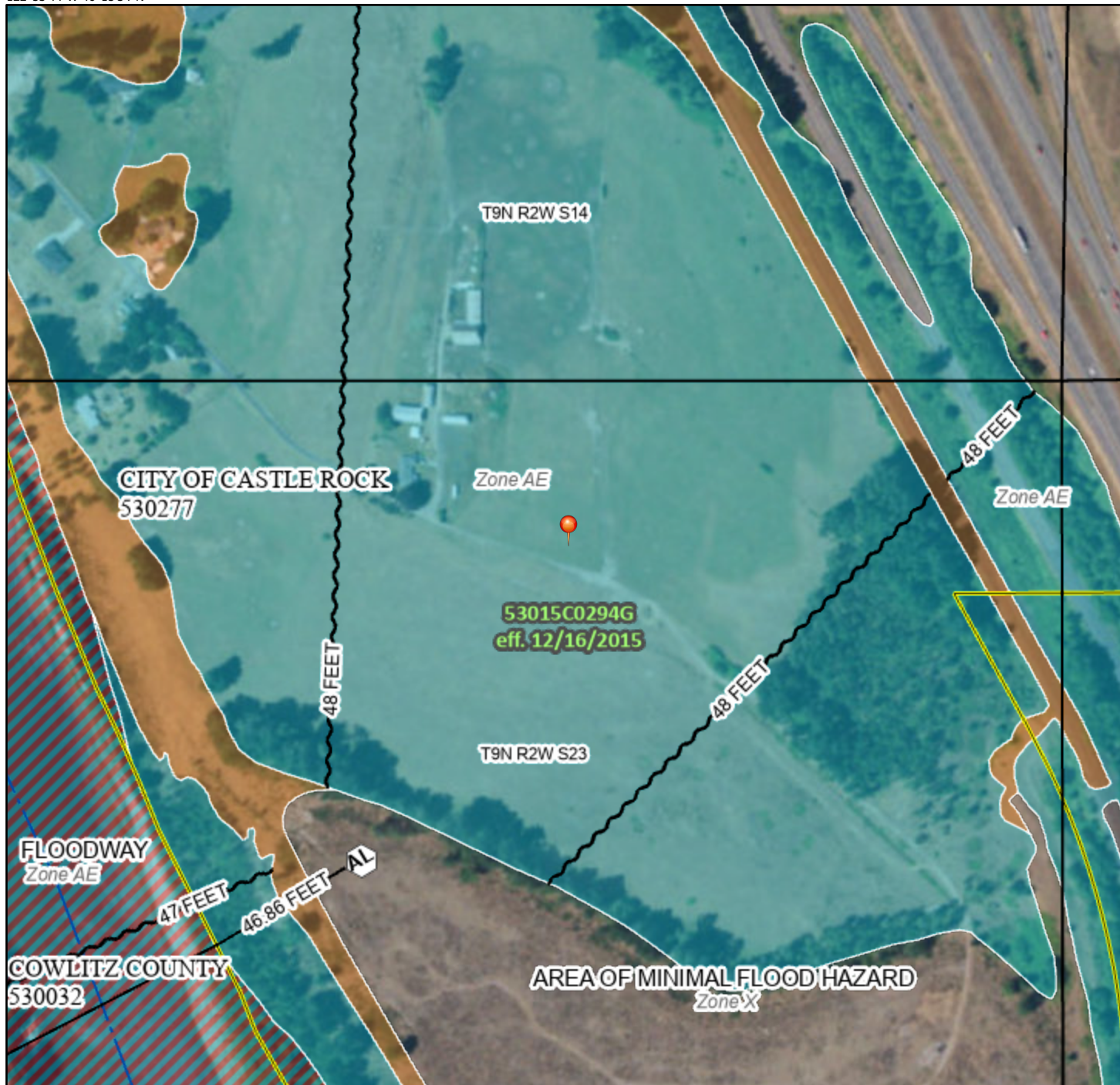
Figure I-2.1 Flowchart Demonstrating Minimum Requirements



National Flood Hazard Layer FIRMette



122°53'44"W 46°15'34"N



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **2/16/2021 at 1:53 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

0 250 500 1,000 1,500 2,000 Feet 1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Appendix B: River and Rainfall Data

Cowlitz River - Castle Rock River Gauge Information

City of Castle Rock Rainfall Data Summary

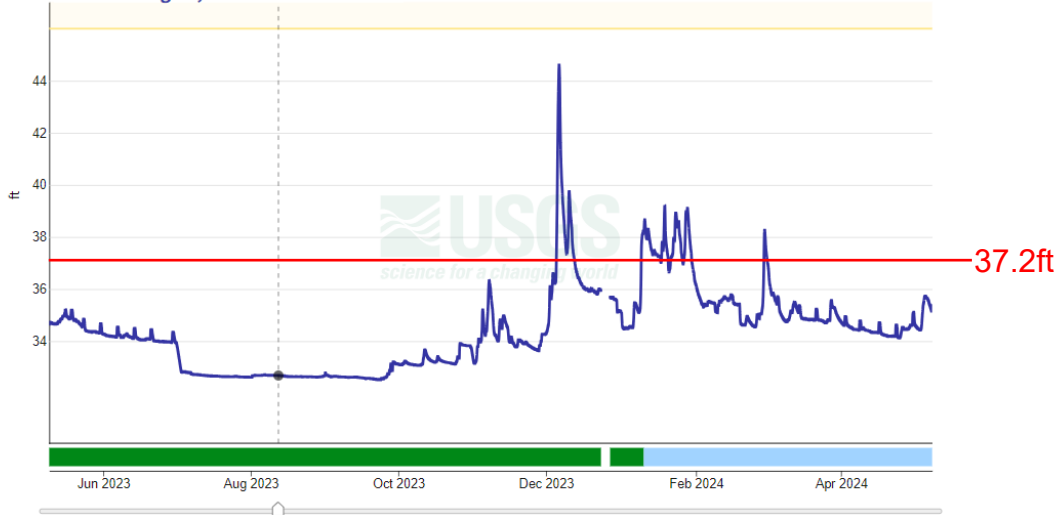
☐ 7 days ☐ 30 days ☒ 1 year

Cowlitz River at Castle Rock, WA - 14243000

May 9, 2023 - May 8, 2024

Gage height, feet

32.68 ft - Aug 12, 2023 10:30:00 AM PDT



	Value	Status	Time
● Latest value	35.18 ft	Provisional	May 08, 2024 09:30:00 AM PDT
● Selected	32.68 ft	Approved	Aug 12, 2023 10:30:00 AM PDT

High 44.60ft, Dec 6, 2023

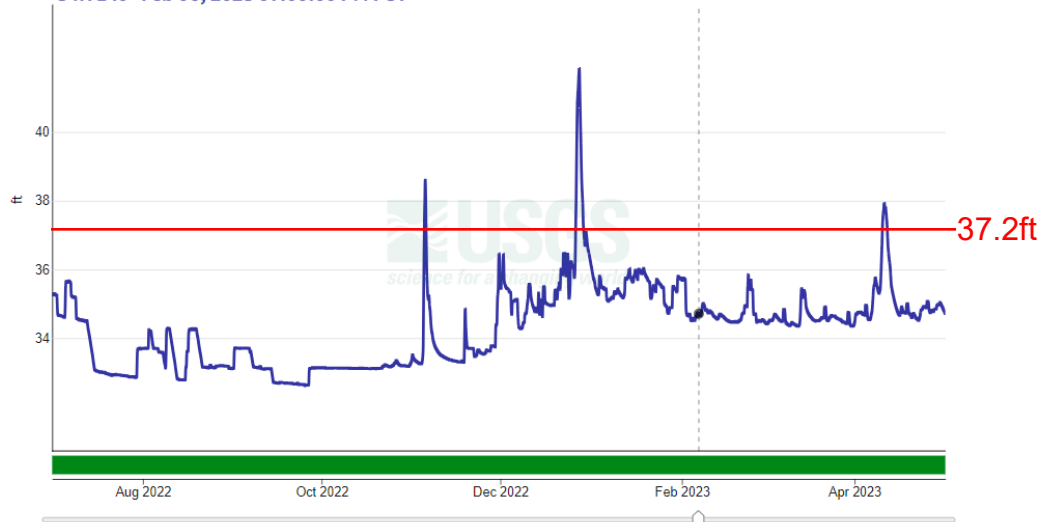
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

July 1, 2022 - May 1, 2023

Gage height, feet

34.71 ft - Feb 06, 2023 07:00:00 PM PST

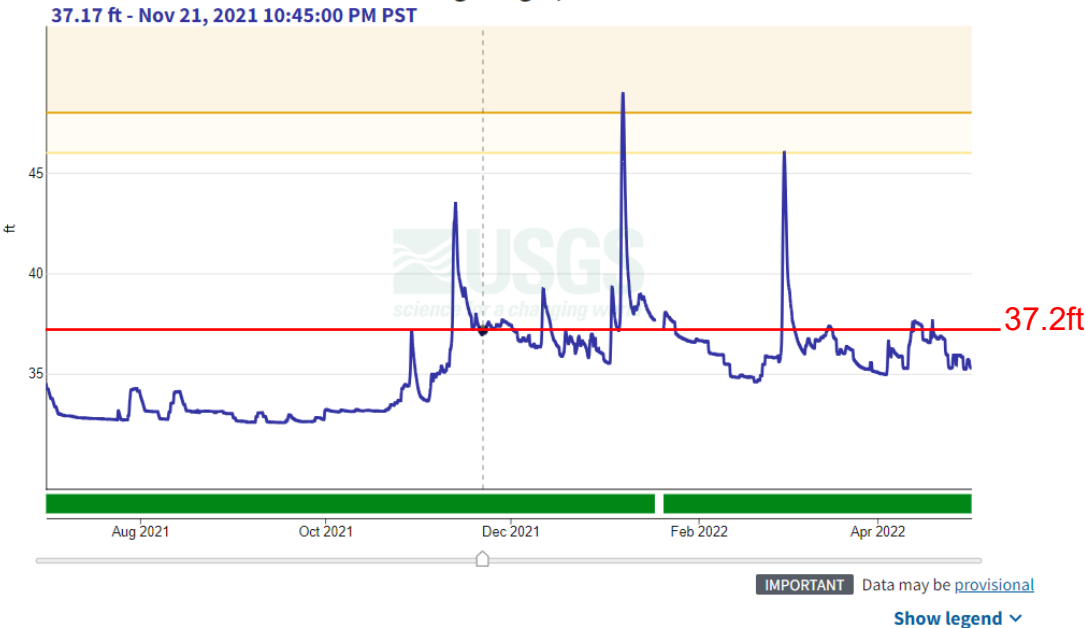


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● Selected	34.71 ft	Approved	Feb 06, 2023 07:00:00 PM PST

High 41.84, Dec 27, 2022

Cowlitz River at Castle Rock, WA - 14243000

July 1, 2021 - May 1, 2022
Gage height, feet

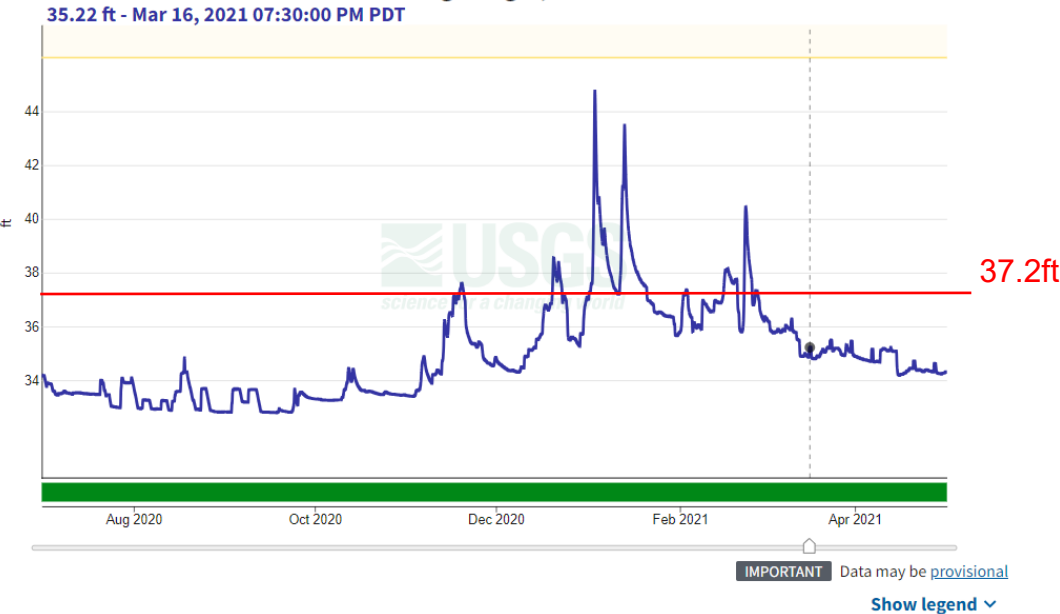


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● Selected	37.17 ft	Approved	Nov 21, 2021 10:45:00 PM PST

High 48.86 Jan 07, 2022

Cowlitz River at Castle Rock, WA - 14243000

July 1, 2020 - May 1, 2021
Gage height, feet



	Value	Status	Time
● Latest value	35.18 ft	Provisional	May 08, 2024 09:30:00 AM PDT
● Selected	35.22 ft	Approved	Mar 16, 2021 07:30:00 PM PDT

High 44.70ft Jan 3, 2021

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☐ 7 days

☐ 30 days

☐ 1 year

Scale

Linear

Log

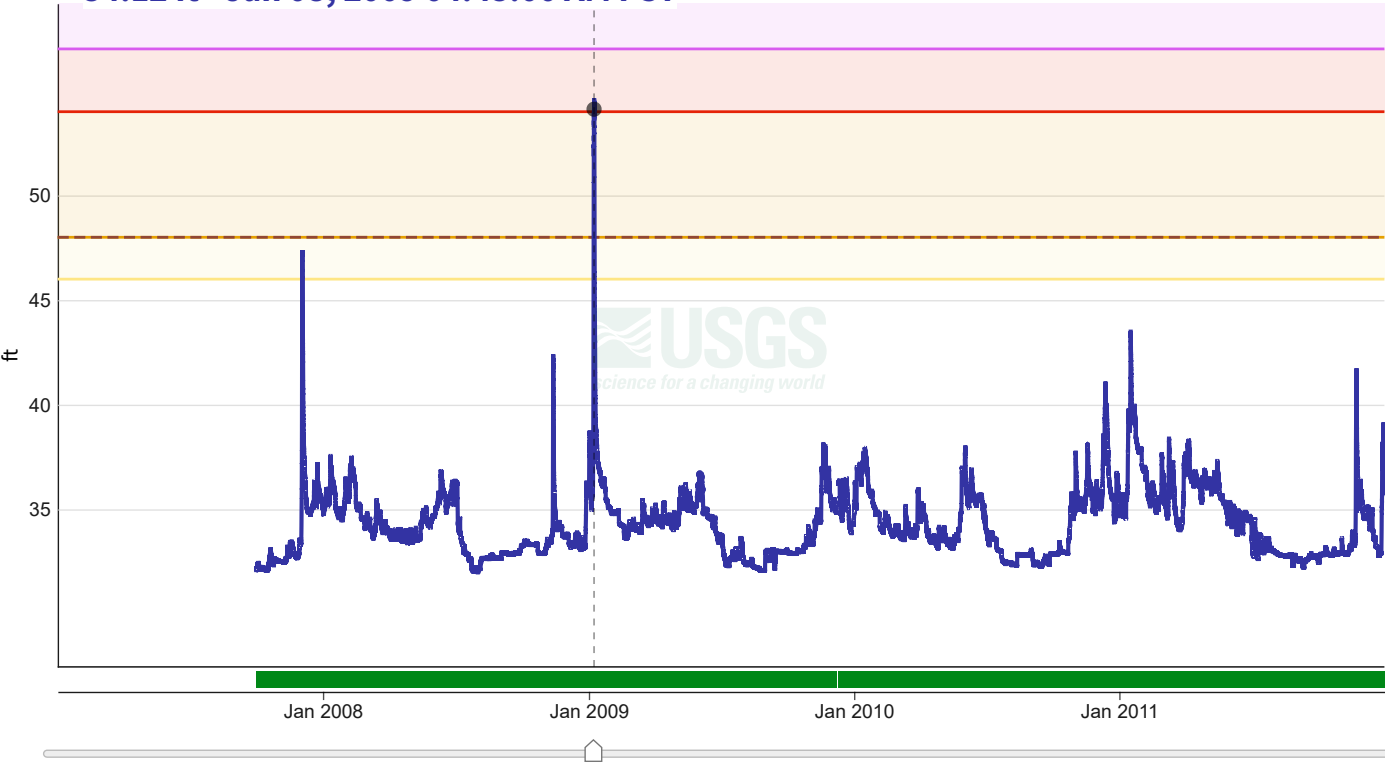
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2007 - December 31, 2011

Gage height, feet [NAVD 1988, feet]

54.12 ft - Jan 08, 2009 04:45:00 AM PST



IMPORTANT Data may be [provisional](#)

Show legend ▾

Hide graph details ^

	Value	Status
Latest	34.98	Provisional
Jan 29, 2025 08:30:00 AM PST		
Selected	54.12	Approved
Jan 08, 2009 04:45:00 AM PST		
Compare		



Not available with custom time spans

IMPORTANT

[Legacy real-time page](#)



☐ 7 days

☐ 30 days

☐ 1 year

Scale

Linear

Log

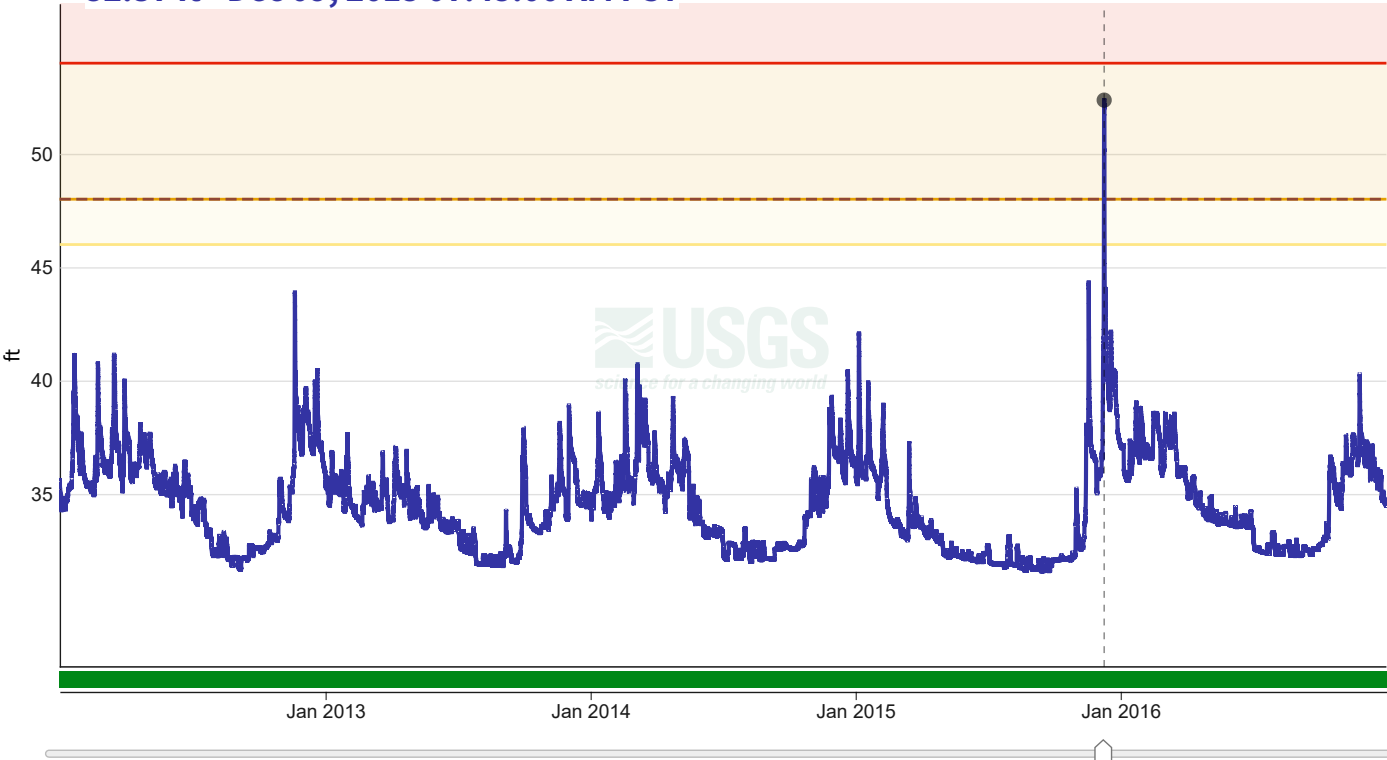
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Cowlitz River at Castle Rock, WA - 14243000

January 1, 2012 - December 31, 2016

Gage height, feet [NAVD 1988, feet]

52.37 ft - Dec 09, 2015 07:45:00 AM PST



IMPORTANT

Data may be [provisional](#)

Show legend ▾

Hide graph details ^

	Value	Status
Latest	34.98	Provisional
Jan 29, 2025 08:30:00 AM PST		
Selected	52.37	Approved
Dec 09, 2015 07:45:00 AM PST		
Compare		

Not available with custom time spans



IMPORTANT

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☐ 7 days

☐ 30 days

☐ 1 year

Scale

Linear

Log

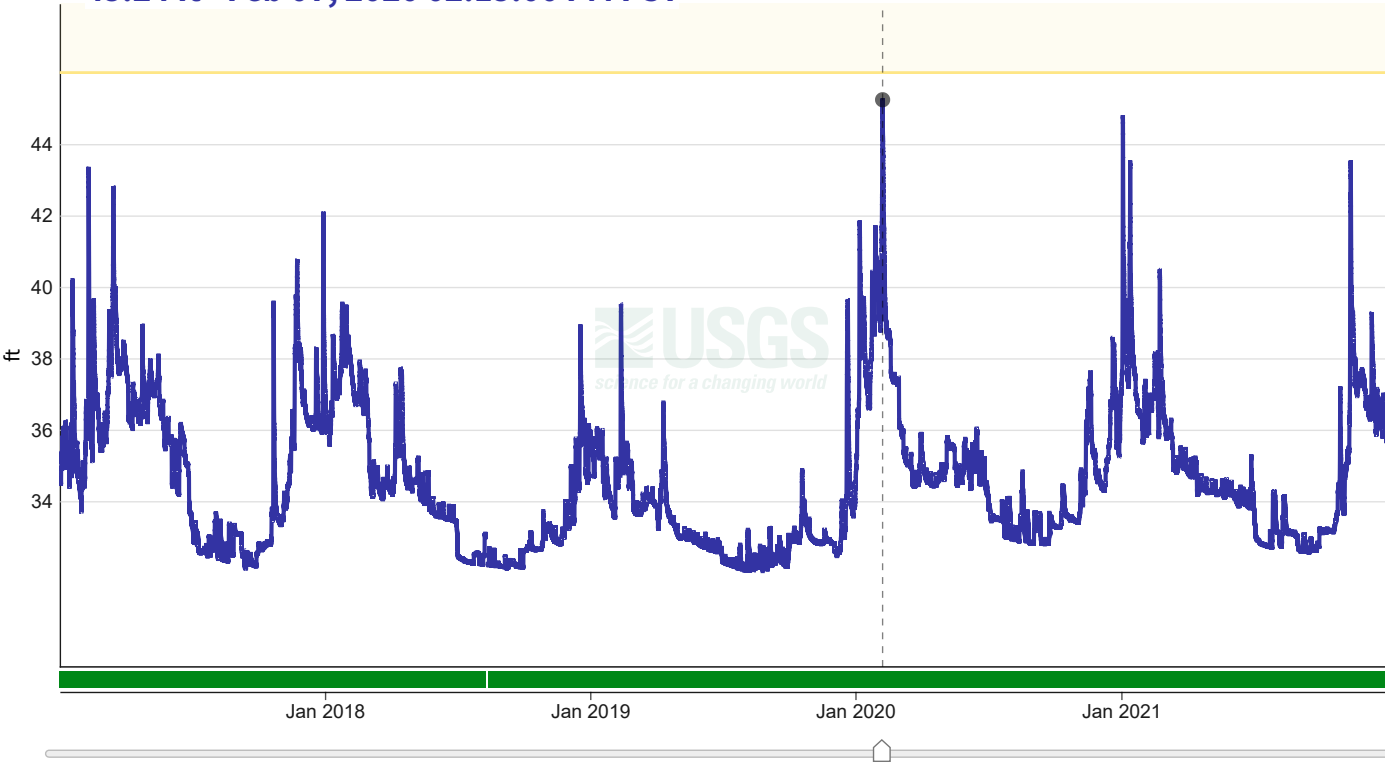
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Cowlitz River at Castle Rock, WA - 14243000

January 1, 2017 - December 31, 2021

Gage height, feet [NAVD 1988, feet]

45.24 ft - Feb 07, 2020 02:15:00 PM PST



IMPORTANT Data may be [provisional](#)

Show legend ▾

Hide graph details ^

	Value	Status
Latest	34.98	Provisional
Jan 29, 2025 08:30:00 AM PST		
Selected	45.24	Approved
Feb 07, 2020 02:15:00 PM PST		
Compare		

Not available with custom time spans



IMPORTANT

[Legacy real-time page](#)



☐ 7 days

☐ 30 days

☐ 1 year

Scale

Linear

Log

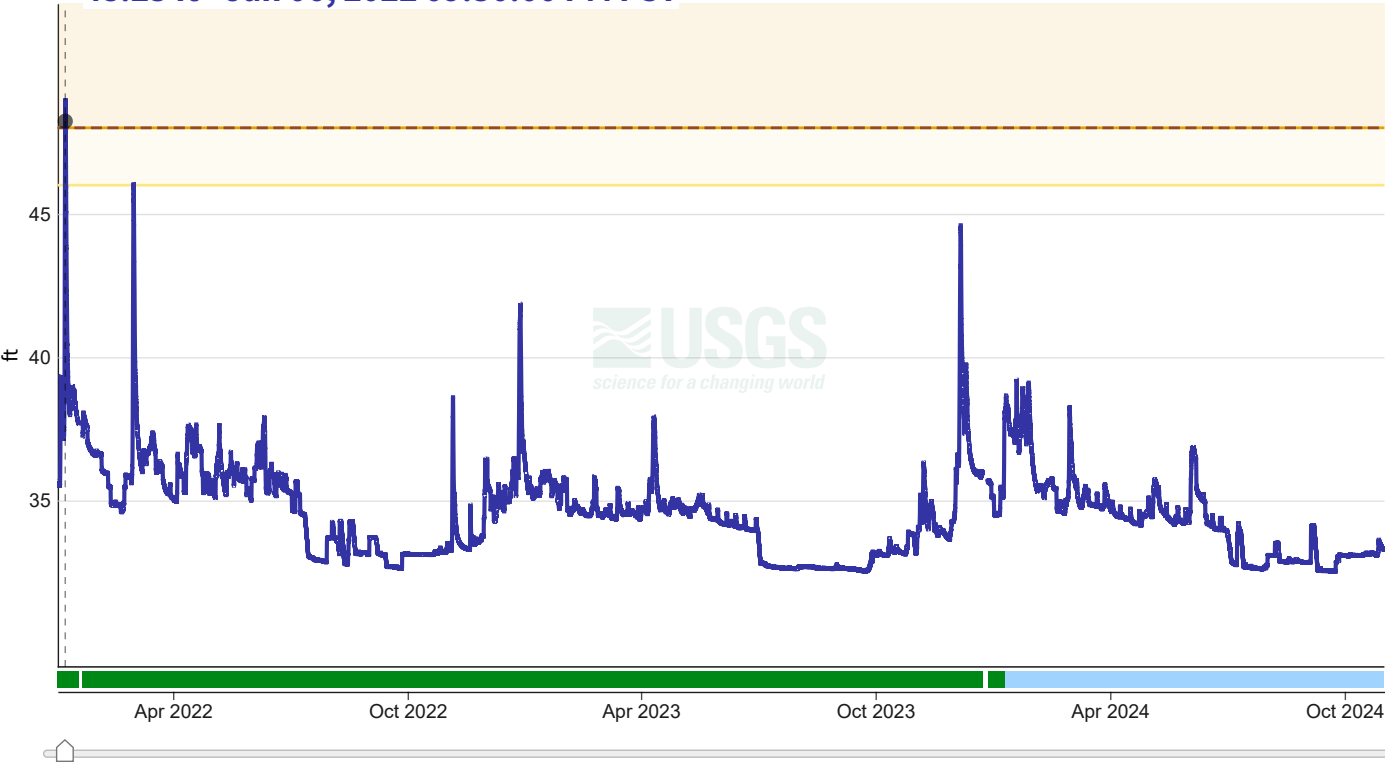
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Cowlitz River at Castle Rock, WA - 14243000

January 1, 2022 - October 31, 2024

Gage height, feet [NAVD 1988, feet]

48.23 ft - Jan 06, 2022 09:30:00 PM PST



IMPORTANT Data may be [provisional](#)

Show legend ▾

Hide graph details ^

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 06, 2022 09:30:00 PM PST	48.23	Approved
Compare		

Not available with custom time spans



IMPORTANT [Legacy real-time page](#) 

☐ 7 days ☐ 30 days ☐ 1 year

Scale Linear

Log

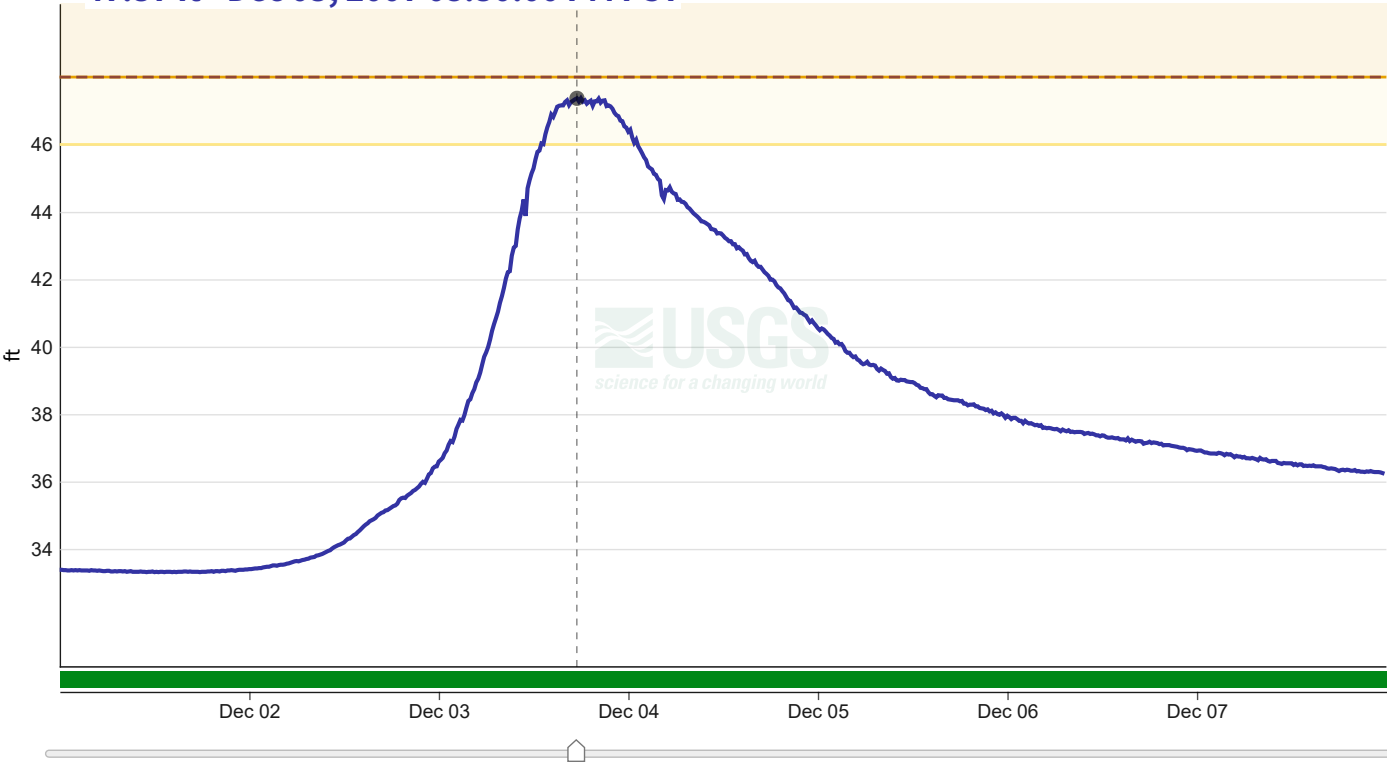
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

December 1, 2007 - December 7, 2007

Gage height, feet [NAVD 1988, feet]

47.37 ft - Dec 03, 2007 05:30:00 PM PST



IMPORTANT Data may be [provisional](#)

Show legend ▾

Hide graph details ^

	Value	Status
Latest	34.98	Provisional
Jan 29, 2025 08:30:00 AM PST		
Selected	47.37	Approved
Dec 03, 2007 05:30:00 PM PST		
Compare		

Questions or Comments



Not available with custom time spans

IMPORTANT [Legacy real-time page](#) 

☐ 7 days ☐ 30 days ☐ 1 year

Scale Linear [Log](#)

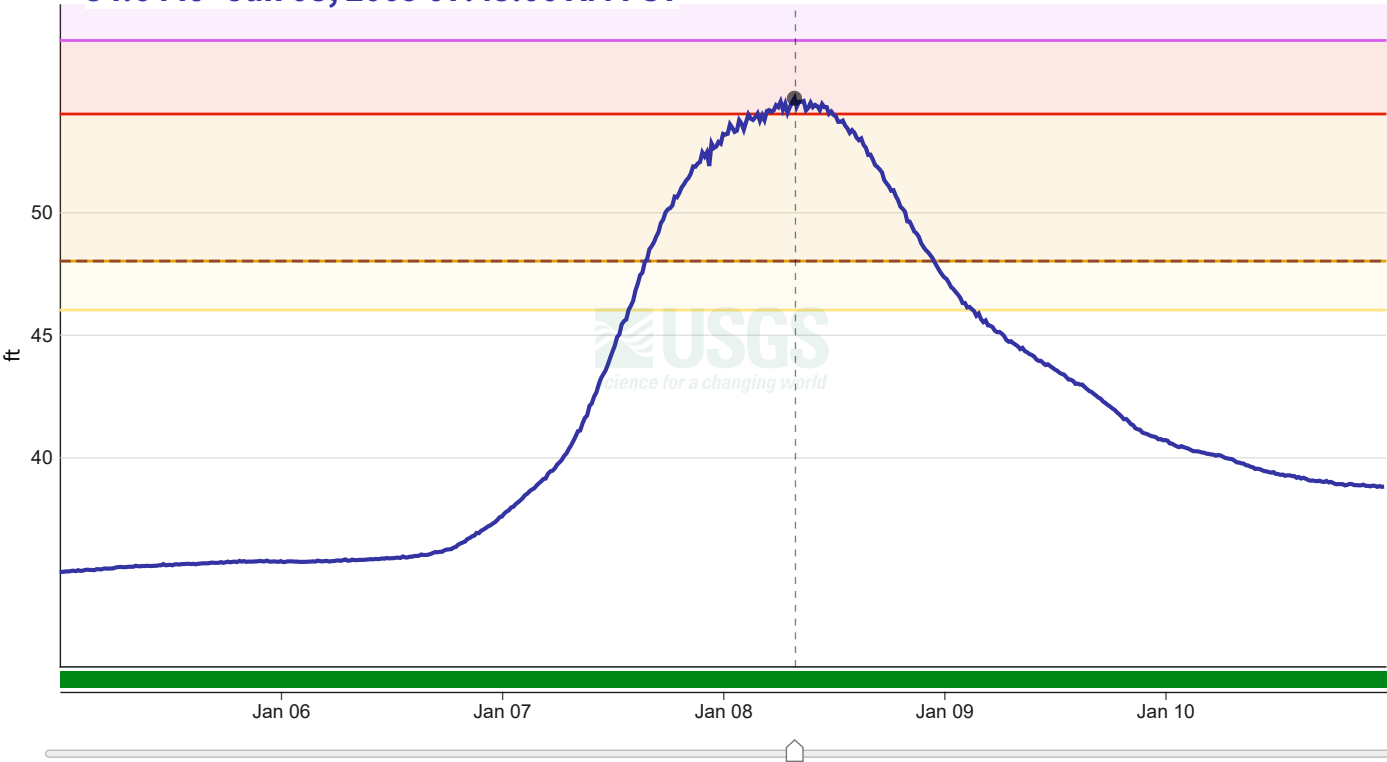
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Cowlitz River at Castle Rock, WA - 14243000

January 5, 2009 - January 10, 2009

Gage height, feet [NAVD 1988, feet]

54.64 ft - Jan 08, 2009 07:45:00 AM PST



IMPORTANT Data may be [provisional](#)

[Show legend](#) 

[Hide graph details](#) 

	Value	Status
 Latest	34.98	Provisional
Jan 29, 2025 08:30:00 AM PST		
 Selected	54.64	Approved
Jan 08, 2009 07:45:00 AM PST		
 Compare		

[Questions or Comments](#)



Not available with custom time spans

IMPORTANT [Legacy real-time page](#) 

☐ 7 days ☐ 30 days ☐ 1 year

Scale Linear

Log

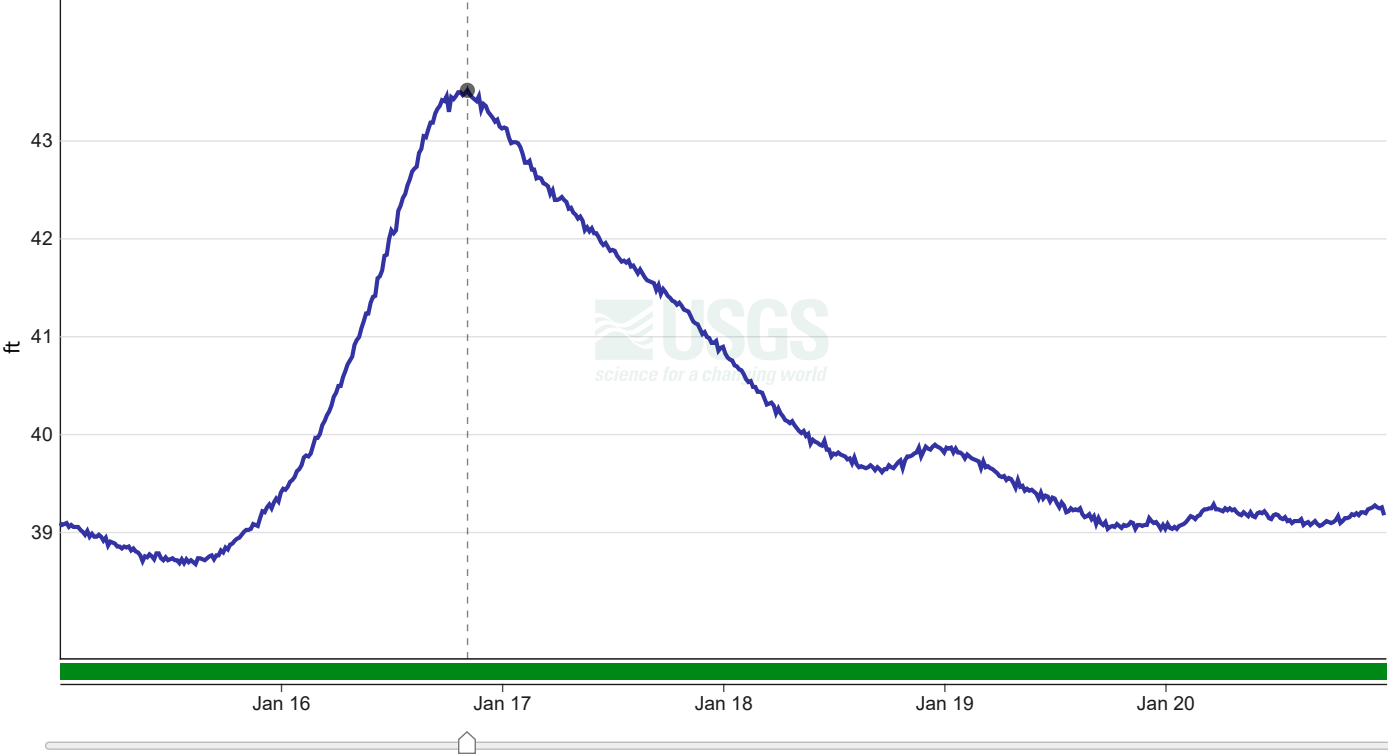
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 15, 2011 - January 20, 2011

Gage height, feet [NAVD 1988, feet]

43.51 ft - Jan 16, 2011 08:15:00 PM PST



IMPORTANT Data may be [provisional](#)

Show legend ▾

Hide graph details ^

	Value	Status
 Latest	34.98	Provisional
Jan 29, 2025 08:30:00 AM PST		
 Selected	43.51	Approved
Jan 16, 2011 08:15:00 PM PST		
 Compare		

Questions or Comments



Not available with custom time spans

IMPORTANT

[Legacy real-time page](#)



☐ 7 days

☐ 30 days

☐ 1 year

Scale

Linear

Log

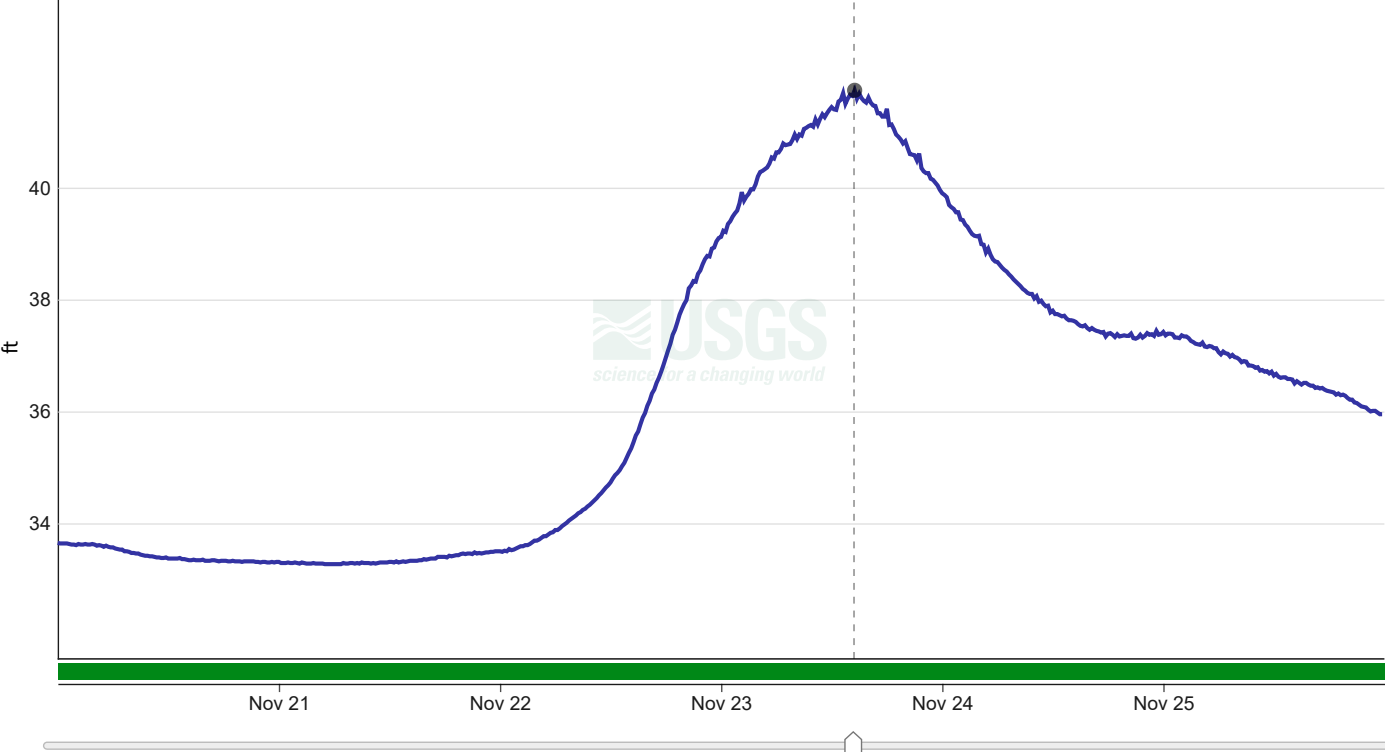
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

November 20, 2011 - November 25, 2011

Gage height, feet [NAVD 1988, feet]

41.74 ft - Nov 23, 2011 02:30:00 PM PST



IMPORTANT Data may be [provisional](#)

Show legend ▾

Hide graph details ^

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Nov 23, 2011 02:30:00 PM PST	41.74	Approved
Compare		

Questions or Comments



Not available with custom time spans

IMPORTANT

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☐ 7 days

☐ 30 days

☐ 1 year

Scale

Linear

Log

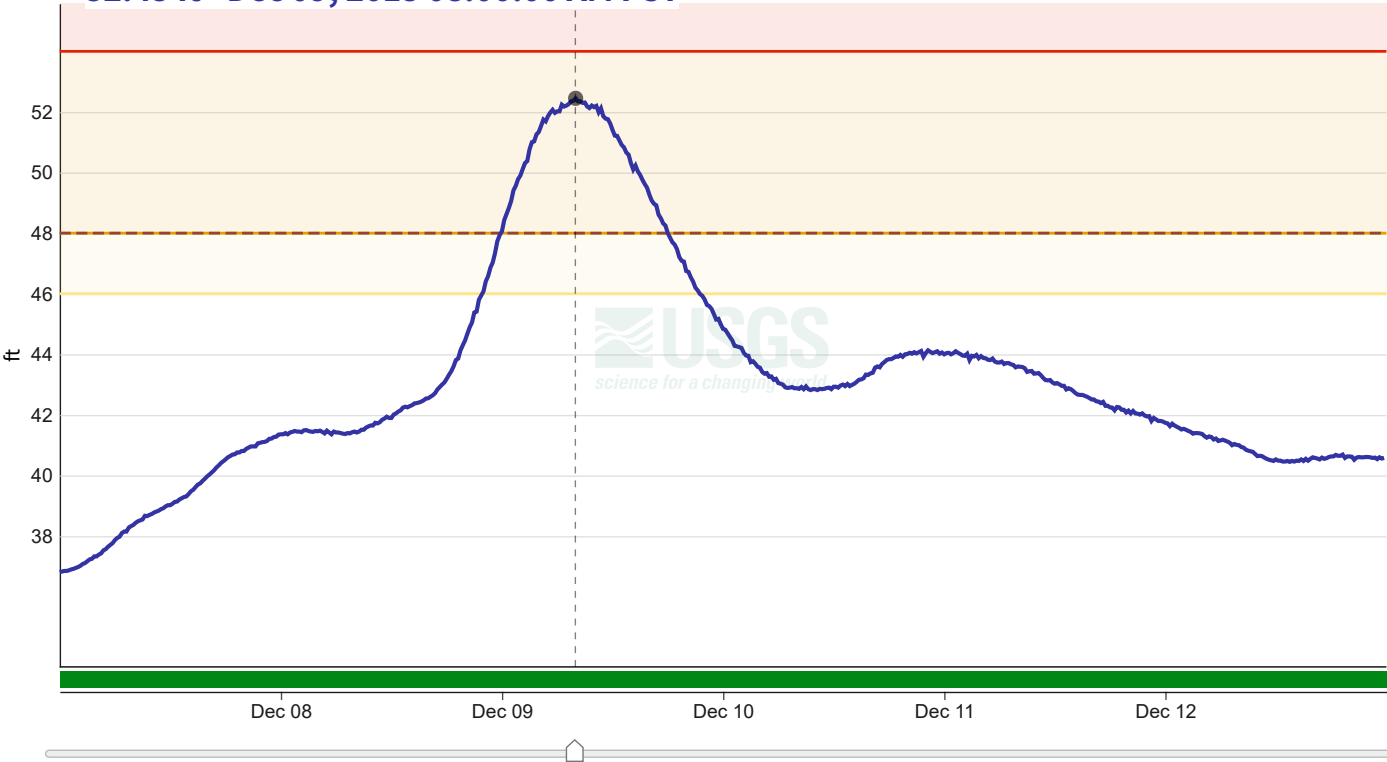
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

December 7, 2015 - December 12, 2015

Gage height, feet [NAVD 1988, feet]

52.45 ft - Dec 09, 2015 08:00:00 AM PST



IMPORTANT Data may be [provisional](#)

Show legend ▾

Hide graph details ^

	Value	Status
Latest	34.98	Provisional
Jan 29, 2025 08:30:00 AM PST		
Selected	52.45	Approved
Dec 09, 2015 08:00:00 AM PST		
Compare		

Questions or Comments



Not available with custom time spans

IMPORTANT [Legacy real-time page](#)

☐ 7 days ☐ 30 days ☐ 1 year

Scale ☐ Linear ☒ Log

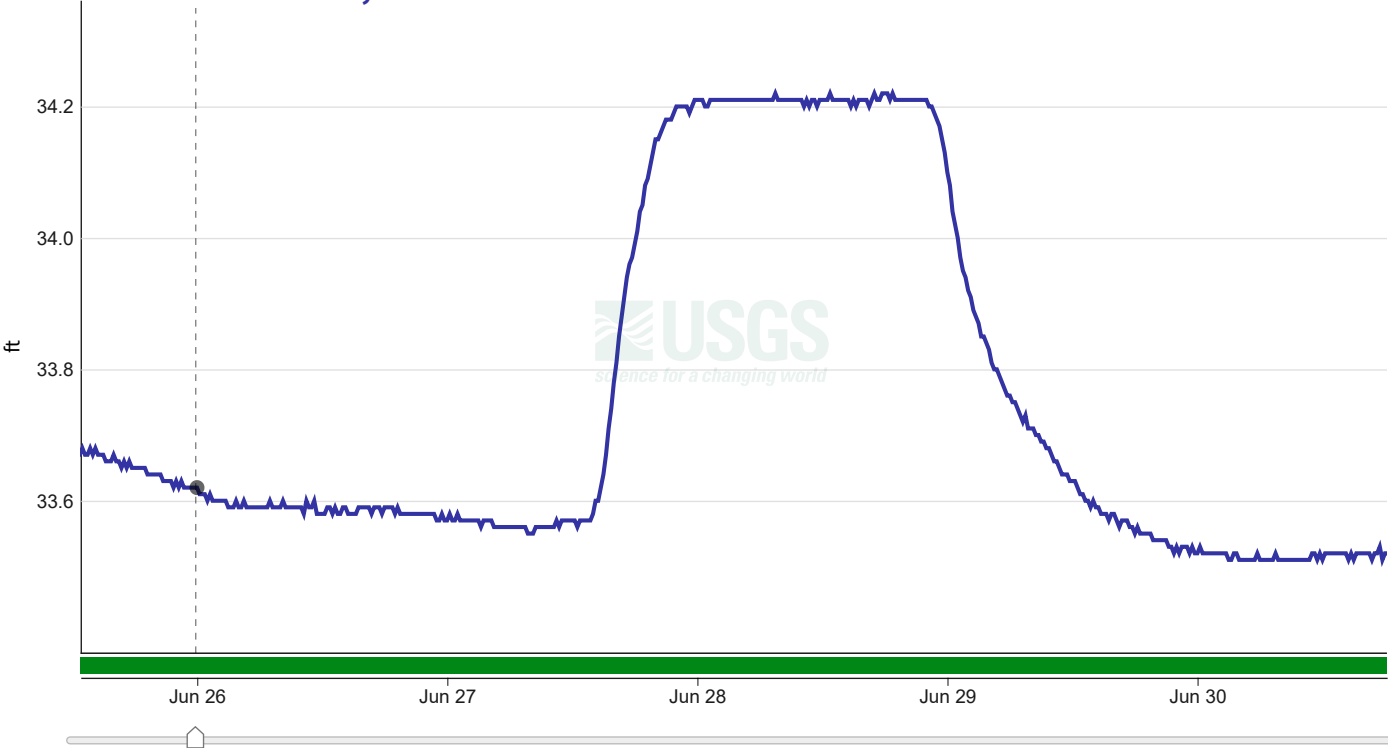
- using custom time span -
- using graph zoom -

Cowlitz River at Castle Rock, WA - 14243000

June 25, 2016 - June 30, 2016

Gage height, feet [NAVD 1988, feet]

33.62 ft - Jun 26, 2016 12:00:00 AM PDT



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[Hide graph details](#)

	Value	Status
Latest	34.98	Provisional
Jan 29, 2025 08:30:00 AM PST		
Selected	33.62	Approved
Jun 26, 2016 12:00:00 AM PDT		
Compare		

Not available with custom time spans



IMPORTANT [Legacy real-time page](#) 

☐ 7 days ☐ 30 days ☐ 1 year

Scale Linear

Log

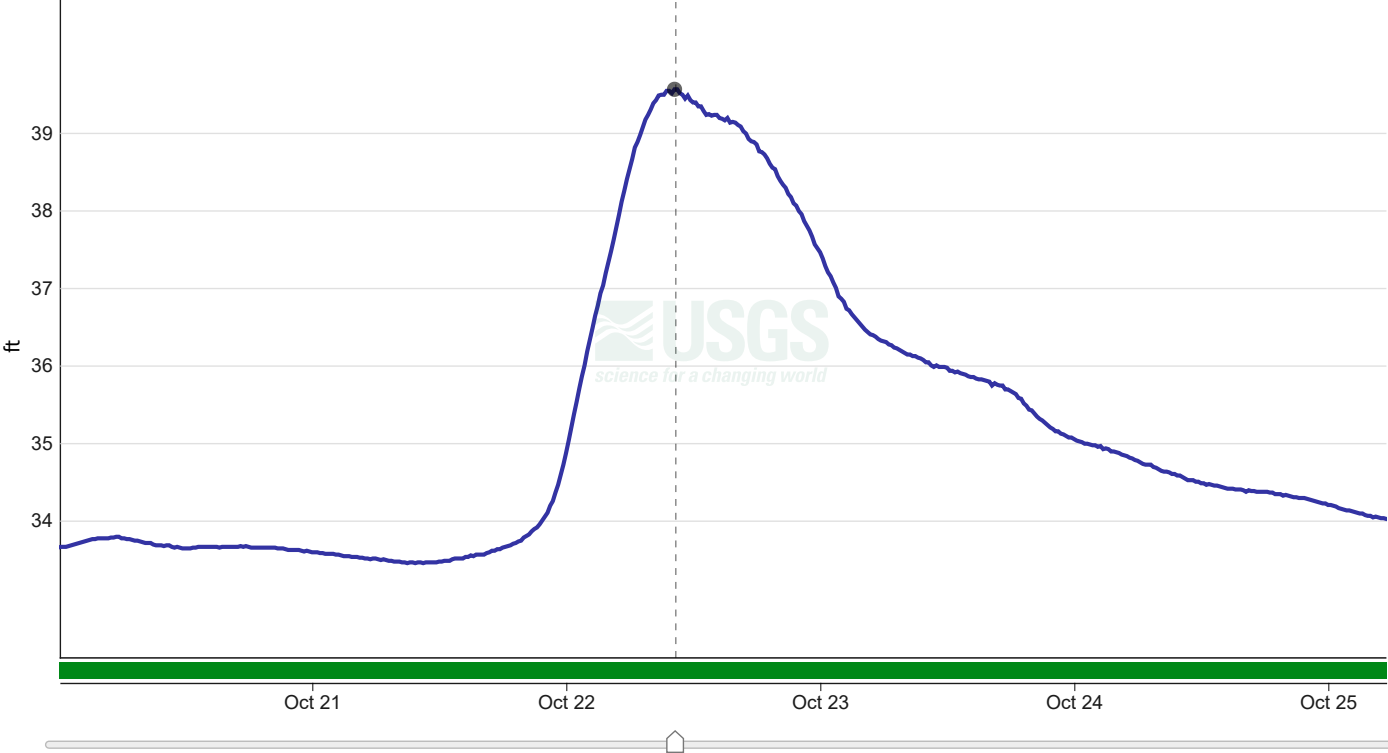
- using custom time span -
- using graph zoom -

Cowlitz River at Castle Rock, WA - 14243000

October 20, 2017 - October 25, 2017

Gage height, feet [NAVD 1988, feet]

39.56 ft - Oct 22, 2017 10:15:00 AM PDT



IMPORTANT Data may be [provisional](#)

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Hide graph details ^

	Value	Status
● Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
● Selected Oct 22, 2017 10:15:00 AM PDT	39.56	Approved
● Compare		

Not available with custom time spans



IMPORTANT

[Legacy real-time page](#)



☐ 7 days

☐ 30 days

☐ 1 year

Scale

Linear

Log

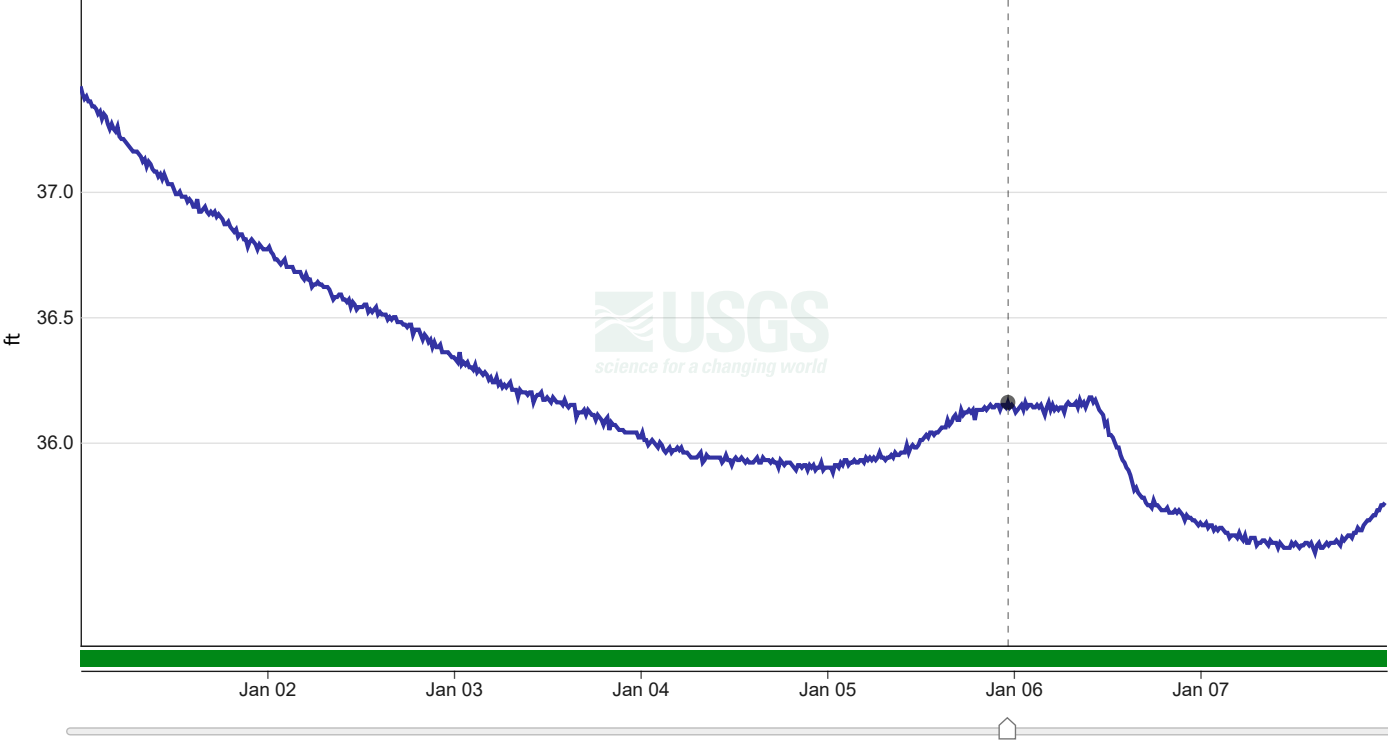
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2018 - January 7, 2018

Gage height, feet [NAVD 1988, feet]

36.16 ft - Jan 05, 2018 11:15:00 PM PST



IMPORTANT Data may be [provisional](#)

Show legend ▾

Hide graph details ^

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 05, 2018 11:15:00 PM PST	36.16	Approved

☐ Compare



Not available with custom time spans

☐ Median



Add median data to graph

IMPORTANT [Legacy real-time page](#) 

☐ 7 days ☐ 30 days ☐ 1 year

Scale ☐ Linear ☒ Log

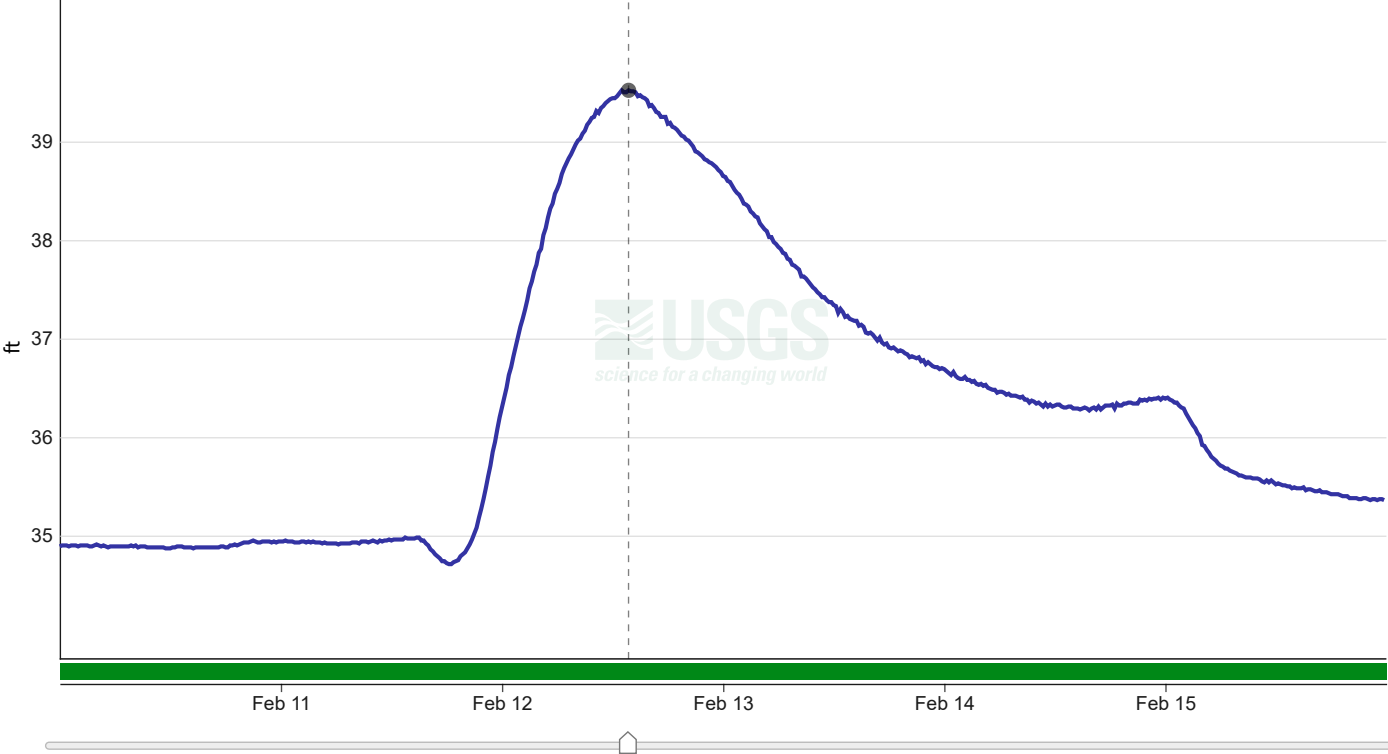
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

February 10, 2019 - February 15, 2019

Gage height, feet [NAVD 1988, feet]

39.52 ft - Feb 12, 2019 01:45:00 PM PST



IMPORTANT Data may be [provisional](#)

[Show legend](#) ▾

[Hide graph details](#) ^

	Value	Status
 Latest	34.98	Provisional
Jan 29, 2025 08:30:00 AM PST		
 Selected	39.52	Approved
Feb 12, 2019 01:45:00 PM PST		
 Compare		

Not available with custom time spans



IMPORTANT

[Legacy real-time page](#)



☐ 7 days

☐ 30 days

☐ 1 year

Scale

Linear

Log

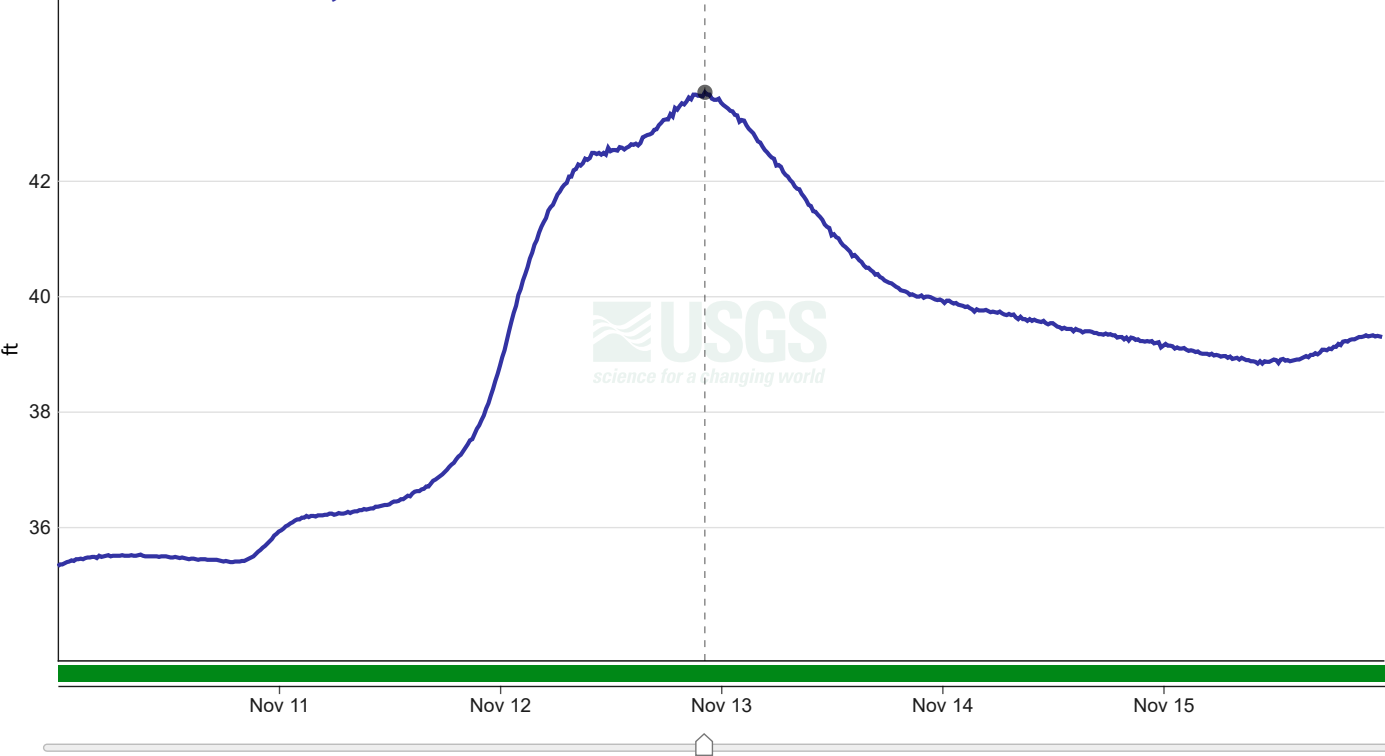
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

November 10, 2021 - November 15, 2021

Gage height, feet [NAVD 1988, feet]

43.53 ft - Nov 12, 2021 10:15:00 PM PST



IMPORTANT Data may be [provisional](#)

Show legend ▾

Hide graph details ^

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Nov 12, 2021 10:15:00 PM PST	43.53	Approved
Compare		

Not available with custom time spans



IMPORTANT

[Legacy real-time page](#)



☐ 7 days

☐ 30 days

☐ 1 year

Scale

Linear

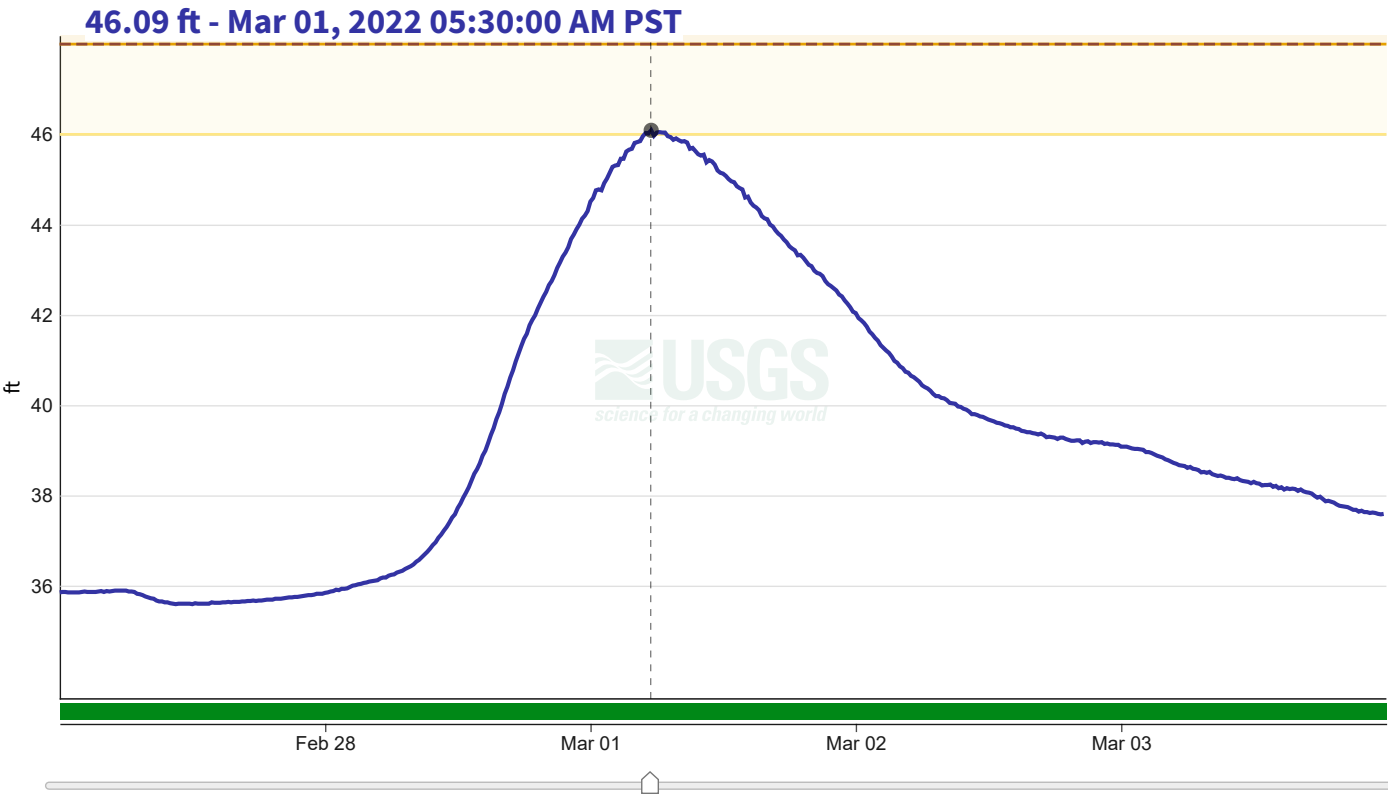
Log

- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

February 27, 2022 - March 3, 2022

Gage height, feet [NAVD 1988, feet]



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Show legend ▾

Hide graph details ^

	Value	Status
Latest	34.98	Provisional
Jan 29, 2025 08:30:00 AM PST		
Selected	46.09	Approved
Mar 01, 2022 05:30:00 AM PST		
Compare		



Not available with custom time spans

City of Castlerock Actual Rainfall Data
from 1/1/07 to 10/31/24

Daily Rainfall		
Date	(inches)	Event Size
12/3/2007	3.79	2-year
1/8/2009	3.31	2-year
1/17/2011	4.00	2-year
11/23/2011	3.35	2-year
12/9/2015	3.37	2-year
6/26/2016	6.50	100-year
10/22/2017	4.12	2-year
1/5/2018	4.00	2-year
2/12/2019	3.42	2-year
11/12/2021	3.41	2-year
3/1/2022	4.50	10-year

USGS Cowlitz River Gage Data at Castle Rock During
Heavy Rain Events

River Elevation Equivalent Elevation		
Date	@ Gage*	@ Site**
12/3/2007	47.37	40.37
1/8/2009	54.64	47.64
1/17/2011	43.51	36.51
11/23/2011	41.74	34.74
12/9/2015	52.45	45.45
6/26/2016	33.62	26.62
10/22/2017	39.56	32.56
1/5/2018	36.16	29.16
2/12/2019	39.52	32.52
11/12/2021	43.53	36.53
3/1/2022	46.09	39.09

* This is the actual reading at the gage

** This equivalent includes a 6.3' drop from the
gage to our site, plus a 0.7' drop for datum change

Appendix C: Stormwater Volume Calculations

WWHM Reports for:

Node A

Node B

Node C

Node D

Node E

WWHM2012
PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node A

Site Name: LOTC

Site Address:

City: Castle Rock, WA

Report Date: 1/21/2025

Gage: Longview

Data Start: 1955/10/01

Data End: 2009/09/30

Timestep: 15 Minute

Precip Scale: 1.429

Version Date: 2024/06/28

Version: 4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
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High Flow Threshold for POC1:	50 Year
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Low Flow Threshold for POC2:	50 Percent of the 2 Year
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High Flow Threshold for POC2:	50 Year
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Landuse Basin Data

Predeveloped Land Use

Node A - Existing Public

Bypass: No

GroundWater: No

Pervious Land Use acre
A B, Forest, Mod 2.844

Pervious Total 2.844

Impervious Land Use acre

Impervious Total 0

Basin Total 2.844

Element Flow Componentants:

Surface	Interflow	Groundwater
Component Flows To:		
POC 1	POC 1	

Node A - Existng C/F

Bypass: No

GroundWater: No

Pervious Land Use acre
A B, Forest, Mod 12.099

Pervious Total 12.099

Impervious Land Use acre

Impervious Total 0

Basin Total 12.099

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

Mitigated Land Use

Node A - Public PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1.684
Impervious Total	1.684
Basin Total	1.684

Element Flow Componants:
Surface Interflow Groundwater
Componant Flows To:
Surface Bioretention Surface Bioretention

Node A - C/F PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	7.516
Impervious Total	7.516
Basin Total	7.516

Element Flow Components:

Surface	Interflow	Groundwater
Component Flows To:		
Surface Bioretention	Surface Bioretention	

Node A - Public Non-PGIS

Bypass: Yes

GroundWater: No

Pervious Land Use acre
A B, Lawn, Mod 1.16

Pervious Total 1.16

Impervious Land Use acre

Impervious Total 0

Basin Total 1.16

Element Flow Componants:

Surface Interflow

Groundwater

Componant Flows To:

POC 1 POC 1

Node A - C/F Non-PGIS

Bypass: Yes

GroundWater: No

Pervious Land Use acre
A B, Lawn, Mod 1.21

Pervious Total 1.21

Impervious Land Use acre
ROOF TOPS FLAT 3.373

Impervious Total 3.373

Basin Total 4.583

Element Flow Componants:

Surface Interflow

Componant Flows To:

POC 2 POC 2

Groundwater

Routing Elements

Predeveloped Routing

Mitigated Routing

Road Bioretention

Bottom Length: 250.00 ft.
 Bottom Width: 5.00 ft.
 Material thickness of first layer: 1.5
 Material type for first layer: SMMWW 12 in/hr
 Material thickness of second layer: 1.5
 Material type for second layer: GRAVEL
 Material thickness of third layer: 0
 Material type for third layer: GRAVEL
 Underdrain used
 Underdrain Diameter (feet): 1
 Orifice Diameter (in.): 12
 Offset (in.): 0
 Flow Through Underdrain (ac-ft.): 381.644
 Total Outflow (ac-ft.): 404.722
 Percent Through Underdrain: 94.3
 Discharge Structure
 Riser Height: 0.5 ft.
 Riser Diameter: 12 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:
 Gravel Trench Bed 2

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0287	0.0000	0.0000	0.0000
0.0440	0.0287	0.0006	0.0000	0.0000
0.0879	0.0287	0.0012	0.0000	0.0000
0.1319	0.0287	0.0017	0.0000	0.0000
0.1758	0.0287	0.0023	0.0000	0.0000
0.2198	0.0287	0.0029	0.0008	0.0000
0.2637	0.0287	0.0035	0.0013	0.0000
0.3077	0.0287	0.0040	0.0021	0.0000
0.3516	0.0287	0.0046	0.0030	0.0000
0.3956	0.0287	0.0052	0.0042	0.0000
0.4396	0.0287	0.0058	0.0056	0.0000
0.4835	0.0287	0.0063	0.0073	0.0000
0.5275	0.0287	0.0069	0.0090	0.0000
0.5714	0.0287	0.0075	0.0092	0.0000
0.6154	0.0287	0.0081	0.0115	0.0000
0.6593	0.0287	0.0087	0.0141	0.0000
0.7033	0.0287	0.0092	0.0170	0.0000
0.7473	0.0287	0.0098	0.0202	0.0000
0.7912	0.0287	0.0104	0.0218	0.0000
0.8352	0.0287	0.0110	0.0238	0.0000
0.8791	0.0287	0.0115	0.0278	0.0000
0.9231	0.0287	0.0121	0.0321	0.0000
0.9670	0.0287	0.0127	0.0369	0.0000
1.0110	0.0287	0.0133	0.0417	0.0000
1.0549	0.0287	0.0138	0.0420	0.0000
1.0989	0.0287	0.0144	0.0475	0.0000
1.1429	0.0287	0.0150	0.0535	0.0000
1.1868	0.0287	0.0156	0.0599	0.0000

1.2308	0.0287	0.0162	0.0667	0.0000
1.2747	0.0287	0.0167	0.0697	0.0000
1.3187	0.0287	0.0173	0.0740	0.0000
1.3626	0.0287	0.0179	0.0818	0.0000
1.4066	0.0287	0.0185	0.0900	0.0000
1.4505	0.0287	0.0190	0.0987	0.0000
1.4945	0.0287	0.0196	0.1069	0.0000
1.5385	0.0287	0.0201	0.1078	0.0000
1.5824	0.0287	0.0207	0.1175	0.0000
1.6264	0.0287	0.0212	0.1276	0.0000
1.6703	0.0287	0.0217	0.1383	0.0000
1.7143	0.0287	0.0222	0.1494	0.0000
1.7582	0.0287	0.0228	0.1538	0.0000
1.8022	0.0287	0.0233	0.1609	0.0000
1.8462	0.0287	0.0238	0.1726	0.0000
1.8901	0.0287	0.0243	0.2315	0.0000
1.9341	0.0287	0.0248	0.2315	0.0000
1.9780	0.0287	0.0254	0.2315	0.0000
2.0220	0.0287	0.0259	0.2315	0.0000
2.0659	0.0287	0.0264	0.2315	0.0000
2.1099	0.0287	0.0269	0.2315	0.0000
2.1538	0.0287	0.0275	0.2315	0.0000
2.1978	0.0287	0.0280	0.2315	0.0000
2.2418	0.0287	0.0285	0.2315	0.0000
2.2857	0.0287	0.0290	0.2315	0.0000
2.3297	0.0287	0.0296	0.2315	0.0000
2.3736	0.0287	0.0301	0.2315	0.0000
2.4176	0.0287	0.0306	0.2315	0.0000
2.4615	0.0287	0.0311	0.2315	0.0000
2.5055	0.0287	0.0317	0.2315	0.0000
2.5495	0.0287	0.0322	0.2315	0.0000
2.5934	0.0287	0.0327	0.2315	0.0000
2.6374	0.0287	0.0332	0.2315	0.0000
2.6813	0.0287	0.0337	0.2315	0.0000
2.7253	0.0287	0.0343	0.2315	0.0000
2.7692	0.0287	0.0348	0.2315	0.0000
2.8132	0.0287	0.0353	0.2315	0.0000
2.8571	0.0287	0.0358	0.2315	0.0000
2.9011	0.0287	0.0364	0.2315	0.0000
2.9451	0.0287	0.0369	0.2315	0.0000
2.9890	0.0287	0.0374	0.2315	0.0000
3.0000	0.0287	0.0375	0.2315	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0287	0.0375	0.0000	0.1736	0.0000
3.0440	0.0287	0.0388	0.0000	0.1736	0.0000
3.0879	0.0287	0.0401	0.0000	0.1838	0.0000
3.1319	0.0287	0.0413	0.0000	0.1889	0.0000
3.1758	0.0287	0.0426	0.0000	0.1940	0.0000
3.2198	0.0287	0.0438	0.0000	0.1990	0.0000
3.2637	0.0287	0.0451	0.0000	0.2041	0.0000
3.3077	0.0287	0.0464	0.0000	0.2092	0.0000
3.3516	0.0287	0.0476	0.0000	0.2143	0.0000
3.3956	0.0287	0.0489	0.0000	0.2194	0.0000
3.4396	0.0287	0.0502	0.0000	0.2245	0.0000
3.4835	0.0287	0.0514	0.0000	0.2296	0.0000
3.5275	0.0287	0.0527	0.0483	0.2315	0.0000

3.5714	0.0287	0.0539	0.2020	0.2315	0.0000
3.6154	0.0287	0.0552	0.4122	0.2315	0.0000
3.6593	0.0287	0.0565	0.6597	0.2315	0.0000
3.7033	0.0287	0.0577	0.9282	0.2315	0.0000
3.7473	0.0287	0.0590	1.2008	0.2315	0.0000
3.7912	0.0287	0.0602	1.4606	0.2315	0.0000
3.8352	0.0287	0.0615	1.6924	0.2315	0.0000
3.8791	0.0287	0.0628	1.8845	0.2315	0.0000
3.9231	0.0287	0.0640	2.0318	0.2315	0.0000
3.9670	0.0287	0.0653	2.1391	0.2315	0.0000
4.0000	0.0287	0.0662	2.2515	0.2315	0.0000

Commerical/Flex Bioretention

Bottom Length: 120.00 ft.
 Bottom Width: 50.00 ft.
 Material thickness of first layer: 1.5
 Material type for first layer: SMMWW 12 in/hr
 Material thickness of second layer: 1.5
 Material type for second layer: GRAVEL
 Material thickness of third layer: 0
 Material type for third layer: GRAVEL
 Underdrain used
 Underdrain Diameter (feet): 1
 Orifice Diameter (in.): 12
 Offset (in.): 0
 Flow Through Underdrain (ac-ft.): 1771.377
 Total Outflow (ac-ft.): 1808.386
 Percent Through Underdrain: 97.95
 Discharge Structure
 Riser Height: 1 ft.
 Riser Diameter: 24 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:
 Road Infiltration Trench

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.1377	0.0000	0.0000	0.0000
0.0549	0.1377	0.0035	0.0000	0.0000
0.1099	0.1377	0.0069	0.0000	0.0000
0.1648	0.1377	0.0104	0.0000	0.0000
0.2198	0.1377	0.0138	0.0057	0.0000
0.2747	0.1377	0.0173	0.0099	0.0000
0.3297	0.1377	0.0208	0.0156	0.0000
0.3846	0.1377	0.0242	0.0165	0.0000
0.4396	0.1377	0.0277	0.0232	0.0000
0.4945	0.1377	0.0311	0.0327	0.0000
0.5495	0.1377	0.0346	0.0442	0.0000
0.6044	0.1377	0.0381	0.0581	0.0000
0.6593	0.1377	0.0415	0.0699	0.0000
0.7143	0.1377	0.0450	0.0743	0.0000
0.7692	0.1377	0.0485	0.0930	0.0000
0.8242	0.1377	0.0519	0.1143	0.0000
0.8791	0.1377	0.0554	0.1384	0.0000
0.9341	0.1377	0.0588	0.1653	0.0000
0.9890	0.1377	0.0623	0.1727	0.0000
1.0440	0.1377	0.0658	0.1952	0.0000
1.0989	0.1377	0.0692	0.2282	0.0000
1.1538	0.1377	0.0727	0.2643	0.0000
1.2088	0.1377	0.0761	0.3036	0.0000
1.2637	0.1377	0.0796	0.3347	0.0000
1.3187	0.1377	0.0831	0.3464	0.0000
1.3736	0.1377	0.0865	0.3925	0.0000
1.4286	0.1377	0.0900	0.4421	0.0000
1.4835	0.1377	0.0934	0.4953	0.0000
1.5385	0.1377	0.0966	0.5521	0.0000
1.5934	0.1377	0.0997	0.5647	0.0000

1.6484	0.1377	0.1029	0.6126	0.0000
1.7033	0.1377	0.1060	0.6767	0.0000
1.7582	0.1377	0.1091	0.7444	0.0000
1.8132	0.1377	0.1123	0.8147	0.0000
1.8681	0.1377	0.1154	1.3889	0.0000
1.9231	0.1377	0.1186	1.3889	0.0000
1.9780	0.1377	0.1217	1.3889	0.0000
2.0330	0.1377	0.1249	1.3889	0.0000
2.0879	0.1377	0.1280	1.3889	0.0000
2.1429	0.1377	0.1311	1.3889	0.0000
2.1978	0.1377	0.1343	1.3889	0.0000
2.2527	0.1377	0.1374	1.3889	0.0000
2.3077	0.1377	0.1406	1.3889	0.0000
2.3626	0.1377	0.1437	1.3889	0.0000
2.4176	0.1377	0.1468	1.3889	0.0000
2.4725	0.1377	0.1500	1.3889	0.0000
2.5275	0.1377	0.1531	1.3889	0.0000
2.5824	0.1377	0.1563	1.3889	0.0000
2.6374	0.1377	0.1594	1.3889	0.0000
2.6923	0.1377	0.1625	1.3889	0.0000
2.7473	0.1377	0.1657	1.3889	0.0000
2.8022	0.1377	0.1688	1.3889	0.0000
2.8571	0.1377	0.1720	1.3889	0.0000
2.9121	0.1377	0.1751	1.3889	0.0000
2.9670	0.1377	0.1782	1.3889	0.0000
3.0000	0.1377	0.1801	1.3889	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infiltr(cfs)
3.0000	0.1377	0.1801	0.0000	0.8333	0.0000
3.0549	0.1377	0.1877	0.0000	0.8333	0.0000
3.1099	0.1377	0.1953	0.0000	0.8944	0.0000
3.1648	0.1377	0.2028	0.0000	0.9249	0.0000
3.2198	0.1377	0.2104	0.0000	0.9554	0.0000
3.2747	0.1377	0.2180	0.0000	0.9860	0.0000
3.3297	0.1377	0.2255	0.0000	1.0165	0.0000
3.3846	0.1377	0.2331	0.0000	1.0470	0.0000
3.4396	0.1377	0.2407	0.0000	1.0775	0.0000
3.4945	0.1377	0.2482	0.0000	1.1081	0.0000
3.5495	0.1377	0.2558	0.0000	1.1386	0.0000
3.6044	0.1377	0.2634	0.0000	1.1691	0.0000
3.6593	0.1377	0.2709	0.0000	1.1996	0.0000
3.7143	0.1377	0.2785	0.0000	1.2302	0.0000
3.7692	0.1377	0.2861	0.0000	1.2607	0.0000
3.8242	0.1377	0.2937	0.0000	1.2912	0.0000
3.8791	0.1377	0.3012	0.0000	1.3217	0.0000
3.9341	0.1377	0.3088	0.0000	1.3523	0.0000
3.9890	0.1377	0.3164	0.0000	1.3828	0.0000
4.0440	0.1377	0.3239	0.1956	1.3889	0.0000
4.0989	0.1377	0.3315	0.6592	1.3889	0.0000
4.1538	0.1377	0.3391	1.2766	1.3889	0.0000
4.2088	0.1377	0.3466	2.0109	1.3889	0.0000
4.2637	0.1377	0.3542	2.8369	1.3889	0.0000
4.3187	0.1377	0.3618	3.7318	1.3889	0.0000
4.3736	0.1377	0.3693	4.6731	1.3889	0.0000
4.4286	0.1377	0.3769	5.6376	1.3889	0.0000
4.4835	0.1377	0.3845	6.6018	1.3889	0.0000
4.5385	0.1377	0.3920	7.5423	1.3889	0.0000

4.5934	0.1377	0.3996	8.4368	1.3889	0.0000
4.6484	0.1377	0.4072	9.2649	1.3889	0.0000
4.7033	0.1377	0.4147	10.010	1.3889	0.0000
4.7582	0.1377	0.4223	10.660	1.3889	0.0000
4.8132	0.1377	0.4299	11.211	1.3889	0.0000
4.8681	0.1377	0.4374	11.664	1.3889	0.0000
4.9231	0.1377	0.4450	12.034	1.3889	0.0000
4.9780	0.1377	0.4526	12.347	1.3889	0.0000
5.0000	0.1377	0.4556	12.805	1.3889	0.0000

Road Infiltration Trench

Bottom Length: 120.00 ft.
 Bottom Width: 50.00 ft.
 Trench bottom slope 1: 0 To 1
 Trench Left side slope 0: 0 To 1
 Trench right side slope 2: 0 To 1
 Material thickness of first layer: 5
 Pour Space of material for first layer: 0.35
 Material thickness of second layer: 0
 Pour Space of material for second layer: 0
 Material thickness of third layer: 0
 Pour Space of material for third layer: 0
 Infiltration On
 Infiltration rate: 2
 Infiltration safety factor: 1
 Total Volume Infiltrated (ac-ft.): 28.422
 Total Volume Through Riser (ac-ft.): 8.597
 Total Volume Through Facility (ac-ft.): 37.019
 Percent Infiltrated: 76.78
 Total Precip Applied to Facility: 0
 Total Evap From Facility: 0
 Discharge Structure
 Riser Height: 4.5 ft.
 Riser Diameter: 24 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.137	0.000	0.000	0.000
0.0556	0.137	0.002	0.000	0.277
0.1111	0.137	0.005	0.000	0.277
0.1667	0.137	0.008	0.000	0.277
0.2222	0.137	0.010	0.000	0.277
0.2778	0.137	0.013	0.000	0.277
0.3333	0.137	0.016	0.000	0.277
0.3889	0.137	0.018	0.000	0.277
0.4444	0.137	0.021	0.000	0.277
0.5000	0.137	0.024	0.000	0.277
0.5556	0.137	0.026	0.000	0.277
0.6111	0.137	0.029	0.000	0.277
0.6667	0.137	0.032	0.000	0.277
0.7222	0.137	0.034	0.000	0.277
0.7778	0.137	0.037	0.000	0.277
0.8333	0.137	0.040	0.000	0.277
0.8889	0.137	0.042	0.000	0.277
0.9444	0.137	0.045	0.000	0.277
1.0000	0.137	0.048	0.000	0.277
1.0556	0.137	0.050	0.000	0.277
1.1111	0.137	0.053	0.000	0.277
1.1667	0.137	0.056	0.000	0.277
1.2222	0.137	0.058	0.000	0.277
1.2778	0.137	0.061	0.000	0.277
1.3333	0.137	0.064	0.000	0.277

1.3889	0.137	0.067	0.000	0.277
1.4444	0.137	0.069	0.000	0.277
1.5000	0.137	0.072	0.000	0.277
1.5556	0.137	0.075	0.000	0.277
1.6111	0.137	0.077	0.000	0.277
1.6667	0.137	0.080	0.000	0.277
1.7222	0.137	0.083	0.000	0.277
1.7778	0.137	0.085	0.000	0.277
1.8333	0.137	0.088	0.000	0.277
1.8889	0.137	0.091	0.000	0.277
1.9444	0.137	0.093	0.000	0.277
2.0000	0.137	0.096	0.000	0.277
2.0556	0.137	0.099	0.000	0.277
2.1111	0.137	0.101	0.000	0.277
2.1667	0.137	0.104	0.000	0.277
2.2222	0.137	0.107	0.000	0.277
2.2778	0.137	0.109	0.000	0.277
2.3333	0.137	0.112	0.000	0.277
2.3889	0.137	0.115	0.000	0.277
2.4444	0.137	0.117	0.000	0.277
2.5000	0.137	0.120	0.000	0.277
2.5556	0.137	0.123	0.000	0.277
2.6111	0.137	0.125	0.000	0.277
2.6667	0.137	0.128	0.000	0.277
2.7222	0.137	0.131	0.000	0.277
2.7778	0.137	0.133	0.000	0.277
2.8333	0.137	0.136	0.000	0.277
2.8889	0.137	0.139	0.000	0.277
2.9444	0.137	0.141	0.000	0.277
3.0000	0.137	0.144	0.000	0.277
3.0556	0.137	0.147	0.000	0.277
3.1111	0.137	0.150	0.000	0.277
3.1667	0.137	0.152	0.000	0.277
3.2222	0.137	0.155	0.000	0.277
3.2778	0.137	0.158	0.000	0.277
3.3333	0.137	0.160	0.000	0.277
3.3889	0.137	0.163	0.000	0.277
3.4444	0.137	0.166	0.000	0.277
3.5000	0.137	0.168	0.000	0.277
3.5556	0.137	0.171	0.000	0.277
3.6111	0.137	0.174	0.000	0.277
3.6667	0.137	0.176	0.000	0.277
3.7222	0.137	0.179	0.000	0.277
3.7778	0.137	0.182	0.000	0.277
3.8333	0.137	0.184	0.000	0.277
3.8889	0.137	0.187	0.000	0.277
3.9444	0.137	0.190	0.000	0.277
4.0000	0.137	0.192	0.000	0.277
4.0556	0.137	0.195	0.000	0.277
4.1111	0.137	0.198	0.000	0.277
4.1667	0.137	0.200	0.000	0.277
4.2222	0.137	0.203	0.000	0.277
4.2778	0.137	0.206	0.000	0.277
4.3333	0.137	0.208	0.000	0.277
4.3889	0.137	0.211	0.000	0.277
4.4444	0.137	0.214	0.000	0.277
4.5000	0.137	0.216	0.000	0.277
4.5556	0.137	0.219	0.277	0.277

4.6111	0.137	0.222	0.784	0.277
4.6667	0.137	0.225	1.438	0.277
4.7222	0.137	0.227	2.205	0.277
4.7778	0.137	0.230	3.059	0.277
4.8333	0.137	0.233	3.979	0.277
4.8889	0.137	0.235	4.939	0.277
4.9444	0.137	0.238	5.917	0.277
5.0000	0.137	0.241	6.887	0.277

Gravel Trench Bed 2

Bottom Length: 250.00 ft.
 Bottom Width: 5.00 ft.
 Trench bottom slope 1: 0 To 1
 Trench Left side slope 0: 0 To 1
 Trench right side slope 2: 0 To 1
 Material thickness of first layer: 5
 Pour Space of material for first layer: 0.35
 Material thickness of second layer: 0
 Pour Space of material for second layer: 0
 Material thickness of third layer: 0
 Pour Space of material for third layer: 0
 Infiltration On
 Infiltration rate: 2
 Infiltration safety factor: 1
 Total Volume Infiltrated (ac-ft.): 16.401
 Total Volume Through Riser (ac-ft.): 6.676
 Total Volume Through Facility (ac-ft.): 23.076
 Percent Infiltrated: 71.07
 Total Precip Applied to Facility: 0
 Total Evap From Facility: 0
 Discharge Structure
 Riser Height: 3 ft.
 Riser Diameter: 12 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:

Gravel Trench Bed Hydraulic Table

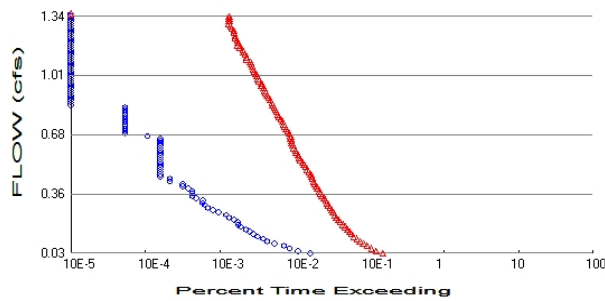
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.028	0.000	0.000	0.000
0.0556	0.028	0.000	0.000	0.057
0.1111	0.028	0.001	0.000	0.057
0.1667	0.028	0.001	0.000	0.057
0.2222	0.028	0.002	0.000	0.057
0.2778	0.028	0.002	0.000	0.057
0.3333	0.028	0.003	0.000	0.057
0.3889	0.028	0.003	0.000	0.057
0.4444	0.028	0.004	0.000	0.057
0.5000	0.028	0.005	0.000	0.057
0.5556	0.028	0.005	0.000	0.057
0.6111	0.028	0.006	0.000	0.057
0.6667	0.028	0.006	0.000	0.057
0.7222	0.028	0.007	0.000	0.057
0.7778	0.028	0.007	0.000	0.057
0.8333	0.028	0.008	0.000	0.057
0.8889	0.028	0.008	0.000	0.057
0.9444	0.028	0.009	0.000	0.057
1.0000	0.028	0.010	0.000	0.057
1.0556	0.028	0.010	0.000	0.057
1.1111	0.028	0.011	0.000	0.057
1.1667	0.028	0.011	0.000	0.057
1.2222	0.028	0.012	0.000	0.057
1.2778	0.028	0.012	0.000	0.057
1.3333	0.028	0.013	0.000	0.057

1.3889	0.028	0.013	0.000	0.057
1.4444	0.028	0.014	0.000	0.057
1.5000	0.028	0.015	0.000	0.057
1.5556	0.028	0.015	0.000	0.057
1.6111	0.028	0.016	0.000	0.057
1.6667	0.028	0.016	0.000	0.057
1.7222	0.028	0.017	0.000	0.057
1.7778	0.028	0.017	0.000	0.057
1.8333	0.028	0.018	0.000	0.057
1.8889	0.028	0.019	0.000	0.057
1.9444	0.028	0.019	0.000	0.057
2.0000	0.028	0.020	0.000	0.057
2.0556	0.028	0.020	0.000	0.057
2.1111	0.028	0.021	0.000	0.057
2.1667	0.028	0.021	0.000	0.057
2.2222	0.028	0.022	0.000	0.057
2.2778	0.028	0.022	0.000	0.057
2.3333	0.028	0.023	0.000	0.057
2.3889	0.028	0.024	0.000	0.057
2.4444	0.028	0.024	0.000	0.057
2.5000	0.028	0.025	0.000	0.057
2.5556	0.028	0.025	0.000	0.057
2.6111	0.028	0.026	0.000	0.057
2.6667	0.028	0.026	0.000	0.057
2.7222	0.028	0.027	0.000	0.057
2.7778	0.028	0.027	0.000	0.057
2.8333	0.028	0.028	0.000	0.057
2.8889	0.028	0.029	0.000	0.057
2.9444	0.028	0.029	0.000	0.057
3.0000	0.028	0.030	0.000	0.057
3.0556	0.028	0.030	0.138	0.057
3.1111	0.028	0.031	0.389	0.057
3.1667	0.028	0.031	0.703	0.057
3.2222	0.028	0.032	1.046	0.057
3.2778	0.028	0.032	1.383	0.057
3.3333	0.028	0.033	1.683	0.057
3.3889	0.028	0.034	1.921	0.057
3.4444	0.028	0.034	2.088	0.057
3.5000	0.028	0.035	2.203	0.057
3.5556	0.028	0.035	2.347	0.057
3.6111	0.028	0.036	2.462	0.057
3.6667	0.028	0.036	2.571	0.057
3.7222	0.028	0.037	2.676	0.057
3.7778	0.028	0.037	2.777	0.057
3.8333	0.028	0.038	2.875	0.057
3.8889	0.028	0.039	2.969	0.057
3.9444	0.028	0.039	3.060	0.057
4.0000	0.028	0.040	3.149	0.057
4.0556	0.028	0.040	3.235	0.057
4.1111	0.028	0.041	3.320	0.057
4.1667	0.028	0.041	3.402	0.057
4.2222	0.028	0.042	3.482	0.057
4.2778	0.028	0.043	3.560	0.057
4.3333	0.028	0.043	3.636	0.057
4.3889	0.028	0.044	3.711	0.057
4.4444	0.028	0.044	3.785	0.057
4.5000	0.028	0.045	3.857	0.057
4.5556	0.028	0.045	3.928	0.057

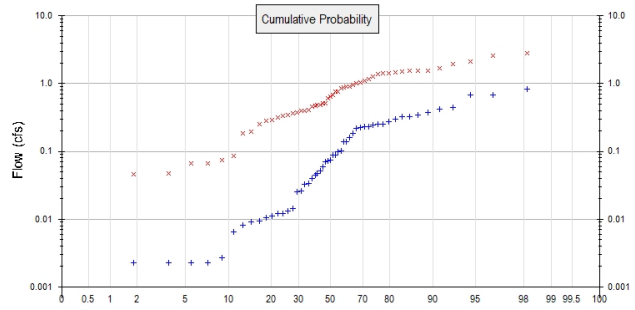
4.6111	0.028	0.046	3.997	0.057
4.6667	0.028	0.046	4.066	0.057
4.7222	0.028	0.047	4.133	0.057
4.7778	0.028	0.048	4.199	0.057
4.8333	0.028	0.048	4.264	0.057
4.8889	0.028	0.049	4.328	0.057
4.9444	0.028	0.049	4.391	0.057
5.0000	0.028	0.050	4.454	0.057

Analysis Results

POC 1



+ Predeveloped x Mitigated



Predeveloped Landuse Totals for POC #1

Total Pervious Area: 2.844
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1

Total Pervious Area: 1.16
Total Impervious Area: 1.684

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.062613
5 year	0.245299
10 year	0.47044
25 year	0.899944
50 year	1.335307
100 year	1.873996

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.615424
5 year	1.548871
10 year	2.243406
25 year	3.088672
50 year	3.657997
100 year	4.163853

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	0.442	1.567
1957	0.045	1.366
1958	0.678	1.403
1959	0.161	0.757
1960	0.673	1.536
1961	0.328	0.863
1962	0.836	1.150
1963	0.246	2.107
1964	0.138	0.900
1965	0.073	0.195

1966	0.009	0.046
1967	0.033	0.516
1968	0.006	0.395
1969	0.033	0.286
1970	0.047	0.184
1971	0.299	0.505
1972	0.222	0.613
1973	0.011	0.480
1974	0.321	1.041
1975	0.346	1.501
1976	0.187	0.398
1977	0.002	0.075
1978	0.375	1.264
1979	0.012	0.471
1980	0.025	0.451
1981	0.040	0.413
1982	0.218	0.945
1983	0.089	0.643
1984	0.272	0.891
1985	0.008	0.379
1986	0.254	1.463
1987	0.013	1.016
1988	0.003	0.287
1989	0.009	0.067
1990	0.099	0.676
1991	0.235	0.361
1992	0.012	0.086
1993	0.059	0.254
1994	0.051	0.066
1995	0.014	1.566
1996	0.424	1.961
1997	0.103	0.870
1998	0.087	2.542
1999	0.011	0.315
2000	0.026	0.481
2001	0.002	0.001
2002	0.072	2.772
2003	0.002	1.678
2004	0.002	0.047
2005	0.002	0.342
2006	0.139	0.338
2007	0.230	1.433
2008	0.071	0.768
2009	0.254	1.096

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.8355	2.7716
2	0.6783	2.5416
3	0.6728	2.1065
4	0.4418	1.9614
5	0.4244	1.6777
6	0.3752	1.5671
7	0.3460	1.5662
8	0.3276	1.5360
9	0.3210	1.5011
10	0.2994	1.4632

11	0.2721	1.4325
12	0.2541	1.4032
13	0.2538	1.3658
14	0.2461	1.2635
15	0.2346	1.1495
16	0.2303	1.0961
17	0.2224	1.0414
18	0.2183	1.0159
19	0.1869	0.9448
20	0.1614	0.8997
21	0.1394	0.8913
22	0.1382	0.8696
23	0.1028	0.8631
24	0.0993	0.7678
25	0.0892	0.7573
26	0.0870	0.6762
27	0.0733	0.6433
28	0.0715	0.6132
29	0.0711	0.5163
30	0.0592	0.5047
31	0.0512	0.4814
32	0.0467	0.4801
33	0.0448	0.4709
34	0.0398	0.4512
35	0.0335	0.4130
36	0.0329	0.3982
37	0.0256	0.3954
38	0.0250	0.3786
39	0.0142	0.3608
40	0.0130	0.3417
41	0.0122	0.3385
42	0.0120	0.3152
43	0.0111	0.2866
44	0.0106	0.2860
45	0.0094	0.2536
46	0.0092	0.1946
47	0.0081	0.1839
48	0.0064	0.0864
49	0.0027	0.0749
50	0.0023	0.0667
51	0.0023	0.0658
52	0.0023	0.0469
53	0.0023	0.0456
54	0.0020	0.0009

Duration Flows

The Duration Matching **Failed**

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0313	303	2874	948	Fail
0.0445	207	2342	1131	Fail
0.0576	161	2028	1259	Fail
0.0708	135	1759	1302	Fail
0.0840	101	1579	1563	Fail
0.0972	81	1416	1748	Fail
0.1103	71	1294	1822	Fail
0.1235	60	1167	1945	Fail
0.1367	52	1086	2088	Fail
0.1499	47	1033	2197	Fail
0.1630	42	965	2297	Fail
0.1762	36	895	2486	Fail
0.1894	33	832	2521	Fail
0.2025	32	775	2421	Fail
0.2157	29	732	2524	Fail
0.2289	25	683	2732	Fail
0.2421	23	649	2821	Fail
0.2552	18	619	3438	Fail
0.2684	15	591	3940	Fail
0.2816	13	565	4346	Fail
0.2947	12	534	4450	Fail
0.3079	11	507	4609	Fail
0.3211	11	490	4454	Fail
0.3343	9	468	5200	Fail
0.3474	8	441	5512	Fail
0.3606	8	423	5287	Fail
0.3738	8	405	5062	Fail
0.3869	7	384	5485	Fail
0.4001	6	368	6133	Fail
0.4133	6	350	5833	Fail
0.4265	4	340	8500	Fail
0.4396	4	325	8125	Fail
0.4528	3	318	10600	Fail
0.4660	3	310	10333	Fail
0.4791	3	292	9733	Fail
0.4923	3	279	9300	Fail
0.5055	3	264	8800	Fail
0.5187	3	252	8400	Fail
0.5318	3	240	8000	Fail
0.5450	3	226	7533	Fail
0.5582	3	214	7133	Fail
0.5713	3	209	6966	Fail
0.5845	3	199	6633	Fail
0.5977	3	193	6433	Fail
0.6109	3	185	6166	Fail
0.6240	3	179	5966	Fail
0.6372	3	173	5766	Fail
0.6504	3	170	5666	Fail
0.6635	3	166	5533	Fail
0.6767	2	166	8300	Fail
0.6899	1	159	15900	Fail
0.7031	1	152	15200	Fail
0.7162	1	146	14600	Fail
0.7294	1	140	14000	Fail

0.7426	1	135	13500	Fail
0.7558	1	130	13000	Fail
0.7689	1	123	12300	Fail
0.7821	1	116	11600	Fail
0.7953	1	111	11100	Fail
0.8084	1	108	10800	Fail
0.8216	1	104	10400	Fail
0.8348	1	100	10000	Fail
0.8480	0	96	n/a	Fail
0.8611	0	94	n/a	Fail
0.8743	0	89	n/a	Fail
0.8875	0	85	n/a	Fail
0.9006	0	80	n/a	Fail
0.9138	0	78	n/a	Fail
0.9270	0	75	n/a	Fail
0.9402	0	73	n/a	Fail
0.9533	0	68	n/a	Fail
0.9665	0	68	n/a	Fail
0.9797	0	63	n/a	Fail
0.9928	0	61	n/a	Fail
1.0060	0	59	n/a	Fail
1.0192	0	57	n/a	Fail
1.0324	0	54	n/a	Fail
1.0455	0	53	n/a	Fail
1.0587	0	51	n/a	Fail
1.0719	0	49	n/a	Fail
1.0850	0	48	n/a	Fail
1.0982	0	43	n/a	Fail
1.1114	0	43	n/a	Fail
1.1246	0	41	n/a	Fail
1.1377	0	39	n/a	Fail
1.1509	0	38	n/a	Fail
1.1641	0	35	n/a	Fail
1.1772	0	33	n/a	Fail
1.1904	0	33	n/a	Fail
1.2036	0	32	n/a	Fail
1.2168	0	30	n/a	Fail
1.2299	0	30	n/a	Fail
1.2431	0	29	n/a	Fail
1.2563	0	29	n/a	Fail
1.2694	0	27	n/a	Fail
1.2826	0	26	n/a	Fail
1.2958	0	25	n/a	Fail
1.3090	0	25	n/a	Fail
1.3221	0	25	n/a	Fail
1.3353	0	25	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0 acre-feet

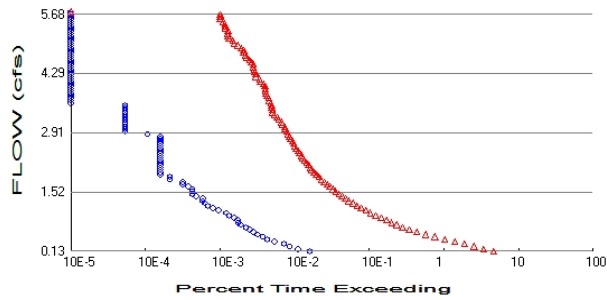
On-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

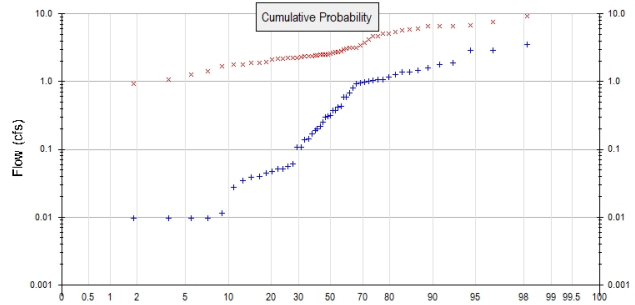
Off-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

POC 2



+ Predeveloped x Mitigated



Predeveloped Landuse Totals for POC #2

Total Pervious Area: 12.099
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2

Total Pervious Area: 1.21
Total Impervious Area: 10.889

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	0.26637
5 year	1.043554
10 year	2.001356
25 year	3.82856
50 year	5.68069
100 year	7.972395

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	2.889243
5 year	4.566276
10 year	5.800523
25 year	7.486366
50 year	8.827735
100 year	10.23843

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1956	1.879	5.091
1957	0.191	5.953
1958	2.885	5.077
1959	0.687	2.521
1960	2.862	6.767
1961	1.394	3.176
1962	3.555	4.703
1963	1.047	9.185
1964	0.588	2.726
1965	0.312	2.577
1966	0.039	2.396

1967	0.142	1.911
1968	0.027	1.674
1969	0.140	2.397
1970	0.199	1.801
1971	1.274	2.833
1972	0.946	2.361
1973	0.045	1.799
1974	1.366	3.180
1975	1.472	5.331
1976	0.795	3.163
1977	0.010	2.183
1978	1.596	5.737
1979	0.051	1.891
1980	0.106	2.320
1981	0.169	2.674
1982	0.929	2.226
1983	0.380	3.092
1984	1.158	2.262
1985	0.035	2.422
1986	1.080	6.547
1987	0.055	2.983
1988	0.011	2.199
1989	0.040	1.067
1990	0.423	2.518
1991	0.998	2.714
1992	0.052	2.117
1993	0.252	1.965
1994	0.218	1.437
1995	0.060	3.467
1996	1.805	6.540
1997	0.437	2.516
1998	0.370	6.571
1999	0.047	1.273
2000	0.109	2.431
2001	0.009	0.700
2002	0.304	7.511
2003	0.010	5.888
2004	0.010	0.931
2005	0.010	2.526
2006	0.593	2.238
2007	0.980	4.638
2008	0.302	3.725
2009	1.081	4.165

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	3.5546	9.1846
2	2.8854	7.5112
3	2.8624	6.7666
4	1.8793	6.5715
5	1.8054	6.5471
6	1.5962	6.5399
7	1.4721	5.9535
8	1.3935	5.8880
9	1.3658	5.7369
10	1.2736	5.3314
11	1.1576	5.0914

12	1.0812	5.0766
13	1.0798	4.7033
14	1.0469	4.6378
15	0.9979	4.1648
16	0.9797	3.7254
17	0.9460	3.4669
18	0.9287	3.1801
19	0.7950	3.1759
20	0.6868	3.1629
21	0.5928	3.0922
22	0.5877	2.9830
23	0.4373	2.8334
24	0.4226	2.7256
25	0.3796	2.7137
26	0.3700	2.6741
27	0.3118	2.5769
28	0.3044	2.5263
29	0.3023	2.5212
30	0.2516	2.5180
31	0.2180	2.5160
32	0.1988	2.4307
33	0.1907	2.4217
34	0.1694	2.3967
35	0.1424	2.3960
36	0.1401	2.3606
37	0.1091	2.3201
38	0.1064	2.2620
39	0.0602	2.2380
40	0.0553	2.2258
41	0.0521	2.1991
42	0.0510	2.1831
43	0.0474	2.1171
44	0.0450	1.9647
45	0.0398	1.9106
46	0.0391	1.8910
47	0.0346	1.8006
48	0.0272	1.7992
49	0.0113	1.6743
50	0.0097	1.4372
51	0.0097	1.2734
52	0.0096	1.0675
53	0.0096	0.9313
54	0.0087	0.7003

Duration Flows

The Duration Matching **Failed**

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1332	300	87442	29147	Fail
0.1892	207	64303	31064	Fail
0.2453	161	48000	29813	Fail
0.3013	135	35541	26326	Fail
0.3573	100	26301	26301	Fail
0.4134	81	19333	23867	Fail
0.4694	70	14353	20504	Fail
0.5254	60	10730	17883	Fail
0.5815	52	8188	15746	Fail
0.6375	47	6497	13823	Fail
0.6935	42	5283	12578	Fail
0.7496	36	4454	12372	Fail
0.8056	33	3757	11384	Fail
0.8616	32	3198	9993	Fail
0.9177	29	2740	9448	Fail
0.9737	25	2314	9256	Fail
1.0298	23	1971	8569	Fail
1.0858	18	1715	9527	Fail
1.1418	15	1468	9786	Fail
1.1979	13	1298	9984	Fail
1.2539	12	1150	9583	Fail
1.3099	11	1011	9190	Fail
1.3660	11	909	8263	Fail
1.4220	9	821	9122	Fail
1.4780	8	742	9275	Fail
1.5341	8	675	8437	Fail
1.5901	8	622	7775	Fail
1.6461	7	556	7942	Fail
1.7022	6	516	8600	Fail
1.7582	6	472	7866	Fail
1.8142	4	430	10750	Fail
1.8703	4	401	10025	Fail
1.9263	3	371	12366	Fail
1.9824	3	345	11500	Fail
2.0384	3	320	10666	Fail
2.0944	3	303	10100	Fail
2.1505	3	289	9633	Fail
2.2065	3	273	9100	Fail
2.2625	3	256	8533	Fail
2.3186	3	244	8133	Fail
2.3746	3	234	7800	Fail
2.4306	3	221	7366	Fail
2.4867	3	210	7000	Fail
2.5427	3	197	6566	Fail
2.5987	3	187	6233	Fail
2.6548	3	182	6066	Fail
2.7108	3	177	5900	Fail
2.7668	3	165	5500	Fail
2.8229	3	159	5300	Fail
2.8789	2	156	7800	Fail
2.9350	1	149	14900	Fail
2.9910	1	140	14000	Fail
3.0470	1	138	13800	Fail
3.1031	1	130	13000	Fail

3.1591	1	126	12600	Fail
3.2151	1	116	11600	Fail
3.2712	1	110	11000	Fail
3.3272	1	101	10100	Fail
3.3832	1	96	9600	Fail
3.4393	1	95	9500	Fail
3.4953	1	93	9300	Fail
3.5513	1	93	9300	Fail
3.6074	0	91	n/a	Fail
3.6634	0	87	n/a	Fail
3.7195	0	85	n/a	Fail
3.7755	0	81	n/a	Fail
3.8315	0	78	n/a	Fail
3.8876	0	76	n/a	Fail
3.9436	0	76	n/a	Fail
3.9996	0	75	n/a	Fail
4.0557	0	72	n/a	Fail
4.1117	0	66	n/a	Fail
4.1677	0	64	n/a	Fail
4.2238	0	57	n/a	Fail
4.2798	0	57	n/a	Fail
4.3358	0	55	n/a	Fail
4.3919	0	54	n/a	Fail
4.4479	0	53	n/a	Fail
4.5039	0	53	n/a	Fail
4.5600	0	50	n/a	Fail
4.6160	0	47	n/a	Fail
4.6721	0	43	n/a	Fail
4.7281	0	41	n/a	Fail
4.7841	0	39	n/a	Fail
4.8402	0	39	n/a	Fail
4.8962	0	36	n/a	Fail
4.9522	0	33	n/a	Fail
5.0083	0	29	n/a	Fail
5.0643	0	28	n/a	Fail
5.1203	0	25	n/a	Fail
5.1764	0	24	n/a	Fail
5.2324	0	24	n/a	Fail
5.2884	0	24	n/a	Fail
5.3445	0	22	n/a	Fail
5.4005	0	22	n/a	Fail
5.4565	0	22	n/a	Fail
5.5126	0	21	n/a	Fail
5.5686	0	19	n/a	Fail
5.6247	0	19	n/a	Fail
5.6807	0	19	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume: 0 acre-feet

On-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

Off-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

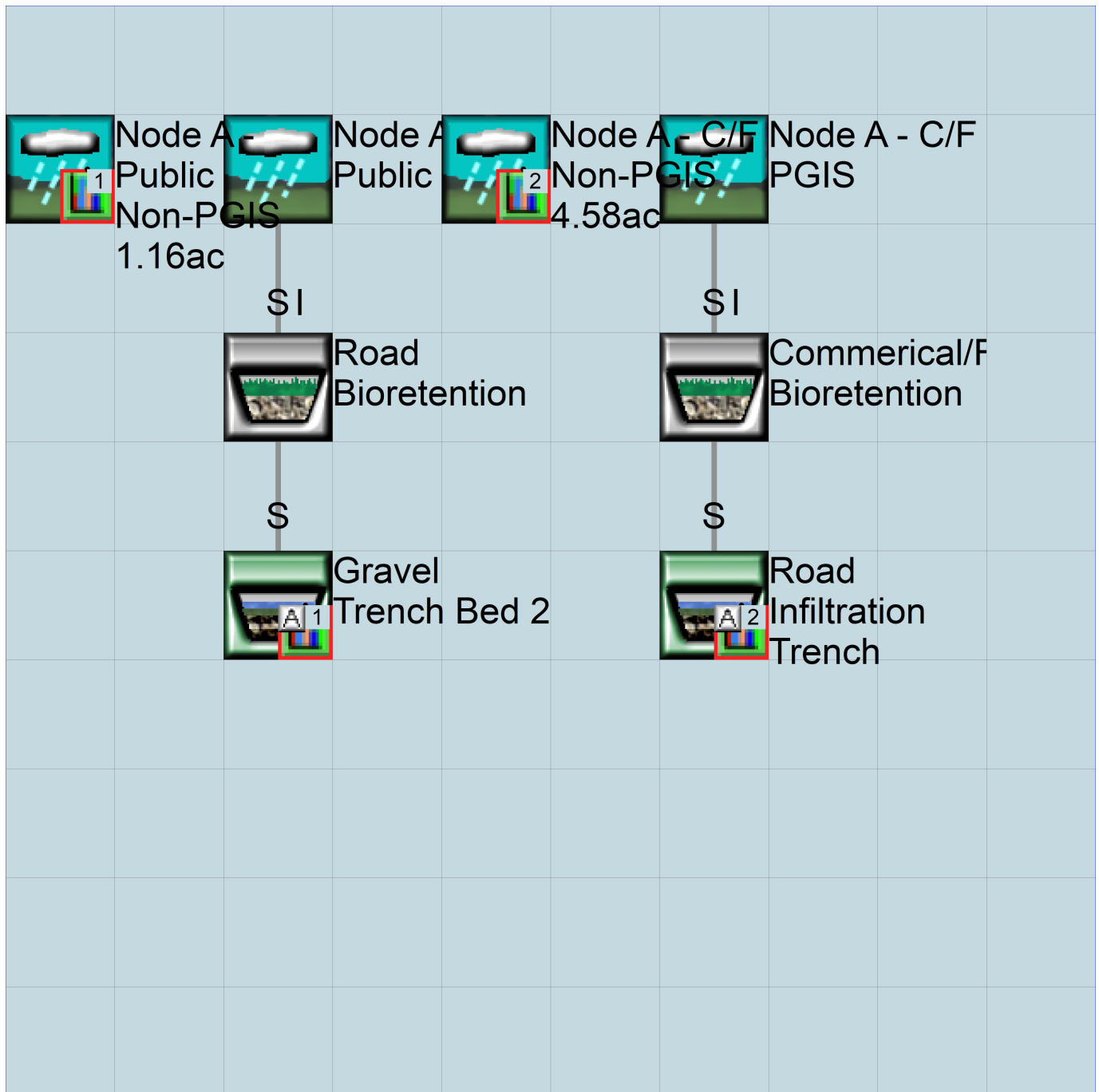


Node A
Existin
Public
2.84ac



Node A -
Existng C/F
12.10ac

Mitigated Schematic



Predeveloped UCI File

RUN

GLOBAL

```
WWM4 model simulation
START      1955 10 01      END      2009 09 30
RUN INTERP OUTPUT LEVEL    3      0
RESUME     0 RUN          1
UNIT SYSTEM                1
END GLOBAL
```

FILES

```
<File> <Un#> <-----File Name----->***
<-ID->                                     ***
WDM      26      18591_Node A.wdm
MESSU    25      Pre18591_Node A.MES
          27      Pre18591_Node A.L61
          28      Pre18591_Node A.L62
          30      POC18591_Node A1.dat
          31      POC18591_Node A2.dat
```

END FILES

OPN SEQUENCE

```
INGRP      INDELT 00:15
  PERLND      2
  COPY        501
  COPY        502
  DISPLY      1
  DISPLY      2
```

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INF01

```
# - #<-----Title----->***TRAN PIVL DIG1 FIL1 PYR DIG2 FIL2 YRND
1      Node A - Existing Public      MAX      1      2      30      9
2      Node A - Existng C/F          MAX      1      2      31      9
```

END DISPLY-INF01

END DISPLY

COPY

TIMESERIES

```
# - # NPT NMN ***
1      1      1
501     1      1
502     1      1
```

END TIMESERIES

END COPY

GENER

OPCODE

```
#      # OPCD ***
```

END OPCODE

PARM

```
#      #      K ***
```

END PARM

END GENER

PERLND

GEN-INFO

```
<PLS ><-----Name----->NBLKS Unit-systems Printer ***
# - # User t-series Engl Metr ***
              in out
2      A/B, Forest, Mod      1      1      1      1      27      0
```

END GEN-INFO

*** Section PWATER***

ACTIVITY

```
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC ***
2      0      0      1      0      0      0      0      0      0      0      0
```

END ACTIVITY

PRINT-INFO


```

<PLS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW PWAT  SED  PST  PWG  PQAL MSTL PEST NITR PHOS TRAC *****
2      0      0      4      0      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

```

```

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
2      0      0      0      0      0      0      0      0      0      0      0
END PWAT-PARM1

```

```

PWAT-PARM2
<PLS > PWATER input info: Part 2 *****
# - # ***FOREST  LZSN  INFILT  LSUR  SLSUR  KVARY  AGWRC
2      0      5      2      400      0.1      0.3      0.996
END PWAT-PARM2

```

```

PWAT-PARM3
<PLS > PWATER input info: Part 3 *****
# - # ***PETMAX  PETMIN  INFEXP  INFILD  DEEPFR  BASETP  AGWETP
2      0      0      2      2      0      0      0
END PWAT-PARM3

```

```

PWAT-PARM4
<PLS > PWATER input info: Part 4 *****
# - # CEPSC  UZSN  NSUR  INTFW  IRC  LZETP ***
2      0.2      0.5      0.35      0      0.7      0.7
END PWAT-PARM4

```

```

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS  SURS  UZS  IFWS  LZS  AGWS  GWVS
2      0      0      0      0      3      1      0
END PWAT-STATE1

```

END PERLND

IMPLND

```

GEN-INFO
<PLS ><-----Name-----> Unit-systems Printer ***
# - # User t-series Engl Metr ***
in out ***

```

```

END GEN-INFO
*** Section IWATER***

```

```

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT  SLD  IWG IQAL ***
END ACTIVITY

```

```

PRINT-INFO
<ILS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW IWAT  SLD  IWG IQAL *****
END PRINT-INFO

```

```

IWAT-PARM1
<PLS > IWATER variable monthly parameter value flags ***
# - # CSNO RTOP VRS  VNN RTLI ***
END IWAT-PARM1

```

```

IWAT-PARM2
<PLS > IWATER input info: Part 2 *****
# - # *** LSUR  SLSUR  NSUR  RETSC
END IWAT-PARM2

```

```

IWAT-PARM3
<PLS > IWATER input info: Part 3 *****
# - # ***PETMAX  PETMIN
END IWAT-PARM3

```

```

IWAT-STATE1
  <PLS > *** Initial conditions at start of simulation
  # - # *** RETS      SURS
END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->
<Name> #
Node A - Existing Public***
PERLND 2 2.844 COPY 501 12
PERLND 2 2.844 COPY 501 13
Node A - Existng C/F***
PERLND 2 12.099 COPY 502 12
PERLND 2 12.099 COPY 502 13

*****Routing*****
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> # <Name> # #<-factor->strg <Name> # # <Name> # # ***
COPY 501 OUTPUT MEAN 1 1 48.4 DISPLY 1 INPUT TIMSER 1
COPY 502 OUTPUT MEAN 1 1 48.4 DISPLY 2 INPUT TIMSER 1

<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> # <Name> # #<-factor->strg <Name> # # <Name> # # ***
END NETWORK

RCHRES
GEN-INFO
  RCHRES Name Nexits Unit Systems Printer ***
  # - #<-----><----> User T-series Engl Metr LKFG ***
  in out
END GEN-INFO
*** Section RCHRES***

ACTIVITY
  <PLS > ***** Active Sections *****
  # - # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
END ACTIVITY

PRINT-INFO
  <PLS > ***** Print-flags ***** PIVL PYR
  # - # HYDR ADCA CONS HEAT SED GQL OXRX NUTR PLNK PHCB PIVL PYR *****
END PRINT-INFO

HYDR-PARM1
  RCHRES Flags for each HYDR Section ***
  # - # VC A1 A2 A3 ODFVFG for each *** ODGTFG for each FUNCT for each
  FG FG FG FG possible exit *** possible exit possible exit
  * * * * *
END HYDR-PARM1

HYDR-PARM2
  # - # FTABNO LEN DELTH STCOR KS DB50 ***
  <-----><-----><-----><-----><-----><----->
END HYDR-PARM2
HYDR-INIT
  RCHRES Initial conditions for each HYDR section ***
  # - # *** VOL Initial value of COLIND Initial value of OUTDGT
  *** ac-ft for each possible exit for each possible exit
  <-----><-----> <---><---><---><---><---> *** <---><---><---><---><--->
END HYDR-INIT
END RCHRES

SPEC-ACTIONS

```

END SPEC-ACTIONS
 FTABLES
 END FTABLES

EXT SOURCES

<-Volume->	<Member>	SsysSgap<-Mult-->Tran	<-Target	vols>	<-Grp>	<-Member->	***
<Name>	#	<Name> # tem strg<-factor->strg	<Name>	#	#	<Name> # #	***
WDM	2	PREC ENGL 1.429	PERLND	1	999	EXTNL PREC	
WDM	2	PREC ENGL 1.429	IMPLND	1	999	EXTNL PREC	
WDM	1	EVAP ENGL 0.76	PERLND	1	999	EXTNL PETINP	
WDM	1	EVAP ENGL 0.76	IMPLND	1	999	EXTNL PETINP	

END EXT SOURCES

EXT TARGETS

<-Volume->	<-Grp>	<-Member-><-Mult-->Tran	<-Volume->	<Member>	Tsys	Tgap	Amd	***
<Name>	#	<Name> # #<-factor->strg	<Name>	#	<Name>	tem	strg	strg***
COPY	501	OUTPUT MEAN 1 1 48.4	WDM	501	FLOW	ENGL		REPL
COPY	502	OUTPUT MEAN 1 1 48.4	WDM	502	FLOW	ENGL		REPL

END EXT TARGETS

MASS-LINK

<Volume>	<-Grp>	<-Member-><-Mult-->	<Target>	<-Grp>	<-Member->***
<Name>	#	<Name> # #<-factor->	<Name>	#	<Name> # #***
MASS-LINK		12			
PERLND	PWATER	SURO 0.083333	COPY	INPUT	MEAN
END MASS-LINK		12			
MASS-LINK		13			
PERLND	PWATER	IFWO 0.083333	COPY	INPUT	MEAN
END MASS-LINK		13			

END MASS-LINK

END RUN

Mitigated UCI File

RUN

GLOBAL

```
WWM4 model simulation
START      1955 10 01      END      2009 09 30
RUN INTERP OUTPUT LEVEL    3      0
RESUME     0 RUN          1
UNIT SYSTEM                1
END GLOBAL
```

FILES

```
<File>  <Un#>  <-----File Name----->***
<-ID->                                     ***
WDM      26      18591_Node A.wdm
MESSU    25      Mit18591_Node A.MES
          27      Mit18591_Node A.L61
          28      Mit18591_Node A.L62
          31      POC18591_Node A2.dat
          30      POC18591_Node A1.dat
```

END FILES

OPN SEQUENCE

INGRP INDELT 00:15

```
IMPLND      1
PERLND      8
IMPLND      4
RCHRES      1
RCHRES      2
RCHRES      3
RCHRES      4
RCHRES      5
RCHRES      6
COPY        2
COPY       502
COPY       602
COPY        1
COPY       501
COPY       601
DISPLY      2
DISPLY      1
```

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INF01

```
# - #<-----Title----->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
  2      Road Infiltration Trench    MAX      1      2      31      9
  1      Gravel Trench Bed 2         MAX      1      2      30      9
```

END DISPLY-INF01

END DISPLY

COPY

TIMESERIES

```
# - # NPT NMN ***
  1      1      1
  2      1      1
502      1      1
602      1      1
501      1      1
601      1      1
```

END TIMESERIES

END COPY

GENER

OPCODE

```
#      # OPCD ***
```

END OPCODE

PARM

```
#      #      K ***
```

END PARM

END GENER

PERLND

```

GEN-INFO
<PLS ><-----Name----->NBLKS      Unit-systems      Printer ***
# - #      User      t-series      Engl Metr ***
                        in      out
8      A/B, Lawn, Mod      1      1      1      1      27      0
END GEN-INFO
*** Section PWATER***

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC ***
8      0      0      1      0      0      0      0      0      0      0      0      0
END ACTIVITY

PRINT-INFO
<PLS > ***** Print-flags ***** PIVL PYR
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC *****
8      0      0      4      0      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG VCS VUZ VNN VIFW VIRC VLE INFC HWT ***
8      0      0      0      0      0      0      0      0      0      0      0
END PWAT-PARM1

PWAT-PARM2
<PLS > PWATER input info: Part 2 ***
# - # ***FOREST LZSN INFILT LSUR SLSUR KVARV AGWRC
8      0      5      0.8      400      0.1      0.3      0.996
END PWAT-PARM2

PWAT-PARM3
<PLS > PWATER input info: Part 3 ***
# - # ***PETMAX PETMIN INFEXP INFILD DEEPFR BASETP AGWETP
8      0      0      2      2      0      0      0
END PWAT-PARM3
PWAT-PARM4
<PLS > PWATER input info: Part 4 ***
# - # CEPSC UZSN NSUR INTFW IRC LZETP ***
8      0.1      0.5      0.25      0      0.7      0.25
END PWAT-PARM4

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS SURS UZS IFWS LZS AGWS GWVS
8      0      0      0      0      3      1      0
END PWAT-STATE1

END PERLND

IMPLND
GEN-INFO
<PLS ><-----Name----->      Unit-systems      Printer ***
# - #      User      t-series      Engl Metr ***
                        in      out
1      ROADS/FLAT      1      1      1      27      0
4      ROOF TOPS/FLAT      1      1      1      27      0
END GEN-INFO
*** Section IWATER***

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT SLD IWG IQAL ***
1      0      0      1      0      0      0
4      0      0      1      0      0      0
END ACTIVITY

PRINT-INFO

```

```

<ILS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW IWAT  SLD  IWG IQAL  *****
1      0      0      4      0      0      4      1      9
4      0      0      4      0      0      0      1      9
END PRINT-INFO

```

```

IWAT-PARM1
<PLS >  IWATER variable monthly parameter value flags  ***
# - # CSNO RTOP  VRS  VNN RTLI  ***
1      0      0      0      0      0
4      0      0      0      0      0
END IWAT-PARM1

```

```

IWAT-PARM2
<PLS >      IWATER input info: Part 2      ***
# - # ***  LSUR      SLSUR      NSUR      RETSC
1      400      0.01      0.1      0.1
4      400      0.01      0.1      0.1
END IWAT-PARM2

```

```

IWAT-PARM3
<PLS >      IWATER input info: Part 3      ***
# - # ***PETMAX  PETMIN
1      0      0
4      0      0
END IWAT-PARM3

```

```

IWAT-STATE1
<PLS > *** Initial conditions at start of simulation
# - # ***  RETS      SURS
1      0      0
4      0      0
END IWAT-STATE1

```

END IMPLND

```

SCHEMATIC
<-Source->      <--Area-->      <-Target->      MBLK      ***
<Name>  #      <-factor->      <Name>  #      Tbl#      ***
Node A - Public PGIS***
IMPLND  1      1.684      RCHRES  1      5
Node A - C/F PGIS***
IMPLND  1      7.516      RCHRES  3      5
Node A - Public Non-PGIS***
PERLND  8      1.16      COPY  501      12
PERLND  8      1.16      COPY  601      12
PERLND  8      1.16      COPY  501      13
PERLND  8      1.16      COPY  601      13
Node A - C/F Non-PGIS***
PERLND  8      1.21      COPY  502      12
PERLND  8      1.21      COPY  602      12
PERLND  8      1.21      COPY  502      13
PERLND  8      1.21      COPY  602      13
IMPLND  4      3.373      COPY  502      15
IMPLND  4      3.373      COPY  602      15

```

```

*****Routing*****
RCHRES  1      1      RCHRES  6      7
RCHRES  1      1      COPY  1      17
RCHRES  1      1      RCHRES  2      8
RCHRES  3      1      RCHRES  5      7
RCHRES  3      1      COPY  2      17
RCHRES  3      1      RCHRES  4      8
RCHRES  5      1      COPY  502      17
RCHRES  6      1      COPY  501      17
END SCHEMATIC

```

```

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>  #      <Name>  #  <-factor->strg <Name>  #  #      <Name>  #  #      ***

```


COPY	502	OUTPUT	MEAN	1	1	48.4	DISPLY	2	INPUT	TIMSER	1
COPY	501	OUTPUT	MEAN	1	1	48.4	DISPLY	1	INPUT	TIMSER	1

```

<-Volume-> <-Grp> <-Member-><-Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> # <Name> # #<-factor->strg <Name> # # <Name> # # ***
END NETWORK

```

RCHRES

GEN-INFO

RCHRES	Name	Nexits	Unit	Systems	Printer			
# - #	<----->	<---->	User	T-series	Engl Metr	LKFG		
				in out				
1	Surface Bioreten-009	2	1	1 1	28 0	1		
2	Road Bioretentio-008	1	1	1 1	28 0	1		
3	Surface Bioreten-011	2	1	1 1	28 0	1		
4	Commerical/Flex -010	1	1	1 1	28 0	1		
5	Road Infiltratio-013	2	1	1 1	28 0	1		
6	Gravel Trench Be-020	2	1	1 1	28 0	1		

END GEN-INFO

*** Section RCHRES***

ACTIVITY

<PLS > ***** Active Sections *****

# - #	HYFG	ADFG	CNFG	HTFG	SDFG	GQFG	OXFG	NUFG	PKFG	PHFG	***
1	1	0	0	0	0	0	0	0	0	0	
2	1	0	0	0	0	0	0	0	0	0	
3	1	0	0	0	0	0	0	0	0	0	
4	1	0	0	0	0	0	0	0	0	0	
5	1	0	0	0	0	0	0	0	0	0	
6	1	0	0	0	0	0	0	0	0	0	

END ACTIVITY

PRINT-INFO

# - #	HYDR	ADCA	CONS	HEAT	SED	GQL	OXRX	NUTR	PLNK	PHCB	PIVL	PYR	*****
1	4	0	0	0	0	0	0	0	0	0	1	9	
2	4	0	0	0	0	0	0	0	0	0	1	9	
3	4	0	0	0	0	0	0	0	0	0	1	9	
4	4	0	0	0	0	0	0	0	0	0	1	9	
5	4	0	0	0	0	0	0	0	0	0	1	9	
6	4	0	0	0	0	0	0	0	0	0	1	9	

END PRINT-INFO

HYDR-PARM1

RCHRES	Flags	for each HYDR Section																
# - #	VC	A1	A2	A3	ODFVFG	for each	***	ODGTFG	for each									
	FG	FG	FG	FG	possible	exit	***	possible	exit									
	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
1	0	1	0	0	4	5	0	0	0	0	0	0	0	0	0	2	2	2
2	0	1	0	0	4	0	0	0	0	0	0	0	0	0	0	2	2	2
3	0	1	0	0	4	5	0	0	0	0	0	0	0	0	0	2	2	2
4	0	1	0	0	4	0	0	0	0	0	0	0	0	0	0	2	2	2
5	0	1	0	0	4	5	0	0	0	0	0	0	0	0	0	2	2	2
6	0	1	0	0	4	5	0	0	0	0	0	0	0	0	0	2	2	2

END HYDR-PARM1

HYDR-PARM2

# - #	FTABNO	LEN	DELTH	STCOR	KS	DB50	
<----->	<----->	<----->	<----->	<----->	<----->	<----->	
1	1	0.01	0.0	0.0	0.0	0.0	
2	2	0.05	0.0	0.0	0.0	0.0	
3	3	0.01	0.0	0.0	0.0	0.0	
4	4	0.02	0.0	0.0	0.0	0.0	
5	5	0.02	0.0	0.0	0.5	0.0	
6	6	0.05	0.0	0.0	0.5	0.0	

END HYDR-PARM2

HYDR-INIT

RCHRES Initial conditions for each HYDR section ***

#	-	***	VOL	Initial value of COLIND					Initial value of OUTDGT				
		***	ac-ft	for each possible exit					for each possible exit				
<----->	<----->			<-->	<-->	<-->	<-->	<-->	***	<-->	<-->	<-->	<-->
1			0	4.0	5.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
2			0	4.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
3			0	4.0	5.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
4			0	4.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
5			0	4.0	5.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
6			0	4.0	5.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0

END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES

FTABLE 2
70 4

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.028696	0.000000	0.000000		
0.043956	0.028696	0.000577	0.000000		
0.087912	0.028696	0.001154	0.000000		
0.131868	0.028696	0.001730	0.000000		
0.175824	0.028696	0.002307	0.000000		
0.219780	0.028696	0.002884	0.000792		
0.263736	0.028696	0.003461	0.001329		
0.307692	0.028696	0.004038	0.002053		
0.351648	0.028696	0.004615	0.002988		
0.395604	0.028696	0.005191	0.004154		
0.439560	0.028696	0.005768	0.005569		
0.483516	0.028696	0.006345	0.007252		
0.527473	0.028696	0.006922	0.009007		
0.571429	0.028696	0.007499	0.009218		
0.615385	0.028696	0.008076	0.011483		
0.659341	0.028696	0.008652	0.014061		
0.703297	0.028696	0.009229	0.016967		
0.747253	0.028696	0.009806	0.020214		
0.791209	0.028696	0.010383	0.021769		
0.835165	0.028696	0.010960	0.023814		
0.879121	0.028696	0.011536	0.027781		
0.923077	0.028696	0.012113	0.032125		
0.967033	0.028696	0.012690	0.036858		
1.010989	0.028696	0.013267	0.041677		
1.054945	0.028696	0.013844	0.041991		
1.098901	0.028696	0.014421	0.047536		
1.142857	0.028696	0.014997	0.053501		
1.186813	0.028696	0.015574	0.059897		
1.230769	0.028696	0.016151	0.066734		
1.274725	0.028696	0.016728	0.069738		
1.318681	0.028696	0.017305	0.074021		
1.362637	0.028696	0.017881	0.081766		
1.406593	0.028696	0.018458	0.089978		
1.450549	0.028696	0.019035	0.098664		
1.494505	0.028696	0.019612	0.106852		
1.538462	0.028696	0.020135	0.107830		
1.582418	0.028696	0.020659	0.117482		
1.626374	0.028696	0.021182	0.127623		
1.670330	0.028696	0.021706	0.138252		
1.714286	0.028696	0.022229	0.149359		
1.758242	0.028696	0.022753	0.153837		
1.802198	0.028696	0.023276	0.160904		
1.846154	0.028696	0.023800	0.172605		
1.890110	0.028696	0.024323	0.231481		
1.934066	0.028696	0.024847	0.231481		
1.978022	0.028696	0.025370	0.231481		
2.021978	0.028696	0.025894	0.231481		
2.065934	0.028696	0.026417	0.231481		
2.109890	0.028696	0.026940	0.231481		
2.153846	0.028696	0.027464	0.231481		
2.197802	0.028696	0.027987	0.231481		

2.241758	0.028696	0.028511	0.231481
2.285714	0.028696	0.029034	0.231481
2.329670	0.028696	0.029558	0.231481
2.373626	0.028696	0.030081	0.231481
2.417582	0.028696	0.030605	0.231481
2.461538	0.028696	0.031128	0.231481
2.505495	0.028696	0.031652	0.231481
2.549451	0.028696	0.032175	0.231481
2.593407	0.028696	0.032699	0.231481
2.637363	0.028696	0.033222	0.231481
2.681319	0.028696	0.033746	0.231481
2.725275	0.028696	0.034269	0.231481
2.769231	0.028696	0.034792	0.231481
2.813187	0.028696	0.035316	0.231481
2.857143	0.028696	0.035839	0.231481
2.901099	0.028696	0.036363	0.231481
2.945055	0.028696	0.036886	0.231481
2.989011	0.028696	0.037410	0.231481
3.000000	0.028696	0.042323	0.231481

END FTABLE 2
FTABLE 1

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.028696	0.000000	0.000000	0.000000		
0.043956	0.028696	0.001261	0.000000	0.173611		
0.087912	0.028696	0.002523	0.000000	0.183786		
0.131868	0.028696	0.003784	0.000000	0.188874		
0.175824	0.028696	0.005045	0.000000	0.193961		
0.219780	0.028696	0.006307	0.000000	0.199049		
0.263736	0.028696	0.007568	0.000000	0.204136		
0.307692	0.028696	0.008830	0.000000	0.209224		
0.351648	0.028696	0.010091	0.000000	0.214311		
0.395604	0.028696	0.011352	0.000000	0.219399		
0.439560	0.028696	0.012614	0.000000	0.224486		
0.483516	0.028696	0.013875	0.000000	0.229574		
0.527473	0.028696	0.015136	0.048301	0.231481		
0.571429	0.028696	0.016398	0.202028	0.231481		
0.615385	0.028696	0.017659	0.412175	0.231481		
0.659341	0.028696	0.018920	0.659695	0.231481		
0.703297	0.028696	0.020182	0.928167	0.231481		
0.747253	0.028696	0.021443	1.200769	0.231481		
0.791209	0.028696	0.022705	1.460630	0.231481		
0.835165	0.028696	0.023966	1.692395	0.231481		
0.879121	0.028696	0.025227	1.884482	0.231481		
0.923077	0.028696	0.026489	2.031838	0.231481		
0.967033	0.028696	0.027750	2.139092	0.231481		
1.000000	0.028696	0.028696	2.251466	0.231481		

END FTABLE 1
FTABLE 4

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.137741	0.000000	0.000000		
0.054945	0.137741	0.003461	0.000000		
0.109890	0.137741	0.006922	0.000000		
0.164835	0.137741	0.010383	0.000000		
0.219780	0.137741	0.013844	0.005654		
0.274725	0.137741	0.017305	0.009856		
0.329670	0.137741	0.020766	0.015634		
0.384615	0.137741	0.024227	0.016455		
0.439560	0.137741	0.027687	0.023180		
0.494505	0.137741	0.031148	0.032664		
0.549451	0.137741	0.034609	0.044245		
0.604396	0.137741	0.038070	0.058067		
0.659341	0.137741	0.041531	0.069906		
0.714286	0.137741	0.044992	0.074267		
0.769231	0.137741	0.048453	0.092974		
0.824176	0.137741	0.051914	0.114309		
0.879121	0.137741	0.055375	0.138388		

0.934066	0.137741	0.058836	0.165321
0.989011	0.137741	0.062297	0.172669
1.043956	0.137741	0.065758	0.195215
1.098901	0.137741	0.069219	0.228171
1.153846	0.137741	0.072680	0.264285
1.208791	0.137741	0.076141	0.303649
1.263736	0.137741	0.079601	0.334742
1.318681	0.137741	0.083062	0.346353
1.373626	0.137741	0.086523	0.392478
1.428571	0.137741	0.089984	0.442103
1.483516	0.137741	0.093445	0.495294
1.538462	0.137741	0.096586	0.552112
1.593407	0.137741	0.099727	0.564683
1.648352	0.137741	0.102868	0.612591
1.703297	0.137741	0.106008	0.676727
1.758242	0.137741	0.109149	0.744394
1.813187	0.137741	0.112290	0.814747
1.868132	0.137741	0.115431	1.388889
1.923077	0.137741	0.118572	1.388889
1.978022	0.137741	0.121712	1.388889
2.032967	0.137741	0.124853	1.388889
2.087912	0.137741	0.127994	1.388889
2.142857	0.137741	0.131135	1.388889
2.197802	0.137741	0.134276	1.388889
2.252747	0.137741	0.137416	1.388889
2.307692	0.137741	0.140557	1.388889
2.362637	0.137741	0.143698	1.388889
2.417582	0.137741	0.146839	1.388889
2.472527	0.137741	0.149980	1.388889
2.527473	0.137741	0.153120	1.388889
2.582418	0.137741	0.156261	1.388889
2.637363	0.137741	0.159402	1.388889
2.692308	0.137741	0.162543	1.388889
2.747253	0.137741	0.165684	1.388889
2.802198	0.137741	0.168824	1.388889
2.857143	0.137741	0.171965	1.388889
2.912088	0.137741	0.175106	1.388889
2.967033	0.137741	0.178247	1.388889
3.000000	0.137741	0.208827	1.388889

END FTABLE 4

FTABLE 3

38 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.137741	0.000000	0.000000	0.000000		
0.054945	0.137741	0.007568	0.000000	0.833334		
0.109890	0.137741	0.015136	0.000000	0.894384		
0.164835	0.137741	0.022705	0.000000	0.924909		
0.219780	0.137741	0.030273	0.000000	0.955434		
0.274725	0.137741	0.037841	0.000000	0.985959		
0.329670	0.137741	0.045409	0.000000	1.016484		
0.384615	0.137741	0.052977	0.000000	1.047009		
0.439560	0.137741	0.060546	0.000000	1.077534		
0.494505	0.137741	0.068114	0.000000	1.108059		
0.549451	0.137741	0.075682	0.000000	1.138585		
0.604396	0.137741	0.083250	0.000000	1.169110		
0.659341	0.137741	0.090818	0.000000	1.199635		
0.714286	0.137741	0.098386	0.000000	1.230160		
0.769231	0.137741	0.105955	0.000000	1.260685		
0.824176	0.137741	0.113523	0.000000	1.291210		
0.879121	0.137741	0.121091	0.000000	1.321735		
0.934066	0.137741	0.128659	0.000000	1.352260		
0.989011	0.137741	0.136227	0.000000	1.382785		
1.043956	0.137741	0.143796	0.195553	1.388889		
1.098901	0.137741	0.151364	0.659242	1.388889		
1.153846	0.137741	0.158932	1.276591	1.388889		
1.208791	0.137741	0.166500	2.010935	1.388889		
1.263736	0.137741	0.174068	2.836899	1.388889		
1.318681	0.137741	0.181637	3.731796	1.388889		
1.373626	0.137741	0.189205	4.673072	1.388889		

1.428571	0.137741	0.196773	5.637608	1.388889
1.483516	0.137741	0.204341	6.601841	1.388889
1.538462	0.137741	0.211909	7.542349	1.388889
1.593407	0.137741	0.219477	8.436754	1.388889
1.648352	0.137741	0.227046	9.264852	1.388889
1.703297	0.137741	0.234614	10.00993	1.388889
1.758242	0.137741	0.242182	10.66024	1.388889
1.813187	0.137741	0.249750	11.21062	1.388889
1.868132	0.137741	0.257318	11.66425	1.388889
1.923077	0.137741	0.264887	12.03449	1.388889
1.978022	0.137741	0.272455	12.34684	1.388889
2.000000	0.137741	0.275482	12.80450	1.388889

END FTABLE 3

FTABLE 5

92	5	Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.137741	0.000000	0.000000	0.000000	0.000000	0.277778		
0.055556	0.137741	0.002678	0.000000	0.000000	0.277778			
0.111111	0.137741	0.005357	0.000000	0.277778				
0.166667	0.137741	0.008035	0.000000	0.277778				
0.222222	0.137741	0.010713	0.000000	0.277778				
0.277778	0.137741	0.013391	0.000000	0.277778				
0.333333	0.137741	0.016070	0.000000	0.277778				
0.388889	0.137741	0.018748	0.000000	0.277778				
0.444444	0.137741	0.021426	0.000000	0.277778				
0.500000	0.137741	0.024105	0.000000	0.277778				
0.555556	0.137741	0.026783	0.000000	0.277778				
0.611111	0.137741	0.029461	0.000000	0.277778				
0.666667	0.137741	0.032140	0.000000	0.277778				
0.722222	0.137741	0.034818	0.000000	0.277778				
0.777778	0.137741	0.037496	0.000000	0.277778				
0.833333	0.137741	0.040174	0.000000	0.277778				
0.888889	0.137741	0.042853	0.000000	0.277778				
0.944444	0.137741	0.045531	0.000000	0.277778				
1.000000	0.137741	0.048209	0.000000	0.277778				
1.055556	0.137741	0.050888	0.000000	0.277778				
1.111111	0.137741	0.053566	0.000000	0.277778				
1.166667	0.137741	0.056244	0.000000	0.277778				
1.222222	0.137741	0.058923	0.000000	0.277778				
1.277778	0.137741	0.061601	0.000000	0.277778				
1.333333	0.137741	0.064279	0.000000	0.277778				
1.388889	0.137741	0.066957	0.000000	0.277778				
1.444444	0.137741	0.069636	0.000000	0.277778				
1.500000	0.137741	0.072314	0.000000	0.277778				
1.555556	0.137741	0.074992	0.000000	0.277778				
1.611111	0.137741	0.077671	0.000000	0.277778				
1.666667	0.137741	0.080349	0.000000	0.277778				
1.722222	0.137741	0.083027	0.000000	0.277778				
1.777778	0.137741	0.085706	0.000000	0.277778				
1.833333	0.137741	0.088384	0.000000	0.277778				
1.888889	0.137741	0.091062	0.000000	0.277778				
1.944444	0.137741	0.093740	0.000000	0.277778				
2.000000	0.137741	0.096419	0.000000	0.277778				
2.055556	0.137741	0.099097	0.000000	0.277778				
2.111111	0.137741	0.101775	0.000000	0.277778				
2.166667	0.137741	0.104454	0.000000	0.277778				
2.222222	0.137741	0.107132	0.000000	0.277778				
2.277778	0.137741	0.109810	0.000000	0.277778				
2.333333	0.137741	0.112489	0.000000	0.277778				
2.388889	0.137741	0.115167	0.000000	0.277778				
2.444444	0.137741	0.117845	0.000000	0.277778				
2.500000	0.137741	0.120523	0.000000	0.277778				
2.555556	0.137741	0.123202	0.000000	0.277778				
2.611111	0.137741	0.125880	0.000000	0.277778				
2.666667	0.137741	0.128558	0.000000	0.277778				
2.722222	0.137741	0.131237	0.000000	0.277778				
2.777778	0.137741	0.133915	0.000000	0.277778				
2.833333	0.137741	0.136593	0.000000	0.277778				
2.888889	0.137741	0.139272	0.000000	0.277778				

2.944444	0.137741	0.141950	0.000000	0.277778
3.000000	0.137741	0.144628	0.000000	0.277778
3.055556	0.137741	0.147306	0.000000	0.277778
3.111111	0.137741	0.149985	0.000000	0.277778
3.166667	0.137741	0.152663	0.000000	0.277778
3.222222	0.137741	0.155341	0.000000	0.277778
3.277778	0.137741	0.158020	0.000000	0.277778
3.333333	0.137741	0.160698	0.000000	0.277778
3.388889	0.137741	0.163376	0.000000	0.277778
3.444444	0.137741	0.166054	0.000000	0.277778
3.500000	0.137741	0.168733	0.000000	0.277778
3.555556	0.137741	0.171411	0.000000	0.277778
3.611111	0.137741	0.174089	0.000000	0.277778
3.666667	0.137741	0.176768	0.000000	0.277778
3.722222	0.137741	0.179446	0.000000	0.277778
3.777778	0.137741	0.182124	0.000000	0.277778
3.833333	0.137741	0.184803	0.000000	0.277778
3.888889	0.137741	0.187481	0.000000	0.277778
3.944444	0.137741	0.190159	0.000000	0.277778
4.000000	0.137741	0.192837	0.000000	0.277778
4.055556	0.137741	0.195516	0.000000	0.277778
4.111111	0.137741	0.198194	0.000000	0.277778
4.166667	0.137741	0.200872	0.000000	0.277778
4.222222	0.137741	0.203551	0.000000	0.277778
4.277778	0.137741	0.206229	0.000000	0.277778
4.333333	0.137741	0.208907	0.000000	0.277778
4.388889	0.137741	0.211586	0.000000	0.277778
4.444444	0.137741	0.214264	0.000000	0.277778
4.500000	0.137741	0.216942	0.000000	0.277778
4.555556	0.137741	0.219620	0.277796	0.277778
4.611111	0.137741	0.222299	0.784769	0.277778
4.666667	0.137741	0.224977	1.438492	0.277778
4.722222	0.137741	0.227655	2.205262	0.277778
4.777778	0.137741	0.230334	3.059929	0.277778
4.833333	0.137741	0.233012	3.979211	0.277778
4.888889	0.137741	0.235690	4.939668	0.277778
4.944444	0.137741	0.238369	5.917238	0.277778
5.000000	0.137741	0.241047	6.887532	0.277778
5.055556	0.137741	0.248699	7.826549	0.277778

END FTABLE 5

FTABLE 6

92 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.028696	0.000000	0.000000	0.000000		
0.055556	0.028696	0.000558	0.000000	0.057870		
0.111111	0.028696	0.001116	0.000000	0.057870		
0.166667	0.028696	0.001674	0.000000	0.057870		
0.222222	0.028696	0.002232	0.000000	0.057870		
0.277778	0.028696	0.002790	0.000000	0.057870		
0.333333	0.028696	0.003348	0.000000	0.057870		
0.388889	0.028696	0.003906	0.000000	0.057870		
0.444444	0.028696	0.004464	0.000000	0.057870		
0.500000	0.028696	0.005022	0.000000	0.057870		
0.555556	0.028696	0.005580	0.000000	0.057870		
0.611111	0.028696	0.006138	0.000000	0.057870		
0.666667	0.028696	0.006696	0.000000	0.057870		
0.722222	0.028696	0.007254	0.000000	0.057870		
0.777778	0.028696	0.007812	0.000000	0.057870		
0.833333	0.028696	0.008370	0.000000	0.057870		
0.888889	0.028696	0.008928	0.000000	0.057870		
0.944444	0.028696	0.009486	0.000000	0.057870		
1.000000	0.028696	0.010044	0.000000	0.057870		
1.055556	0.028696	0.010602	0.000000	0.057870		
1.111111	0.028696	0.011160	0.000000	0.057870		
1.166667	0.028696	0.011718	0.000000	0.057870		
1.222222	0.028696	0.012276	0.000000	0.057870		
1.277778	0.028696	0.012834	0.000000	0.057870		
1.333333	0.028696	0.013391	0.000000	0.057870		
1.388889	0.028696	0.013949	0.000000	0.057870		

1.444444	0.028696	0.014507	0.000000	0.057870
1.500000	0.028696	0.015065	0.000000	0.057870
1.555556	0.028696	0.015623	0.000000	0.057870
1.611111	0.028696	0.016181	0.000000	0.057870
1.666667	0.028696	0.016739	0.000000	0.057870
1.722222	0.028696	0.017297	0.000000	0.057870
1.777778	0.028696	0.017855	0.000000	0.057870
1.833333	0.028696	0.018413	0.000000	0.057870
1.888889	0.028696	0.018971	0.000000	0.057870
1.944444	0.028696	0.019529	0.000000	0.057870
2.000000	0.028696	0.020087	0.000000	0.057870
2.055556	0.028696	0.020645	0.000000	0.057870
2.111111	0.028696	0.021203	0.000000	0.057870
2.166667	0.028696	0.021761	0.000000	0.057870
2.222222	0.028696	0.022319	0.000000	0.057870
2.277778	0.028696	0.022877	0.000000	0.057870
2.333333	0.028696	0.023435	0.000000	0.057870
2.388889	0.028696	0.023993	0.000000	0.057870
2.444444	0.028696	0.024551	0.000000	0.057870
2.500000	0.028696	0.025109	0.000000	0.057870
2.555556	0.028696	0.025667	0.000000	0.057870
2.611111	0.028696	0.026225	0.000000	0.057870
2.666667	0.028696	0.026783	0.000000	0.057870
2.722222	0.028696	0.027341	0.000000	0.057870
2.777778	0.028696	0.027899	0.000000	0.057870
2.833333	0.028696	0.028457	0.000000	0.057870
2.888889	0.028696	0.029015	0.000000	0.057870
2.944444	0.028696	0.029573	0.000000	0.057870
3.000000	0.028696	0.030131	0.000000	0.057870
3.055556	0.028696	0.030689	0.138729	0.057870
3.111111	0.028696	0.031247	0.389839	0.057870
3.166667	0.028696	0.031805	0.703432	0.057870
3.222222	0.028696	0.032363	1.046030	0.057870
3.277778	0.028696	0.032921	1.383552	0.057870
3.333333	0.028696	0.033479	1.683468	0.057870
3.388889	0.028696	0.034037	1.921105	0.057870
3.444444	0.028696	0.034595	2.088233	0.057870
3.500000	0.028696	0.035153	2.203335	0.057870
3.555556	0.028696	0.035711	2.347596	0.057870
3.611111	0.028696	0.036269	2.462179	0.057870
3.666667	0.028696	0.036827	2.571662	0.057870
3.722222	0.028696	0.037385	2.676671	0.057870
3.777778	0.028696	0.037943	2.777713	0.057870
3.833333	0.028696	0.038501	2.875206	0.057870
3.888889	0.028696	0.039059	2.969500	0.057870
3.944444	0.028696	0.039616	3.060890	0.057870
4.000000	0.028696	0.040174	3.149630	0.057870
4.055556	0.028696	0.040732	3.235937	0.057870
4.111111	0.028696	0.041290	3.320002	0.057870
4.166667	0.028696	0.041848	3.401989	0.057870
4.222222	0.028696	0.042406	3.482047	0.057870
4.277778	0.028696	0.042964	3.560305	0.057870
4.333333	0.028696	0.043522	3.636879	0.057870
4.388889	0.028696	0.044080	3.711875	0.057870
4.444444	0.028696	0.044638	3.785384	0.057870
4.500000	0.028696	0.045196	3.857493	0.057870
4.555556	0.028696	0.045754	3.928279	0.057870
4.611111	0.028696	0.046312	3.997811	0.057870
4.666667	0.028696	0.046870	4.066155	0.057870
4.722222	0.028696	0.047428	4.133369	0.057870
4.777778	0.028696	0.047986	4.199507	0.057870
4.833333	0.028696	0.048544	4.264619	0.057870
4.888889	0.028696	0.049102	4.328752	0.057870
4.944444	0.028696	0.049660	4.391949	0.057870
5.000000	0.028696	0.050218	4.454250	0.057870
5.055556	0.028696	0.051812	4.515690	0.057870

END FTABLE 6

END FTABLES

EXT SOURCES

<-Volume-> <Name>	<Member> #	SsysSgap <Name> #	<-Mult-->Tran strg<-factor-->strg	<-Target <Name> #	vols> #	<-Grp> <Name> #	<-Member-> <Name> #	*** ***
WDM	2	PREC	ENGL 1.429	PERLND	1	999	EXTNL	PREC
WDM	2	PREC	ENGL 1.429	IMPLND	1	999	EXTNL	PREC
WDM	1	EVAP	ENGL 0.76	PERLND	1	999	EXTNL	PETINP
WDM	1	EVAP	ENGL 0.76	IMPLND	1	999	EXTNL	PETINP
WDM	2	PREC	ENGL 1.429	RCHRES	1		EXTNL	PREC
WDM	2	PREC	ENGL 1.429	RCHRES	3		EXTNL	PREC
WDM	1	EVAP	ENGL 0.5	RCHRES	1		EXTNL	POTEV
WDM	1	EVAP	ENGL 0.76	RCHRES	2		EXTNL	POTEV
WDM	1	EVAP	ENGL 0.5	RCHRES	3		EXTNL	POTEV
WDM	1	EVAP	ENGL 0.76	RCHRES	4		EXTNL	POTEV

END EXT SOURCES

EXT TARGETS

<-Volume-> <Name>	<-Grp> #	<-Member-> <Name> #	<-Mult-->Tran strg<-factor-->strg	<-Volume-> <Name> #	<Member> <Name> #	Tsys tem	Tgap strg	Amd strg	*** ***
RCHRES	5	HYDR	RO 1 1 1	WDM	1004	FLOW	ENGL	REPL	
RCHRES	5	HYDR	0 1 1 1	WDM	1005	FLOW	ENGL	REPL	
RCHRES	5	HYDR	0 2 1 1	WDM	1006	FLOW	ENGL	REPL	
RCHRES	5	HYDR	STAGE 1 1 1	WDM	1007	STAG	ENGL	REPL	
COPY	2	OUTPUT	MEAN 1 1 48.4	WDM	702	FLOW	ENGL	REPL	
COPY	502	OUTPUT	MEAN 1 1 48.4	WDM	802	FLOW	ENGL	REPL	
COPY	602	OUTPUT	MEAN 1 1 48.4	WDM	902	FLOW	ENGL	REPL	
COPY	1	OUTPUT	MEAN 1 1 48.4	WDM	701	FLOW	ENGL	REPL	
COPY	501	OUTPUT	MEAN 1 1 48.4	WDM	801	FLOW	ENGL	REPL	
COPY	601	OUTPUT	MEAN 1 1 48.4	WDM	901	FLOW	ENGL	REPL	
RCHRES	6	HYDR	RO 1 1 1	WDM	1014	FLOW	ENGL	REPL	
RCHRES	6	HYDR	0 1 1 1	WDM	1015	FLOW	ENGL	REPL	
RCHRES	6	HYDR	0 2 1 1	WDM	1016	FLOW	ENGL	REPL	
RCHRES	6	HYDR	STAGE 1 1 1	WDM	1017	STAG	ENGL	REPL	

MASS-LINK

<Volume> <Name>	<-Grp> #	<-Member-> <Name> #	<-Mult--> strg<-factor-->	<Target> <Name>	<-Grp> #	<-Member-> <Name> #	*** ***
MASS-LINK		5					
IMPLND	IWATER	SURO	0.083333	RCHRES	INFLOW	IVOL	
END MASS-LINK		5					
MASS-LINK		7					
RCHRES	OFLOW	OVOL	1	RCHRES	INFLOW	IVOL	
END MASS-LINK		7					
MASS-LINK		8					
RCHRES	OFLOW	OVOL	2	RCHRES	INFLOW	IVOL	
END MASS-LINK		8					
MASS-LINK		12					
PERLND	PWATER	SURO	0.083333	COPY	INPUT	MEAN	
END MASS-LINK		12					
MASS-LINK		13					
PERLND	PWATER	IFW0	0.083333	COPY	INPUT	MEAN	
END MASS-LINK		13					
MASS-LINK		15					
IMPLND	IWATER	SURO	0.083333	COPY	INPUT	MEAN	
END MASS-LINK		15					
MASS-LINK		17					
RCHRES	OFLOW	OVOL	1	COPY	INPUT	MEAN	
END MASS-LINK		17					

END MASS-LINK

END RUN

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WWHM2012
PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node B

Site Name: LOTC

Site Address:

City: Castle Rock, WA

Report Date: 1/21/2025

Gage: Longview

Data Start: 1955/10/01

Data End: 2009/09/30

Timestep: 15 Minute

Precip Scale: 1.429

Version Date: 2024/06/28

Version: 4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
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High Flow Threshold for POC1:	50 Year
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Low Flow Threshold for POC2:	50 Percent of the 2 Year
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High Flow Threshold for POC2:	50 Year
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Landuse Basin Data

Predeveloped Land Use

Node A - Existing Public

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	0.341
Pervious Total	0.341
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.341

Element Flow Componentants:

Surface	Interflow	Groundwater
Component Flows To:		
POC 1	POC 1	

Node A - Existng C/F

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	8.921
Pervious Total	8.921
Impervious Land Use	acre
Impervious Total	0
Basin Total	8.921

Element Flow Componants:		
Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

Mitigated Land Use

Node B - Public PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.25
Impervious Total	0.25
Basin Total	0.25

Element Flow Componants:		
Surface	Interflow	Groundwater
Componant Flows To:		
Surface Bioretention	Surface Bioretention	

Node B - Subdivision PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	2.176
Impervious Total	2.176
Basin Total	2.176

Element Flow Componants:

Surface	Interflow	Groundwater
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Componant Flows To:

Surface Bioretention	Surface Bioretention
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Node B - Public Non-PGIS

Bypass: Yes

GroundWater: No

Pervious Land Use acre
A B, Lawn, Mod 0.091

Pervious Total 0.091

Impervious Land Use acre

Impervious Total 0

Basin Total 0.091

Element Flow Components:

Surface Interflow

Groundwater

Component Flows To:

POC 1 POC 1

Node B - Subdivision Non-PGIS

Bypass: Yes

GroundWater: No

Pervious Land Use acre
A B, Lawn, Mod 4.645

Pervious Total 4.645

Impervious Land Use acre
ROOF TOPS FLAT 2.1

Impervious Total 2.1

Basin Total 6.745

Element Flow Componants:

Surface Interflow

Groundwater

Componant Flows To:

POC 2 POC 2

Routing Elements

Predeveloped Routing

Mitigated Routing

Road Bioretention

Bottom Length: 40.00 ft.
 Bottom Width: 5.00 ft.
 Material thickness of first layer: 1.5
 Material type for first layer: SMMWW 12 in/hr
 Material thickness of second layer: 1.5
 Material type for second layer: GRAVEL
 Material thickness of third layer: 0
 Material type for third layer: GRAVEL
 Underdrain used
 Underdrain Diameter (feet): 1
 Orifice Diameter (in.): 12
 Offset (in.): 0
 Flow Through Underdrain (ac-ft.): 57.121
 Total Outflow (ac-ft.): 60.09
 Percent Through Underdrain: 95.06
 Discharge Structure
 Riser Height: 0.5 ft.
 Riser Diameter: 12 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:
 Gravel Trench Bed 1

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0046	0.0000	0.0000	0.0000
0.0440	0.0046	0.0001	0.0000	0.0000
0.0879	0.0046	0.0002	0.0000	0.0000
0.1319	0.0046	0.0003	0.0000	0.0000
0.1758	0.0046	0.0004	0.0000	0.0000
0.2198	0.0046	0.0005	0.0001	0.0000
0.2637	0.0046	0.0006	0.0002	0.0000
0.3077	0.0046	0.0006	0.0003	0.0000
0.3516	0.0046	0.0007	0.0005	0.0000
0.3956	0.0046	0.0008	0.0007	0.0000
0.4396	0.0046	0.0009	0.0009	0.0000
0.4835	0.0046	0.0010	0.0012	0.0000
0.5275	0.0046	0.0011	0.0014	0.0000
0.5714	0.0046	0.0012	0.0015	0.0000
0.6154	0.0046	0.0013	0.0018	0.0000
0.6593	0.0046	0.0014	0.0022	0.0000
0.7033	0.0046	0.0015	0.0027	0.0000
0.7473	0.0046	0.0016	0.0032	0.0000
0.7912	0.0046	0.0017	0.0035	0.0000
0.8352	0.0046	0.0018	0.0038	0.0000
0.8791	0.0046	0.0018	0.0044	0.0000
0.9231	0.0046	0.0019	0.0051	0.0000
0.9670	0.0046	0.0020	0.0059	0.0000
1.0110	0.0046	0.0021	0.0067	0.0000
1.0549	0.0046	0.0022	0.0067	0.0000
1.0989	0.0046	0.0023	0.0076	0.0000
1.1429	0.0046	0.0024	0.0086	0.0000
1.1868	0.0046	0.0025	0.0096	0.0000

1.2308	0.0046	0.0026	0.0107	0.0000
1.2747	0.0046	0.0027	0.0112	0.0000
1.3187	0.0046	0.0028	0.0118	0.0000
1.3626	0.0046	0.0029	0.0131	0.0000
1.4066	0.0046	0.0030	0.0144	0.0000
1.4505	0.0046	0.0030	0.0158	0.0000
1.4945	0.0046	0.0031	0.0171	0.0000
1.5385	0.0046	0.0032	0.0173	0.0000
1.5824	0.0046	0.0033	0.0188	0.0000
1.6264	0.0046	0.0034	0.0204	0.0000
1.6703	0.0046	0.0035	0.0221	0.0000
1.7143	0.0046	0.0036	0.0239	0.0000
1.7582	0.0046	0.0036	0.0246	0.0000
1.8022	0.0046	0.0037	0.0257	0.0000
1.8462	0.0046	0.0038	0.0276	0.0000
1.8901	0.0046	0.0039	0.0370	0.0000
1.9341	0.0046	0.0040	0.0370	0.0000
1.9780	0.0046	0.0041	0.0370	0.0000
2.0220	0.0046	0.0041	0.0370	0.0000
2.0659	0.0046	0.0042	0.0370	0.0000
2.1099	0.0046	0.0043	0.0370	0.0000
2.1538	0.0046	0.0044	0.0370	0.0000
2.1978	0.0046	0.0045	0.0370	0.0000
2.2418	0.0046	0.0046	0.0370	0.0000
2.2857	0.0046	0.0046	0.0370	0.0000
2.3297	0.0046	0.0047	0.0370	0.0000
2.3736	0.0046	0.0048	0.0370	0.0000
2.4176	0.0046	0.0049	0.0370	0.0000
2.4615	0.0046	0.0050	0.0370	0.0000
2.5055	0.0046	0.0051	0.0370	0.0000
2.5495	0.0046	0.0051	0.0370	0.0000
2.5934	0.0046	0.0052	0.0370	0.0000
2.6374	0.0046	0.0053	0.0370	0.0000
2.6813	0.0046	0.0054	0.0370	0.0000
2.7253	0.0046	0.0055	0.0370	0.0000
2.7692	0.0046	0.0056	0.0370	0.0000
2.8132	0.0046	0.0057	0.0370	0.0000
2.8571	0.0046	0.0057	0.0370	0.0000
2.9011	0.0046	0.0058	0.0370	0.0000
2.9451	0.0046	0.0059	0.0370	0.0000
2.9890	0.0046	0.0060	0.0370	0.0000
3.0000	0.0046	0.0060	0.0370	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0046	0.0060	0.0000	0.0278	0.0000
3.0440	0.0046	0.0062	0.0000	0.0278	0.0000
3.0879	0.0046	0.0064	0.0000	0.0294	0.0000
3.1319	0.0046	0.0066	0.0000	0.0302	0.0000
3.1758	0.0046	0.0068	0.0000	0.0310	0.0000
3.2198	0.0046	0.0070	0.0000	0.0318	0.0000
3.2637	0.0046	0.0072	0.0000	0.0327	0.0000
3.3077	0.0046	0.0074	0.0000	0.0335	0.0000
3.3516	0.0046	0.0076	0.0000	0.0343	0.0000
3.3956	0.0046	0.0078	0.0000	0.0351	0.0000
3.4396	0.0046	0.0080	0.0000	0.0359	0.0000
3.4835	0.0046	0.0082	0.0000	0.0367	0.0000
3.5275	0.0046	0.0084	0.0483	0.0370	0.0000

3.5714	0.0046	0.0086	0.2020	0.0370	0.0000
3.6154	0.0046	0.0088	0.4122	0.0370	0.0000
3.6593	0.0046	0.0090	0.6597	0.0370	0.0000
3.7033	0.0046	0.0092	0.9282	0.0370	0.0000
3.7473	0.0046	0.0094	1.2008	0.0370	0.0000
3.7912	0.0046	0.0096	1.4606	0.0370	0.0000
3.8352	0.0046	0.0098	1.6924	0.0370	0.0000
3.8791	0.0046	0.0100	1.8845	0.0370	0.0000
3.9231	0.0046	0.0102	2.0318	0.0370	0.0000
3.9670	0.0046	0.0104	2.1391	0.0370	0.0000
4.0000	0.0046	0.0106	2.2515	0.0370	0.0000

Subdivision Bioretention

Bottom Length: 270.00 ft.
 Bottom Width: 5.00 ft.
 Material thickness of first layer: 1.5
 Material type for first layer: SMMWW 12 in/hr
 Material thickness of second layer: 1.5
 Material type for second layer: GRAVEL
 Material thickness of third layer: 0
 Material type for third layer: GRAVEL
 Underdrain used
 Underdrain Diameter (feet): 1
 Orifice Diameter (in.): 12
 Offset (in.): 0
 Flow Through Underdrain (ac-ft.): 477.621
 Total Outflow (ac-ft.): 521.954
 Percent Through Underdrain: 91.51
 Discharge Structure
 Riser Height: 0.5 ft.
 Riser Diameter: 12 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:
 Gravel Trench Bed 1

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0310	0.0000	0.0000	0.0000
0.0440	0.0310	0.0006	0.0000	0.0000
0.0879	0.0310	0.0012	0.0000	0.0000
0.1319	0.0310	0.0019	0.0000	0.0000
0.1758	0.0310	0.0025	0.0000	0.0000
0.2198	0.0310	0.0031	0.0009	0.0000
0.2637	0.0310	0.0037	0.0014	0.0000
0.3077	0.0310	0.0044	0.0022	0.0000
0.3516	0.0310	0.0050	0.0032	0.0000
0.3956	0.0310	0.0056	0.0045	0.0000
0.4396	0.0310	0.0062	0.0060	0.0000
0.4835	0.0310	0.0069	0.0078	0.0000
0.5275	0.0310	0.0075	0.0097	0.0000
0.5714	0.0310	0.0081	0.0100	0.0000
0.6154	0.0310	0.0087	0.0124	0.0000
0.6593	0.0310	0.0093	0.0152	0.0000
0.7033	0.0310	0.0100	0.0183	0.0000
0.7473	0.0310	0.0106	0.0218	0.0000
0.7912	0.0310	0.0112	0.0235	0.0000
0.8352	0.0310	0.0118	0.0257	0.0000
0.8791	0.0310	0.0125	0.0300	0.0000
0.9231	0.0310	0.0131	0.0347	0.0000
0.9670	0.0310	0.0137	0.0398	0.0000
1.0110	0.0310	0.0143	0.0450	0.0000
1.0549	0.0310	0.0150	0.0454	0.0000
1.0989	0.0310	0.0156	0.0513	0.0000
1.1429	0.0310	0.0162	0.0578	0.0000
1.1868	0.0310	0.0168	0.0647	0.0000
1.2308	0.0310	0.0174	0.0721	0.0000
1.2747	0.0310	0.0181	0.0753	0.0000

1.3187	0.0310	0.0187	0.0799	0.0000
1.3626	0.0310	0.0193	0.0883	0.0000
1.4066	0.0310	0.0199	0.0972	0.0000
1.4505	0.0310	0.0206	0.1066	0.0000
1.4945	0.0310	0.0212	0.1154	0.0000
1.5385	0.0310	0.0217	0.1165	0.0000
1.5824	0.0310	0.0223	0.1269	0.0000
1.6264	0.0310	0.0229	0.1378	0.0000
1.6703	0.0310	0.0234	0.1493	0.0000
1.7143	0.0310	0.0240	0.1613	0.0000
1.7582	0.0310	0.0246	0.1661	0.0000
1.8022	0.0310	0.0251	0.1738	0.0000
1.8462	0.0310	0.0257	0.1864	0.0000
1.8901	0.0310	0.0263	0.2500	0.0000
1.9341	0.0310	0.0268	0.2500	0.0000
1.9780	0.0310	0.0274	0.2500	0.0000
2.0220	0.0310	0.0280	0.2500	0.0000
2.0659	0.0310	0.0285	0.2500	0.0000
2.1099	0.0310	0.0291	0.2500	0.0000
2.1538	0.0310	0.0297	0.2500	0.0000
2.1978	0.0310	0.0302	0.2500	0.0000
2.2418	0.0310	0.0308	0.2500	0.0000
2.2857	0.0310	0.0314	0.2500	0.0000
2.3297	0.0310	0.0319	0.2500	0.0000
2.3736	0.0310	0.0325	0.2500	0.0000
2.4176	0.0310	0.0331	0.2500	0.0000
2.4615	0.0310	0.0336	0.2500	0.0000
2.5055	0.0310	0.0342	0.2500	0.0000
2.5495	0.0310	0.0347	0.2500	0.0000
2.5934	0.0310	0.0353	0.2500	0.0000
2.6374	0.0310	0.0359	0.2500	0.0000
2.6813	0.0310	0.0364	0.2500	0.0000
2.7253	0.0310	0.0370	0.2500	0.0000
2.7692	0.0310	0.0376	0.2500	0.0000
2.8132	0.0310	0.0381	0.2500	0.0000
2.8571	0.0310	0.0387	0.2500	0.0000
2.9011	0.0310	0.0393	0.2500	0.0000
2.9451	0.0310	0.0398	0.2500	0.0000
2.9890	0.0310	0.0404	0.2500	0.0000
3.0000	0.0310	0.0405	0.2500	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infiltr(cfs)
3.0000	0.0310	0.0405	0.0000	0.1875	0.0000
3.0440	0.0310	0.0419	0.0000	0.1875	0.0000
3.0879	0.0310	0.0433	0.0000	0.1985	0.0000
3.1319	0.0310	0.0446	0.0000	0.2040	0.0000
3.1758	0.0310	0.0460	0.0000	0.2095	0.0000
3.2198	0.0310	0.0474	0.0000	0.2150	0.0000
3.2637	0.0310	0.0487	0.0000	0.2205	0.0000
3.3077	0.0310	0.0501	0.0000	0.2260	0.0000
3.3516	0.0310	0.0514	0.0000	0.2315	0.0000
3.3956	0.0310	0.0528	0.0000	0.2370	0.0000
3.4396	0.0310	0.0542	0.0000	0.2424	0.0000
3.4835	0.0310	0.0555	0.0000	0.2479	0.0000
3.5275	0.0310	0.0569	0.0483	0.2500	0.0000
3.5714	0.0310	0.0583	0.2020	0.2500	0.0000
3.6154	0.0310	0.0596	0.4122	0.2500	0.0000

3.6593	0.0310	0.0610	0.6597	0.2500	0.0000
3.7033	0.0310	0.0623	0.9282	0.2500	0.0000
3.7473	0.0310	0.0637	1.2008	0.2500	0.0000
3.7912	0.0310	0.0651	1.4606	0.2500	0.0000
3.8352	0.0310	0.0664	1.6924	0.2500	0.0000
3.8791	0.0310	0.0678	1.8845	0.2500	0.0000
3.9231	0.0310	0.0692	2.0318	0.2500	0.0000
3.9670	0.0310	0.0705	2.1391	0.2500	0.0000
4.0000	0.0310	0.0715	2.2515	0.2500	0.0000

Gravel Trench Bed 1

Bottom Length: 40.00 ft.
 Bottom Width: 5.00 ft.
 Trench bottom slope 1: 0 To 1
 Trench Left side slope 0: 0 To 1
 Trench right side slope 2: 0 To 1
 Material thickness of first layer: 5
 Pour Space of material for first layer: 0.35
 Material thickness of second layer: 0
 Pour Space of material for second layer: 0
 Material thickness of third layer: 0
 Pour Space of material for third layer: 0
 Infiltration On
 Infiltration rate: 2
 Infiltration safety factor: 1
 Wetted surface area On
 Total Volume Infiltrated (ac-ft.): 2.156
 Total Volume Through Riser (ac-ft.): 0.813
 Total Volume Through Facility (ac-ft.): 2.969
 Percent Infiltrated: 72.62
 Total Precip Applied to Facility: 0
 Total Evap From Facility: 0
 Discharge Structure
 Riser Height: 3 ft.
 Riser Diameter: 12 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.004	0.000	0.000	0.000
0.0556	0.004	0.000	0.000	0.009
0.1111	0.004	0.000	0.000	0.009
0.1667	0.004	0.000	0.000	0.009
0.2222	0.004	0.000	0.000	0.009
0.2778	0.004	0.000	0.000	0.009
0.3333	0.004	0.000	0.000	0.009
0.3889	0.004	0.000	0.000	0.009
0.4444	0.004	0.000	0.000	0.009
0.5000	0.004	0.000	0.000	0.009
0.5556	0.004	0.000	0.000	0.009
0.6111	0.004	0.001	0.000	0.009
0.6667	0.004	0.001	0.000	0.009
0.7222	0.004	0.001	0.000	0.009
0.7778	0.004	0.001	0.000	0.009
0.8333	0.004	0.001	0.000	0.009
0.8889	0.004	0.001	0.000	0.009
0.9444	0.004	0.001	0.000	0.009
1.0000	0.004	0.001	0.000	0.009
1.0556	0.004	0.001	0.000	0.009
1.1111	0.004	0.001	0.000	0.009
1.1667	0.004	0.001	0.000	0.009
1.2222	0.004	0.002	0.000	0.009
1.2778	0.004	0.002	0.000	0.009

1.3333	0.004	0.002	0.000	0.009
1.3889	0.004	0.002	0.000	0.009
1.4444	0.004	0.002	0.000	0.009
1.5000	0.004	0.002	0.000	0.009
1.5556	0.004	0.002	0.000	0.009
1.6111	0.004	0.002	0.000	0.009
1.6667	0.004	0.002	0.000	0.009
1.7222	0.004	0.002	0.000	0.009
1.7778	0.004	0.002	0.000	0.009
1.8333	0.004	0.002	0.000	0.009
1.8889	0.004	0.003	0.000	0.009
1.9444	0.004	0.003	0.000	0.009
2.0000	0.004	0.003	0.000	0.009
2.0556	0.004	0.003	0.000	0.009
2.1111	0.004	0.003	0.000	0.009
2.1667	0.004	0.003	0.000	0.009
2.2222	0.004	0.003	0.000	0.009
2.2778	0.004	0.003	0.000	0.009
2.3333	0.004	0.003	0.000	0.009
2.3889	0.004	0.003	0.000	0.009
2.4444	0.004	0.003	0.000	0.009
2.5000	0.004	0.004	0.000	0.009
2.5556	0.004	0.004	0.000	0.009
2.6111	0.004	0.004	0.000	0.009
2.6667	0.004	0.004	0.000	0.009
2.7222	0.004	0.004	0.000	0.009
2.7778	0.004	0.004	0.000	0.009
2.8333	0.004	0.004	0.000	0.009
2.8889	0.004	0.004	0.000	0.009
2.9444	0.004	0.004	0.000	0.009
3.0000	0.004	0.004	0.000	0.009
3.0556	0.004	0.004	0.138	0.009
3.1111	0.004	0.005	0.389	0.009
3.1667	0.004	0.005	0.703	0.009
3.2222	0.004	0.005	1.046	0.009
3.2778	0.004	0.005	1.383	0.009
3.3333	0.004	0.005	1.683	0.009
3.3889	0.004	0.005	1.921	0.009
3.4444	0.004	0.005	2.088	0.009
3.5000	0.004	0.005	2.203	0.009
3.5556	0.004	0.005	2.347	0.009
3.6111	0.004	0.005	2.462	0.009
3.6667	0.004	0.005	2.571	0.009
3.7222	0.004	0.006	2.676	0.009
3.7778	0.004	0.006	2.777	0.009
3.8333	0.004	0.006	2.875	0.009
3.8889	0.004	0.006	2.969	0.009
3.9444	0.004	0.006	3.060	0.009
4.0000	0.004	0.006	3.149	0.009
4.0556	0.004	0.006	3.235	0.009
4.1111	0.004	0.006	3.320	0.009
4.1667	0.004	0.006	3.402	0.009
4.2222	0.004	0.006	3.482	0.009
4.2778	0.004	0.006	3.560	0.009
4.3333	0.004	0.007	3.636	0.009
4.3889	0.004	0.007	3.711	0.009
4.4444	0.004	0.007	3.785	0.009
4.5000	0.004	0.007	3.857	0.009

4.5556	0.004	0.007	3.928	0.009
4.6111	0.004	0.007	3.997	0.009
4.6667	0.004	0.007	4.066	0.009
4.7222	0.004	0.007	4.133	0.009
4.7778	0.004	0.007	4.199	0.009
4.8333	0.004	0.007	4.264	0.009
4.8889	0.004	0.007	4.328	0.009
4.9444	0.004	0.007	4.391	0.009
5.0000	0.004	0.008	4.454	0.009

Gravel Trench Bed 1

Bottom Length: 270.00 ft.
 Bottom Width: 5.00 ft.
 Trench bottom slope 1: 0 To 1
 Trench Left side slope 0: 0 To 1
 Trench right side slope 2: 0 To 1
 Material thickness of first layer: 6
 Pour Space of material for first layer: 0.35
 Material thickness of second layer: 0
 Pour Space of material for second layer: 0
 Material thickness of third layer: 0
 Pour Space of material for third layer: 0
 Infiltration On
 Infiltration rate: 2
 Infiltration safety factor: 1
 Wetted surface area On
 Total Volume Infiltrated (ac-ft.): 31.896
 Total Volume Through Riser (ac-ft.): 12.447
 Total Volume Through Facility (ac-ft.): 44.343
 Percent Infiltrated: 71.93
 Total Precip Applied to Facility: 0
 Total Evap From Facility: 0
 Discharge Structure
 Riser Height: 4 ft.
 Riser Diameter: 12 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:

Gravel Trench Bed Hydraulic Table

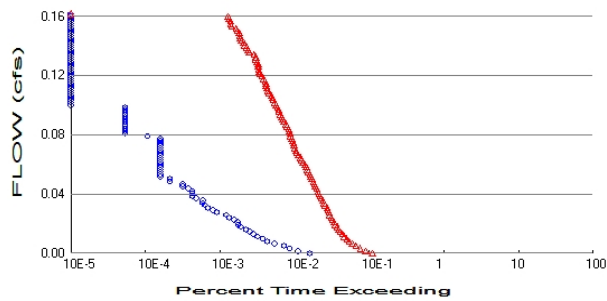
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.031	0.000	0.000	0.000
0.0667	0.031	0.000	0.000	0.062
0.1333	0.031	0.001	0.000	0.062
0.2000	0.031	0.002	0.000	0.062
0.2667	0.031	0.002	0.000	0.062
0.3333	0.031	0.003	0.000	0.062
0.4000	0.031	0.004	0.000	0.062
0.4667	0.031	0.005	0.000	0.062
0.5333	0.031	0.005	0.000	0.062
0.6000	0.031	0.006	0.000	0.062
0.6667	0.031	0.007	0.000	0.062
0.7333	0.031	0.008	0.000	0.062
0.8000	0.031	0.008	0.000	0.062
0.8667	0.031	0.009	0.000	0.062
0.9333	0.031	0.010	0.000	0.062
1.0000	0.031	0.010	0.000	0.062
1.0667	0.031	0.011	0.000	0.062
1.1333	0.031	0.012	0.000	0.062
1.2000	0.031	0.013	0.000	0.062
1.2667	0.031	0.013	0.000	0.062
1.3333	0.031	0.014	0.000	0.062
1.4000	0.031	0.015	0.000	0.062
1.4667	0.031	0.015	0.000	0.062
1.5333	0.031	0.016	0.000	0.062

1.6000	0.031	0.017	0.000	0.062
1.6667	0.031	0.018	0.000	0.062
1.7333	0.031	0.018	0.000	0.062
1.8000	0.031	0.019	0.000	0.062
1.8667	0.031	0.020	0.000	0.062
1.9333	0.031	0.021	0.000	0.062
2.0000	0.031	0.021	0.000	0.062
2.0667	0.031	0.022	0.000	0.062
2.1333	0.031	0.023	0.000	0.062
2.2000	0.031	0.023	0.000	0.062
2.2667	0.031	0.024	0.000	0.062
2.3333	0.031	0.025	0.000	0.062
2.4000	0.031	0.026	0.000	0.062
2.4667	0.031	0.026	0.000	0.062
2.5333	0.031	0.027	0.000	0.062
2.6000	0.031	0.028	0.000	0.062
2.6667	0.031	0.028	0.000	0.062
2.7333	0.031	0.029	0.000	0.062
2.8000	0.031	0.030	0.000	0.062
2.8667	0.031	0.031	0.000	0.062
2.9333	0.031	0.031	0.000	0.062
3.0000	0.031	0.032	0.000	0.062
3.0667	0.031	0.033	0.000	0.062
3.1333	0.031	0.034	0.000	0.062
3.2000	0.031	0.034	0.000	0.062
3.2667	0.031	0.035	0.000	0.062
3.3333	0.031	0.036	0.000	0.062
3.4000	0.031	0.036	0.000	0.062
3.4667	0.031	0.037	0.000	0.062
3.5333	0.031	0.038	0.000	0.062
3.6000	0.031	0.039	0.000	0.062
3.6667	0.031	0.039	0.000	0.062
3.7333	0.031	0.040	0.000	0.062
3.8000	0.031	0.041	0.000	0.062
3.8667	0.031	0.041	0.000	0.062
3.9333	0.031	0.042	0.000	0.062
4.0000	0.031	0.043	0.000	0.062
4.0667	0.031	0.044	0.182	0.062
4.1333	0.031	0.044	0.509	0.062
4.2000	0.031	0.045	0.907	0.062
4.2667	0.031	0.046	1.318	0.062
4.3333	0.031	0.047	1.683	0.062
4.4000	0.031	0.047	1.960	0.062
4.4667	0.031	0.048	2.138	0.062
4.5333	0.031	0.049	2.300	0.062
4.6000	0.031	0.049	2.439	0.062
4.6667	0.031	0.050	2.571	0.062
4.7333	0.031	0.051	2.697	0.062
4.8000	0.031	0.052	2.817	0.062
4.8667	0.031	0.052	2.932	0.062
4.9333	0.031	0.053	3.042	0.062
5.0000	0.031	0.054	3.149	0.062
5.0667	0.031	0.055	3.252	0.062
5.1333	0.031	0.055	3.353	0.062
5.2000	0.031	0.056	3.450	0.062
5.2667	0.031	0.057	3.544	0.062
5.3333	0.031	0.057	3.636	0.062
5.4000	0.031	0.058	3.726	0.062

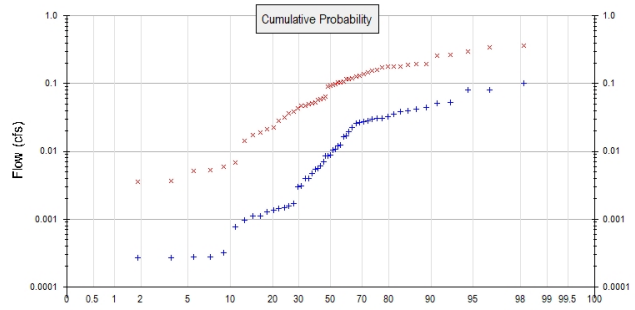
5.4667	0.031	0.059	3.814	0.062
5.5333	0.031	0.060	3.900	0.062
5.6000	0.031	0.060	3.984	0.062
5.6667	0.031	0.061	4.066	0.062
5.7333	0.031	0.062	4.146	0.062
5.8000	0.031	0.062	4.225	0.062
5.8667	0.031	0.063	4.303	0.062
5.9333	0.031	0.064	4.379	0.062
6.0000	0.031	0.065	4.454	0.062

Analysis Results

POC 1



+ Predeveloped x Mitigated



Predeveloped Landuse Totals for POC #1

Total Pervious Area: 0.341
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1

Total Pervious Area: 0.091
Total Impervious Area: 0.25

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.007507
5 year	0.029412
10 year	0.056407
25 year	0.107905
50 year	0.160105
100 year	0.224695

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.070579
5 year	0.199326
10 year	0.302374
25 year	0.433258
50 year	0.524072
100 year	0.606271

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	0.053	0.196
1957	0.005	0.176
1958	0.081	0.196
1959	0.019	0.099
1960	0.081	0.191
1961	0.039	0.120
1962	0.100	0.145
1963	0.030	0.266
1964	0.017	0.117
1965	0.009	0.019

1966	0.001	0.004
1967	0.004	0.061
1968	0.001	0.047
1969	0.004	0.022
1970	0.006	0.014
1971	0.036	0.053
1972	0.027	0.089
1973	0.001	0.064
1974	0.038	0.126
1975	0.041	0.180
1976	0.022	0.031
1977	0.000	0.006
1978	0.045	0.158
1979	0.001	0.058
1980	0.003	0.047
1981	0.005	0.049
1982	0.026	0.104
1983	0.011	0.096
1984	0.033	0.117
1985	0.001	0.051
1986	0.030	0.177
1987	0.002	0.129
1988	0.000	0.036
1989	0.001	0.005
1990	0.012	0.092
1991	0.028	0.028
1992	0.001	0.007
1993	0.007	0.018
1994	0.006	0.005
1995	0.002	0.153
1996	0.051	0.257
1997	0.012	0.108
1998	0.010	0.338
1999	0.001	0.021
2000	0.003	0.059
2001	0.000	0.000
2002	0.009	0.362
2003	0.000	0.295
2004	0.000	0.004
2005	0.000	0.043
2006	0.017	0.039
2007	0.028	0.179
2008	0.009	0.104
2009	0.030	0.139

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1002	0.3619
2	0.0813	0.3384
3	0.0807	0.2950
4	0.0530	0.2656
5	0.0509	0.2572
6	0.0450	0.1964
7	0.0415	0.1962
8	0.0393	0.1911
9	0.0385	0.1800
10	0.0359	0.1785

11	0.0326	0.1766
12	0.0305	0.1756
13	0.0304	0.1579
14	0.0295	0.1533
15	0.0281	0.1451
16	0.0276	0.1390
17	0.0267	0.1287
18	0.0262	0.1257
19	0.0224	0.1196
20	0.0194	0.1172
21	0.0167	0.1170
22	0.0166	0.1080
23	0.0123	0.1038
24	0.0119	0.1037
25	0.0107	0.0988
26	0.0104	0.0958
27	0.0088	0.0921
28	0.0086	0.0891
29	0.0085	0.0637
30	0.0071	0.0613
31	0.0061	0.0591
32	0.0056	0.0580
33	0.0054	0.0532
34	0.0048	0.0508
35	0.0040	0.0493
36	0.0039	0.0475
37	0.0031	0.0469
38	0.0030	0.0434
39	0.0017	0.0390
40	0.0016	0.0359
41	0.0015	0.0312
42	0.0014	0.0283
43	0.0013	0.0224
44	0.0013	0.0210
45	0.0011	0.0190
46	0.0011	0.0176
47	0.0010	0.0144
48	0.0008	0.0068
49	0.0003	0.0059
50	0.0003	0.0052
51	0.0003	0.0052
52	0.0003	0.0037
53	0.0003	0.0036
54	0.0002	0.0001

Duration Flows

The Duration Matching **Failed**

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0038	300	2071	690	Fail
0.0053	207	1685	814	Fail
0.0069	161	1438	893	Fail
0.0085	135	1246	922	Fail
0.0101	100	1109	1109	Fail
0.0117	81	1022	1261	Fail
0.0132	70	949	1355	Fail
0.0148	60	875	1458	Fail
0.0164	52	823	1582	Fail
0.0180	47	772	1642	Fail
0.0195	42	730	1738	Fail
0.0211	36	702	1950	Fail
0.0227	33	667	2021	Fail
0.0243	32	633	1978	Fail
0.0259	29	607	2093	Fail
0.0274	25	587	2348	Fail
0.0290	23	562	2443	Fail
0.0306	17	543	3194	Fail
0.0322	15	526	3506	Fail
0.0338	13	513	3946	Fail
0.0353	12	485	4041	Fail
0.0369	11	471	4281	Fail
0.0385	11	449	4081	Fail
0.0401	9	427	4744	Fail
0.0417	8	412	5150	Fail
0.0432	8	400	5000	Fail
0.0448	8	387	4837	Fail
0.0464	7	375	5357	Fail
0.0480	6	357	5950	Fail
0.0496	6	350	5833	Fail
0.0511	4	335	8375	Fail
0.0527	4	322	8050	Fail
0.0543	3	311	10366	Fail
0.0559	3	303	10100	Fail
0.0574	3	287	9566	Fail
0.0590	3	280	9333	Fail
0.0606	3	270	9000	Fail
0.0622	3	258	8600	Fail
0.0638	3	244	8133	Fail
0.0653	3	233	7766	Fail
0.0669	3	226	7533	Fail
0.0685	3	210	7000	Fail
0.0701	3	200	6666	Fail
0.0717	3	196	6533	Fail
0.0732	3	190	6333	Fail
0.0748	3	185	6166	Fail
0.0764	3	182	6066	Fail
0.0780	3	177	5900	Fail
0.0796	3	173	5766	Fail
0.0811	2	167	8350	Fail
0.0827	1	164	16400	Fail
0.0843	1	160	16000	Fail
0.0859	1	157	15700	Fail
0.0875	1	150	15000	Fail

0.0890	1	145	14500	Fail
0.0906	1	136	13600	Fail
0.0922	1	131	13100	Fail
0.0938	1	127	12700	Fail
0.0954	1	121	12100	Fail
0.0969	1	116	11600	Fail
0.0985	1	116	11600	Fail
0.1001	1	112	11200	Fail
0.1017	0	107	n/a	Fail
0.1032	0	103	n/a	Fail
0.1048	0	97	n/a	Fail
0.1064	0	95	n/a	Fail
0.1080	0	92	n/a	Fail
0.1096	0	87	n/a	Fail
0.1111	0	82	n/a	Fail
0.1127	0	80	n/a	Fail
0.1143	0	78	n/a	Fail
0.1159	0	78	n/a	Fail
0.1175	0	76	n/a	Fail
0.1190	0	73	n/a	Fail
0.1206	0	69	n/a	Fail
0.1222	0	64	n/a	Fail
0.1238	0	63	n/a	Fail
0.1254	0	62	n/a	Fail
0.1269	0	61	n/a	Fail
0.1285	0	61	n/a	Fail
0.1301	0	59	n/a	Fail
0.1317	0	57	n/a	Fail
0.1333	0	57	n/a	Fail
0.1348	0	54	n/a	Fail
0.1364	0	46	n/a	Fail
0.1380	0	45	n/a	Fail
0.1396	0	43	n/a	Fail
0.1412	0	40	n/a	Fail
0.1427	0	39	n/a	Fail
0.1443	0	36	n/a	Fail
0.1459	0	35	n/a	Fail
0.1475	0	35	n/a	Fail
0.1490	0	34	n/a	Fail
0.1506	0	32	n/a	Fail
0.1522	0	31	n/a	Fail
0.1538	0	27	n/a	Fail
0.1554	0	26	n/a	Fail
0.1569	0	26	n/a	Fail
0.1585	0	25	n/a	Fail
0.1601	0	24	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

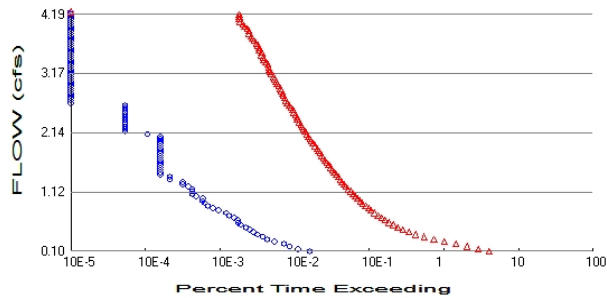
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

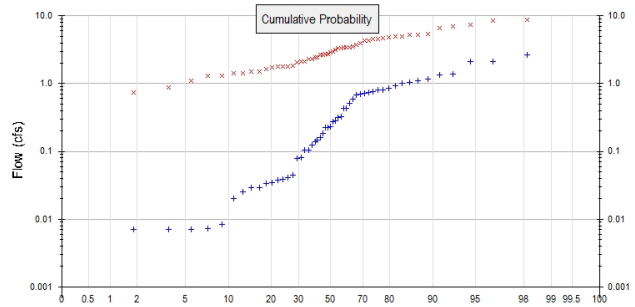
Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0 acre-feet
On-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.
Off-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.

POC 2



+ Predeveloped x Mitigated



Predeveloped Landuse Totals for POC #2

Total Pervious Area: 8.921
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2

Total Pervious Area: 4.645
Total Impervious Area: 4.276

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	0.196403
5 year	0.769448
10 year	1.475668
25 year	2.822928
50 year	4.188567
100 year	5.878319

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	2.868293
5 year	4.69185
10 year	5.932872
25 year	7.49532
50 year	8.640685
100 year	9.763214

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1956	1.386	5.348
1957	0.141	4.555
1958	2.128	4.802
1959	0.506	2.689
1960	2.111	5.210
1961	1.027	3.955
1962	2.621	4.530
1963	0.772	6.990
1964	0.433	3.370
1965	0.230	1.660
1966	0.029	1.497

1967	0.105	1.822
1968	0.020	1.439
1969	0.103	2.452
1970	0.147	1.738
1971	0.939	3.457
1972	0.698	2.448
1973	0.033	1.764
1974	1.007	4.317
1975	1.085	7.386
1976	0.586	3.305
1977	0.007	1.402
1978	1.177	4.325
1979	0.038	1.778
1980	0.078	2.286
1981	0.125	2.129
1982	0.685	3.376
1983	0.280	3.102
1984	0.854	3.385
1985	0.025	1.515
1986	0.796	4.936
1987	0.041	3.473
1988	0.008	2.117
1989	0.029	0.888
1990	0.312	2.615
1991	0.736	2.900
1992	0.038	1.318
1993	0.186	2.076
1994	0.161	1.110
1995	0.044	5.305
1996	1.331	6.563
1997	0.322	2.997
1998	0.273	8.364
1999	0.035	1.293
2000	0.080	2.319
2001	0.006	0.436
2002	0.224	8.813
2003	0.007	4.955
2004	0.007	0.737
2005	0.007	1.774
2006	0.437	2.765
2007	0.722	4.680
2008	0.223	2.746
2009	0.797	3.732

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	2.6209	8.8125
2	2.1275	8.3638
3	2.1106	7.3857
4	1.3857	6.9896
5	1.3312	6.5631
6	1.1770	5.3481
7	1.0854	5.3052
8	1.0275	5.2096
9	1.0070	4.9547
10	0.9390	4.9359
11	0.8536	4.8018

12	0.7972	4.6799
13	0.7962	4.5549
14	0.7719	4.5303
15	0.7358	4.3252
16	0.7224	4.3172
17	0.6975	3.9553
18	0.6848	3.7317
19	0.5862	3.4734
20	0.5064	3.4571
21	0.4371	3.3854
22	0.4334	3.3764
23	0.3224	3.3704
24	0.3116	3.3051
25	0.2799	3.1021
26	0.2728	2.9973
27	0.2299	2.8999
28	0.2244	2.7653
29	0.2229	2.7457
30	0.1855	2.6888
31	0.1607	2.6153
32	0.1466	2.4515
33	0.1406	2.4484
34	0.1249	2.3191
35	0.1050	2.2856
36	0.1033	2.1292
37	0.0804	2.1169
38	0.0784	2.0765
39	0.0444	1.8221
40	0.0408	1.7776
41	0.0384	1.7736
42	0.0376	1.7640
43	0.0349	1.7380
44	0.0332	1.6603
45	0.0294	1.5147
46	0.0288	1.4970
47	0.0255	1.4394
48	0.0201	1.4024
49	0.0083	1.3182
50	0.0072	1.2933
51	0.0071	1.1102
52	0.0071	0.8885
53	0.0071	0.7370
54	0.0064	0.4364

Duration Flows

The Duration Matching **Failed**

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0982	300	76687	25562	Fail
0.1395	207	54457	26307	Fail
0.1808	161	38646	24003	Fail
0.2222	135	27229	20169	Fail
0.2635	100	19257	19257	Fail
0.3048	81	13932	17200	Fail
0.3461	70	10282	14688	Fail
0.3874	60	7864	13106	Fail
0.4287	52	6415	12336	Fail
0.4701	47	5328	11336	Fail
0.5114	42	4565	10869	Fail
0.5527	36	3984	11066	Fail
0.5940	33	3475	10530	Fail
0.6353	32	3062	9568	Fail
0.6766	29	2772	9558	Fail
0.7180	25	2465	9860	Fail
0.7593	23	2212	9617	Fail
0.8006	18	1986	11033	Fail
0.8419	15	1842	12280	Fail
0.8832	13	1684	12953	Fail
0.9245	12	1544	12866	Fail
0.9659	11	1433	13027	Fail
1.0072	11	1313	11936	Fail
1.0485	9	1228	13644	Fail
1.0898	8	1147	14337	Fail
1.1311	8	1065	13312	Fail
1.1724	8	983	12287	Fail
1.2138	7	920	13142	Fail
1.2551	6	862	14366	Fail
1.2964	6	810	13500	Fail
1.3377	4	770	19250	Fail
1.3790	4	727	18175	Fail
1.4203	3	681	22700	Fail
1.4617	3	645	21500	Fail
1.5030	3	607	20233	Fail
1.5443	3	569	18966	Fail
1.5856	3	537	17900	Fail
1.6269	3	508	16933	Fail
1.6682	3	483	16100	Fail
1.7096	3	459	15300	Fail
1.7509	3	437	14566	Fail
1.7922	3	414	13800	Fail
1.8335	3	394	13133	Fail
1.8748	3	376	12533	Fail
1.9161	3	354	11800	Fail
1.9575	3	333	11100	Fail
1.9988	3	315	10500	Fail
2.0401	3	304	10133	Fail
2.0814	3	285	9500	Fail
2.1227	2	275	13750	Fail
2.1640	1	260	26000	Fail
2.2054	1	247	24700	Fail
2.2467	1	238	23800	Fail
2.2880	1	230	23000	Fail

2.3293	1	214	21400	Fail
2.3706	1	205	20500	Fail
2.4119	1	202	20200	Fail
2.4533	1	193	19300	Fail
2.4946	1	183	18300	Fail
2.5359	1	178	17800	Fail
2.5772	1	168	16800	Fail
2.6185	1	159	15900	Fail
2.6598	0	150	n/a	Fail
2.7012	0	143	n/a	Fail
2.7425	0	138	n/a	Fail
2.7838	0	132	n/a	Fail
2.8251	0	129	n/a	Fail
2.8664	0	126	n/a	Fail
2.9077	0	122	n/a	Fail
2.9491	0	116	n/a	Fail
2.9904	0	109	n/a	Fail
3.0317	0	106	n/a	Fail
3.0730	0	103	n/a	Fail
3.1143	0	98	n/a	Fail
3.1556	0	91	n/a	Fail
3.1970	0	88	n/a	Fail
3.2383	0	87	n/a	Fail
3.2796	0	85	n/a	Fail
3.3209	0	83	n/a	Fail
3.3622	0	78	n/a	Fail
3.4035	0	72	n/a	Fail
3.4449	0	72	n/a	Fail
3.4862	0	68	n/a	Fail
3.5275	0	68	n/a	Fail
3.5688	0	63	n/a	Fail
3.6101	0	63	n/a	Fail
3.6514	0	61	n/a	Fail
3.6928	0	58	n/a	Fail
3.7341	0	54	n/a	Fail
3.7754	0	51	n/a	Fail
3.8167	0	49	n/a	Fail
3.8580	0	46	n/a	Fail
3.8993	0	46	n/a	Fail
3.9407	0	44	n/a	Fail
3.9820	0	40	n/a	Fail
4.0233	0	38	n/a	Fail
4.0646	0	35	n/a	Fail
4.1059	0	34	n/a	Fail
4.1473	0	34	n/a	Fail
4.1886	0	34	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume: 0 acre-feet

On-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

Off-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

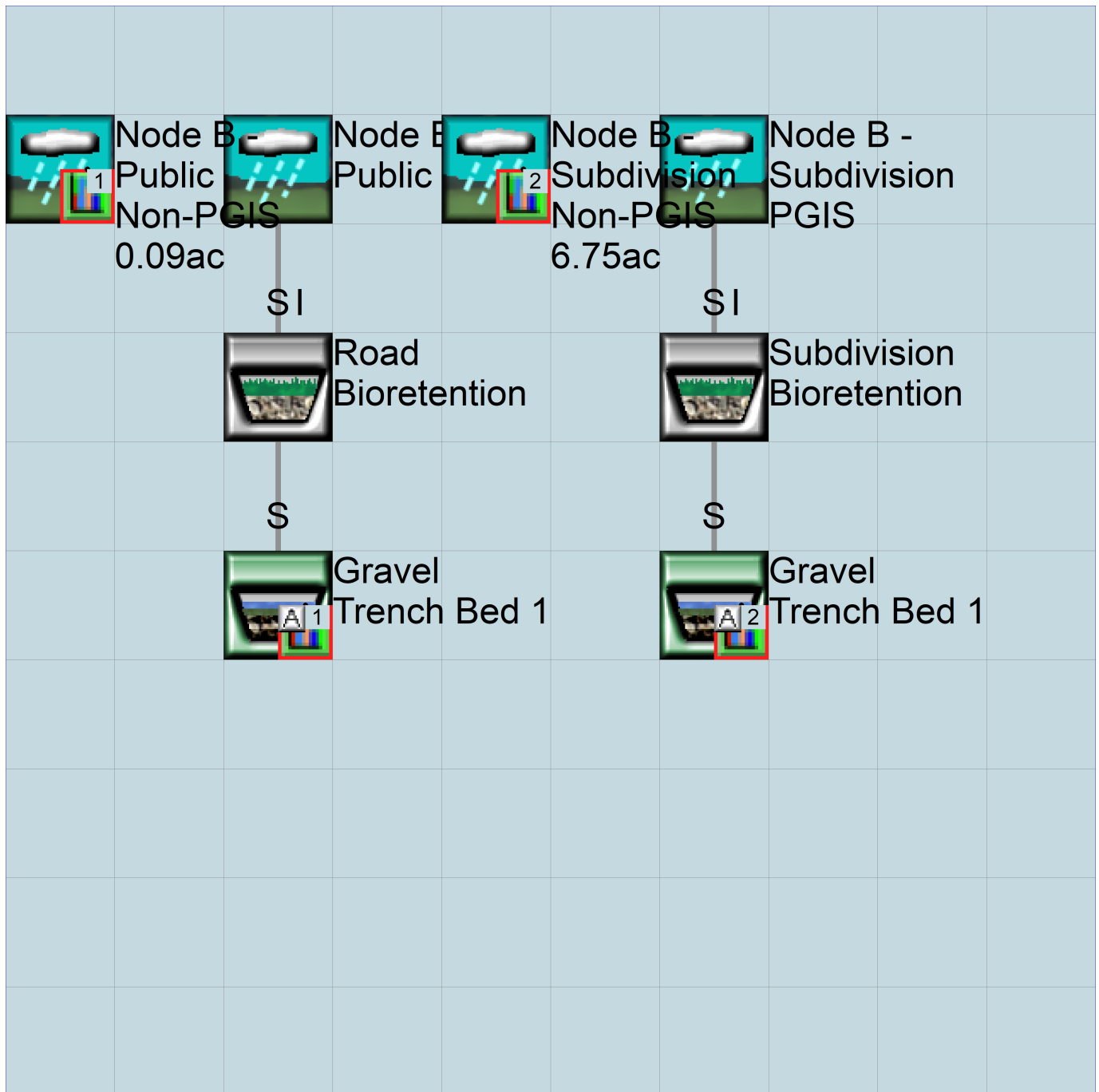


Node A
Existing
Public
0.34ac



Node A -
Existing C/F
8.92ac

Mitigated Schematic



Predeveloped UCI File

RUN

GLOBAL

```
WWM4 model simulation
START      1955 10 01      END      2009 09 30
RUN INTERP OUTPUT LEVEL    3      0
RESUME     0 RUN          1
UNIT SYSTEM                1
END GLOBAL
```

FILES

```
<File> <Un#> <-----File Name----->***
<-ID->                                     ***
WDM      26      18591_Node B.wdm
MESSU    25      Pre18591_Node B.MES
          27      Pre18591_Node B.L61
          28      Pre18591_Node B.L62
          30      POC18591_Node B1.dat
          31      POC18591_Node B2.dat
```

END FILES

OPN SEQUENCE

```
INGRP      INDELT 00:15
  PERLND      2
  COPY        501
  COPY        502
  DISPLY      1
  DISPLY      2
```

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INF01

```
# - #<-----Title----->***TRAN PIVL DIG1 FIL1 PYR DIG2 FIL2 YRND
  1      Node A - Existing Public      MAX      1      2      30      9
  2      Node A - Existng C/F          MAX      1      2      31      9
```

END DISPLY-INF01

END DISPLY

COPY

TIMESERIES

```
# - # NPT NMN ***
  1      1      1
  501     1      1
  502     1      1
```

END TIMESERIES

END COPY

GENER

OPCODE

```
#      # OPCD ***
```

END OPCODE

PARM

```
#      #      K ***
```

END PARM

END GENER

PERLND

GEN-INFO

```
<PLS ><-----Name----->NBLKS Unit-systems Printer ***
# - # User t-series Engl Metr ***
          in out
  2      A/B, Forest, Mod      1      1      1      1      27      0
```

END GEN-INFO

*** Section PWATER***

ACTIVITY

```
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC ***
  2      0      0      1      0      0      0      0      0      0      0      0
```

END ACTIVITY

PRINT-INFO

```

      <PLS > ***** Print-flags ***** PIVL  PYR
      # - # ATMP SNOW PWAT  SED  PST  PWG  PQAL MSTL PEST NITR PHOS TRAC *****
      2      0      0      4      0      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
      # - # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
      2      0      0      0      0      0      0      0      0      0      0      0
END PWAT-PARM1

PWAT-PARM2
<PLS > PWATER input info: Part 2 *****
      # - # ***FOREST  LZSN  INFILT  LSUR  SLSUR  KVARY  AGWRC
      2      0      5      2      400      0.1      0.3      0.996
END PWAT-PARM2

PWAT-PARM3
<PLS > PWATER input info: Part 3 *****
      # - # ***PETMAX  PETMIN  INFEXP  INFILD  DEEPFR  BASETP  AGWETP
      2      0      0      2      2      0      0      0
END PWAT-PARM3

PWAT-PARM4
<PLS > PWATER input info: Part 4 *****
      # - # CEPSC  UZSN  NSUR  INTFW  IRC  LZETP ***
      2      0.2      0.5      0.35      0      0.7      0.7
END PWAT-PARM4

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
      ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
      # - # *** CEPS  SURS  UZS  IFWS  LZS  AGWS  GWVS
      2      0      0      0      0      3      1      0
END PWAT-STATE1

END PERLND

IMPLND
GEN-INFO
<PLS ><-----Name-----> Unit-systems Printer ***
      # - # User t-series Engr Metr ***
                        in out ***
END GEN-INFO
*** Section IWATER***

ACTIVITY
<PLS > ***** Active Sections *****
      # - # ATMP SNOW IWAT  SLD  IWG IQAL ***
END ACTIVITY

PRINT-INFO
<ILS > ***** Print-flags ***** PIVL  PYR
      # - # ATMP SNOW IWAT  SLD  IWG IQAL *****
END PRINT-INFO

IWAT-PARM1
<PLS > IWATER variable monthly parameter value flags ***
      # - # CSNO RTOP VRS  VNN RTLI ***
END IWAT-PARM1

IWAT-PARM2
<PLS > IWATER input info: Part 2 *****
      # - # *** LSUR  SLSUR  NSUR  RETSC
END IWAT-PARM2

IWAT-PARM3
<PLS > IWATER input info: Part 3 *****
      # - # ***PETMAX  PETMIN
END IWAT-PARM3

```



```

IWAT-STATE1
  <PLS > *** Initial conditions at start of simulation
  # - # *** RETS      SURS
END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->
<Name> #
Node A - Existing Public***
PERLND 2 0.341 COPY 501 12
PERLND 2 0.341 COPY 501 13
Node A - Existng C/F***
PERLND 2 8.921 COPY 502 12
PERLND 2 8.921 COPY 502 13

*****Routing*****
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> # <Name> # #<-factor->strg <Name> # # <Name> # # ***
COPY 501 OUTPUT MEAN 1 1 48.4 DISPLY 1 INPUT TIMSER 1
COPY 502 OUTPUT MEAN 1 1 48.4 DISPLY 2 INPUT TIMSER 1

<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> # <Name> # #<-factor->strg <Name> # # <Name> # # ***
END NETWORK

RCHRES
GEN-INFO
  RCHRES Name Nexits Unit Systems Printer ***
  # - #<-----><----> User T-series Engl Metr LKFG ***
  in out
END GEN-INFO
*** Section RCHRES***

ACTIVITY
  <PLS > ***** Active Sections *****
  # - # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
END ACTIVITY

PRINT-INFO
  <PLS > ***** Print-flags ***** PIVL PYR
  # - # HYDR ADCA CONS HEAT SED GQL OXRX NUTR PLNK PHCB PIVL PYR *****
END PRINT-INFO

HYDR-PARM1
  RCHRES Flags for each HYDR Section ***
  # - # VC A1 A2 A3 ODFVFG for each *** ODGTFG for each FUNCT for each
  FG FG FG FG possible exit *** possible exit possible exit
  * * * * *
END HYDR-PARM1

HYDR-PARM2
  # - # FTABNO LEN DELTH STCOR KS DB50 ***
  <-----><-----><-----><-----><-----><----->
END HYDR-PARM2
HYDR-INIT
  RCHRES Initial conditions for each HYDR section ***
  # - # *** VOL Initial value of COLIND Initial value of OUTDGT
  *** ac-ft for each possible exit for each possible exit
  <-----><-----> <---><---><---><---><---> *** <---><---><---><---><--->
END HYDR-INIT
END RCHRES

SPEC-ACTIONS

```

END SPEC-ACTIONS
 FTABLES
 END FTABLES

EXT SOURCES

<-Volume->	<Member>	SsysSgap<-Mult-->Tran	<-Target	vols>	<-Grp>	<-Member->	***
<Name>	#	<Name> # tem strg<-factor->strg	<Name>	#	#	<Name> # #	***
WDM	2	PREC ENGL 1.429	PERLND	1	999	EXTNL PREC	
WDM	2	PREC ENGL 1.429	IMPLND	1	999	EXTNL PREC	
WDM	1	EVAP ENGL 0.76	PERLND	1	999	EXTNL PETINP	
WDM	1	EVAP ENGL 0.76	IMPLND	1	999	EXTNL PETINP	

END EXT SOURCES

EXT TARGETS

<-Volume->	<-Grp>	<-Member-><-Mult-->Tran	<-Volume->	<Member>	Tsys	Tgap	Amd	***
<Name>	#	<Name> # #<-factor->strg	<Name>	#	<Name>	tem	strg	strg***
COPY	501	OUTPUT MEAN 1 1 48.4	WDM	501	FLOW	ENGL	REPL	
COPY	502	OUTPUT MEAN 1 1 48.4	WDM	502	FLOW	ENGL	REPL	

END EXT TARGETS

MASS-LINK

<Volume>	<-Grp>	<-Member-><-Mult-->	<Target>	<-Grp>	<-Member->***
<Name>	#	<Name> # #<-factor->	<Name>	#	<Name> # #***
MASS-LINK		12			
PERLND	PWATER	SURO 0.083333	COPY	INPUT	MEAN
END MASS-LINK		12			
MASS-LINK		13			
PERLND	PWATER	IFWO 0.083333	COPY	INPUT	MEAN
END MASS-LINK		13			

END MASS-LINK

END RUN

Mitigated UCI File

RUN

GLOBAL

WWM4 model simulation
START 1955 10 01 END 2009 09 30
RUN INTERP OUTPUT LEVEL 3 0
RESUME 0 RUN 1 UNIT SYSTEM 1
END GLOBAL

FILES

<File>	<Un#>	<-----File Name----->	***
<-ID->			***
WDM	26	18591_Node B.wdm	
MESSU	25	Mit18591_Node B.MES	
	27	Mit18591_Node B.L61	
	28	Mit18591_Node B.L62	
	30	POC18591_Node B1.dat	
	31	POC18591_Node B2.dat	

END FILES

OPN SEQUENCE

INGRP INDELT 00:15

IMPLND	1
PERLND	8
IMPLND	4
RCHRES	1
RCHRES	2
RCHRES	3
RCHRES	4
RCHRES	5
RCHRES	6
COPY	1
COPY	501
COPY	601
COPY	2
COPY	502
COPY	602
DISPLY	1
DISPLY	2

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INF01

#	-	#	<-----Title----->	***	TRAN	PIVL	DIG1	FIL1	PYR	DIG2	FIL2	YRND
1			Gravel Trench Bed 1		MAX				1	2	30	9
2			Gravel Trench Bed 1		MAX				1	2	31	9

END DISPLY-INF01

END DISPLY

COPY

TIMESERIES

#	-	#	NPT	NMN	***
1			1	1	
501			1	1	
601			1	1	
2			1	1	
502			1	1	
602			1	1	

END TIMESERIES

END COPY

GENER

OPCODE

#	#	OPCD	***
---	---	------	-----

END OPCODE

PARM

#	#	K	***
---	---	---	-----

END PARM

END GENER

PERLND

```

GEN-INFO
<PLS ><-----Name----->NBLKS      Unit-systems      Printer ***
# - #      User      t-series      Engl Metr ***
                        in      out
8      A/B, Lawn, Mod      1      1      1      1      27      0
END GEN-INFO
*** Section PWATER***

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC ***
8      0      0      1      0      0      0      0      0      0      0      0      0
END ACTIVITY

PRINT-INFO
<PLS > ***** Print-flags ***** PIVL PYR
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC *****
8      0      0      4      0      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG VCS VUZ VNN VIFW VIRC VLE INFC HWT ***
8      0      0      0      0      0      0      0      0      0      0      0
END PWAT-PARM1

PWAT-PARM2
<PLS > PWATER input info: Part 2 ***
# - # ***FOREST LZSN INFILT LSUR SLSUR KVARY AGWRC
8      0      5      0.8      400      0.1      0.3      0.996
END PWAT-PARM2

PWAT-PARM3
<PLS > PWATER input info: Part 3 ***
# - # ***PETMAX PETMIN INFEXP INFILD DEEPFR BASETP AGWETP
8      0      0      2      2      0      0      0
END PWAT-PARM3
PWAT-PARM4
<PLS > PWATER input info: Part 4 ***
# - # CEPSC UZSN NSUR INTFW IRC LZETP ***
8      0.1      0.5      0.25      0      0.7      0.25
END PWAT-PARM4

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS SURS UZS IFWS LZS AGWS GWVS
8      0      0      0      0      3      1      0
END PWAT-STATE1

END PERLND

IMPLND
GEN-INFO
<PLS ><-----Name----->      Unit-systems      Printer ***
# - #      User      t-series      Engl Metr ***
                        in      out
1      ROADS/FLAT      1      1      1      27      0
4      ROOF TOPS/FLAT      1      1      1      27      0
END GEN-INFO
*** Section IWATER***

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT SLD IWG IQAL ***
1      0      0      1      0      0      0
4      0      0      1      0      0      0
END ACTIVITY

PRINT-INFO

```

```

<ILS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW IWAT  SLD  IWG IQAL  *****
1      0      0      4      0      0      4      1      9
4      0      0      4      0      0      0      1      9
END PRINT-INFO

```

```

IWAT-PARM1
<PLS >  IWATER variable monthly parameter value flags  ***
# - # CSNO RTOP  VRS  VNN RTLI  ***
1      0      0      0      0      0
4      0      0      0      0      0
END IWAT-PARM1

```

```

IWAT-PARM2
<PLS >      IWATER input info: Part 2      ***
# - # ***  LSUR      SLSUR      NSUR      RETSC
1      400      0.01      0.1      0.1
4      400      0.01      0.1      0.1
END IWAT-PARM2

```

```

IWAT-PARM3
<PLS >      IWATER input info: Part 3      ***
# - # ***PETMAX      PETMIN
1      0      0
4      0      0
END IWAT-PARM3

```

```

IWAT-STATE1
<PLS > *** Initial conditions at start of simulation
# - # ***  RETS      SURS
1      0      0
4      0      0
END IWAT-STATE1

```

END IMPLND

```

SCHEMATIC
<-Source->      <--Area-->      <-Target->      MBLK      ***
<Name>  #      <-factor->      <Name>  #      Tbl#      ***
Node B - Public PGIS***
IMPLND  1      0.25      RCHRES  1      5
Node B - Subdivision PGIS***
IMPLND  1      2.176      RCHRES  3      5
Node B - Public Non-PGIS***
PERLND  8      0.091      COPY  501      12
PERLND  8      0.091      COPY  601      12
PERLND  8      0.091      COPY  501      13
PERLND  8      0.091      COPY  601      13
Node B - Subdivision Non-PGIS***
PERLND  8      4.645      COPY  502      12
PERLND  8      4.645      COPY  602      12
PERLND  8      4.645      COPY  502      13
PERLND  8      4.645      COPY  602      13
IMPLND  4      2.1      COPY  502      15
IMPLND  4      2.1      COPY  602      15

```

```

*****Routing*****
RCHRES  1      1      RCHRES  5      7
RCHRES  1      1      COPY  1      17
RCHRES  1      1      RCHRES  2      8
RCHRES  3      1      RCHRES  6      7
RCHRES  3      1      COPY  2      17
RCHRES  3      1      RCHRES  4      8
RCHRES  5      1      COPY  501      17
RCHRES  6      1      COPY  502      17
END SCHEMATIC

```

```

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>  #      <Name>  #  <-factor->strg <Name>  #  #      <Name>  #  #      ***

```

COPY	501	OUTPUT	MEAN	1	1	48.4	DISPLY	1	INPUT	TIMSER	1
COPY	502	OUTPUT	MEAN	1	1	48.4	DISPLY	2	INPUT	TIMSER	1

```

<-Volume-> <-Grp> <-Member-><-Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> # <Name> # #<-factor->strg <Name> # # <Name> # # ***
END NETWORK

```

RCHRES

GEN-INFO

RCHRES	Name	Nexits	Unit	Systems	Printer			
# - #	<----->	<---->	User	T-series	Engl Metr	LKFG		
				in out				
1	Surface Bioreten-009	2	1	1 1	28 0	1		
2	Road Bioretentio-008	1	1	1 1	28 0	1		
3	Surface Bioreten-021	2	1	1 1	28 0	1		
4	Subdivision Bior-020	1	1	1 1	28 0	1		
5	Gravel Trench Be-022	2	1	1 1	28 0	1		
6	Gravel Trench Be-023	2	1	1 1	28 0	1		

END GEN-INFO

*** Section RCHRES***

ACTIVITY

```

<PLS > ***** Active Sections *****
# - # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
1      1      0      0      0      0      0      0      0      0      0
2      1      0      0      0      0      0      0      0      0      0
3      1      0      0      0      0      0      0      0      0      0
4      1      0      0      0      0      0      0      0      0      0
5      1      0      0      0      0      0      0      0      0      0
6      1      0      0      0      0      0      0      0      0      0

```

END ACTIVITY

PRINT-INFO

```

<PLS > ***** Print-flags ***** PIVL PYR *****
# - # HYDR ADCA CONS HEAT SED GQL OXRX NUTR PLNK PHCB PIVL PYR
1      4      0      0      0      0      0      0      0      0      0      1      9
2      4      0      0      0      0      0      0      0      0      0      1      9
3      4      0      0      0      0      0      0      0      0      0      1      9
4      4      0      0      0      0      0      0      0      0      0      1      9
5      4      0      0      0      0      0      0      0      0      0      1      9
6      4      0      0      0      0      0      0      0      0      0      1      9

```

END PRINT-INFO

HYDR-PARM1

RCHRES	Flags for each HYDR Section	ODGTFG for each	FUNCT for each
# - #	VC A1 A2 A3 ODFVFG for each possible exit	*** possible exit ***	possible exit
	FG FG FG FG	* * * * *	* * * * *
1	0 1 0 0 4 5 0 0 0	0 0 0 0 0	2 2 2 2 2
2	0 1 0 0 4 0 0 0 0	0 0 0 0 0	2 2 2 2 2
3	0 1 0 0 4 5 0 0 0	0 0 0 0 0	2 2 2 2 2
4	0 1 0 0 4 0 0 0 0	0 0 0 0 0	2 2 2 2 2
5	0 1 0 0 4 5 0 0 0	0 0 0 0 0	2 2 2 2 2
6	0 1 0 0 4 5 0 0 0	0 0 0 0 0	2 2 2 2 2

END HYDR-PARM1

HYDR-PARM2

# - #	FTABNO	LEN	DELTH	STCOR	KS	DB50
<----->	<----->	<----->	<----->	<----->	<----->	<----->
1	1	0.01	0.0	0.0	0.0	0.0
2	2	0.01	0.0	0.0	0.0	0.0
3	3	0.01	0.0	0.0	0.0	0.0
4	4	0.05	0.0	0.0	0.0	0.0
5	5	0.01	0.0	0.0	0.5	0.0
6	6	0.05	0.0	0.0	0.5	0.0

END HYDR-PARM2

HYDR-INIT

RCHRES Initial conditions for each HYDR section ***

#	-	# ***	VOL	Initial value of COLIND					Initial value of OUTDGT				
		***	ac-ft	for each possible exit					for each possible exit				
<----->	<----->	<----->	<----->	<----->	<----->	<----->	<----->	***	<----->	<----->	<----->	<----->	<----->
1			0	4.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2			0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3			0	4.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4			0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5			0	4.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6			0	4.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

END HYDR-INIT

END RCHRES

SPEC-ACTIONS

END SPEC-ACTIONS

FTABLES

FTABLE 2

70 4

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.004591	0.000000	0.000000		
0.043956	0.004591	0.000092	0.000000		
0.087912	0.004591	0.000185	0.000000		
0.131868	0.004591	0.000277	0.000000		
0.175824	0.004591	0.000369	0.000000		
0.219780	0.004591	0.000461	0.000127		
0.263736	0.004591	0.000554	0.000213		
0.307692	0.004591	0.000646	0.000329		
0.351648	0.004591	0.000738	0.000478		
0.395604	0.004591	0.000831	0.000665		
0.439560	0.004591	0.000923	0.000891		
0.483516	0.004591	0.001015	0.001160		
0.527473	0.004591	0.001107	0.001441		
0.571429	0.004591	0.001200	0.001475		
0.615385	0.004591	0.001292	0.001837		
0.659341	0.004591	0.001384	0.002250		
0.703297	0.004591	0.001477	0.002715		
0.747253	0.004591	0.001569	0.003234		
0.791209	0.004591	0.001661	0.003483		
0.835165	0.004591	0.001754	0.003810		
0.879121	0.004591	0.001846	0.004445		
0.923077	0.004591	0.001938	0.005140		
0.967033	0.004591	0.002030	0.005897		
1.010989	0.004591	0.002123	0.006668		
1.054945	0.004591	0.002215	0.006719		
1.098901	0.004591	0.002307	0.007606		
1.142857	0.004591	0.002400	0.008560		
1.186813	0.004591	0.002492	0.009584		
1.230769	0.004591	0.002584	0.010678		
1.274725	0.004591	0.002676	0.011158		
1.318681	0.004591	0.002769	0.011843		
1.362637	0.004591	0.002861	0.013083		
1.406593	0.004591	0.002953	0.014396		
1.450549	0.004591	0.003046	0.015786		
1.494505	0.004591	0.003138	0.017096		
1.538462	0.004591	0.003222	0.017253		
1.582418	0.004591	0.003305	0.018797		
1.626374	0.004591	0.003389	0.020420		
1.670330	0.004591	0.003473	0.022120		
1.714286	0.004591	0.003557	0.023897		
1.758242	0.004591	0.003640	0.024614		
1.802198	0.004591	0.003724	0.025745		
1.846154	0.004591	0.003808	0.027617		
1.890110	0.004591	0.003892	0.037037		
1.934066	0.004591	0.003975	0.037037		
1.978022	0.004591	0.004059	0.037037		
2.021978	0.004591	0.004143	0.037037		
2.065934	0.004591	0.004227	0.037037		
2.109890	0.004591	0.004310	0.037037		
2.153846	0.004591	0.004394	0.037037		
2.197802	0.004591	0.004478	0.037037		

2.241758	0.004591	0.004562	0.037037
2.285714	0.004591	0.004645	0.037037
2.329670	0.004591	0.004729	0.037037
2.373626	0.004591	0.004813	0.037037
2.417582	0.004591	0.004897	0.037037
2.461538	0.004591	0.004981	0.037037
2.505495	0.004591	0.005064	0.037037
2.549451	0.004591	0.005148	0.037037
2.593407	0.004591	0.005232	0.037037
2.637363	0.004591	0.005316	0.037037
2.681319	0.004591	0.005399	0.037037
2.725275	0.004591	0.005483	0.037037
2.769231	0.004591	0.005567	0.037037
2.813187	0.004591	0.005651	0.037037
2.857143	0.004591	0.005734	0.037037
2.901099	0.004591	0.005818	0.037037
2.945055	0.004591	0.005902	0.037037
2.989011	0.004591	0.005986	0.037037
3.000000	0.004591	0.006772	0.037037

END FTABLE 2
FTABLE 1

24	5						
Depth	Area	Volume	Outflow1	Outflow2	Velocity	Travel Time***	
(ft)	(acres)	(acre-ft)	(cfs)	(cfs)	(ft/sec)	(Minutes)***	
0.000000	0.004591	0.000000	0.000000	0.000000			
0.043956	0.004591	0.000202	0.000000	0.027778			
0.087912	0.004591	0.000404	0.000000	0.029406			
0.131868	0.004591	0.000605	0.000000	0.030220			
0.175824	0.004591	0.000807	0.000000	0.031034			
0.219780	0.004591	0.001009	0.000000	0.031848			
0.263736	0.004591	0.001211	0.000000	0.032662			
0.307692	0.004591	0.001413	0.000000	0.033476			
0.351648	0.004591	0.001615	0.000000	0.034290			
0.395604	0.004591	0.001816	0.000000	0.035104			
0.439560	0.004591	0.002018	0.000000	0.035918			
0.483516	0.004591	0.002220	0.000000	0.036732			
0.527473	0.004591	0.002422	0.048301	0.037037			
0.571429	0.004591	0.002624	0.202028	0.037037			
0.615385	0.004591	0.002825	0.412175	0.037037			
0.659341	0.004591	0.003027	0.659695	0.037037			
0.703297	0.004591	0.003229	0.928167	0.037037			
0.747253	0.004591	0.003431	1.200769	0.037037			
0.791209	0.004591	0.003633	1.460630	0.037037			
0.835165	0.004591	0.003835	1.692395	0.037037			
0.879121	0.004591	0.004036	1.884482	0.037037			
0.923077	0.004591	0.004238	2.031838	0.037037			
0.967033	0.004591	0.004440	2.139092	0.037037			
1.000000	0.004591	0.004591	2.251466	0.037037			

END FTABLE 1
FTABLE 4

70	4						
Depth	Area	Volume	Outflow1	Velocity	Travel Time***		
(ft)	(acres)	(acre-ft)	(cfs)	(ft/sec)	(Minutes)***		
0.000000	0.030992	0.000000	0.000000				
0.043956	0.030992	0.000623	0.000000				
0.087912	0.030992	0.001246	0.000000				
0.131868	0.030992	0.001869	0.000000				
0.175824	0.030992	0.002492	0.000000				
0.219780	0.030992	0.003115	0.000855				
0.263736	0.030992	0.003738	0.001435				
0.307692	0.030992	0.004361	0.002218				
0.351648	0.030992	0.004984	0.003227				
0.395604	0.030992	0.005607	0.004486				
0.439560	0.030992	0.006230	0.006015				
0.483516	0.030992	0.006853	0.007832				
0.527473	0.030992	0.007476	0.009728				
0.571429	0.030992	0.008099	0.009955				
0.615385	0.030992	0.008722	0.012401				
0.659341	0.030992	0.009345	0.015186				
0.703297	0.030992	0.009967	0.018325				

0.747253	0.030992	0.010590	0.021831
0.791209	0.030992	0.011213	0.023511
0.835165	0.030992	0.011836	0.025719
0.879121	0.030992	0.012459	0.030003
0.923077	0.030992	0.013082	0.034695
0.967033	0.030992	0.013705	0.039806
1.010989	0.030992	0.014328	0.045011
1.054945	0.030992	0.014951	0.045351
1.098901	0.030992	0.015574	0.051338
1.142857	0.030992	0.016197	0.057781
1.186813	0.030992	0.016820	0.064689
1.230769	0.030992	0.017443	0.072073
1.274725	0.030992	0.018066	0.075317
1.318681	0.030992	0.018689	0.079943
1.362637	0.030992	0.019312	0.088308
1.406593	0.030992	0.019935	0.097176
1.450549	0.030992	0.020558	0.106557
1.494505	0.030992	0.021181	0.115400
1.538462	0.030992	0.021746	0.116456
1.582418	0.030992	0.022312	0.126881
1.626374	0.030992	0.022877	0.137833
1.670330	0.030992	0.023442	0.149312
1.714286	0.030992	0.024008	0.161308
1.758242	0.030992	0.024573	0.166144
1.802198	0.030992	0.025138	0.173777
1.846154	0.030992	0.025704	0.186414
1.890110	0.030992	0.026269	0.250000
1.934066	0.030992	0.026834	0.250000
1.978022	0.030992	0.027400	0.250000
2.021978	0.030992	0.027965	0.250000
2.065934	0.030992	0.028530	0.250000
2.109890	0.030992	0.029096	0.250000
2.153846	0.030992	0.029661	0.250000
2.197802	0.030992	0.030226	0.250000
2.241758	0.030992	0.030792	0.250000
2.285714	0.030992	0.031357	0.250000
2.329670	0.030992	0.031922	0.250000
2.373626	0.030992	0.032488	0.250000
2.417582	0.030992	0.033053	0.250000
2.461538	0.030992	0.033618	0.250000
2.505495	0.030992	0.034184	0.250000
2.549451	0.030992	0.034749	0.250000
2.593407	0.030992	0.035315	0.250000
2.637363	0.030992	0.035880	0.250000
2.681319	0.030992	0.036445	0.250000
2.725275	0.030992	0.037011	0.250000
2.769231	0.030992	0.037576	0.250000
2.813187	0.030992	0.038141	0.250000
2.857143	0.030992	0.038707	0.250000
2.901099	0.030992	0.039272	0.250000
2.945055	0.030992	0.039837	0.250000
2.989011	0.030992	0.040403	0.250000
3.000000	0.030992	0.045709	0.250000

END FTABLE 4

FTABLE 3

24 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.030992	0.000000	0.000000	0.000000		
0.043956	0.030992	0.001362	0.000000	0.187500		
0.087912	0.030992	0.002725	0.000000	0.198489		
0.131868	0.030992	0.004087	0.000000	0.203984		
0.175824	0.030992	0.005449	0.000000	0.209478		
0.219780	0.030992	0.006811	0.000000	0.214973		
0.263736	0.030992	0.008174	0.000000	0.220467		
0.307692	0.030992	0.009536	0.000000	0.225962		
0.351648	0.030992	0.010898	0.000000	0.231456		
0.395604	0.030992	0.012260	0.000000	0.236951		
0.439560	0.030992	0.013623	0.000000	0.242445		
0.483516	0.030992	0.014985	0.000000	0.247940		

0.527473	0.030992	0.016347	0.048301	0.250000
0.571429	0.030992	0.017710	0.202028	0.250000
0.615385	0.030992	0.019072	0.412175	0.250000
0.659341	0.030992	0.020434	0.659695	0.250000
0.703297	0.030992	0.021796	0.928167	0.250000
0.747253	0.030992	0.023159	1.200769	0.250000
0.791209	0.030992	0.024521	1.460630	0.250000
0.835165	0.030992	0.025883	1.692395	0.250000
0.879121	0.030992	0.027245	1.884482	0.250000
0.923077	0.030992	0.028608	2.031838	0.250000
0.967033	0.030992	0.029970	2.139092	0.250000
1.000000	0.030992	0.030992	2.251466	0.250000

END FTABLE 3

FTABLE 5

92	5	Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.004591	0.000000	0.000000	0.000000	0.000000	0.009259		
0.055556	0.004591	0.000089	0.000000	0.000000	0.009259			
0.111111	0.004591	0.000179	0.000000	0.009259				
0.166667	0.004591	0.000268	0.000000	0.009259				
0.222222	0.004591	0.000357	0.000000	0.009259				
0.277778	0.004591	0.000446	0.000000	0.009259				
0.333333	0.004591	0.000536	0.000000	0.009259				
0.388889	0.004591	0.000625	0.000000	0.009259				
0.444444	0.004591	0.000714	0.000000	0.009259				
0.500000	0.004591	0.000803	0.000000	0.009259				
0.555556	0.004591	0.000893	0.000000	0.009259				
0.611111	0.004591	0.000982	0.000000	0.009259				
0.666667	0.004591	0.001071	0.000000	0.009259				
0.722222	0.004591	0.001161	0.000000	0.009259				
0.777778	0.004591	0.001250	0.000000	0.009259				
0.833333	0.004591	0.001339	0.000000	0.009259				
0.888889	0.004591	0.001428	0.000000	0.009259				
0.944444	0.004591	0.001518	0.000000	0.009259				
1.000000	0.004591	0.001607	0.000000	0.009259				
1.055556	0.004591	0.001696	0.000000	0.009259				
1.111111	0.004591	0.001786	0.000000	0.009259				
1.166667	0.004591	0.001875	0.000000	0.009259				
1.222222	0.004591	0.001964	0.000000	0.009259				
1.277778	0.004591	0.002053	0.000000	0.009259				
1.333333	0.004591	0.002143	0.000000	0.009259				
1.388889	0.004591	0.002232	0.000000	0.009259				
1.444444	0.004591	0.002321	0.000000	0.009259				
1.500000	0.004591	0.002410	0.000000	0.009259				
1.555556	0.004591	0.002500	0.000000	0.009259				
1.611111	0.004591	0.002589	0.000000	0.009259				
1.666667	0.004591	0.002678	0.000000	0.009259				
1.722222	0.004591	0.002768	0.000000	0.009259				
1.777778	0.004591	0.002857	0.000000	0.009259				
1.833333	0.004591	0.002946	0.000000	0.009259				
1.888889	0.004591	0.003035	0.000000	0.009259				
1.944444	0.004591	0.003125	0.000000	0.009259				
2.000000	0.004591	0.003214	0.000000	0.009259				
2.055556	0.004591	0.003303	0.000000	0.009259				
2.111111	0.004591	0.003393	0.000000	0.009259				
2.166667	0.004591	0.003482	0.000000	0.009259				
2.222222	0.004591	0.003571	0.000000	0.009259				
2.277778	0.004591	0.003660	0.000000	0.009259				
2.333333	0.004591	0.003750	0.000000	0.009259				
2.388889	0.004591	0.003839	0.000000	0.009259				
2.444444	0.004591	0.003928	0.000000	0.009259				
2.500000	0.004591	0.004017	0.000000	0.009259				
2.555556	0.004591	0.004107	0.000000	0.009259				
2.611111	0.004591	0.004196	0.000000	0.009259				
2.666667	0.004591	0.004285	0.000000	0.009259				
2.722222	0.004591	0.004375	0.000000	0.009259				
2.777778	0.004591	0.004464	0.000000	0.009259				
2.833333	0.004591	0.004553	0.000000	0.009259				
2.888889	0.004591	0.004642	0.000000	0.009259				

2.944444	0.004591	0.004732	0.000000	0.009259
3.000000	0.004591	0.004821	0.000000	0.009259
3.055556	0.004591	0.004910	0.138729	0.009259
3.111111	0.004591	0.004999	0.389839	0.009259
3.166667	0.004591	0.005089	0.703432	0.009259
3.222222	0.004591	0.005178	1.046030	0.009259
3.277778	0.004591	0.005267	1.383552	0.009259
3.333333	0.004591	0.005357	1.683468	0.009259
3.388889	0.004591	0.005446	1.921105	0.009259
3.444444	0.004591	0.005535	2.088233	0.009259
3.500000	0.004591	0.005624	2.203335	0.009259
3.555556	0.004591	0.005714	2.347596	0.009259
3.611111	0.004591	0.005803	2.462179	0.009259
3.666667	0.004591	0.005892	2.571662	0.009259
3.722222	0.004591	0.005982	2.676671	0.009259
3.777778	0.004591	0.006071	2.777713	0.009259
3.833333	0.004591	0.006160	2.875206	0.009259
3.888889	0.004591	0.006249	2.969500	0.009259
3.944444	0.004591	0.006339	3.060890	0.009259
4.000000	0.004591	0.006428	3.149630	0.009259
4.055556	0.004591	0.006517	3.235937	0.009259
4.111111	0.004591	0.006606	3.320002	0.009259
4.166667	0.004591	0.006696	3.401989	0.009259
4.222222	0.004591	0.006785	3.482047	0.009259
4.277778	0.004591	0.006874	3.560305	0.009259
4.333333	0.004591	0.006964	3.636879	0.009259
4.388889	0.004591	0.007053	3.711875	0.009259
4.444444	0.004591	0.007142	3.785384	0.009259
4.500000	0.004591	0.007231	3.857493	0.009259
4.555556	0.004591	0.007321	3.928279	0.009259
4.611111	0.004591	0.007410	3.997811	0.009259
4.666667	0.004591	0.007499	4.066155	0.009259
4.722222	0.004591	0.007589	4.133369	0.009259
4.777778	0.004591	0.007678	4.199507	0.009259
4.833333	0.004591	0.007767	4.264619	0.009259
4.888889	0.004591	0.007856	4.328752	0.009259
4.944444	0.004591	0.007946	4.391949	0.009259
5.000000	0.004591	0.008035	4.454250	0.009259
5.055556	0.004591	0.008290	4.515690	0.009259

END FTABLE 5

FTABLE 6

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.030992	0.000000	0.000000	0.000000		
0.066667	0.030992	0.000723	0.000000	0.062500		
0.133333	0.030992	0.001446	0.000000	0.062500		
0.200000	0.030992	0.002169	0.000000	0.062500		
0.266667	0.030992	0.002893	0.000000	0.062500		
0.333333	0.030992	0.003616	0.000000	0.062500		
0.400000	0.030992	0.004339	0.000000	0.062500		
0.466667	0.030992	0.005062	0.000000	0.062500		
0.533333	0.030992	0.005785	0.000000	0.062500		
0.600000	0.030992	0.006508	0.000000	0.062500		
0.666667	0.030992	0.007231	0.000000	0.062500		
0.733333	0.030992	0.007955	0.000000	0.062500		
0.800000	0.030992	0.008678	0.000000	0.062500		
0.866667	0.030992	0.009401	0.000000	0.062500		
0.933333	0.030992	0.010124	0.000000	0.062500		
1.000000	0.030992	0.010847	0.000000	0.062500		
1.066667	0.030992	0.011570	0.000000	0.062500		
1.133333	0.030992	0.012293	0.000000	0.062500		
1.200000	0.030992	0.013017	0.000000	0.062500		
1.266667	0.030992	0.013740	0.000000	0.062500		
1.333333	0.030992	0.014463	0.000000	0.062500		
1.400000	0.030992	0.015186	0.000000	0.062500		
1.466667	0.030992	0.015909	0.000000	0.062500		
1.533333	0.030992	0.016632	0.000000	0.062500		
1.600000	0.030992	0.017355	0.000000	0.062500		
1.666667	0.030992	0.018079	0.000000	0.062500		

1.733333	0.030992	0.018802	0.000000	0.062500
1.800000	0.030992	0.019525	0.000000	0.062500
1.866667	0.030992	0.020248	0.000000	0.062500
1.933333	0.030992	0.020971	0.000000	0.062500
2.000000	0.030992	0.021694	0.000000	0.062500
2.066667	0.030992	0.022417	0.000000	0.062500
2.133333	0.030992	0.023140	0.000000	0.062500
2.200000	0.030992	0.023864	0.000000	0.062500
2.266667	0.030992	0.024587	0.000000	0.062500
2.333333	0.030992	0.025310	0.000000	0.062500
2.400000	0.030992	0.026033	0.000000	0.062500
2.466667	0.030992	0.026756	0.000000	0.062500
2.533333	0.030992	0.027479	0.000000	0.062500
2.600000	0.030992	0.028202	0.000000	0.062500
2.666667	0.030992	0.028926	0.000000	0.062500
2.733333	0.030992	0.029649	0.000000	0.062500
2.800000	0.030992	0.030372	0.000000	0.062500
2.866667	0.030992	0.031095	0.000000	0.062500
2.933333	0.030992	0.031818	0.000000	0.062500
3.000000	0.030992	0.032541	0.000000	0.062500
3.066667	0.030992	0.033264	0.000000	0.062500
3.133333	0.030992	0.033988	0.000000	0.062500
3.200000	0.030992	0.034711	0.000000	0.062500
3.266667	0.030992	0.035434	0.000000	0.062500
3.333333	0.030992	0.036157	0.000000	0.062500
3.400000	0.030992	0.036880	0.000000	0.062500
3.466667	0.030992	0.037603	0.000000	0.062500
3.533333	0.030992	0.038326	0.000000	0.062500
3.600000	0.030992	0.039050	0.000000	0.062500
3.666667	0.030992	0.039773	0.000000	0.062500
3.733333	0.030992	0.040496	0.000000	0.062500
3.800000	0.030992	0.041219	0.000000	0.062500
3.866667	0.030992	0.041942	0.000000	0.062500
3.933333	0.030992	0.042665	0.000000	0.062500
4.000000	0.030992	0.043388	0.000000	0.062500
4.066667	0.030992	0.044112	0.182234	0.062500
4.133333	0.030992	0.044835	0.509662	0.062500
4.200000	0.030992	0.045558	0.907676	0.062500
4.266667	0.030992	0.046281	1.318080	0.062500
4.333333	0.030992	0.047004	1.683468	0.062500
4.400000	0.030992	0.047727	1.960035	0.062500
4.466667	0.030992	0.048450	2.138326	0.062500
4.533333	0.030992	0.049174	2.300165	0.062500
4.600000	0.030992	0.049897	2.439693	0.062500
4.666667	0.030992	0.050620	2.571662	0.062500
4.733333	0.030992	0.051343	2.697182	0.062500
4.800000	0.030992	0.052066	2.817115	0.062500
4.866667	0.030992	0.052789	2.932146	0.062500
4.933333	0.030992	0.053512	3.042832	0.062500
5.000000	0.030992	0.054236	3.149630	0.062500
5.066667	0.030992	0.054959	3.252924	0.062500
5.133333	0.030992	0.055682	3.353037	0.062500
5.200000	0.030992	0.056405	3.450247	0.062500
5.266667	0.030992	0.057128	3.544792	0.062500
5.333333	0.030992	0.057851	3.636879	0.062500
5.400000	0.030992	0.058574	3.726693	0.062500
5.466667	0.030992	0.059298	3.814391	0.062500
5.533333	0.030992	0.060021	3.900119	0.062500
5.600000	0.030992	0.060744	3.984002	0.062500
5.666667	0.030992	0.061467	4.066155	0.062500
5.733333	0.030992	0.062190	4.146681	0.062500
5.800000	0.030992	0.062913	4.225672	0.062500
5.866667	0.030992	0.063636	4.303214	0.062500
5.933333	0.030992	0.064360	4.379383	0.062500
6.000000	0.030992	0.065083	4.454250	0.062500
6.066667	0.030992	0.065806	4.527878	0.062500

END FTABLE 6

END FTABLES

EXT SOURCES

<-Volume->	<Member>	SsysSgap	<-Mult-->Tran	<-Target	vols>	<-Grp>	<-Member->	***
<Name>	#	<Name>	#	tem strg	<-factor-->strg	<Name>	#	#
WDM	2	PREC	ENGL	1.429		PERLND	1	999
WDM	2	PREC	ENGL	1.429		IMPLND	1	999
WDM	1	EVAP	ENGL	0.76		PERLND	1	999
WDM	1	EVAP	ENGL	0.76		IMPLND	1	999
WDM	2	PREC	ENGL	1.429		RCHRES	1	
WDM	2	PREC	ENGL	1.429		RCHRES	3	
WDM	1	EVAP	ENGL	0.5		RCHRES	1	
WDM	1	EVAP	ENGL	0.76		RCHRES	2	
WDM	1	EVAP	ENGL	0.5		RCHRES	3	
WDM	1	EVAP	ENGL	0.76		RCHRES	4	

END EXT SOURCES

EXT TARGETS

<-Volume->	<-Grp>	<-Member->	<-Mult-->Tran	<-Volume->	<Member>	Tsys	Tgap	Amd	***
<Name>	#	<Name>	#	tem strg	<-factor-->strg	<Name>	#	<Name>	tem strg
COPY	1	OUTPUT	MEAN	1	1	48.4		WDM	701
COPY	501	OUTPUT	MEAN	1	1	48.4		WDM	801
COPY	601	OUTPUT	MEAN	1	1	48.4		WDM	901
COPY	2	OUTPUT	MEAN	1	1	48.4		WDM	702
COPY	502	OUTPUT	MEAN	1	1	48.4		WDM	802
COPY	602	OUTPUT	MEAN	1	1	48.4		WDM	902
RCHRES	5	HYDR	RO	1	1	1		WDM	1020
RCHRES	5	HYDR	0	1	1	1		WDM	1021
RCHRES	5	HYDR	0	2	1	1		WDM	1022
RCHRES	5	HYDR	STAGE	1	1	1		WDM	1023
RCHRES	6	HYDR	RO	1	1	1		WDM	1024
RCHRES	6	HYDR	0	1	1	1		WDM	1025
RCHRES	6	HYDR	0	2	1	1		WDM	1026
RCHRES	6	HYDR	STAGE	1	1	1		WDM	1027

MASS-LINK

<Volume>	<-Grp>	<-Member->	<-Mult-->	<Target>	<-Grp>	<-Member->	***
<Name>	#	<Name>	#	<-factor-->	<Name>	#	#
MASS-LINK		5					
IMPLND	IWATER	SURO		0.083333	RCHRES	INFLOW	IVOL
END MASS-LINK		5					
MASS-LINK		7					
RCHRES	OFLOW	OVOL	1		RCHRES	INFLOW	IVOL
END MASS-LINK		7					
MASS-LINK		8					
RCHRES	OFLOW	OVOL	2		RCHRES	INFLOW	IVOL
END MASS-LINK		8					
MASS-LINK		12					
PERLND	PWATER	SURO		0.083333	COPY	INPUT	MEAN
END MASS-LINK		12					
MASS-LINK		13					
PERLND	PWATER	IFWO		0.083333	COPY	INPUT	MEAN
END MASS-LINK		13					
MASS-LINK		15					
IMPLND	IWATER	SURO		0.083333	COPY	INPUT	MEAN
END MASS-LINK		15					
MASS-LINK		17					
RCHRES	OFLOW	OVOL	1		COPY	INPUT	MEAN
END MASS-LINK		17					

END MASS-LINK

END RUN

Mitigated HSPF Message File

ERROR/WARNING ID: 341 6

DATE/TIME: 1997/10/30 11: 0

RCHRES: 3

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
24 1305.5	1350.0	1360.1	

ERROR/WARNING ID: 341 5

DATE/TIME: 1997/10/30 11: 0

RCHRES: 3

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT	
0.0000E+00	2700.0	-3.311E+03	1.2262	1.2262		2

ERROR/WARNING ID: 341 6

DATE/TIME: 2002/ 1/ 6 17: 0

RCHRES: 3

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
24 1305.5	1350.0	1447.7	

ERROR/WARNING ID: 341 5

DATE/TIME: 2002/ 1/ 6 17: 0

RCHRES: 3

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT	
0.0000E+00	2700.0	-8.625E+03	3.1945	3.1945E+00		2

ERROR/WARNING ID: 341 6

DATE/TIME: 2002/10/19 15: 0

RCHRES: 3

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
24	1.3055E+03	1350.0	1458.0

ERROR/WARNING ID: 341 5

DATE/TIME: 2002/10/19 15: 0

RCHRES: 3

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	2700.0	-9.248E+03	3.4253	3.4253E+00	2

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WWHM2012
PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node C

Site Name: LOTC

Site Address:

City: Castle Rock, WA

Report Date: 1/21/2025

Gage: Longview

Data Start: 1955/10/01

Data End: 2009/09/30

Timestep: 15 Minute

Precip Scale: 1.429

Version Date: 2024/06/28

Version: 4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
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High Flow Threshold for POC1:	50 Year
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Low Flow Threshold for POC2:	50 Percent of the 2 Year
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High Flow Threshold for POC2:	50 Year
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Landuse Basin Data

Predeveloped Land Use

Node C - Existing Public

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	0.949
Pervious Total	0.949
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.949

Element Flow Componentants:

Surface	Interflow	Groundwater
Component Flows To:		
POC 1	POC 1	

Node C - Existng Flex

Bypass: No

GroundWater: No

Pervious Land Use acre
A B, Forest, Mod 3.063

Pervious Total 3.063

Impervious Land Use acre

Impervious Total 0

Basin Total 3.063

Element Flow Componants:

Surface Interflow

Componant Flows To:

POC 2 POC 2

Groundwater

Mitigated Land Use

Node C - Public PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.71
Impervious Total	0.71
Basin Total	0.71

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Surface Bioretention	Surface Bioretention	

Node C - Flex PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1.685
Impervious Total	1.685
Basin Total	1.685

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Surface Bioretention	Surface Bioretention	

Node C - Public Non-PGIS

Bypass: Yes

GroundWater: No

Pervious Land Use acre
A B, Lawn, Mod 0.239

Pervious Total 0.239

Impervious Land Use acre

Impervious Total 0

Basin Total 0.239

Element Flow Components:

Surface Interflow

Groundwater

Component Flows To:

POC 1 POC 1

Node C - Flex Non-PGIS

Bypass: Yes

GroundWater: No

Pervious Land Use acre
A B, Lawn, Mod 0.306

Pervious Total 0.306

Impervious Land Use acre
ROOF TOPS FLAT 1.072

Impervious Total 1.072

Basin Total 1.378

Element Flow Componants:

Surface Interflow

Componant Flows To:

POC 2 POC 2

Groundwater

Routing Elements

Predeveloped Routing

Mitigated Routing

Road Bioretention

Bottom Length: 120.00 ft.
 Bottom Width: 5.00 ft.
 Material thickness of first layer: 1.5
 Material type for first layer: SMMWW 12 in/hr
 Material thickness of second layer: 1.5
 Material type for second layer: GRAVEL
 Material thickness of third layer: 0
 Material type for third layer: GRAVEL
 Underdrain used
 Underdrain Diameter (feet): 1
 Orifice Diameter (in.): 12
 Offset (in.): 0
 Flow Through Underdrain (ac-ft.): 163.644
 Total Outflow (ac-ft.): 170.904
 Percent Through Underdrain: 95.75
 Discharge Structure
 Riser Height: 0.5 ft.
 Riser Diameter: 12 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:
 Gravel Trench Bed 2

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0138	0.0000	0.0000	0.0000
0.0440	0.0138	0.0003	0.0000	0.0000
0.0879	0.0138	0.0006	0.0000	0.0000
0.1319	0.0138	0.0008	0.0000	0.0000
0.1758	0.0138	0.0011	0.0000	0.0000
0.2198	0.0138	0.0014	0.0004	0.0000
0.2637	0.0138	0.0017	0.0006	0.0000
0.3077	0.0138	0.0019	0.0010	0.0000
0.3516	0.0138	0.0022	0.0014	0.0000
0.3956	0.0138	0.0025	0.0020	0.0000
0.4396	0.0138	0.0028	0.0027	0.0000
0.4835	0.0138	0.0030	0.0035	0.0000
0.5275	0.0138	0.0033	0.0043	0.0000
0.5714	0.0138	0.0036	0.0044	0.0000
0.6154	0.0138	0.0039	0.0055	0.0000
0.6593	0.0138	0.0042	0.0067	0.0000
0.7033	0.0138	0.0044	0.0081	0.0000
0.7473	0.0138	0.0047	0.0097	0.0000
0.7912	0.0138	0.0050	0.0104	0.0000
0.8352	0.0138	0.0053	0.0114	0.0000
0.8791	0.0138	0.0055	0.0133	0.0000
0.9231	0.0138	0.0058	0.0154	0.0000
0.9670	0.0138	0.0061	0.0177	0.0000
1.0110	0.0138	0.0064	0.0200	0.0000
1.0549	0.0138	0.0066	0.0202	0.0000
1.0989	0.0138	0.0069	0.0228	0.0000
1.1429	0.0138	0.0072	0.0257	0.0000
1.1868	0.0138	0.0075	0.0288	0.0000

1.2308	0.0138	0.0078	0.0320	0.0000
1.2747	0.0138	0.0080	0.0335	0.0000
1.3187	0.0138	0.0083	0.0355	0.0000
1.3626	0.0138	0.0086	0.0392	0.0000
1.4066	0.0138	0.0089	0.0432	0.0000
1.4505	0.0138	0.0091	0.0474	0.0000
1.4945	0.0138	0.0094	0.0513	0.0000
1.5385	0.0138	0.0097	0.0518	0.0000
1.5824	0.0138	0.0099	0.0564	0.0000
1.6264	0.0138	0.0102	0.0613	0.0000
1.6703	0.0138	0.0104	0.0664	0.0000
1.7143	0.0138	0.0107	0.0717	0.0000
1.7582	0.0138	0.0109	0.0738	0.0000
1.8022	0.0138	0.0112	0.0772	0.0000
1.8462	0.0138	0.0114	0.0829	0.0000
1.8901	0.0138	0.0117	0.1111	0.0000
1.9341	0.0138	0.0119	0.1111	0.0000
1.9780	0.0138	0.0122	0.1111	0.0000
2.0220	0.0138	0.0124	0.1111	0.0000
2.0659	0.0138	0.0127	0.1111	0.0000
2.1099	0.0138	0.0129	0.1111	0.0000
2.1538	0.0138	0.0132	0.1111	0.0000
2.1978	0.0138	0.0134	0.1111	0.0000
2.2418	0.0138	0.0137	0.1111	0.0000
2.2857	0.0138	0.0139	0.1111	0.0000
2.3297	0.0138	0.0142	0.1111	0.0000
2.3736	0.0138	0.0144	0.1111	0.0000
2.4176	0.0138	0.0147	0.1111	0.0000
2.4615	0.0138	0.0149	0.1111	0.0000
2.5055	0.0138	0.0152	0.1111	0.0000
2.5495	0.0138	0.0154	0.1111	0.0000
2.5934	0.0138	0.0157	0.1111	0.0000
2.6374	0.0138	0.0159	0.1111	0.0000
2.6813	0.0138	0.0162	0.1111	0.0000
2.7253	0.0138	0.0164	0.1111	0.0000
2.7692	0.0138	0.0167	0.1111	0.0000
2.8132	0.0138	0.0170	0.1111	0.0000
2.8571	0.0138	0.0172	0.1111	0.0000
2.9011	0.0138	0.0175	0.1111	0.0000
2.9451	0.0138	0.0177	0.1111	0.0000
2.9890	0.0138	0.0180	0.1111	0.0000
3.0000	0.0138	0.0180	0.1111	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac.-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0138	0.0180	0.0000	0.0833	0.0000
3.0440	0.0138	0.0186	0.0000	0.0833	0.0000
3.0879	0.0138	0.0192	0.0000	0.0882	0.0000
3.1319	0.0138	0.0198	0.0000	0.0907	0.0000
3.1758	0.0138	0.0204	0.0000	0.0931	0.0000
3.2198	0.0138	0.0210	0.0000	0.0955	0.0000
3.2637	0.0138	0.0217	0.0000	0.0980	0.0000
3.3077	0.0138	0.0223	0.0000	0.1004	0.0000
3.3516	0.0138	0.0229	0.0000	0.1029	0.0000
3.3956	0.0138	0.0235	0.0000	0.1053	0.0000
3.4396	0.0138	0.0241	0.0000	0.1078	0.0000
3.4835	0.0138	0.0247	0.0000	0.1102	0.0000
3.5275	0.0138	0.0253	0.0483	0.1111	0.0000

3.5714	0.0138	0.0259	0.2020	0.1111	0.0000
3.6154	0.0138	0.0265	0.4122	0.1111	0.0000
3.6593	0.0138	0.0271	0.6597	0.1111	0.0000
3.7033	0.0138	0.0277	0.9282	0.1111	0.0000
3.7473	0.0138	0.0283	1.2008	0.1111	0.0000
3.7912	0.0138	0.0289	1.4606	0.1111	0.0000
3.8352	0.0138	0.0295	1.6924	0.1111	0.0000
3.8791	0.0138	0.0301	1.8845	0.1111	0.0000
3.9231	0.0138	0.0307	2.0318	0.1111	0.0000
3.9670	0.0138	0.0313	2.1391	0.1111	0.0000
4.0000	0.0138	0.0318	2.2515	0.1111	0.0000

Commerical/Flex Bioretention

Bottom Length: 60.00 ft.
 Bottom Width: 20.00 ft.
 Material thickness of first layer: 1.5
 Material type for first layer: SMMWW 12 in/hr
 Material thickness of second layer: 1.5
 Material type for second layer: GRAVEL
 Material thickness of third layer: 0
 Material type for third layer: GRAVEL
 Underdrain used
 Underdrain Diameter (feet): 1
 Orifice Diameter (in.): 12
 Offset (in.): 0
 Flow Through Underdrain (ac-ft.): 392.553
 Total Outflow (ac-ft.): 404.757
 Percent Through Underdrain: 96.98
 Discharge Structure
 Riser Height: 1 ft.
 Riser Diameter: 24 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:
 Road Infiltration Trench

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0275	0.0000	0.0000	0.0000
0.0549	0.0275	0.0007	0.0000	0.0000
0.1099	0.0275	0.0014	0.0000	0.0000
0.1648	0.0275	0.0021	0.0000	0.0000
0.2198	0.0275	0.0028	0.0011	0.0000
0.2747	0.0275	0.0035	0.0020	0.0000
0.3297	0.0275	0.0042	0.0031	0.0000
0.3846	0.0275	0.0048	0.0033	0.0000
0.4396	0.0275	0.0055	0.0046	0.0000
0.4945	0.0275	0.0062	0.0065	0.0000
0.5495	0.0275	0.0069	0.0088	0.0000
0.6044	0.0275	0.0076	0.0116	0.0000
0.6593	0.0275	0.0083	0.0140	0.0000
0.7143	0.0275	0.0090	0.0149	0.0000
0.7692	0.0275	0.0097	0.0186	0.0000
0.8242	0.0275	0.0104	0.0229	0.0000
0.8791	0.0275	0.0111	0.0277	0.0000
0.9341	0.0275	0.0118	0.0331	0.0000
0.9890	0.0275	0.0125	0.0345	0.0000
1.0440	0.0275	0.0132	0.0390	0.0000
1.0989	0.0275	0.0138	0.0456	0.0000
1.1538	0.0275	0.0145	0.0529	0.0000
1.2088	0.0275	0.0152	0.0607	0.0000
1.2637	0.0275	0.0159	0.0669	0.0000
1.3187	0.0275	0.0166	0.0693	0.0000
1.3736	0.0275	0.0173	0.0785	0.0000
1.4286	0.0275	0.0180	0.0884	0.0000
1.4835	0.0275	0.0187	0.0991	0.0000
1.5385	0.0275	0.0193	0.1104	0.0000
1.5934	0.0275	0.0199	0.1129	0.0000

1.6484	0.0275	0.0206	0.1225	0.0000
1.7033	0.0275	0.0212	0.1353	0.0000
1.7582	0.0275	0.0218	0.1489	0.0000
1.8132	0.0275	0.0225	0.1629	0.0000
1.8681	0.0275	0.0231	0.2778	0.0000
1.9231	0.0275	0.0237	0.2778	0.0000
1.9780	0.0275	0.0243	0.2778	0.0000
2.0330	0.0275	0.0250	0.2778	0.0000
2.0879	0.0275	0.0256	0.2778	0.0000
2.1429	0.0275	0.0262	0.2778	0.0000
2.1978	0.0275	0.0269	0.2778	0.0000
2.2527	0.0275	0.0275	0.2778	0.0000
2.3077	0.0275	0.0281	0.2778	0.0000
2.3626	0.0275	0.0287	0.2778	0.0000
2.4176	0.0275	0.0294	0.2778	0.0000
2.4725	0.0275	0.0300	0.2778	0.0000
2.5275	0.0275	0.0306	0.2778	0.0000
2.5824	0.0275	0.0313	0.2778	0.0000
2.6374	0.0275	0.0319	0.2778	0.0000
2.6923	0.0275	0.0325	0.2778	0.0000
2.7473	0.0275	0.0331	0.2778	0.0000
2.8022	0.0275	0.0338	0.2778	0.0000
2.8571	0.0275	0.0344	0.2778	0.0000
2.9121	0.0275	0.0350	0.2778	0.0000
2.9670	0.0275	0.0356	0.2778	0.0000
3.0000	0.0275	0.0360	0.2778	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infiltr(cfs)
3.0000	0.0275	0.0360	0.0000	0.1667	0.0000
3.0549	0.0275	0.0375	0.0000	0.1667	0.0000
3.1099	0.0275	0.0391	0.0000	0.1789	0.0000
3.1648	0.0275	0.0406	0.0000	0.1850	0.0000
3.2198	0.0275	0.0421	0.0000	0.1911	0.0000
3.2747	0.0275	0.0436	0.0000	0.1972	0.0000
3.3297	0.0275	0.0451	0.0000	0.2033	0.0000
3.3846	0.0275	0.0466	0.0000	0.2094	0.0000
3.4396	0.0275	0.0481	0.0000	0.2155	0.0000
3.4945	0.0275	0.0496	0.0000	0.2216	0.0000
3.5495	0.0275	0.0512	0.0000	0.2277	0.0000
3.6044	0.0275	0.0527	0.0000	0.2338	0.0000
3.6593	0.0275	0.0542	0.0000	0.2399	0.0000
3.7143	0.0275	0.0557	0.0000	0.2460	0.0000
3.7692	0.0275	0.0572	0.0000	0.2521	0.0000
3.8242	0.0275	0.0587	0.0000	0.2582	0.0000
3.8791	0.0275	0.0602	0.0000	0.2643	0.0000
3.9341	0.0275	0.0618	0.0000	0.2705	0.0000
3.9890	0.0275	0.0633	0.0000	0.2766	0.0000
4.0440	0.0275	0.0648	0.1956	0.2778	0.0000
4.0989	0.0275	0.0663	0.6592	0.2778	0.0000
4.1538	0.0275	0.0678	1.2766	0.2778	0.0000
4.2088	0.0275	0.0693	2.0109	0.2778	0.0000
4.2637	0.0275	0.0708	2.8369	0.2778	0.0000
4.3187	0.0275	0.0724	3.7318	0.2778	0.0000
4.3736	0.0275	0.0739	4.6731	0.2778	0.0000
4.4286	0.0275	0.0754	5.6376	0.2778	0.0000
4.4835	0.0275	0.0769	6.6018	0.2778	0.0000
4.5385	0.0275	0.0784	7.5423	0.2778	0.0000

4.5934	0.0275	0.0799	8.4368	0.2778	0.0000
4.6484	0.0275	0.0814	9.2649	0.2778	0.0000
4.7033	0.0275	0.0829	10.010	0.2778	0.0000
4.7582	0.0275	0.0845	10.660	0.2778	0.0000
4.8132	0.0275	0.0860	11.211	0.2778	0.0000
4.8681	0.0275	0.0875	11.664	0.2778	0.0000
4.9231	0.0275	0.0890	12.034	0.2778	0.0000
4.9780	0.0275	0.0905	12.347	0.2778	0.0000
5.0000	0.0275	0.0911	12.805	0.2778	0.0000

Road Infiltration Trench

Bottom Length: 60.00 ft.
 Bottom Width: 20.00 ft.
 Trench bottom slope 1: 0 To 1
 Trench Left side slope 0: 0 To 1
 Trench right side slope 2: 0 To 1
 Material thickness of first layer: 6
 Pour Space of material for first layer: 0.35
 Material thickness of second layer: 0
 Pour Space of material for second layer: 0
 Material thickness of third layer: 0
 Pour Space of material for third layer: 0
 Infiltration On
 Infiltration rate: 2
 Infiltration safety factor: 1
 Wetted surface area On
 Total Volume Infiltrated (ac-ft.): 8.798
 Total Volume Through Riser (ac-ft.): 3.405
 Total Volume Through Facility (ac-ft.): 12.202
 Percent Infiltrated: 72.1
 Total Precip Applied to Facility: 0
 Total Evap From Facility: 0
 Discharge Structure
 Riser Height: 4 ft.
 Riser Diameter: 12 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.027	0.000	0.000	0.000
0.0556	0.027	0.000	0.000	0.055
0.1111	0.027	0.001	0.000	0.055
0.1667	0.027	0.001	0.000	0.055
0.2222	0.027	0.002	0.000	0.055
0.2778	0.027	0.002	0.000	0.055
0.3333	0.027	0.003	0.000	0.055
0.3889	0.027	0.003	0.000	0.055
0.4444	0.027	0.004	0.000	0.055
0.5000	0.027	0.004	0.000	0.055
0.5556	0.027	0.005	0.000	0.055
0.6111	0.027	0.005	0.000	0.055
0.6667	0.027	0.006	0.000	0.055
0.7222	0.027	0.007	0.000	0.055
0.7778	0.027	0.007	0.000	0.055
0.8333	0.027	0.008	0.000	0.055
0.8889	0.027	0.008	0.000	0.055
0.9444	0.027	0.009	0.000	0.055
1.0000	0.027	0.009	0.000	0.055
1.0556	0.027	0.010	0.000	0.055
1.1111	0.027	0.010	0.000	0.055
1.1667	0.027	0.011	0.000	0.055
1.2222	0.027	0.011	0.000	0.055
1.2778	0.027	0.012	0.000	0.055

1.3333	0.027	0.012	0.000	0.055
1.3889	0.027	0.013	0.000	0.055
1.4444	0.027	0.013	0.000	0.055
1.5000	0.027	0.014	0.000	0.055
1.5556	0.027	0.015	0.000	0.055
1.6111	0.027	0.015	0.000	0.055
1.6667	0.027	0.016	0.000	0.055
1.7222	0.027	0.016	0.000	0.055
1.7778	0.027	0.017	0.000	0.055
1.8333	0.027	0.017	0.000	0.055
1.8889	0.027	0.018	0.000	0.055
1.9444	0.027	0.018	0.000	0.055
2.0000	0.027	0.019	0.000	0.055
2.0556	0.027	0.019	0.000	0.055
2.1111	0.027	0.020	0.000	0.055
2.1667	0.027	0.020	0.000	0.055
2.2222	0.027	0.021	0.000	0.055
2.2778	0.027	0.022	0.000	0.055
2.3333	0.027	0.022	0.000	0.055
2.3889	0.027	0.023	0.000	0.055
2.4444	0.027	0.023	0.000	0.055
2.5000	0.027	0.024	0.000	0.055
2.5556	0.027	0.024	0.000	0.055
2.6111	0.027	0.025	0.000	0.055
2.6667	0.027	0.025	0.000	0.055
2.7222	0.027	0.026	0.000	0.055
2.7778	0.027	0.026	0.000	0.055
2.8333	0.027	0.027	0.000	0.055
2.8889	0.027	0.027	0.000	0.055
2.9444	0.027	0.028	0.000	0.055
3.0000	0.027	0.028	0.000	0.055
3.0556	0.027	0.029	0.000	0.055
3.1111	0.027	0.030	0.000	0.055
3.1667	0.027	0.030	0.000	0.055
3.2222	0.027	0.031	0.000	0.055
3.2778	0.027	0.031	0.000	0.055
3.3333	0.027	0.032	0.000	0.055
3.3889	0.027	0.032	0.000	0.055
3.4444	0.027	0.033	0.000	0.055
3.5000	0.027	0.033	0.000	0.055
3.5556	0.027	0.034	0.000	0.055
3.6111	0.027	0.034	0.000	0.055
3.6667	0.027	0.035	0.000	0.055
3.7222	0.027	0.035	0.000	0.055
3.7778	0.027	0.036	0.000	0.055
3.8333	0.027	0.037	0.000	0.055
3.8889	0.027	0.037	0.000	0.055
3.9444	0.027	0.038	0.000	0.055
4.0000	0.027	0.038	0.000	0.055
4.0556	0.027	0.039	0.138	0.055
4.1111	0.027	0.039	0.389	0.055
4.1667	0.027	0.040	0.703	0.055
4.2222	0.027	0.040	1.046	0.055
4.2778	0.027	0.041	1.383	0.055
4.3333	0.027	0.041	1.683	0.055
4.3889	0.027	0.042	1.921	0.055
4.4444	0.027	0.042	2.088	0.055
4.5000	0.027	0.043	2.203	0.055

4.5556	0.027	0.043	2.347	0.055
4.6111	0.027	0.044	2.462	0.055
4.6667	0.027	0.045	2.571	0.055
4.7222	0.027	0.045	2.676	0.055
4.7778	0.027	0.046	2.777	0.055
4.8333	0.027	0.046	2.875	0.055
4.8889	0.027	0.047	2.969	0.055
4.9444	0.027	0.047	3.060	0.055
5.0000	0.027	0.048	3.149	0.055

Gravel Trench Bed 2

Bottom Length: 120.00 ft.
 Bottom Width: 5.00 ft.
 Trench bottom slope 1: 0 To 1
 Trench Left side slope 0: 0 To 1
 Trench right side slope 2: 0 To 1
 Material thickness of first layer: 5
 Pour Space of material for first layer: 0.35
 Material thickness of second layer: 0
 Pour Space of material for second layer: 0
 Material thickness of third layer: 0
 Pour Space of material for third layer: 0
 Infiltration On
 Infiltration rate: 2
 Infiltration safety factor: 1
 Wetted surface area On
 Total Volume Infiltrated (ac-ft.): 5.406
 Total Volume Through Riser (ac-ft.): 1.854
 Total Volume Through Facility (ac-ft.): 7.261
 Percent Infiltrated: 74.45
 Total Precip Applied to Facility: 0
 Total Evap From Facility: 0
 Discharge Structure
 Riser Height: 3 ft.
 Riser Diameter: 12 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:

Gravel Trench Bed Hydraulic Table

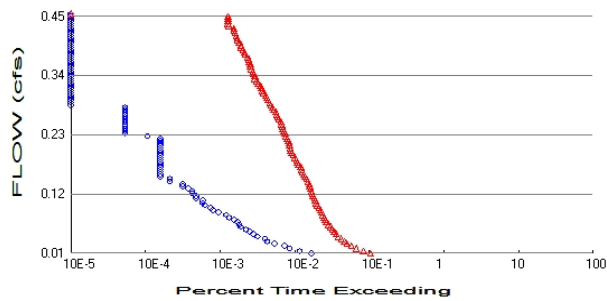
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.013	0.000	0.000	0.000
0.0556	0.013	0.000	0.000	0.027
0.1111	0.013	0.000	0.000	0.027
0.1667	0.013	0.000	0.000	0.027
0.2222	0.013	0.001	0.000	0.027
0.2778	0.013	0.001	0.000	0.027
0.3333	0.013	0.001	0.000	0.027
0.3889	0.013	0.001	0.000	0.027
0.4444	0.013	0.002	0.000	0.027
0.5000	0.013	0.002	0.000	0.027
0.5556	0.013	0.002	0.000	0.027
0.6111	0.013	0.002	0.000	0.027
0.6667	0.013	0.003	0.000	0.027
0.7222	0.013	0.003	0.000	0.027
0.7778	0.013	0.003	0.000	0.027
0.8333	0.013	0.004	0.000	0.027
0.8889	0.013	0.004	0.000	0.027
0.9444	0.013	0.004	0.000	0.027
1.0000	0.013	0.004	0.000	0.027
1.0556	0.013	0.005	0.000	0.027
1.1111	0.013	0.005	0.000	0.027
1.1667	0.013	0.005	0.000	0.027
1.2222	0.013	0.005	0.000	0.027
1.2778	0.013	0.006	0.000	0.027

1.3333	0.013	0.006	0.000	0.027
1.3889	0.013	0.006	0.000	0.027
1.4444	0.013	0.007	0.000	0.027
1.5000	0.013	0.007	0.000	0.027
1.5556	0.013	0.007	0.000	0.027
1.6111	0.013	0.007	0.000	0.027
1.6667	0.013	0.008	0.000	0.027
1.7222	0.013	0.008	0.000	0.027
1.7778	0.013	0.008	0.000	0.027
1.8333	0.013	0.008	0.000	0.027
1.8889	0.013	0.009	0.000	0.027
1.9444	0.013	0.009	0.000	0.027
2.0000	0.013	0.009	0.000	0.027
2.0556	0.013	0.009	0.000	0.027
2.1111	0.013	0.010	0.000	0.027
2.1667	0.013	0.010	0.000	0.027
2.2222	0.013	0.010	0.000	0.027
2.2778	0.013	0.011	0.000	0.027
2.3333	0.013	0.011	0.000	0.027
2.3889	0.013	0.011	0.000	0.027
2.4444	0.013	0.011	0.000	0.027
2.5000	0.013	0.012	0.000	0.027
2.5556	0.013	0.012	0.000	0.027
2.6111	0.013	0.012	0.000	0.027
2.6667	0.013	0.012	0.000	0.027
2.7222	0.013	0.013	0.000	0.027
2.7778	0.013	0.013	0.000	0.027
2.8333	0.013	0.013	0.000	0.027
2.8889	0.013	0.013	0.000	0.027
2.9444	0.013	0.014	0.000	0.027
3.0000	0.013	0.014	0.000	0.027
3.0556	0.013	0.014	0.138	0.027
3.1111	0.013	0.015	0.389	0.027
3.1667	0.013	0.015	0.703	0.027
3.2222	0.013	0.015	1.046	0.027
3.2778	0.013	0.015	1.383	0.027
3.3333	0.013	0.016	1.683	0.027
3.3889	0.013	0.016	1.921	0.027
3.4444	0.013	0.016	2.088	0.027
3.5000	0.013	0.016	2.203	0.027
3.5556	0.013	0.017	2.347	0.027
3.6111	0.013	0.017	2.462	0.027
3.6667	0.013	0.017	2.571	0.027
3.7222	0.013	0.017	2.676	0.027
3.7778	0.013	0.018	2.777	0.027
3.8333	0.013	0.018	2.875	0.027
3.8889	0.013	0.018	2.969	0.027
3.9444	0.013	0.019	3.060	0.027
4.0000	0.013	0.019	3.149	0.027
4.0556	0.013	0.019	3.235	0.027
4.1111	0.013	0.019	3.320	0.027
4.1667	0.013	0.020	3.402	0.027
4.2222	0.013	0.020	3.482	0.027
4.2778	0.013	0.020	3.560	0.027
4.3333	0.013	0.020	3.636	0.027
4.3889	0.013	0.021	3.711	0.027
4.4444	0.013	0.021	3.785	0.027
4.5000	0.013	0.021	3.857	0.027

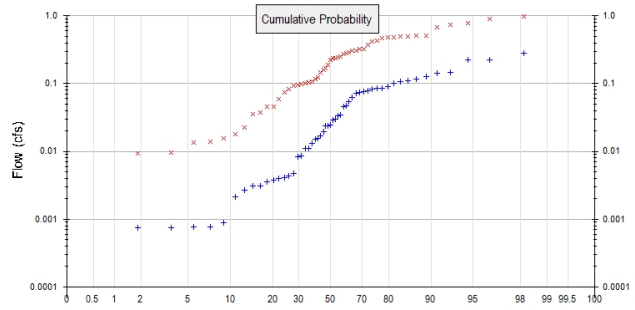
4.5556	0.013	0.022	3.928	0.027
4.6111	0.013	0.022	3.997	0.027
4.6667	0.013	0.022	4.066	0.027
4.7222	0.013	0.022	4.133	0.027
4.7778	0.013	0.023	4.199	0.027
4.8333	0.013	0.023	4.264	0.027
4.8889	0.013	0.023	4.328	0.027
4.9444	0.013	0.023	4.391	0.027
5.0000	0.013	0.024	4.454	0.027

Analysis Results

POC 1



+ Predeveloped x Mitigated



Predeveloped Landuse Totals for POC #1

Total Pervious Area: 0.949
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1

Total Pervious Area: 0.239
Total Impervious Area: 0.71

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.020893
5 year	0.081852
10 year	0.156979
25 year	0.300298
50 year	0.445572
100 year	0.625325

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.171451
5 year	0.492709
10 year	0.752674
25 year	1.084996
50 year	1.316616
100 year	1.526848

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	0.147	0.490
1957	0.015	0.486
1958	0.226	0.516
1959	0.054	0.237
1960	0.225	0.516
1961	0.109	0.308
1962	0.279	0.415
1963	0.082	0.726
1964	0.046	0.306
1965	0.024	0.035

1966	0.003	0.009
1967	0.011	0.125
1968	0.002	0.117
1969	0.011	0.059
1970	0.016	0.038
1971	0.100	0.104
1972	0.074	0.222
1973	0.004	0.158
1974	0.107	0.323
1975	0.115	0.490
1976	0.062	0.082
1977	0.001	0.015
1978	0.125	0.425
1979	0.004	0.147
1980	0.008	0.093
1981	0.013	0.099
1982	0.073	0.238
1983	0.030	0.247
1984	0.091	0.244
1985	0.003	0.102
1986	0.085	0.483
1987	0.004	0.327
1988	0.001	0.046
1989	0.003	0.014
1990	0.033	0.190
1991	0.078	0.074
1992	0.004	0.018
1993	0.020	0.046
1994	0.017	0.014
1995	0.005	0.286
1996	0.142	0.673
1997	0.034	0.278
1998	0.029	0.899
1999	0.004	0.023
2000	0.009	0.168
2001	0.001	0.000
2002	0.024	0.982
2003	0.001	0.782
2004	0.001	0.010
2005	0.001	0.106
2006	0.047	0.094
2007	0.077	0.467
2008	0.024	0.271
2009	0.085	0.376

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2788	0.9817
2	0.2263	0.8995
3	0.2245	0.7819
4	0.1474	0.7258
5	0.1416	0.6733
6	0.1252	0.5162
7	0.1155	0.5156
8	0.1093	0.4905
9	0.1071	0.4903
10	0.0999	0.4864

11	0.0908	0.4828
12	0.0848	0.4674
13	0.0847	0.4246
14	0.0821	0.4145
15	0.0783	0.3760
16	0.0768	0.3266
17	0.0742	0.3233
18	0.0728	0.3078
19	0.0624	0.3061
20	0.0539	0.2860
21	0.0465	0.2782
22	0.0461	0.2709
23	0.0343	0.2474
24	0.0331	0.2437
25	0.0298	0.2378
26	0.0290	0.2372
27	0.0245	0.2224
28	0.0239	0.1896
29	0.0237	0.1683
30	0.0197	0.1583
31	0.0171	0.1475
32	0.0156	0.1246
33	0.0150	0.1169
34	0.0133	0.1056
35	0.0112	0.1040
36	0.0110	0.1019
37	0.0086	0.0991
38	0.0083	0.0945
39	0.0047	0.0928
40	0.0043	0.0820
41	0.0041	0.0743
42	0.0040	0.0589
43	0.0037	0.0463
44	0.0035	0.0459
45	0.0031	0.0379
46	0.0031	0.0355
47	0.0027	0.0226
48	0.0021	0.0178
49	0.0009	0.0154
50	0.0008	0.0137
51	0.0008	0.0136
52	0.0008	0.0097
53	0.0008	0.0094
54	0.0007	0.0002

Duration Flows

The Duration Matching **Failed**

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0104	315	1950	619	Fail
0.0148	220	1571	714	Fail
0.0192	161	1271	789	Fail
0.0236	137	1093	797	Fail
0.0280	100	948	947	Fail
0.0324	81	873	1077	Fail
0.0368	75	795	1060	Fail
0.0412	60	718	1196	Fail
0.0456	53	679	1281	Fail
0.0500	47	642	1365	Fail
0.0544	42	605	1440	Fail
0.0588	36	571	1586	Fail
0.0632	34	535	1573	Fail
0.0676	32	505	1578	Fail
0.0720	29	483	1665	Fail
0.0764	25	466	1864	Fail
0.0808	23	452	1965	Fail
0.0852	18	436	2422	Fail
0.0896	15	418	2786	Fail
0.0940	14	398	2842	Fail
0.0984	12	384	3200	Fail
0.1027	11	367	3336	Fail
0.1071	11	355	3227	Fail
0.1115	9	348	3866	Fail
0.1159	9	334	3711	Fail
0.1203	8	324	4050	Fail
0.1247	8	318	3975	Fail
0.1291	7	306	4371	Fail
0.1335	6	301	5016	Fail
0.1379	6	295	4916	Fail
0.1423	4	282	7050	Fail
0.1467	4	273	6825	Fail
0.1511	3	258	8600	Fail
0.1555	3	250	8333	Fail
0.1599	3	242	8066	Fail
0.1643	3	233	7766	Fail
0.1687	3	227	7566	Fail
0.1731	3	209	6966	Fail
0.1775	3	205	6833	Fail
0.1819	3	201	6700	Fail
0.1863	3	191	6366	Fail
0.1906	3	180	6000	Fail
0.1950	3	170	5666	Fail
0.1994	3	167	5566	Fail
0.2038	3	165	5500	Fail
0.2082	3	161	5366	Fail
0.2126	3	160	5333	Fail
0.2170	3	156	5200	Fail
0.2214	3	149	4966	Fail
0.2258	2	143	7150	Fail
0.2302	1	141	14100	Fail
0.2346	1	136	13600	Fail
0.2390	1	130	13000	Fail
0.2434	1	129	12900	Fail

0.2478	1	127	12700	Fail
0.2522	1	123	12300	Fail
0.2566	1	115	11500	Fail
0.2610	1	112	11200	Fail
0.2654	1	109	10900	Fail
0.2698	1	105	10500	Fail
0.2742	1	98	9800	Fail
0.2786	1	95	9500	Fail
0.2829	0	91	n/a	Fail
0.2873	0	88	n/a	Fail
0.2917	0	83	n/a	Fail
0.2961	0	80	n/a	Fail
0.3005	0	77	n/a	Fail
0.3049	0	73	n/a	Fail
0.3093	0	69	n/a	Fail
0.3137	0	68	n/a	Fail
0.3181	0	66	n/a	Fail
0.3225	0	61	n/a	Fail
0.3269	0	59	n/a	Fail
0.3313	0	55	n/a	Fail
0.3357	0	55	n/a	Fail
0.3401	0	53	n/a	Fail
0.3445	0	52	n/a	Fail
0.3489	0	50	n/a	Fail
0.3533	0	48	n/a	Fail
0.3577	0	48	n/a	Fail
0.3621	0	46	n/a	Fail
0.3665	0	46	n/a	Fail
0.3709	0	44	n/a	Fail
0.3752	0	41	n/a	Fail
0.3796	0	40	n/a	Fail
0.3840	0	38	n/a	Fail
0.3884	0	36	n/a	Fail
0.3928	0	36	n/a	Fail
0.3972	0	34	n/a	Fail
0.4016	0	32	n/a	Fail
0.4060	0	32	n/a	Fail
0.4104	0	31	n/a	Fail
0.4148	0	30	n/a	Fail
0.4192	0	29	n/a	Fail
0.4236	0	29	n/a	Fail
0.4280	0	25	n/a	Fail
0.4324	0	24	n/a	Fail
0.4368	0	24	n/a	Fail
0.4412	0	24	n/a	Fail
0.4456	0	24	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0 acre-feet

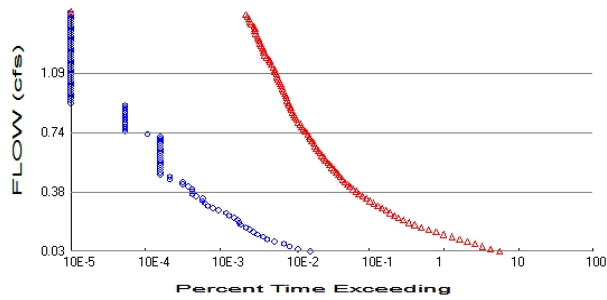
On-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

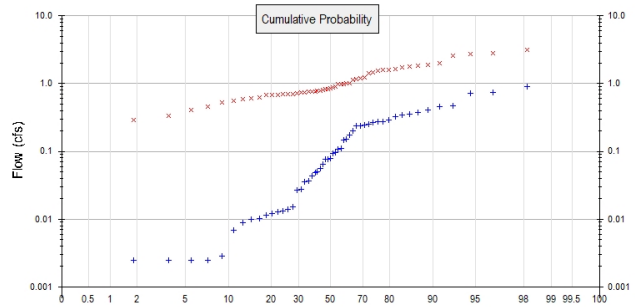
Off-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

POC 2



+ Predeveloped x Mitigated



Predeveloped Landuse Totals for POC #2

Total Pervious Area: 3.063
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2

Total Pervious Area: 0.306
Total Impervious Area: 2.757

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	0.067435
5 year	0.264188
10 year	0.506666
25 year	0.969244
50 year	1.438131
100 year	2.018302

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	0.940639
5 year	1.511344
10 year	1.936477
25 year	2.522369
50 year	2.99203
100 year	3.488751

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1956	0.476	1.430
1957	0.048	1.756
1958	0.730	1.819
1959	0.174	0.893
1960	0.725	1.901
1961	0.353	1.009
1962	0.900	1.477
1963	0.265	2.598
1964	0.149	1.015
1965	0.079	0.818
1966	0.010	0.761

1967	0.036	0.599
1968	0.007	0.532
1969	0.035	0.742
1970	0.050	0.560
1971	0.322	0.866
1972	0.239	0.750
1973	0.011	0.677
1974	0.346	0.973
1975	0.373	1.630
1976	0.201	0.978
1977	0.002	0.693
1978	0.404	1.612
1979	0.013	0.594
1980	0.027	0.720
1981	0.043	0.849
1982	0.235	0.786
1983	0.096	1.135
1984	0.293	0.697
1985	0.009	0.770
1986	0.273	1.774
1987	0.014	1.182
1988	0.003	0.684
1989	0.010	0.335
1990	0.107	0.767
1991	0.253	0.838
1992	0.013	0.673
1993	0.064	0.621
1994	0.055	0.457
1995	0.015	1.238
1996	0.457	2.013
1997	0.111	0.987
1998	0.094	2.809
1999	0.012	0.402
2000	0.028	0.772
2001	0.002	0.223
2002	0.077	3.175
2003	0.002	2.704
2004	0.002	0.293
2005	0.002	0.799
2006	0.150	0.689
2007	0.248	1.587
2008	0.077	1.153
2009	0.274	1.545

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	0.8999	3.1751
2	0.7305	2.8089
3	0.7247	2.7045
4	0.4758	2.5985
5	0.4571	2.0129
6	0.4041	1.9010
7	0.3727	1.8190
8	0.3528	1.7738
9	0.3458	1.7558
10	0.3224	1.6296
11	0.2931	1.6117

12	0.2737	1.5869
13	0.2734	1.5448
14	0.2650	1.4773
15	0.2526	1.4305
16	0.2480	1.2383
17	0.2395	1.1822
18	0.2351	1.1531
19	0.2013	1.1346
20	0.1739	1.0154
21	0.1501	1.0090
22	0.1488	0.9873
23	0.1107	0.9783
24	0.1070	0.9734
25	0.0961	0.8926
26	0.0937	0.8663
27	0.0789	0.8487
28	0.0771	0.8380
29	0.0765	0.8179
30	0.0637	0.7989
31	0.0552	0.7862
32	0.0503	0.7724
33	0.0483	0.7695
34	0.0429	0.7670
35	0.0361	0.7614
36	0.0355	0.7502
37	0.0276	0.7424
38	0.0269	0.7204
39	0.0153	0.6965
40	0.0140	0.6935
41	0.0132	0.6893
42	0.0129	0.6838
43	0.0120	0.6771
44	0.0114	0.6728
45	0.0101	0.6214
46	0.0099	0.5992
47	0.0087	0.5935
48	0.0069	0.5598
49	0.0029	0.5321
50	0.0025	0.4567
51	0.0025	0.4024
52	0.0024	0.3347
53	0.0024	0.2928
54	0.0022	0.2226

Duration Flows

The Duration Matching **Failed**

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0337	306	104673	34206	Fail
0.0479	209	80247	38395	Fail
0.0621	161	62183	38622	Fail
0.0763	135	49458	36635	Fail
0.0905	101	39120	38732	Fail
0.1046	81	30807	38033	Fail
0.1188	72	24350	33819	Fail
0.1330	60	18712	31186	Fail
0.1472	52	14803	28467	Fail
0.1614	47	11766	25034	Fail
0.1756	42	9422	22433	Fail
0.1898	36	7678	21327	Fail
0.2039	34	6436	18929	Fail
0.2181	32	5393	16853	Fail
0.2323	29	4673	16113	Fail
0.2465	25	4094	16375	Fail
0.2607	23	3624	15756	Fail
0.2749	18	3183	17683	Fail
0.2891	15	2804	18693	Fail
0.3033	13	2456	18892	Fail
0.3174	12	2168	18066	Fail
0.3316	11	1937	17609	Fail
0.3458	11	1730	15727	Fail
0.3600	9	1538	17088	Fail
0.3742	8	1379	17237	Fail
0.3884	8	1259	15737	Fail
0.4026	8	1155	14437	Fail
0.4167	7	1046	14942	Fail
0.4309	6	969	16150	Fail
0.4451	6	881	14683	Fail
0.4593	4	829	20725	Fail
0.4735	4	774	19350	Fail
0.4877	3	726	24200	Fail
0.5019	3	686	22866	Fail
0.5160	3	638	21266	Fail
0.5302	3	597	19900	Fail
0.5444	3	556	18533	Fail
0.5586	3	526	17533	Fail
0.5728	3	489	16300	Fail
0.5870	3	465	15500	Fail
0.6012	3	439	14633	Fail
0.6153	3	413	13766	Fail
0.6295	3	392	13066	Fail
0.6437	3	369	12300	Fail
0.6579	3	352	11733	Fail
0.6721	3	341	11366	Fail
0.6863	3	323	10766	Fail
0.7005	3	305	10166	Fail
0.7146	3	296	9866	Fail
0.7288	2	282	14100	Fail
0.7430	1	262	26200	Fail
0.7572	1	248	24800	Fail
0.7714	1	237	23700	Fail
0.7856	1	226	22600	Fail

0.7998	1	207	20700	Fail
0.8139	1	201	20100	Fail
0.8281	1	190	19000	Fail
0.8423	1	184	18400	Fail
0.8565	1	174	17400	Fail
0.8707	1	168	16800	Fail
0.8849	1	167	16700	Fail
0.8991	1	158	15800	Fail
0.9132	0	156	n/a	Fail
0.9274	0	151	n/a	Fail
0.9416	0	147	n/a	Fail
0.9558	0	143	n/a	Fail
0.9700	0	139	n/a	Fail
0.9842	0	134	n/a	Fail
0.9984	0	129	n/a	Fail
1.0126	0	125	n/a	Fail
1.0267	0	122	n/a	Fail
1.0409	0	118	n/a	Fail
1.0551	0	113	n/a	Fail
1.0693	0	109	n/a	Fail
1.0835	0	108	n/a	Fail
1.0977	0	103	n/a	Fail
1.1119	0	102	n/a	Fail
1.1260	0	97	n/a	Fail
1.1402	0	92	n/a	Fail
1.1544	0	88	n/a	Fail
1.1686	0	87	n/a	Fail
1.1828	0	81	n/a	Fail
1.1970	0	75	n/a	Fail
1.2112	0	73	n/a	Fail
1.2253	0	72	n/a	Fail
1.2395	0	70	n/a	Fail
1.2537	0	68	n/a	Fail
1.2679	0	64	n/a	Fail
1.2821	0	63	n/a	Fail
1.2963	0	61	n/a	Fail
1.3105	0	60	n/a	Fail
1.3246	0	57	n/a	Fail
1.3388	0	55	n/a	Fail
1.3530	0	55	n/a	Fail
1.3672	0	54	n/a	Fail
1.3814	0	50	n/a	Fail
1.3956	0	48	n/a	Fail
1.4098	0	46	n/a	Fail
1.4239	0	44	n/a	Fail
1.4381	0	42	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume: 0 acre-feet

On-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

Off-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

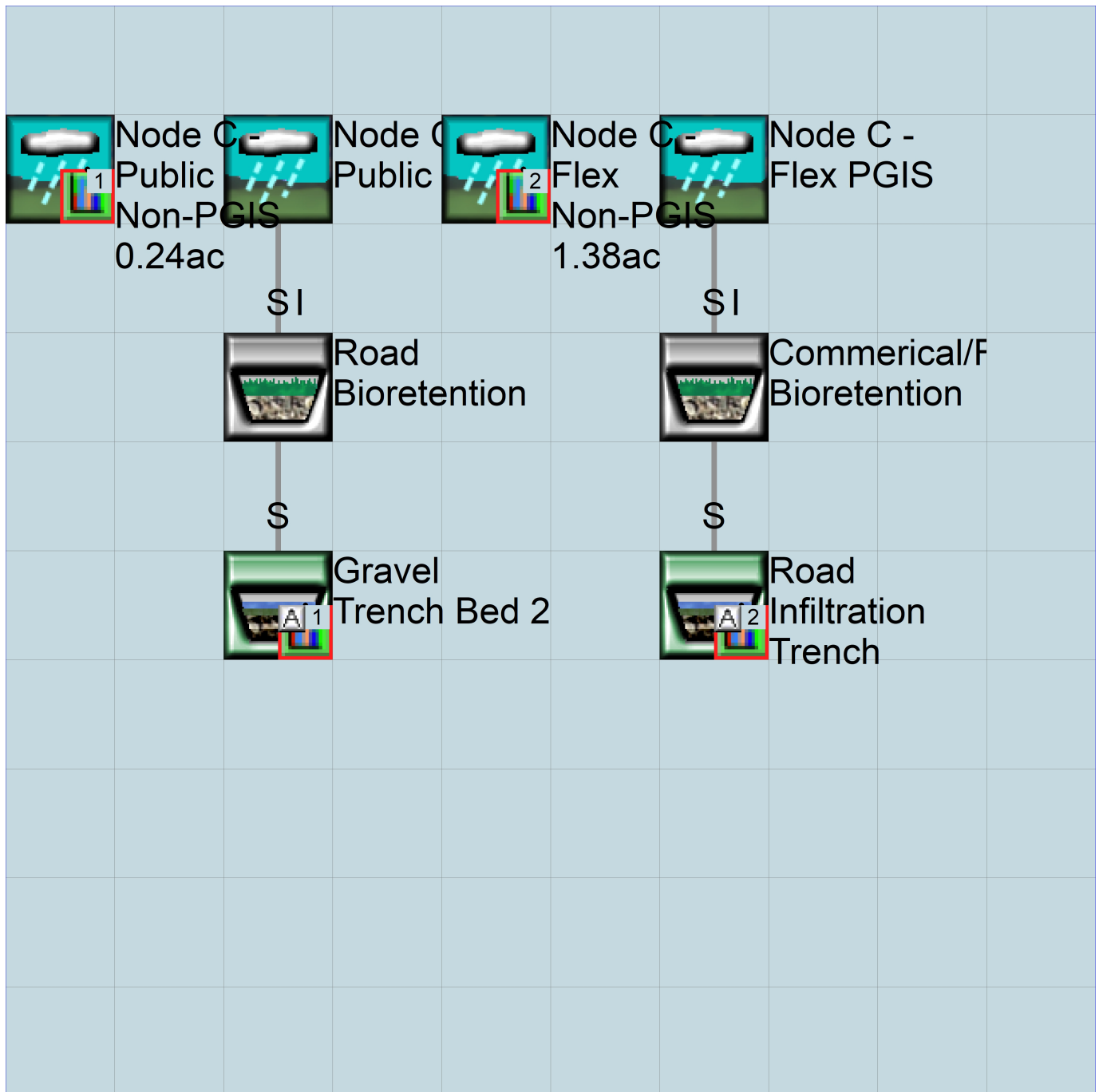


Node C
Existing
Public
0.95ac



Node C -
Existing Flex
3.06ac

Mitigated Schematic



Predeveloped UCI File

RUN

GLOBAL

```
WWM4 model simulation
START      1955 10 01      END      2009 09 30
RUN INTERP OUTPUT LEVEL    3      0
RESUME     0 RUN          1
UNIT SYSTEM      1
END GLOBAL
```

FILES

```
<File> <Un#> <-----File Name----->***
<-ID->                                     ***
WDM      26      18591_Node C.wdm
MESSU    25      Pre18591_Node C.MES
          27      Pre18591_Node C.L61
          28      Pre18591_Node C.L62
          30      POC18591_Node C1.dat
          31      POC18591_Node C2.dat
```

END FILES

OPN SEQUENCE

```
INGRP      INDELT 00:15
  PERLND      2
  COPY        501
  COPY        502
  DISPLY      1
  DISPLY      2
```

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INF01

```
# - #<-----Title----->***TRAN PIVL DIG1 FIL1 PYR DIG2 FIL2 YRND
1      Node C - Existing Public      MAX      1      2      30      9
2      Node C - Existing Flex      MAX      1      2      31      9
```

END DISPLY-INF01

END DISPLY

COPY

TIMESERIES

```
# - # NPT NMN ***
1      1      1
501      1      1
502      1      1
```

END TIMESERIES

END COPY

GENER

OPCODE

```
#      # OPCD ***
```

END OPCODE

PARM

```
#      #      K ***
```

END PARM

END GENER

PERLND

GEN-INFO

```
<PLS ><-----Name----->NBLKS Unit-systems Printer ***
# - # User t-series Engl Metr ***
          in out
2      A/B, Forest, Mod      1      1      1      1      27      0
```

END GEN-INFO

*** Section PWATER***

ACTIVITY

```
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC ***
2      0      0      1      0      0      0      0      0      0      0      0
```

END ACTIVITY

PRINT-INFO

```

<PLS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW PWAT  SED  PST  PWG  PQAL MSTL PEST NITR PHOS TRAC *****
2      0      0      4      0      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

```

```

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
2      0      0      0      0      0      0      0      0      0      0      0
END PWAT-PARM1

```

```

PWAT-PARM2
<PLS > PWATER input info: Part 2 *****
# - # ***FOREST  LZSN  INFILT  LSUR  SLSUR  KVARY  AGWRC
2      0      5      2      400      0.1      0.3      0.996
END PWAT-PARM2

```

```

PWAT-PARM3
<PLS > PWATER input info: Part 3 *****
# - # ***PETMAX  PETMIN  INFEXP  INFILD  DEEPFR  BASETP  AGWETP
2      0      0      2      2      0      0      0
END PWAT-PARM3

```

```

PWAT-PARM4
<PLS > PWATER input info: Part 4 *****
# - # CEPSC  UZSN  NSUR  INTFW  IRC  LZETP ***
2      0.2      0.5      0.35      0      0.7      0.7
END PWAT-PARM4

```

```

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS  SURS  UZS  IFWS  LZS  AGWS  GWVS
2      0      0      0      0      3      1      0
END PWAT-STATE1

```

END PERLND

IMPLND

```

GEN-INFO
<PLS ><-----Name-----> Unit-systems  Printer ***
# - # User t-series Engl Metr ***
in out

```

```

END GEN-INFO
*** Section IWATER***

```

```

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT  SLD  IWG IQAL ***
END ACTIVITY

```

```

PRINT-INFO
<ILS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW IWAT  SLD  IWG IQAL *****
END PRINT-INFO

```

```

IWAT-PARM1
<PLS > IWATER variable monthly parameter value flags ***
# - # CSNO RTOP VRS  VNN RTLI ***
END IWAT-PARM1

```

```

IWAT-PARM2
<PLS > IWATER input info: Part 2 *****
# - # *** LSUR  SLSUR  NSUR  RETSC
END IWAT-PARM2

```

```

IWAT-PARM3
<PLS > IWATER input info: Part 3 *****
# - # ***PETMAX  PETMIN
END IWAT-PARM3

```

```

IWAT-STATE1
  <PLS > *** Initial conditions at start of simulation
  # - # *** RETS      SURS
END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                <--Area-->      <-Target->      MBLK      ***
<Name>   #                <-factor->      <Name>   #      Tbl#      ***
Node C - Existing Public***
PERLND   2                0.949          COPY    501      12
PERLND   2                0.949          COPY    501      13
Node C - Existng Flex***
PERLND   2                3.063          COPY    502      12
PERLND   2                3.063          COPY    502      13

*****Routing*****
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>   #      <Name> # #<-factor->strg <Name>   #   #      <Name> # #      ***
COPY    501 OUTPUT MEAN   1 1  48.4      DISPLY   1      INPUT TIMSER 1
COPY    502 OUTPUT MEAN   1 1  48.4      DISPLY   2      INPUT TIMSER 1

<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>   #      <Name> # #<-factor->strg <Name>   #   #      <Name> # #      ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES      Name      Nexits      Unit Systems      Printer      ***
    # - #<-----><----> User T-series Engl Metr LKFG      ***
                                in out
  END GEN-INFO
  *** Section RCHRES***

ACTIVITY
  <PLS > ***** Active Sections *****
  # - # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
END ACTIVITY

PRINT-INFO
  <PLS > ***** Print-flags ***** PIVL  PYR
  # - # HYDR ADCA CONS HEAT SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR *****
END PRINT-INFO

HYDR-PARM1
  RCHRES      Flags for each HYDR Section      ***
  # - # VC A1 A2 A3 ODFVFG for each *** ODGTFG for each FUNCT for each
          FG FG FG FG possible exit *** possible exit possible exit
          * * * * * * * *
END HYDR-PARM1

HYDR-PARM2
  # - # FTABNO      LEN      DELTH      STCOR      KS      DB50      ***
<-----><-----><-----><-----><-----><----->
END HYDR-PARM2
HYDR-INIT
  RCHRES      Initial conditions for each HYDR section      ***
  # - # *** VOL      Initial value of COLIND      Initial value of OUTDGT
          *** ac-ft      for each possible exit      for each possible exit
  <-----><----->      <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS

```

END SPEC-ACTIONS
 FTABLES
 END FTABLES

EXT SOURCES

<-Volume->	<Member>	SsysSgap<-Mult-->Tran	<-Target	vols>	<-Grp>	<-Member->	***
<Name>	#	<Name> # tem strg<-factor->strg	<Name>	#	#	<Name> # #	***
WDM	2	PREC ENGL 1.429	PERLND	1	999	EXTNL PREC	
WDM	2	PREC ENGL 1.429	IMPLND	1	999	EXTNL PREC	
WDM	1	EVAP ENGL 0.76	PERLND	1	999	EXTNL PETINP	
WDM	1	EVAP ENGL 0.76	IMPLND	1	999	EXTNL PETINP	

END EXT SOURCES

EXT TARGETS

<-Volume->	<-Grp>	<-Member-><-Mult-->Tran	<-Volume->	<Member>	Tsys	Tgap	Amd	***
<Name>	#	<Name> # #<-factor->strg	<Name>	#	<Name>	tem	strg	strg***
COPY	501	OUTPUT MEAN 1 1 48.4	WDM	501	FLOW	ENGL	REPL	
COPY	502	OUTPUT MEAN 1 1 48.4	WDM	502	FLOW	ENGL	REPL	

END EXT TARGETS

MASS-LINK

<Volume>	<-Grp>	<-Member-><-Mult-->	<Target>	<-Grp>	<-Member->***
<Name>	#	<Name> # #<-factor->	<Name>	#	<Name> # #***
MASS-LINK		12			
PERLND	PWATER	SURO 0.083333	COPY	INPUT	MEAN
END MASS-LINK		12			
MASS-LINK		13			
PERLND	PWATER	IFWO 0.083333	COPY	INPUT	MEAN
END MASS-LINK		13			

END MASS-LINK

END RUN

Mitigated UCI File

RUN

GLOBAL

WWM4 model simulation
START 1955 10 01 END 2009 09 30
RUN INTERP OUTPUT LEVEL 3 0
RESUME 0 RUN 1 UNIT SYSTEM 1
END GLOBAL

FILES

<File>	<Un#>	<-----File Name----->	***
<-ID->			***
WDM	26	18591_Node C.wdm	
MESSU	25	Mit18591_Node C.MES	
	27	Mit18591_Node C.L61	
	28	Mit18591_Node C.L62	
	31	POC18591_Node C2.dat	
	30	POC18591_Node C1.dat	

END FILES

OPN SEQUENCE

INGRP INDELT 00:15

IMPLND	1
PERLND	8
IMPLND	4
RCHRES	1
RCHRES	2
RCHRES	3
RCHRES	4
RCHRES	5
RCHRES	6
COPY	2
COPY	502
COPY	602
COPY	1
COPY	501
COPY	601
DISPLY	2
DISPLY	1

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INF01

#	-	#	<-----Title----->	***	TRAN	PIVL	DIG1	FIL1	PYR	DIG2	FIL2	YRND
2			Road Infiltration Trench		MAX				1	2	31	9
1			Gravel Trench Bed 2		MAX				1	2	30	9

END DISPLY-INF01

END DISPLY

COPY

TIMESERIES

#	-	#	NPT	NMN	***
1			1	1	
2			1	1	
502			1	1	
602			1	1	
501			1	1	
601			1	1	

END TIMESERIES

END COPY

GENER

OPCODE

#	#	OPCD	***
---	---	------	-----

END OPCODE

PARM

#	#	K	***
---	---	---	-----

END PARM

END GENER

PERLND

```

GEN-INFO
<PLS ><-----Name----->NBLKS      Unit-systems      Printer ***
# - #      User      t-series      Engl Metr ***
                        in      out
8      A/B, Lawn, Mod      1      1      1      1      27      0
END GEN-INFO
*** Section PWATER***

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC ***
8      0      0      1      0      0      0      0      0      0      0      0      0
END ACTIVITY

PRINT-INFO
<PLS > ***** Print-flags ***** PIVL PYR
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC *****
8      0      0      4      0      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG VCS VUZ VNN VIFW VIRC VLE INFC HWT ***
8      0      0      0      0      0      0      0      0      0      0      0
END PWAT-PARM1

PWAT-PARM2
<PLS > PWATER input info: Part 2 ***
# - # ***FOREST LZSN INFILT LSUR SLSUR KVARV AGWRC
8      0      5      0.8      400      0.1      0.3      0.996
END PWAT-PARM2

PWAT-PARM3
<PLS > PWATER input info: Part 3 ***
# - # ***PETMAX PETMIN INFEXP INFILD DEEPFR BASETP AGWETP
8      0      0      2      2      0      0      0
END PWAT-PARM3
PWAT-PARM4
<PLS > PWATER input info: Part 4 ***
# - # CEPSC UZSN NSUR INTFW IRC LZETP ***
8      0.1      0.5      0.25      0      0.7      0.25
END PWAT-PARM4

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS SURS UZS IFWS LZS AGWS GWVS
8      0      0      0      0      3      1      0
END PWAT-STATE1

END PERLND

IMPLND
GEN-INFO
<PLS ><-----Name----->      Unit-systems      Printer ***
# - #      User      t-series      Engl Metr ***
                        in      out
1      ROADS/FLAT      1      1      1      27      0
4      ROOF TOPS/FLAT      1      1      1      27      0
END GEN-INFO
*** Section IWATER***

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT SLD IWG IQAL ***
1      0      0      1      0      0      0
4      0      0      1      0      0      0
END ACTIVITY

PRINT-INFO

```



```

<ILS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW IWAT  SLD  IWG IQAL  *****
1      0      0      4      0      0      4      1      9
4      0      0      4      0      0      0      1      9
END PRINT-INFO

```

```

IWAT-PARM1
<PLS >  IWATER variable monthly parameter value flags  ***
# - # CSNO RTOP  VRS  VNN RTLI  ***
1      0      0      0      0      0
4      0      0      0      0      0
END IWAT-PARM1

```

```

IWAT-PARM2
<PLS >      IWATER input info: Part 2      ***
# - # ***  LSUR      SLSUR      NSUR      RETSC
1      400      0.01      0.1      0.1
4      400      0.01      0.1      0.1
END IWAT-PARM2

```

```

IWAT-PARM3
<PLS >      IWATER input info: Part 3      ***
# - # ***PETMAX  PETMIN
1      0      0
4      0      0
END IWAT-PARM3

```

```

IWAT-STATE1
<PLS > *** Initial conditions at start of simulation
# - # ***  RETS      SURS
1      0      0
4      0      0
END IWAT-STATE1

```

END IMPLND

```

SCHEMATIC
<-Source->      <--Area-->      <-Target->      MBLK      ***
<Name>  #      <-factor->      <Name>  #      Tbl#      ***
Node C - Public PGIS***
IMPLND  1      0.71      RCHRES  1      5
Node C - Flex PGIS***
IMPLND  1      1.685      RCHRES  3      5
Node C - Public Non-PGIS***
PERLND  8      0.239      COPY  501      12
PERLND  8      0.239      COPY  601      12
PERLND  8      0.239      COPY  501      13
PERLND  8      0.239      COPY  601      13
Node C - Flex Non-PGIS***
PERLND  8      0.306      COPY  502      12
PERLND  8      0.306      COPY  602      12
PERLND  8      0.306      COPY  502      13
PERLND  8      0.306      COPY  602      13
IMPLND  4      1.072      COPY  502      15
IMPLND  4      1.072      COPY  602      15

```

```

*****Routing*****
RCHRES  1      1      RCHRES  6      7
RCHRES  1      1      COPY  1      17
RCHRES  1      1      RCHRES  2      8
RCHRES  3      1      RCHRES  5      7
RCHRES  3      1      COPY  2      17
RCHRES  3      1      RCHRES  4      8
RCHRES  5      1      COPY  502      17
RCHRES  6      1      COPY  501      17
END SCHEMATIC

```

```

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>  #      <Name>  #  <-factor->strg <Name>  #  #      <Name>  #  #      ***

```

COPY	502	OUTPUT	MEAN	1	1	48.4	DISPLY	2	INPUT	TIMSER	1
COPY	501	OUTPUT	MEAN	1	1	48.4	DISPLY	1	INPUT	TIMSER	1

```

<-Volume-> <-Grp> <-Member-><-Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> # <Name> # #<-factor->strg <Name> # # <Name> # # ***
END NETWORK

```

RCHRES

GEN-INFO

RCHRES	Name	Nexits	Unit	Systems	Printer			
# - #	<-----><----->	User	T-series	Engl Metr	LKFG			
			in out					
1	Surface Bioreten-009	2	1	1 1	28 0	1		
2	Road Bioretentio-008	1	1	1 1	28 0	1		
3	Surface Bioreten-011	2	1	1 1	28 0	1		
4	Commerical/Flex -010	1	1	1 1	28 0	1		
5	Road Infiltratio-013	2	1	1 1	28 0	1		
6	Gravel Trench Be-021	2	1	1 1	28 0	1		

END GEN-INFO

*** Section RCHRES***

ACTIVITY

<PLS > ***** Active Sections *****

# - #	HYFG	ADFG	CNFG	HTFG	SDFG	GQFG	OXFG	NUFG	PKFG	PHFG	***
1	1	0	0	0	0	0	0	0	0	0	
2	1	0	0	0	0	0	0	0	0	0	
3	1	0	0	0	0	0	0	0	0	0	
4	1	0	0	0	0	0	0	0	0	0	
5	1	0	0	0	0	0	0	0	0	0	
6	1	0	0	0	0	0	0	0	0	0	

END ACTIVITY

PRINT-INFO

# - #	HYDR	ADCA	CONS	HEAT	SED	GQL	OXRX	NUTR	PLNK	PHCB	PIVL	PYR	*****
1	4	0	0	0	0	0	0	0	0	0	1	9	
2	4	0	0	0	0	0	0	0	0	0	1	9	
3	4	0	0	0	0	0	0	0	0	0	1	9	
4	4	0	0	0	0	0	0	0	0	0	1	9	
5	4	0	0	0	0	0	0	0	0	0	1	9	
6	4	0	0	0	0	0	0	0	0	0	1	9	

END PRINT-INFO

HYDR-PARM1

RCHRES	Flags	for each HYDR Section																
# - #	VC	A1	A2	A3	ODFVFG	for each	***	ODGTFG	for each									
	FG	FG	FG	FG	possible	exit	***	possible	exit									
	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
1	0	1	0	0	4	5	0	0	0	0	0	0	0	0	0	2	2	2
2	0	1	0	0	4	0	0	0	0	0	0	0	0	0	0	2	2	2
3	0	1	0	0	4	5	0	0	0	0	0	0	0	0	0	2	2	2
4	0	1	0	0	4	0	0	0	0	0	0	0	0	0	0	2	2	2
5	0	1	0	0	4	5	0	0	0	0	0	0	0	0	0	2	2	2
6	0	1	0	0	4	5	0	0	0	0	0	0	0	0	0	2	2	2

END HYDR-PARM1

HYDR-PARM2

# - #	FTABNO	LEN	DELTH	STCOR	KS	DB50	
<-----><-----><-----><-----><-----><----->							
1	1	0.01	0.0	0.0	0.0	0.0	
2	2	0.02	0.0	0.0	0.0	0.0	
3	3	0.01	0.0	0.0	0.0	0.0	
4	4	0.01	0.0	0.0	0.0	0.0	
5	5	0.01	0.0	0.0	0.5	0.0	
6	6	0.02	0.0	0.0	0.5	0.0	

END HYDR-PARM2

HYDR-INIT

RCHRES Initial conditions for each HYDR section ***

#	-	***	VOL	Initial value of COLIND					Initial value of OUTDGT				
***			ac-ft	for each possible exit					for each possible exit				
<----->			<----->	<----->	<----->	<----->	<----->	***	<----->	<----->	<----->	<----->	
1			0	4.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2			0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3			0	4.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
4			0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5			0	4.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
6			0	4.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES

FTABLE 2
70 4

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.013774	0.000000	0.000000		
0.043956	0.013774	0.000277	0.000000		
0.087912	0.013774	0.000554	0.000000		
0.131868	0.013774	0.000831	0.000000		
0.175824	0.013774	0.001107	0.000000		
0.219780	0.013774	0.001384	0.000380		
0.263736	0.013774	0.001661	0.000638		
0.307692	0.013774	0.001938	0.000986		
0.351648	0.013774	0.002215	0.001434		
0.395604	0.013774	0.002492	0.001994		
0.439560	0.013774	0.002769	0.002673		
0.483516	0.013774	0.003046	0.003481		
0.527473	0.013774	0.003322	0.004323		
0.571429	0.013774	0.003599	0.004425		
0.615385	0.013774	0.003876	0.005512		
0.659341	0.013774	0.004153	0.006749		
0.703297	0.013774	0.004430	0.008144		
0.747253	0.013774	0.004707	0.009703		
0.791209	0.013774	0.004984	0.010449		
0.835165	0.013774	0.005261	0.011431		
0.879121	0.013774	0.005537	0.013335		
0.923077	0.013774	0.005814	0.015420		
0.967033	0.013774	0.006091	0.017692		
1.010989	0.013774	0.006368	0.020005		
1.054945	0.013774	0.006645	0.020156		
1.098901	0.013774	0.006922	0.022817		
1.142857	0.013774	0.007199	0.025680		
1.186813	0.013774	0.007476	0.028751		
1.230769	0.013774	0.007752	0.032033		
1.274725	0.013774	0.008029	0.033474		
1.318681	0.013774	0.008306	0.035530		
1.362637	0.013774	0.008583	0.039248		
1.406593	0.013774	0.008860	0.043189		
1.450549	0.013774	0.009137	0.047359		
1.494505	0.013774	0.009414	0.051289		
1.538462	0.013774	0.009665	0.051758		
1.582418	0.013774	0.009916	0.056391		
1.626374	0.013774	0.010168	0.061259		
1.670330	0.013774	0.010419	0.066361		
1.714286	0.013774	0.010670	0.071692		
1.758242	0.013774	0.010921	0.073842		
1.802198	0.013774	0.011173	0.077234		
1.846154	0.013774	0.011424	0.082851		
1.890110	0.013774	0.011675	0.111111		
1.934066	0.013774	0.011926	0.111111		
1.978022	0.013774	0.012178	0.111111		
2.021978	0.013774	0.012429	0.111111		
2.065934	0.013774	0.012680	0.111111		
2.109890	0.013774	0.012931	0.111111		
2.153846	0.013774	0.013183	0.111111		
2.197802	0.013774	0.013434	0.111111		

2.241758	0.013774	0.013685	0.111111
2.285714	0.013774	0.013936	0.111111
2.329670	0.013774	0.014188	0.111111
2.373626	0.013774	0.014439	0.111111
2.417582	0.013774	0.014690	0.111111
2.461538	0.013774	0.014942	0.111111
2.505495	0.013774	0.015193	0.111111
2.549451	0.013774	0.015444	0.111111
2.593407	0.013774	0.015695	0.111111
2.637363	0.013774	0.015947	0.111111
2.681319	0.013774	0.016198	0.111111
2.725275	0.013774	0.016449	0.111111
2.769231	0.013774	0.016700	0.111111
2.813187	0.013774	0.016952	0.111111
2.857143	0.013774	0.017203	0.111111
2.901099	0.013774	0.017454	0.111111
2.945055	0.013774	0.017705	0.111111
2.989011	0.013774	0.017957	0.111111
3.000000	0.013774	0.020315	0.111111

END FTABLE 2
FTABLE 1

24	5	Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
		0.000000	0.013774	0.000000	0.000000	0.000000		
		0.043956	0.013774	0.000605	0.000000	0.083333		
		0.087912	0.013774	0.001211	0.000000	0.088217		
		0.131868	0.013774	0.001816	0.000000	0.090659		
		0.175824	0.013774	0.002422	0.000000	0.093101		
		0.219780	0.013774	0.003027	0.000000	0.095543		
		0.263736	0.013774	0.003633	0.000000	0.097985		
		0.307692	0.013774	0.004238	0.000000	0.100427		
		0.351648	0.013774	0.004844	0.000000	0.102869		
		0.395604	0.013774	0.005449	0.000000	0.105311		
		0.439560	0.013774	0.006055	0.000000	0.107753		
		0.483516	0.013774	0.006660	0.000000	0.110195		
		0.527473	0.013774	0.007265	0.048301	0.111111		
		0.571429	0.013774	0.007871	0.202028	0.111111		
		0.615385	0.013774	0.008476	0.412175	0.111111		
		0.659341	0.013774	0.009082	0.659695	0.111111		
		0.703297	0.013774	0.009687	0.928167	0.111111		
		0.747253	0.013774	0.010293	1.200769	0.111111		
		0.791209	0.013774	0.010898	1.460630	0.111111		
		0.835165	0.013774	0.011504	1.692395	0.111111		
		0.879121	0.013774	0.012109	1.884482	0.111111		
		0.923077	0.013774	0.012715	2.031838	0.111111		
		0.967033	0.013774	0.013320	2.139092	0.111111		
		1.000000	0.013774	0.013774	2.251466	0.111111		

END FTABLE 1
FTABLE 4

56	4	Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
		0.000000	0.027548	0.000000	0.000000		
		0.054945	0.027548	0.000692	0.000000		
		0.109890	0.027548	0.001384	0.000000		
		0.164835	0.027548	0.002077	0.000000		
		0.219780	0.027548	0.002769	0.001131		
		0.274725	0.027548	0.003461	0.001971		
		0.329670	0.027548	0.004153	0.003127		
		0.384615	0.027548	0.004845	0.003291		
		0.439560	0.027548	0.005537	0.004636		
		0.494505	0.027548	0.006230	0.006533		
		0.549451	0.027548	0.006922	0.008849		
		0.604396	0.027548	0.007614	0.011613		
		0.659341	0.027548	0.008306	0.013981		
		0.714286	0.027548	0.008998	0.014853		
		0.769231	0.027548	0.009691	0.018595		
		0.824176	0.027548	0.010383	0.022862		
		0.879121	0.027548	0.011075	0.027678		

0.934066	0.027548	0.011767	0.033064
0.989011	0.027548	0.012459	0.034534
1.043956	0.027548	0.013152	0.039043
1.098901	0.027548	0.013844	0.045634
1.153846	0.027548	0.014536	0.052857
1.208791	0.027548	0.015228	0.060730
1.263736	0.027548	0.015920	0.066948
1.318681	0.027548	0.016612	0.069271
1.373626	0.027548	0.017305	0.078496
1.428571	0.027548	0.017997	0.088421
1.483516	0.027548	0.018689	0.099059
1.538462	0.027548	0.019317	0.110422
1.593407	0.027548	0.019945	0.112937
1.648352	0.027548	0.020574	0.122518
1.703297	0.027548	0.021202	0.135345
1.758242	0.027548	0.021830	0.148879
1.813187	0.027548	0.022458	0.162949
1.868132	0.027548	0.023086	0.277778
1.923077	0.027548	0.023714	0.277778
1.978022	0.027548	0.024342	0.277778
2.032967	0.027548	0.024971	0.277778
2.087912	0.027548	0.025599	0.277778
2.142857	0.027548	0.026227	0.277778
2.197802	0.027548	0.026855	0.277778
2.252747	0.027548	0.027483	0.277778
2.307692	0.027548	0.028111	0.277778
2.362637	0.027548	0.028740	0.277778
2.417582	0.027548	0.029368	0.277778
2.472527	0.027548	0.029996	0.277778
2.527473	0.027548	0.030624	0.277778
2.582418	0.027548	0.031252	0.277778
2.637363	0.027548	0.031880	0.277778
2.692308	0.027548	0.032509	0.277778
2.747253	0.027548	0.033137	0.277778
2.802198	0.027548	0.033765	0.277778
2.857143	0.027548	0.034393	0.277778
2.912088	0.027548	0.035021	0.277778
2.967033	0.027548	0.035649	0.277778
3.000000	0.027548	0.041765	0.277778

END FTABLE 4

FTABLE 3

38 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.027548	0.000000	0.000000	0.000000		
0.054945	0.027548	0.001514	0.000000	0.166667		
0.109890	0.027548	0.003027	0.000000	0.178877		
0.164835	0.027548	0.004541	0.000000	0.184982		
0.219780	0.027548	0.006055	0.000000	0.191087		
0.274725	0.027548	0.007568	0.000000	0.197192		
0.329670	0.027548	0.009082	0.000000	0.203297		
0.384615	0.027548	0.010595	0.000000	0.209402		
0.439560	0.027548	0.012109	0.000000	0.215507		
0.494505	0.027548	0.013623	0.000000	0.221612		
0.549451	0.027548	0.015136	0.000000	0.227717		
0.604396	0.027548	0.016650	0.000000	0.233822		
0.659341	0.027548	0.018164	0.000000	0.239927		
0.714286	0.027548	0.019677	0.000000	0.246032		
0.769231	0.027548	0.021191	0.000000	0.252137		
0.824176	0.027548	0.022705	0.000000	0.258242		
0.879121	0.027548	0.024218	0.000000	0.264347		
0.934066	0.027548	0.025732	0.000000	0.270452		
0.989011	0.027548	0.027245	0.000000	0.276557		
1.043956	0.027548	0.028759	0.195553	0.277778		
1.098901	0.027548	0.030273	0.659242	0.277778		
1.153846	0.027548	0.031786	1.276591	0.277778		
1.208791	0.027548	0.033300	2.010935	0.277778		
1.263736	0.027548	0.034814	2.836899	0.277778		
1.318681	0.027548	0.036327	3.731796	0.277778		
1.373626	0.027548	0.037841	4.673072	0.277778		

1.428571	0.027548	0.039355	5.637608	0.277778
1.483516	0.027548	0.040868	6.601841	0.277778
1.538462	0.027548	0.042382	7.542349	0.277778
1.593407	0.027548	0.043895	8.436754	0.277778
1.648352	0.027548	0.045409	9.264852	0.277778
1.703297	0.027548	0.046923	10.00993	0.277778
1.758242	0.027548	0.048436	10.66024	0.277778
1.813187	0.027548	0.049950	11.21062	0.277778
1.868132	0.027548	0.051464	11.66425	0.277778
1.923077	0.027548	0.052977	12.03449	0.277778
1.978022	0.027548	0.054491	12.34684	0.277778
2.000000	0.027548	0.055096	12.80450	0.277778

END FTABLE 3

FTABLE 5

92	5						
Depth	Area	Volume	Outflow1	Outflow2	Velocity	Travel Time***	
(ft)	(acres)	(acre-ft)	(cfs)	(cfs)	(ft/sec)	(Minutes)***	
0.000000	0.027548	0.000000	0.000000	0.000000			
0.055556	0.027548	0.000536	0.000000	0.055556			
0.111111	0.027548	0.001071	0.000000	0.055556			
0.166667	0.027548	0.001607	0.000000	0.055556			
0.222222	0.027548	0.002143	0.000000	0.055556			
0.277778	0.027548	0.002678	0.000000	0.055556			
0.333333	0.027548	0.003214	0.000000	0.055556			
0.388889	0.027548	0.003750	0.000000	0.055556			
0.444444	0.027548	0.004285	0.000000	0.055556			
0.500000	0.027548	0.004821	0.000000	0.055556			
0.555556	0.027548	0.005357	0.000000	0.055556			
0.611111	0.027548	0.005892	0.000000	0.055556			
0.666667	0.027548	0.006428	0.000000	0.055556			
0.722222	0.027548	0.006964	0.000000	0.055556			
0.777778	0.027548	0.007499	0.000000	0.055556			
0.833333	0.027548	0.008035	0.000000	0.055556			
0.888889	0.027548	0.008571	0.000000	0.055556			
0.944444	0.027548	0.009106	0.000000	0.055556			
1.000000	0.027548	0.009642	0.000000	0.055556			
1.055556	0.027548	0.010178	0.000000	0.055556			
1.111111	0.027548	0.010713	0.000000	0.055556			
1.166667	0.027548	0.011249	0.000000	0.055556			
1.222222	0.027548	0.011785	0.000000	0.055556			
1.277778	0.027548	0.012320	0.000000	0.055556			
1.333333	0.027548	0.012856	0.000000	0.055556			
1.388889	0.027548	0.013391	0.000000	0.055556			
1.444444	0.027548	0.013927	0.000000	0.055556			
1.500000	0.027548	0.014463	0.000000	0.055556			
1.555556	0.027548	0.014998	0.000000	0.055556			
1.611111	0.027548	0.015534	0.000000	0.055556			
1.666667	0.027548	0.016070	0.000000	0.055556			
1.722222	0.027548	0.016605	0.000000	0.055556			
1.777778	0.027548	0.017141	0.000000	0.055556			
1.833333	0.027548	0.017677	0.000000	0.055556			
1.888889	0.027548	0.018212	0.000000	0.055556			
1.944444	0.027548	0.018748	0.000000	0.055556			
2.000000	0.027548	0.019284	0.000000	0.055556			
2.055556	0.027548	0.019819	0.000000	0.055556			
2.111111	0.027548	0.020355	0.000000	0.055556			
2.166667	0.027548	0.020891	0.000000	0.055556			
2.222222	0.027548	0.021426	0.000000	0.055556			
2.277778	0.027548	0.021962	0.000000	0.055556			
2.333333	0.027548	0.022498	0.000000	0.055556			
2.388889	0.027548	0.023033	0.000000	0.055556			
2.444444	0.027548	0.023569	0.000000	0.055556			
2.500000	0.027548	0.024105	0.000000	0.055556			
2.555556	0.027548	0.024640	0.000000	0.055556			
2.611111	0.027548	0.025176	0.000000	0.055556			
2.666667	0.027548	0.025712	0.000000	0.055556			
2.722222	0.027548	0.026247	0.000000	0.055556			
2.777778	0.027548	0.026783	0.000000	0.055556			
2.833333	0.027548	0.027319	0.000000	0.055556			
2.888889	0.027548	0.027854	0.000000	0.055556			

2.944444	0.027548	0.028390	0.000000	0.055556
3.000000	0.027548	0.028926	0.000000	0.055556
3.055556	0.027548	0.029461	0.000000	0.055556
3.111111	0.027548	0.029997	0.000000	0.055556
3.166667	0.027548	0.030533	0.000000	0.055556
3.222222	0.027548	0.031068	0.000000	0.055556
3.277778	0.027548	0.031604	0.000000	0.055556
3.333333	0.027548	0.032140	0.000000	0.055556
3.388889	0.027548	0.032675	0.000000	0.055556
3.444444	0.027548	0.033211	0.000000	0.055556
3.500000	0.027548	0.033747	0.000000	0.055556
3.555556	0.027548	0.034282	0.000000	0.055556
3.611111	0.027548	0.034818	0.000000	0.055556
3.666667	0.027548	0.035354	0.000000	0.055556
3.722222	0.027548	0.035889	0.000000	0.055556
3.777778	0.027548	0.036425	0.000000	0.055556
3.833333	0.027548	0.036961	0.000000	0.055556
3.888889	0.027548	0.037496	0.000000	0.055556
3.944444	0.027548	0.038032	0.000000	0.055556
4.000000	0.027548	0.038567	0.000000	0.055556
4.055556	0.027548	0.039103	0.138729	0.055556
4.111111	0.027548	0.039639	0.389839	0.055556
4.166667	0.027548	0.040174	0.703432	0.055556
4.222222	0.027548	0.040710	1.046030	0.055556
4.277778	0.027548	0.041246	1.383552	0.055556
4.333333	0.027548	0.041781	1.683468	0.055556
4.388889	0.027548	0.042317	1.921105	0.055556
4.444444	0.027548	0.042853	2.088233	0.055556
4.500000	0.027548	0.043388	2.203335	0.055556
4.555556	0.027548	0.043924	2.347596	0.055556
4.611111	0.027548	0.044460	2.462179	0.055556
4.666667	0.027548	0.044995	2.571662	0.055556
4.722222	0.027548	0.045531	2.676671	0.055556
4.777778	0.027548	0.046067	2.777713	0.055556
4.833333	0.027548	0.046602	2.875206	0.055556
4.888889	0.027548	0.047138	2.969500	0.055556
4.944444	0.027548	0.047674	3.060890	0.055556
5.000000	0.027548	0.048209	3.149630	0.055556
5.055556	0.027548	0.048745	3.235937	0.055556

END FTABLE 5

FTABLE 6

92 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.013774	0.000000	0.000000	0.000000		
0.055556	0.013774	0.000268	0.000000	0.027778		
0.111111	0.013774	0.000536	0.000000	0.027778		
0.166667	0.013774	0.000803	0.000000	0.027778		
0.222222	0.013774	0.001071	0.000000	0.027778		
0.277778	0.013774	0.001339	0.000000	0.027778		
0.333333	0.013774	0.001607	0.000000	0.027778		
0.388889	0.013774	0.001875	0.000000	0.027778		
0.444444	0.013774	0.002143	0.000000	0.027778		
0.500000	0.013774	0.002410	0.000000	0.027778		
0.555556	0.013774	0.002678	0.000000	0.027778		
0.611111	0.013774	0.002946	0.000000	0.027778		
0.666667	0.013774	0.003214	0.000000	0.027778		
0.722222	0.013774	0.003482	0.000000	0.027778		
0.777778	0.013774	0.003750	0.000000	0.027778		
0.833333	0.013774	0.004017	0.000000	0.027778		
0.888889	0.013774	0.004285	0.000000	0.027778		
0.944444	0.013774	0.004553	0.000000	0.027778		
1.000000	0.013774	0.004821	0.000000	0.027778		
1.055556	0.013774	0.005089	0.000000	0.027778		
1.111111	0.013774	0.005357	0.000000	0.027778		
1.166667	0.013774	0.005624	0.000000	0.027778		
1.222222	0.013774	0.005892	0.000000	0.027778		
1.277778	0.013774	0.006160	0.000000	0.027778		
1.333333	0.013774	0.006428	0.000000	0.027778		
1.388889	0.013774	0.006696	0.000000	0.027778		

1.444444	0.013774	0.006964	0.000000	0.027778
1.500000	0.013774	0.007231	0.000000	0.027778
1.555556	0.013774	0.007499	0.000000	0.027778
1.611111	0.013774	0.007767	0.000000	0.027778
1.666667	0.013774	0.008035	0.000000	0.027778
1.722222	0.013774	0.008303	0.000000	0.027778
1.777778	0.013774	0.008571	0.000000	0.027778
1.833333	0.013774	0.008838	0.000000	0.027778
1.888889	0.013774	0.009106	0.000000	0.027778
1.944444	0.013774	0.009374	0.000000	0.027778
2.000000	0.013774	0.009642	0.000000	0.027778
2.055556	0.013774	0.009910	0.000000	0.027778
2.111111	0.013774	0.010178	0.000000	0.027778
2.166667	0.013774	0.010445	0.000000	0.027778
2.222222	0.013774	0.010713	0.000000	0.027778
2.277778	0.013774	0.010981	0.000000	0.027778
2.333333	0.013774	0.011249	0.000000	0.027778
2.388889	0.013774	0.011517	0.000000	0.027778
2.444444	0.013774	0.011785	0.000000	0.027778
2.500000	0.013774	0.012052	0.000000	0.027778
2.555556	0.013774	0.012320	0.000000	0.027778
2.611111	0.013774	0.012588	0.000000	0.027778
2.666667	0.013774	0.012856	0.000000	0.027778
2.722222	0.013774	0.013124	0.000000	0.027778
2.777778	0.013774	0.013391	0.000000	0.027778
2.833333	0.013774	0.013659	0.000000	0.027778
2.888889	0.013774	0.013927	0.000000	0.027778
2.944444	0.013774	0.014195	0.000000	0.027778
3.000000	0.013774	0.014463	0.000000	0.027778
3.055556	0.013774	0.014731	0.138729	0.027778
3.111111	0.013774	0.014998	0.389839	0.027778
3.166667	0.013774	0.015266	0.703432	0.027778
3.222222	0.013774	0.015534	1.046030	0.027778
3.277778	0.013774	0.015802	1.383552	0.027778
3.333333	0.013774	0.016070	1.683468	0.027778
3.388889	0.013774	0.016338	1.921105	0.027778
3.444444	0.013774	0.016605	2.088233	0.027778
3.500000	0.013774	0.016873	2.203335	0.027778
3.555556	0.013774	0.017141	2.347596	0.027778
3.611111	0.013774	0.017409	2.462179	0.027778
3.666667	0.013774	0.017677	2.571662	0.027778
3.722222	0.013774	0.017945	2.676671	0.027778
3.777778	0.013774	0.018212	2.777713	0.027778
3.833333	0.013774	0.018480	2.875206	0.027778
3.888889	0.013774	0.018748	2.969500	0.027778
3.944444	0.013774	0.019016	3.060890	0.027778
4.000000	0.013774	0.019284	3.149630	0.027778
4.055556	0.013774	0.019552	3.235937	0.027778
4.111111	0.013774	0.019819	3.320002	0.027778
4.166667	0.013774	0.020087	3.401989	0.027778
4.222222	0.013774	0.020355	3.482047	0.027778
4.277778	0.013774	0.020623	3.560305	0.027778
4.333333	0.013774	0.020891	3.636879	0.027778
4.388889	0.013774	0.021159	3.711875	0.027778
4.444444	0.013774	0.021426	3.785384	0.027778
4.500000	0.013774	0.021694	3.857493	0.027778
4.555556	0.013774	0.021962	3.928279	0.027778
4.611111	0.013774	0.022230	3.997811	0.027778
4.666667	0.013774	0.022498	4.066155	0.027778
4.722222	0.013774	0.022766	4.133369	0.027778
4.777778	0.013774	0.023033	4.199507	0.027778
4.833333	0.013774	0.023301	4.264619	0.027778
4.888889	0.013774	0.023569	4.328752	0.027778
4.944444	0.013774	0.023837	4.391949	0.027778
5.000000	0.013774	0.024105	4.454250	0.027778
5.055556	0.013774	0.024870	4.515690	0.027778

END FTABLE 6

END FTABLES

EXT SOURCES

<-Volume->	<Member>	SsysSgap	<-Mult-->Tran	<-Target	vols>	<-Grp>	<-Member->	***
<Name>	#	<Name>	#	tem strg	<-factor->strg	<Name>	#	#
WDM	2	PREC	ENGL	1.429		PERLND	1	999
WDM	2	PREC	ENGL	1.429		IMPLND	1	999
WDM	1	EVAP	ENGL	0.76		PERLND	1	999
WDM	1	EVAP	ENGL	0.76		IMPLND	1	999
WDM	2	PREC	ENGL	1.429		RCHRES	1	
WDM	2	PREC	ENGL	1.429		RCHRES	3	
WDM	1	EVAP	ENGL	0.5		RCHRES	1	
WDM	1	EVAP	ENGL	0.76		RCHRES	2	
WDM	1	EVAP	ENGL	0.5		RCHRES	3	
WDM	1	EVAP	ENGL	0.76		RCHRES	4	

END EXT SOURCES

EXT TARGETS

<-Volume->	<-Grp>	<-Member->	<-Mult-->Tran	<-Volume->	<Member>	Tsys	Tgap	Amd	***
<Name>	#	<Name>	#	tem strg	<-factor->strg	<Name>	#	<Name>	tem strg
RCHRES	5	HYDR	RO	1	1	WDM	1004	FLOW	ENGL
RCHRES	5	HYDR	0	1	1	WDM	1005	FLOW	ENGL
RCHRES	5	HYDR	0	2	1	WDM	1006	FLOW	ENGL
RCHRES	5	HYDR	STAGE	1	1	WDM	1007	STAG	ENGL
COPY	2	OUTPUT	MEAN	1	1	WDM	702	FLOW	ENGL
COPY	502	OUTPUT	MEAN	1	1	WDM	802	FLOW	ENGL
COPY	602	OUTPUT	MEAN	1	1	WDM	902	FLOW	ENGL
COPY	1	OUTPUT	MEAN	1	1	WDM	701	FLOW	ENGL
COPY	501	OUTPUT	MEAN	1	1	WDM	801	FLOW	ENGL
COPY	601	OUTPUT	MEAN	1	1	WDM	901	FLOW	ENGL
RCHRES	6	HYDR	RO	1	1	WDM	1014	FLOW	ENGL
RCHRES	6	HYDR	0	1	1	WDM	1015	FLOW	ENGL
RCHRES	6	HYDR	0	2	1	WDM	1016	FLOW	ENGL
RCHRES	6	HYDR	STAGE	1	1	WDM	1017	STAG	ENGL

MASS-LINK

<Volume>	<-Grp>	<-Member->	<-Mult-->	<Target>	<-Grp>	<-Member->	***
<Name>	#	<Name>	#	<-factor->	<Name>	#	#
MASS-LINK		5					
IMPLND	IWATER	SURO		0.083333	RCHRES	INFLOW	IVOL
END MASS-LINK		5					
MASS-LINK		7					
RCHRES	OFLOW	OVOL	1		RCHRES	INFLOW	IVOL
END MASS-LINK		7					
MASS-LINK		8					
RCHRES	OFLOW	OVOL	2		RCHRES	INFLOW	IVOL
END MASS-LINK		8					
MASS-LINK		12					
PERLND	PWATER	SURO		0.083333	COPY	INPUT	MEAN
END MASS-LINK		12					
MASS-LINK		13					
PERLND	PWATER	IFWO		0.083333	COPY	INPUT	MEAN
END MASS-LINK		13					
MASS-LINK		15					
IMPLND	IWATER	SURO		0.083333	COPY	INPUT	MEAN
END MASS-LINK		15					
MASS-LINK		17					
RCHRES	OFLOW	OVOL	1		COPY	INPUT	MEAN
END MASS-LINK		17					

END MASS-LINK

END RUN

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WWHM2012
PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node D

Site Name: LOTC

Site Address:

City: Castle Rock, WA

Report Date: 3/7/2025

Gage: Longview

Data Start: 1955/10/01

Data End: 2009/09/30

Timestep: 15 Minute

Precip Scale: 1.429

Version Date: 2024/06/28

Version: 4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Node D - Remaining Onsite Areas

Bypass: No

GroundWater: No

Pervious Land Use acre
A B, Forest, Mod 75.858

Pervious Total 75.858

Impervious Land Use acre

Impervious Total 0

Basin Total 75.858

Element Flow Componentants:

Surface	Interflow	Groundwater
Component Flows To:		
POC 1	POC 1	

Mitigated Land Use

Node D - Non-PGIS

Bypass: Yes

GroundWater: No

Pervious Land Use acre
A B, Lawn, Mod 9.462

Pervious Total 9.462

Impervious Land Use acre
ROOF TOPS FLAT 20.159

Impervious Total 20.159

Basin Total 29.621

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Node D - PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	46.237
Impervious Total	46.237
Basin Total	46.237

Element Flow Components:

Surface	Interflow	Groundwater
Component Flows To:		
Surface retention 1	80.0	POC 1

Routing Elements

Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length: 270.00 ft.
 Bottom Width: 270.00 ft.
 Material thickness of first layer: 1.5
 Material type for first layer: SMMWW 12 in/hr
 Material thickness of second layer: 3
 Material type for second layer: GRAVEL
 Material thickness of third layer: 0
 Material type for third layer: GRAVEL
 Underdrain used
 Underdrain Diameter (feet): 2
 Orifice Diameter (in.): 24
 Offset (in.): 0
 Flow Through Underdrain (ac-ft.): 11251.882
 Total Outflow (ac-ft.): 11264.741
 Percent Through Underdrain: 99.89
 Discharge Structure
 Riser Height: 1 ft.
 Riser Diameter: 60 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:
 Gravel Trench Bed 1

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	1.6736	0.0000	0.0000	0.0000
0.0714	1.6736	0.0547	0.0000	0.0000
0.1429	1.6736	0.1093	0.0000	0.0000
0.2143	1.6736	0.1640	0.0000	0.0000
0.2857	1.6736	0.2187	0.0000	0.0000
0.3571	1.6736	0.2733	0.0000	0.0000
0.4286	1.6736	0.3280	0.0000	0.0000
0.5000	1.6736	0.3827	0.0000	0.0000
0.5714	1.6736	0.4373	0.0000	0.0000
0.6429	1.6736	0.4920	0.0000	0.0000
0.7143	1.6736	0.5467	0.0000	0.0000
0.7857	1.6736	0.6013	0.0000	0.0000
0.8571	1.6736	0.6560	0.0000	0.0000
0.9286	1.6736	0.7107	0.0000	0.0000
1.0000	1.6736	0.7653	0.0000	0.0000
1.0714	1.6736	0.8200	0.0000	0.0000
1.1429	1.6736	0.8746	0.0000	0.0000
1.2143	1.6736	0.9293	0.0000	0.0000
1.2857	1.6736	0.9840	0.0000	0.0000
1.3571	1.6736	1.0386	0.0000	0.0000
1.4286	1.6736	1.0933	0.0000	0.0000
1.5000	1.6736	1.1480	0.0000	0.0000
1.5714	1.6736	1.1976	0.0000	0.0000
1.6429	1.6736	1.2472	0.0000	0.0000
1.7143	1.6736	1.2968	0.0000	0.0000
1.7857	1.6736	1.3464	0.0000	0.0000
1.8571	1.6736	1.3960	0.0000	0.0000
1.9286	1.6736	1.4456	0.0000	0.0000

2.0000	1.6736	1.4952	0.0000	0.0000
2.0714	1.6736	1.5448	0.0000	0.0000
2.1429	1.6736	1.5945	0.0000	0.0000
2.2143	1.6736	1.6441	0.0000	0.0000
2.2857	1.6736	1.6937	0.0000	0.0000
2.3571	1.6736	1.7433	0.0000	0.0000
2.4286	1.6736	1.7929	0.0000	0.0000
2.5000	1.6736	1.8425	0.0000	0.0000
2.5714	1.6736	1.8921	0.0000	0.0000
2.6429	1.6736	1.9417	0.0000	0.0000
2.7143	1.6736	1.9913	0.0000	0.0000
2.7857	1.6736	2.0409	0.0000	0.0000
2.8571	1.6736	2.0905	0.0000	0.0000
2.9286	1.6736	2.1402	0.0000	0.0000
3.0000	1.6736	2.1898	0.0000	0.0000
3.0714	1.6736	2.2394	0.0000	0.0000
3.1429	1.6736	2.2890	0.0000	0.0000
3.2143	1.6736	2.3386	0.0000	0.0000
3.2857	1.6736	2.3882	0.0000	0.0000
3.3571	1.6736	2.4378	0.0000	0.0000
3.4286	1.6736	2.4874	0.0000	0.0000
3.5000	1.6736	2.5370	0.0000	0.0000
3.5714	1.6736	2.5866	0.0000	0.0000
3.6429	1.6736	2.6362	0.0000	0.0000
3.7143	1.6736	2.6859	0.0000	0.0000
3.7857	1.6736	2.7355	0.0000	0.0000
3.8571	1.6736	2.7851	0.0000	0.0000
3.9286	1.6736	2.8347	0.0000	0.0000
4.0000	1.6736	2.8843	0.0000	0.0000
4.0714	1.6736	2.9339	0.0000	0.0000
4.1429	1.6736	2.9835	0.0000	0.0000
4.2143	1.6736	3.0331	0.0000	0.0000
4.2857	1.6736	3.0827	0.0000	0.0000
4.3571	1.6736	3.1323	0.0000	0.0000
4.4286	1.6736	3.1819	0.0000	0.0000
4.5000	1.6736	3.2315	0.0000	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infiltr(cfs)
4.5000	1.6736	3.2315	0.0000	10.125	0.0000
4.5714	1.6736	3.3511	0.0000	10.125	0.0000
4.6429	1.6736	3.4706	0.0000	11.089	0.0000
4.7143	1.6736	3.5902	0.0531	11.571	0.0000
4.7857	1.6736	3.7097	0.0620	12.054	0.0000
4.8571	1.6736	3.8292	0.1138	12.536	0.0000
4.9286	1.6736	3.9488	0.2065	13.018	0.0000
5.0000	1.6736	4.0683	0.2736	13.500	0.0000
5.0714	1.6736	4.1879	0.3362	13.982	0.0000
5.1429	1.6736	4.3074	0.5073	14.464	0.0000
5.2143	1.6736	4.4269	0.6872	14.946	0.0000
5.2857	1.6736	4.5465	0.7239	15.429	0.0000
5.3571	1.6736	4.6660	0.9895	15.911	0.0000
5.4286	1.6736	4.7856	1.3076	16.393	0.0000
5.5000	1.6736	4.9051	1.3450	16.875	0.0000
5.5714	1.6736	5.0246	1.6814	16.875	0.0000
5.6429	1.6736	5.1442	2.1138	16.875	0.0000
5.7143	1.6736	5.2637	2.2825	16.875	0.0000
5.7857	1.6736	5.3833	2.6076	16.875	0.0000

5.8571	1.6736	5.5028	3.1654	16.875	0.0000
5.9286	1.6736	5.6223	3.5316	16.875	0.0000
6.0000	1.6736	5.7419	3.7898	16.875	0.0000
6.0714	1.6736	5.8614	4.4831	16.875	0.0000
6.1429	1.6736	5.9810	5.1210	16.875	0.0000
6.2143	1.6736	6.1005	5.2475	16.875	0.0000
6.2857	1.6736	6.2200	6.0849	16.875	0.0000
6.3571	1.6736	6.3396	6.9967	16.875	0.0000
6.4286	1.6736	6.4591	7.0772	16.875	0.0000
6.5000	1.6736	6.5787	7.9838	16.875	0.0000
6.5000	1.6736	6.5787	9.0444	16.875	0.0000

Gravel Trench Bed 1

Bottom Length: 270.00 ft.
 Bottom Width: 270.00 ft.
 Trench bottom slope 1: 0 To 1
 Trench Left side slope 0: 0 To 1
 Trench right side slope 2: 0 To 1
 Material thickness of first layer: 5
 Pour Space of material for first layer: 0.35
 Material thickness of second layer: 0
 Pour Space of material for second layer: 0
 Material thickness of third layer: 0
 Pour Space of material for third layer: 0
 Infiltration On
 Infiltration rate: 2
 Infiltration safety factor: 1
 Wetted surface area On
 Total Volume Infiltrated (ac-ft.): 12.558
 Total Volume Through Riser (ac-ft.): 0.301
 Total Volume Through Facility (ac-ft.): 12.859
 Percent Infiltrated: 97.66
 Total Precip Applied to Facility: 0
 Total Evap From Facility: 0
 Discharge Structure
 Riser Height: 3 ft.
 Riser Diameter: 24 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:

Gravel Trench Bed Hydraulic Table

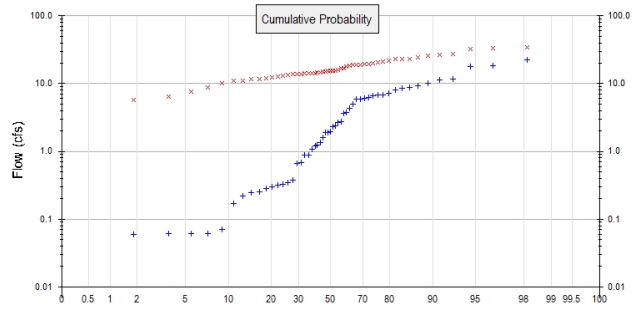
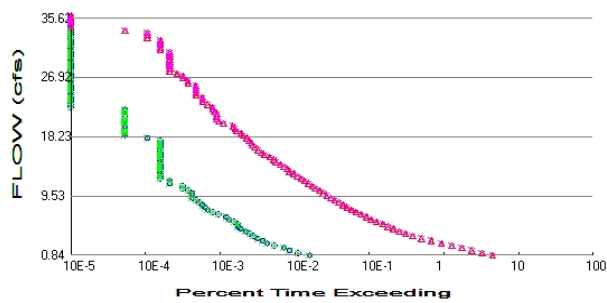
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	1.673	0.000	0.000	0.000
0.0556	1.673	0.032	0.000	3.375
0.1111	1.673	0.065	0.000	3.375
0.1667	1.673	0.097	0.000	3.375
0.2222	1.673	0.130	0.000	3.375
0.2778	1.673	0.162	0.000	3.375
0.3333	1.673	0.195	0.000	3.375
0.3889	1.673	0.227	0.000	3.375
0.4444	1.673	0.260	0.000	3.375
0.5000	1.673	0.292	0.000	3.375
0.5556	1.673	0.325	0.000	3.375
0.6111	1.673	0.358	0.000	3.375
0.6667	1.673	0.390	0.000	3.375
0.7222	1.673	0.423	0.000	3.375
0.7778	1.673	0.455	0.000	3.375
0.8333	1.673	0.488	0.000	3.375
0.8889	1.673	0.520	0.000	3.375
0.9444	1.673	0.553	0.000	3.375
1.0000	1.673	0.585	0.000	3.375
1.0556	1.673	0.618	0.000	3.375
1.1111	1.673	0.650	0.000	3.375
1.1667	1.673	0.683	0.000	3.375
1.2222	1.673	0.715	0.000	3.375
1.2778	1.673	0.748	0.000	3.375

1.3333	1.673	0.781	0.000	3.375
1.3889	1.673	0.813	0.000	3.375
1.4444	1.673	0.846	0.000	3.375
1.5000	1.673	0.878	0.000	3.375
1.5556	1.673	0.911	0.000	3.375
1.6111	1.673	0.943	0.000	3.375
1.6667	1.673	0.976	0.000	3.375
1.7222	1.673	1.008	0.000	3.375
1.7778	1.673	1.041	0.000	3.375
1.8333	1.673	1.073	0.000	3.375
1.8889	1.673	1.106	0.000	3.375
1.9444	1.673	1.138	0.000	3.375
2.0000	1.673	1.171	0.000	3.375
2.0556	1.673	1.204	0.000	3.375
2.1111	1.673	1.236	0.000	3.375
2.1667	1.673	1.269	0.000	3.375
2.2222	1.673	1.301	0.000	3.375
2.2778	1.673	1.334	0.000	3.375
2.3333	1.673	1.366	0.000	3.375
2.3889	1.673	1.399	0.000	3.375
2.4444	1.673	1.431	0.000	3.375
2.5000	1.673	1.464	0.000	3.375
2.5556	1.673	1.496	0.000	3.375
2.6111	1.673	1.529	0.000	3.375
2.6667	1.673	1.562	0.000	3.375
2.7222	1.673	1.594	0.000	3.375
2.7778	1.673	1.627	0.000	3.375
2.8333	1.673	1.659	0.000	3.375
2.8889	1.673	1.692	0.000	3.375
2.9444	1.673	1.724	0.000	3.375
3.0000	1.673	1.757	0.000	3.375
3.0556	1.673	1.789	0.277	3.375
3.1111	1.673	1.822	0.784	3.375
3.1667	1.673	1.854	1.438	3.375
3.2222	1.673	1.887	2.205	3.375
3.2778	1.673	1.919	3.059	3.375
3.3333	1.673	1.952	3.979	3.375
3.3889	1.673	1.985	4.939	3.375
3.4444	1.673	2.017	5.917	3.375
3.5000	1.673	2.050	6.887	3.375
3.5556	1.673	2.082	7.826	3.375
3.6111	1.673	2.115	8.711	3.375
3.6667	1.673	2.147	9.523	3.375
3.7222	1.673	2.180	10.24	3.375
3.7778	1.673	2.212	10.86	3.375
3.8333	1.673	2.245	11.38	3.375
3.8889	1.673	2.277	11.81	3.375
3.9444	1.673	2.310	12.16	3.375
4.0000	1.673	2.343	12.46	3.375
4.0556	1.673	2.375	12.94	3.375
4.1111	1.673	2.408	13.28	3.375
4.1667	1.673	2.440	13.60	3.375
4.2222	1.673	2.473	13.92	3.375
4.2778	1.673	2.505	14.24	3.375
4.3333	1.673	2.538	14.54	3.375
4.3889	1.673	2.570	14.84	3.375
4.4444	1.673	2.603	15.14	3.375
4.5000	1.673	2.635	15.43	3.375

4.5556	1.673	2.668	15.71	3.375
4.6111	1.673	2.700	15.99	3.375
4.6667	1.673	2.733	16.26	3.375
4.7222	1.673	2.766	16.53	3.375
4.7778	1.673	2.798	16.79	3.375
4.8333	1.673	2.831	17.05	3.375
4.8889	1.673	2.863	17.31	3.375
4.9444	1.673	2.896	17.56	3.375
5.0000	1.673	2.928	17.81	3.375

Analysis Results

POC 1



+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area: 75.858
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1

Total Pervious Area: 9.462
Total Impervious Area: 66.396

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	1.670079
5 year	6.542852
10 year	12.548052
25 year	24.004219
50 year	35.616656
100 year	49.985137

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	16.233163
5 year	22.237087
10 year	25.642726
25 year	29.385321
50 year	31.824944
100 year	34.011067

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	11.783	20.849
1957	1.196	23.161
1958	18.091	23.233
1959	4.306	15.629
1960	17.947	24.220
1961	8.737	18.992
1962	22.286	22.757
1963	6.564	26.517
1964	3.685	16.922
1965	1.955	15.433

1966	0.245	14.323
1967	0.893	11.648
1968	0.171	10.007
1969	0.878	14.874
1970	1.246	11.115
1971	7.985	17.904
1972	5.931	14.145
1973	0.282	11.049
1974	8.563	20.064
1975	9.230	33.703
1976	4.984	19.669
1977	0.061	13.058
1978	10.008	20.342
1979	0.320	11.515
1980	0.667	14.348
1981	1.062	16.016
1982	5.823	13.914
1983	2.380	19.155
1984	7.258	14.153
1985	0.217	14.478
1986	6.770	18.775
1987	0.347	18.336
1988	0.071	13.572
1989	0.250	6.508
1990	2.649	13.690
1991	6.257	16.913
1992	0.326	12.653
1993	1.578	11.828
1994	1.367	8.665
1995	0.378	21.604
1996	11.319	25.823
1997	2.742	15.649
1998	2.320	32.629
1999	0.297	7.677
2000	0.684	14.529
2001	0.054	4.186
2002	1.908	34.153
2003	0.060	27.586
2004	0.060	5.656
2005	0.061	15.214
2006	3.717	13.999
2007	6.143	18.747
2008	1.895	12.420
2009	6.779	15.371

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	22.2864	34.1531
2	18.0910	33.7027
3	17.9468	32.6294
4	11.7830	27.5863
5	11.3193	26.5168
6	10.0080	25.8225
7	9.2298	24.2195
8	8.7370	23.2331
9	8.5630	23.1614
10	7.9849	22.7572

11	7.2581	21.6043
12	6.7787	20.8486
13	6.7703	20.3423
14	6.5635	20.0637
15	6.2565	19.6689
16	6.1427	19.1554
17	5.9314	18.9916
18	5.8228	18.7749
19	4.9844	18.7467
20	4.3062	18.3363
21	3.7170	17.9043
22	3.6851	16.9224
23	2.7417	16.9125
24	2.6495	16.0159
25	2.3802	15.6489
26	2.3197	15.6294
27	1.9547	15.4333
28	1.9082	15.3714
29	1.8954	15.2138
30	1.5777	14.8740
31	1.3666	14.5286
32	1.2462	14.4775
33	1.1956	14.3481
34	1.0620	14.3226
35	0.8929	14.1533
36	0.8782	14.1449
37	0.6839	13.9987
38	0.6671	13.9144
39	0.3777	13.6904
40	0.3468	13.5717
41	0.3264	13.0576
42	0.3199	12.6530
43	0.2971	12.4203
44	0.2819	11.8284
45	0.2497	11.6482
46	0.2449	11.5151
47	0.2167	11.1151
48	0.1708	11.0490
49	0.0708	10.0069
50	0.0611	8.6654
51	0.0608	7.6767
52	0.0604	6.5083
53	0.0603	5.6563
54	0.0543	4.1859

Duration Flows

The Duration Matching **Failed**

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.8350	300	84223	28074	Fail
1.1864	207	61179	29555	Fail
1.5377	161	45046	27978	Fail
1.8890	135	32758	24265	Fail
2.2404	100	24010	24010	Fail
2.5917	81	17430	21518	Fail
2.9430	70	12757	18224	Fail
3.2943	60	9483	15805	Fail
3.6457	52	7239	13921	Fail
3.9970	47	5771	12278	Fail
4.3483	42	4743	11292	Fail
4.6997	36	3969	11025	Fail
5.0510	33	3348	10145	Fail
5.4023	32	2857	8928	Fail
5.7537	29	2361	8141	Fail
6.1050	25	1979	7916	Fail
6.4563	23	1720	7478	Fail
6.8076	18	1454	8077	Fail
7.1590	15	1254	8360	Fail
7.5103	13	1093	8407	Fail
7.8616	12	951	7925	Fail
8.2130	11	833	7572	Fail
8.5643	10	740	7400	Fail
8.9156	9	647	7188	Fail
9.2669	8	579	7237	Fail
9.6183	8	512	6400	Fail
9.9696	8	452	5650	Fail
10.3209	7	404	5771	Fail
10.6723	6	355	5916	Fail
11.0236	6	326	5433	Fail
11.3749	4	289	7225	Fail
11.7263	4	255	6375	Fail
12.0776	3	230	7666	Fail
12.4289	3	205	6833	Fail
12.7802	3	182	6066	Fail
13.1316	3	159	5300	Fail
13.4829	3	148	4933	Fail
13.8342	3	136	4533	Fail
14.1856	3	121	4033	Fail
14.5369	3	107	3566	Fail
14.8882	3	99	3300	Fail
15.2395	3	88	2933	Fail
15.5909	3	74	2466	Fail
15.9422	3	68	2266	Fail
16.2935	3	61	2033	Fail
16.6449	3	55	1833	Fail
16.9962	3	51	1700	Fail
17.3475	3	49	1633	Fail
17.6989	3	46	1533	Fail
18.0502	2	43	2150	Fail
18.4015	1	38	3800	Fail
18.7528	1	36	3600	Fail
19.1042	1	31	3100	Fail
19.4555	1	30	3000	Fail

19.8068	1	28	2800	Fail
20.1582	1	21	2100	Fail
20.5095	1	18	1800	Fail
20.8608	1	17	1700	Fail
21.2121	1	17	1700	Fail
21.5635	1	17	1700	Fail
21.9148	1	16	1600	Fail
22.2661	1	15	1500	Fail
22.6175	0	15	n/a	Fail
22.9688	0	13	n/a	Fail
23.3201	0	11	n/a	Fail
23.6715	0	11	n/a	Fail
24.0228	0	11	n/a	Fail
24.3741	0	9	n/a	Fail
24.7254	0	9	n/a	Fail
25.0768	0	9	n/a	Fail
25.4281	0	9	n/a	Fail
25.7794	0	9	n/a	Fail
26.1308	0	7	n/a	Fail
26.4821	0	7	n/a	Fail
26.8334	0	6	n/a	Fail
27.1847	0	6	n/a	Fail
27.5361	0	5	n/a	Fail
27.8874	0	4	n/a	Fail
28.2387	0	4	n/a	Fail
28.5901	0	4	n/a	Fail
28.9414	0	4	n/a	Fail
29.2927	0	4	n/a	Fail
29.6441	0	4	n/a	Fail
29.9954	0	4	n/a	Fail
30.3467	0	4	n/a	Fail
30.6980	0	4	n/a	Fail
31.0494	0	3	n/a	Fail
31.4007	0	3	n/a	Fail
31.7520	0	3	n/a	Fail
32.1034	0	3	n/a	Fail
32.4547	0	3	n/a	Fail
32.8060	0	2	n/a	Fail
33.1573	0	2	n/a	Fail
33.5087	0	2	n/a	Fail
33.8600	0	1	n/a	Fail
34.2113	0	0	n/a	Pass
34.5627	0	0	0	Pass
34.9140	0	0	0	Pass
35.2653	0	0	0	Pass
35.6167	0	0	0	Pass

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0 acre-feet
On-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.
Off-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

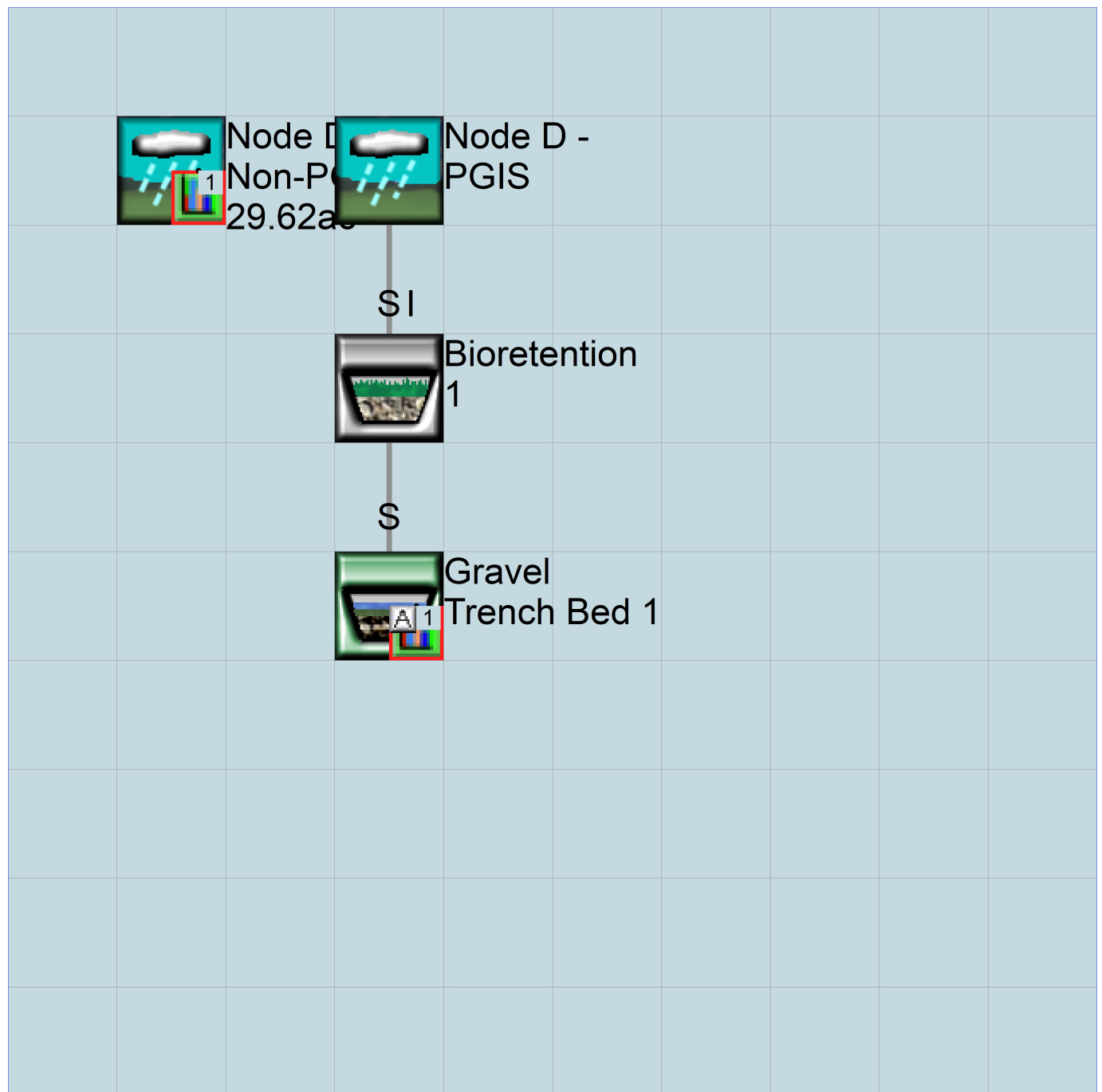
No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Node D -
Remaining
Onsite Areas
75.86ac

Mitigated Schematic



Predeveloped UCI File

RUN

GLOBAL

```
WWM4 model simulation
START      1955 10 01      END      2009 09 30
RUN INTERP OUTPUT LEVEL    3      0
RESUME     0 RUN          1
UNIT SYSTEM 1
```

END GLOBAL

FILES

```
<File>  <Un#>  <-----File Name----->***
<-ID->                                     ***
WDM      26     18591_Node D.wdm
MESSU    25     Pre18591_Node D.MES
          27     Pre18591_Node D.L61
          28     Pre18591_Node D.L62
          30     POC18591_Node D1.dat
```

END FILES

OPN SEQUENCE

INGRP INDELT 00:15

```
PERLND    2
COPY      501
DISPLY    1
```

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INF01

```
# - #<-----Title----->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
1      Node D - Remaining Onsite  MAX      1      2      30      9
```

END DISPLY-INF01

END DISPLY

COPY

TIMESERIES

```
# - # NPT NMN ***
1      1      1
501    1      1
```

END TIMESERIES

END COPY

GENER

OPCODE

```
#      # OPCD ***
```

END OPCODE

PARM

```
#      #      K ***
```

END PARM

END GENER

PERLND

GEN-INFO

```
<PLS ><-----Name----->NBLKS      Unit-systems      Printer ***
# - #      User      t-series      Engl Metr ***
```

```
2      A/B, Forest, Mod      1      1      1      1      27      0
```

END GEN-INFO

*** Section PWATER***

ACTIVITY

```
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC ***
2      0      0      1      0      0      0      0      0      0      0      0
```

END ACTIVITY

PRINT-INFO

```
<PLS > ***** Print-flags ***** PIVL PYR
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC *****
2      0      0      4      0      0      0      0      0      0      0      0      1      9
```

END PRINT-INFO

```

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG VCS VUZ VNN VIFW VIRC VLE INFC HWT ***
2 0 0 0 0 0 0 0 0 0 0 0
END PWAT-PARM1

PWAT-PARM2
<PLS > PWATER input info: Part 2 ***
# - # ***FOREST LZSN INFILT LSUR SLSUR KVARY AGWRC
2 0 5 2 400 0.1 0.3 0.996
END PWAT-PARM2

PWAT-PARM3
<PLS > PWATER input info: Part 3 ***
# - # ***PETMAX PETMIN INFEXP INFILD DEEPFR BASETP AGWETP
2 0 0 2 2 0 0 0
END PWAT-PARM3

PWAT-PARM4
<PLS > PWATER input info: Part 4 ***
# - # CEPSC UZSN NSUR INTFW IRC LZETP ***
2 0.2 0.5 0.35 0 0.7 0.7 ***
END PWAT-PARM4

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS SURS UZS IFWS LZS AGWS GWVS
2 0 0 0 0 3 1 0
END PWAT-STATE1

END PERLND

IMPLND
GEN-INFO
<PLS ><-----Name-----> Unit-systems Printer ***
# - # User t-series Engl Metr ***
in out ***

END GEN-INFO
*** Section IWATER***

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT SLD IWG IQAL ***
END ACTIVITY

PRINT-INFO
<ILS > ***** Print-flags ***** PIVL PYR
# - # ATMP SNOW IWAT SLD IWG IQAL *****
END PRINT-INFO

IWAT-PARM1
<PLS > IWATER variable monthly parameter value flags ***
# - # CSNO RTOP VRS VNN RTLI ***
END IWAT-PARM1

IWAT-PARM2
<PLS > IWATER input info: Part 2 ***
# - # *** LSUR SLSUR NSUR RETSC
END IWAT-PARM2

IWAT-PARM3
<PLS > IWATER input info: Part 3 ***
# - # ***PETMAX PETMIN
END IWAT-PARM3

IWAT-STATE1
<PLS > *** Initial conditions at start of simulation
# - # *** RETS SURS
END IWAT-STATE1

```

END IMPLND

SCHEMATIC

```
<-Source->          <--Area-->      <-Target->  MBLK    ***
<Name>   #          <-factor->      <Name>   #    Tbl#    ***
Node D - Remaining Onsite Areas***
PERLND   2          75.858          COPY    501      12
PERLND   2          75.858          COPY    501      13
```

*****Routing*****

END SCHEMATIC

NETWORK

```
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>   #      <Name> # #<-factor->strg <Name>   #   #   <Name> # #   ***
COPY    501 OUTPUT MEAN   1 1   48.4      DISPLY    1     INPUT  TIMSER 1
```

```
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>   #      <Name> # #<-factor->strg <Name>   #   #   <Name> # #   ***
END NETWORK
```

RCHRES

```
GEN-INFO
RCHRES      Name      Nexits   Unit Systems   Printer      ***
# - #<-----><----> User T-series Engl Metr LKFG      ***
                               in out                      ***
```

END GEN-INFO

*** Section RCHRES***

ACTIVITY

```
<PLS > ***** Active Sections *****
# - # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
END ACTIVITY
```

PRINT-INFO

```
<PLS > ***** Print-flags ***** PIVL  PYR
# - # HYDR ADCA CONS HEAT  SED  GQL  OXRX NUTR PLNK PHCB PIVL  PYR  *****
END PRINT-INFO
```

HYDR-PARM1

```
RCHRES      Flags for each HYDR Section      ***
# - #      VC A1 A2 A3  ODFVFG for each *** ODGTFG for each  FUNCT for each
          FG FG FG FG  possible exit *** possible exit  possible exit
          * * * *   * * * *   * * * *   * * * *   * * * *
END HYDR-PARM1
```

HYDR-PARM2

```
# - #      FTABNO      LEN      DELTH      STCOR      KS      DB50      ***
<-----><-----><-----><-----><-----><-----><----->      ***
```

END HYDR-PARM2

HYDR-INIT

```
RCHRES      Initial conditions for each HYDR section      ***
# - # *** VOL      Initial value of COLIND      Initial value of OUTDGT
          *** ac-ft      for each possible exit      for each possible exit
<-----><----->      <---><---><---><---><---> *** <---><---><---><---><--->
```

END HYDR-INIT

END RCHRES

SPEC-ACTIONS

END SPEC-ACTIONS

FTABLES

END FTABLES

EXT SOURCES

```
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #   <Name> # #   ***
WDM      2 PREC      ENGL      1.429          PERLND    1 999 EXTNL  PREC
WDM      2 PREC      ENGL      1.429          IMPLND    1 999 EXTNL  PREC
```

WDM	1	EVAP	ENGL	0.76	PERLND	1	999	EXTNL	PETINP
WDM	1	EVAP	ENGL	0.76	IMPLND	1	999	EXTNL	PETINP

END EXT SOURCES

EXT TARGETS

<-Volume->	<-Grp>	<-Member->	<--Mult-->	Tran	<-Volume->	<Member>	Tsys	Tgap	Amd	***
<Name>	#	<Name>	#	#<-factor->	strg	<Name>	#	<Name>	tem	strg
COPY	501	OUTPUT	MEAN	1 1	48.4	WDM	501	FLOW	ENGL	REPL

END EXT TARGETS

MASS-LINK

<Volume>	<-Grp>	<-Member->	<--Mult-->	<Target>	<-Grp>	<-Member->	***
<Name>		<Name>	#	#<-factor->	<Name>		#
MASS-LINK		12					
PERLND	PWATER	SURO		0.083333	COPY	INPUT	MEAN
END MASS-LINK		12					

MASS-LINK		13					
PERLND	PWATER	IFW0		0.083333	COPY	INPUT	MEAN
END MASS-LINK		13					

END MASS-LINK

END RUN

Mitigated UCI File

RUN

GLOBAL

```
WWM4 model simulation
START      1955 10 01      END      2009 09 30
RUN INTERP OUTPUT LEVEL    3      0
RESUME     0 RUN      1      UNIT SYSTEM      1
END GLOBAL
```

FILES

```
<File>  <Un#>  <-----File Name----->***
<-ID->                                     ***
WDM      26      18591_Node D.wdm
MESSU    25      Mit18591_Node D.MES
          27      Mit18591_Node D.L61
          28      Mit18591_Node D.L62
          30      POC18591_Node D1.dat
```

END FILES

OPN SEQUENCE

INGRP INDELT 00:15

```
PERLND      8
IMPLND      4
IMPLND      1
RCHRES      1
RCHRES      2
RCHRES      3
COPY        1
COPY       501
COPY       601
DISPLY      1
```

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INF01

```
# - #<-----Title----->***TRAN PIVL DIG1 FIL1 PYR DIG2 FIL2 YRND
1      Gravel Trench Bed 1      MAX      1      2      30      9
```

END DISPLY-INF01

END DISPLY

COPY

TIMESERIES

```
# - # NPT NMN ***
1      1      1
501      1      1
601      1      1
```

END TIMESERIES

END COPY

GENER

OPCODE

```
#      # OPCD ***
```

END OPCODE

PARM

```
#      #      K ***
```

END PARM

END GENER

PERLND

GEN-INFO

```
<PLS ><-----Name----->NBLKS Unit-systems Printer ***
# - # User t-series Engl Metr ***
          in out ***
```

```
8      A/B, Lawn, Mod      1      1      1      1      27      0
```

END GEN-INFO

*** Section PWATER***

ACTIVITY

```
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC ***
8      0      0      1      0      0      0      0      0      0      0      0      0
```

END ACTIVITY

PRINT-INFO

```
<PLS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW PWAT  SED  PST  PWG  PQAL MSTL PEST NITR PHOS TRAC  *****
8      0      0      4      0      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO
```

PWAT-PARM1

```
<PLS >  PWATER variable monthly parameter value flags  ***
# - # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT  ***
8      0      0      0      0      0      0      0      0      0      0      0
END PWAT-PARM1
```

PWAT-PARM2

```
<PLS >          PWATER input info: Part 2          ***
# - # ***FOREST      LZSN      INFILT      LSUR      SLSUR      KVARY      AGWRC
8      0      5      0.8      400      0.1      0.3      0.996
END PWAT-PARM2
```

PWAT-PARM3

```
<PLS >          PWATER input info: Part 3          ***
# - # ***PETMAX      PETMIN      INFEXP      INFILD      DEEPFR      BASETP      AGWETP
8      0      0      2      2      0      0      0
END PWAT-PARM3
```

PWAT-PARM4

```
<PLS >          PWATER input info: Part 4          ***
# - #      CEPSC      UZSN      NSUR      INTFW      IRC      LZETP  ***
8      0.1      0.5      0.25      0      0.7      0.25
END PWAT-PARM4
```

PWAT-STATE1

```
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS      SURS      UZS      IFWS      LZS      AGWS      GWVS
8      0      0      0      0      3      1      0
END PWAT-STATE1
```

END PERLND

IMPLND

GEN-INFO

```
<PLS ><-----Name----->  Unit-systems  Printer  ***
# - #      User  t-series  Engl Metr  ***
# - #      in   out
4      ROOF TOPS/FLAT      1      1      1      27      0
1      ROADS/FLAT      1      1      1      27      0
END GEN-INFO
*** Section IWATER***
```

ACTIVITY

```
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT  SLD  IWG IQAL  ***
4      0      0      1      0      0      0
1      0      0      1      0      0      0
END ACTIVITY
```

PRINT-INFO

```
<ILS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW IWAT  SLD  IWG IQAL  *****
4      0      0      4      0      0      4      1      9
1      0      0      4      0      0      0      1      9
END PRINT-INFO
```

IWAT-PARM1

```
<PLS >  IWATER variable monthly parameter value flags  ***
# - # CSNO RTOP  VRS  VNN RTLI  ***
4      0      0      0      0      0
1      0      0      0      0      0
END IWAT-PARM1
```

```

IWAT-PARM2
<PLS >          IWATER input info: Part 2          ***
# - # ***  LSUR      SLSUR      NSUR      RETSC
4          400      0.01      0.1      0.1
1          400      0.01      0.1      0.1
END IWAT-PARM2

IWAT-PARM3
<PLS >          IWATER input info: Part 3          ***
# - # ***PETMAX      PETMIN
4          0          0
1          0          0
END IWAT-PARM3

IWAT-STATE1
<PLS > *** Initial conditions at start of simulation
# - # ***  RETS      SURS
4          0          0
1          0          0
END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->          <--Area-->          <-Target->          MBLK          ***
<Name> #          <-factor->          <Name> #          Tbl#          ***
Node D - PGIS***
IMPLND 1          46.237      RCHRES 1          5
Node D - Non-PGIS***
PERLND 8          9.462      COPY 501      12
PERLND 8          9.462      COPY 601      12
PERLND 8          9.462      COPY 501      13
PERLND 8          9.462      COPY 601      13
IMPLND 4          20.159      COPY 501      15
IMPLND 4          20.159      COPY 601      15

*****Routing*****
RCHRES 1          1      RCHRES 3          7
RCHRES 1          1      COPY 1          17
RCHRES 1          1      RCHRES 2          8
RCHRES 3          1      COPY 501      17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> #          <Name> # #<-factor->strg <Name> # #          <Name> # #          ***
COPY 501 OUTPUT MEAN 1 1 48.4      DISPLY 1          INPUT TIMSER 1

<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> #          <Name> # #<-factor->strg <Name> # #          <Name> # #          ***
END NETWORK

RCHRES
GEN-INFO
RCHRES          Name          Nexits          Unit Systems          Printer          ***
# - #<-----><----> User T-series Engl Metr LKFG          ***
1          Surface retentio-007      2          1          1          1          28          0          1          ***
2          Bioretention 1          1          1          1          28          0          1
3          Gravel Trench Be-008      2          1          1          1          28          0          1
END GEN-INFO
*** Section RCHRES***

ACTIVITY
<PLS > ***** Active Sections *****
# - # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
1          1          0          0          0          0          0          0          0          0

```


2	1	0	0	0	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0	0	0	0

END ACTIVITY

PRINT-INFO

<PLS > ***** Print-flags ***** PIVL PYR *****

# - #	HYDR	ADCA	CONS	HEAT	SED	GQL	OXRX	NUTR	PLNK	PHCB	PIVL	PYR
1	4	0	0	0	0	0	0	0	0	0	1	9
2	4	0	0	0	0	0	0	0	0	0	1	9
3	4	0	0	0	0	0	0	0	0	0	1	9

END PRINT-INFO

HYDR-PARM1

RCHRES Flags for each HYDR Section ***

# - #	VC	A1	A2	A3	ODFVFG	for each possible exit	***	ODGTFG	for each possible exit	FUNCT	for each possible exit
	FG	FG	FG	FG							
	*	*	*	*	*	*	*	*	*	*	*
1	0	1	0	0	4	5	0	0	0	2	2
2	0	1	0	0	4	0	0	0	0	2	2
3	0	1	0	0	4	5	0	0	0	2	2

END HYDR-PARM1

HYDR-PARM2

# - #	FTABNO	LEN	DELTH	STCOR	KS	DB50
<-----><-----><-----><-----><-----><-----><----->						
1	1	0.01	0.0	0.0	0.0	0.0
2	2	0.05	0.0	0.0	0.0	0.0
3	3	0.05	0.0	0.0	0.5	0.0

END HYDR-PARM2

HYDR-INIT

RCHRES Initial conditions for each HYDR section ***

# - #	***	VOL	Initial value of COLIND	Initial value of OUTDGT
	ac-ft		for each possible exit	for each possible exit
	<-----><----->		<-----><-----><-----><-----><-----><-----><-----><-----><-----><-----><-----><----->	
1	0	4.0	5.0	0.0
2	0	4.0	0.0	0.0
3	0	4.0	5.0	0.0

END HYDR-INIT

END RCHRES

SPEC-ACTIONS

END SPEC-ACTIONS

FTABLES

FTABLE	2				
64	4				
Depth	Area	Volume	Outflow1	Velocity	Travel Time***
(ft)	(acres)	(acre-ft)	(cfs)	(ft/sec)	(Minutes)***
0.000000	1.673554	0.000000	0.000000		
0.071429	1.673554	0.054665	0.000000		
0.142857	1.673554	0.109331	0.000000		
0.214286	1.673554	0.163996	0.053063		
0.285714	1.673554	0.218662	0.062046		
0.357143	1.673554	0.273327	0.113823		
0.428571	1.673554	0.327993	0.206503		
0.500000	1.673554	0.382658	0.273592		
0.571429	1.673554	0.437323	0.336186		
0.642857	1.673554	0.491989	0.507312		
0.714286	1.673554	0.546654	0.687248		
0.785714	1.673554	0.601320	0.723873		
0.857143	1.673554	0.655985	0.989523		
0.928571	1.673554	0.710651	1.307648		
1.000000	1.673554	0.765316	1.344970		
1.071429	1.673554	0.819982	1.681409		
1.142857	1.673554	0.874647	2.113782		
1.214286	1.673554	0.929312	2.282526		
1.285714	1.673554	0.983978	2.607569		
1.357143	1.673554	1.038643	3.165420		
1.428571	1.673554	1.093309	3.531615		
1.500000	1.673554	1.147974	3.789831		
1.571429	1.673554	1.197583	4.483143		

1.642857	1.673554	1.247192	5.121006
1.714286	1.673554	1.296801	5.247516
1.785714	1.673554	1.346410	6.084869
1.857143	1.673554	1.396019	6.996734
1.928571	1.673554	1.445628	7.077219
2.000000	1.673554	1.495237	7.983839
2.071429	1.673554	1.544845	9.044384
2.142857	1.673554	1.594454	9.424985
2.214286	1.673554	1.644063	10.12500
2.285714	1.673554	1.693672	12.82566
2.357143	1.673554	1.743281	14.15858
2.428571	1.673554	1.792890	15.05991
2.500000	1.673554	1.842499	15.63173
2.571429	1.673554	1.892108	16.18322
2.642857	1.673554	1.941717	16.71641
2.714286	1.673554	1.991326	16.87500
2.785714	1.673554	2.040935	16.87500
2.857143	1.673554	2.090544	16.87500
2.928571	1.673554	2.140152	16.87500
3.000000	1.673554	2.189761	16.87500
3.071429	1.673554	2.239370	16.87500
3.142857	1.673554	2.288979	16.87500
3.214286	1.673554	2.338588	16.87500
3.285714	1.673554	2.388197	16.87500
3.357143	1.673554	2.437806	16.87500
3.428571	1.673554	2.487415	16.87500
3.500000	1.673554	2.537024	16.87500
3.571429	1.673554	2.586633	16.87500
3.642857	1.673554	2.636242	16.87500
3.714286	1.673554	2.685851	16.87500
3.785714	1.673554	2.735459	16.87500
3.857143	1.673554	2.785068	16.87500
3.928571	1.673554	2.834677	16.87500
4.000000	1.673554	2.884286	16.87500
4.071429	1.673554	2.933895	16.87500
4.142857	1.673554	2.983504	16.87500
4.214286	1.673554	3.033113	16.87500
4.285714	1.673554	3.082722	16.87500
4.357143	1.673554	3.132331	16.87500
4.428571	1.673554	3.181940	16.87500
4.500000	1.673554	3.580206	16.87500

END FTABLE 2

FTABLE 1

30 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	1.673554	0.000000	0.000000	0.000000		
0.071429	1.673554	0.119540	0.000000	10.12501		
0.142857	1.673554	0.239079	0.000000	11.08929		
0.214286	1.673554	0.358619	0.000000	11.57144		
0.285714	1.673554	0.478158	0.000000	12.05358		
0.357143	1.673554	0.597698	0.000000	12.53572		
0.428571	1.673554	0.717237	0.000000	13.01787		
0.500000	1.673554	0.836777	0.000000	13.50001		
0.571429	1.673554	0.956316	0.000000	13.98215		
0.642857	1.673554	1.075856	0.000000	14.46430		
0.714286	1.673554	1.195396	0.000000	14.94644		
0.785714	1.673554	1.314935	0.000000	15.42858		
0.857143	1.673554	1.434475	0.000000	15.91073		
0.928571	1.673554	1.554014	0.000000	16.39287		
1.000000	1.673554	1.673554	0.000000	16.87500		
1.071429	1.673554	1.793093	1.013052	16.87500		
1.142857	1.673554	1.912633	2.863613	16.87500		
1.214286	1.673554	2.032172	5.257786	16.87500		
1.285714	1.673554	2.151712	8.089179	16.87500		
1.357143	1.673554	2.271251	11.29374	16.87500		
1.428571	1.673554	2.390791	14.82485	16.87500		
1.500000	1.673554	2.510331	18.64436	16.87500		
1.571429	1.673554	2.629870	22.71831	16.87500		
1.642857	1.673554	2.749410	27.01478	16.87500		

1.714286	1.673554	2.868949	31.50260	16.87500
1.785714	1.673554	2.988489	36.15072	16.87500
1.857143	1.673554	3.108028	40.92774	16.87500
1.928571	1.673554	3.227568	45.80182	16.87500
2.000000	1.673554	3.347107	50.74064	16.87500
2.000000	1.673554	3.347107	55.71151	16.87500

END FTABLE 1
FTABLE 3

92	5						
Depth	Area	Volume	Outflow1	Outflow2	Velocity	Travel Time***	
(ft)	(acres)	(acre-ft)	(cfs)	(cfs)	(ft/sec)	(Minutes)***	
0.000000	1.673554	0.000000	0.000000	0.000000			
0.055556	1.673554	0.032541	0.000000	3.375000			
0.111111	1.673554	0.065083	0.000000	3.375000			
0.166667	1.673554	0.097624	0.000000	3.375000			
0.222222	1.673554	0.130165	0.000000	3.375000			
0.277778	1.673554	0.162707	0.000000	3.375000			
0.333333	1.673554	0.195248	0.000000	3.375000			
0.388889	1.673554	0.227789	0.000000	3.375000			
0.444444	1.673554	0.260331	0.000000	3.375000			
0.500000	1.673554	0.292872	0.000000	3.375000			
0.555556	1.673554	0.325413	0.000000	3.375000			
0.611111	1.673554	0.357955	0.000000	3.375000			
0.666667	1.673554	0.390496	0.000000	3.375000			
0.722222	1.673554	0.423037	0.000000	3.375000			
0.777778	1.673554	0.455579	0.000000	3.375000			
0.833333	1.673554	0.488120	0.000000	3.375000			
0.888889	1.673554	0.520661	0.000000	3.375000			
0.944444	1.673554	0.553202	0.000000	3.375000			
1.000000	1.673554	0.585744	0.000000	3.375000			
1.055556	1.673554	0.618285	0.000000	3.375000			
1.111111	1.673554	0.650826	0.000000	3.375000			
1.166667	1.673554	0.683368	0.000000	3.375000			
1.222222	1.673554	0.715909	0.000000	3.375000			
1.277778	1.673554	0.748450	0.000000	3.375000			
1.333333	1.673554	0.780992	0.000000	3.375000			
1.388889	1.673554	0.813533	0.000000	3.375000			
1.444444	1.673554	0.846074	0.000000	3.375000			
1.500000	1.673554	0.878616	0.000000	3.375000			
1.555556	1.673554	0.911157	0.000000	3.375000			
1.611111	1.673554	0.943698	0.000000	3.375000			
1.666667	1.673554	0.976240	0.000000	3.375000			
1.722222	1.673554	1.008781	0.000000	3.375000			
1.777778	1.673554	1.041322	0.000000	3.375000			
1.833333	1.673554	1.073864	0.000000	3.375000			
1.888889	1.673554	1.106405	0.000000	3.375000			
1.944444	1.673554	1.138946	0.000000	3.375000			
2.000000	1.673554	1.171488	0.000000	3.375000			
2.055556	1.673554	1.204029	0.000000	3.375000			
2.111111	1.673554	1.236570	0.000000	3.375000			
2.166667	1.673554	1.269112	0.000000	3.375000			
2.222222	1.673554	1.301653	0.000000	3.375000			
2.277778	1.673554	1.334194	0.000000	3.375000			
2.333333	1.673554	1.366736	0.000000	3.375000			
2.388889	1.673554	1.399277	0.000000	3.375000			
2.444444	1.673554	1.431818	0.000000	3.375000			
2.500000	1.673554	1.464360	0.000000	3.375000			
2.555556	1.673554	1.496901	0.000000	3.375000			
2.611111	1.673554	1.529442	0.000000	3.375000			
2.666667	1.673554	1.561983	0.000000	3.375000			
2.722222	1.673554	1.594525	0.000000	3.375000			
2.777778	1.673554	1.627066	0.000000	3.375000			
2.833333	1.673554	1.659607	0.000000	3.375000			
2.888889	1.673554	1.692149	0.000000	3.375000			
2.944444	1.673554	1.724690	0.000000	3.375000			
3.000000	1.673554	1.757231	0.000000	3.375000			
3.055556	1.673554	1.789773	0.277796	3.375000			
3.111111	1.673554	1.822314	0.784769	3.375000			
3.166667	1.673554	1.854855	1.438492	3.375000			
3.222222	1.673554	1.887397	2.205262	3.375000			

3.277778	1.673554	1.919938	3.059929	3.375000
3.333333	1.673554	1.952479	3.979211	3.375000
3.388889	1.673554	1.985021	4.939668	3.375000
3.444444	1.673554	2.017562	5.917238	3.375000
3.500000	1.673554	2.050103	6.887532	3.375000
3.555556	1.673554	2.082645	7.826549	3.375000
3.611111	1.673554	2.115186	8.711714	3.375000
3.666667	1.673554	2.147727	9.523132	3.375000
3.722222	1.673554	2.180269	10.24504	3.375000
3.777778	1.673554	2.212810	10.86741	3.375000
3.833333	1.673554	2.245351	11.38772	3.375000
3.888889	1.673554	2.277893	11.81283	3.375000
3.944444	1.673554	2.310434	12.16099	3.375000
4.000000	1.673554	2.342975	12.46394	3.375000
4.055556	1.673554	2.375517	12.94375	3.375000
4.111111	1.673554	2.408058	13.28001	3.375000
4.166667	1.673554	2.440599	13.60796	3.375000
4.222222	1.673554	2.473140	13.92819	3.375000
4.277778	1.673554	2.505682	14.24122	3.375000
4.333333	1.673554	2.538223	14.54752	3.375000
4.388889	1.673554	2.570764	14.84750	3.375000
4.444444	1.673554	2.603306	15.14154	3.375000
4.500000	1.673554	2.635847	15.42997	3.375000
4.555556	1.673554	2.668388	15.71312	3.375000
4.611111	1.673554	2.700930	15.99125	3.375000
4.666667	1.673554	2.733471	16.26462	3.375000
4.722222	1.673554	2.766012	16.53347	3.375000
4.777778	1.673554	2.798554	16.79803	3.375000
4.833333	1.673554	2.831095	17.05848	3.375000
4.888889	1.673554	2.863636	17.31501	3.375000
4.944444	1.673554	2.896178	17.56780	3.375000
5.000000	1.673554	2.928719	17.81700	3.375000
5.055556	1.673554	3.021694	18.06276	3.375000

END FTABLE 3
END FTABLES

EXT SOURCES

<-Volume->	<Member>	SsysSgap<--Mult-->Tran	<-Target	vols>	<-Grp>	<-Member->	***
<Name>	#	<Name> # tem strg<-factor->strg	<Name>	#	#	<Name> # #	***
WDM	2	PREC ENGL 1.429	PERLND	1	999	EXTNL PREC	
WDM	2	PREC ENGL 1.429	IMPLND	1	999	EXTNL PREC	
WDM	1	EVAP ENGL 0.76	PERLND	1	999	EXTNL PETINP	
WDM	1	EVAP ENGL 0.76	IMPLND	1	999	EXTNL PETINP	
WDM	2	PREC ENGL 1.429	RCHRES	1		EXTNL PREC	
WDM	1	EVAP ENGL 0.5	RCHRES	1		EXTNL POTEV	
WDM	1	EVAP ENGL 0.76	RCHRES	2		EXTNL POTEV	

END EXT SOURCES

EXT TARGETS

<-Volume->	<-Grp>	<-Member-><--Mult-->Tran	<-Volume->	<Member>	Tsys	Tgap	Amd	***
<Name>	#	<Name> # #<-factor->strg	<Name>	#	<Name>	tem	strg	strg***
COPY	1	OUTPUT MEAN 1 1 48.4	WDM	701	FLOW	ENGL		REPL
COPY	501	OUTPUT MEAN 1 1 48.4	WDM	801	FLOW	ENGL		REPL
COPY	601	OUTPUT MEAN 1 1 48.4	WDM	901	FLOW	ENGL		REPL
RCHRES	3	HYDR RO 1 1 1	WDM	1006	FLOW	ENGL		REPL
RCHRES	3	HYDR 0 1 1 1	WDM	1008	FLOW	ENGL		REPL
RCHRES	3	HYDR 0 2 1 1	WDM	1009	FLOW	ENGL		REPL
RCHRES	3	HYDR STAGE 1 1 1	WDM	1007	STAG	ENGL		REPL

END EXT TARGETS

MASS-LINK

<Volume>	<-Grp>	<-Member-><--Mult-->	<Target>	<-Grp>	<-Member->***
<Name>		<Name> # #<-factor->	<Name>		<Name> # #***
MASS-LINK		5			
IMPLND	IWATER	SURO 0.083333	RCHRES	INFLOW	IVOL
END MASS-LINK		5			
MASS-LINK		7			
RCHRES	OFLOW	OVOL 1	RCHRES	INFLOW	IVOL

END MASS-LINK	7					
MASS-LINK	8					
RCHRES	OFLOW	OVOL	2		RCHRES	INFLOW IVOL
END MASS-LINK	8					
MASS-LINK	12					
PERLND	PWATER	SURO		0.083333	COPY	INPUT MEAN
END MASS-LINK	12					
MASS-LINK	13					
PERLND	PWATER	IFWO		0.083333	COPY	INPUT MEAN
END MASS-LINK	13					
MASS-LINK	15					
IMPLND	IWATER	SURO		0.083333	COPY	INPUT MEAN
END MASS-LINK	15					
MASS-LINK	17					
RCHRES	OFLOW	OVOL	1		COPY	INPUT MEAN
END MASS-LINK	17					
END MASS-LINK						
END RUN						

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WWHM2012
PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node E

Site Name: LOTC

Site Address:

City: Castle Rock, WA

Report Date: 3/7/2025

Gage: Longview

Data Start: 1955/10/01

Data End: 2009/09/30

Timestep: 15 Minute

Precip Scale: 1.429

Version Date: 2024/06/28

Version: 4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
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High Flow Threshold for POC1:	50 Year
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Low Flow Threshold for POC2:	50 Percent of the 2 Year
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High Flow Threshold for POC2:	50 Year
-------------------------------	---------

Landuse Basin Data

Predeveloped Land Use

Node E - Offsite

Bypass: No

GroundWater: No

Pervious Land Use acre
A B, Forest, Mod 31.732

Pervious Total 31.732

Impervious Land Use acre

Impervious Total 0

Basin Total 31.732

Element Flow Component:

Surface	Interflow	Groundwater
Component Flows To:		
POC 1	POC 1	

Node E - Larson Runoff

Bypass: No

GroundWater: No

Pervious Land Use acre
A B, Forest, Mod 0.263

Pervious Total 0.263

Impervious Land Use acre

Impervious Total 0

Basin Total 0.263

Element Flow Componants:

Surface Interflow

Componant Flows To:

POC 2 POC 2

Groundwater

Mitigated Land Use

Node E - Offsite

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	25.386
Pervious Total	25.386
Impervious Land Use	acre
ROOF TOPS FLAT	6.346
Impervious Total	6.346
Basin Total	31.732

Element Flow Componants:		
Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Node E - Larson Runoff

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	0.107
Pervious Total	0.107
Impervious Land Use	acre
ROADS FLAT	0.156
Impervious Total	0.156
Basin Total	0.263

Element Flow Componants:		
Surface	Interflow	Groundwater
Componant Flows To:		
Surface retention 1	80%	POC 1

Routing Elements

Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length: 20.00 ft.
 Bottom Width: 5.00 ft.
 Material thickness of first layer: 1.5
 Material type for first layer: SMMWW 12 in/hr
 Material thickness of second layer: 1.5
 Material type for second layer: GRAVEL
 Material thickness of third layer: 0
 Material type for third layer: GRAVEL
 Underdrain used
 Underdrain Diameter (feet): 1
 Orifice Diameter (in.): 12
 Offset (in.): 0
 Flow Through Underdrain (ac-ft.): 34.447
 Total Outflow (ac-ft.): 38.031
 Percent Through Underdrain: 90.58
 Discharge Structure
 Riser Height: 0.5 ft.
 Riser Diameter: 12 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:
 Gravel Trench Bed 1

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0023	0.0000	0.0000	0.0000
0.0440	0.0023	0.0000	0.0000	0.0000
0.0879	0.0023	0.0001	0.0000	0.0000
0.1319	0.0023	0.0001	0.0000	0.0000
0.1758	0.0023	0.0002	0.0000	0.0000
0.2198	0.0023	0.0002	0.0000	0.0000
0.2637	0.0023	0.0003	0.0000	0.0000
0.3077	0.0023	0.0003	0.0000	0.0000
0.3516	0.0023	0.0004	0.0000	0.0000
0.3956	0.0023	0.0004	0.0000	0.0000
0.4396	0.0023	0.0005	0.0000	0.0000
0.4835	0.0023	0.0005	0.0000	0.0000
0.5275	0.0023	0.0006	0.0000	0.0000
0.5714	0.0023	0.0006	0.0000	0.0000
0.6154	0.0023	0.0006	0.0000	0.0000
0.6593	0.0023	0.0007	0.0000	0.0000
0.7033	0.0023	0.0007	0.0000	0.0000
0.7473	0.0023	0.0008	0.0000	0.0000
0.7912	0.0023	0.0008	0.0000	0.0000
0.8352	0.0023	0.0009	0.0000	0.0000
0.8791	0.0023	0.0009	0.0000	0.0000
0.9231	0.0023	0.0010	0.0000	0.0000
0.9670	0.0023	0.0010	0.0000	0.0000
1.0110	0.0023	0.0011	0.0000	0.0000
1.0549	0.0023	0.0011	0.0000	0.0000
1.0989	0.0023	0.0012	0.0000	0.0000
1.1429	0.0023	0.0012	0.0000	0.0000
1.1868	0.0023	0.0012	0.0000	0.0000

1.2308	0.0023	0.0013	0.0000	0.0000
1.2747	0.0023	0.0013	0.0000	0.0000
1.3187	0.0023	0.0014	0.0000	0.0000
1.3626	0.0023	0.0014	0.0000	0.0000
1.4066	0.0023	0.0015	0.0000	0.0000
1.4505	0.0023	0.0015	0.0000	0.0000
1.4945	0.0023	0.0016	0.0000	0.0000
1.5385	0.0023	0.0016	0.0000	0.0000
1.5824	0.0023	0.0017	0.0000	0.0000
1.6264	0.0023	0.0017	0.0000	0.0000
1.6703	0.0023	0.0017	0.0000	0.0000
1.7143	0.0023	0.0018	0.0000	0.0000
1.7582	0.0023	0.0018	0.0000	0.0000
1.8022	0.0023	0.0019	0.0000	0.0000
1.8462	0.0023	0.0019	0.0000	0.0000
1.8901	0.0023	0.0019	0.0000	0.0000
1.9341	0.0023	0.0020	0.0000	0.0000
1.9780	0.0023	0.0020	0.0000	0.0000
2.0220	0.0023	0.0021	0.0000	0.0000
2.0659	0.0023	0.0021	0.0000	0.0000
2.1099	0.0023	0.0022	0.0000	0.0000
2.1538	0.0023	0.0022	0.0000	0.0000
2.1978	0.0023	0.0022	0.0000	0.0000
2.2418	0.0023	0.0023	0.0000	0.0000
2.2857	0.0023	0.0023	0.0000	0.0000
2.3297	0.0023	0.0024	0.0000	0.0000
2.3736	0.0023	0.0024	0.0000	0.0000
2.4176	0.0023	0.0024	0.0000	0.0000
2.4615	0.0023	0.0025	0.0000	0.0000
2.5055	0.0023	0.0025	0.0000	0.0000
2.5495	0.0023	0.0026	0.0000	0.0000
2.5934	0.0023	0.0026	0.0000	0.0000
2.6374	0.0023	0.0027	0.0000	0.0000
2.6813	0.0023	0.0027	0.0000	0.0000
2.7253	0.0023	0.0027	0.0000	0.0000
2.7692	0.0023	0.0028	0.0000	0.0000
2.8132	0.0023	0.0028	0.0000	0.0000
2.8571	0.0023	0.0029	0.0000	0.0000
2.9011	0.0023	0.0029	0.0000	0.0000
2.9451	0.0023	0.0030	0.0000	0.0000
2.9890	0.0023	0.0030	0.0000	0.0000
3.0000	0.0023	0.0030	0.0000	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infiltr(cfs)
3.0000	0.0023	0.0030	0.0000	0.0139	0.0000
3.0440	0.0023	0.0031	0.0000	0.0139	0.0000
3.0879	0.0023	0.0032	0.0000	0.0147	0.0000
3.1319	0.0023	0.0033	0.0000	0.0151	0.0000
3.1758	0.0023	0.0034	0.0000	0.0155	0.0000
3.2198	0.0023	0.0035	0.0001	0.0159	0.0000
3.2637	0.0023	0.0036	0.0001	0.0163	0.0000
3.3077	0.0023	0.0037	0.0002	0.0167	0.0000
3.3516	0.0023	0.0038	0.0002	0.0171	0.0000
3.3956	0.0023	0.0039	0.0003	0.0176	0.0000
3.4396	0.0023	0.0040	0.0004	0.0180	0.0000
3.4835	0.0023	0.0041	0.0006	0.0184	0.0000
3.5275	0.0023	0.0042	0.0007	0.0185	0.0000

3.5714	0.0023	0.0043	0.0007	0.0185	0.0000
3.6154	0.0023	0.0044	0.0009	0.0185	0.0000
3.6593	0.0023	0.0045	0.0011	0.0185	0.0000
3.7033	0.0023	0.0046	0.0014	0.0185	0.0000
3.7473	0.0023	0.0047	0.0016	0.0185	0.0000
3.7912	0.0023	0.0048	0.0017	0.0185	0.0000
3.8352	0.0023	0.0049	0.0019	0.0185	0.0000
3.8791	0.0023	0.0050	0.0022	0.0185	0.0000
3.9231	0.0023	0.0051	0.0026	0.0185	0.0000
3.9670	0.0023	0.0052	0.0029	0.0185	0.0000
4.0000	0.0023	0.0053	0.0033	0.0185	0.0000

Gravel Trench Bed 1

Bottom Length: 20.00 ft.
 Bottom Width: 5.00 ft.
 Trench bottom slope 1: 0 To 1
 Trench Left side slope 0: 0 To 1
 Trench right side slope 2: 0 To 1
 Material thickness of first layer: 5
 Pour Space of material for first layer: 0.35
 Material thickness of second layer: 0
 Pour Space of material for second layer: 0
 Material thickness of third layer: 0
 Pour Space of material for third layer: 0
 Infiltration On
 Infiltration rate: 2
 Infiltration safety factor: 1
 Wetted surface area On
 Total Volume Infiltrated (ac-ft.): 2.163
 Total Volume Through Riser (ac-ft.): 1.42
 Total Volume Through Facility (ac-ft.): 3.584
 Percent Infiltrated: 60.35
 Total Precip Applied to Facility: 0
 Total Evap From Facility: 0
 Discharge Structure
 Riser Height: 3 ft.
 Riser Diameter: 12 in.
 Element Outlets:
 Outlet 1 Outlet 2
 Outlet Flows To:

Gravel Trench Bed Hydraulic Table

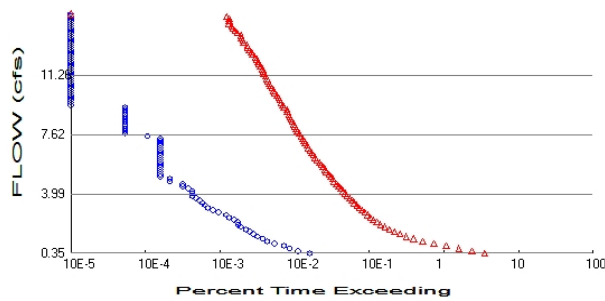
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.002	0.000	0.000	0.000
0.0556	0.002	0.000	0.000	0.004
0.1111	0.002	0.000	0.000	0.004
0.1667	0.002	0.000	0.000	0.004
0.2222	0.002	0.000	0.000	0.004
0.2778	0.002	0.000	0.000	0.004
0.3333	0.002	0.000	0.000	0.004
0.3889	0.002	0.000	0.000	0.004
0.4444	0.002	0.000	0.000	0.004
0.5000	0.002	0.000	0.000	0.004
0.5556	0.002	0.000	0.000	0.004
0.6111	0.002	0.000	0.000	0.004
0.6667	0.002	0.000	0.000	0.004
0.7222	0.002	0.000	0.000	0.004
0.7778	0.002	0.000	0.000	0.004
0.8333	0.002	0.000	0.000	0.004
0.8889	0.002	0.000	0.000	0.004
0.9444	0.002	0.000	0.000	0.004
1.0000	0.002	0.000	0.000	0.004
1.0556	0.002	0.000	0.000	0.004
1.1111	0.002	0.000	0.000	0.004
1.1667	0.002	0.000	0.000	0.004
1.2222	0.002	0.001	0.000	0.004
1.2778	0.002	0.001	0.000	0.004

1.3333	0.002	0.001	0.000	0.004
1.3889	0.002	0.001	0.000	0.004
1.4444	0.002	0.001	0.000	0.004
1.5000	0.002	0.001	0.000	0.004
1.5556	0.002	0.001	0.000	0.004
1.6111	0.002	0.001	0.000	0.004
1.6667	0.002	0.001	0.000	0.004
1.7222	0.002	0.001	0.000	0.004
1.7778	0.002	0.001	0.000	0.004
1.8333	0.002	0.001	0.000	0.004
1.8889	0.002	0.001	0.000	0.004
1.9444	0.002	0.001	0.000	0.004
2.0000	0.002	0.001	0.000	0.004
2.0556	0.002	0.001	0.000	0.004
2.1111	0.002	0.001	0.000	0.004
2.1667	0.002	0.001	0.000	0.004
2.2222	0.002	0.001	0.000	0.004
2.2778	0.002	0.001	0.000	0.004
2.3333	0.002	0.001	0.000	0.004
2.3889	0.002	0.001	0.000	0.004
2.4444	0.002	0.002	0.000	0.004
2.5000	0.002	0.002	0.000	0.004
2.5556	0.002	0.002	0.000	0.004
2.6111	0.002	0.002	0.000	0.004
2.6667	0.002	0.002	0.000	0.004
2.7222	0.002	0.002	0.000	0.004
2.7778	0.002	0.002	0.000	0.004
2.8333	0.002	0.002	0.000	0.004
2.8889	0.002	0.002	0.000	0.004
2.9444	0.002	0.002	0.000	0.004
3.0000	0.002	0.002	0.000	0.004
3.0556	0.002	0.002	0.138	0.004
3.1111	0.002	0.002	0.389	0.004
3.1667	0.002	0.002	0.703	0.004
3.2222	0.002	0.002	1.046	0.004
3.2778	0.002	0.002	1.383	0.004
3.3333	0.002	0.002	1.683	0.004
3.3889	0.002	0.002	1.921	0.004
3.4444	0.002	0.002	2.088	0.004
3.5000	0.002	0.002	2.203	0.004
3.5556	0.002	0.002	2.347	0.004
3.6111	0.002	0.002	2.462	0.004
3.6667	0.002	0.002	2.571	0.004
3.7222	0.002	0.003	2.676	0.004
3.7778	0.002	0.003	2.777	0.004
3.8333	0.002	0.003	2.875	0.004
3.8889	0.002	0.003	2.969	0.004
3.9444	0.002	0.003	3.060	0.004
4.0000	0.002	0.003	3.149	0.004
4.0556	0.002	0.003	3.235	0.004
4.1111	0.002	0.003	3.320	0.004
4.1667	0.002	0.003	3.402	0.004
4.2222	0.002	0.003	3.482	0.004
4.2778	0.002	0.003	3.560	0.004
4.3333	0.002	0.003	3.636	0.004
4.3889	0.002	0.003	3.711	0.004
4.4444	0.002	0.003	3.785	0.004
4.5000	0.002	0.003	3.857	0.004

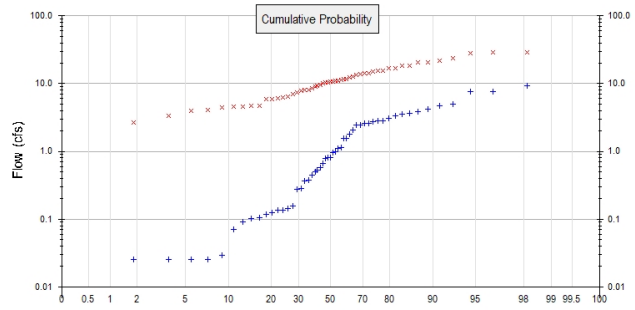
4.5556	0.002	0.003	3.928	0.004
4.6111	0.002	0.003	3.997	0.004
4.6667	0.002	0.003	4.066	0.004
4.7222	0.002	0.003	4.133	0.004
4.7778	0.002	0.003	4.199	0.004
4.8333	0.002	0.003	4.264	0.004
4.8889	0.002	0.003	4.328	0.004
4.9444	0.002	0.004	4.391	0.004
5.0000	0.002	0.004	4.454	0.004

Analysis Results

POC 1



+ Predeveloped x Mitigated



Predeveloped Landuse Totals for POC #1

Total Pervious Area: 31.732
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1

Total Pervious Area: 25.386
Total Impervious Area: 6.346

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.698607
5 year	2.736926
10 year	5.248949
25 year	10.041153
50 year	14.898727
100 year	20.909175

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	10.181605
5 year	16.645989
10 year	20.920649
25 year	26.152545
50 year	29.881953
100 year	33.451577

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	4.929	18.492
1957	0.500	14.150
1958	7.568	18.468
1959	1.801	11.186
1960	7.507	20.649
1961	3.655	13.271
1962	9.323	20.388
1963	2.746	23.662
1964	1.541	11.684
1965	0.818	6.157

1966	0.102	4.539
1967	0.374	5.969
1968	0.071	4.412
1969	0.367	10.206
1970	0.521	7.051
1971	3.340	15.385
1972	2.481	10.422
1973	0.118	6.455
1974	3.582	16.943
1975	3.861	29.087
1976	2.085	13.884
1977	0.025	4.692
1978	4.186	14.240
1979	0.134	5.997
1980	0.279	9.360
1981	0.444	7.936
1982	2.436	10.529
1983	0.996	12.806
1984	3.036	10.830
1985	0.091	4.597
1986	2.832	16.637
1987	0.145	10.877
1988	0.030	8.578
1989	0.104	3.338
1990	1.108	9.592
1991	2.617	12.293
1992	0.137	4.696
1993	0.660	8.007
1994	0.572	3.999
1995	0.158	15.682
1996	4.735	21.445
1997	1.147	11.075
1998	0.970	28.091
1999	0.124	4.137
2000	0.286	7.504
2001	0.023	1.320
2002	0.798	28.796
2003	0.025	8.959
2004	0.025	2.686
2005	0.026	5.945
2006	1.555	10.670
2007	2.570	14.987
2008	0.793	8.057
2009	2.836	11.702

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	9.3226	29.0871
2	7.5676	28.7959
3	7.5073	28.0914
4	4.9289	23.6615
5	4.7350	21.4449
6	4.1865	20.6489
7	3.8609	20.3880
8	3.6548	18.4916
9	3.5820	18.4681
10	3.3401	16.9431

11	3.0361	16.6366
12	2.8356	15.6821
13	2.8321	15.3847
14	2.7456	14.9865
15	2.6171	14.2395
16	2.5696	14.1504
17	2.4811	13.8837
18	2.4357	13.2711
19	2.0850	12.8064
20	1.8013	12.2932
21	1.5549	11.7017
22	1.5415	11.6841
23	1.1469	11.1855
24	1.1083	11.0754
25	0.9957	10.8771
26	0.9703	10.8299
27	0.8177	10.6703
28	0.7982	10.5291
29	0.7928	10.4224
30	0.6600	10.2060
31	0.5717	9.5925
32	0.5213	9.3598
33	0.5001	8.9586
34	0.4442	8.5780
35	0.3735	8.0573
36	0.3674	8.0067
37	0.2861	7.9357
38	0.2790	7.5044
39	0.1580	7.0513
40	0.1451	6.4546
41	0.1365	6.1567
42	0.1338	5.9974
43	0.1243	5.9695
44	0.1179	5.9449
45	0.1045	4.6964
46	0.1024	4.6918
47	0.0906	4.5974
48	0.0715	4.5392
49	0.0296	4.4116
50	0.0255	4.1370
51	0.0254	3.9986
52	0.0253	3.3379
53	0.0252	2.6857
54	0.0227	1.3197

Duration Flows

The Duration Matching **Failed**

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3493	300	66557	22185	Fail
0.4963	207	44706	21597	Fail
0.6432	161	30031	18652	Fail
0.7902	135	20204	14965	Fail
0.9372	100	13879	13878	Fail
1.0841	81	9877	12193	Fail
1.2311	70	7426	10608	Fail
1.3781	60	5889	9815	Fail
1.5250	52	4874	9373	Fail
1.6720	47	4115	8755	Fail
1.8189	42	3511	8359	Fail
1.9659	36	3056	8488	Fail
2.1129	33	2687	8142	Fail
2.2598	32	2373	7415	Fail
2.4068	29	2123	7320	Fail
2.5538	25	1952	7808	Fail
2.7007	23	1787	7769	Fail
2.8477	18	1648	9155	Fail
2.9947	15	1504	10026	Fail
3.1416	13	1380	10615	Fail
3.2886	12	1290	10750	Fail
3.4355	11	1198	10890	Fail
3.5825	10	1115	11150	Fail
3.7295	9	1030	11444	Fail
3.8764	8	952	11900	Fail
4.0234	8	898	11225	Fail
4.1704	8	842	10525	Fail
4.3173	7	788	11257	Fail
4.4643	6	739	12316	Fail
4.6113	6	687	11450	Fail
4.7582	4	637	15925	Fail
4.9052	4	610	15250	Fail
5.0521	3	578	19266	Fail
5.1991	3	543	18100	Fail
5.3461	3	502	16733	Fail
5.4930	3	480	16000	Fail
5.6400	3	456	15200	Fail
5.7870	3	430	14333	Fail
5.9339	3	404	13466	Fail
6.0809	3	375	12500	Fail
6.2279	3	356	11866	Fail
6.3748	3	335	11166	Fail
6.5218	3	319	10633	Fail
6.6688	3	304	10133	Fail
6.8157	3	290	9666	Fail
6.9627	3	276	9200	Fail
7.1096	3	260	8666	Fail
7.2566	3	252	8400	Fail
7.4036	3	242	8066	Fail
7.5505	2	231	11550	Fail
7.6975	1	217	21700	Fail
7.8445	1	206	20600	Fail
7.9914	1	198	19800	Fail
8.1384	1	189	18900	Fail

8.2854	1	182	18200	Fail
8.4323	1	174	17400	Fail
8.5793	1	168	16800	Fail
8.7262	1	163	16300	Fail
8.8732	1	158	15800	Fail
9.0202	1	150	15000	Fail
9.1671	1	148	14800	Fail
9.3141	1	136	13600	Fail
9.4611	0	131	n/a	Fail
9.6080	0	123	n/a	Fail
9.7550	0	120	n/a	Fail
9.9020	0	115	n/a	Fail
10.0489	0	109	n/a	Fail
10.1959	0	103	n/a	Fail
10.3428	0	98	n/a	Fail
10.4898	0	94	n/a	Fail
10.6368	0	89	n/a	Fail
10.7837	0	86	n/a	Fail
10.9307	0	83	n/a	Fail
11.0777	0	81	n/a	Fail
11.2246	0	77	n/a	Fail
11.3716	0	73	n/a	Fail
11.5186	0	71	n/a	Fail
11.6655	0	70	n/a	Fail
11.8125	0	65	n/a	Fail
11.9594	0	62	n/a	Fail
12.1064	0	61	n/a	Fail
12.2534	0	59	n/a	Fail
12.4003	0	56	n/a	Fail
12.5473	0	51	n/a	Fail
12.6943	0	50	n/a	Fail
12.8412	0	46	n/a	Fail
12.9882	0	45	n/a	Fail
13.1352	0	44	n/a	Fail
13.2821	0	39	n/a	Fail
13.4291	0	38	n/a	Fail
13.5761	0	36	n/a	Fail
13.7230	0	36	n/a	Fail
13.8700	0	32	n/a	Fail
14.0169	0	30	n/a	Fail
14.1639	0	28	n/a	Fail
14.3109	0	27	n/a	Fail
14.4578	0	25	n/a	Fail
14.6048	0	25	n/a	Fail
14.7518	0	25	n/a	Fail
14.8987	0	23	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0 acre-feet

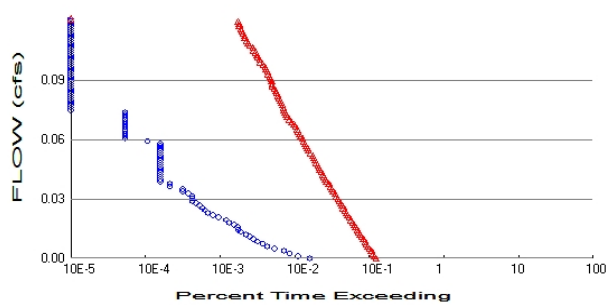
On-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

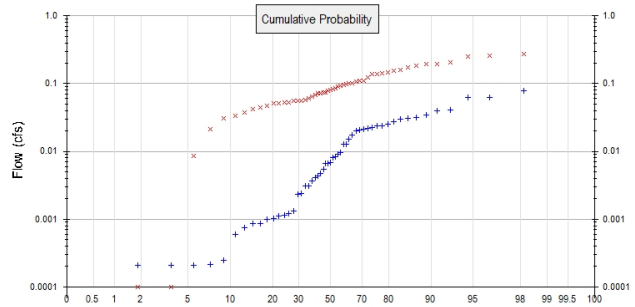
Off-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

POC 2



+ Predeveloped x Mitigated



Predeveloped Landuse Totals for POC #2

Total Pervious Area: 0.263
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2

Total Pervious Area: 0.107
Total Impervious Area: 0.156

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	0.00579
5 year	0.022684
10 year	0.043504
25 year	0.083223
50 year	0.123483
100 year	0.173299

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	0.105461
5 year	0.168787
10 year	0.205135
25 year	0.243928
50 year	0.268061
100 year	0.288656

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1956	0.041	0.155
1957	0.004	0.143
1958	0.063	0.172
1959	0.015	0.078
1960	0.062	0.181
1961	0.030	0.111
1962	0.077	0.111
1963	0.023	0.205
1964	0.013	0.102
1965	0.007	0.051
1966	0.001	0.031

1967	0.003	0.056
1968	0.001	0.052
1969	0.003	0.044
1970	0.004	0.056
1971	0.028	0.064
1972	0.021	0.093
1973	0.001	0.051
1974	0.030	0.148
1975	0.032	0.248
1976	0.017	0.058
1977	0.000	0.022
1978	0.035	0.123
1979	0.001	0.047
1980	0.002	0.089
1981	0.004	0.074
1982	0.020	0.096
1983	0.008	0.071
1984	0.025	0.097
1985	0.001	0.056
1986	0.023	0.140
1987	0.001	0.101
1988	0.000	0.038
1989	0.001	0.000
1990	0.009	0.072
1991	0.022	0.061
1992	0.001	0.042
1993	0.005	0.074
1994	0.005	0.009
1995	0.001	0.160
1996	0.039	0.196
1997	0.010	0.084
1998	0.008	0.259
1999	0.001	0.034
2000	0.002	0.085
2001	0.000	0.000
2002	0.007	0.273
2003	0.000	0.193
2004	0.000	0.000
2005	0.000	0.052
2006	0.013	0.069
2007	0.021	0.137
2008	0.007	0.080
2009	0.024	0.108

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	0.0773	0.2727
2	0.0627	0.2588
3	0.0622	0.2484
4	0.0409	0.2052
5	0.0392	0.1964
6	0.0347	0.1934
7	0.0320	0.1809
8	0.0303	0.1720
9	0.0297	0.1599
10	0.0277	0.1547
11	0.0252	0.1478

12	0.0235	0.1425
13	0.0235	0.1400
14	0.0228	0.1374
15	0.0217	0.1226
16	0.0213	0.1112
17	0.0206	0.1110
18	0.0202	0.1081
19	0.0173	0.1020
20	0.0149	0.1010
21	0.0129	0.0975
22	0.0128	0.0963
23	0.0095	0.0934
24	0.0092	0.0893
25	0.0083	0.0849
26	0.0080	0.0835
27	0.0068	0.0797
28	0.0066	0.0783
29	0.0066	0.0737
30	0.0055	0.0735
31	0.0047	0.0717
32	0.0043	0.0710
33	0.0041	0.0688
34	0.0037	0.0643
35	0.0031	0.0612
36	0.0030	0.0576
37	0.0024	0.0564
38	0.0023	0.0561
39	0.0013	0.0559
40	0.0012	0.0520
41	0.0011	0.0520
42	0.0011	0.0512
43	0.0010	0.0507
44	0.0010	0.0475
45	0.0009	0.0443
46	0.0008	0.0425
47	0.0008	0.0377
48	0.0006	0.0338
49	0.0002	0.0311
50	0.0002	0.0215
51	0.0002	0.0085
52	0.0002	0.0000
53	0.0002	0.0000
54	0.0002	0.0000

Duration Flows

The Duration Matching **Failed**

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0029	300	2335	778	Fail
0.0041	207	2210	1067	Fail
0.0053	161	2113	1312	Fail
0.0065	135	2001	1482	Fail
0.0078	100	1893	1893	Fail
0.0090	81	1797	2218	Fail
0.0102	70	1721	2458	Fail
0.0114	60	1656	2760	Fail
0.0126	52	1573	3025	Fail
0.0139	47	1493	3176	Fail
0.0151	42	1427	3397	Fail
0.0163	36	1361	3780	Fail
0.0175	33	1296	3927	Fail
0.0187	32	1234	3856	Fail
0.0199	29	1184	4082	Fail
0.0212	25	1134	4536	Fail
0.0224	23	1069	4647	Fail
0.0236	18	1016	5644	Fail
0.0248	15	963	6419	Fail
0.0260	13	927	7130	Fail
0.0273	12	893	7441	Fail
0.0285	11	850	7727	Fail
0.0297	10	813	8130	Fail
0.0309	9	782	8688	Fail
0.0321	8	747	9337	Fail
0.0333	8	721	9012	Fail
0.0346	8	683	8537	Fail
0.0358	7	653	9328	Fail
0.0370	6	622	10366	Fail
0.0382	6	594	9900	Fail
0.0394	4	569	14225	Fail
0.0407	4	541	13525	Fail
0.0419	3	506	16866	Fail
0.0431	3	485	16166	Fail
0.0443	3	470	15666	Fail
0.0455	3	451	15033	Fail
0.0467	3	427	14233	Fail
0.0480	3	411	13700	Fail
0.0492	3	400	13333	Fail
0.0504	3	385	12833	Fail
0.0516	3	369	12300	Fail
0.0528	3	353	11766	Fail
0.0541	3	340	11333	Fail
0.0553	3	328	10933	Fail
0.0565	3	303	10100	Fail
0.0577	3	287	9566	Fail
0.0589	3	281	9366	Fail
0.0601	3	269	8966	Fail
0.0614	3	258	8600	Fail
0.0626	2	251	12550	Fail
0.0638	1	241	24100	Fail
0.0650	1	226	22600	Fail
0.0662	1	218	21800	Fail
0.0675	1	209	20900	Fail

0.0687	1	205	20500	Fail
0.0699	1	194	19400	Fail
0.0711	1	185	18500	Fail
0.0723	1	170	17000	Fail
0.0735	1	161	16100	Fail
0.0748	1	149	14900	Fail
0.0760	1	146	14600	Fail
0.0772	1	138	13800	Fail
0.0784	0	136	n/a	Fail
0.0796	0	134	n/a	Fail
0.0809	0	129	n/a	Fail
0.0821	0	125	n/a	Fail
0.0833	0	121	n/a	Fail
0.0845	0	117	n/a	Fail
0.0857	0	112	n/a	Fail
0.0869	0	108	n/a	Fail
0.0882	0	105	n/a	Fail
0.0894	0	100	n/a	Fail
0.0906	0	94	n/a	Fail
0.0918	0	94	n/a	Fail
0.0930	0	93	n/a	Fail
0.0942	0	91	n/a	Fail
0.0955	0	88	n/a	Fail
0.0967	0	84	n/a	Fail
0.0979	0	82	n/a	Fail
0.0991	0	78	n/a	Fail
0.1003	0	76	n/a	Fail
0.1016	0	71	n/a	Fail
0.1028	0	65	n/a	Fail
0.1040	0	64	n/a	Fail
0.1052	0	60	n/a	Fail
0.1064	0	59	n/a	Fail
0.1076	0	57	n/a	Fail
0.1089	0	53	n/a	Fail
0.1101	0	52	n/a	Fail
0.1113	0	47	n/a	Fail
0.1125	0	45	n/a	Fail
0.1137	0	43	n/a	Fail
0.1150	0	40	n/a	Fail
0.1162	0	40	n/a	Fail
0.1174	0	38	n/a	Fail
0.1186	0	37	n/a	Fail
0.1198	0	36	n/a	Fail
0.1210	0	34	n/a	Fail
0.1223	0	34	n/a	Fail
0.1235	0	33	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume: 0 acre-feet

On-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

Off-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

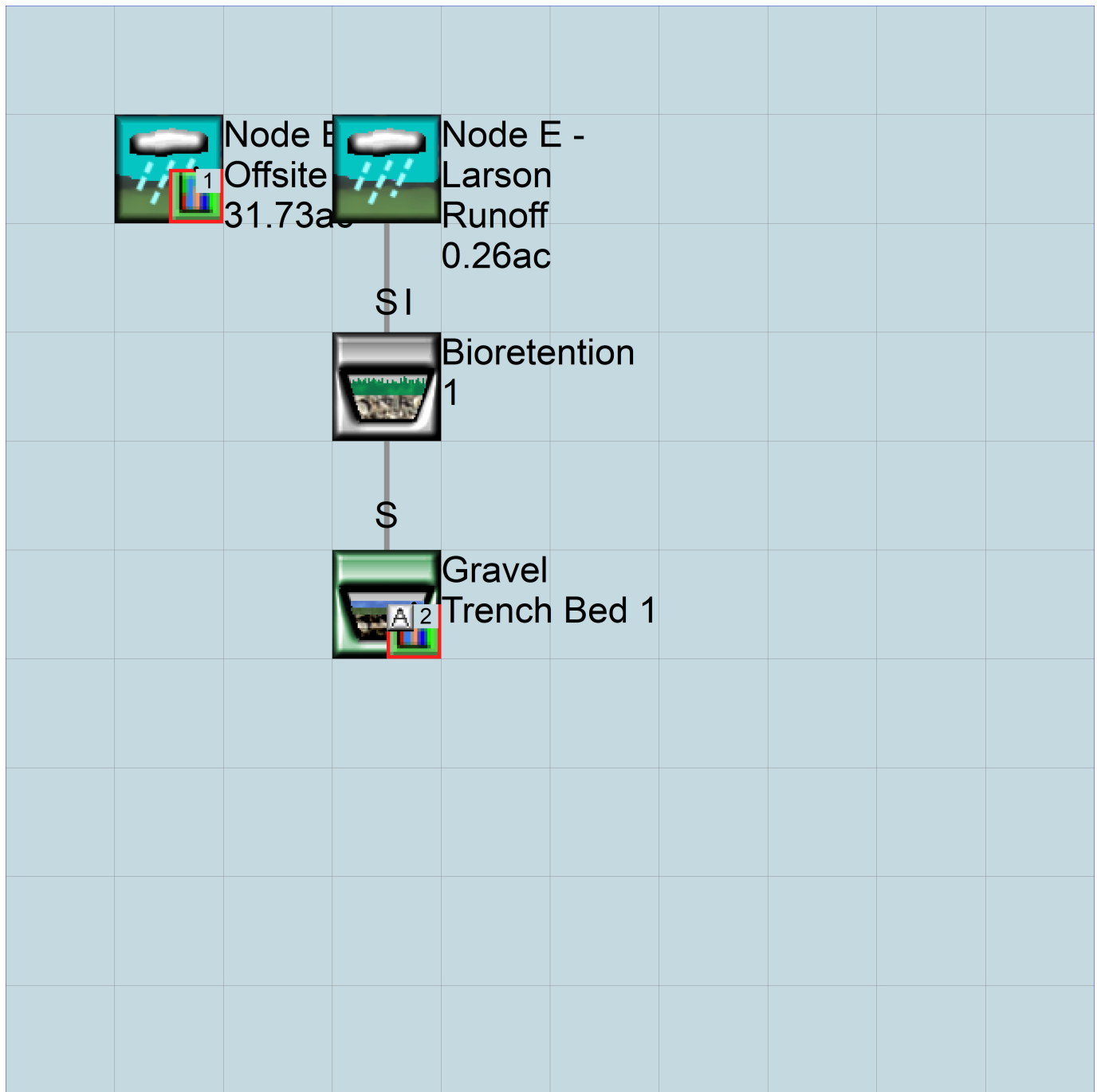


Node E
Offsite
31.73ac



Node E -
Larson
Runoff
0.26ac

Mitigated Schematic



Predeveloped UCI File

RUN

GLOBAL

```
WWM4 model simulation
START      1955 10 01      END      2009 09 30
RUN INTERP OUTPUT LEVEL    3      0
RESUME     0 RUN          1
UNIT SYSTEM                1
END GLOBAL
```

FILES

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<-ID->                                     ***
WDM      26     18591_Node E.wdm
MESSU    25     Pre18591_Node E.MES
          27     Pre18591_Node E.L61
          28     Pre18591_Node E.L62
          30     POC18591_Node E1.dat
          31     POC18591_Node E2.dat
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END FILES

OPN SEQUENCE

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INGRP      INDELT 00:15
  PERLND      2
  COPY        501
  COPY        502
  DISPLY      1
  DISPLY      2
```

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INF01

```
# - #<-----Title----->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
  1      Node E - Offsite      MAX      1      2      30      9
  2      Node E - Larson Runoff  MAX      1      2      31      9
```

END DISPLY-INF01

END DISPLY

COPY

TIMESERIES

```
# - # NPT NMN ***
  1      1      1
  501      1      1
  502      1      1
```

END TIMESERIES

END COPY

GENER

OPCODE

```
#      # OPCD ***
```

END OPCODE

PARM

```
#      #      K ***
```

END PARM

END GENER

PERLND

GEN-INFO

```
<PLS ><-----Name----->NBLKS  Unit-systems  Printer ***
# - #      User  t-series  Engl Metr ***
          in  out
  2      A/B, Forest, Mod      1      1      1      1      27      0
```

END GEN-INFO

*** Section PWATER***

ACTIVITY

```
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT  SED  PST  PWG  PQAL MSTL  PEST  NITR  PHOS  TRAC ***
  2      0      0      1      0      0      0      0      0      0      0      0
```

END ACTIVITY

PRINT-INFO

```

<PLS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW PWAT  SED  PST  PWG  PQAL MSTL PEST NITR PHOS TRAC *****
2   0   0   4   0   0   0   0   0   0   0   0   0   0   1   9
END PRINT-INFO

```

```

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
2   0   0   0   0   0   0   0   0   0   0   0   0
END PWAT-PARM1

```

```

PWAT-PARM2
<PLS > PWATER input info: Part 2 *****
# - # ***FOREST  LZSN  INFILT  LSUR  SLSUR  KVARV  AGWRC
2   0   5   2   400  0.1  0.3  0.996
END PWAT-PARM2

```

```

PWAT-PARM3
<PLS > PWATER input info: Part 3 *****
# - # ***PETMAX  PETMIN  INFEXP  INFILD  DEEPFR  BASETP  AGWETP
2   0   0   2   2   0   0   0
END PWAT-PARM3

```

```

PWAT-PARM4
<PLS > PWATER input info: Part 4 *****
# - # CEPSC  UZSN  NSUR  INTFW  IRC  LZETP ***
2   0.2  0.5  0.35  0   0.7  0.7 ***
END PWAT-PARM4

```

```

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS  SURS  UZS  IFWS  LZS  AGWS  GWVS
2   0   0   0   0   3   1   0
END PWAT-STATE1

```

END PERLND

IMPLND

```

GEN-INFO
<PLS ><-----Name-----> Unit-systems  Printer ***
# - # User t-series Engl Metr ***
in out ***

```

```

END GEN-INFO
*** Section IWATER***

```

```

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT  SLD  IWG IQAL ***
END ACTIVITY

```

```

PRINT-INFO
<ILS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW IWAT  SLD  IWG IQAL *****
END PRINT-INFO

```

```

IWAT-PARM1
<PLS > IWATER variable monthly parameter value flags ***
# - # CSNO RTOP VRS  VNN RTLI ***
END IWAT-PARM1

```

```

IWAT-PARM2
<PLS > IWATER input info: Part 2 *****
# - # *** LSUR  SLSUR  NSUR  RETSC
END IWAT-PARM2

```

```

IWAT-PARM3
<PLS > IWATER input info: Part 3 *****
# - # ***PETMAX  PETMIN
END IWAT-PARM3

```

```

IWAT-STATE1
  <PLS > *** Initial conditions at start of simulation
  # - # *** RETS      SURS
END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->          <--Area-->      <-Target->      MBLK      ***
<Name>   #          <-factor->      <Name>   #      Tbl#      ***
Node E - Offsite***
PERLND   2          31.732          COPY    501      12
PERLND   2          31.732          COPY    501      13
Node E - Larson Runoff***
PERLND   2          0.263          COPY    502      12
PERLND   2          0.263          COPY    502      13

*****Routing*****
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>   #      <Name> # #<-factor->strg <Name>   #   #      <Name> # #      ***
COPY    501 OUTPUT MEAN   1 1  48.4          DISPLY   1      INPUT TIMSER 1
COPY    502 OUTPUT MEAN   1 1  48.4          DISPLY   2      INPUT TIMSER 1

<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>   #      <Name> # #<-factor->strg <Name>   #   #      <Name> # #      ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES      Name      Nexits      Unit Systems      Printer      ***
    # - #<-----><----> User T-series Engl Metr LKFG      ***
                                in out
  END GEN-INFO
  *** Section RCHRES***

ACTIVITY
  <PLS > ***** Active Sections *****
  # - # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
END ACTIVITY

PRINT-INFO
  <PLS > ***** Print-flags ***** PIVL  PYR
  # - # HYDR ADCA CONS HEAT SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR *****
END PRINT-INFO

HYDR-PARM1
  RCHRES      Flags for each HYDR Section      ***
  # - # VC A1 A2 A3 ODFVFG for each *** ODGTFG for each FUNCT for each
          FG FG FG FG possible exit *** possible exit possible exit
          * * * * * * * *
END HYDR-PARM1

HYDR-PARM2
  # - # FTABNO      LEN      DELTH      STCOR      KS      DB50      ***
<-----><-----><-----><-----><-----><----->
END HYDR-PARM2
HYDR-INIT
  RCHRES      Initial conditions for each HYDR section      ***
  # - # *** VOL      Initial value of COLIND      Initial value of OUTDGT
          *** ac-ft      for each possible exit      for each possible exit
  <-----><----->      <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS

```

END SPEC-ACTIONS
 FTABLES
 END FTABLES

EXT SOURCES

<-Volume->	<Member>	SsysSgap<-Mult-->Tran	<-Target	vols>	<-Grp>	<-Member->	***
<Name>	#	<Name> # tem strg<-factor->strg	<Name>	#	#	<Name> # #	***
WDM	2	PREC ENGL 1.429	PERLND	1	999	EXTNL PREC	
WDM	2	PREC ENGL 1.429	IMPLND	1	999	EXTNL PREC	
WDM	1	EVAP ENGL 0.76	PERLND	1	999	EXTNL PETINP	
WDM	1	EVAP ENGL 0.76	IMPLND	1	999	EXTNL PETINP	

END EXT SOURCES

EXT TARGETS

<-Volume->	<-Grp>	<-Member-><-Mult-->Tran	<-Volume->	<Member>	Tsys	Tgap	Amd	***
<Name>	#	<Name> # #<-factor->strg	<Name>	#	<Name>	tem	strg	strg***
COPY	501	OUTPUT MEAN 1 1 48.4	WDM	501	FLOW	ENGL	REPL	
COPY	502	OUTPUT MEAN 1 1 48.4	WDM	502	FLOW	ENGL	REPL	

END EXT TARGETS

MASS-LINK

<Volume>	<-Grp>	<-Member-><-Mult-->	<Target>	<-Grp>	<-Member->***
<Name>	#	<Name> # #<-factor->	<Name>	#	<Name> # #***
MASS-LINK		12			
PERLND	PWATER	SURO 0.083333	COPY	INPUT	MEAN
END MASS-LINK		12			
MASS-LINK		13			
PERLND	PWATER	IFWO 0.083333	COPY	INPUT	MEAN
END MASS-LINK		13			

END MASS-LINK

END RUN

Mitigated UCI File

RUN

GLOBAL

WWM4 model simulation
START 1955 10 01 END 2009 09 30
RUN INTERP OUTPUT LEVEL 3 0
RESUME 0 RUN 1 UNIT SYSTEM 1
END GLOBAL

FILES

<File>	<Un#>	<-----File Name----->	***
<-ID->			***
WDM	26	18591_Node E.wdm	
MESSU	25	Mit18591_Node E.MES	
	27	Mit18591_Node E.L61	
	28	Mit18591_Node E.L62	
	30	POC18591_Node E1.dat	
	31	POC18591_Node E2.dat	

END FILES

OPN SEQUENCE

INGRP INDELT 00:15

PERLND	8
IMPLND	4
IMPLND	1
RCHRES	1
RCHRES	2
RCHRES	3
COPY	501
COPY	2
COPY	502
DISPLY	1
DISPLY	2

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INF01

#	-	#	<-----Title----->	***	TRAN	PIVL	DIG1	FIL1	PYR	DIG2	FIL2	YRND
1			Node E - Offsite		MAX				1	2	30	9
2			Gravel Trench Bed 1		MAX				1	2	31	9

END DISPLY-INF01

END DISPLY

COPY

TIMESERIES

#	-	#	NPT	NMN	***
1			1	1	
501			1	1	
2			1	1	
502			1	1	

END TIMESERIES

END COPY

GENER

OPCODE

#	#	OPCD	***
---	---	------	-----

END OPCODE

PARM

#	#	K	***
---	---	---	-----

END PARM

END GENER

PERLND

GEN-INFO

<PLS >	<-----Name----->	NBLKS	Unit-systems	Printer	***	
#	-	#	User	t-series	Engl Metr	***
			in	out		***

8	A/B, Lawn, Mod	1	1	1	1	27	0
---	----------------	---	---	---	---	----	---

END GEN-INFO

*** Section PWATER***

```

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC ***
8      0      0      1      0      0      0      0      0      0      0      0      0
END ACTIVITY

PRINT-INFO
<PLS > ***** Print-flags ***** PIVL PYR
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC *****
8      0      0      4      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG VCS VUZ VNN VIFW VIRC VLE INFC HWT ***
8      0      0      0      0      0      0      0      0      0      0      0
END PWAT-PARM1

PWAT-PARM2
<PLS > PWATER input info: Part 2 ***
# - # ***FOREST LZSN INFILT LSUR SLSUR KVARV AGWRC
8      0      5      0.8      400      0.1      0.3      0.996
END PWAT-PARM2

PWAT-PARM3
<PLS > PWATER input info: Part 3 ***
# - # ***PETMAX PETMIN INFEXP INFILD DEEPFR BASETP AGWETP
8      0      0      2      2      0      0      0
END PWAT-PARM3

PWAT-PARM4
<PLS > PWATER input info: Part 4 ***
# - # CEPSC UZSN NSUR INTFW IRC LZETP ***
8      0.1      0.5      0.25      0      0.7      0.25
END PWAT-PARM4

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS SURS UZS IFWS LZS AGWS GWVS
8      0      0      0      0      3      1      0
END PWAT-STATE1

END PERLND

IMPLND
GEN-INFO
<PLS ><-----Name-----> Unit-systems Printer ***
# - # User t-series Engl Metr ***
# - # in out
4 ROOF TOPS/FLAT 1 1 1 27 0
1 ROADS/FLAT 1 1 1 27 0
END GEN-INFO
*** Section IWATER***

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT SLD IWG IQAL ***
4      0      0      1      0      0      0
1      0      0      1      0      0      0
END ACTIVITY

PRINT-INFO
<ILS > ***** Print-flags ***** PIVL PYR
# - # ATMP SNOW IWAT SLD IWG IQAL *****
4      0      0      4      0      0      4      1      9
1      0      0      4      0      0      0      1      9
END PRINT-INFO

IWAT-PARM1
<PLS > IWATER variable monthly parameter value flags ***

```

```

# - # CSNO RTOP VRS VNN RTLI ***
4      0      0      0      0      0
1      0      0      0      0      0
END IWAT-PARM1

```

```

IWAT-PARM2
<PLS >          IWATER input info: Part 2          ***
# - # *** LSUR   SLSUR   NSUR   RETSC
4      400      0.01   0.1    0.1
1      400      0.01   0.1    0.1
END IWAT-PARM2

```

```

IWAT-PARM3
<PLS >          IWATER input info: Part 3          ***
# - # *** PETMAX  PETMIN
4      0        0
1      0        0
END IWAT-PARM3

```

```

IWAT-STATE1
<PLS > *** Initial conditions at start of simulation
# - # *** RETS    SURS
4      0        0
1      0        0
END IWAT-STATE1

```

END IMPLND

```

SCHEMATIC
<-Source->          <-Area-->    <-Target->    MBLK    ***
<Name> #          <-factor->    <Name> #    Tbl#    ***
Node E - Larson Runoff***
PERLND 8          0.107    RCHRES 1      2
PERLND 8          0.107    RCHRES 1      3
IMPLND 1          0.156    RCHRES 1      5
Node E - Offsite***
PERLND 8          25.386    COPY 501    12
PERLND 8          25.386    COPY 501    13
IMPLND 4          6.346    COPY 501    15

```

```

*****Routing*****
RCHRES 1          1    RCHRES 3      7
RCHRES 1          1    COPY 2      17
RCHRES 1          1    RCHRES 2      8
RCHRES 3          1    COPY 502    17
END SCHEMATIC

```

```

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> #      <Name> # #<-factor->strg <Name> # #      <Name> # #      ***
COPY 501 OUTPUT MEAN 1 1 48.4    DISPLY 1      INPUT TIMSER 1
COPY 502 OUTPUT MEAN 1 1 48.4    DISPLY 2      INPUT TIMSER 1

```

```

<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> #      <Name> # #<-factor->strg <Name> # #      <Name> # #      ***
END NETWORK

```

```

RCHRES
GEN-INFO
RCHRES          Name          Nexits    Unit Systems    Printer          ***
# - #<-----><----> User T-series  Enl Metr LKFG    ***
1      Surface retentio-007    2      1      1      1    28      0      1    ***
2      Bioretention 1          1      1      1      1    28      0      1
3      Gravel Trench Be-011    2      1      1      1    28      0      1
END GEN-INFO
*** Section RCHRES***

```

```

ACTIVITY
<PLS > ***** Active Sections *****
# - # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
1      1      0      0      0      0      0      0      0      0      0
2      1      0      0      0      0      0      0      0      0      0
3      1      0      0      0      0      0      0      0      0      0
END ACTIVITY

PRINT-INFO
<PLS > ***** Print-flags ***** PIVL  PYR *****
# - # HYDR ADCA CONS HEAT SED  GQL OXRX  NUTR PLNK PHCB PIVL  PYR *****
1      4      0      0      0      0      0      0      0      0      0      1      9
2      4      0      0      0      0      0      0      0      0      0      1      9
3      4      0      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

HYDR-PARM1
RCHRES  Flags for each HYDR Section *****
# - # VC A1 A2 A3 ODFVFG for each *** ODGTFG for each  FUNCT for each
      FG FG FG FG possible exit *** possible exit  possible exit
      * * * * * * * * * * * * * * * * * * * * * * *
1      0  1  0  0      4  5  0  0  0      0  0  0  0  0      2  2  2  2  2
2      0  1  0  0      4  0  0  0  0      0  0  0  0  0      2  2  2  2  2
3      0  1  0  0      4  5  0  0  0      0  0  0  0  0      2  2  2  2  2
END HYDR-PARM1

HYDR-PARM2
# - # FTABNO      LEN      DELTH      STCOR      KS      DB50      ***
<-----><-----><-----><-----><-----><-----><----->
1      1      0.01      0.0      0.0      0.0      0.0
2      2      0.01      0.0      0.0      0.0      0.0
3      3      0.01      0.0      0.0      0.0      0.0
END HYDR-PARM2

HYDR-INIT
RCHRES  Initial conditions for each HYDR section *****
# - # *** VOL      Initial value of COLIND      Initial value of OUTDGT
      *** ac-ft      for each possible exit      for each possible exit
<-----><-----><-----><-----><-----><-----><-----><----->
1      0      4.0  5.0  0.0  0.0  0.0      0.0  0.0  0.0  0.0  0.0
2      0      4.0  0.0  0.0  0.0  0.0      0.0  0.0  0.0  0.0  0.0
3      0      4.0  5.0  0.0  0.0  0.0      0.0  0.0  0.0  0.0  0.0
END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
FTABLE      2
70      4
Depth      Area      Volume      Outflow1      Velocity      Travel Time***
(ft)      (acres)      (acre-ft)      (cfs)      (ft/sec)      (Minutes)***
0.000000  0.002296  0.000000  0.000000
0.043956  0.002296  0.000046  0.000000
0.087912  0.002296  0.000092  0.000000
0.131868  0.002296  0.000138  0.000000
0.175824  0.002296  0.000185  0.000000
0.219780  0.002296  0.000231  0.000063
0.263736  0.002296  0.000277  0.000106
0.307692  0.002296  0.000323  0.000164
0.351648  0.002296  0.000369  0.000239
0.395604  0.002296  0.000415  0.000332
0.439560  0.002296  0.000461  0.000446
0.483516  0.002296  0.000508  0.000580
0.527473  0.002296  0.000554  0.000721
0.571429  0.002296  0.000600  0.000737
0.615385  0.002296  0.000646  0.000919
0.659341  0.002296  0.000692  0.001125
0.703297  0.002296  0.000738  0.001357
0.747253  0.002296  0.000784  0.001617
0.791209  0.002296  0.000831  0.001742

```

0.835165	0.002296	0.000877	0.001905
0.879121	0.002296	0.000923	0.002222
0.923077	0.002296	0.000969	0.002570
0.967033	0.002296	0.001015	0.002949
1.010989	0.002296	0.001061	0.003334
1.054945	0.002296	0.001107	0.003359
1.098901	0.002296	0.001154	0.003803
1.142857	0.002296	0.001200	0.004280
1.186813	0.002296	0.001246	0.004792
1.230769	0.002296	0.001292	0.005339
1.274725	0.002296	0.001338	0.005579
1.318681	0.002296	0.001384	0.005922
1.362637	0.002296	0.001431	0.006541
1.406593	0.002296	0.001477	0.007198
1.450549	0.002296	0.001523	0.007893
1.494505	0.002296	0.001569	0.008548
1.538462	0.002296	0.001611	0.008626
1.582418	0.002296	0.001653	0.009399
1.626374	0.002296	0.001695	0.010210
1.670330	0.002296	0.001736	0.011060
1.714286	0.002296	0.001778	0.011949
1.758242	0.002296	0.001820	0.012307
1.802198	0.002296	0.001862	0.012872
1.846154	0.002296	0.001904	0.013808
1.890110	0.002296	0.001946	0.018519
1.934066	0.002296	0.001988	0.018519
1.978022	0.002296	0.002030	0.018519
2.021978	0.002296	0.002071	0.018519
2.065934	0.002296	0.002113	0.018519
2.109890	0.002296	0.002155	0.018519
2.153846	0.002296	0.002197	0.018519
2.197802	0.002296	0.002239	0.018519
2.241758	0.002296	0.002281	0.018519
2.285714	0.002296	0.002323	0.018519
2.329670	0.002296	0.002365	0.018519
2.373626	0.002296	0.002407	0.018519
2.417582	0.002296	0.002448	0.018519
2.461538	0.002296	0.002490	0.018519
2.505495	0.002296	0.002532	0.018519
2.549451	0.002296	0.002574	0.018519
2.593407	0.002296	0.002616	0.018519
2.637363	0.002296	0.002658	0.018519
2.681319	0.002296	0.002700	0.018519
2.725275	0.002296	0.002742	0.018519
2.769231	0.002296	0.002783	0.018519
2.813187	0.002296	0.002825	0.018519
2.857143	0.002296	0.002867	0.018519
2.901099	0.002296	0.002909	0.018519
2.945055	0.002296	0.002951	0.018519
2.989011	0.002296	0.002993	0.018519
3.000000	0.002296	0.003386	0.018519

END FTABLE 2

FTABLE 1

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.002296	0.000000	0.000000	0.000000		
0.043956	0.002296	0.000101	0.000000	0.013889		
0.087912	0.002296	0.000202	0.000000	0.014703		
0.131868	0.002296	0.000303	0.000000	0.015110		
0.175824	0.002296	0.000404	0.000000	0.015517		
0.219780	0.002296	0.000505	0.000000	0.015924		
0.263736	0.002296	0.000605	0.000000	0.016331		
0.307692	0.002296	0.000706	0.000000	0.016738		
0.351648	0.002296	0.000807	0.000000	0.017145		
0.395604	0.002296	0.000908	0.000000	0.017552		
0.439560	0.002296	0.001009	0.000000	0.017959		
0.483516	0.002296	0.001110	0.000000	0.018366		
0.527473	0.002296	0.001211	0.048301	0.018519		
0.571429	0.002296	0.001312	0.202028	0.018519		

0.615385	0.002296	0.001413	0.412175	0.018519
0.659341	0.002296	0.001514	0.659695	0.018519
0.703297	0.002296	0.001615	0.928167	0.018519
0.747253	0.002296	0.001715	1.200769	0.018519
0.791209	0.002296	0.001816	1.460630	0.018519
0.835165	0.002296	0.001917	1.692395	0.018519
0.879121	0.002296	0.002018	1.884482	0.018519
0.923077	0.002296	0.002119	2.031838	0.018519
0.967033	0.002296	0.002220	2.139092	0.018519
1.000000	0.002296	0.002296	2.251466	0.018519

END FTABLE 1

FTABLE 3

92 5	Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
	0.000000	0.002296	0.000000	0.000000	0.000000		
	0.055556	0.002296	0.000045	0.000000	0.004630		
	0.111111	0.002296	0.000089	0.000000	0.004630		
	0.166667	0.002296	0.000134	0.000000	0.004630		
	0.222222	0.002296	0.000179	0.000000	0.004630		
	0.277778	0.002296	0.000223	0.000000	0.004630		
	0.333333	0.002296	0.000268	0.000000	0.004630		
	0.388889	0.002296	0.000312	0.000000	0.004630		
	0.444444	0.002296	0.000357	0.000000	0.004630		
	0.500000	0.002296	0.000402	0.000000	0.004630		
	0.555556	0.002296	0.000446	0.000000	0.004630		
	0.611111	0.002296	0.000491	0.000000	0.004630		
	0.666667	0.002296	0.000536	0.000000	0.004630		
	0.722222	0.002296	0.000580	0.000000	0.004630		
	0.777778	0.002296	0.000625	0.000000	0.004630		
	0.833333	0.002296	0.000670	0.000000	0.004630		
	0.888889	0.002296	0.000714	0.000000	0.004630		
	0.944444	0.002296	0.000759	0.000000	0.004630		
	1.000000	0.002296	0.000803	0.000000	0.004630		
	1.055556	0.002296	0.000848	0.000000	0.004630		
	1.111111	0.002296	0.000893	0.000000	0.004630		
	1.166667	0.002296	0.000937	0.000000	0.004630		
	1.222222	0.002296	0.000982	0.000000	0.004630		
	1.277778	0.002296	0.001027	0.000000	0.004630		
	1.333333	0.002296	0.001071	0.000000	0.004630		
	1.388889	0.002296	0.001116	0.000000	0.004630		
	1.444444	0.002296	0.001161	0.000000	0.004630		
	1.500000	0.002296	0.001205	0.000000	0.004630		
	1.555556	0.002296	0.001250	0.000000	0.004630		
	1.611111	0.002296	0.001295	0.000000	0.004630		
	1.666667	0.002296	0.001339	0.000000	0.004630		
	1.722222	0.002296	0.001384	0.000000	0.004630		
	1.777778	0.002296	0.001428	0.000000	0.004630		
	1.833333	0.002296	0.001473	0.000000	0.004630		
	1.888889	0.002296	0.001518	0.000000	0.004630		
	1.944444	0.002296	0.001562	0.000000	0.004630		
	2.000000	0.002296	0.001607	0.000000	0.004630		
	2.055556	0.002296	0.001652	0.000000	0.004630		
	2.111111	0.002296	0.001696	0.000000	0.004630		
	2.166667	0.002296	0.001741	0.000000	0.004630		
	2.222222	0.002296	0.001786	0.000000	0.004630		
	2.277778	0.002296	0.001830	0.000000	0.004630		
	2.333333	0.002296	0.001875	0.000000	0.004630		
	2.388889	0.002296	0.001919	0.000000	0.004630		
	2.444444	0.002296	0.001964	0.000000	0.004630		
	2.500000	0.002296	0.002009	0.000000	0.004630		
	2.555556	0.002296	0.002053	0.000000	0.004630		
	2.611111	0.002296	0.002098	0.000000	0.004630		
	2.666667	0.002296	0.002143	0.000000	0.004630		
	2.722222	0.002296	0.002187	0.000000	0.004630		
	2.777778	0.002296	0.002232	0.000000	0.004630		
	2.833333	0.002296	0.002277	0.000000	0.004630		
	2.888889	0.002296	0.002321	0.000000	0.004630		
	2.944444	0.002296	0.002366	0.000000	0.004630		
	3.000000	0.002296	0.002410	0.000000	0.004630		

3.055556	0.002296	0.002455	0.138729	0.004630
3.111111	0.002296	0.002500	0.389839	0.004630
3.166667	0.002296	0.002544	0.703432	0.004630
3.222222	0.002296	0.002589	1.046030	0.004630
3.277778	0.002296	0.002634	1.383552	0.004630
3.333333	0.002296	0.002678	1.683468	0.004630
3.388889	0.002296	0.002723	1.921105	0.004630
3.444444	0.002296	0.002768	2.088233	0.004630
3.500000	0.002296	0.002812	2.203335	0.004630
3.555556	0.002296	0.002857	2.347596	0.004630
3.611111	0.002296	0.002901	2.462179	0.004630
3.666667	0.002296	0.002946	2.571662	0.004630
3.722222	0.002296	0.002991	2.676671	0.004630
3.777778	0.002296	0.003035	2.777713	0.004630
3.833333	0.002296	0.003080	2.875206	0.004630
3.888889	0.002296	0.003125	2.969500	0.004630
3.944444	0.002296	0.003169	3.060890	0.004630
4.000000	0.002296	0.003214	3.149630	0.004630
4.055556	0.002296	0.003259	3.235937	0.004630
4.111111	0.002296	0.003303	3.320002	0.004630
4.166667	0.002296	0.003348	3.401989	0.004630
4.222222	0.002296	0.003393	3.482047	0.004630
4.277778	0.002296	0.003437	3.560305	0.004630
4.333333	0.002296	0.003482	3.636879	0.004630
4.388889	0.002296	0.003526	3.711875	0.004630
4.444444	0.002296	0.003571	3.785384	0.004630
4.500000	0.002296	0.003616	3.857493	0.004630
4.555556	0.002296	0.003660	3.928279	0.004630
4.611111	0.002296	0.003705	3.997811	0.004630
4.666667	0.002296	0.003750	4.066155	0.004630
4.722222	0.002296	0.003794	4.133369	0.004630
4.777778	0.002296	0.003839	4.199507	0.004630
4.833333	0.002296	0.003884	4.264619	0.004630
4.888889	0.002296	0.003928	4.328752	0.004630
4.944444	0.002296	0.003973	4.391949	0.004630
5.000000	0.002296	0.004017	4.454250	0.004630
5.055556	0.002296	0.004145	4.515690	0.004630

END FTABLE 3
END FTABLES

EXT SOURCES

<-Volume->	<Member>	SsysSgap<-Mult-->	Tran	<-Target	vols>	<-Grp>	<-Member->	***
<Name>	#	<Name>	#	tem strg<-factor->	strg	<Name>	#	***
WDM	2	PREC	ENGL	1.429	PERLND	1 999	EXTNL	PREC
WDM	2	PREC	ENGL	1.429	IMPLND	1 999	EXTNL	PREC
WDM	1	EVAP	ENGL	0.76	PERLND	1 999	EXTNL	PETINP
WDM	1	EVAP	ENGL	0.76	IMPLND	1 999	EXTNL	PETINP
WDM	2	PREC	ENGL	1.429	RCHRES	1	EXTNL	PREC
WDM	1	EVAP	ENGL	0.5	RCHRES	1	EXTNL	POTEV
WDM	1	EVAP	ENGL	0.76	RCHRES	2	EXTNL	POTEV

END EXT SOURCES

EXT TARGETS

<-Volume->	<-Grp>	<-Member->	<-Mult-->	Tran	<-Volume->	<Member>	Tsys	Tgap	Amd	***
<Name>	#	<Name>	#	tem strg<-factor->	strg	<Name>	#	<Name>	tem strg	strg
COPY	1	OUTPUT	MEAN	1 1	48.4	WDM	701	FLOW	ENGL	REPL
COPY	501	OUTPUT	MEAN	1 1	48.4	WDM	801	FLOW	ENGL	REPL
RCHRES	3	HYDR	RO	1 1	1	WDM	1010	FLOW	ENGL	REPL
RCHRES	3	HYDR	O	1 1	1	WDM	1011	FLOW	ENGL	REPL
RCHRES	3	HYDR	O	2 1	1	WDM	1012	FLOW	ENGL	REPL
RCHRES	3	HYDR	STAGE	1 1	1	WDM	1013	STAG	ENGL	REPL
COPY	2	OUTPUT	MEAN	1 1	48.4	WDM	702	FLOW	ENGL	REPL
COPY	502	OUTPUT	MEAN	1 1	48.4	WDM	802	FLOW	ENGL	REPL

END EXT TARGETS

MASS-LINK

<Volume>	<-Grp>	<-Member->	<-Mult-->	<Target>	<-Grp>	<-Member->	***
<Name>		<Name>	#	<-factor->	<Name>	#	***
MASS-LINK			2				

PERLND	PWATER	SURO		0.083333	RCHRES	INFLOW	IVOL
END MASS-LINK		2					
MASS-LINK		3					
PERLND	PWATER	IFW0		0.083333	RCHRES	INFLOW	IVOL
END MASS-LINK		3					
MASS-LINK		5					
IMPLND	IWATER	SURO		0.083333	RCHRES	INFLOW	IVOL
END MASS-LINK		5					
MASS-LINK		7					
RCHRES	OFLOW	OVOL	1		RCHRES	INFLOW	IVOL
END MASS-LINK		7					
MASS-LINK		8					
RCHRES	OFLOW	OVOL	2		RCHRES	INFLOW	IVOL
END MASS-LINK		8					
MASS-LINK		12					
PERLND	PWATER	SURO		0.083333	COPY	INPUT	MEAN
END MASS-LINK		12					
MASS-LINK		13					
PERLND	PWATER	IFW0		0.083333	COPY	INPUT	MEAN
END MASS-LINK		13					
MASS-LINK		15					
IMPLND	IWATER	SURO		0.083333	COPY	INPUT	MEAN
END MASS-LINK		15					
MASS-LINK		17					
RCHRES	OFLOW	OVOL	1		COPY	INPUT	MEAN
END MASS-LINK		17					
END MASS-LINK							
END RUN							

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Appendix D: Stormwater Conveyance Calculations

HydroCAD Reports for:

Onsite 25-Year – OHWM or Below

Onsite 100-Year – OHWM or Below

Onsite 25-Year – Minor Flood Stage

Onsite 100-Year – Minor Flood Stage

Onsite 25-Year – Moderate Flood Stage

Onsite 100-Year – Moderate Flood Stage

Onsite 100-Year – Flooded and Closed

Offsite 25-Year – OHWM or Below

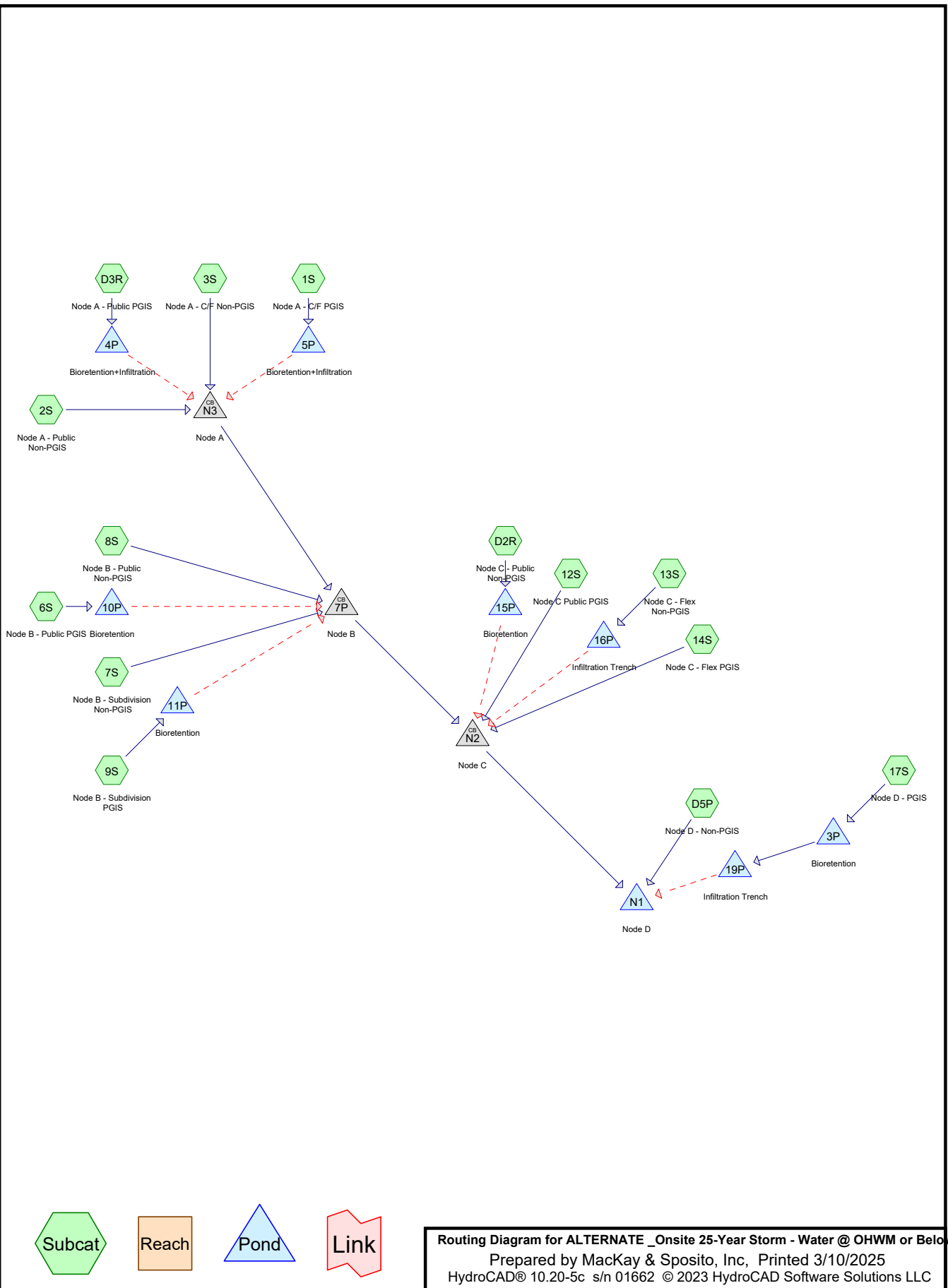
Offsite 100-Year – OHWM or Below

Offsite 25-Year – Valves Closed

Offsite 25-Year – Valves Closed

Brochure for Tideflex CheckMate UltraFlex Check Valve

Pump Cut Sheet



ALTERNATE _Onsite 25-Year Storm - Water @ OHWM or Below

Prepared by MacKay & Sposito, Inc

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	92	TOTAL AREA

ALTERNATE _Onsite 25-Year Storm - Water @ OHWM or Below

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	38.896	0.000	0.000	0.000	104.075	TOTAL AREA	

ALTERNATE _Onsite 25-Year Storm - Water @ OHWM or Below

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=8.64 cfs 3.046 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.29"
 Tc=20.0 min CN=59 Runoff=0.20 cfs 0.125 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=3.76"
 Tc=20.0 min CN=88 Runoff=4.22 cfs 1.438 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=0.29 cfs 0.101 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=3.46"
 Tc=20.0 min CN=85 Runoff=5.62 cfs 1.945 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=2.89"
 Tc=20.0 min CN=79 Runoff=0.06 cfs 0.022 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=2.50 cfs 0.882 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=0.82 cfs 0.288 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=4.19"
 Tc=20.0 min CN=92 Runoff=1.42 cfs 0.481 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=1.94 cfs 0.683 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=53.15 cfs 18.738 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=1.95"
 Tc=20.0 min CN=68 Runoff=0.09 cfs 0.039 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=1.94 cfs 0.682 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=3.17"
 Tc=20.0 min CN=82 Runoff=22.11 cfs 7.822 af

Pond 3P: Bioretention Peak Elev=54.62' Storage=2.845 af Inflow=53.15 cfs 18.738 af
 Outflow=28.78 cfs 18.424 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.73' Storage=0.037 af Inflow=1.94 cfs 0.682 af
 Primary=0.15 cfs 0.277 af Secondary=1.78 cfs 0.406 af Outflow=1.93 cfs 0.682 af

Pond 5P: Bioretention+Infiltration Peak Elev=4.97' Storage=0.240 af Inflow=8.64 cfs 3.046 af
 Primary=0.36 cfs 0.882 af Secondary=8.26 cfs 2.164 af Outflow=8.62 cfs 3.046 af

Pond 7P: Node B Peak Elev=48.56' Inflow=22.70 cfs 6.681 af
 24.0" Round Culvert n=0.012 L=379.7' S=0.0030 ' / ' Outflow=22.70 cfs 6.681 af

Pond 10P: Bioretention Peak Elev=3.25' Storage=0.005 af Inflow=0.29 cfs 0.101 af
 Primary=0.02 cfs 0.045 af Secondary=0.26 cfs 0.056 af Outflow=0.29 cfs 0.101 af

Pond 11P: Bioretention Peak Elev=4.87' Storage=0.053 af Inflow=2.50 cfs 0.882 af
 Primary=0.19 cfs 0.356 af Secondary=2.30 cfs 0.526 af Outflow=2.48 cfs 0.882 af

Pond 15P: Bioretention Peak Elev=0.73' Storage=0.004 af Inflow=0.09 cfs 0.039 af
 Primary=0.04 cfs 0.039 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.039 af

Pond 16P: Infiltration Trench Peak Elev=4.61' Storage=0.044 af Inflow=1.42 cfs 0.481 af
 Primary=0.09 cfs 0.189 af Secondary=1.32 cfs 0.292 af Outflow=1.41 cfs 0.481 af

Pond 19P: Infiltration Trench Peak Elev=3.86' Storage=2.259 af Inflow=28.78 cfs 18.424 af
 Primary=3.57 cfs 8.564 af Secondary=24.41 cfs 9.860 af Outflow=27.97 cfs 18.424 af

Pond N1: Node D Peak Elev=42.27' Storage=9.485 cf Inflow=65.60 cfs 25.625 af
 42.0" Round Culvert n=0.012 L=270.3' S=0.0018 ' / ' Outflow=57.61 cfs 25.625 af

Pond N2: Node C Peak Elev=44.32' Inflow=26.76 cfs 7.943 af
 30.0" Round Culvert n=0.012 L=410.7' S=0.0029 ' / ' Outflow=26.76 cfs 7.943 af

Pond N3: Node A Peak Elev=50.24' Inflow=14.45 cfs 4.132 af
 24.0" Round Culvert n=0.012 L=369.0' S=0.0030 ' / ' Outflow=14.45 cfs 4.132 af

Total Runoff Area = 104.075 ac Runoff Volume = 36.290 af Average Runoff Depth = 4.18"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

Runoff = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af, Depth= 4.86"
 Routed to Pond 5P : Bioretention+Infiltration

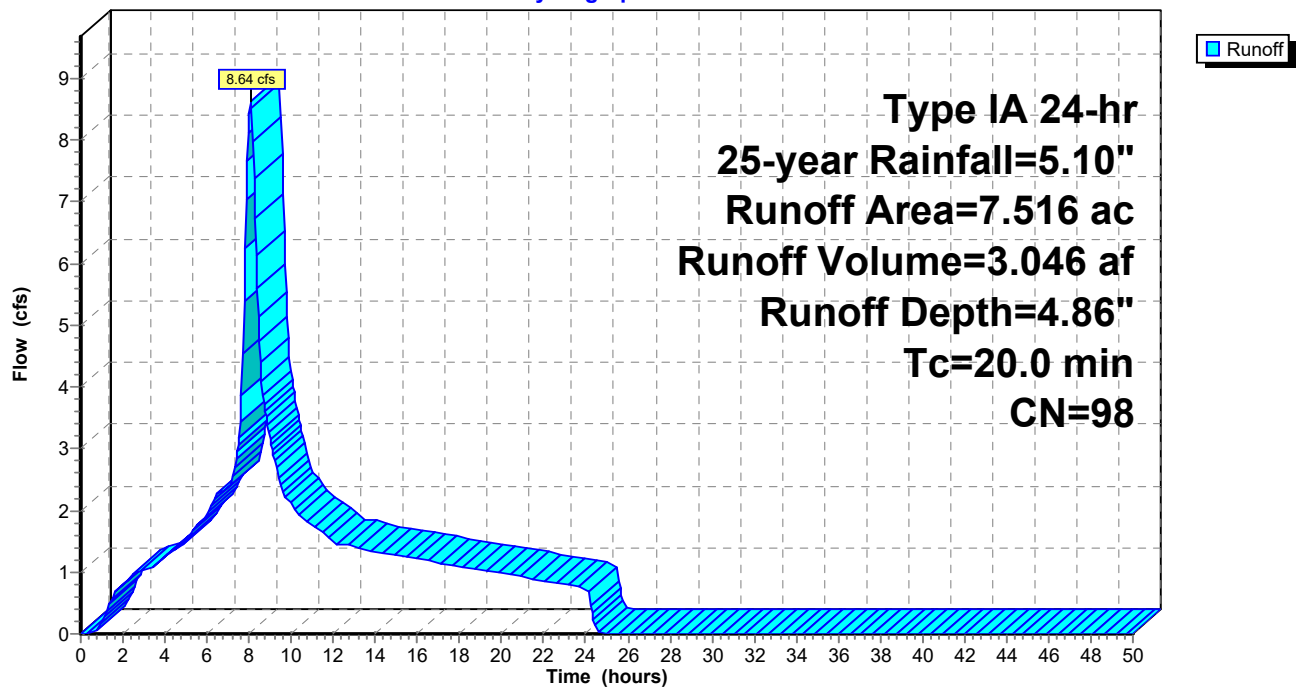
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Node A - C/F PGIS

Hydrograph



Summary for Subcatchment 2S: Node A - Public Non-PGIS

Runoff = 0.20 cfs @ 8.19 hrs, Volume= 0.125 af, Depth= 1.29"
 Routed to Pond N3 : Node A

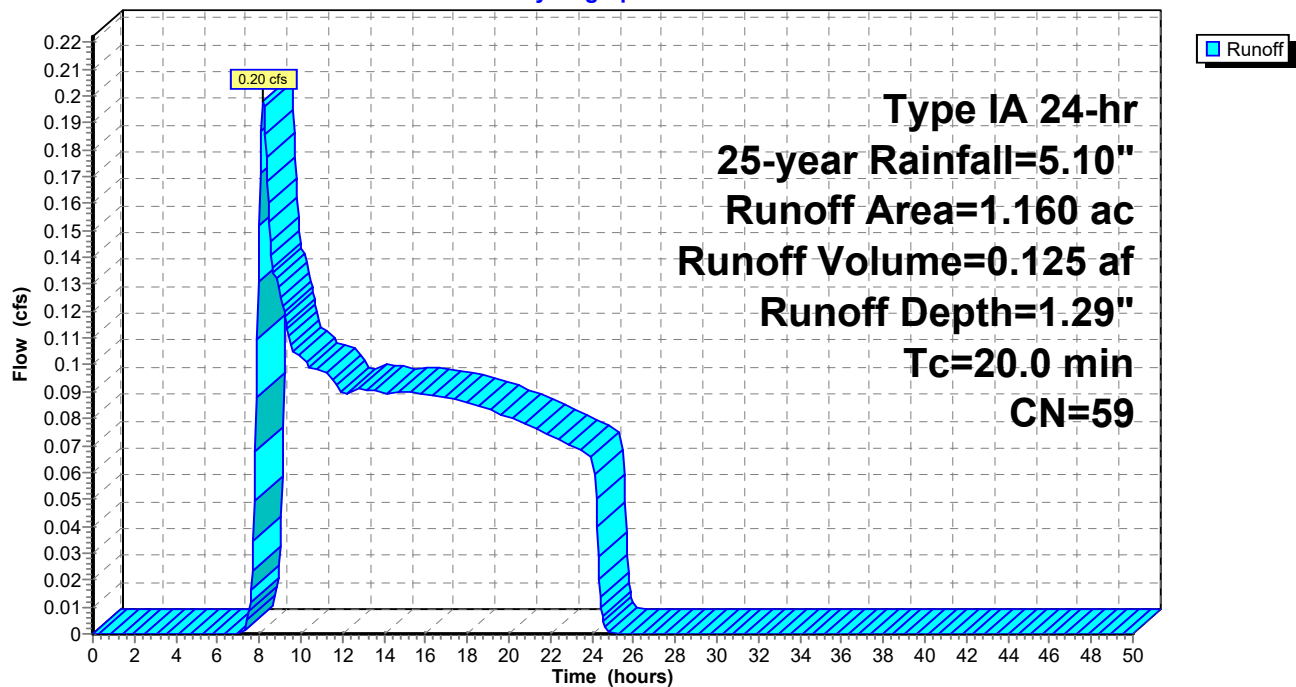
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
* 1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 2S: Node A - Public Non-PGIS

Hydrograph



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

Runoff = 4.22 cfs @ 8.09 hrs, Volume= 1.438 af, Depth= 3.76"
 Routed to Pond N3 : Node A

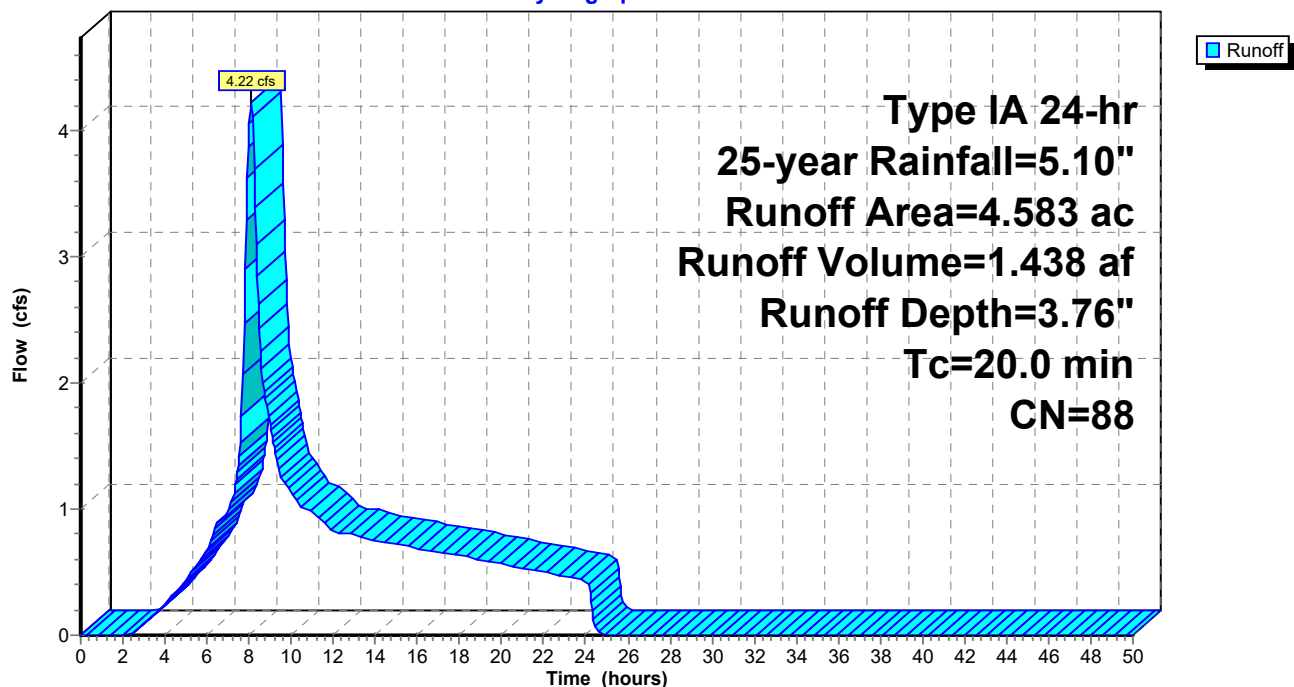
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
* 1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
3.373	98	Roofs, HSG A
4.583	88	Weighted Average
1.210		26.40% Pervious Area
3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 3S: Node A - C/F Non-PGIS

Hydrograph



Summary for Subcatchment 6S: Node B - Public PGIS

Runoff = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af, Depth= 4.86"
 Routed to Pond 10P : Bioretention

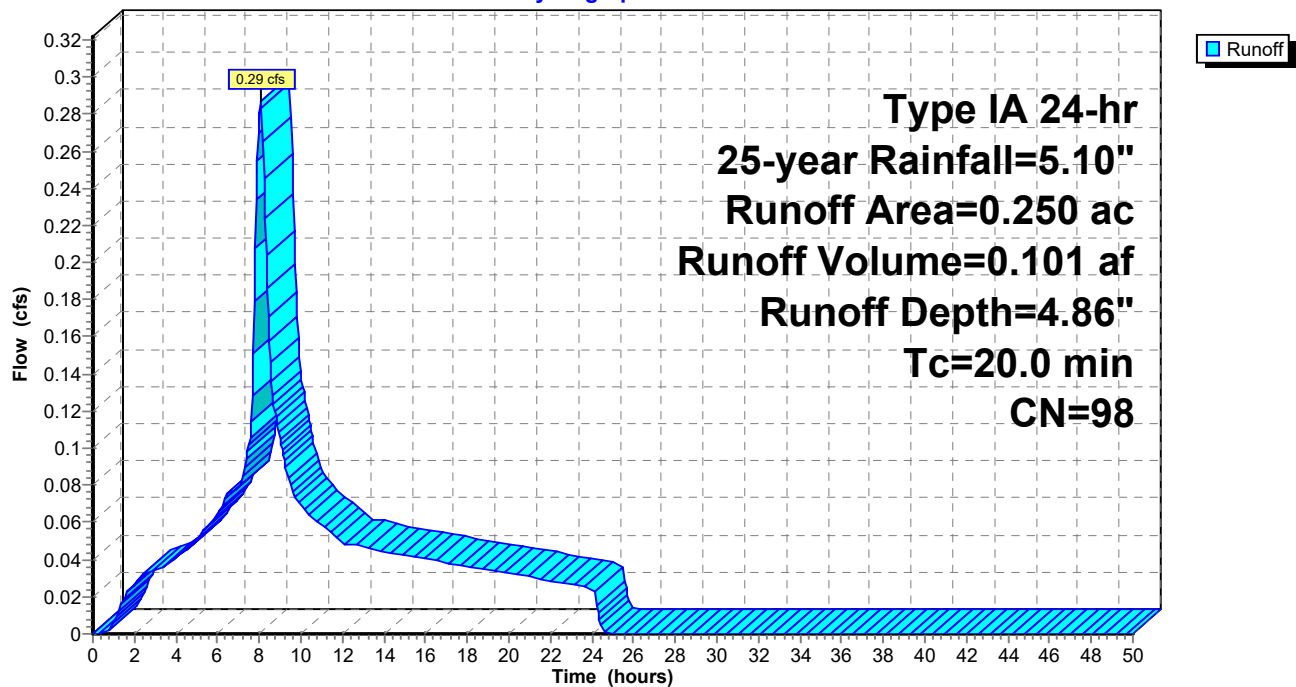
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 6S: Node B - Public PGIS

Hydrograph



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

Runoff = 5.62 cfs @ 8.10 hrs, Volume= 1.945 af, Depth= 3.46"
 Routed to Pond 7P : Node B

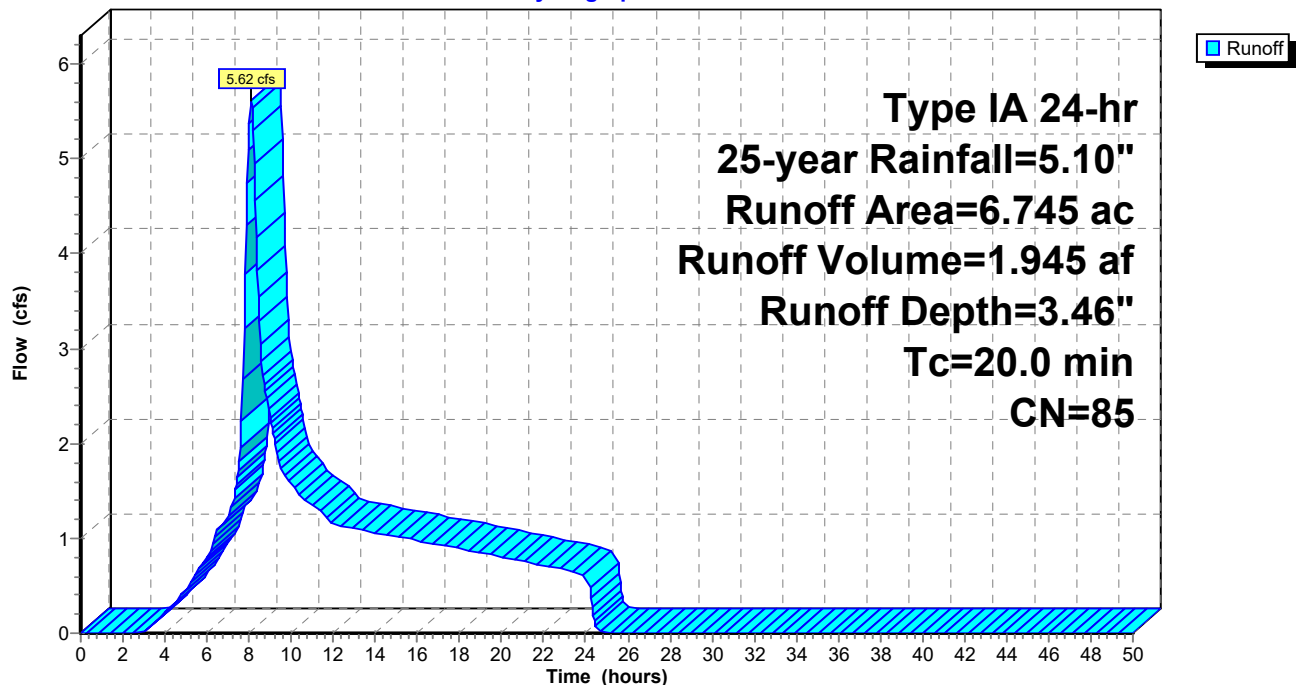
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 7S: Node B - Subdivision Non-PGIS

Hydrograph



Summary for Subcatchment 8S: Node B - Public Non-PGIS

Runoff = 0.06 cfs @ 8.11 hrs, Volume= 0.022 af, Depth= 2.89"
 Routed to Pond 7P : Node B

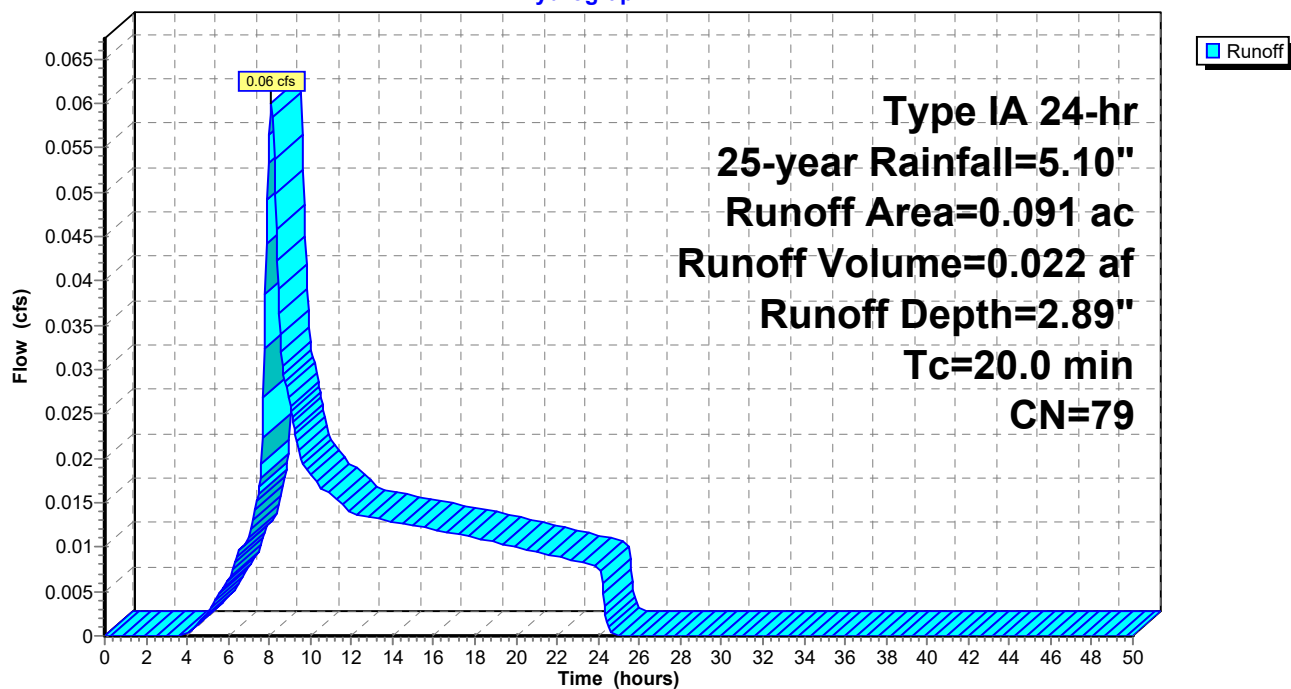
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 8S: Node B - Public Non-PGIS

Hydrograph



Summary for Subcatchment 9S: Node B - Subdivision PGIS

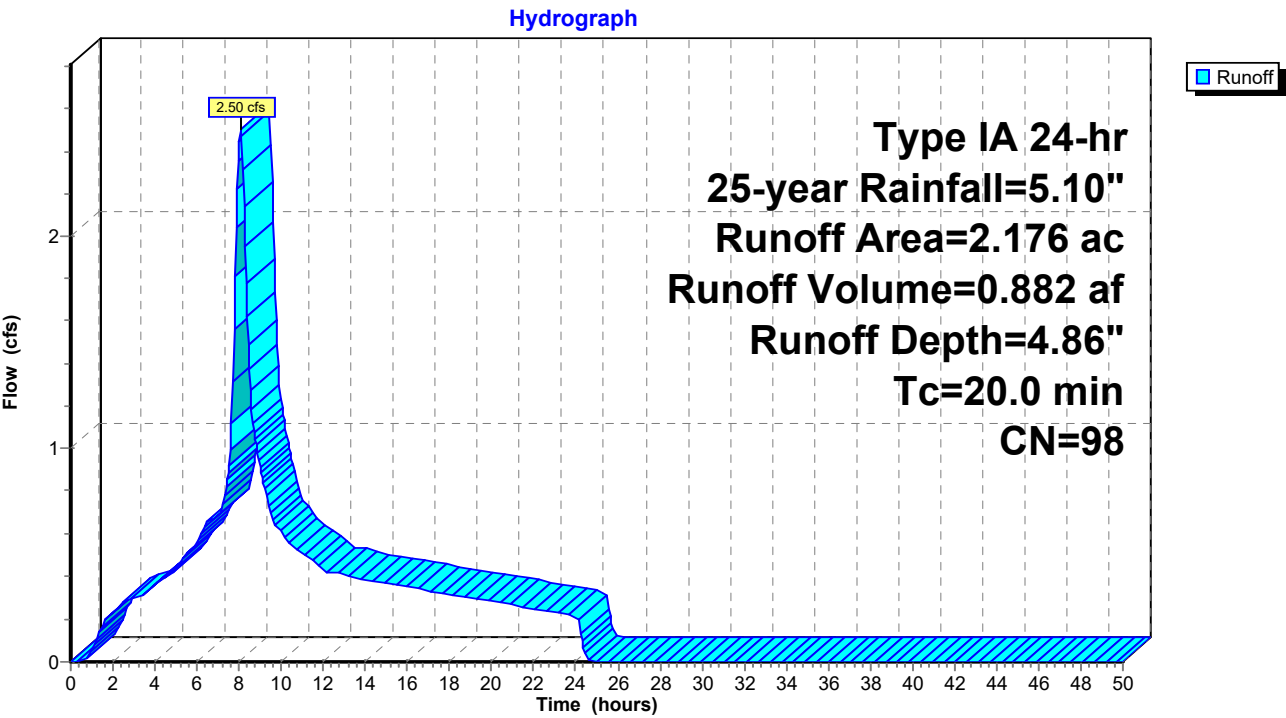
Runoff = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af, Depth= 4.86"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

Runoff = 0.82 cfs @ 8.08 hrs, Volume= 0.288 af, Depth= 4.86"
 Routed to Pond N2 : Node C

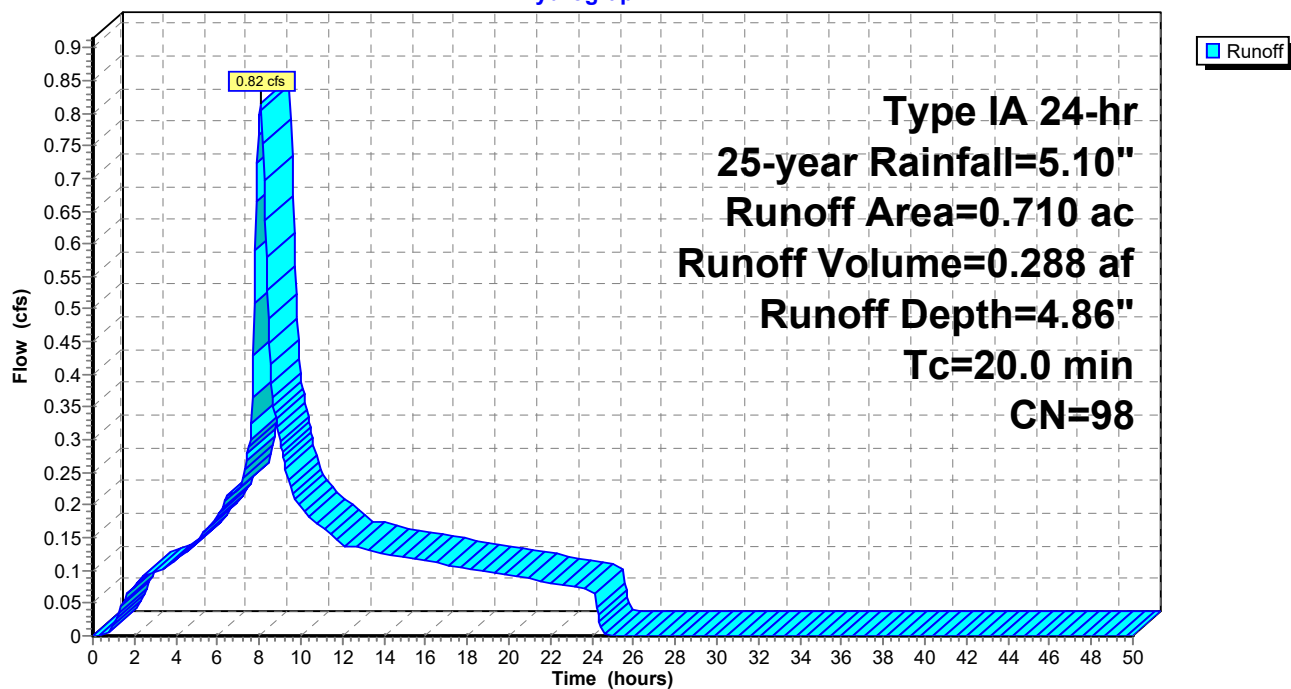
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 12S: Node C Public PGIS

Hydrograph



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

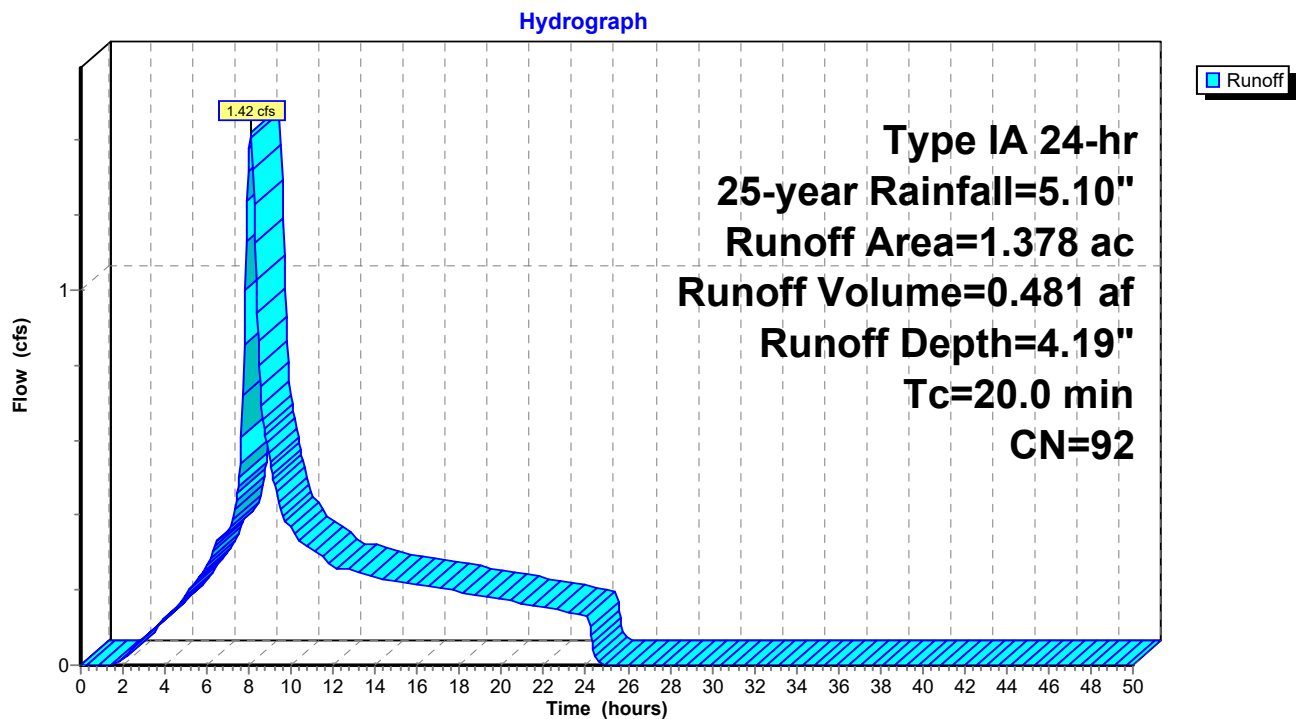
Runoff = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af, Depth= 4.19"
 Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.683 af, Depth= 4.86"
 Routed to Pond N2 : Node C

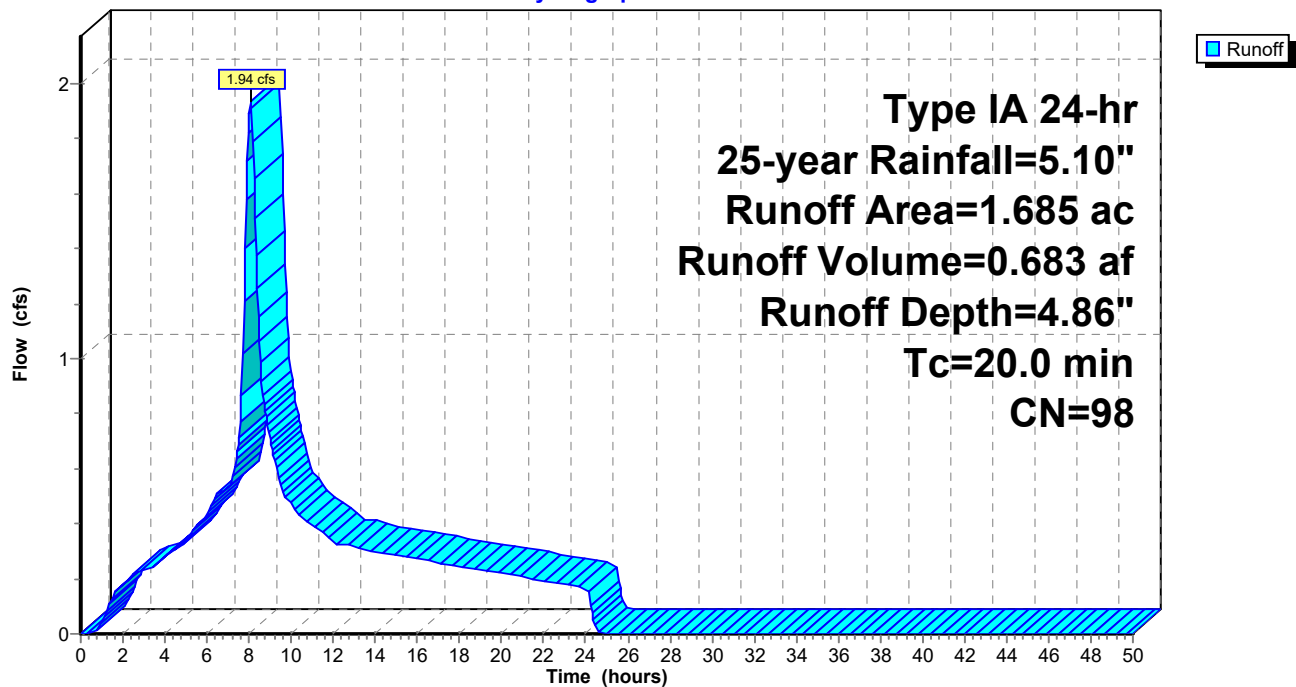
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 14S: Node C - Flex PGIS

Hydrograph



Summary for Subcatchment 17S: Node D - PGIS

Runoff = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af, Depth= 4.86"
 Routed to Pond 3P : Bioretention

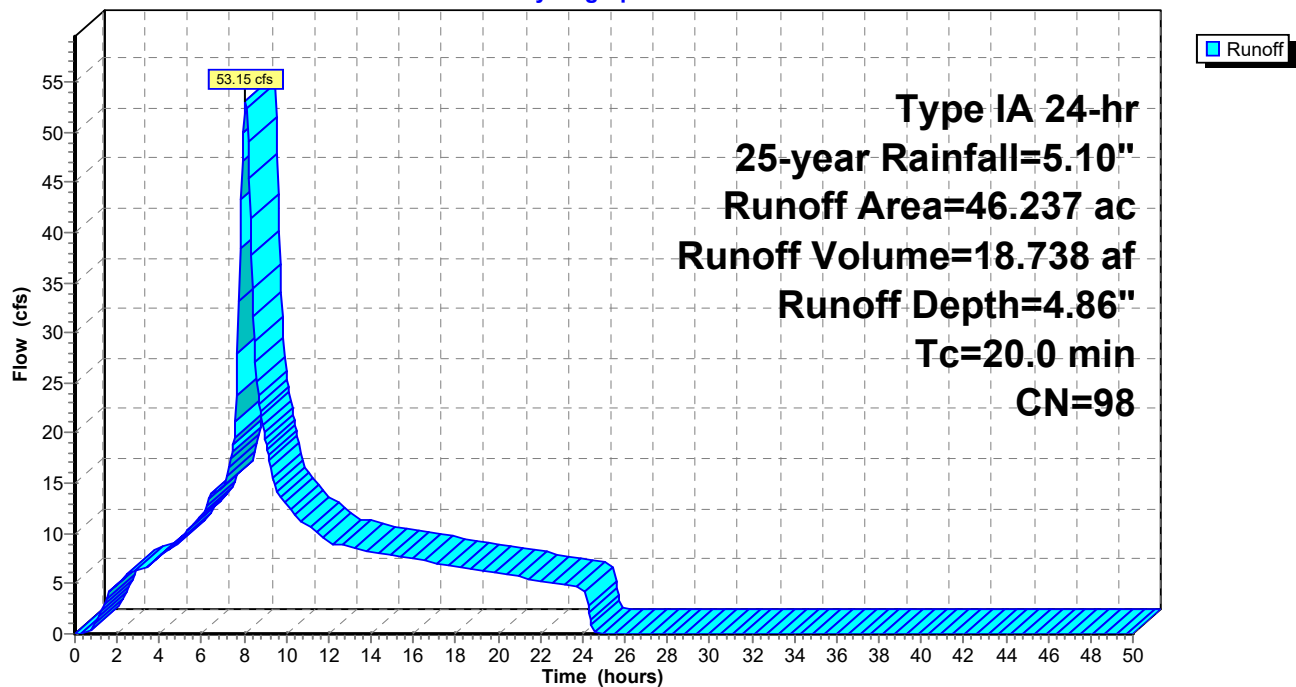
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 17S: Node D - PGIS

Hydrograph



Summary for Subcatchment D2R: Node C - Public Non-PGIS

Runoff = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af, Depth= 1.95"
 Routed to Pond 15P : Bioretention

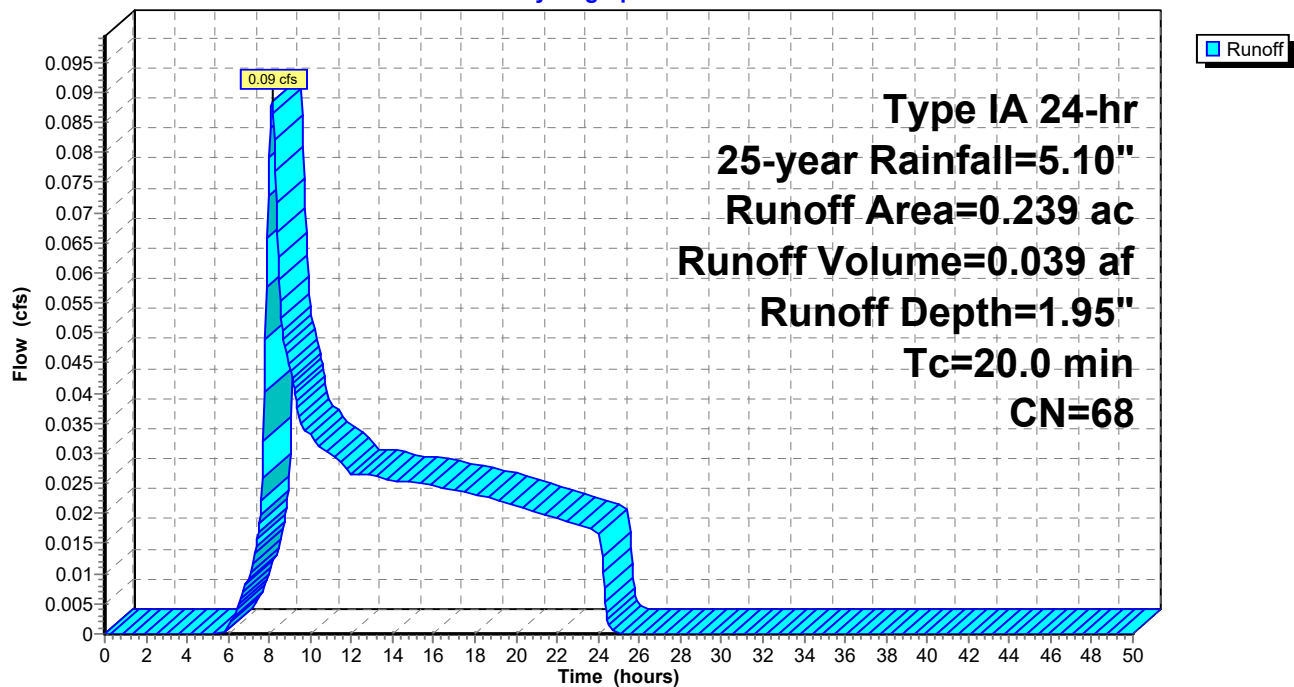
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D2R: Node C - Public Non-PGIS

Hydrograph



Summary for Subcatchment D3R: Node A - Public PGIS

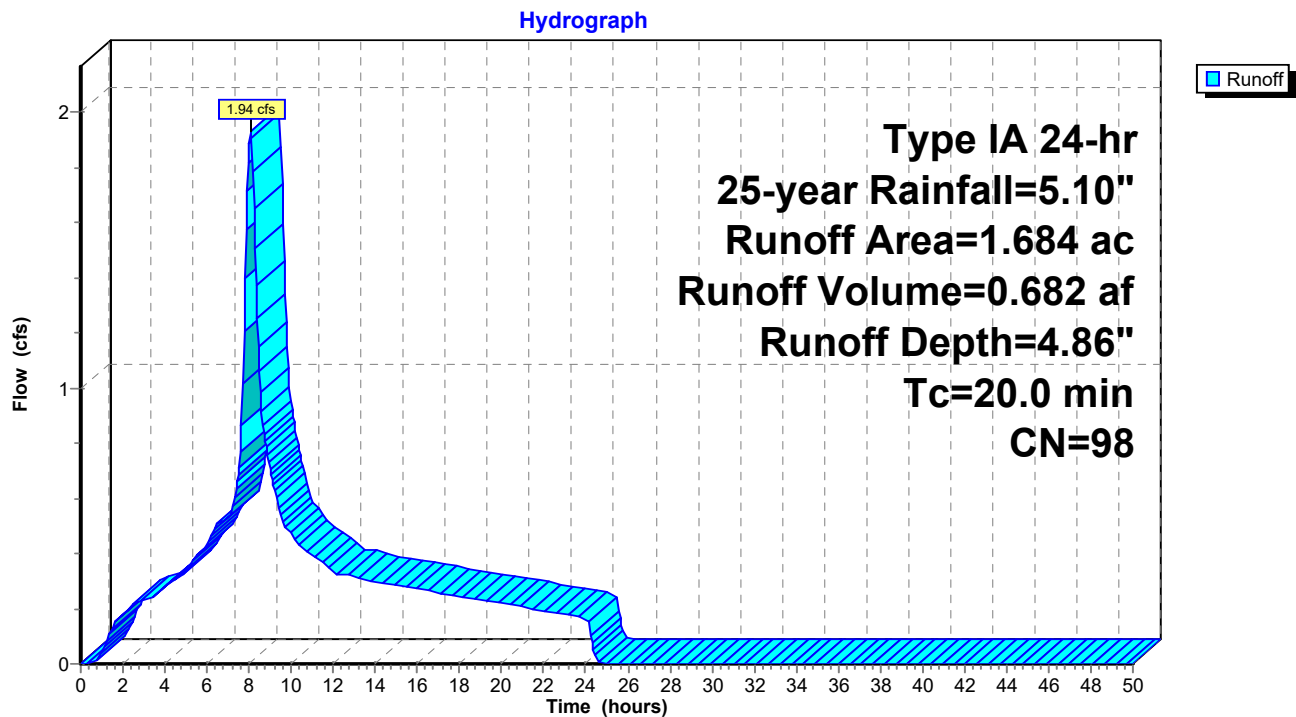
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af, Depth= 4.86"
 Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

Runoff = 22.11 cfs @ 8.11 hrs, Volume= 7.822 af, Depth= 3.17"
 Routed to Pond N1 : Node D

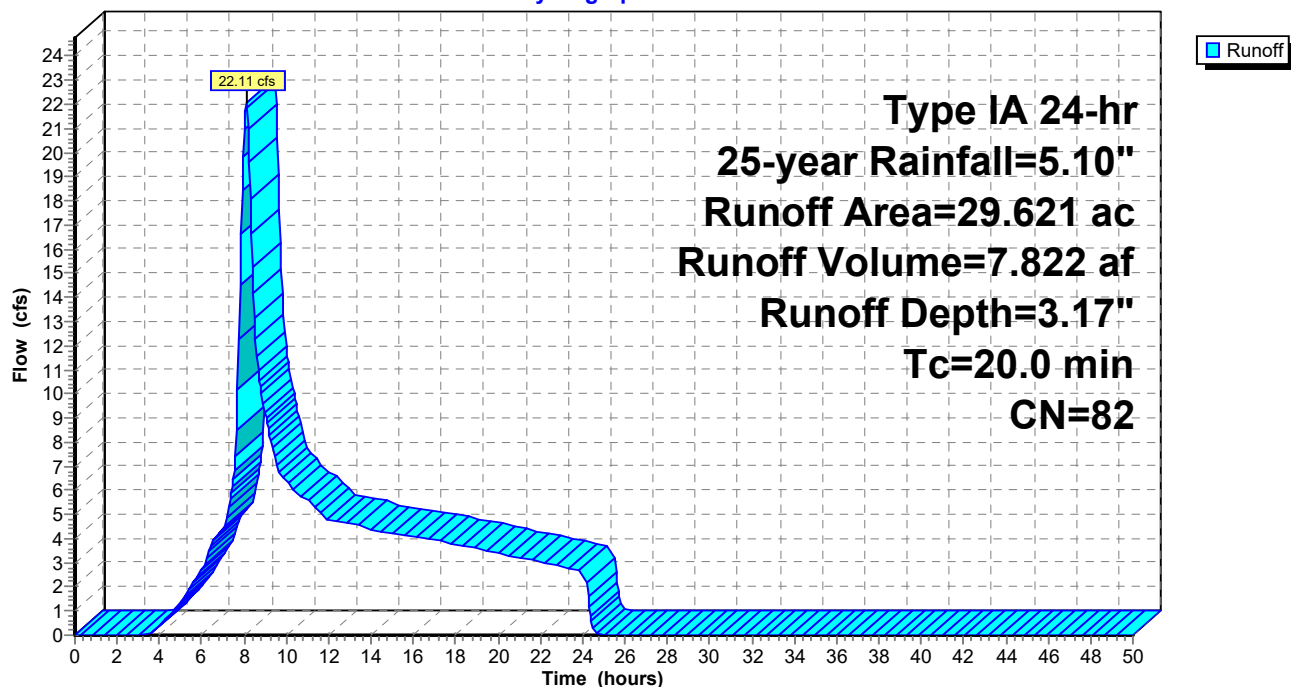
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D5P: Node D - Non-PGIS

Hydrograph



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af
 Outflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af, Atten= 46%, Lag= 25.9 min
 Primary = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
 Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 54.62' @ 8.51 hrs Surf.Area= 1.674 ac Storage= 2.845 af

Plug-Flow detention time= 90.8 min calculated for 18.424 af (98% of inflow)
 Center-of-Mass det. time= 77.7 min (745.3 - 667.6)

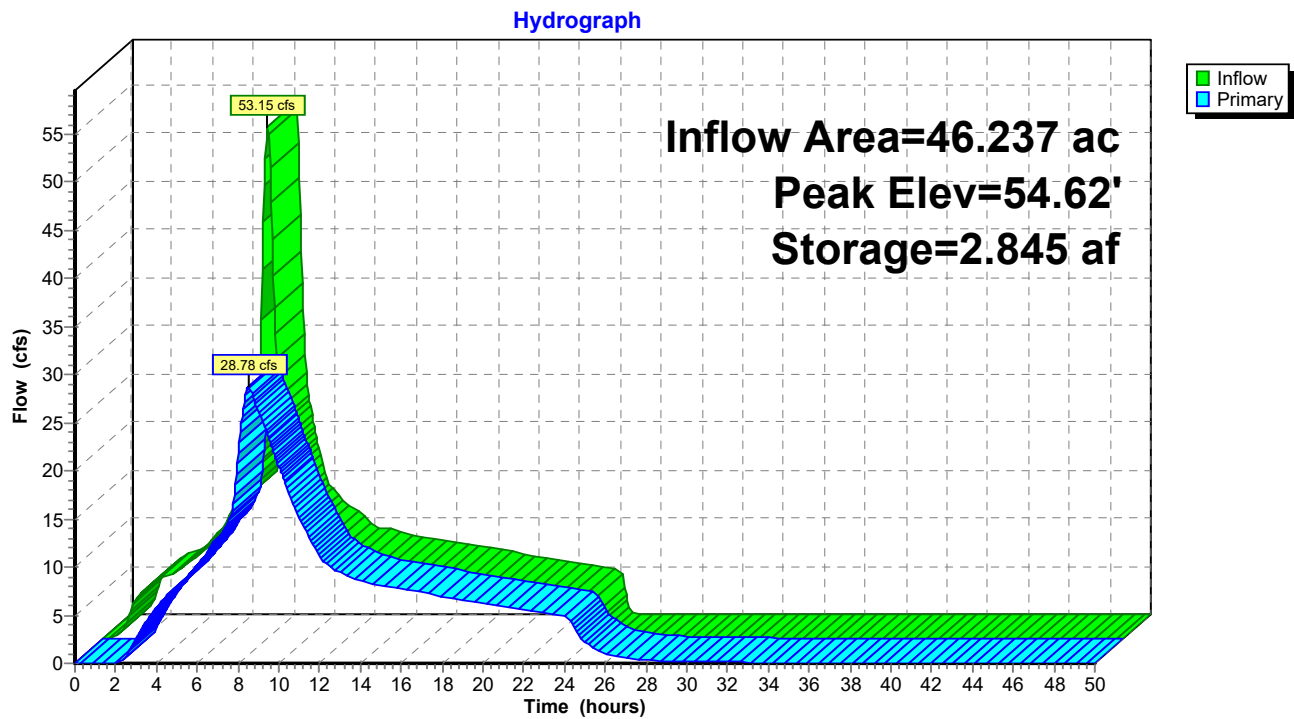
Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	270.00'W x 270.00'L x 6.50'H Prisma 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	270.00'W x 270.00'L x 2.00'H Prisma Inside #1
#3	50.50'	0.019 af	24.0" Round Pipe Storage Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	60.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	24.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=28.76 cfs @ 8.51 hrs HW=54.62' (Free Discharge)

1=Orifice/Grate (Weir Controls 2.05 cfs @ 1.12 fps)
 2=Orifice/Grate (Orifice Controls 26.71 cfs @ 8.50 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af
 Outflow = 1.93 cfs @ 8.11 hrs, Volume= 0.682 af, Atten= 0%, Lag= 1.7 min
 Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.277 af
 Secondary = 1.78 cfs @ 8.11 hrs, Volume= 0.406 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.73' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.037 af

Plug-Flow detention time= 65.8 min calculated for 0.682 af (100% of inflow)
 Center-of-Mass det. time= 65.7 min (733.3 - 667.6)

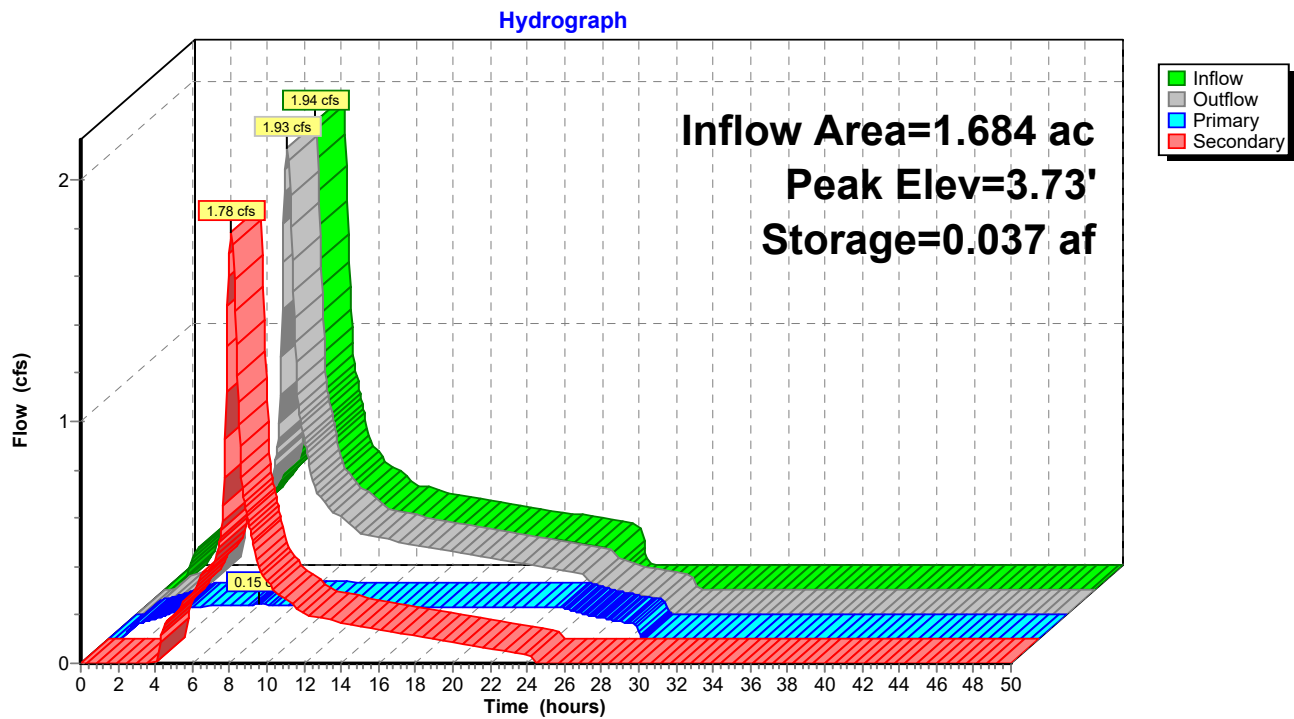
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	5.00'W x 250.00'L x 5.00'H Bioretention 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=1.78 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 1.78 cfs @ 2.90 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

Inflow Area = 7.516 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af
 Outflow = 8.62 cfs @ 8.10 hrs, Volume= 3.046 af, Atten= 0%, Lag= 1.2 min
 Primary = 0.36 cfs @ 8.10 hrs, Volume= 0.882 af
 Secondary = 8.26 cfs @ 8.10 hrs, Volume= 2.164 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.97' @ 8.10 hrs Surf.Area= 0.138 ac Storage= 0.240 af

Plug-Flow detention time= 109.9 min calculated for 3.046 af (100% of inflow)
 Center-of-Mass det. time= 109.8 min (777.4 - 667.6)

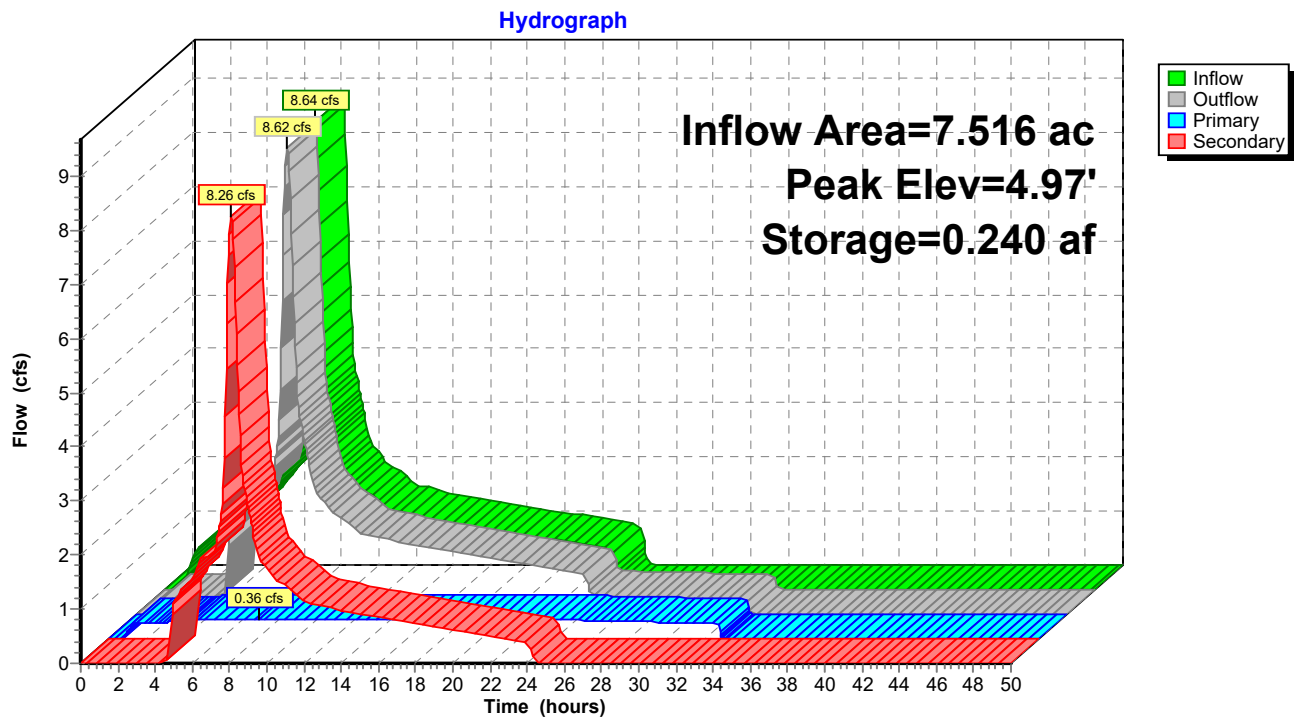
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	50.00'W x 120.00'L x 5.00'H Infiltration Trench 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.50'	30.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=8.25 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 8.25 cfs @ 2.24 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 48.56' (Flood elevation advised)
 [81] Warning: Exceeded Pond 10P by 45.31' @ 8.10 hrs
 [81] Warning: Exceeded Pond 11P by 44.32' @ 33.00 hrs
 [79] Warning: Submerged Pond N3 Primary device # 1 INLET by 7.12'

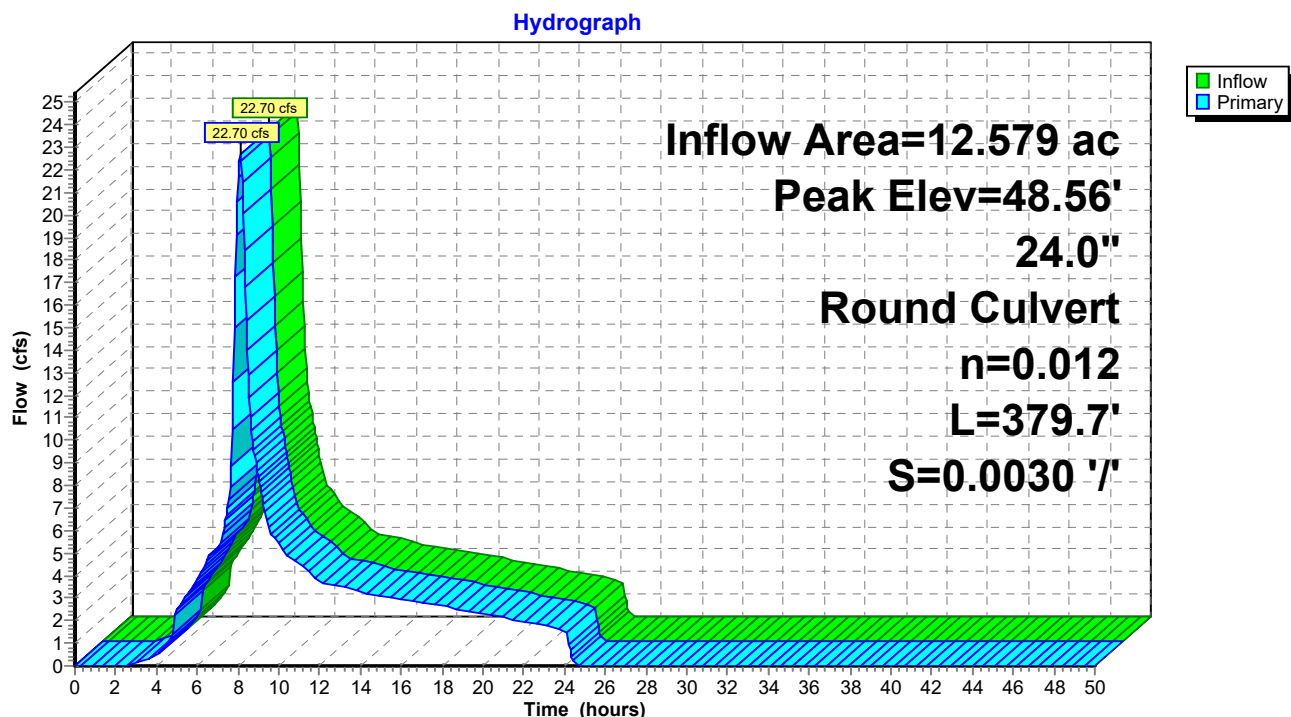
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 6.37" for 25-year event
 Inflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
 Outflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af, Atten= 0%, Lag= 0.0 min
 Primary = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 48.56' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	24.0" Round Culvert L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=22.70 cfs @ 8.10 hrs HW=48.56' TW=44.32' (Fixed TW Elev= 44.32')
 1=Culvert (Outlet Controls 22.70 cfs @ 7.22 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af
 Outflow = 0.29 cfs @ 8.09 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.045 af
 Secondary = 0.26 cfs @ 8.09 hrs, Volume= 0.056 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.25' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 67.0 min calculated for 0.101 af (100% of inflow)
 Center-of-Mass det. time= 67.1 min (734.7 - 667.6)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	5.00'W x 40.00'L x 5.00'H Bioretention 0.023 af Overall x 35.0% Voids

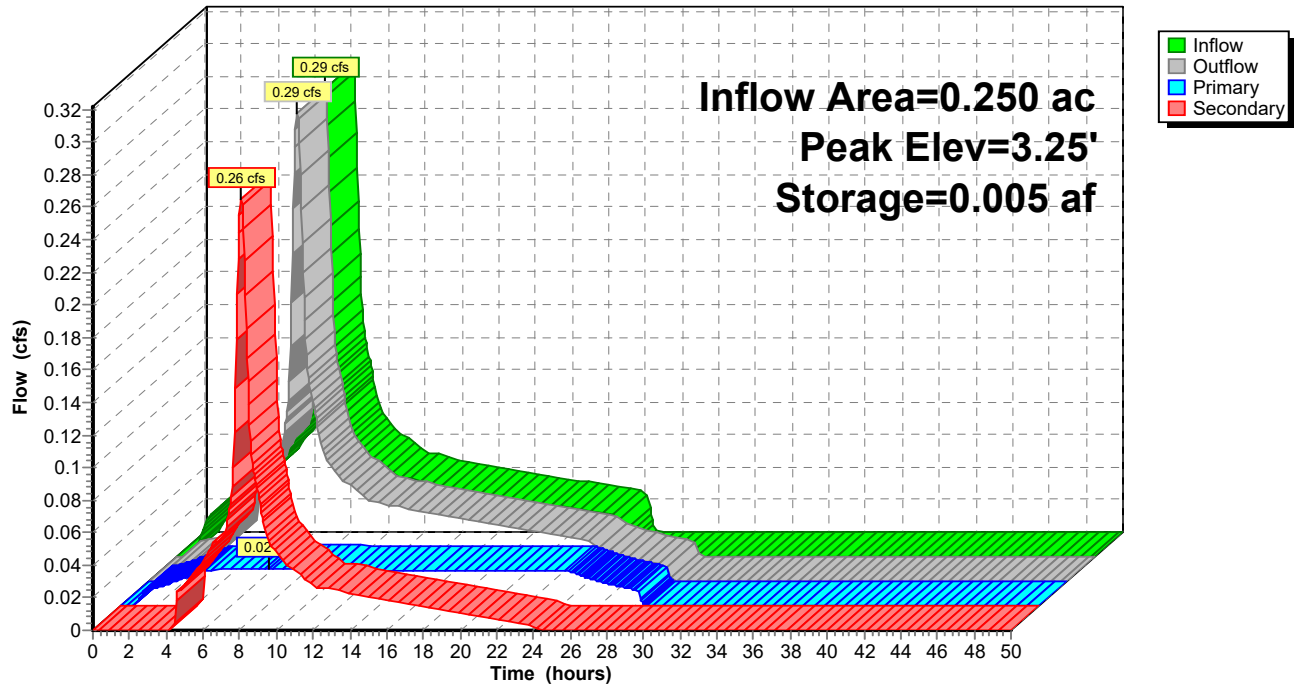
Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.26 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
 ↑2=Orifice/Grate (Orifice Controls 0.26 cfs @ 1.71 fps)

Pond 10P: Bioretention

Hydrograph



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af
 Outflow = 2.48 cfs @ 8.11 hrs, Volume= 0.882 af, Atten= 1%, Lag= 2.0 min
 Primary = 0.19 cfs @ 8.11 hrs, Volume= 0.356 af
 Secondary = 2.30 cfs @ 8.11 hrs, Volume= 0.526 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.87' @ 8.11 hrs Surf.Area= 0.031 ac Storage= 0.053 af

Plug-Flow detention time= 73.2 min calculated for 0.881 af (100% of inflow)
 Center-of-Mass det. time= 73.4 min (741.0 - 667.6)

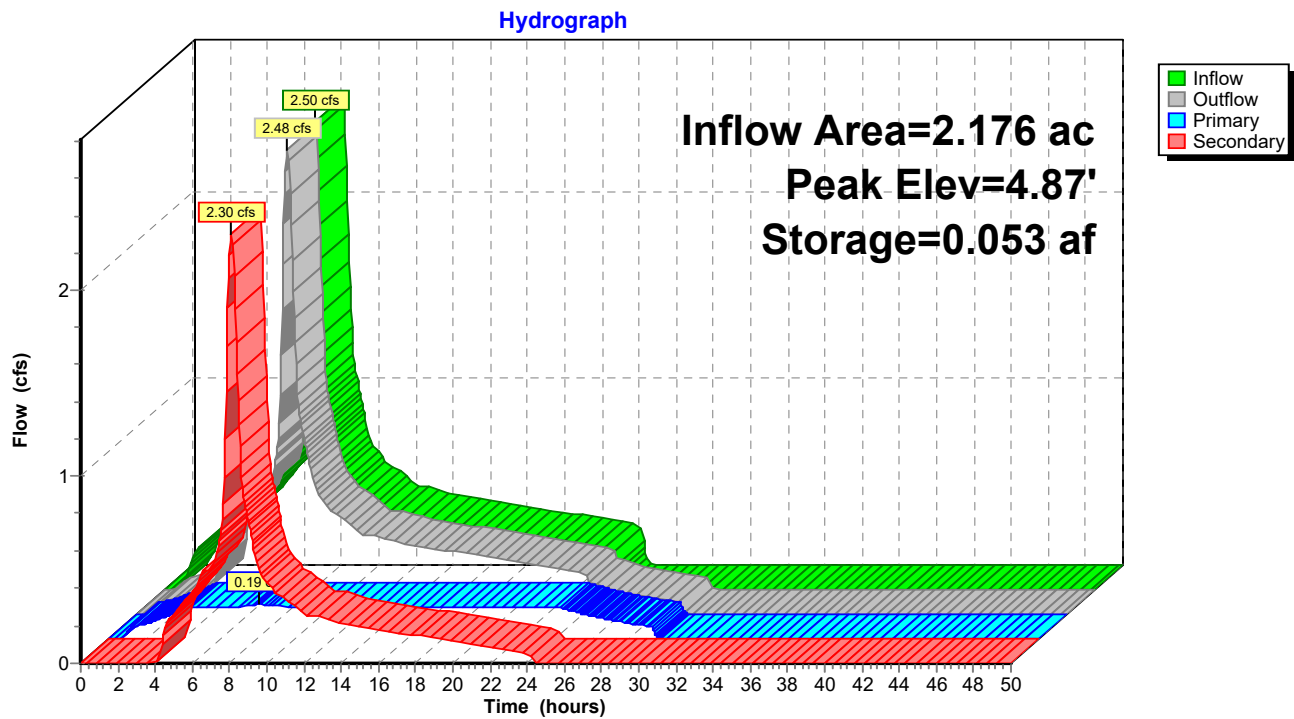
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	5.00'W x 270.00'L x 6.00'H Bioretention 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.30 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
 ↑2=Orifice/Grate (Orifice Controls 2.30 cfs @ 3.17 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 1.95" for 25-year event
 Inflow = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af
 Outflow = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af, Atten= 59%, Lag= 79.6 min
 Primary = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 0.73' @ 9.47 hrs Surf.Area= 0.014 ac Storage= 0.004 af

Plug-Flow detention time= 31.1 min calculated for 0.039 af (100% of inflow)
 Center-of-Mass det. time= 31.1 min (884.7 - 853.6)

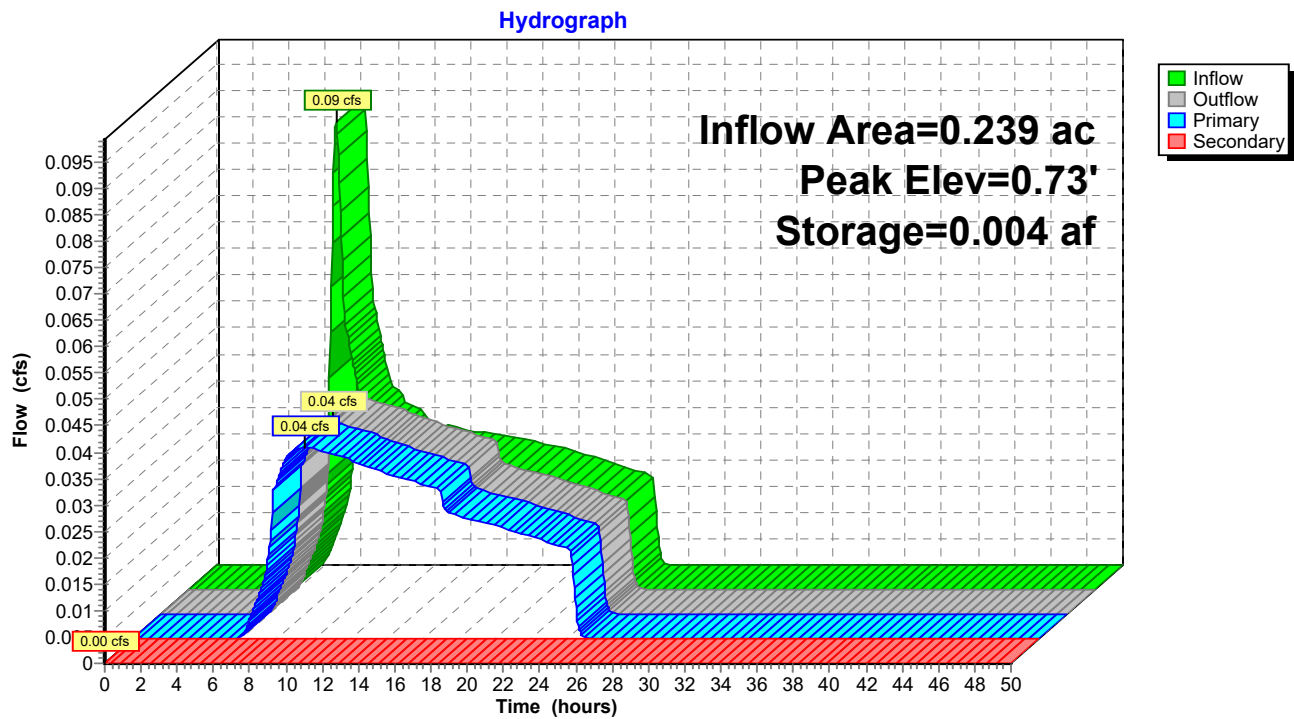
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	5.00'W x 120.00'L x 5.00'H Bioretention 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 9.47 hrs HW=0.73' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
 ↑**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 4.19" for 25-year event
 Inflow = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af
 Outflow = 1.41 cfs @ 8.12 hrs, Volume= 0.481 af, Atten= 1%, Lag= 1.8 min
 Primary = 0.09 cfs @ 8.12 hrs, Volume= 0.189 af
 Secondary = 1.32 cfs @ 8.12 hrs, Volume= 0.292 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.61' @ 8.12 hrs Surf.Area= 0.028 ac Storage= 0.044 af

Plug-Flow detention time= 110.7 min calculated for 0.480 af (100% of inflow)
 Center-of-Mass det. time= 111.0 min (827.2 - 716.3)

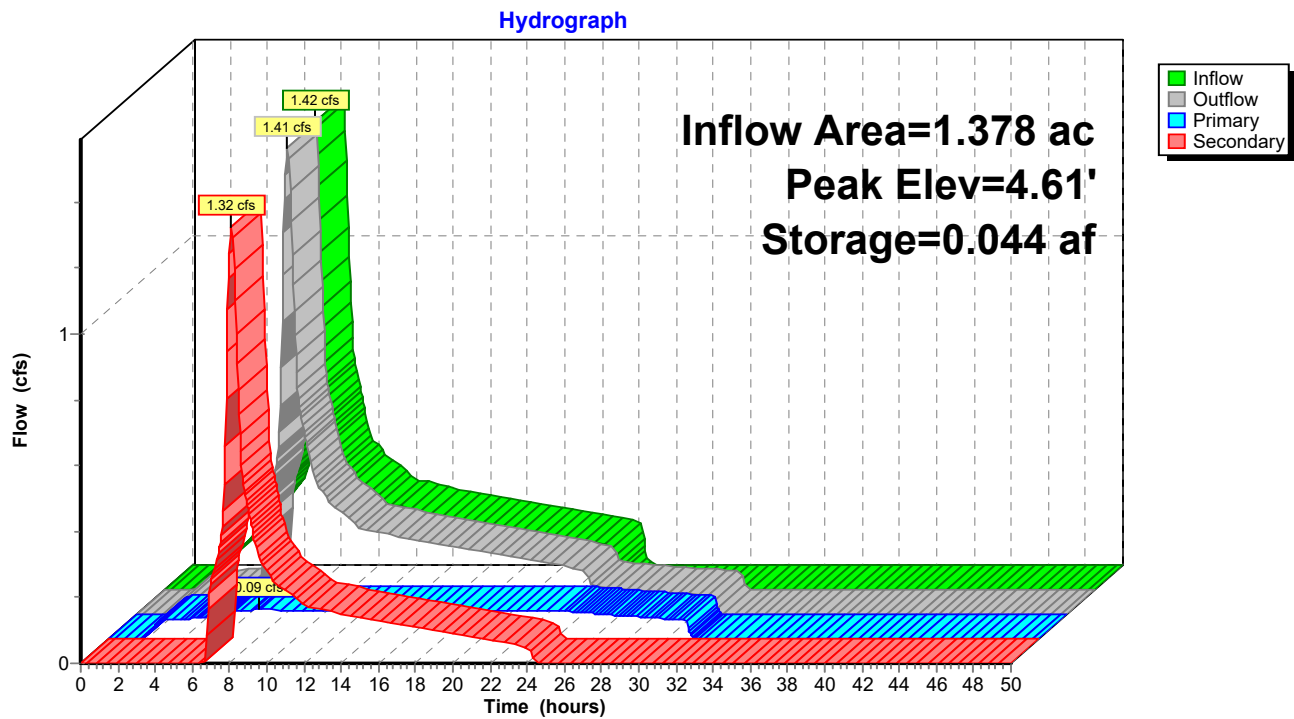
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	20.00'W x 60.00'L x 6.00'H Infiltration Trench 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.32 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 1.32 cfs @ 2.65 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth > 4.78" for 25-year event
 Inflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
 Outflow = 27.97 cfs @ 8.70 hrs, Volume= 18.424 af, Atten= 3%, Lag= 11.7 min
 Primary = 3.57 cfs @ 8.70 hrs, Volume= 8.564 af
 Secondary = 24.41 cfs @ 8.70 hrs, Volume= 9.860 af
 Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.86' @ 8.70 hrs Surf.Area= 1.674 ac Storage= 2.259 af

Plug-Flow detention time= 143.4 min calculated for 18.424 af (100% of inflow)
 Center-of-Mass det. time= 143.3 min (888.6 - 745.3)

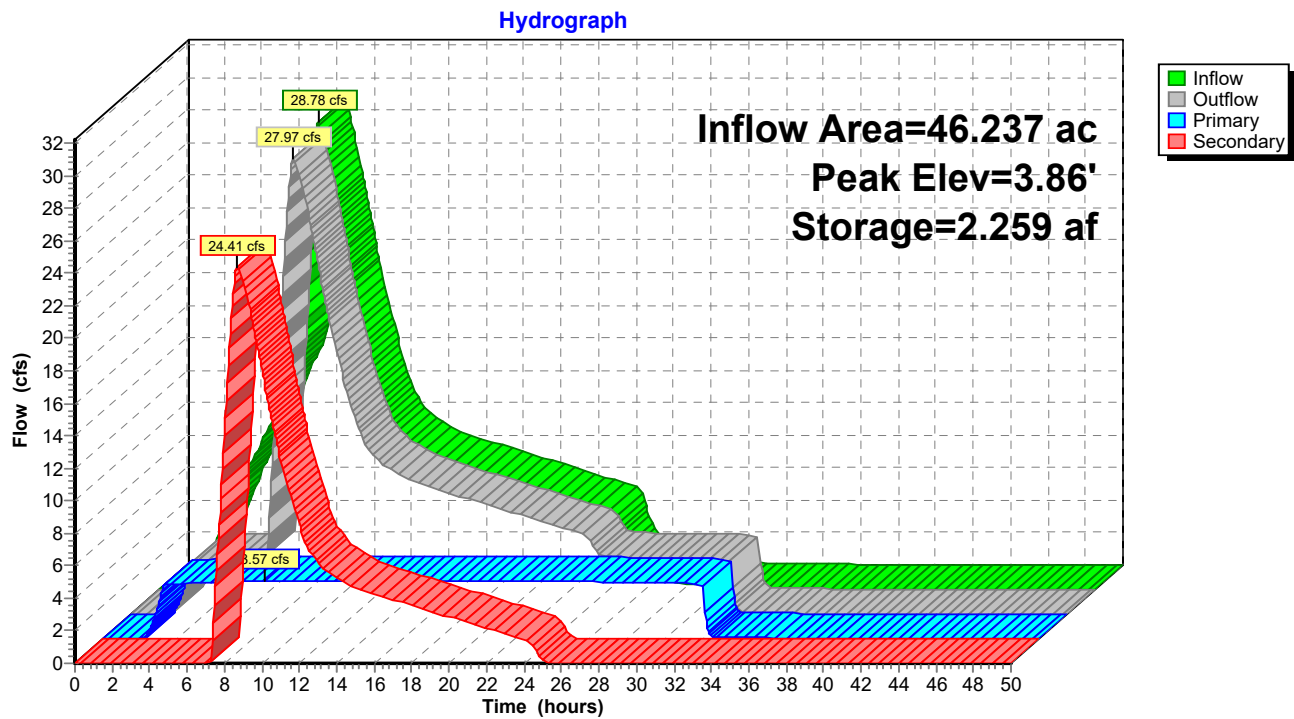
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	270.00'W x 270.00'L x 5.00'H Infiltration Trench 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	36.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.57 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 3.57 cfs)

Secondary OutFlow Max=24.40 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 24.40 cfs @ 3.03 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=13)

[81] Warning: Exceeded Pond 19P by 38.51' @ 8.25 hrs

[79] Warning: Submerged Pond N2 Primary device # 1 INLET by 3.08'

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 6.90" for 25-year event
 Inflow = 65.60 cfs @ 8.14 hrs, Volume= 25.625 af
 Outflow = 57.61 cfs @ 8.35 hrs, Volume= 25.625 af, Atten= 12%, Lag= 12.5 min
 Primary = 57.61 cfs @ 8.35 hrs, Volume= 25.625 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 42.27' @ 8.35 hrs Surf.Area= 34,718 sf Storage= 9,485 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 0.3 min (742.9 - 742.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

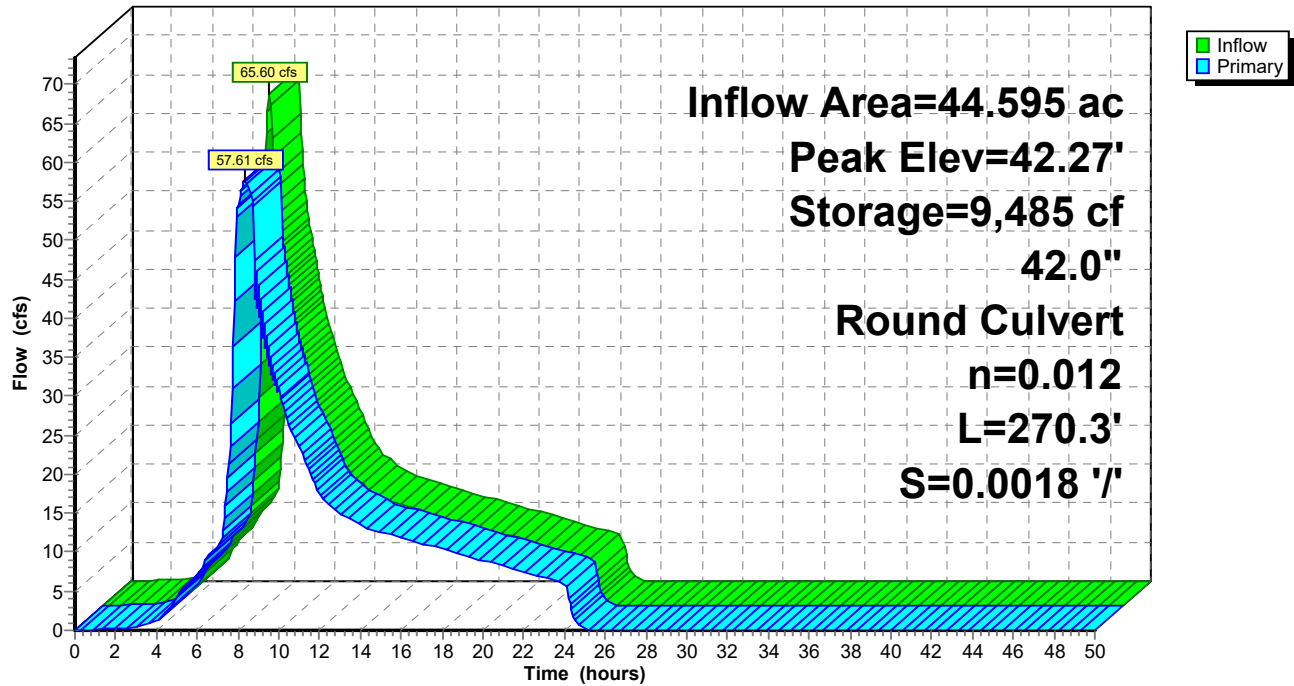
Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	42.0" Round Culvert L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=57.64 cfs @ 8.35 hrs HW=42.27' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 57.64 cfs @ 6.24 fps)

Pond N1: Node D

Hydrograph



Summary for Pond N2: Node C

[57] Hint: Peaked at 44.32' (Flood elevation advised)
 [81] Warning: Exceeded Pond 7P by 1.94' @ 2.10 hrs
 [81] Warning: Exceeded Pond 15P by 44.04' @ 8.10 hrs
 [81] Warning: Exceeded Pond 16P by 42.27' @ 1.60 hrs

Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 6.37" for 25-year event
 Inflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
 Outflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af, Atten= 0%, Lag= 0.0 min
 Primary = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
 Routed to Pond N1 : Node D

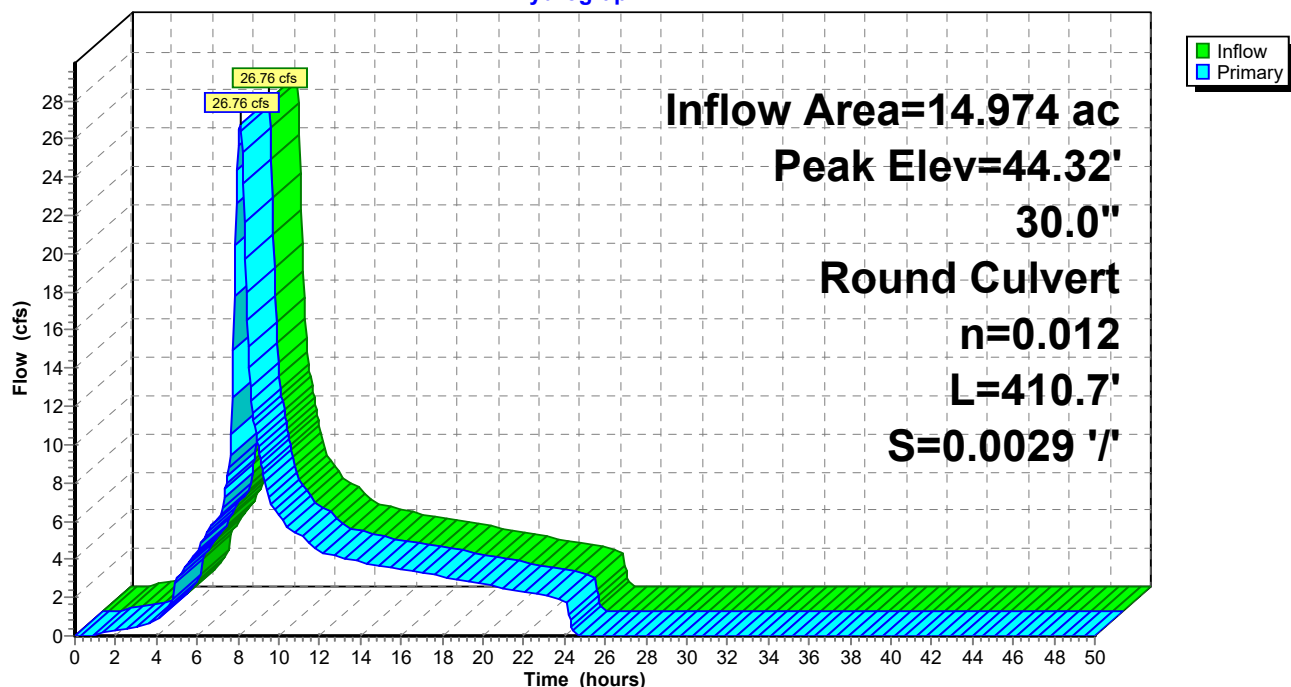
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 44.32' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	30.0" Round Culvert L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=26.76 cfs @ 8.10 hrs HW=44.32' TW=42.27' (Fixed TW Elev= 42.27')
 1=Culvert (Outlet Controls 26.76 cfs @ 5.45 fps)

Pond N2: Node C

Hydrograph



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.24' (Flood elevation advised)
 [81] Warning: Exceeded Pond 4P by 48.49' @ 31.50 hrs
 [81] Warning: Exceeded Pond 5P by 48.49' @ 35.90 hrs

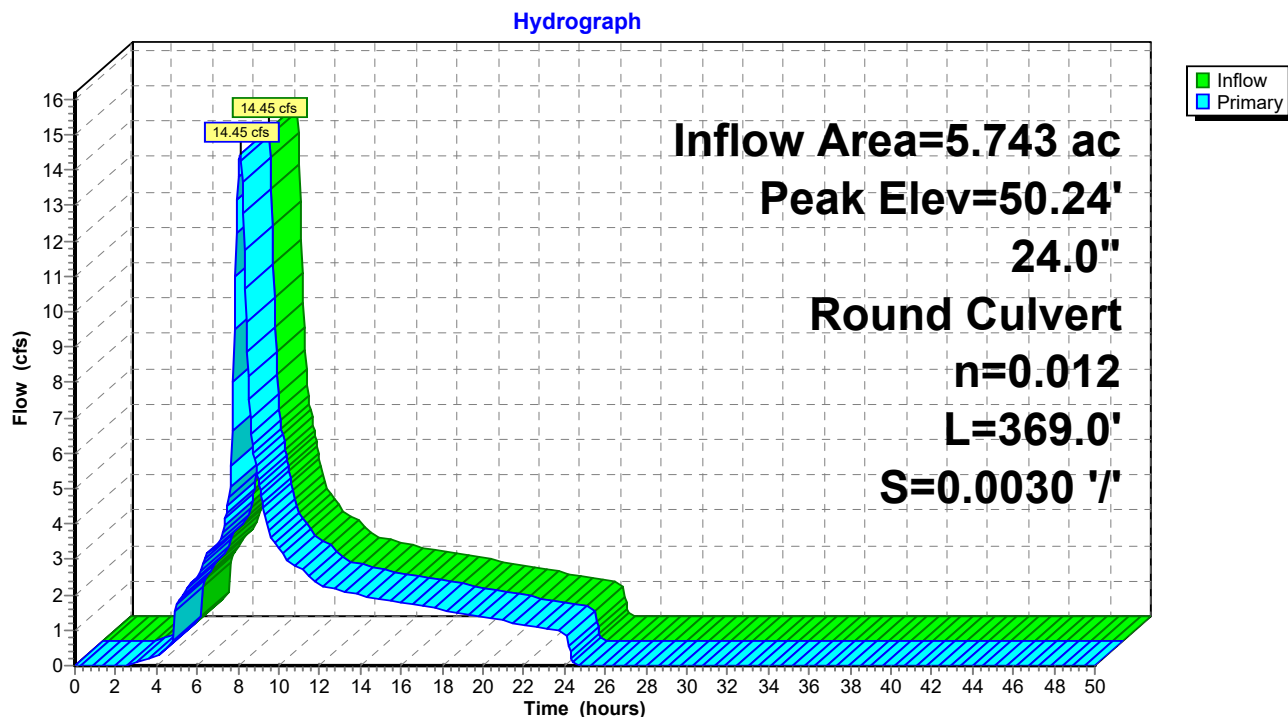
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 8.63" for 25-year event
 Inflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
 Outflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af, Atten= 0%, Lag= 0.0 min
 Primary = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
 Routed to Pond 7P : Node B

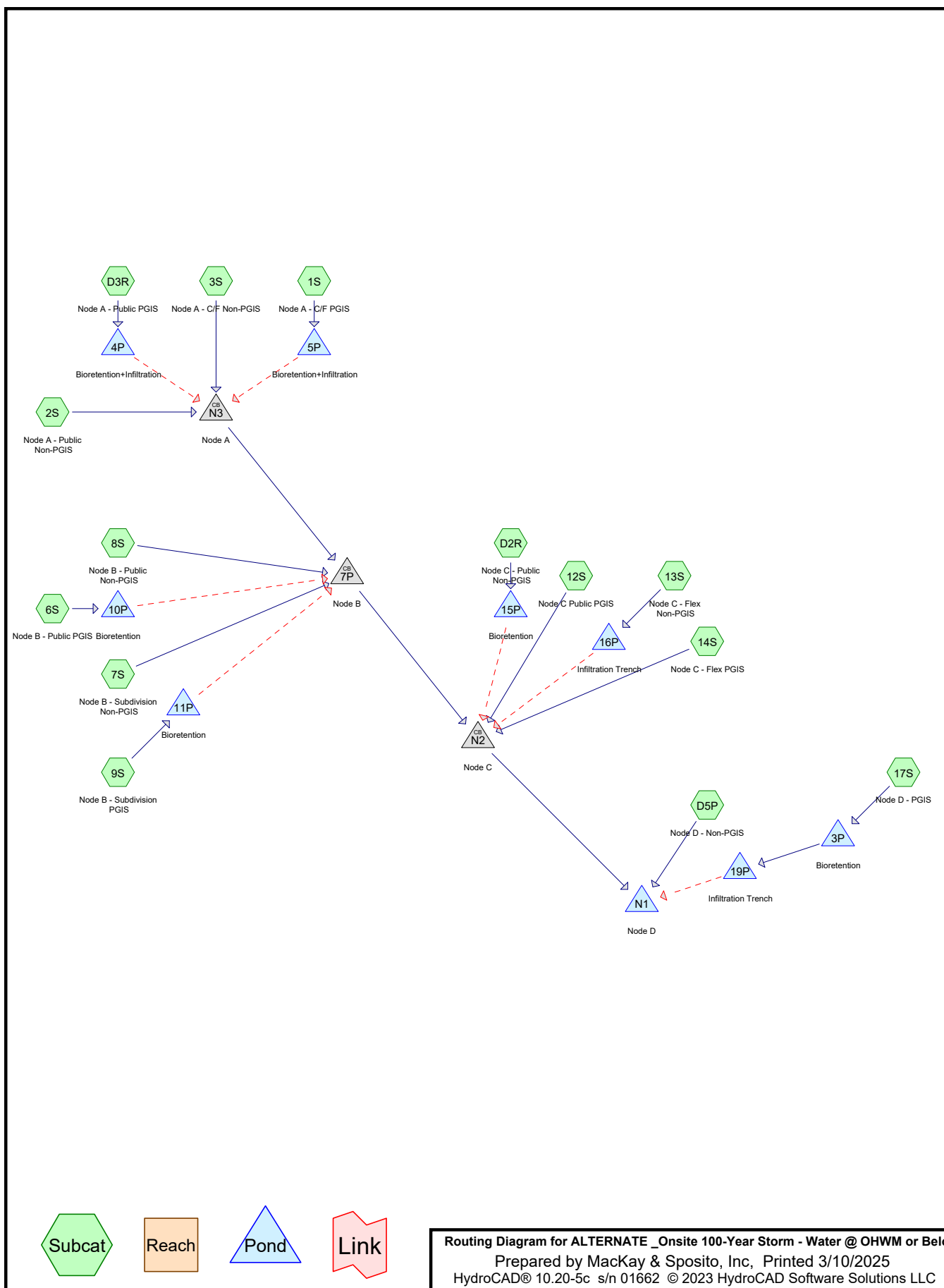
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 50.24' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	24.0" Round Culvert L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=14.45 cfs @ 8.10 hrs HW=50.24' TW=48.56' (Fixed TW Elev= 48.56')
 1=Culvert (Outlet Controls 14.45 cfs @ 4.60 fps)

Pond N3: Node A





ALTERNATE _Onsite 100-Year Storm - Water @ OHWM or Below

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	92	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	38.896	0.000	0.000	0.000	104.075	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 7P: Node B Peak Elev=49.68' Inflow=28.83 cfs 8.778 af
Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=43.12' Storage=42,363 cf Inflow=84.32 cfs 34.599 af
Primary=66.43 cfs 34.599 af Secondary=0.00 cfs 0.000 af Outflow=66.43 cfs 34.599 af

Pond N2: Node C Peak Elev=46.40' Inflow=33.86 cfs 10.379 af
Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.56' Inflow=18.21 cfs 5.428 af
Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
 Routed to Pond 5P : Bioretention+Infiltration

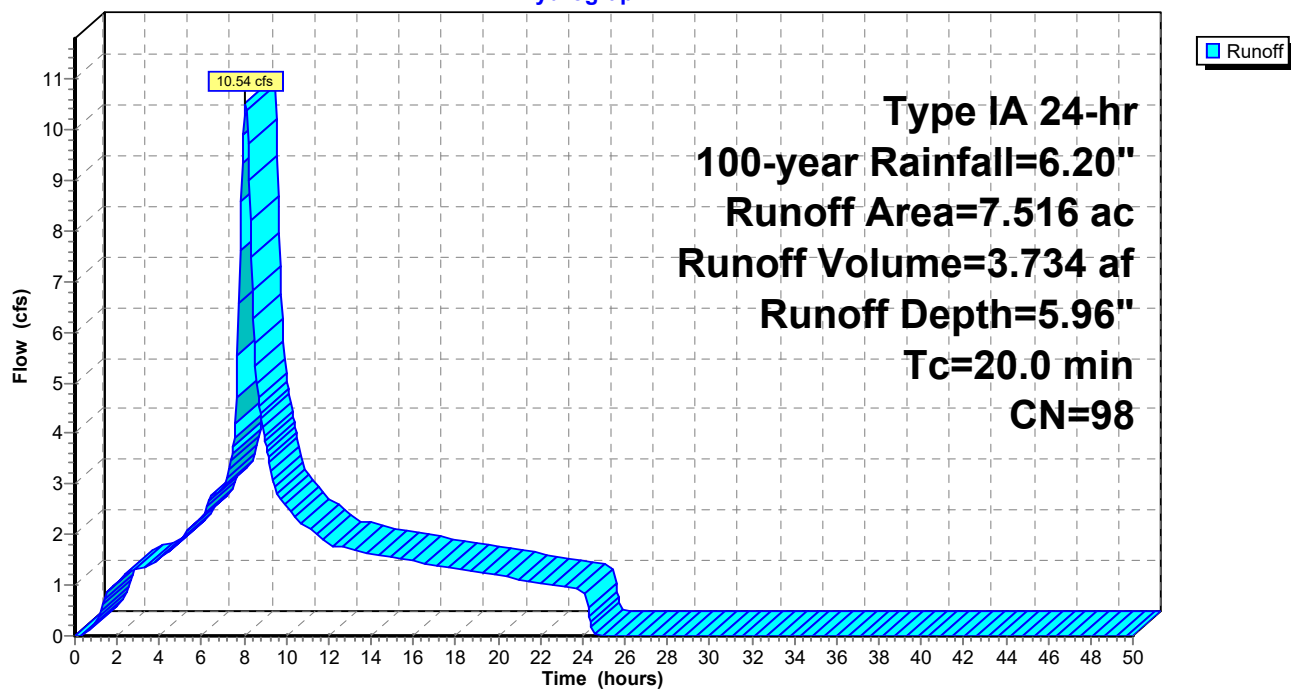
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Node A - C/F PGIS

Hydrograph



Summary for Subcatchment 2S: Node A - Public Non-PGIS

Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
 Routed to Pond N3 : Node A

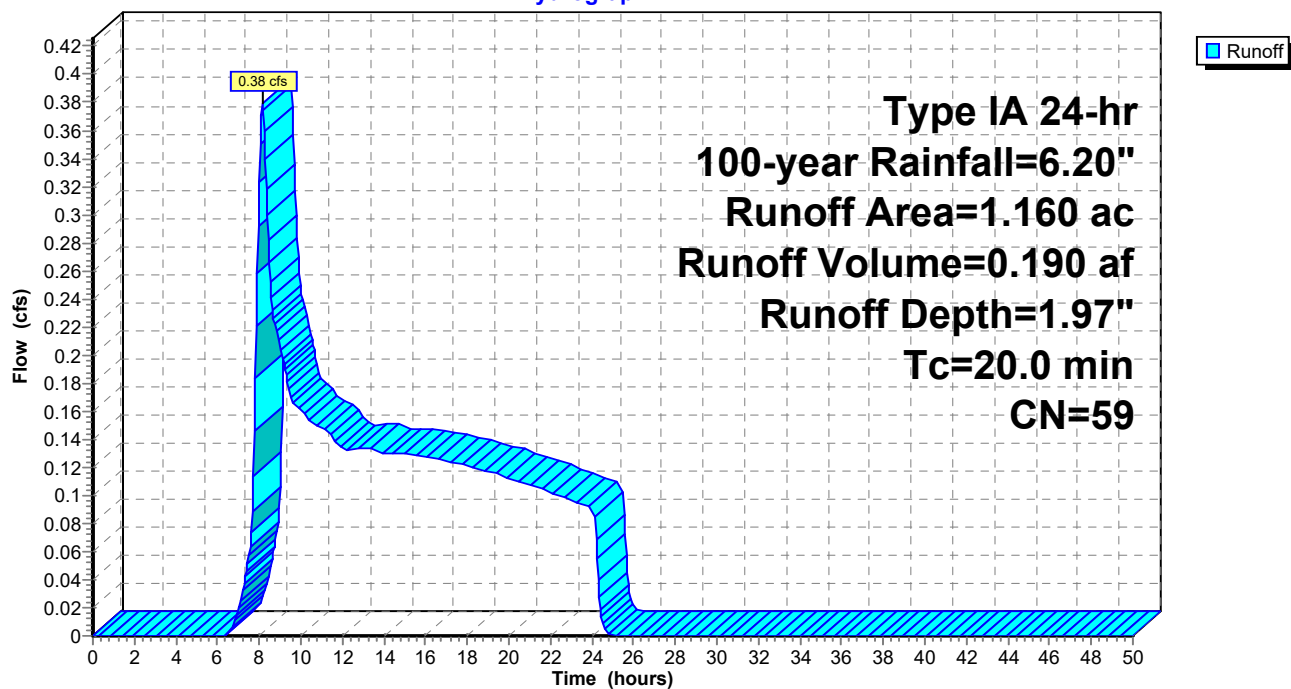
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
* 1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 2S: Node A - Public Non-PGIS

Hydrograph



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
 Routed to Pond N3 : Node A

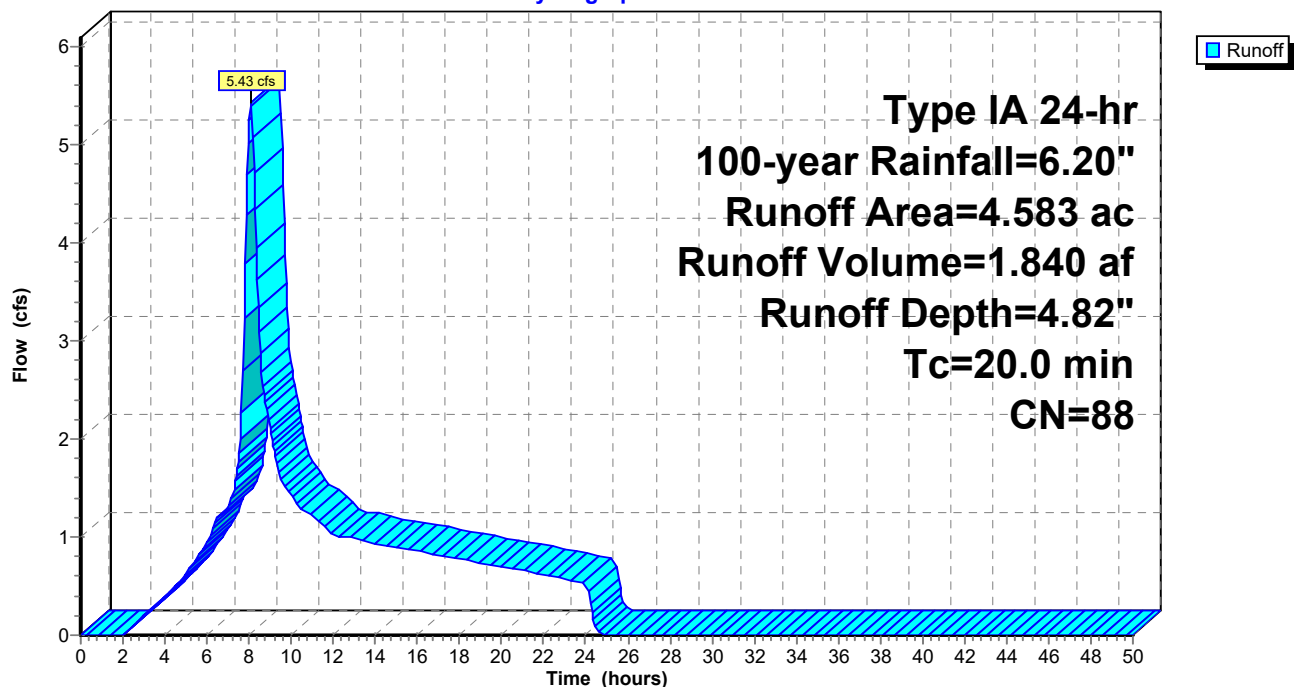
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
* 1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
3.373	98	Roofs, HSG A
4.583	88	Weighted Average
1.210		26.40% Pervious Area
3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 3S: Node A - C/F Non-PGIS

Hydrograph



Summary for Subcatchment 6S: Node B - Public PGIS

Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
 Routed to Pond 10P : Bioretention

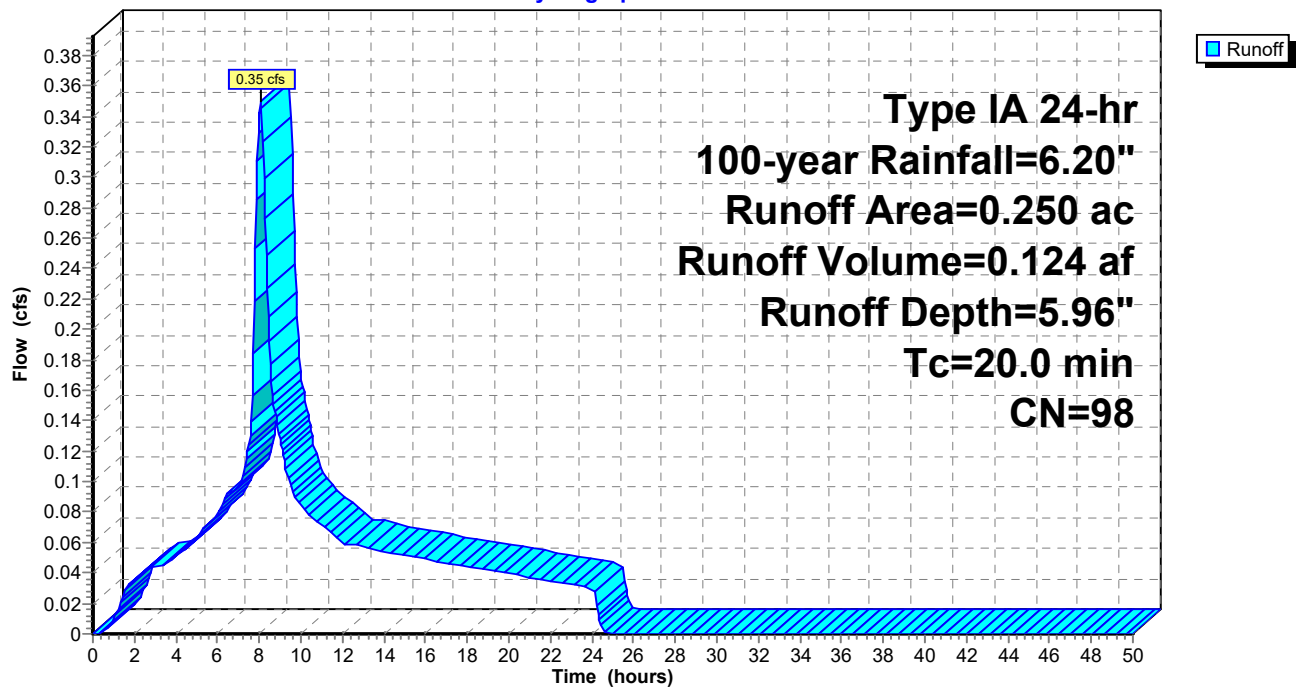
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 6S: Node B - Public PGIS

Hydrograph



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
 Routed to Pond 7P : Node B

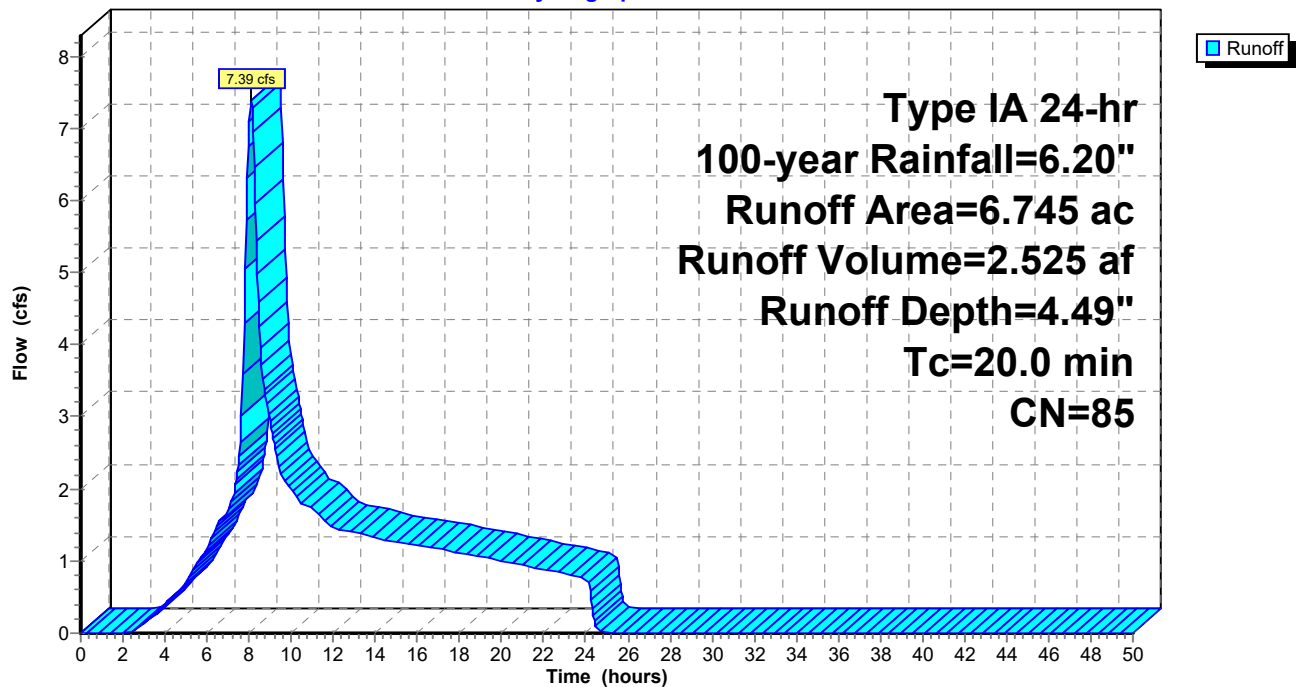
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 7S: Node B - Subdivision Non-PGIS

Hydrograph



Summary for Subcatchment 8S: Node B - Public Non-PGIS

Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
 Routed to Pond 7P : Node B

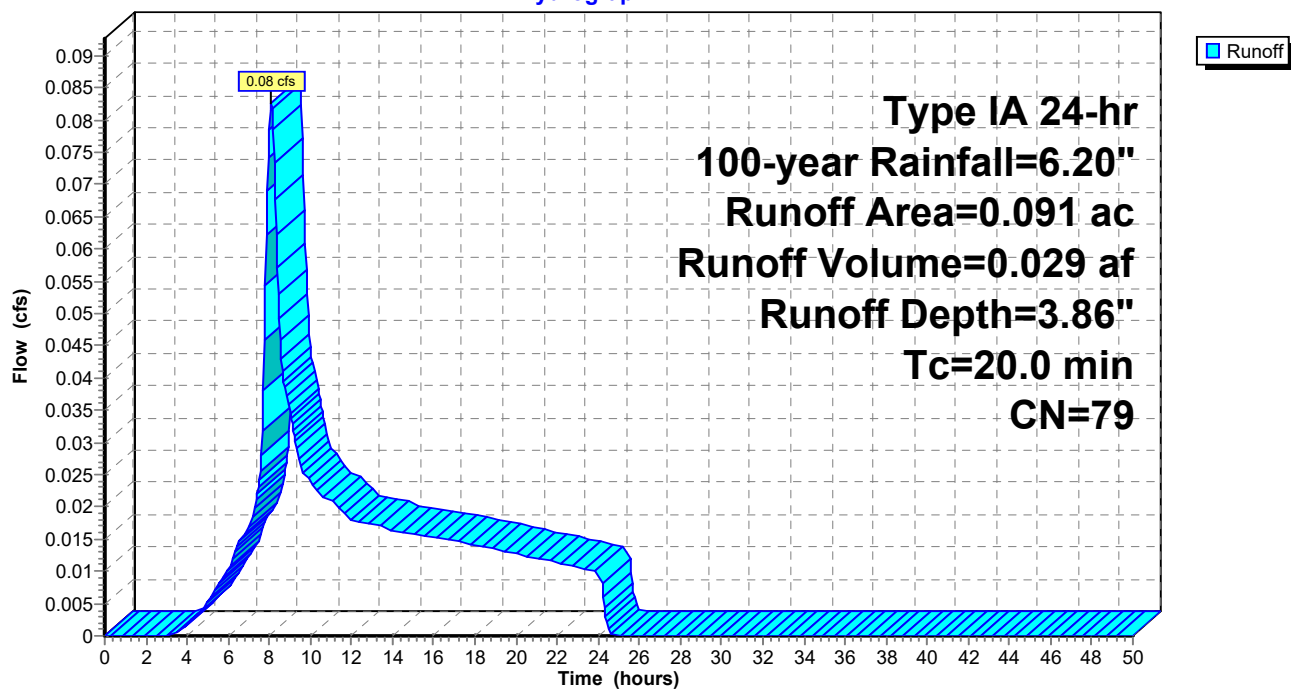
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 8S: Node B - Public Non-PGIS

Hydrograph



Summary for Subcatchment 9S: Node B - Subdivision PGIS

Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
 Routed to Pond 11P : Bioretention

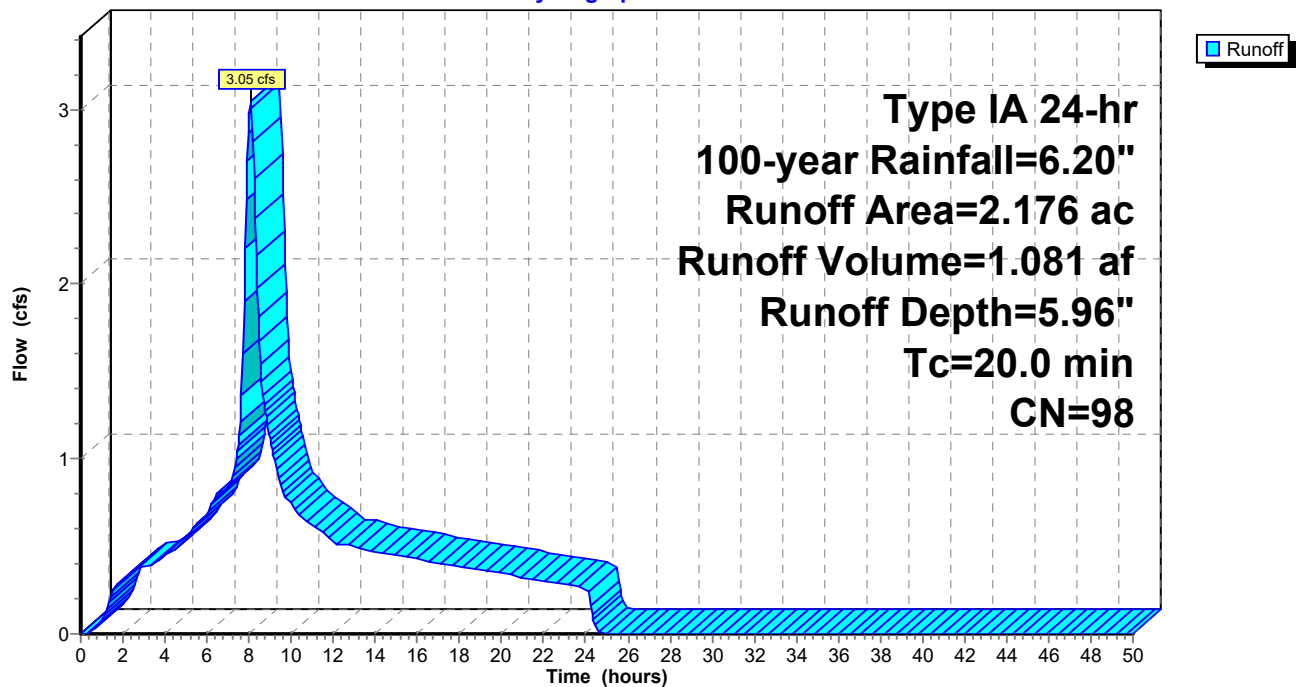
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 9S: Node B - Subdivision PGIS

Hydrograph



Summary for Subcatchment 12S: Node C Public PGIS

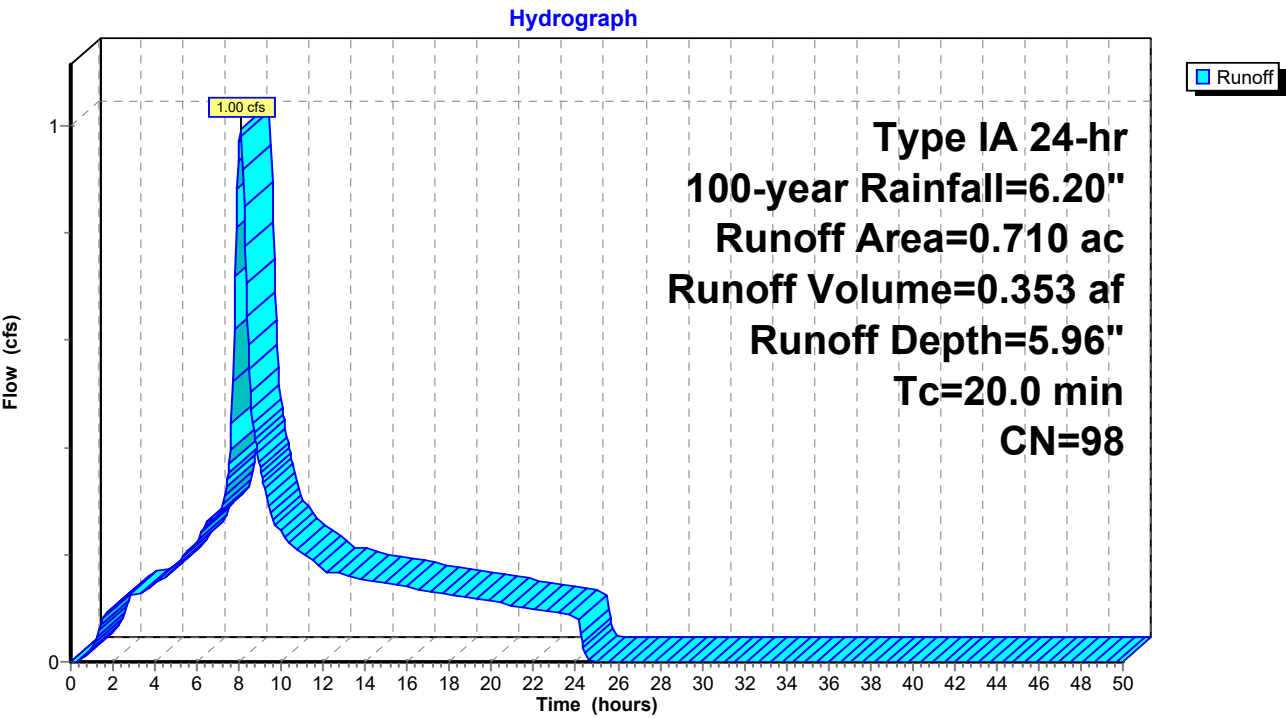
Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

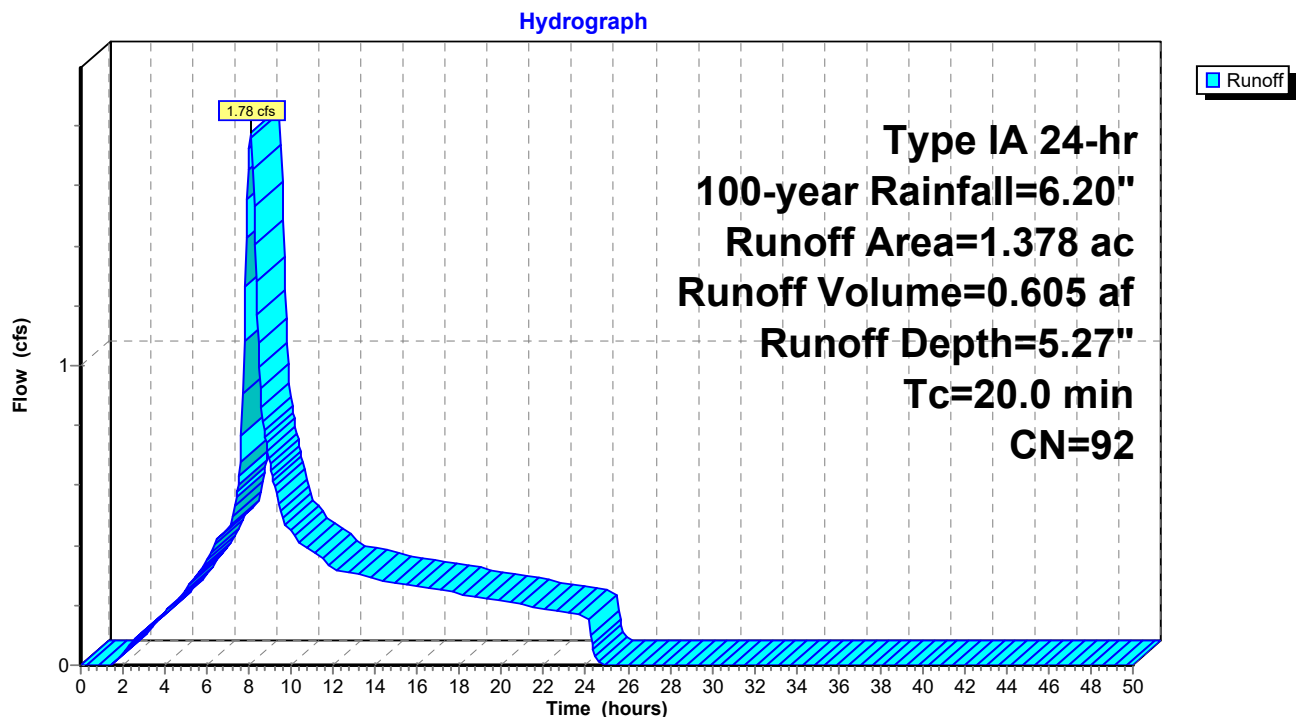
Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
 Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
 Routed to Pond N2 : Node C

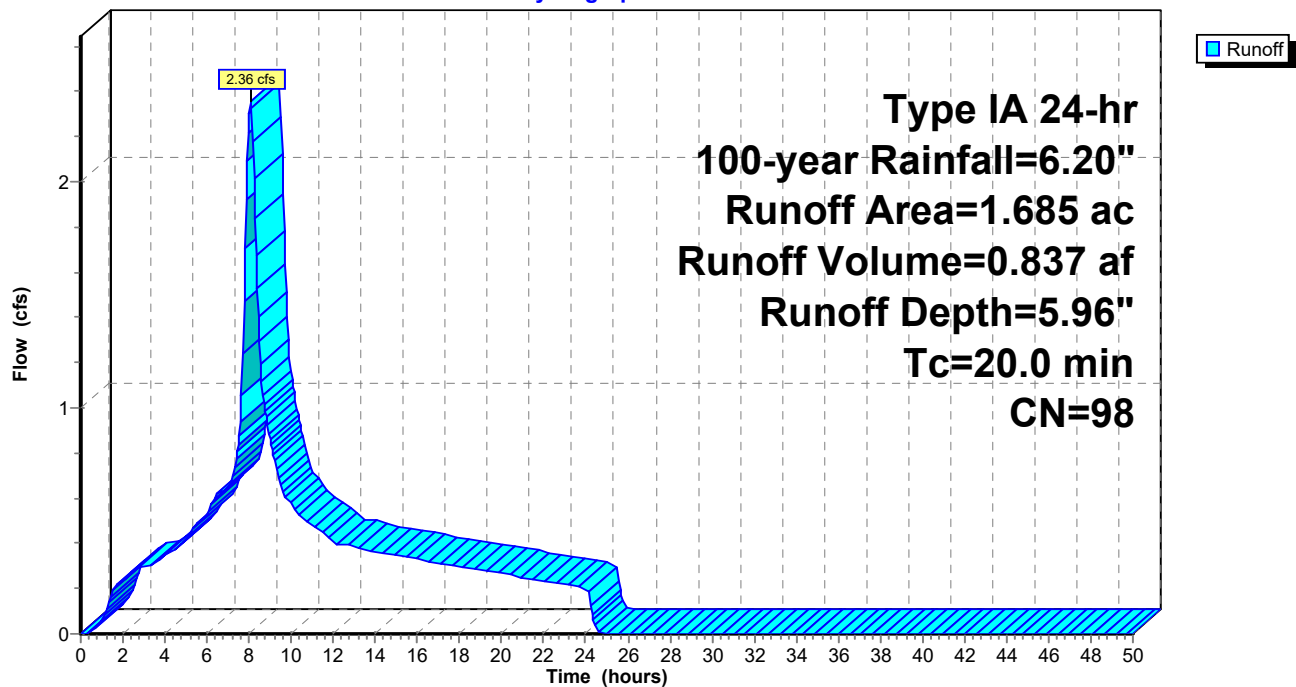
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 14S: Node C - Flex PGIS

Hydrograph



Summary for Subcatchment 17S: Node D - PGIS

Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
 Routed to Pond 3P : Bioretention

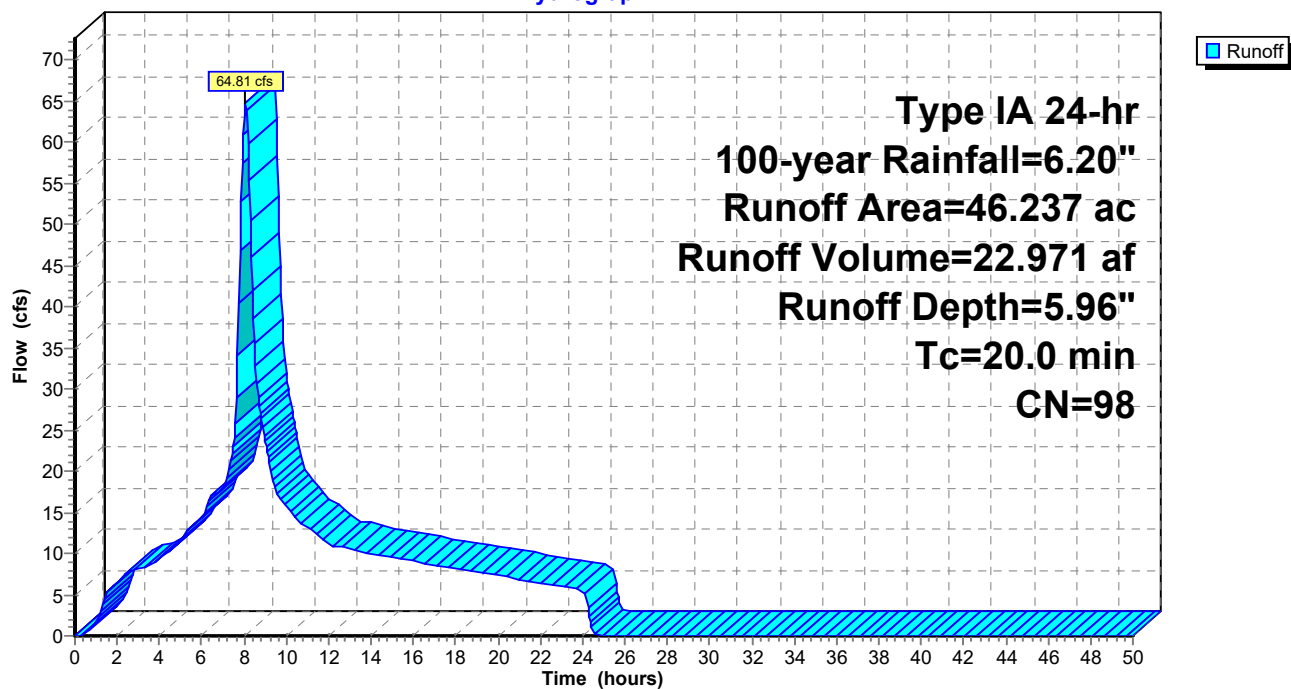
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 17S: Node D - PGIS

Hydrograph



Summary for Subcatchment D2R: Node C - Public Non-PGIS

Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
 Routed to Pond 15P : Bioretention

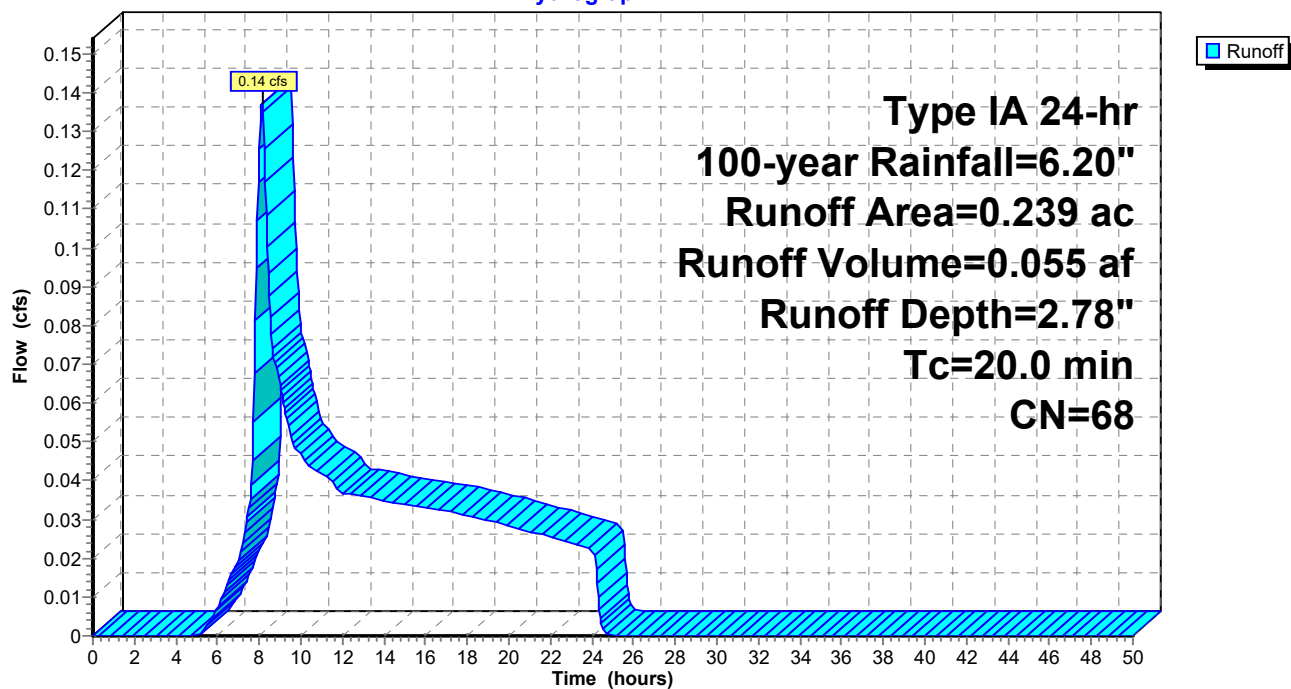
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D2R: Node C - Public Non-PGIS

Hydrograph



Summary for Subcatchment D3R: Node A - Public PGIS

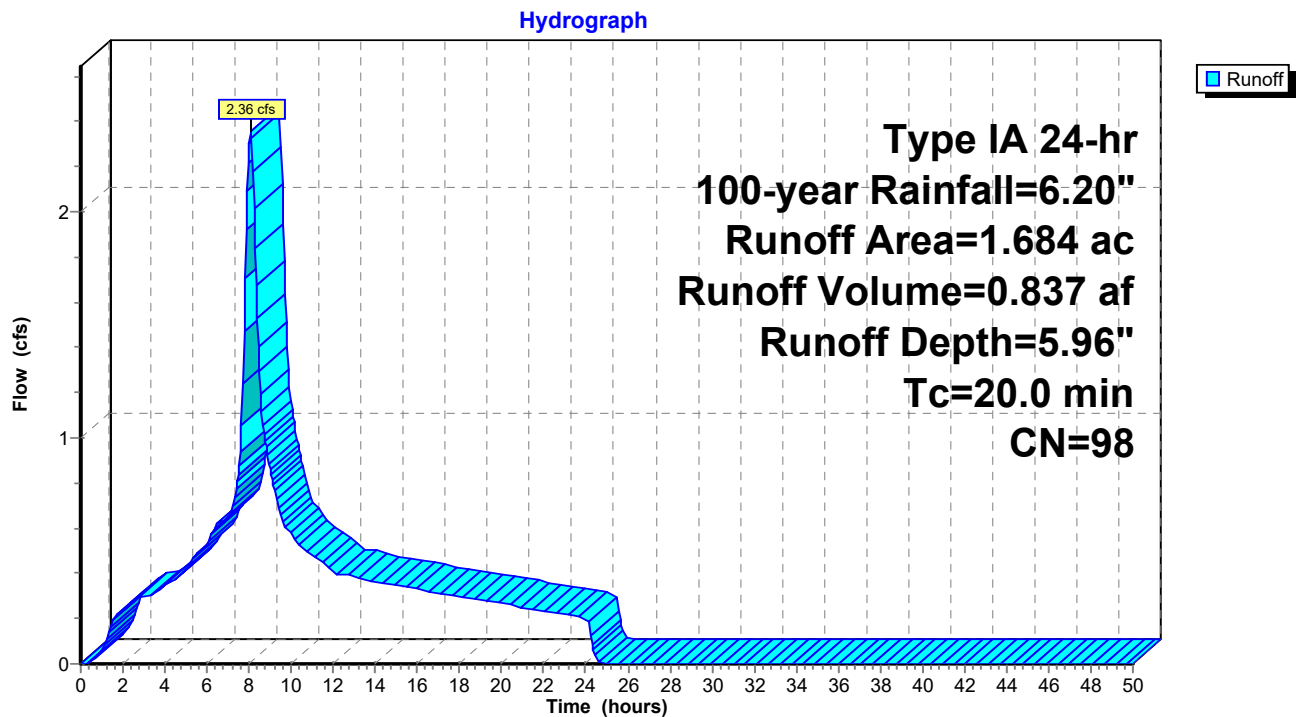
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
 Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
 Routed to Pond N1 : Node D

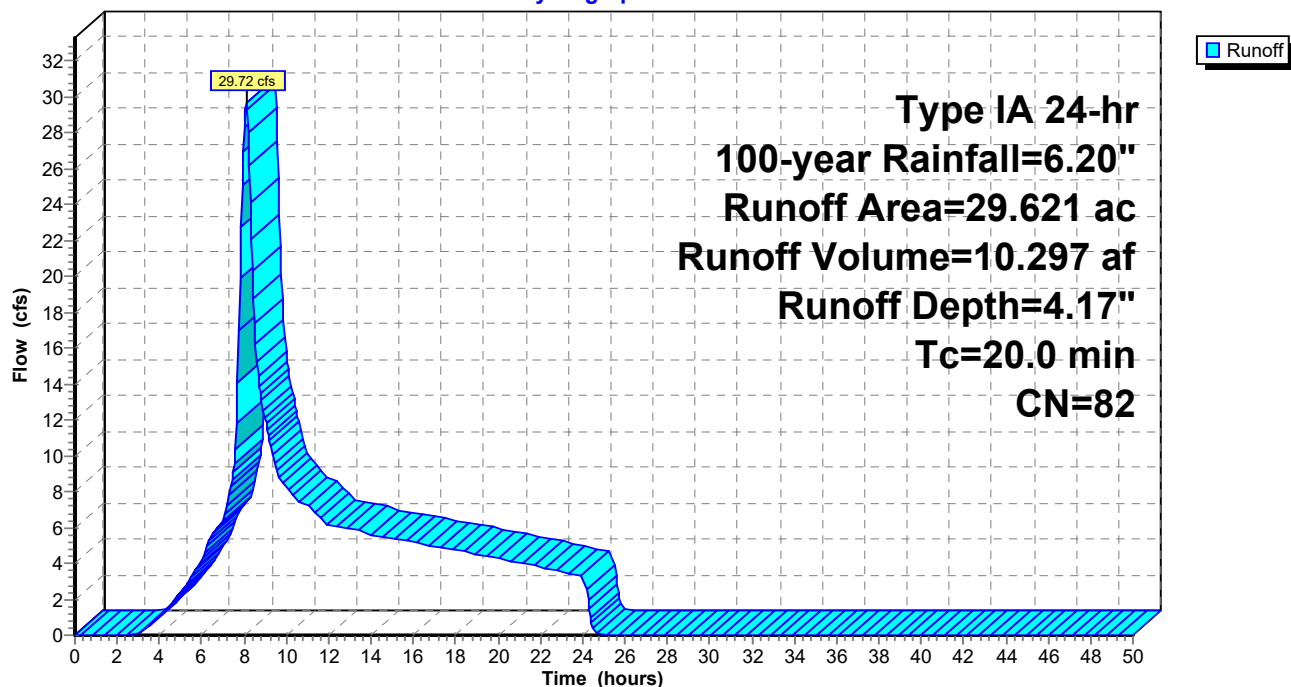
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D5P: Node D - Non-PGIS

Hydrograph



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
 Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
 Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
 Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
 Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	270.00'W x 270.00'L x 6.50'H Prisma 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	270.00'W x 270.00'L x 2.00'H Prisma Inside #1
#3	50.50'	0.019 af	24.0" Round Pipe Storage Inside #1 L= 269.0'
		5.996 af	Total Available Storage

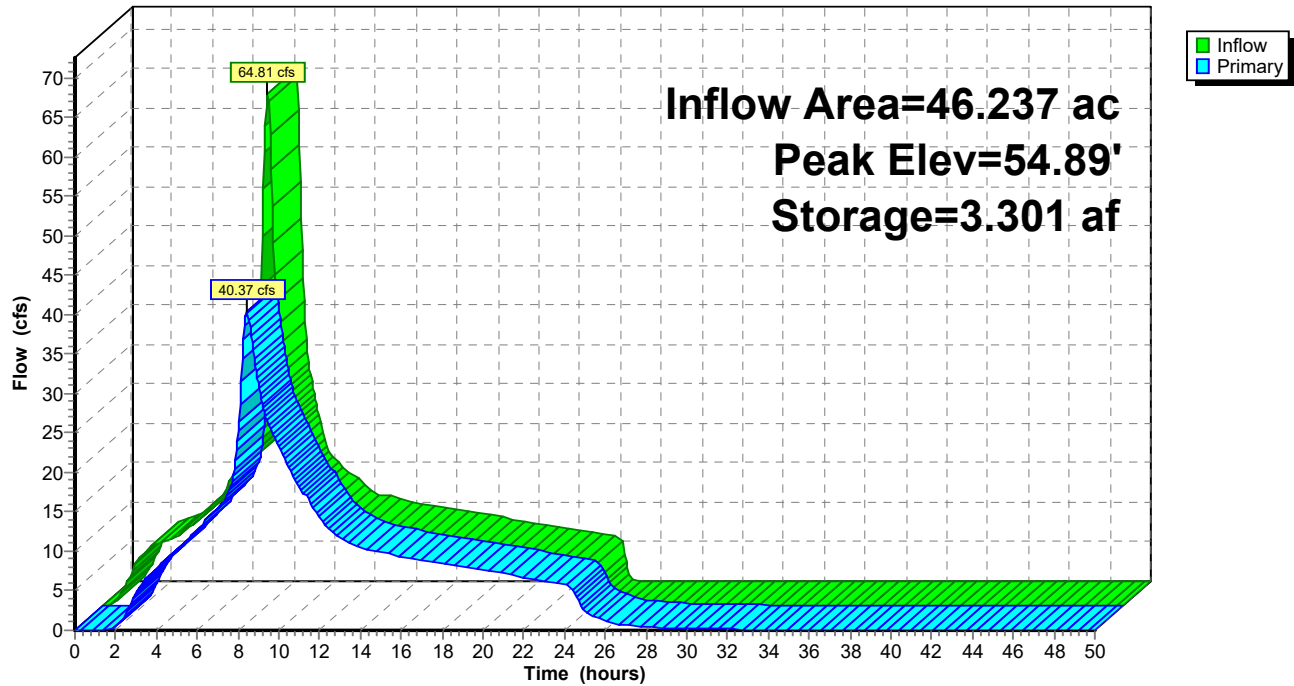
Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	60.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	24.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)

↑ **1=Orifice/Grate** (Weir Controls 12.44 cfs @ 2.04 fps)
 — **2=Orifice/Grate** (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention

Hydrograph



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
 Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
 Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
 Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
 Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

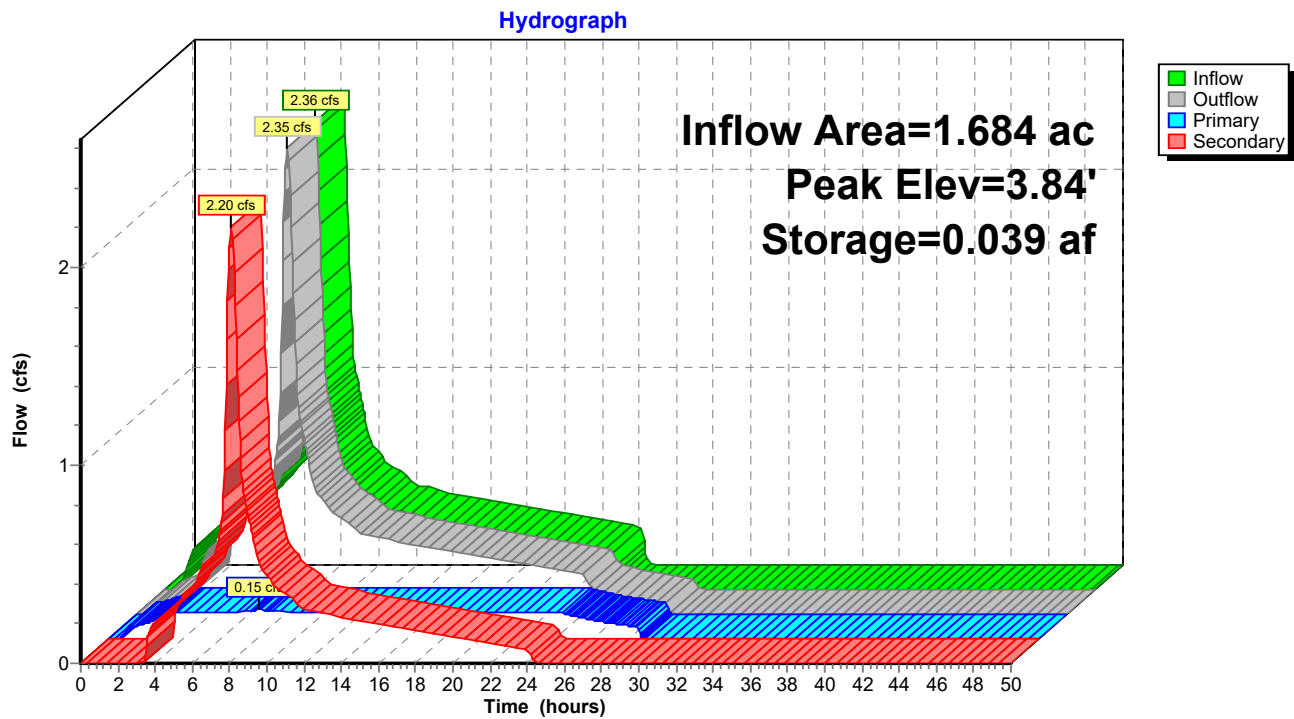
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	5.00'W x 250.00'L x 5.00'H Bioretention 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
 Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
 Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
 Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

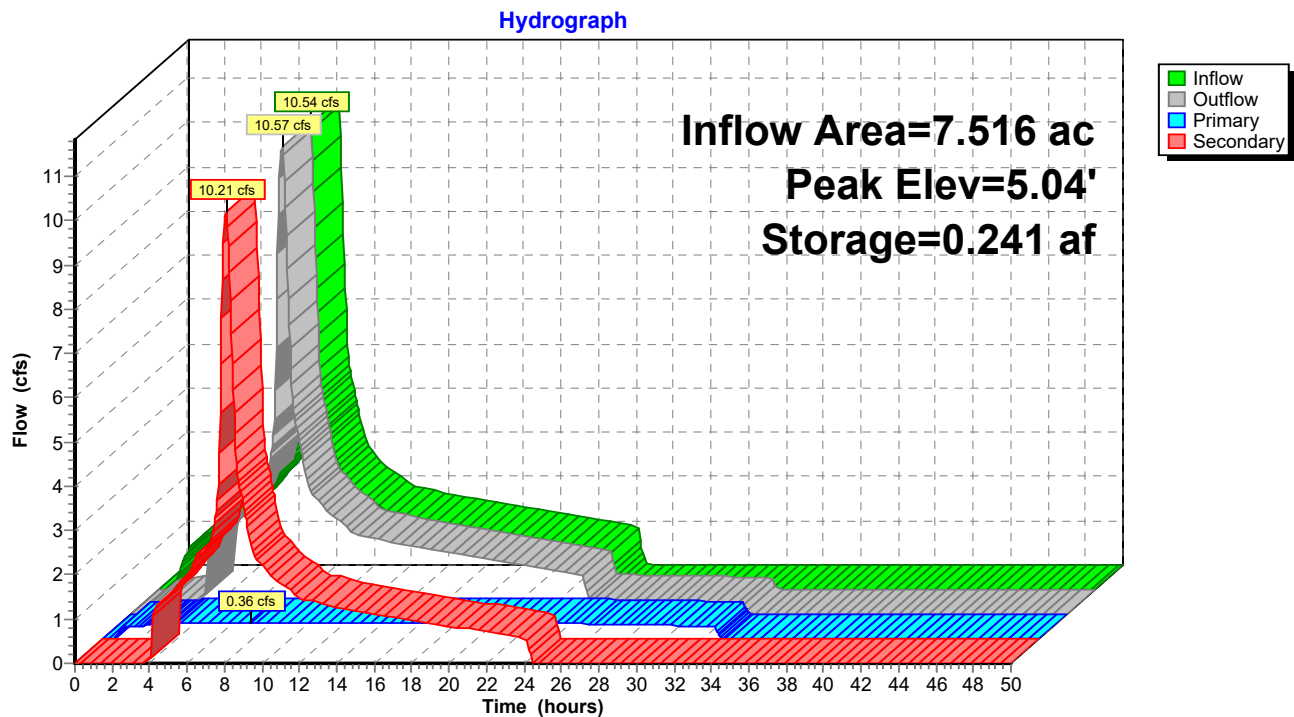
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	50.00'W x 120.00'L x 5.00'H Infiltration Trench 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.50'	30.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.68' (Flood elevation advised)
 [81] Warning: Exceeded Pond 10P by 46.40' @ 31.35 hrs
 [81] Warning: Exceeded Pond 11P by 46.40' @ 33.05 hrs

Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
 Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
 Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
 Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
 Routed to Pond N2 : Node C

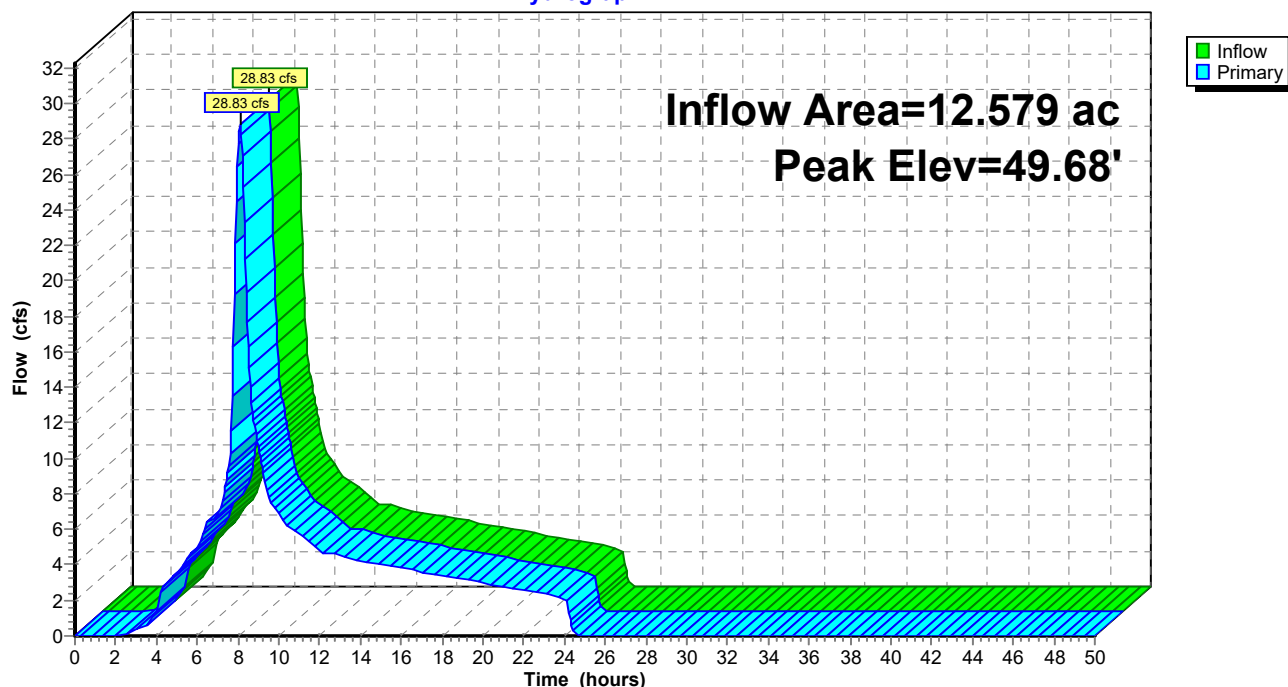
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 49.68' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	24.0" Round Culvert L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=28.67 cfs @ 8.09 hrs HW=49.68' TW=46.40' (Fixed TW Elev= 46.40')
 1=Culvert (Outlet Controls 19.95 cfs @ 6.35 fps)
 2=Sharp-Crested Rectangular Weir (Weir Controls 8.72 cfs @ 1.37 fps)

Pond 7P: Node B

Hydrograph



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
 Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
 Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
 Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	5.00'W x 40.00'L x 5.00'H Bioretention 0.023 af Overall x 35.0% Voids

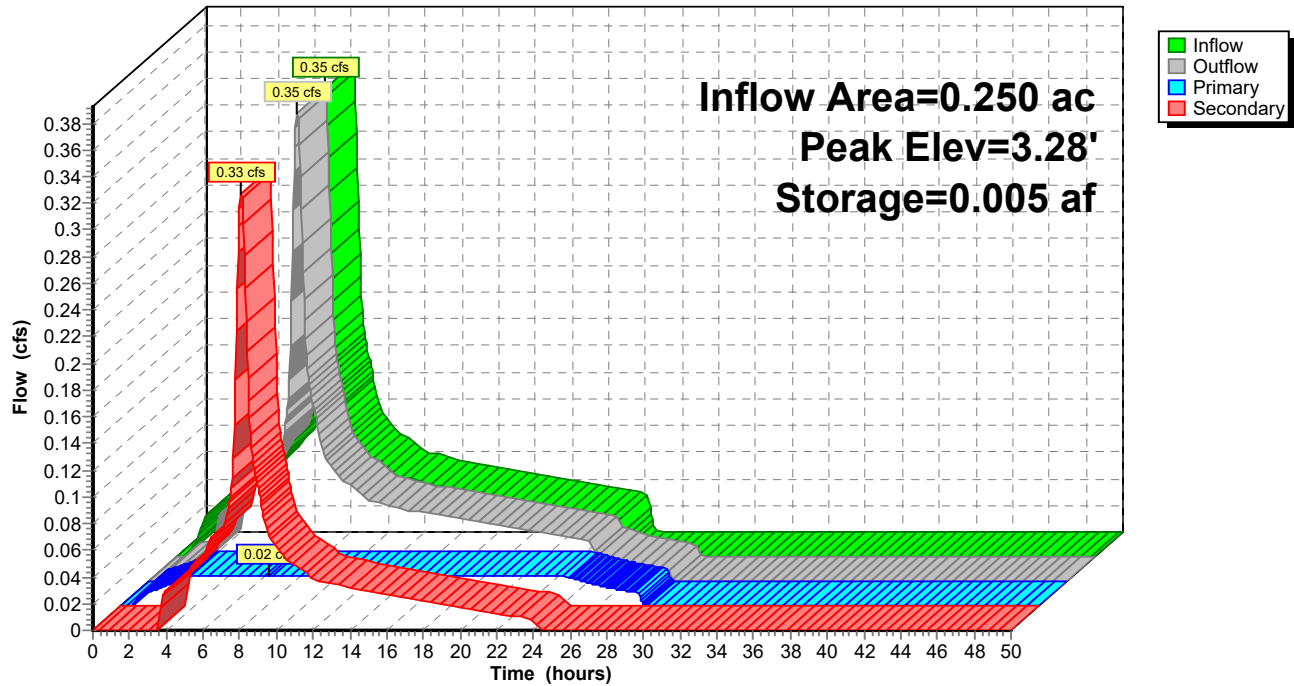
Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention

Hydrograph



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
 Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
 Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
 Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
 Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	5.00'W x 270.00'L x 6.00'H Bioretention 0.186 af Overall x 35.0% Voids

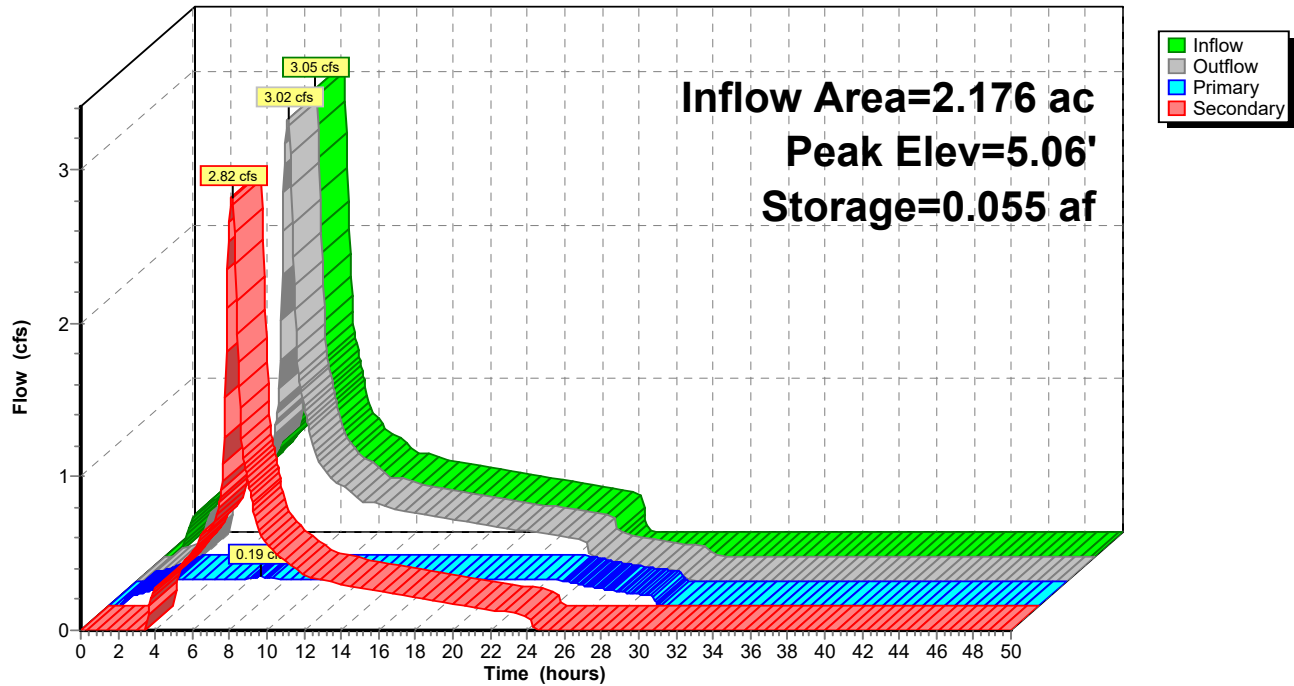
Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention

Hydrograph



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
 Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
 Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
 Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
 Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

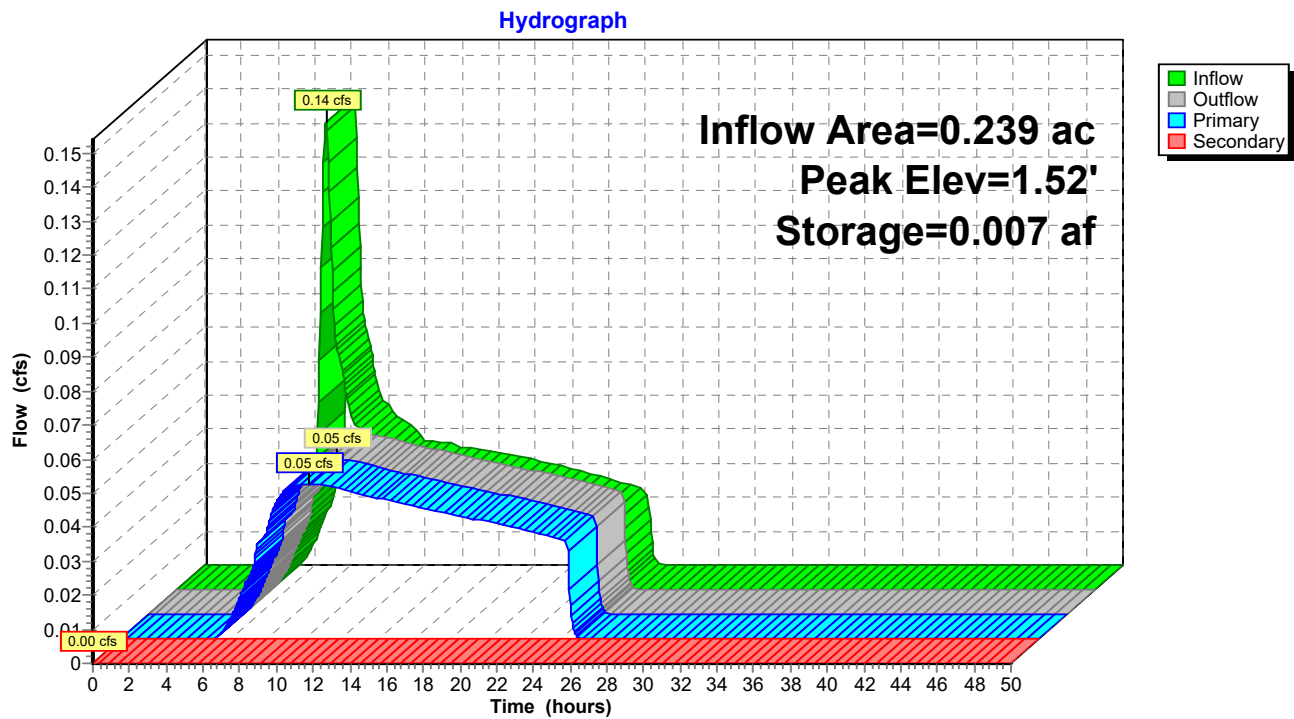
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	5.00'W x 120.00'L x 5.00'H Bioretention 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
 ↑**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
 Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
 Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
 Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
 Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
 Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

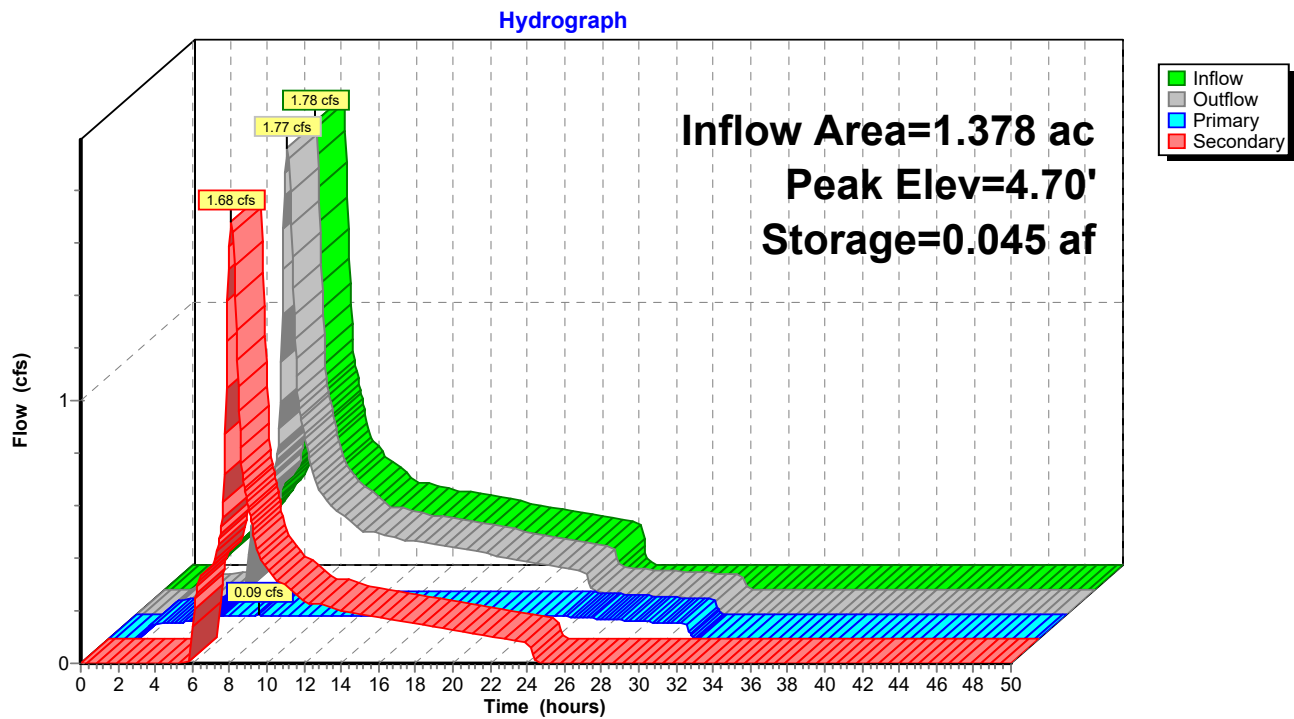
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	20.00'W x 60.00'L x 6.00'H Infiltration Trench 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth > 5.88" for 100-year event
 Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
 Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
 Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
 Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
 Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
 Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

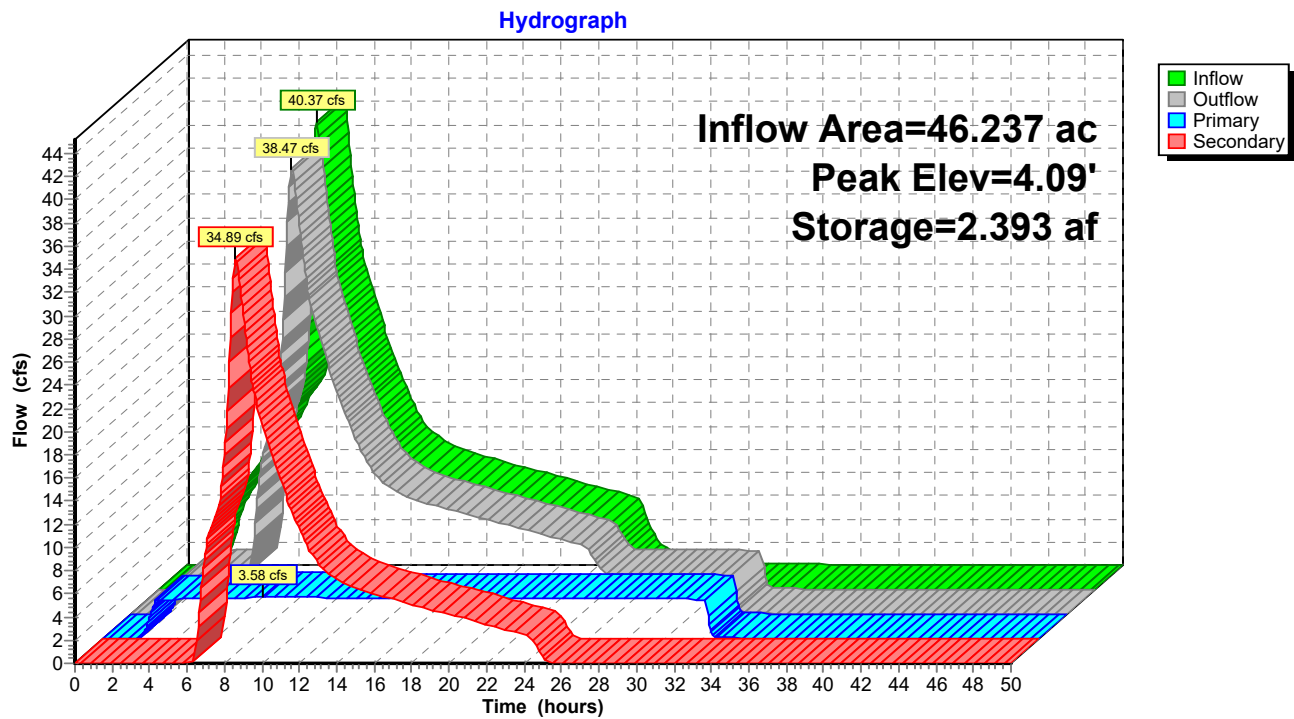
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	270.00'W x 270.00'L x 5.00'H Infiltration Trench 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	36.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
 ↑**2=Orifice/Grate** (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=14)

[81] Warning: Exceeded Pond 19P by 39.03' @ 8.60 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
 Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
 Outflow = 66.43 cfs @ 8.60 hrs, Volume= 34.599 af, Atten= 21%, Lag= 27.5 min
 Primary = 66.43 cfs @ 8.60 hrs, Volume= 34.599 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 43.12' @ 8.60 hrs Surf.Area= 43,113 sf Storage= 42,363 cf

Plug-Flow detention time= 2.0 min calculated for 34.599 af (100% of inflow)
 Center-of-Mass det. time= 2.0 min (737.6 - 735.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Secondary	48.00'	30.0' long + 1.0 ' SideZ x 4.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Primary	38.00'	42.0" Round Culvert L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 ' / Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

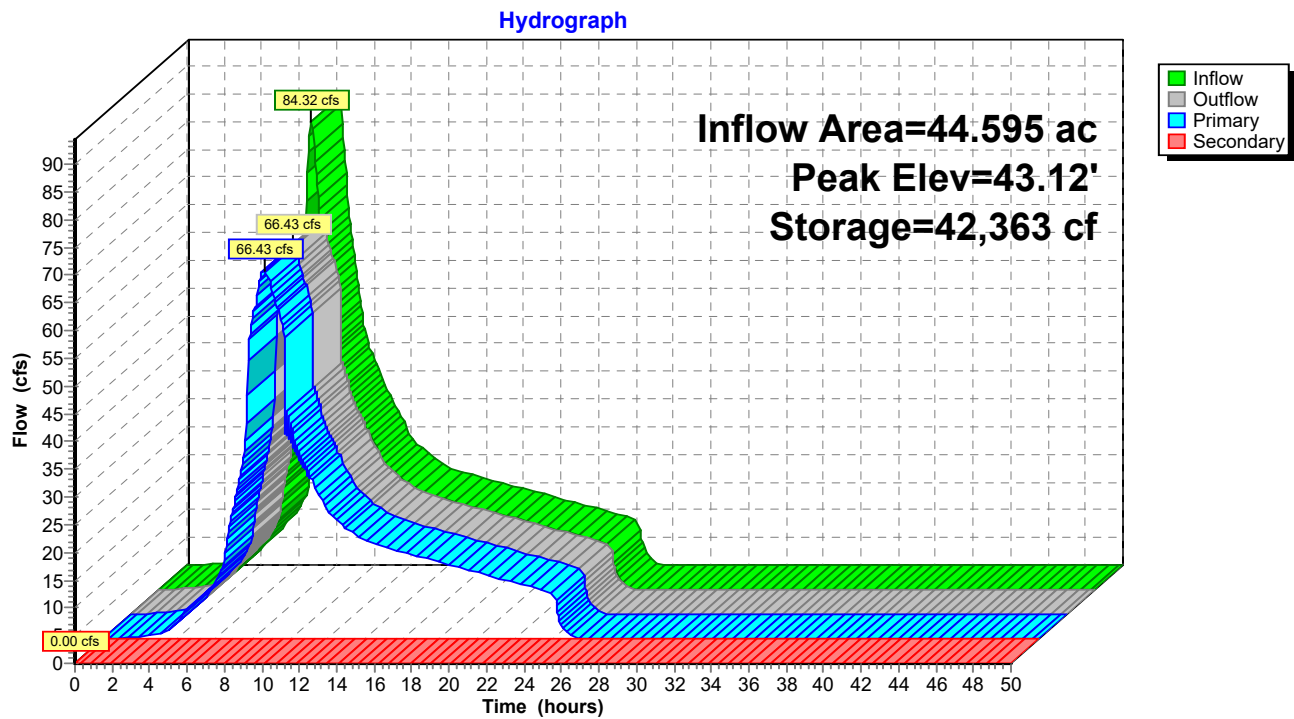
Primary OutFlow Max=66.43 cfs @ 8.60 hrs HW=43.12' (Free Discharge)

↑ **2=Culvert** (Barrel Controls 66.43 cfs @ 6.90 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)

↑ **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 46.40' (Flood elevation advised)
 [81] Warning: Exceeded Pond 7P by 2.80' @ 1.75 hrs
 [81] Warning: Exceeded Pond 15P by 45.83' @ 8.05 hrs
 [81] Warning: Exceeded Pond 16P by 43.12' @ 1.45 hrs

Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
 Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
 Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
 Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
 Routed to Pond N1 : Node D

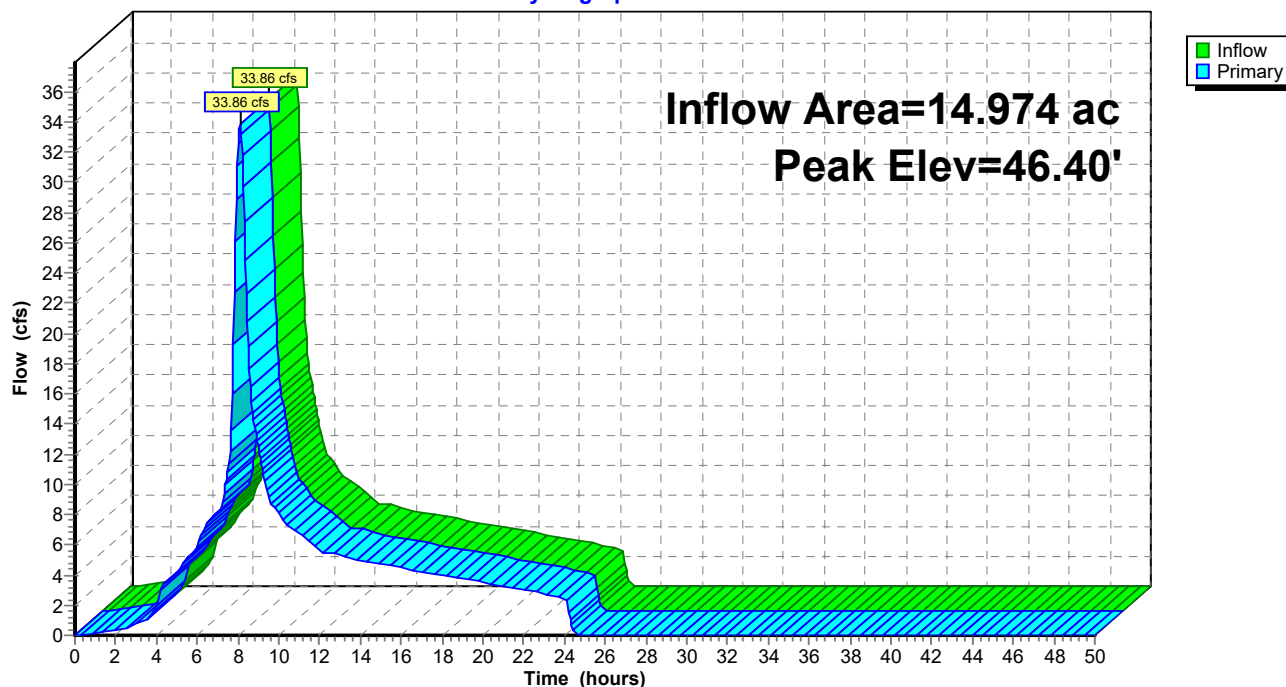
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 46.40' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	30.0" Round Culvert L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 ' S= 0.0029 ' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=33.80 cfs @ 8.09 hrs HW=46.39' TW=43.12' (Fixed TW Elev= 43.12')
 1=Culvert (Outlet Controls 33.80 cfs @ 6.88 fps)
 2=Sharp-Crested Rectangular Weir(Controls 0.00 cfs)

Pond N2: Node C

Hydrograph



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.56' (Flood elevation advised)
 [81] Warning: Exceeded Pond 4P by 49.68' @ 31.55 hrs
 [81] Warning: Exceeded Pond 5P by 49.68' @ 35.95 hrs

Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
 Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
 Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
 Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
 Routed to Pond 7P : Node B

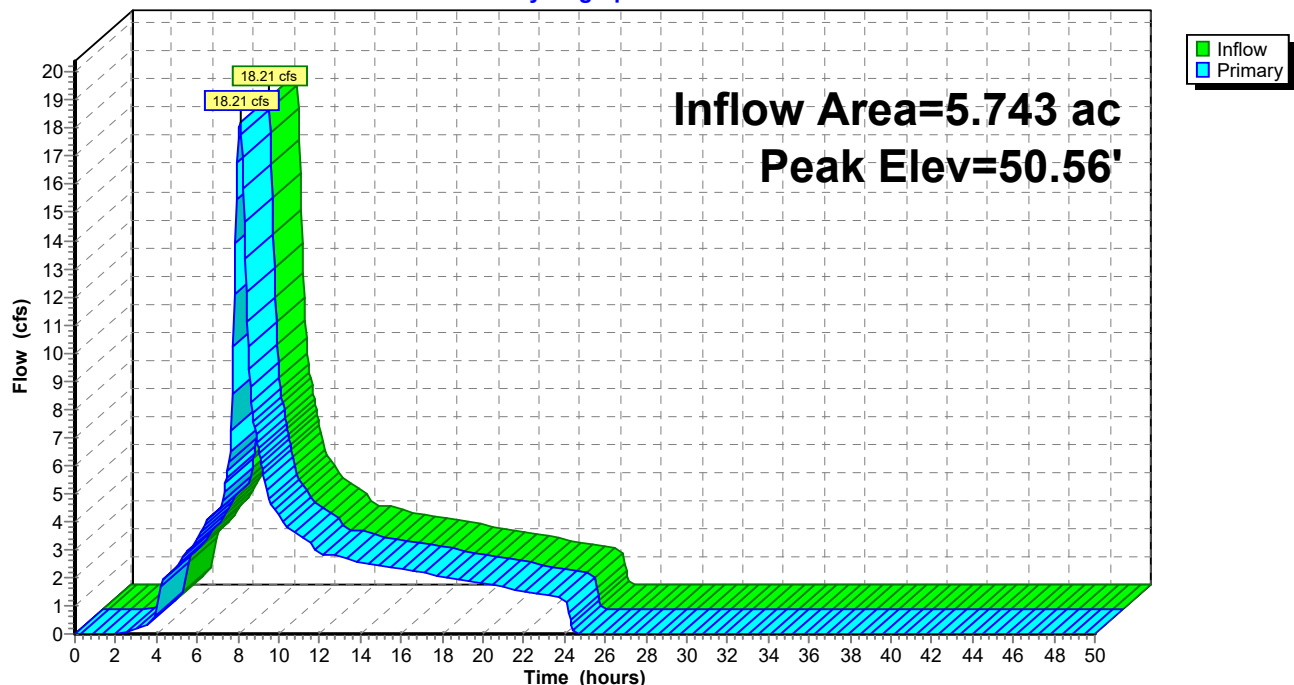
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 50.56' @ 8.09 hrs

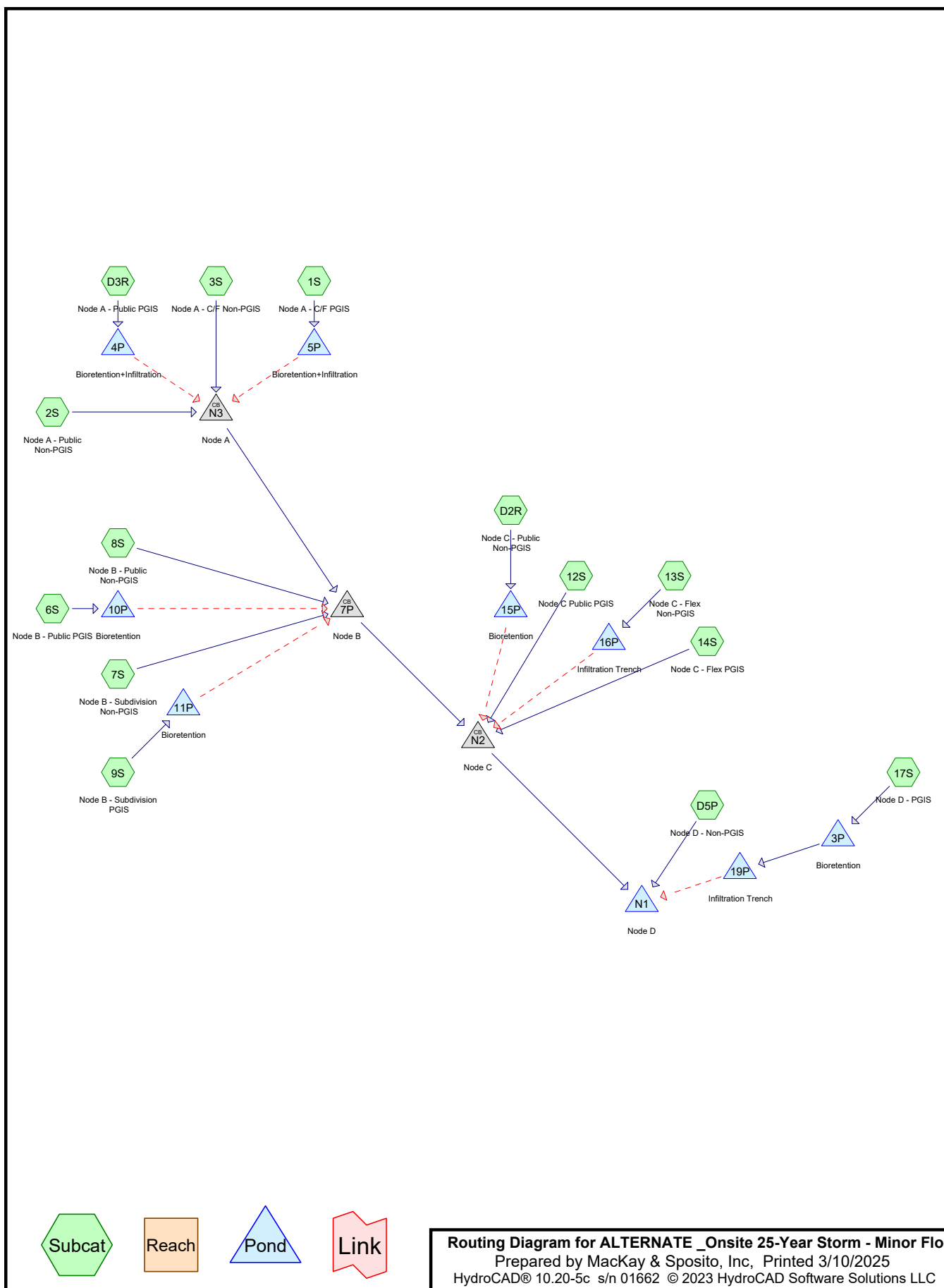
Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	24.0" Round Culvert L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=17.89 cfs @ 8.09 hrs HW=50.56' TW=49.68' (Fixed TW Elev= 49.68')
 1=Culvert (Outlet Controls 10.45 cfs @ 3.33 fps)
 2=Sharp-Crested Rectangular Weir (Weir Controls 7.44 cfs @ 1.30 fps)

Pond N3: Node A

Hydrograph





ALTERNATE _Onsite 25-Year Storm - Minor Flood

Prepared by MacKay & Sposito, Inc

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	92	TOTAL AREA

ALTERNATE _Onsite 25-Year Storm - Minor Flood

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		TOTAL AREA

ALTERNATE _Onsite 25-Year Storm - Minor Flood

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	38.896	0.000	0.000	0.000	104.075	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=8.64 cfs 3.046 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.29"
Tc=20.0 min CN=59 Runoff=0.20 cfs 0.125 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=3.76"
Tc=20.0 min CN=88 Runoff=4.22 cfs 1.438 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.29 cfs 0.101 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=3.46"
Tc=20.0 min CN=85 Runoff=5.62 cfs 1.945 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=0.06 cfs 0.022 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=2.50 cfs 0.882 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.82 cfs 0.288 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=4.19"
Tc=20.0 min CN=92 Runoff=1.42 cfs 0.481 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.683 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=53.15 cfs 18.738 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=1.95"
Tc=20.0 min CN=68 Runoff=0.09 cfs 0.039 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.682 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=3.17"
Tc=20.0 min CN=82 Runoff=22.11 cfs 7.822 af

Pond 3P: Bioretention Peak Elev=54.62' Storage=2.845 af Inflow=53.15 cfs 18.738 af
Outflow=28.78 cfs 18.424 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.73' Storage=0.037 af Inflow=1.94 cfs 0.682 af
Primary=0.15 cfs 0.277 af Secondary=1.78 cfs 0.406 af Outflow=1.93 cfs 0.682 af

Pond 5P: Bioretention+Infiltration Peak Elev=4.97' Storage=0.240 af Inflow=8.64 cfs 3.046 af
Primary=0.36 cfs 0.882 af Secondary=8.26 cfs 2.164 af Outflow=8.62 cfs 3.046 af

Pond 7P: Node B Peak Elev=48.77' Inflow=22.70 cfs 6.681 af
24.0" Round Culvert n=0.012 L=379.7' S=0.0030 '/' Outflow=22.70 cfs 6.681 af

Pond 10P: Bioretention Peak Elev=3.25' Storage=0.005 af Inflow=0.29 cfs 0.101 af
Primary=0.02 cfs 0.045 af Secondary=0.26 cfs 0.056 af Outflow=0.29 cfs 0.101 af

Pond 11P: Bioretention Peak Elev=4.87' Storage=0.053 af Inflow=2.50 cfs 0.882 af
Primary=0.19 cfs 0.356 af Secondary=2.30 cfs 0.526 af Outflow=2.48 cfs 0.882 af

Pond 15P: Bioretention Peak Elev=0.73' Storage=0.004 af Inflow=0.09 cfs 0.039 af
Primary=0.04 cfs 0.039 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.039 af

Pond 16P: Infiltration Trench Peak Elev=4.61' Storage=0.044 af Inflow=1.42 cfs 0.481 af
Primary=0.09 cfs 0.189 af Secondary=1.32 cfs 0.292 af Outflow=1.41 cfs 0.481 af

Pond 19P: Infiltration Trench Peak Elev=3.86' Storage=2.259 af Inflow=28.78 cfs 18.424 af
Primary=3.57 cfs 8.564 af Secondary=24.41 cfs 9.860 af Outflow=27.97 cfs 18.424 af

Pond N1: Node D Peak Elev=42.48' Storage=16,980 cf Inflow=65.60 cfs 25.625 af
42.0" Round Culvert n=0.012 L=270.3' S=0.0018 '/' Outflow=56.41 cfs 25.621 af

Pond N2: Node C Peak Elev=44.53' Inflow=26.76 cfs 7.943 af
30.0" Round Culvert n=0.012 L=410.7' S=0.0029 '/' Outflow=26.76 cfs 7.943 af

Pond N3: Node A Peak Elev=50.45' Inflow=14.45 cfs 4.132 af
24.0" Round Culvert n=0.012 L=369.0' S=0.0030 '/' Outflow=14.45 cfs 4.132 af

Total Runoff Area = 104.075 ac Runoff Volume = 36.290 af Average Runoff Depth = 4.18"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

Runoff = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af, Depth= 4.86"
 Routed to Pond 5P : Bioretention+Infiltration

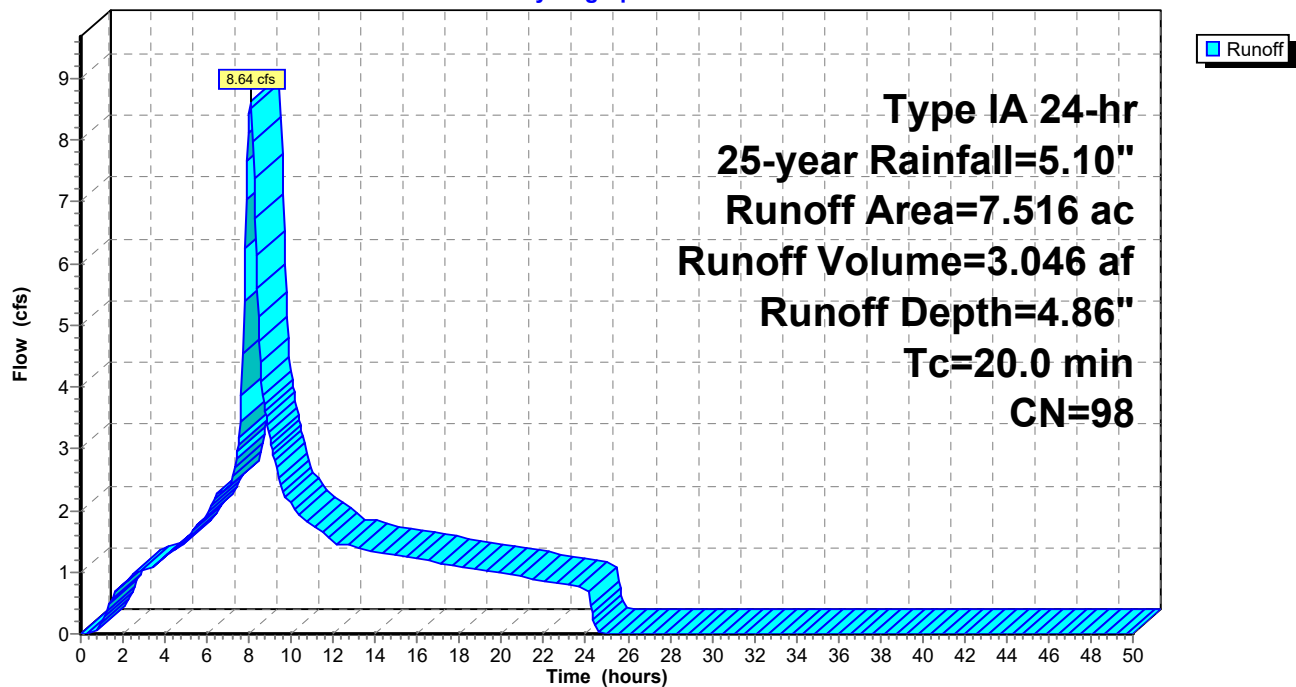
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Node A - C/F PGIS

Hydrograph



Summary for Subcatchment 2S: Node A - Public Non-PGIS

Runoff = 0.20 cfs @ 8.19 hrs, Volume= 0.125 af, Depth= 1.29"
 Routed to Pond N3 : Node A

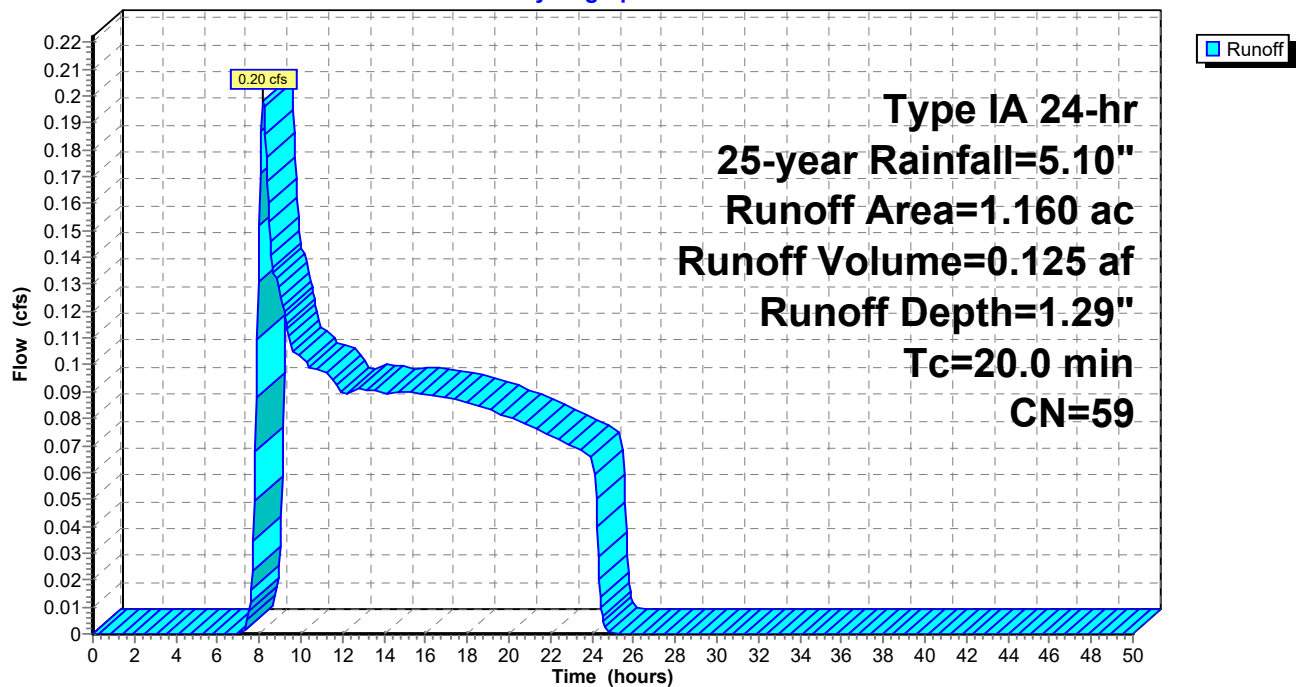
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
* 1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 2S: Node A - Public Non-PGIS

Hydrograph



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

Runoff = 4.22 cfs @ 8.09 hrs, Volume= 1.438 af, Depth= 3.76"
 Routed to Pond N3 : Node A

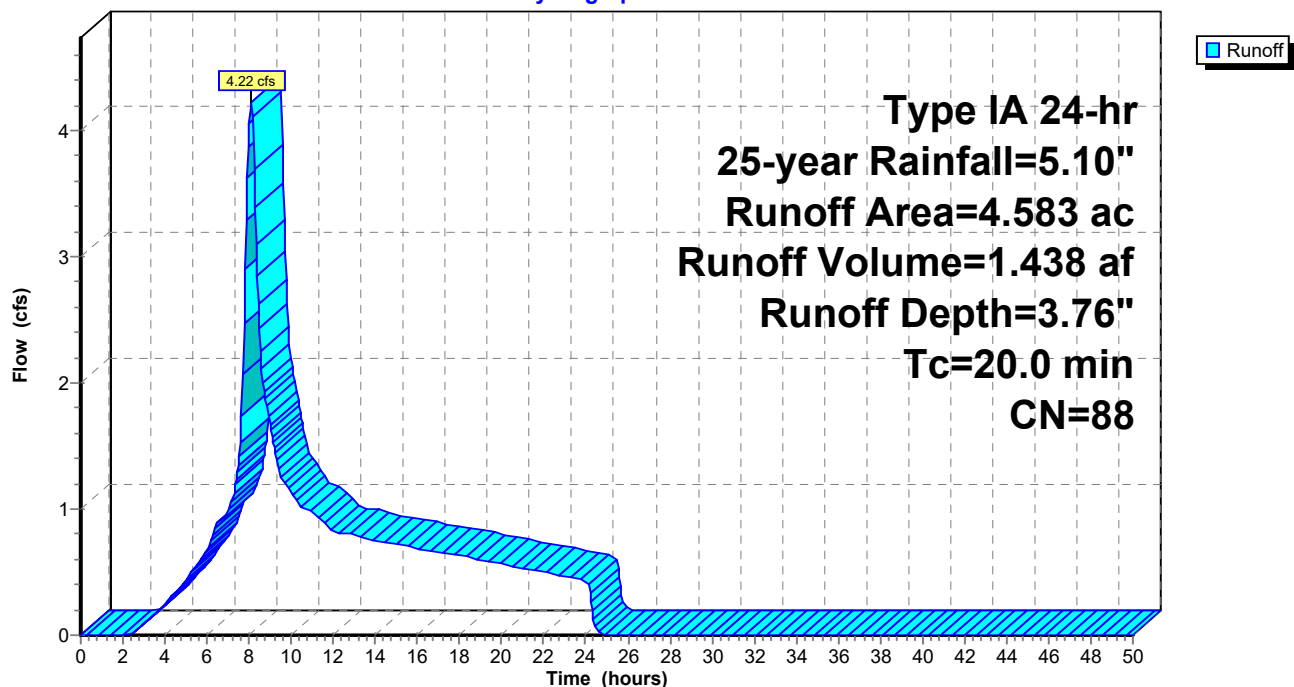
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
* 1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
3.373	98	Roofs, HSG A
4.583	88	Weighted Average
1.210		26.40% Pervious Area
3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 3S: Node A - C/F Non-PGIS

Hydrograph



Summary for Subcatchment 6S: Node B - Public PGIS

Runoff = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af, Depth= 4.86"
 Routed to Pond 10P : Bioretention

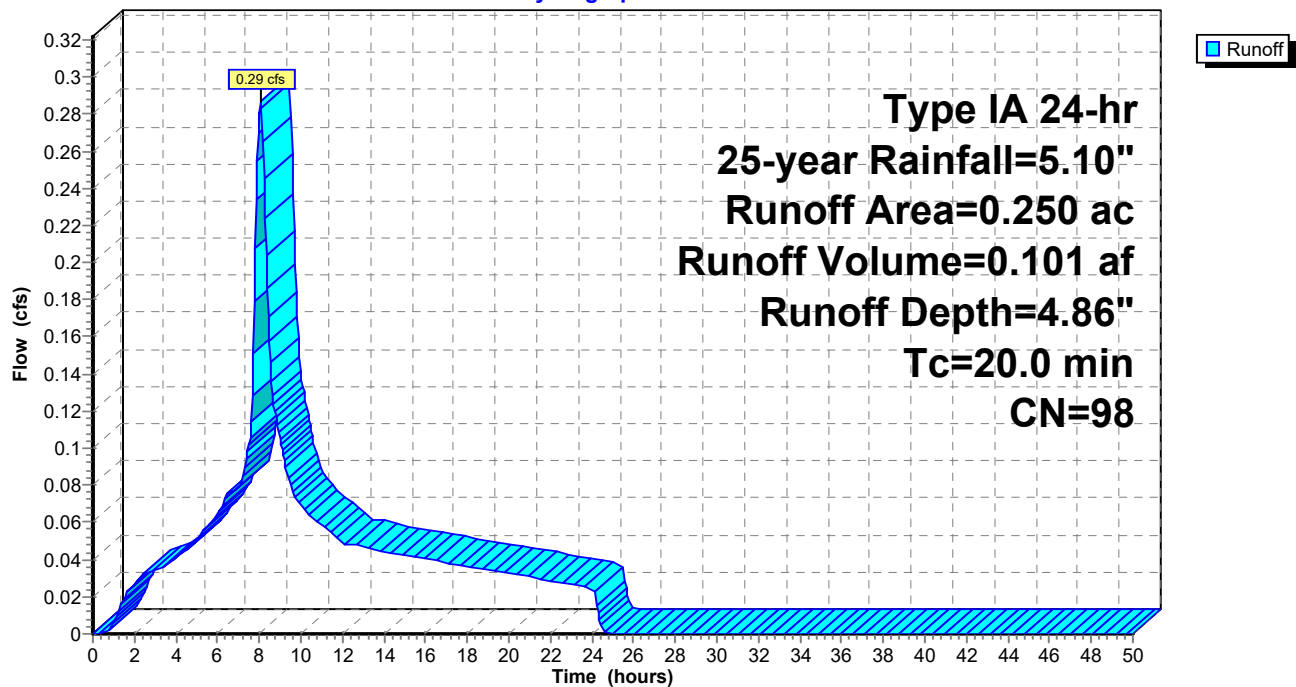
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 6S: Node B - Public PGIS

Hydrograph



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

Runoff = 5.62 cfs @ 8.10 hrs, Volume= 1.945 af, Depth= 3.46"
 Routed to Pond 7P : Node B

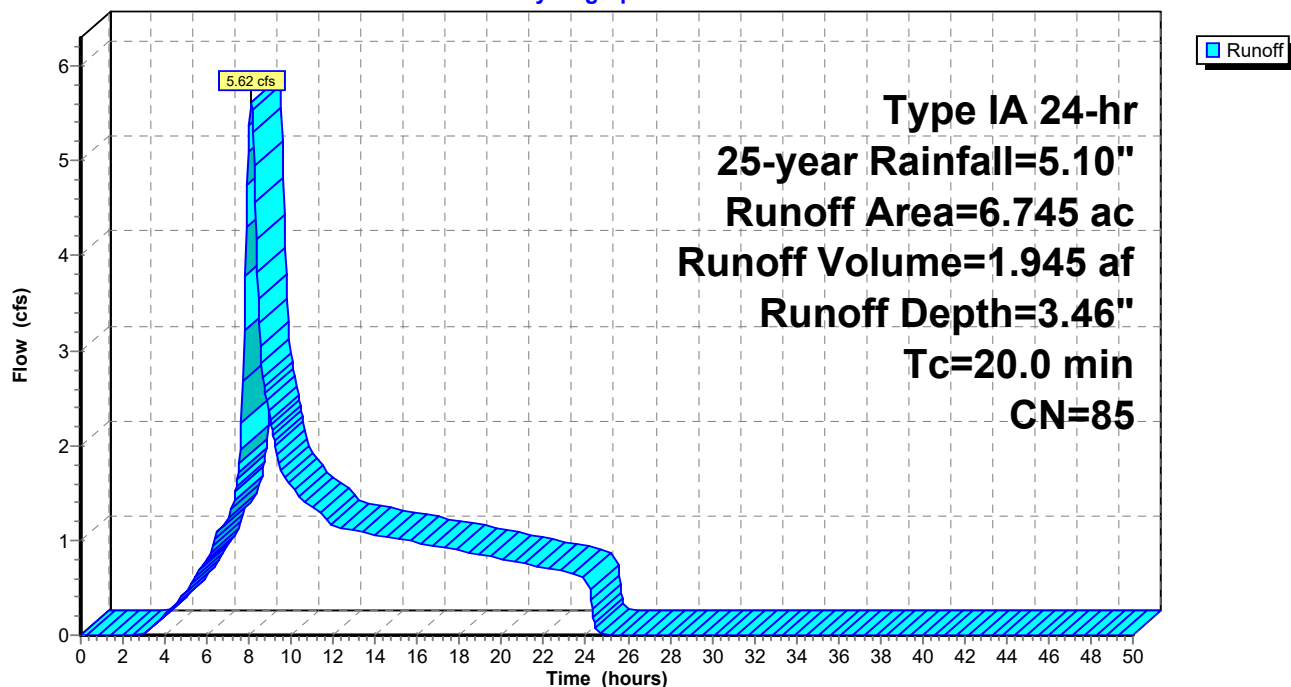
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 7S: Node B - Subdivision Non-PGIS

Hydrograph



Summary for Subcatchment 8S: Node B - Public Non-PGIS

Runoff = 0.06 cfs @ 8.11 hrs, Volume= 0.022 af, Depth= 2.89"
 Routed to Pond 7P : Node B

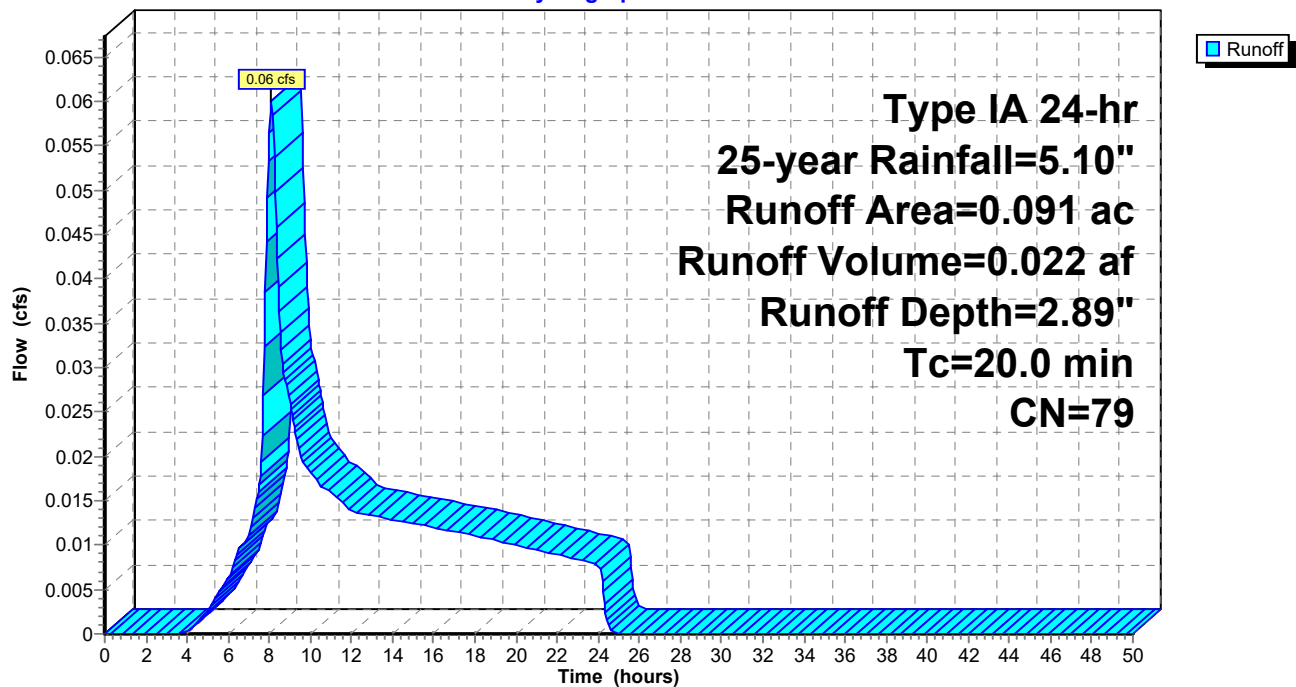
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 8S: Node B - Public Non-PGIS

Hydrograph



Summary for Subcatchment 9S: Node B - Subdivision PGIS

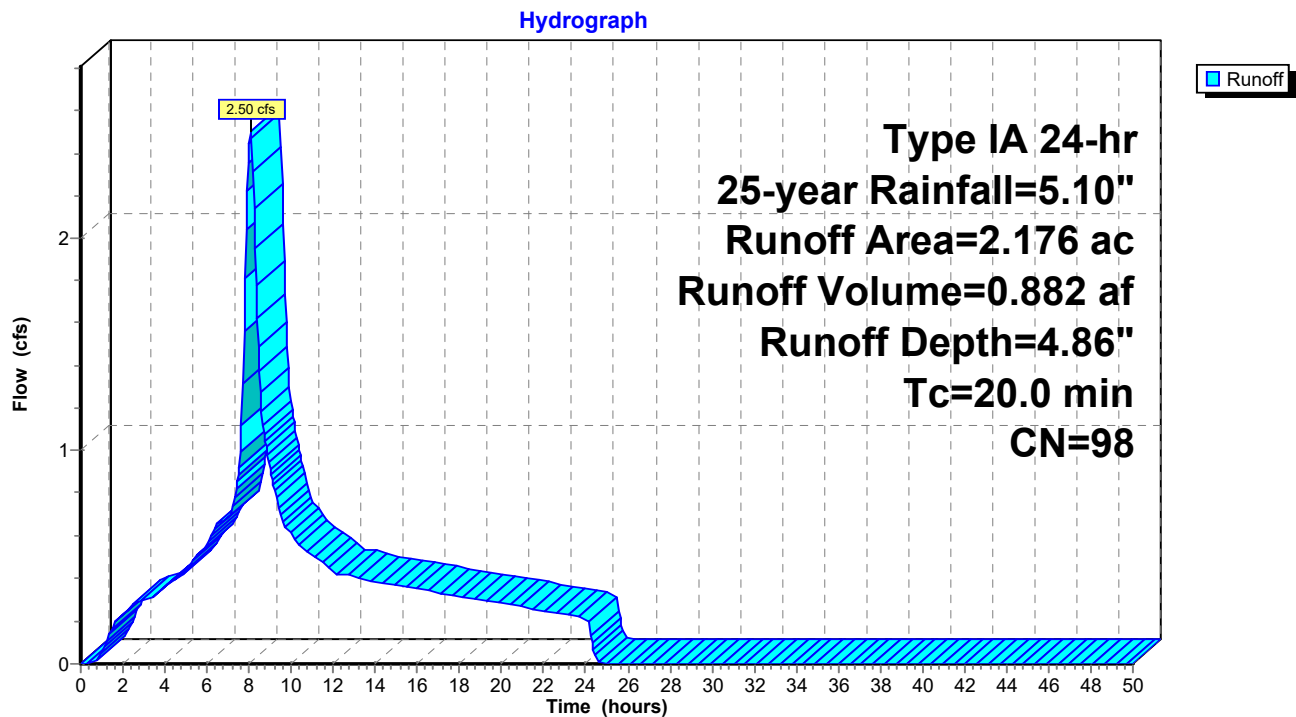
Runoff = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af, Depth= 4.86"
 Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

Runoff = 0.82 cfs @ 8.08 hrs, Volume= 0.288 af, Depth= 4.86"
 Routed to Pond N2 : Node C

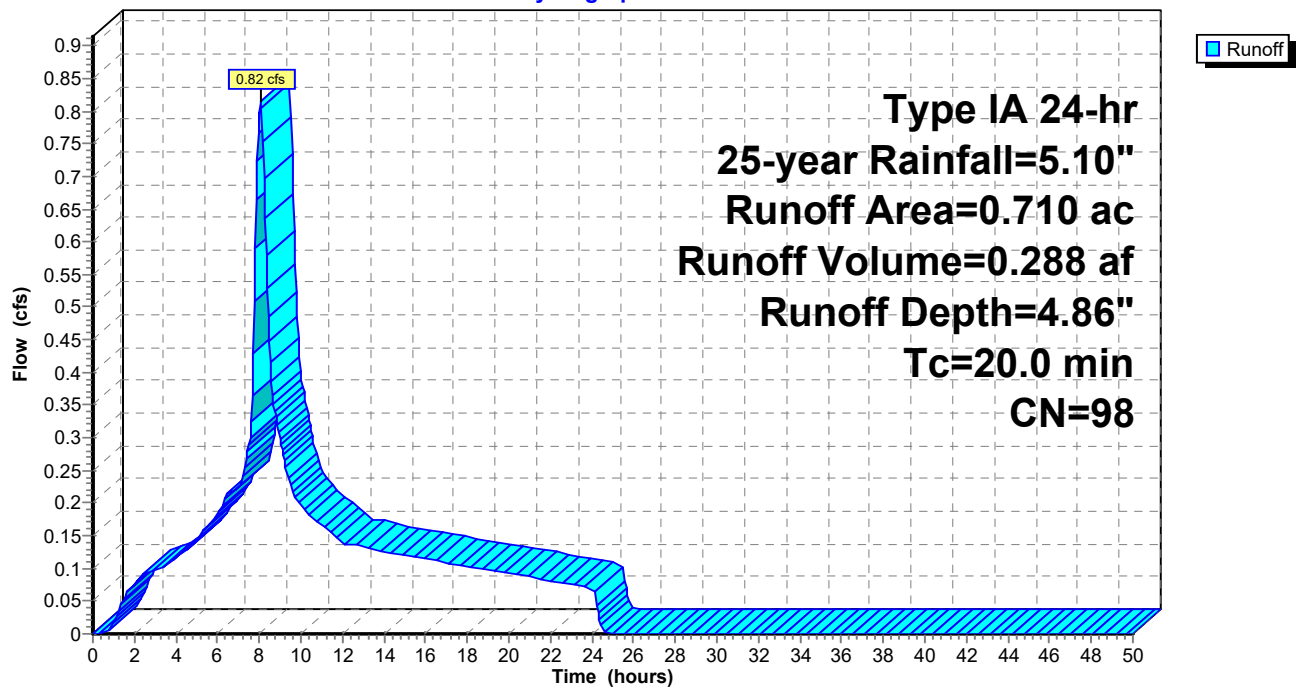
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 12S: Node C Public PGIS

Hydrograph



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

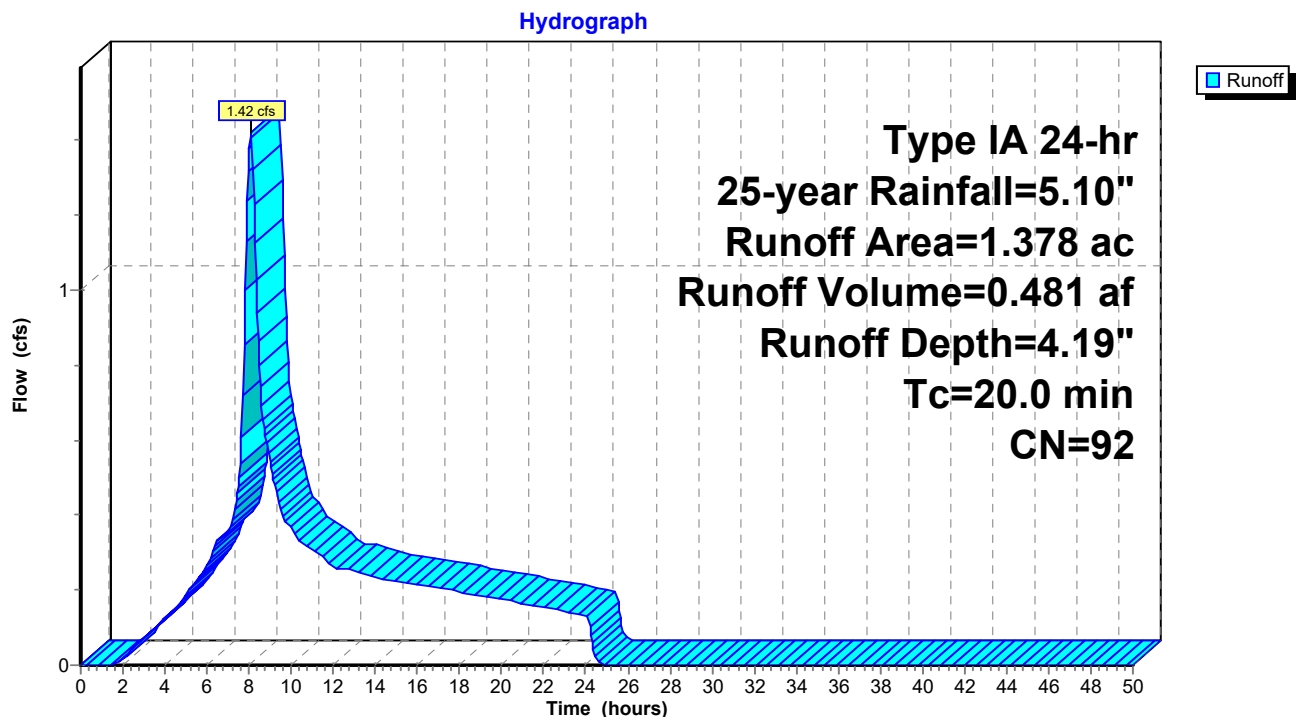
Runoff = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af, Depth= 4.19"
 Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.683 af, Depth= 4.86"
 Routed to Pond N2 : Node C

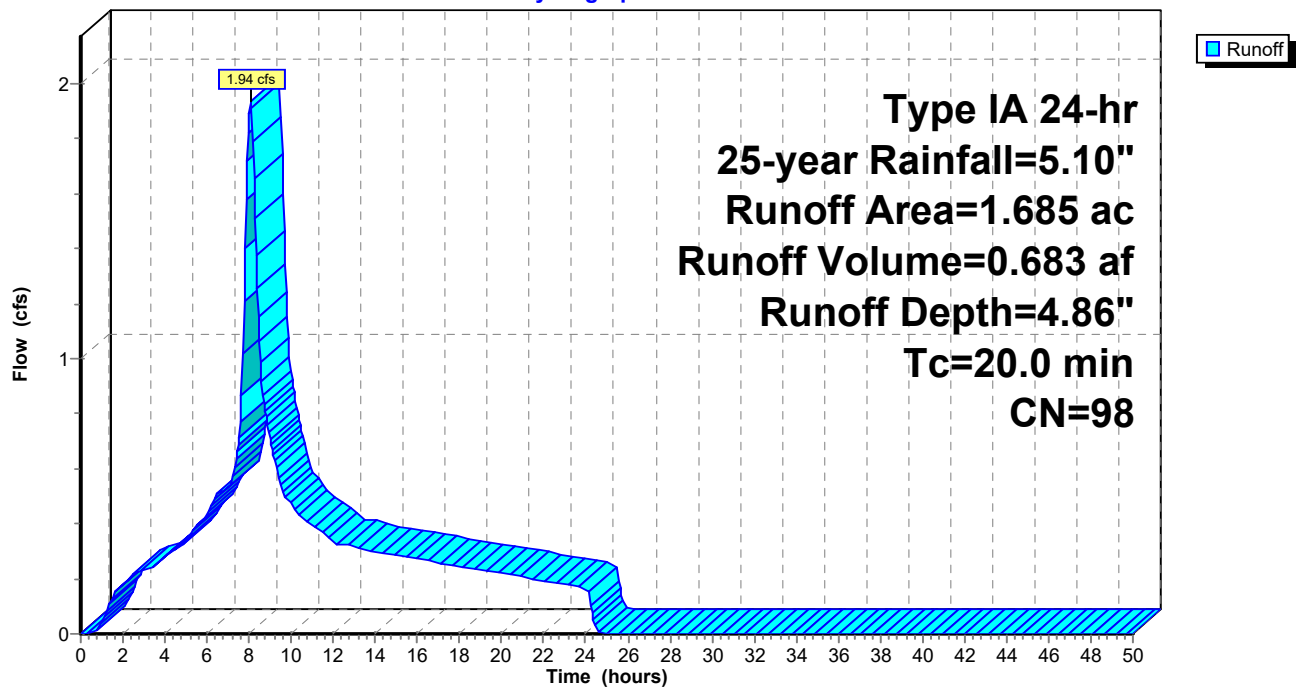
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 14S: Node C - Flex PGIS

Hydrograph



Summary for Subcatchment 17S: Node D - PGIS

Runoff = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af, Depth= 4.86"
 Routed to Pond 3P : Bioretention

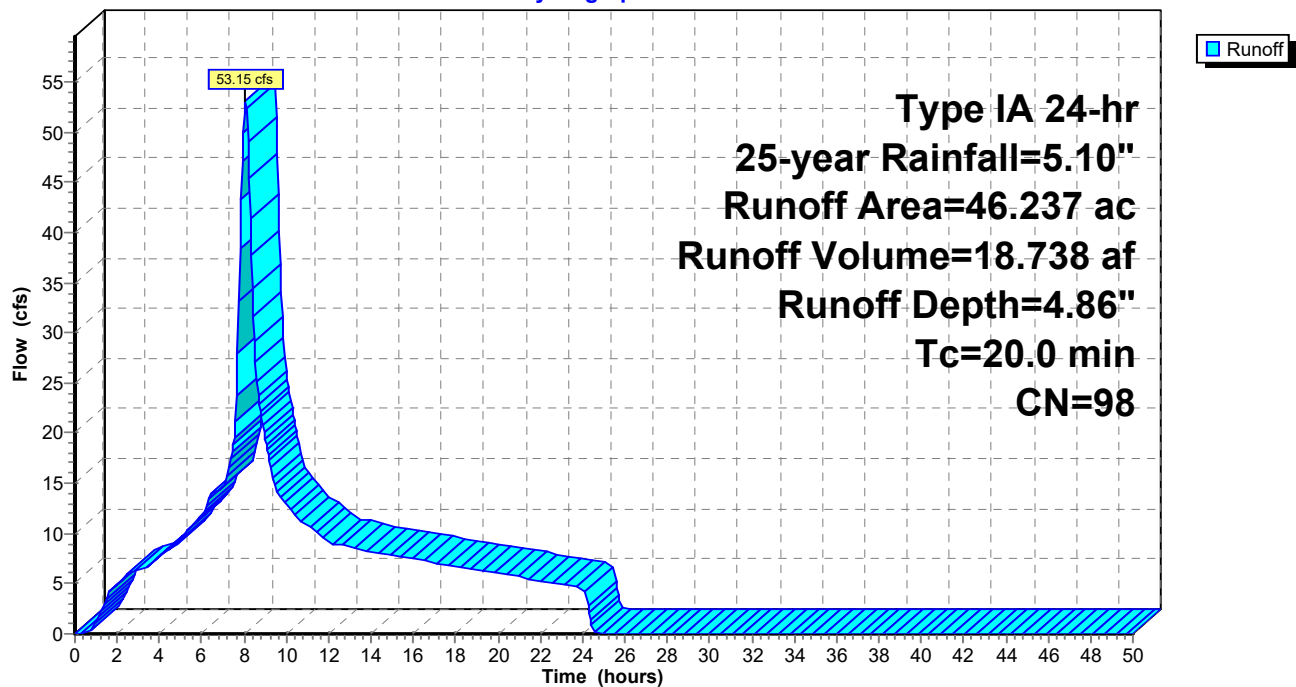
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 17S: Node D - PGIS

Hydrograph



Summary for Subcatchment D2R: Node C - Public Non-PGIS

Runoff = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af, Depth= 1.95"
 Routed to Pond 15P : Bioretention

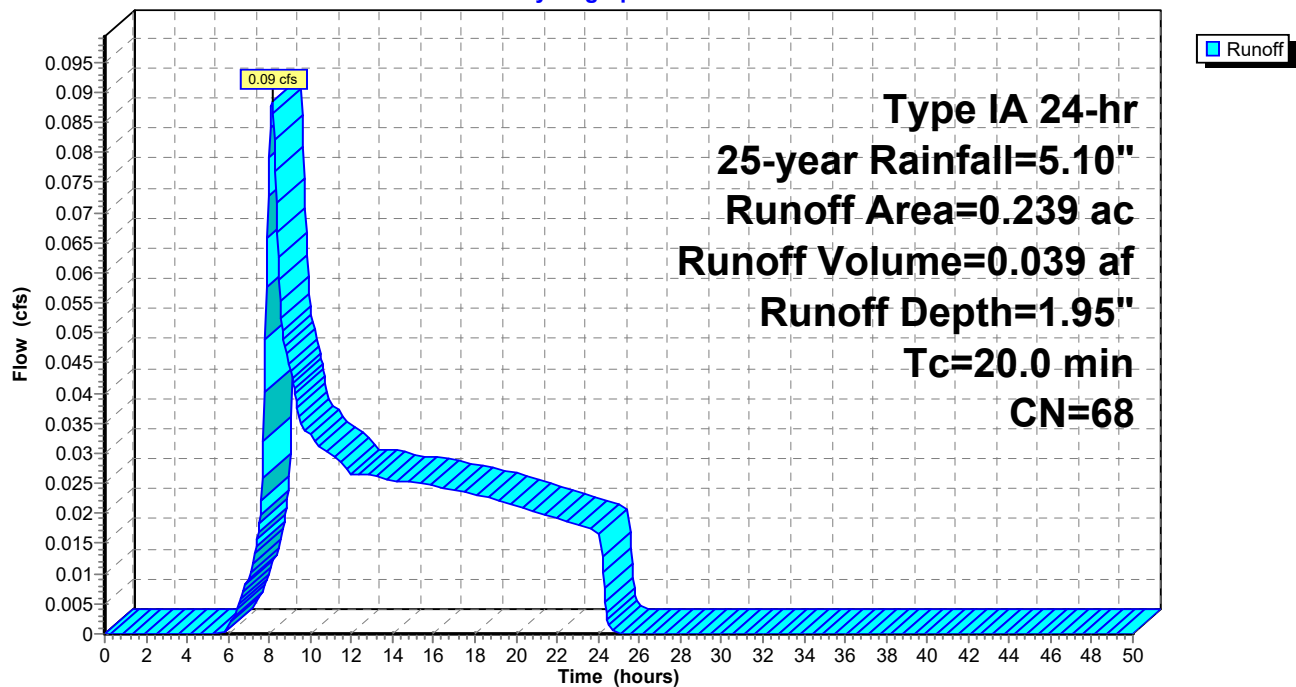
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D2R: Node C - Public Non-PGIS

Hydrograph



Summary for Subcatchment D3R: Node A - Public PGIS

Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af, Depth= 4.86"
 Routed to Pond 4P : Bioretention+Infiltration

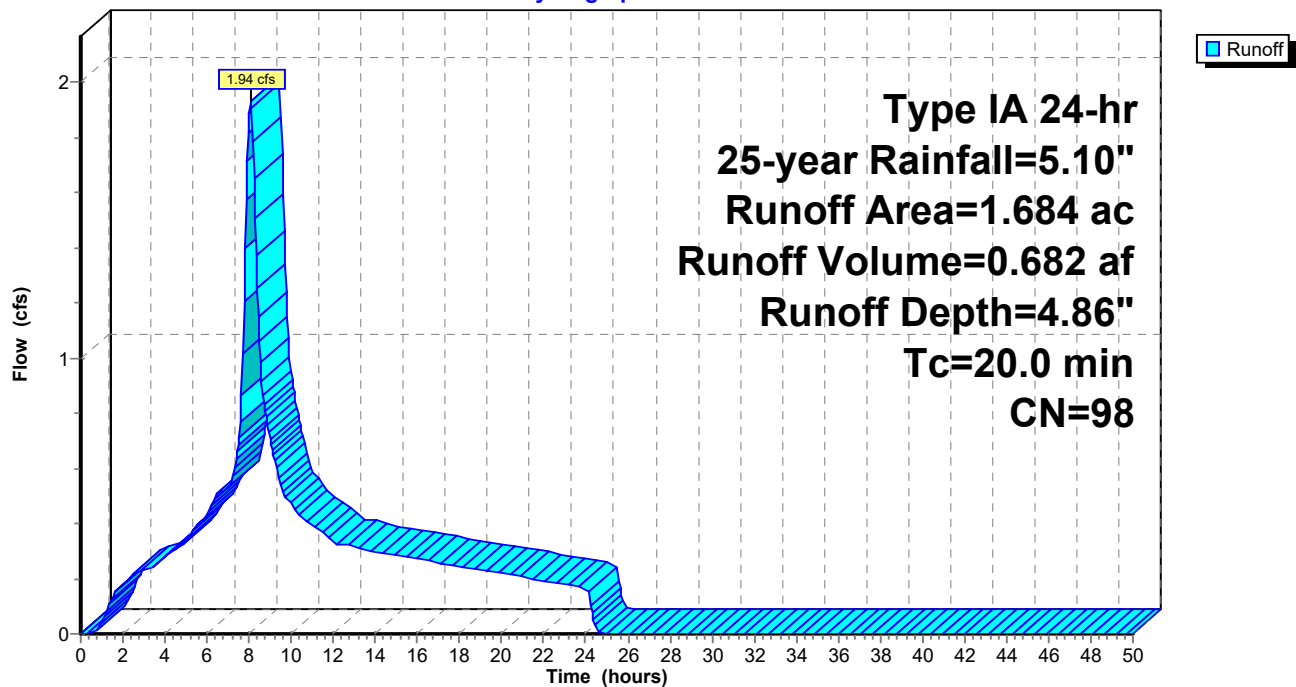
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D3R: Node A - Public PGIS

Hydrograph



Summary for Subcatchment D5P: Node D - Non-PGIS

Runoff = 22.11 cfs @ 8.11 hrs, Volume= 7.822 af, Depth= 3.17"
 Routed to Pond N1 : Node D

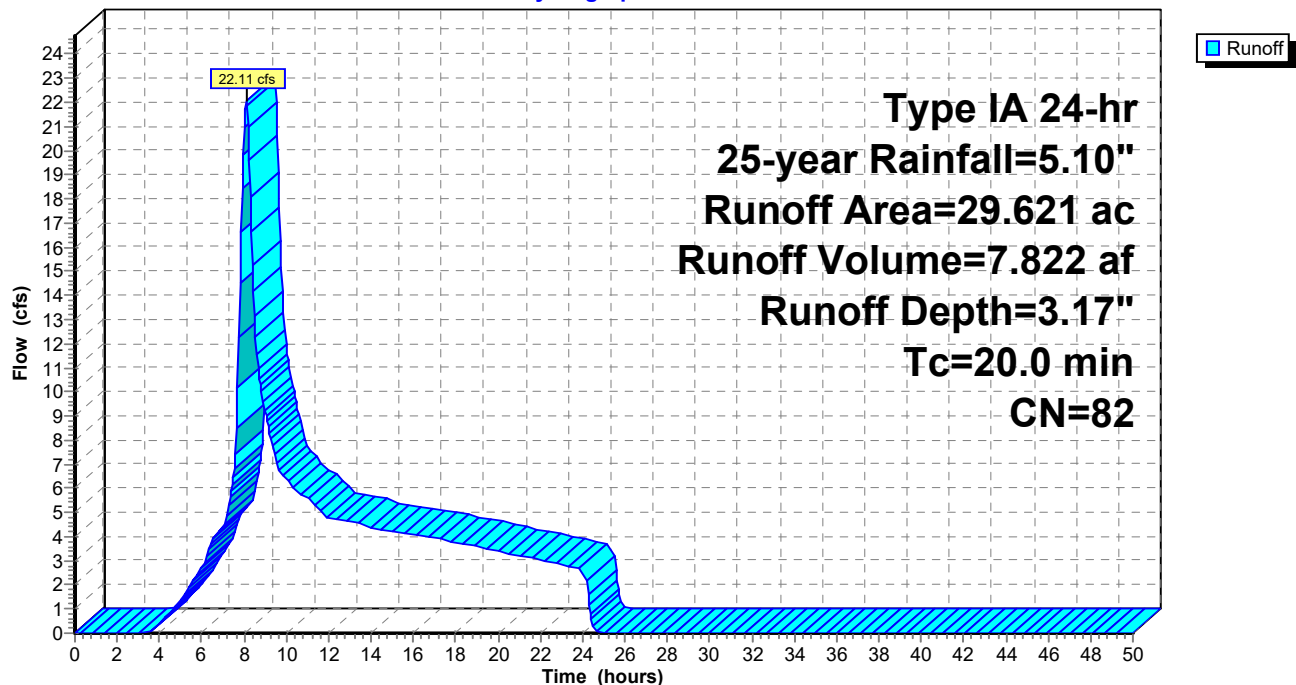
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D5P: Node D - Non-PGIS

Hydrograph



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af
 Outflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af, Atten= 46%, Lag= 25.9 min
 Primary = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
 Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 54.62' @ 8.51 hrs Surf.Area= 1.674 ac Storage= 2.845 af

Plug-Flow detention time= 90.8 min calculated for 18.424 af (98% of inflow)
 Center-of-Mass det. time= 77.7 min (745.3 - 667.6)

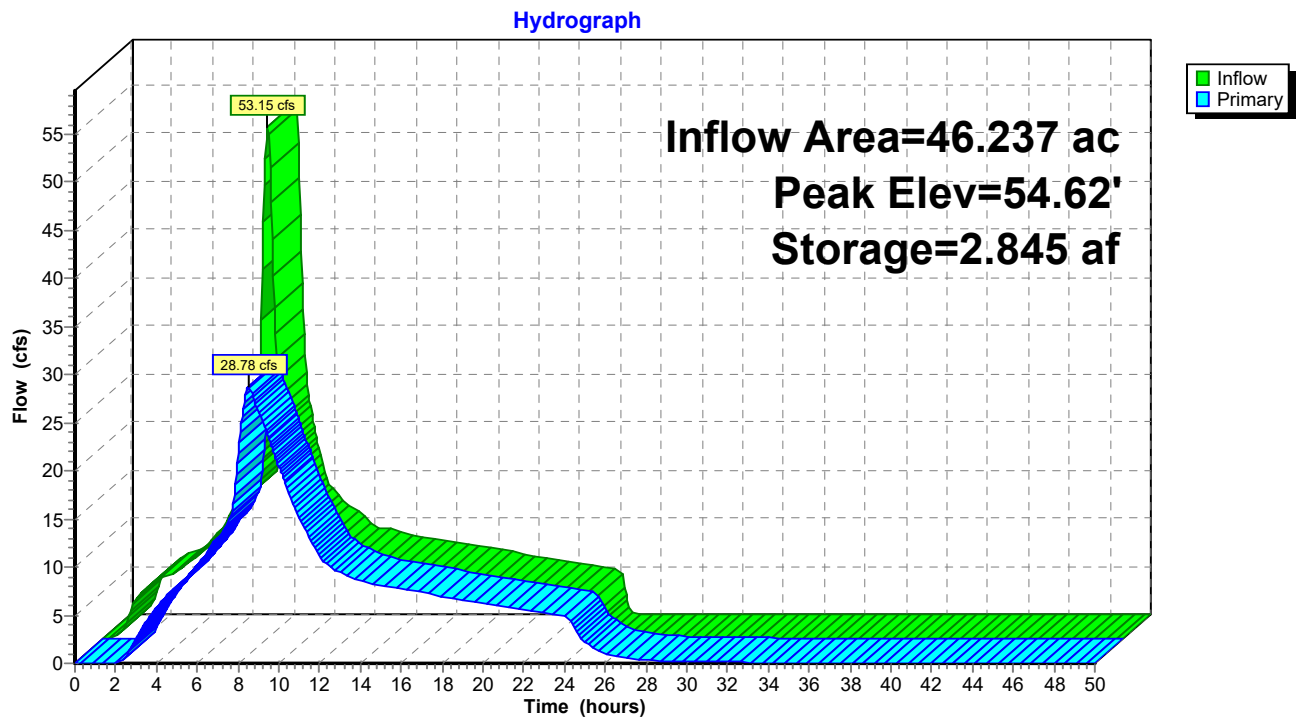
Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	270.00'W x 270.00'L x 6.50'H Prismatic 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	270.00'W x 270.00'L x 2.00'H Prismatic Inside #1
#3	50.50'	0.019 af	24.0" Round Pipe Storage Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	60.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	24.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=28.76 cfs @ 8.51 hrs HW=54.62' (Free Discharge)

↑ **1=Orifice/Grate** (Weir Controls 2.05 cfs @ 1.12 fps)
 — **2=Orifice/Grate** (Orifice Controls 26.71 cfs @ 8.50 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af
 Outflow = 1.93 cfs @ 8.11 hrs, Volume= 0.682 af, Atten= 0%, Lag= 1.7 min
 Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.277 af
 Secondary = 1.78 cfs @ 8.11 hrs, Volume= 0.406 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.73' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.037 af

Plug-Flow detention time= 65.8 min calculated for 0.682 af (100% of inflow)
 Center-of-Mass det. time= 65.7 min (733.3 - 667.6)

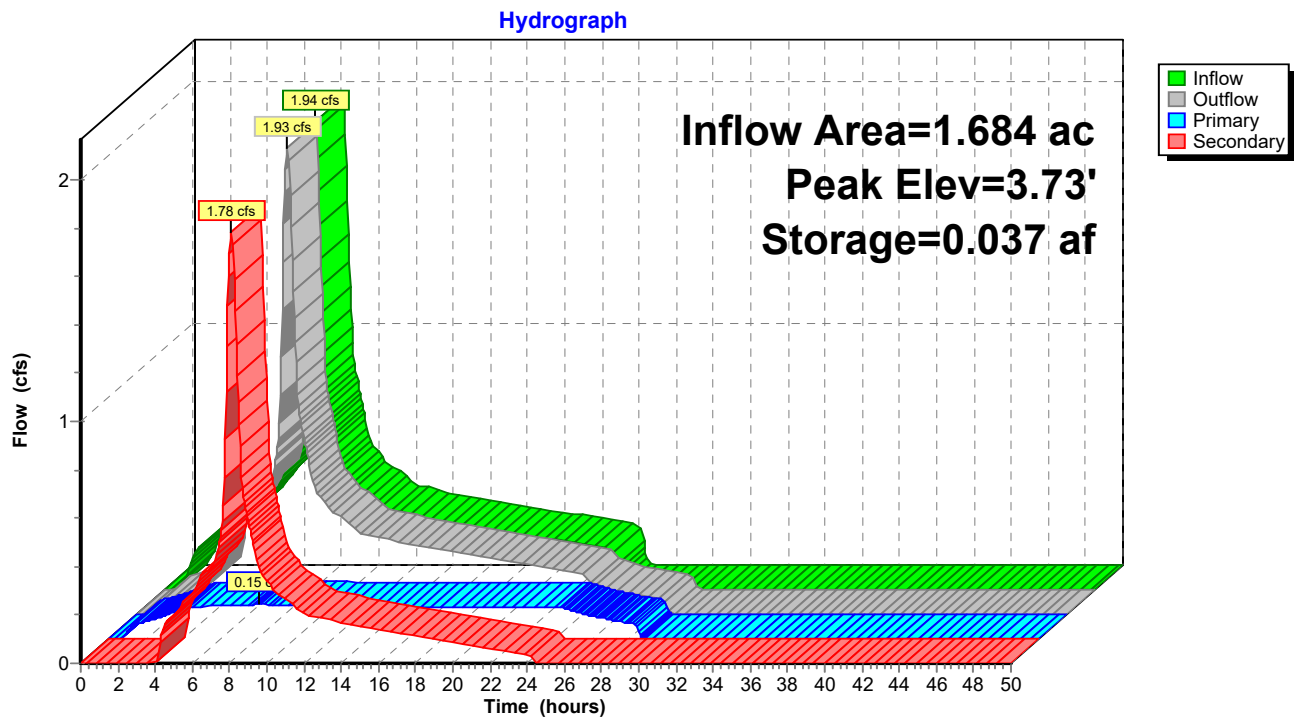
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	5.00'W x 250.00'L x 5.00'H Bioretention 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=1.78 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
 ↳ **2=Orifice/Grate** (Orifice Controls 1.78 cfs @ 2.90 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

Inflow Area = 7.516 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af
 Outflow = 8.62 cfs @ 8.10 hrs, Volume= 3.046 af, Atten= 0%, Lag= 1.2 min
 Primary = 0.36 cfs @ 8.10 hrs, Volume= 0.882 af
 Secondary = 8.26 cfs @ 8.10 hrs, Volume= 2.164 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.97' @ 8.10 hrs Surf.Area= 0.138 ac Storage= 0.240 af

Plug-Flow detention time= 109.9 min calculated for 3.046 af (100% of inflow)
 Center-of-Mass det. time= 109.8 min (777.4 - 667.6)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	50.00'W x 120.00'L x 5.00'H Infiltration Trench 0.689 af Overall x 35.0% Voids

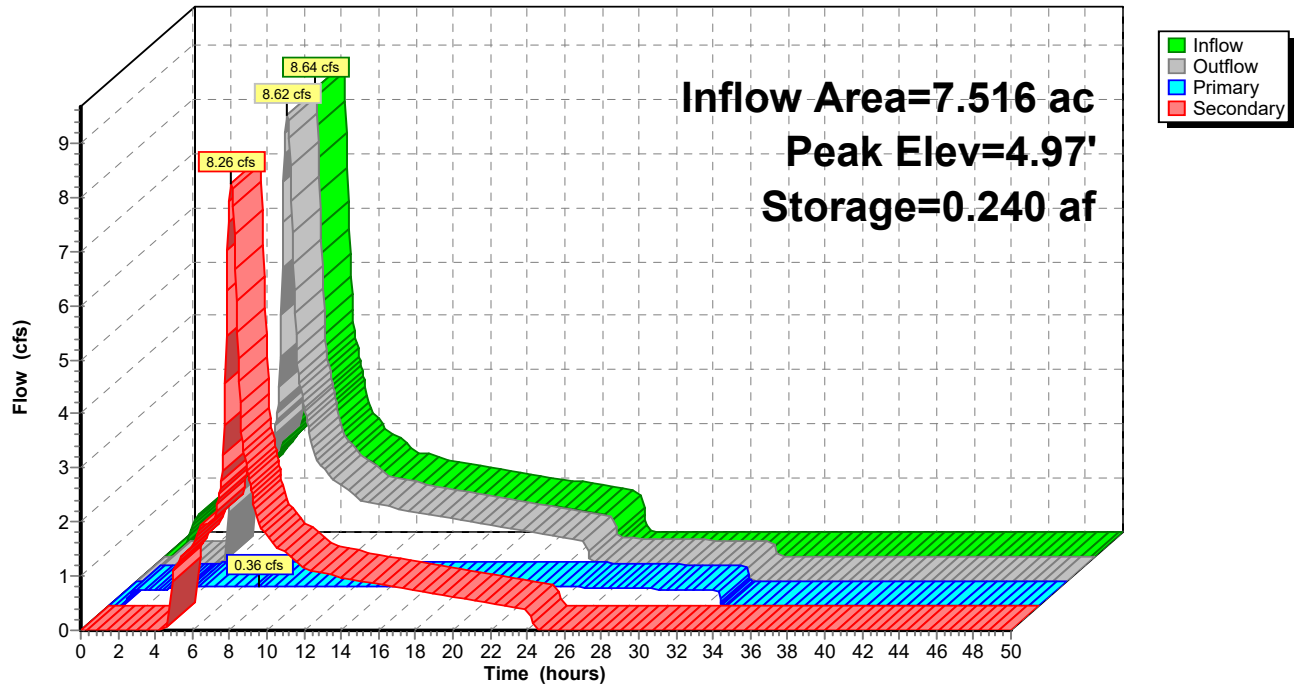
Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.50'	30.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=8.25 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 8.25 cfs @ 2.24 fps)

Pond 5P: Bioretention+Infiltration

Hydrograph



Summary for Pond 7P: Node B

[57] Hint: Peaked at 48.77' (Flood elevation advised)
 [81] Warning: Exceeded Pond 10P by 45.52' @ 8.10 hrs
 [81] Warning: Exceeded Pond 11P by 44.53' @ 33.00 hrs
 [79] Warning: Submerged Pond N3 Primary device # 1 INLET by 7.33'

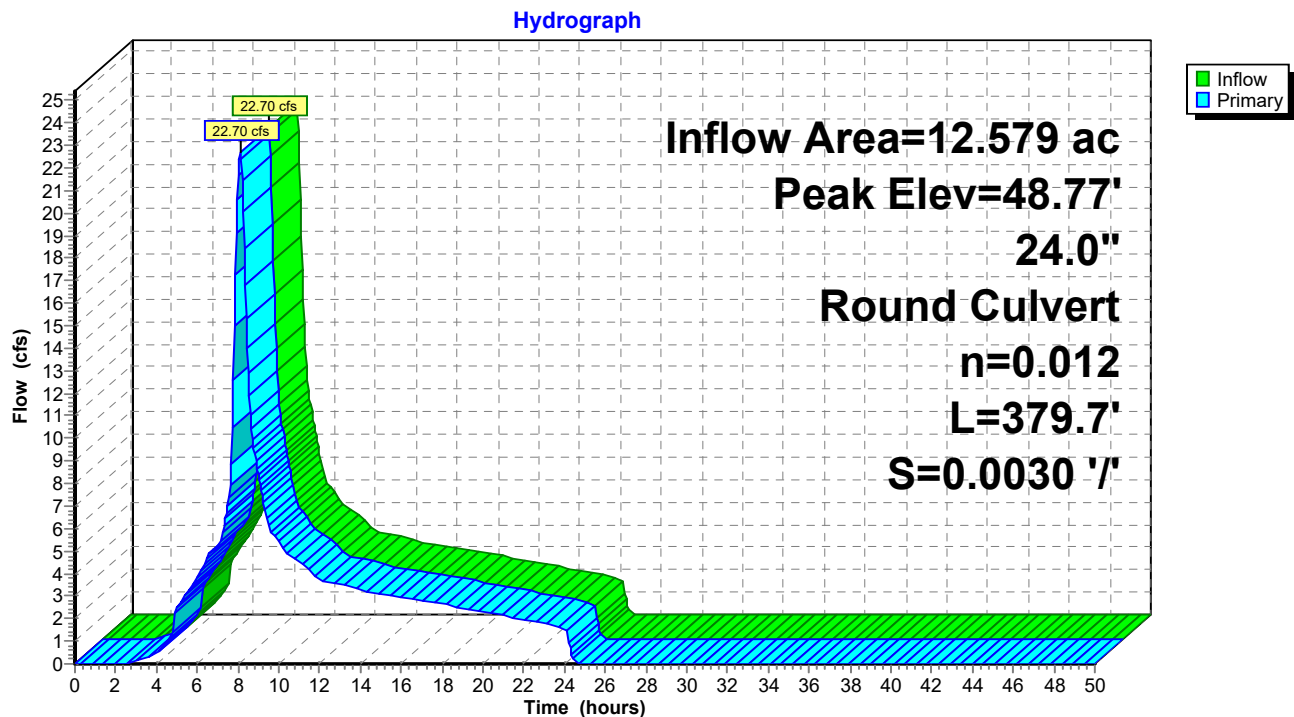
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 6.37" for 25-year event
 Inflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
 Outflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af, Atten= 0%, Lag= 0.0 min
 Primary = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 48.77' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	24.0" Round Culvert L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/ Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=22.70 cfs @ 8.10 hrs HW=48.77' TW=44.53' (Fixed TW Elev= 44.53')
 1=Culvert (Outlet Controls 22.70 cfs @ 7.22 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af
 Outflow = 0.29 cfs @ 8.09 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.045 af
 Secondary = 0.26 cfs @ 8.09 hrs, Volume= 0.056 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.25' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 67.0 min calculated for 0.101 af (100% of inflow)
 Center-of-Mass det. time= 67.1 min (734.7 - 667.6)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	5.00'W x 40.00'L x 5.00'H Bioretention 0.023 af Overall x 35.0% Voids

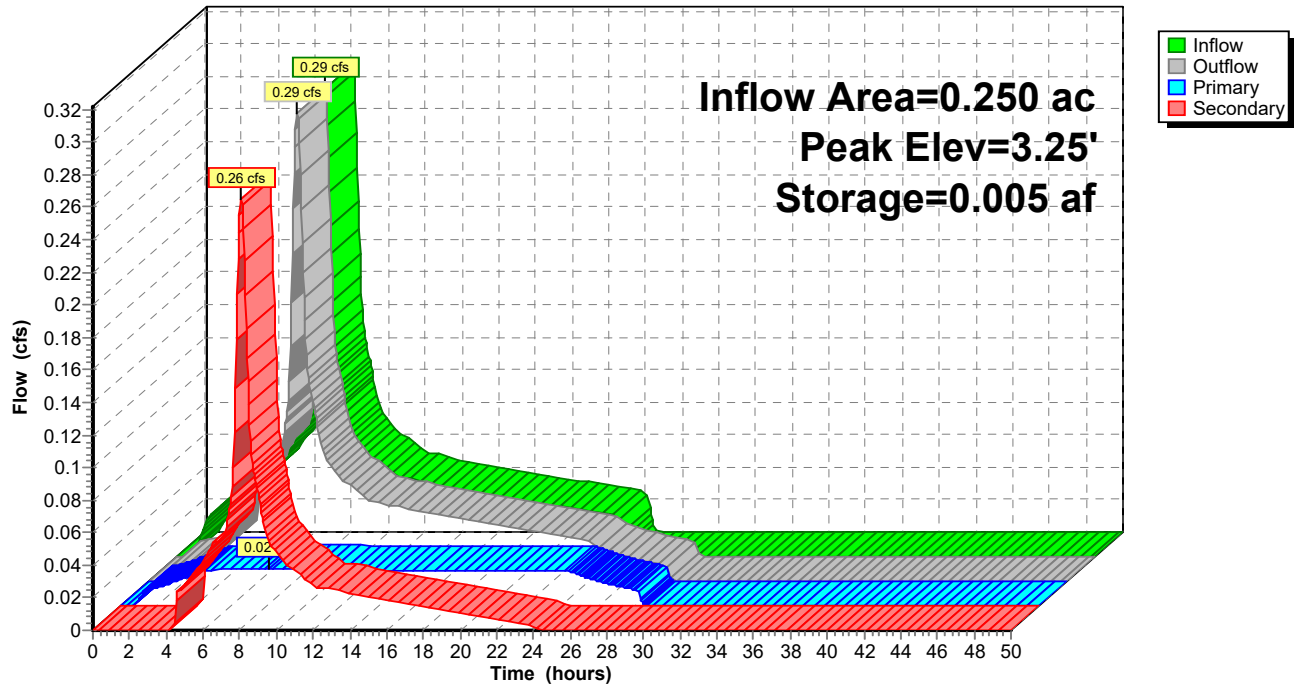
Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.26 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 0.26 cfs @ 1.71 fps)

Pond 10P: Bioretention

Hydrograph



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af
 Outflow = 2.48 cfs @ 8.11 hrs, Volume= 0.882 af, Atten= 1%, Lag= 2.0 min
 Primary = 0.19 cfs @ 8.11 hrs, Volume= 0.356 af
 Secondary = 2.30 cfs @ 8.11 hrs, Volume= 0.526 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.87' @ 8.11 hrs Surf.Area= 0.031 ac Storage= 0.053 af

Plug-Flow detention time= 73.2 min calculated for 0.881 af (100% of inflow)
 Center-of-Mass det. time= 73.4 min (741.0 - 667.6)

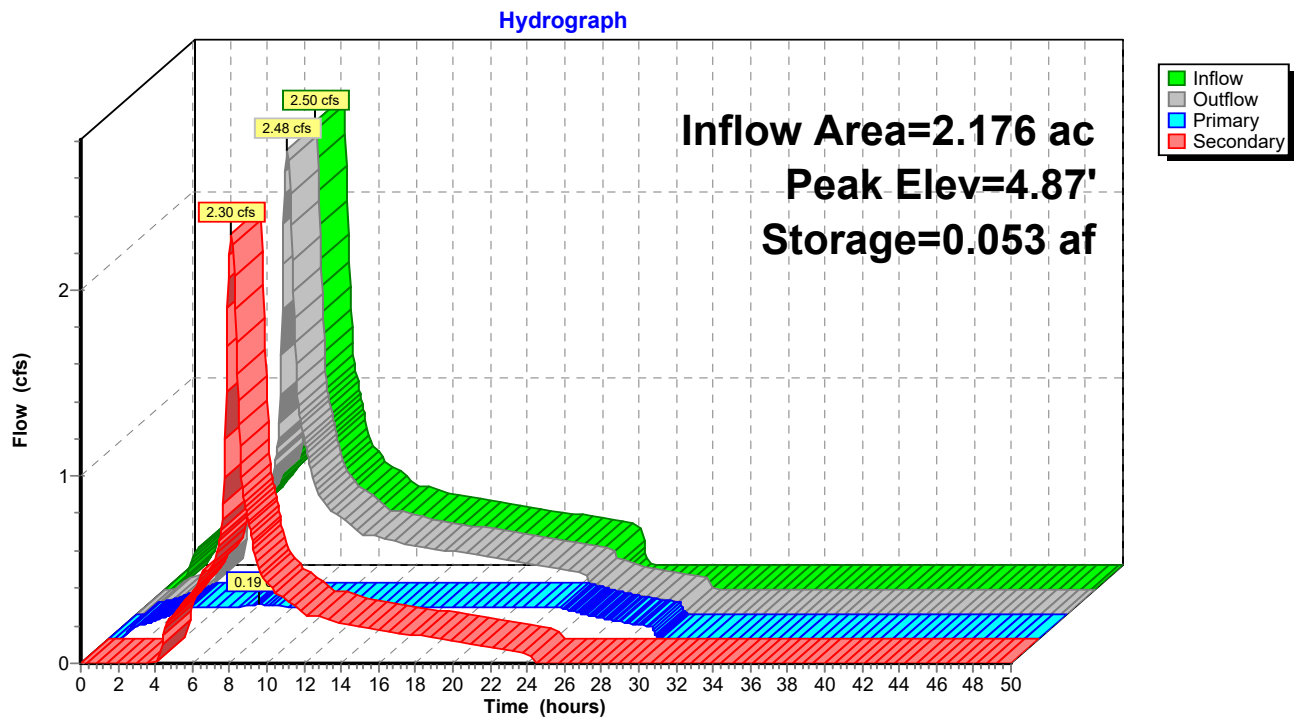
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	5.00'W x 270.00'L x 6.00'H Bioretention 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.30 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
 ↳ **2=Orifice/Grate** (Orifice Controls 2.30 cfs @ 3.17 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 1.95" for 25-year event
 Inflow = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af
 Outflow = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af, Atten= 59%, Lag= 79.6 min
 Primary = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 0.73' @ 9.47 hrs Surf.Area= 0.014 ac Storage= 0.004 af

Plug-Flow detention time= 31.1 min calculated for 0.039 af (100% of inflow)
 Center-of-Mass det. time= 31.1 min (884.7 - 853.6)

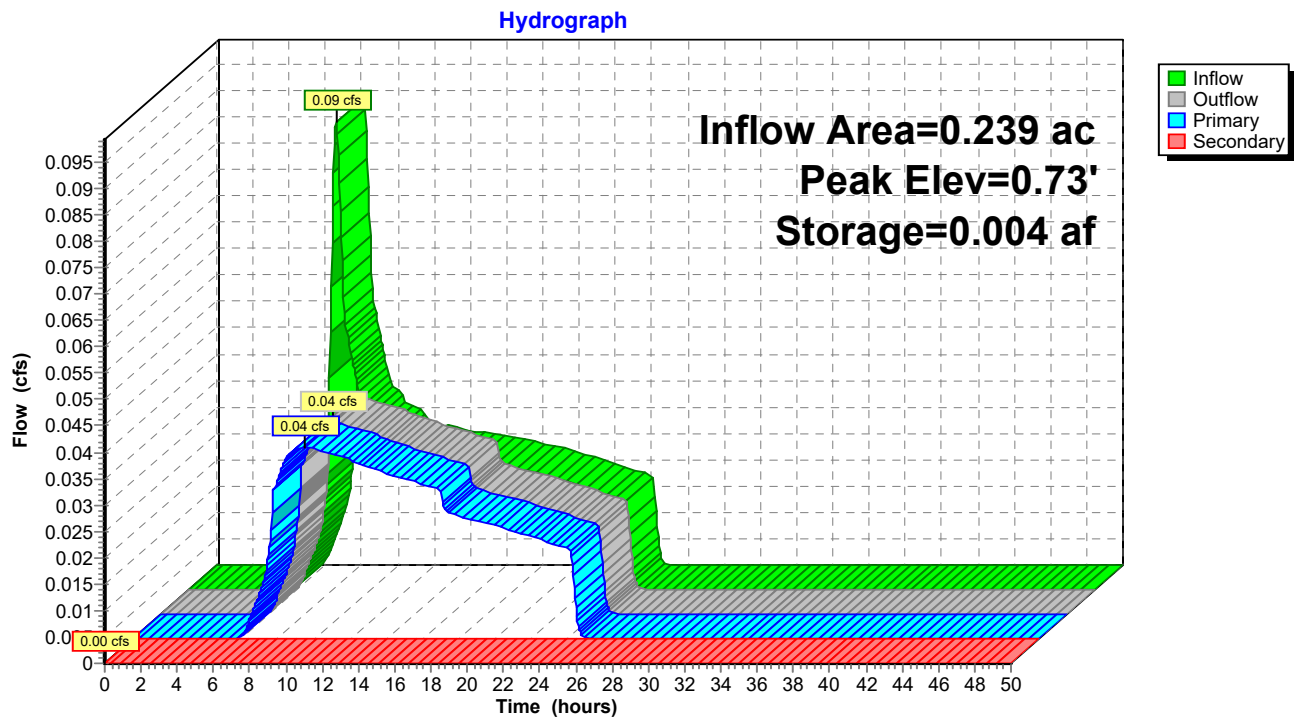
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	5.00'W x 120.00'L x 5.00'H Bioretention 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 9.47 hrs HW=0.73' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
 ↑**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 4.19" for 25-year event
 Inflow = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af
 Outflow = 1.41 cfs @ 8.12 hrs, Volume= 0.481 af, Atten= 1%, Lag= 1.8 min
 Primary = 0.09 cfs @ 8.12 hrs, Volume= 0.189 af
 Secondary = 1.32 cfs @ 8.12 hrs, Volume= 0.292 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.61' @ 8.12 hrs Surf.Area= 0.028 ac Storage= 0.044 af

Plug-Flow detention time= 110.7 min calculated for 0.480 af (100% of inflow)
 Center-of-Mass det. time= 111.0 min (827.2 - 716.3)

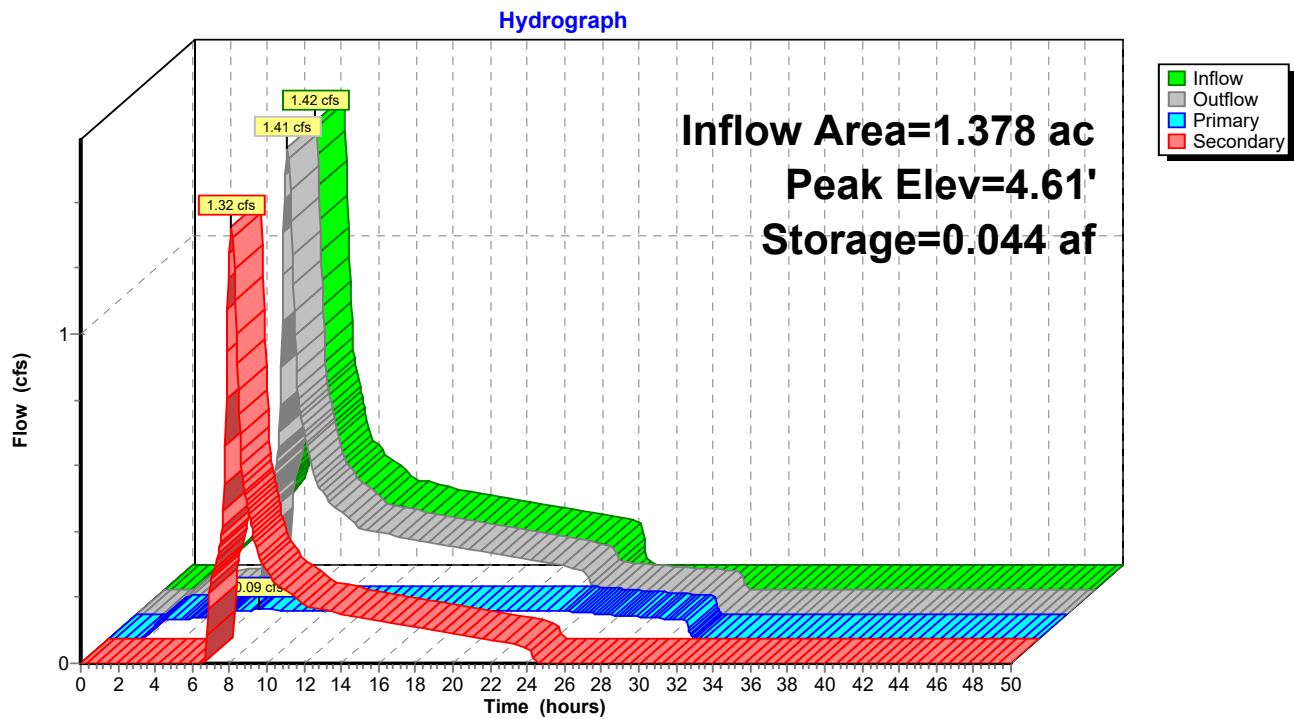
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	20.00'W x 60.00'L x 6.00'H Infiltration Trench 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.32 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 1.32 cfs @ 2.65 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth > 4.78" for 25-year event
 Inflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
 Outflow = 27.97 cfs @ 8.70 hrs, Volume= 18.424 af, Atten= 3%, Lag= 11.7 min
 Primary = 3.57 cfs @ 8.70 hrs, Volume= 8.564 af
 Secondary = 24.41 cfs @ 8.70 hrs, Volume= 9.860 af
 Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.86' @ 8.70 hrs Surf.Area= 1.674 ac Storage= 2.259 af

Plug-Flow detention time= 143.4 min calculated for 18.424 af (100% of inflow)
 Center-of-Mass det. time= 143.3 min (888.6 - 745.3)

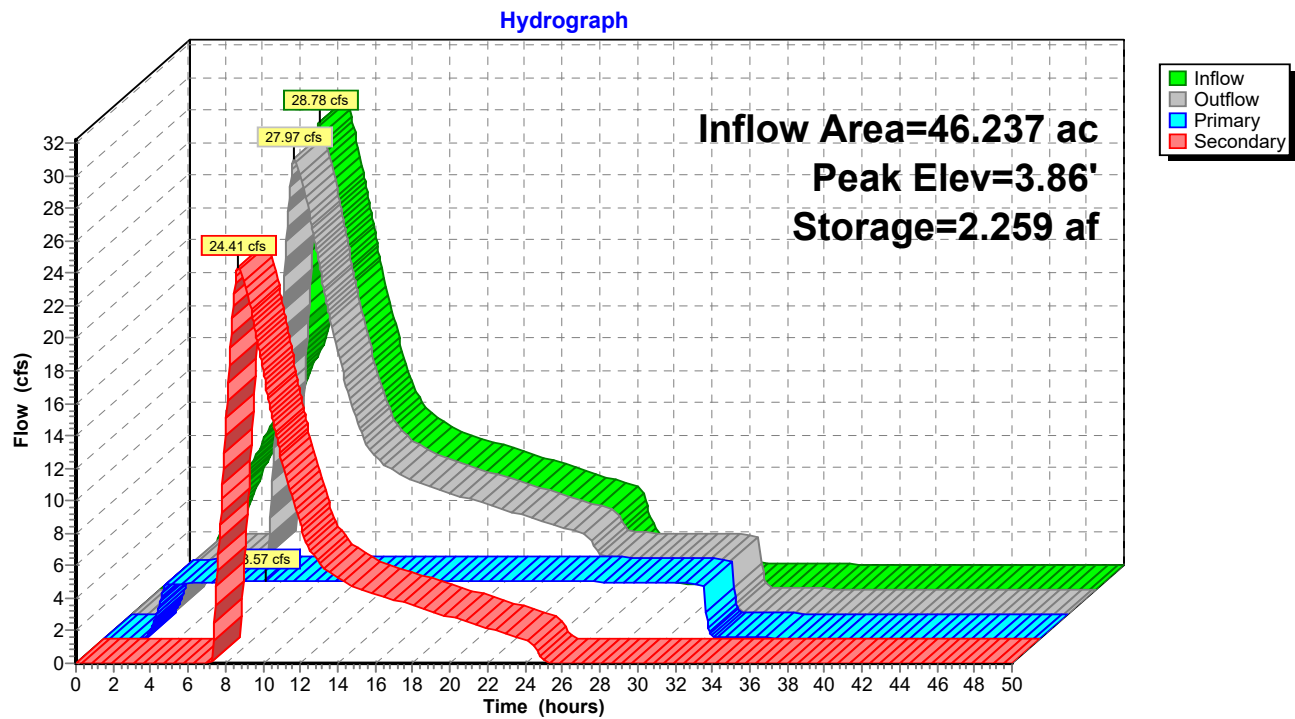
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	270.00'W x 270.00'L x 5.00'H Infiltration Trench 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	36.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.57 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 3.57 cfs)

Secondary OutFlow Max=24.40 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
 ↳ **2=Orifice/Grate** (Weir Controls 24.40 cfs @ 3.03 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=58)

[81] Warning: Exceeded Pond 19P by 41.00' @ 2.00 hrs

[79] Warning: Submerged Pond N2 Primary device # 1 INLET by 3.29'

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 6.90" for 25-year event
 Inflow = 65.60 cfs @ 8.14 hrs, Volume= 25.625 af
 Outflow = 56.41 cfs @ 8.38 hrs, Volume= 25.621 af, Atten= 14%, Lag= 14.0 min
 Primary = 56.41 cfs @ 8.38 hrs, Volume= 25.621 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 42.48' @ 8.38 hrs Surf.Area= 36,800 sf Storage= 16,980 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 0.8 min (743.3 - 742.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

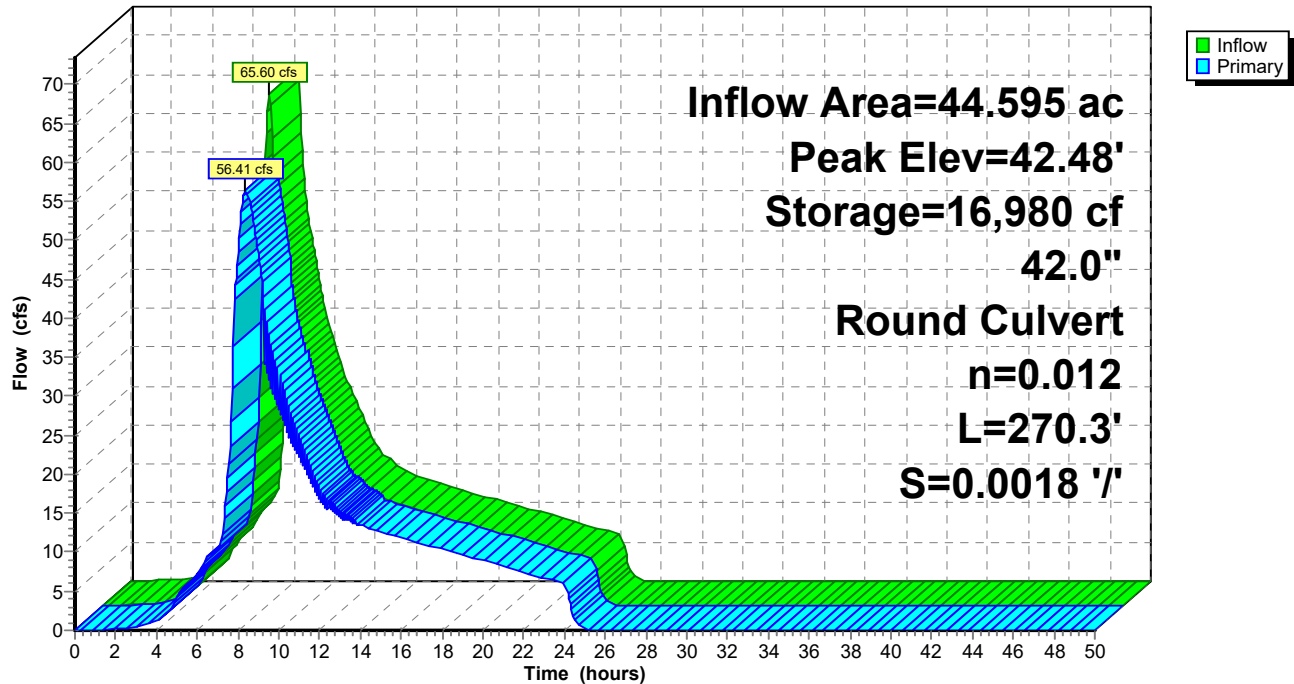
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	42.0" Round Culvert L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=56.39 cfs @ 8.38 hrs HW=42.48' TW=41.00' (Fixed TW Elev= 41.00')
 ↑ **1=Culvert** (Inlet Controls 56.39 cfs @ 5.86 fps)

Pond N1: Node D

Hydrograph



Summary for Pond N2: Node C

[57] Hint: Peaked at 44.53' (Flood elevation advised)
 [81] Warning: Exceeded Pond 7P by 2.15' @ 2.10 hrs
 [81] Warning: Exceeded Pond 15P by 44.25' @ 8.05 hrs
 [81] Warning: Exceeded Pond 16P by 42.48' @ 1.60 hrs

Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 6.37" for 25-year event
 Inflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
 Outflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af, Atten= 0%, Lag= 0.0 min
 Primary = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
 Routed to Pond N1 : Node D

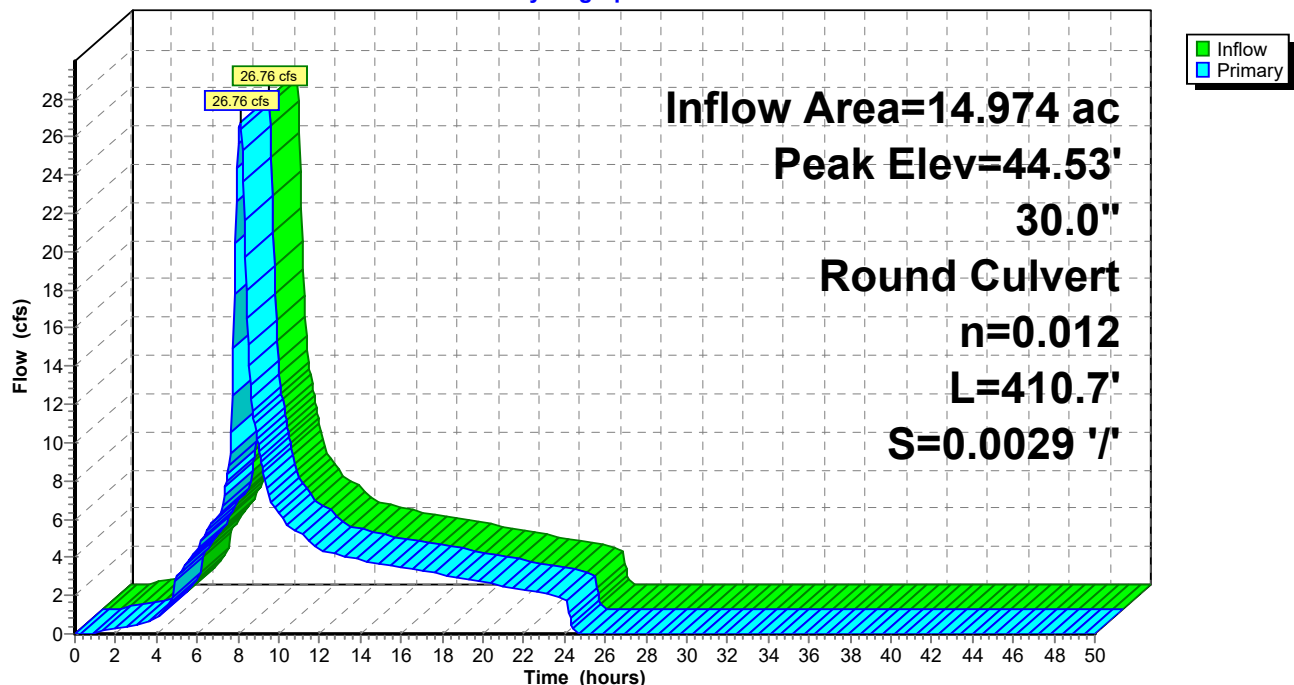
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 44.53' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	30.0" Round Culvert L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=26.76 cfs @ 8.10 hrs HW=44.53' TW=42.48' (Fixed TW Elev= 42.48')
 ↑1=Culvert (Outlet Controls 26.76 cfs @ 5.45 fps)

Pond N2: Node C

Hydrograph



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.45' (Flood elevation advised)
 [81] Warning: Exceeded Pond 4P by 48.70' @ 31.50 hrs
 [81] Warning: Exceeded Pond 5P by 48.70' @ 35.90 hrs

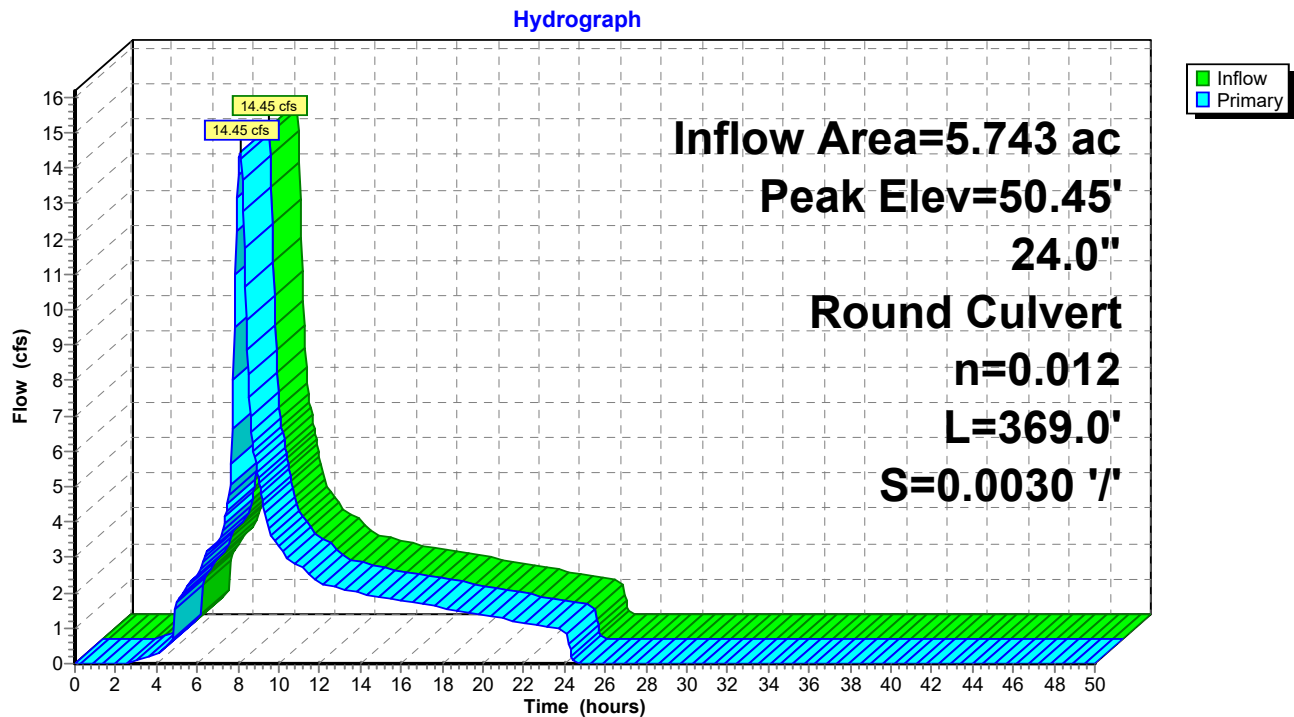
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 8.63" for 25-year event
 Inflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
 Outflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af, Atten= 0%, Lag= 0.0 min
 Primary = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
 Routed to Pond 7P : Node B

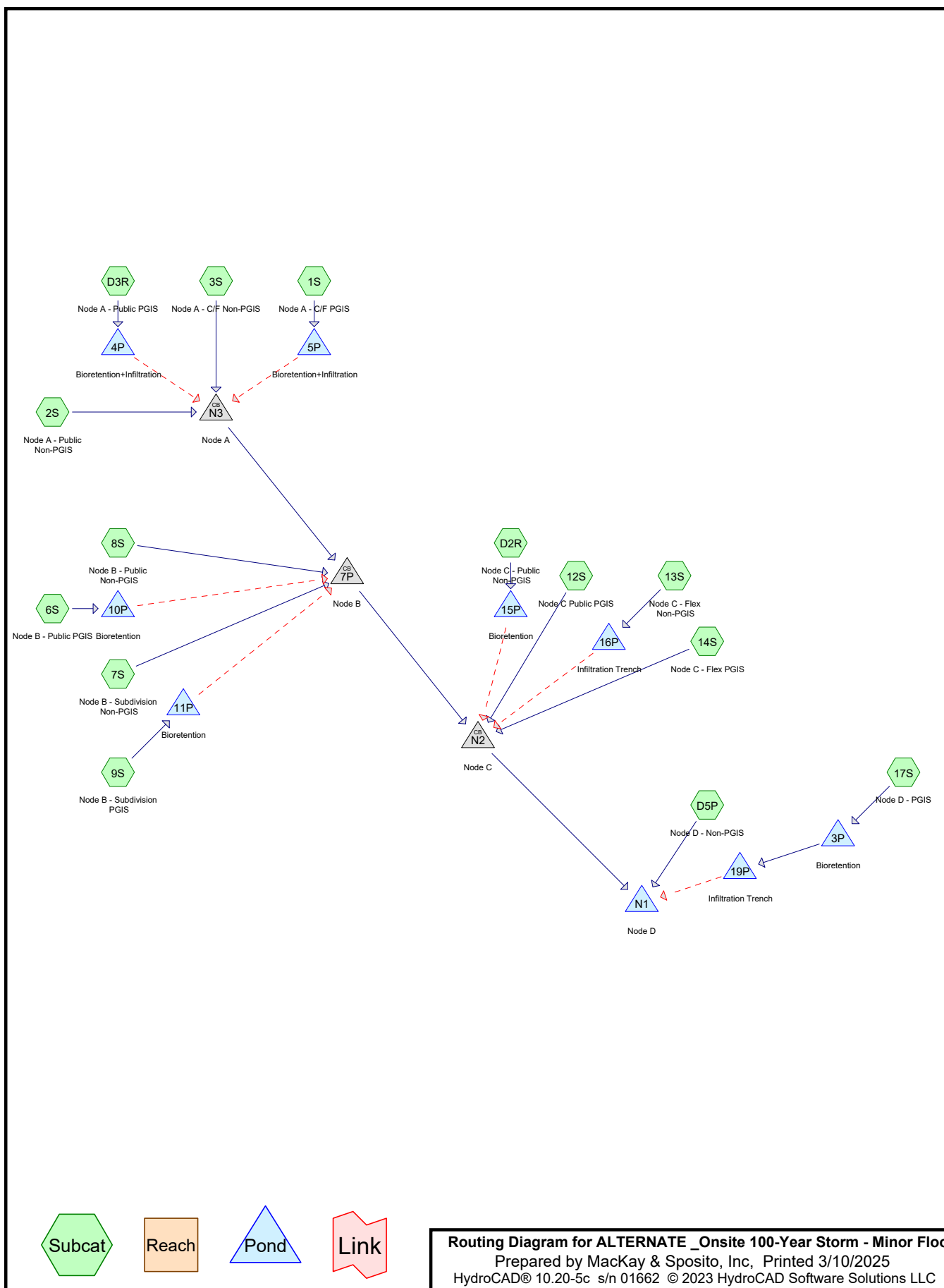
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 50.45' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	24.0" Round Culvert L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=14.45 cfs @ 8.10 hrs HW=50.45' TW=48.77' (Fixed TW Elev= 48.77')
 ↑1=Culvert (Outlet Controls 14.45 cfs @ 4.60 fps)

Pond N3: Node A





ALTERNATE _Onsite 100-Year Storm - Minor Flood

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	92	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	38.896	0.000	0.000	0.000	104.075	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 7P: Node B Peak Elev=49.68' Inflow=28.83 cfs 8.778 af
Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=43.19' Storage=45,518 cf Inflow=84.32 cfs 34.599 af
Primary=67.56 cfs 34.595 af Secondary=0.00 cfs 0.000 af Outflow=67.56 cfs 34.595 af

Pond N2: Node C Peak Elev=46.47' Inflow=33.86 cfs 10.379 af
Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.56' Inflow=18.21 cfs 5.428 af
Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
 Routed to Pond 5P : Bioretention+Infiltration

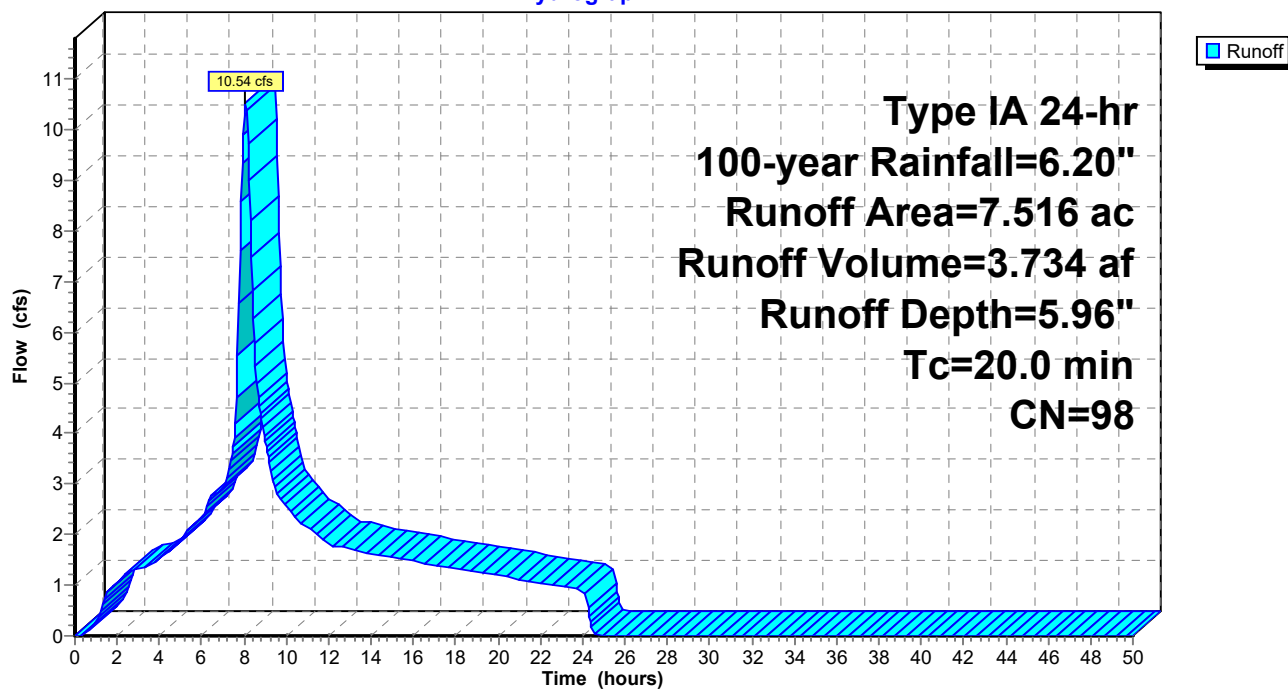
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Node A - C/F PGIS

Hydrograph



Summary for Subcatchment 2S: Node A - Public Non-PGIS

Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
 Routed to Pond N3 : Node A

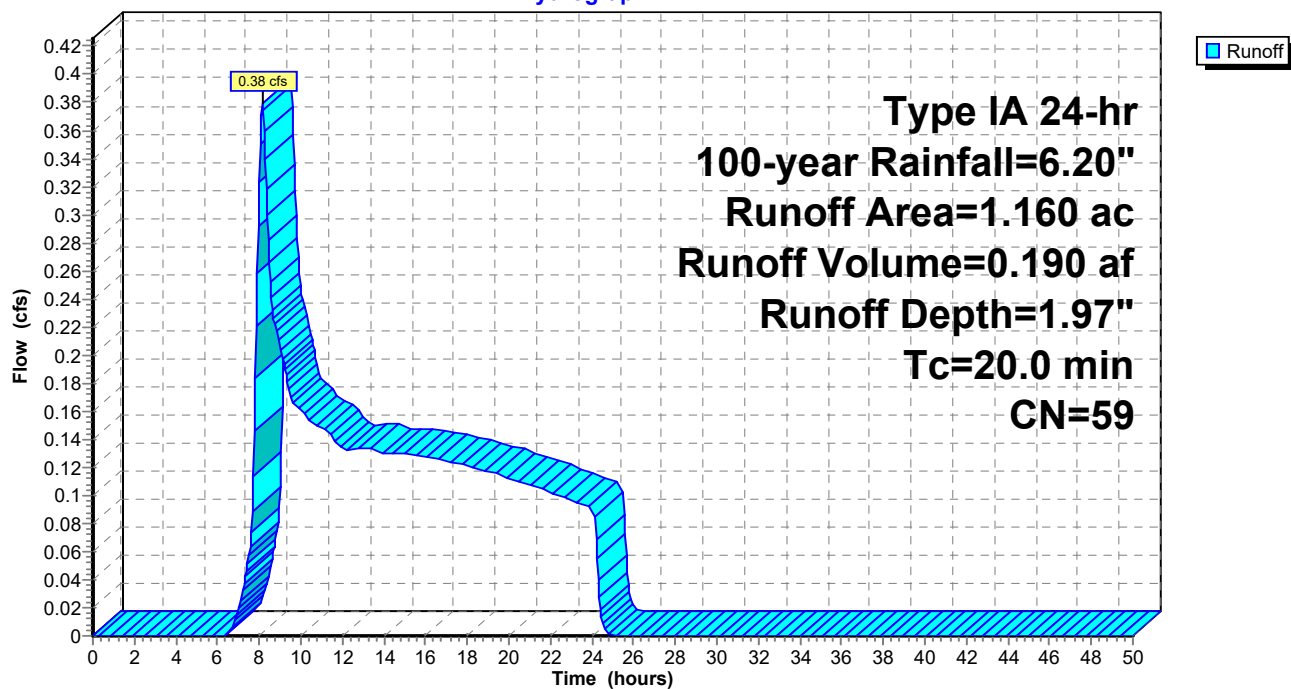
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
* 1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 2S: Node A - Public Non-PGIS

Hydrograph



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
 Routed to Pond N3 : Node A

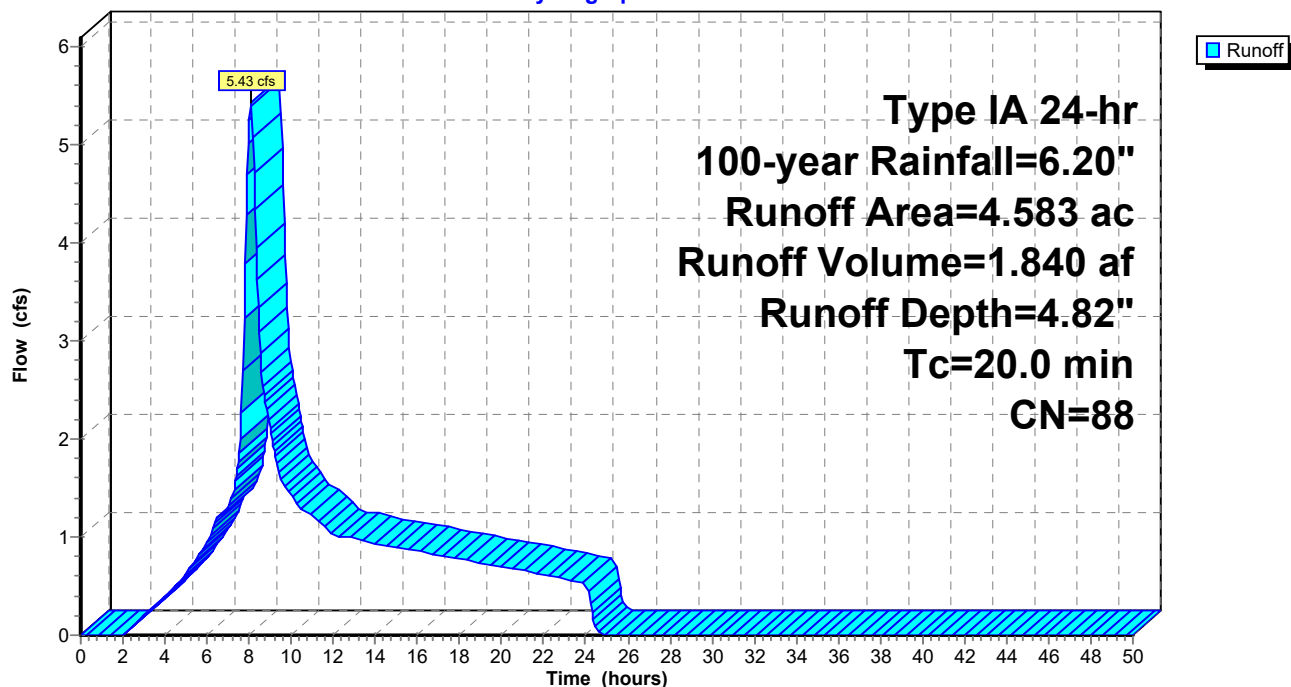
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
* 1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
3.373	98	Roofs, HSG A
4.583	88	Weighted Average
1.210		26.40% Pervious Area
3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 3S: Node A - C/F Non-PGIS

Hydrograph



Summary for Subcatchment 6S: Node B - Public PGIS

Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
 Routed to Pond 10P : Bioretention

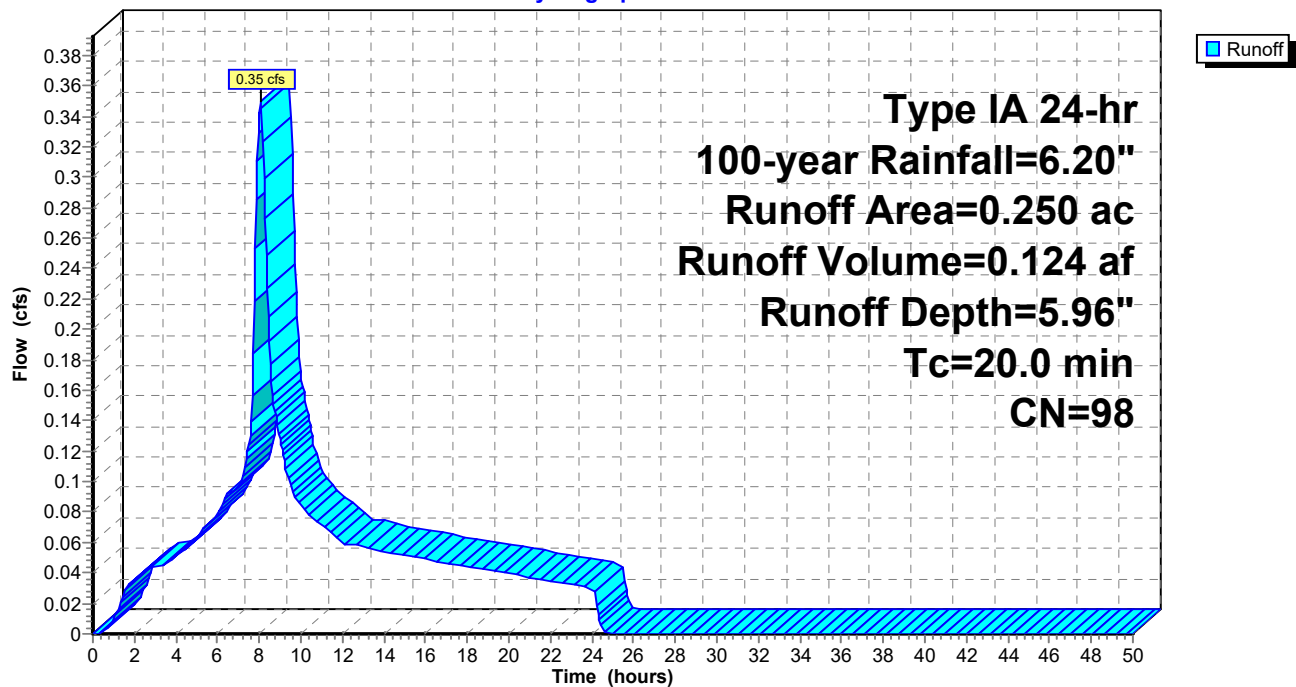
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 6S: Node B - Public PGIS

Hydrograph



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

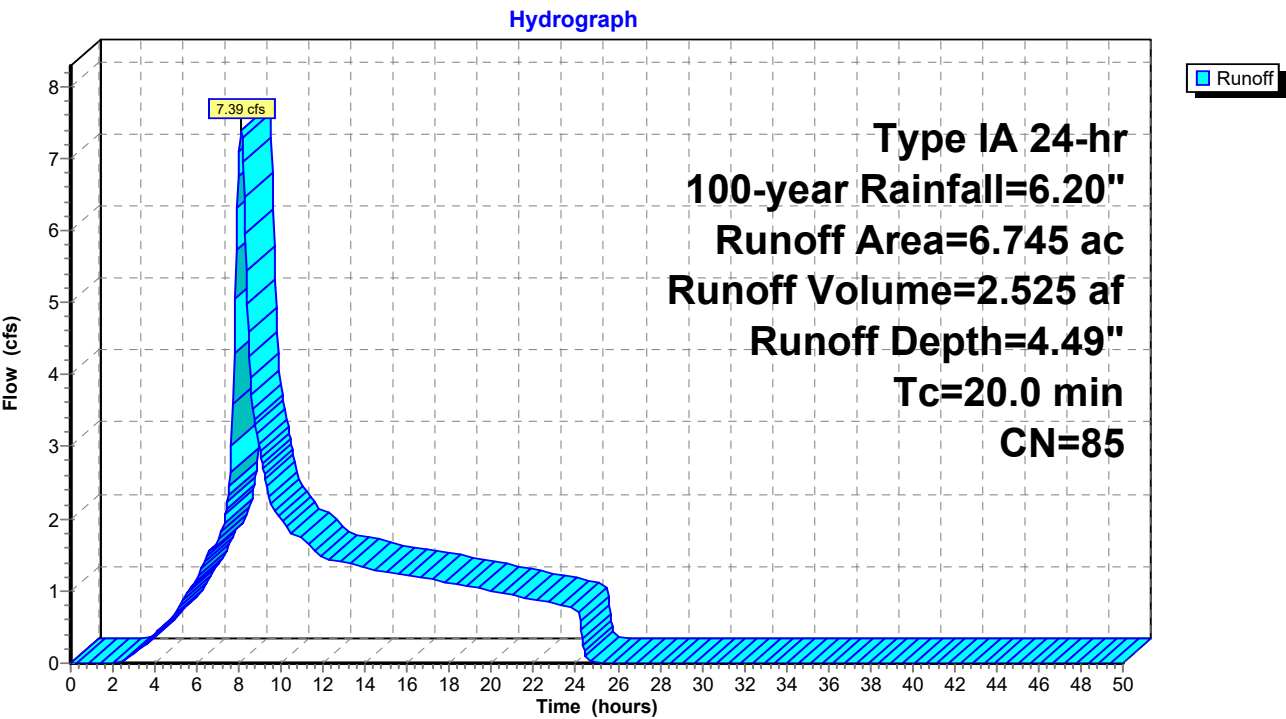
Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
 Routed to Pond 7P : Node B

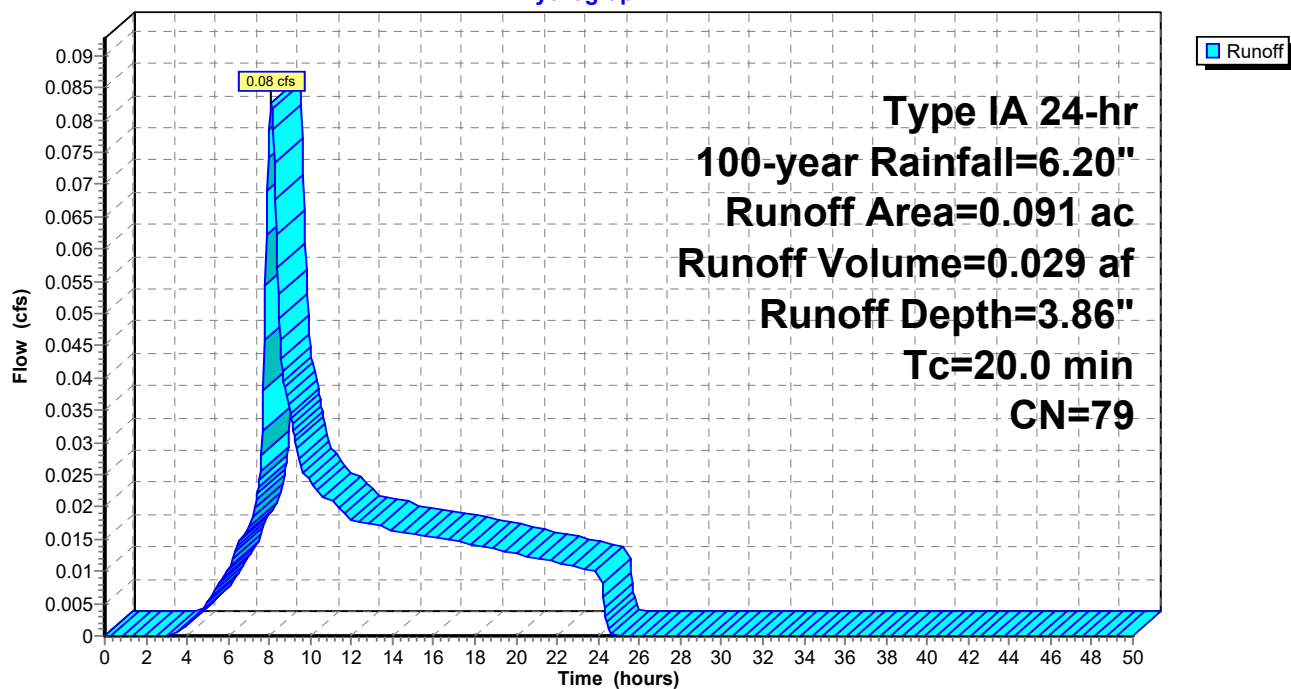
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 8S: Node B - Public Non-PGIS

Hydrograph



Summary for Subcatchment 9S: Node B - Subdivision PGIS

Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
 Routed to Pond 11P : Bioretention

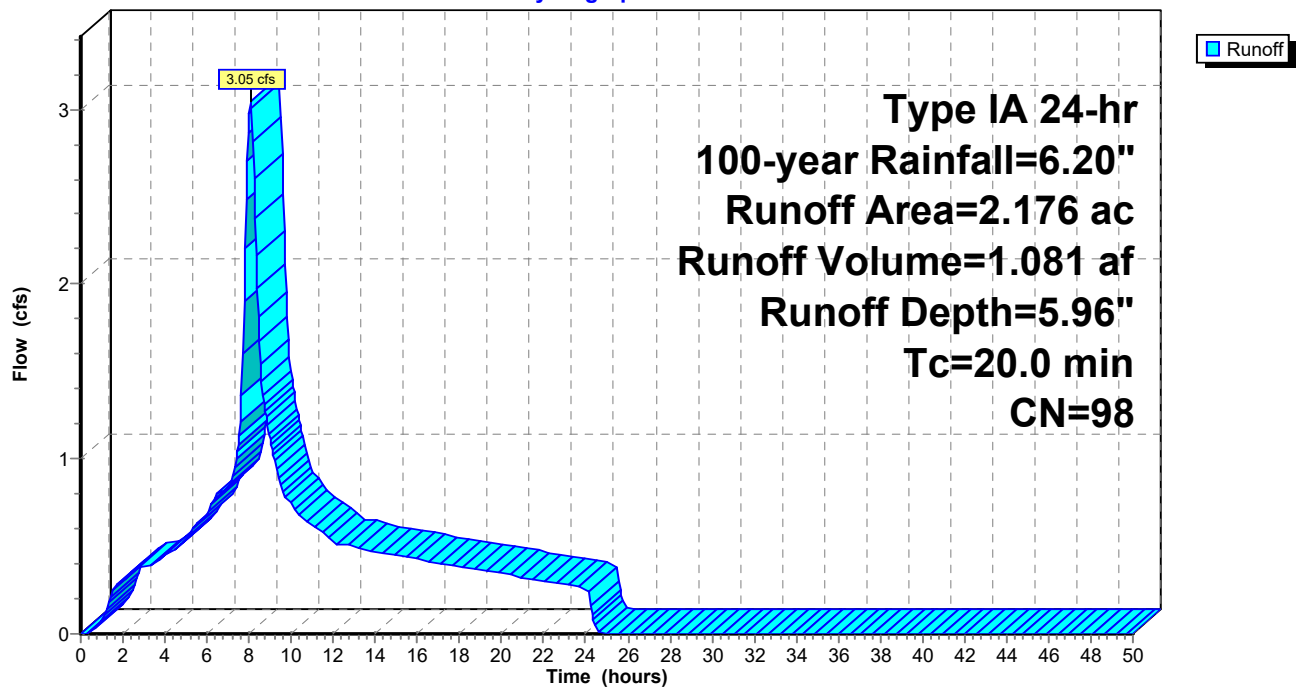
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 9S: Node B - Subdivision PGIS

Hydrograph



Summary for Subcatchment 12S: Node C Public PGIS

Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
 Routed to Pond N2 : Node C

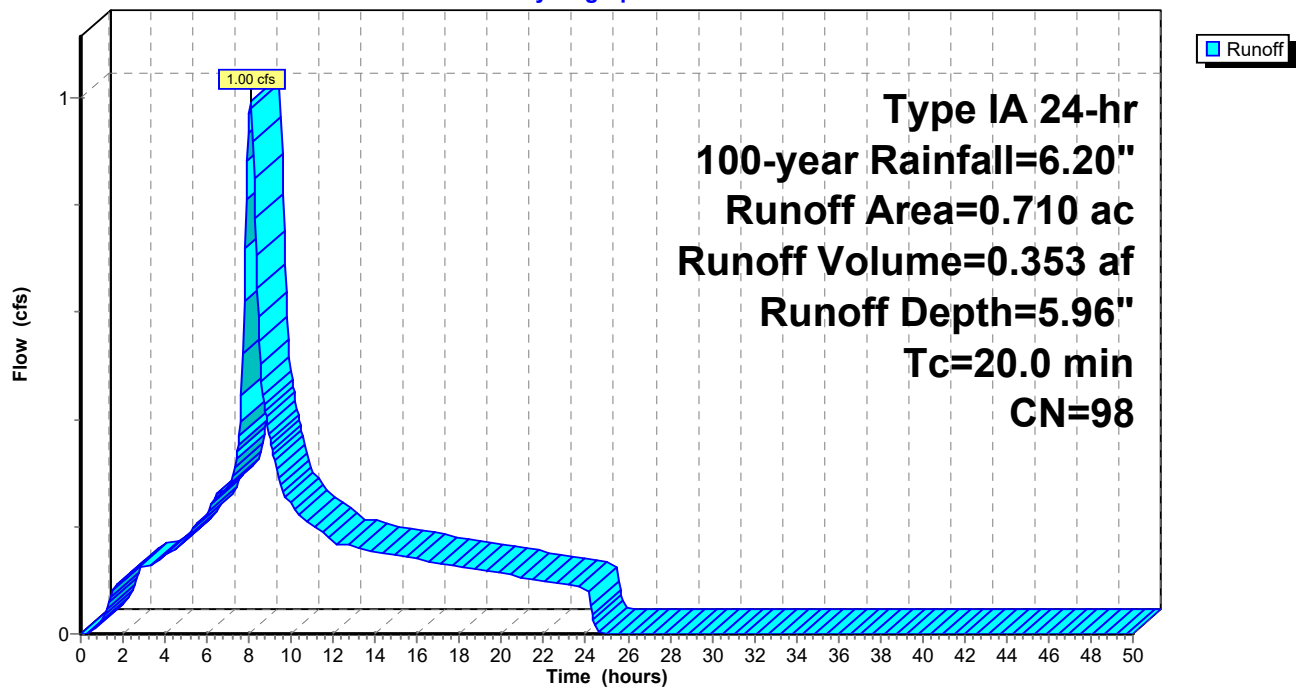
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 12S: Node C Public PGIS

Hydrograph



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
 Routed to Pond 16P : Infiltration Trench

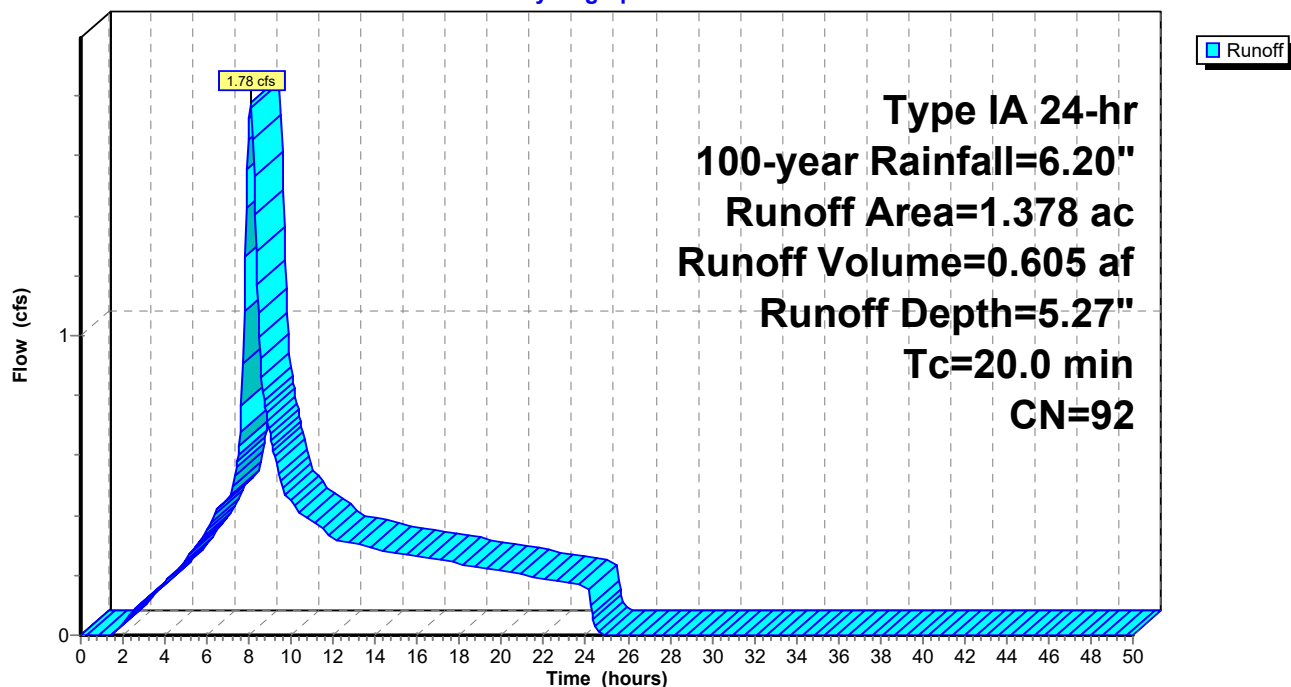
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 13S: Node C - Flex Non-PGIS

Hydrograph



Summary for Subcatchment 14S: Node C - Flex PGIS

Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
 Routed to Pond N2 : Node C

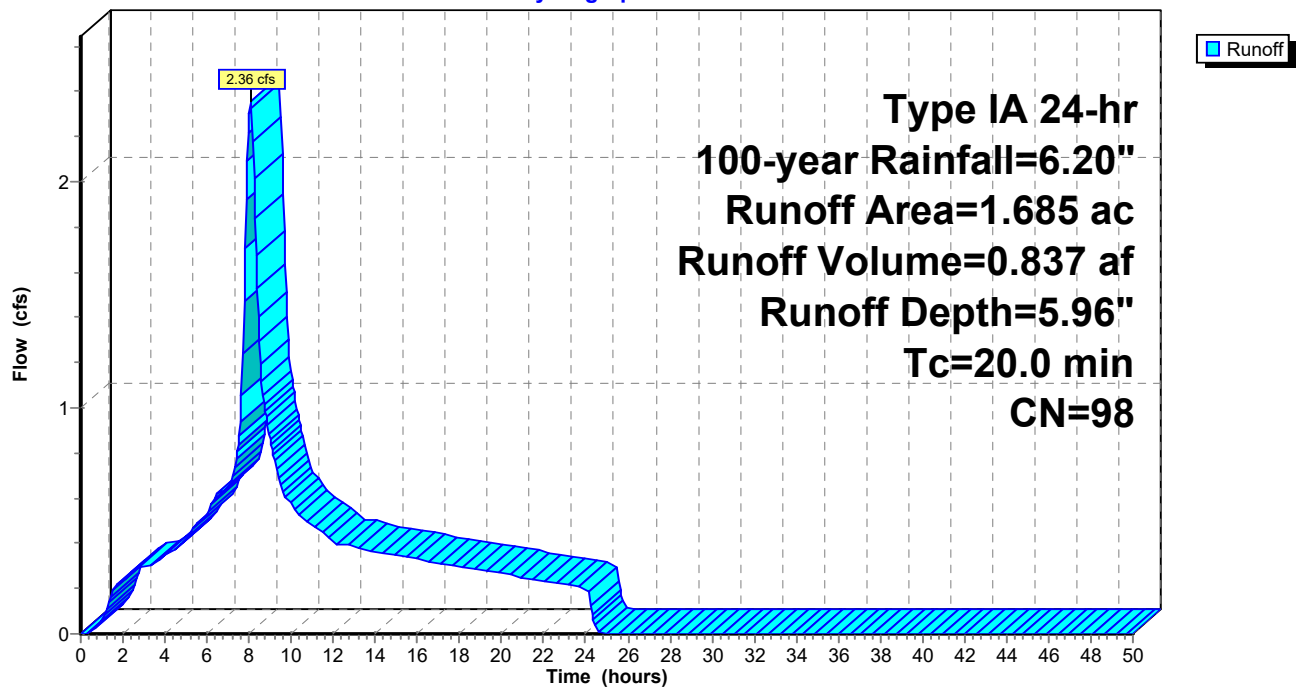
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 14S: Node C - Flex PGIS

Hydrograph



Summary for Subcatchment 17S: Node D - PGIS

Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
 Routed to Pond 3P : Bioretention

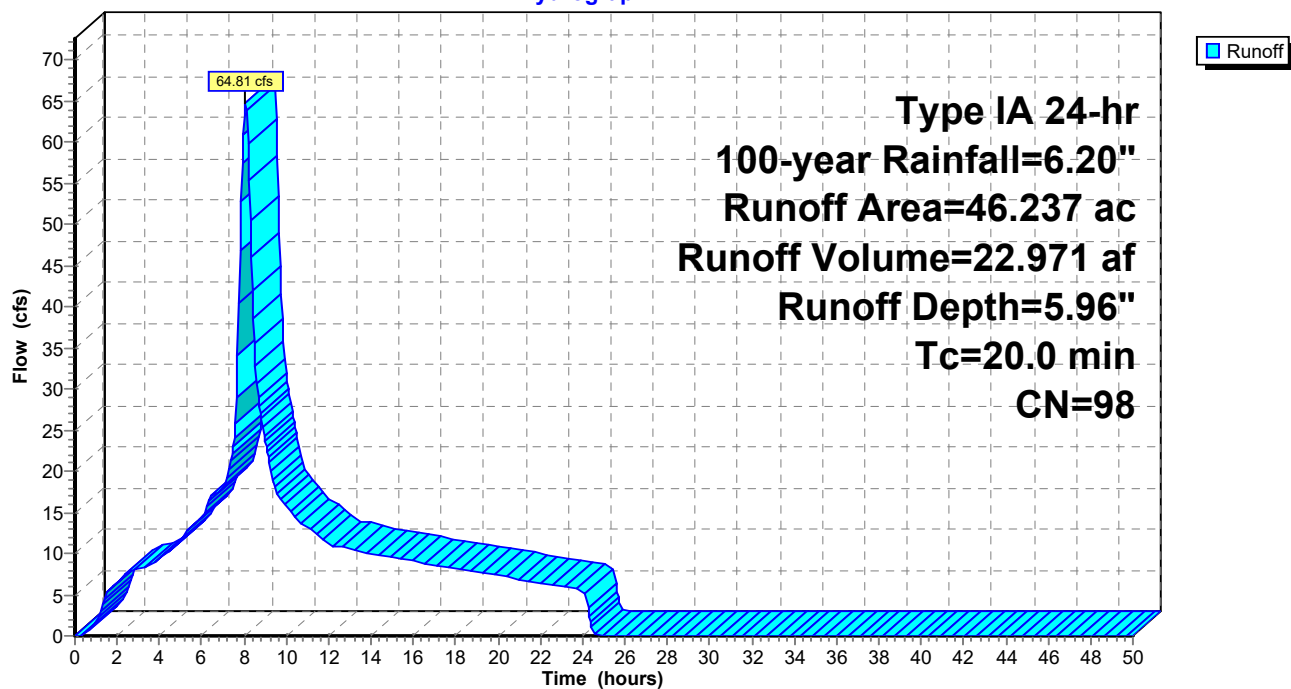
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 17S: Node D - PGIS

Hydrograph



Summary for Subcatchment D2R: Node C - Public Non-PGIS

Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
 Routed to Pond 15P : Bioretention

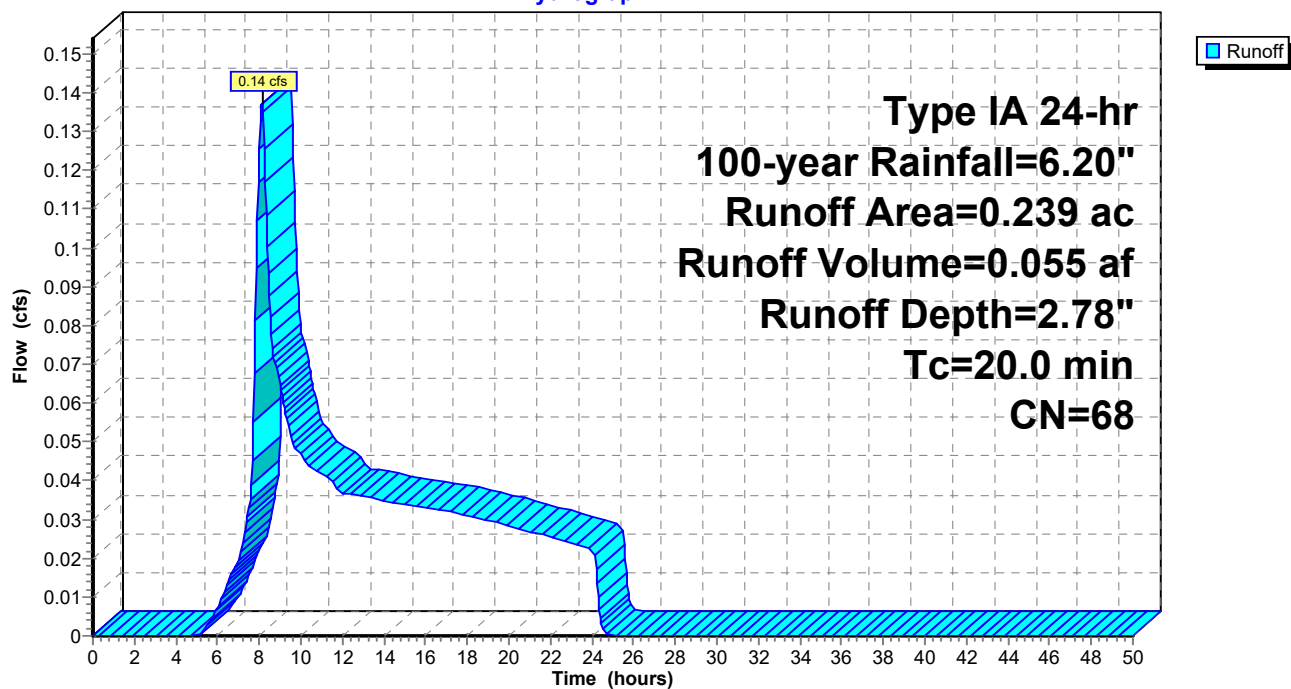
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D2R: Node C - Public Non-PGIS

Hydrograph



Summary for Subcatchment D3R: Node A - Public PGIS

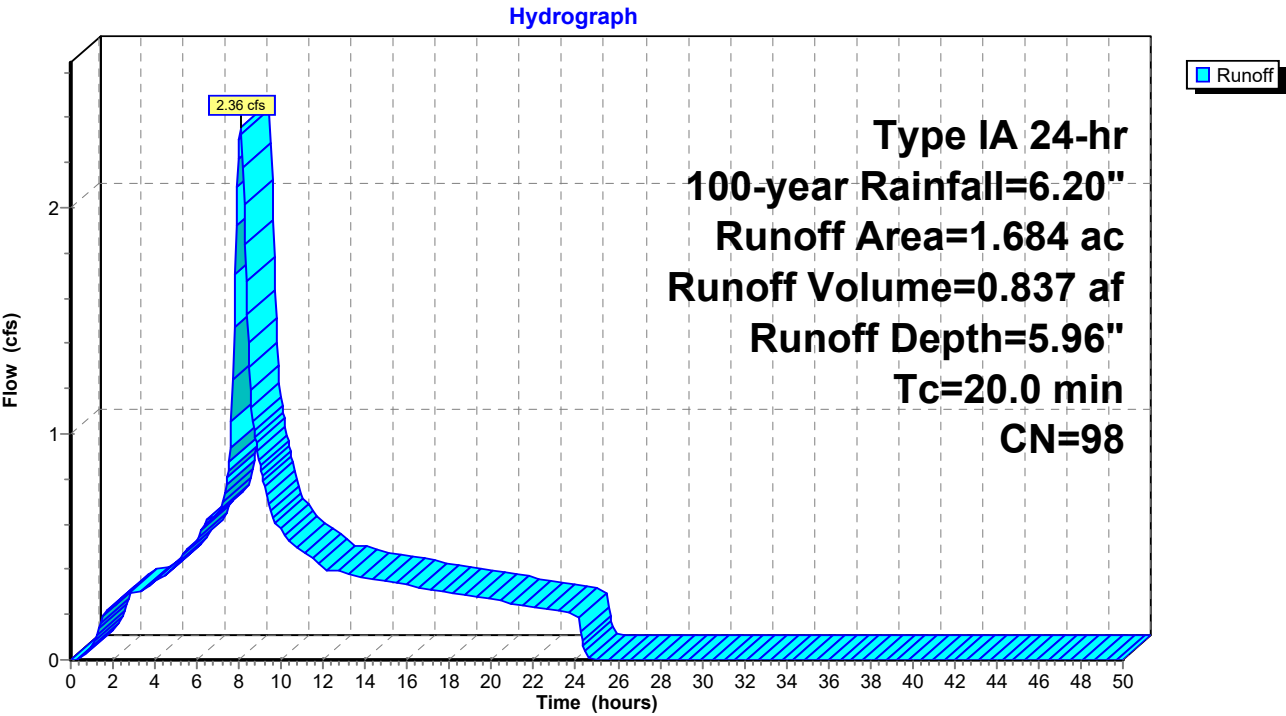
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
 Routed to Pond N1 : Node D

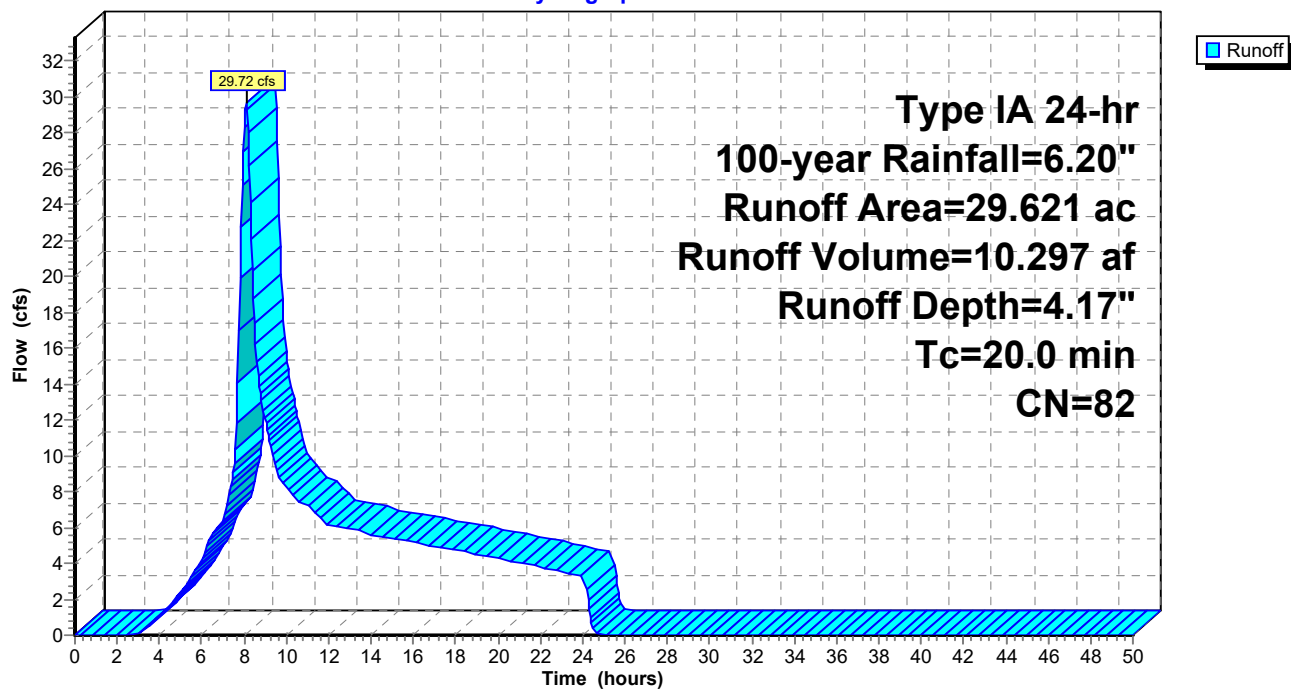
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D5P: Node D - Non-PGIS

Hydrograph



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
 Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
 Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
 Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
 Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	270.00'W x 270.00'L x 6.50'H Prismatic 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	270.00'W x 270.00'L x 2.00'H Prismatic Inside #1
#3	50.50'	0.019 af	24.0" Round Pipe Storage Inside #1 L= 269.0'
		5.996 af	Total Available Storage

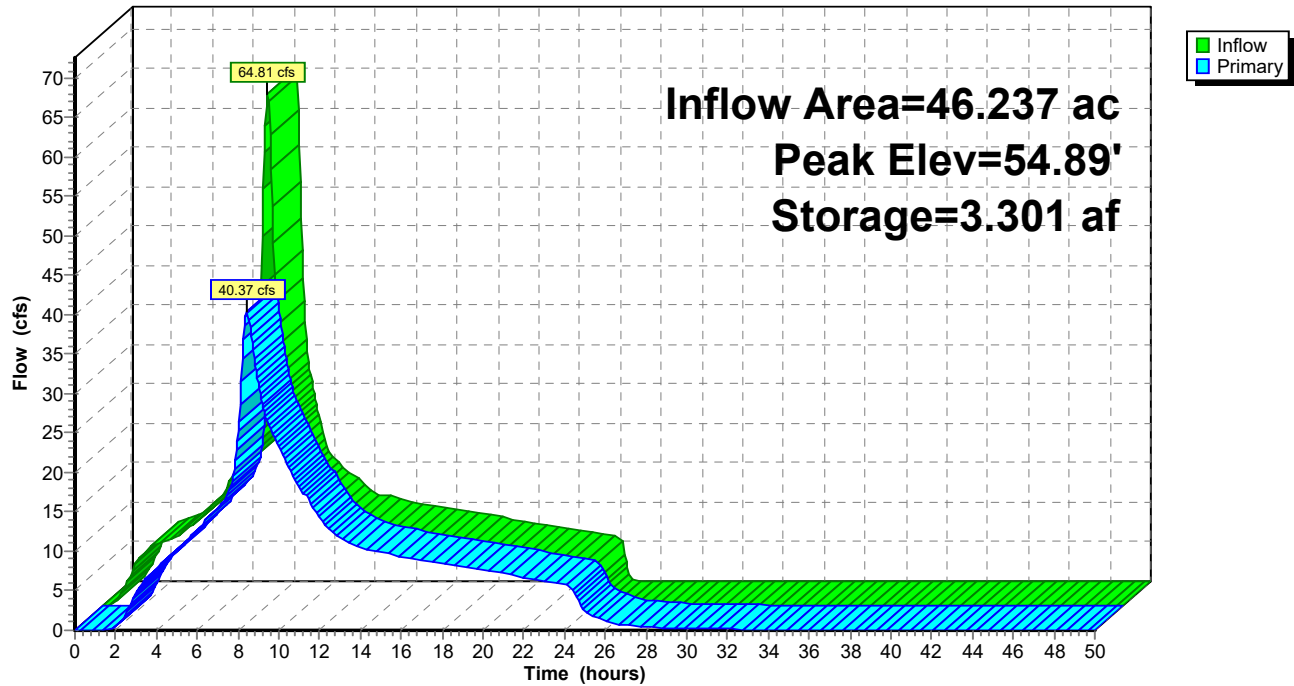
Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	60.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	24.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)

↑ **1=Orifice/Grate** (Weir Controls 12.44 cfs @ 2.04 fps)
 ↓ **2=Orifice/Grate** (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention

Hydrograph



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
 Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
 Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
 Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
 Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

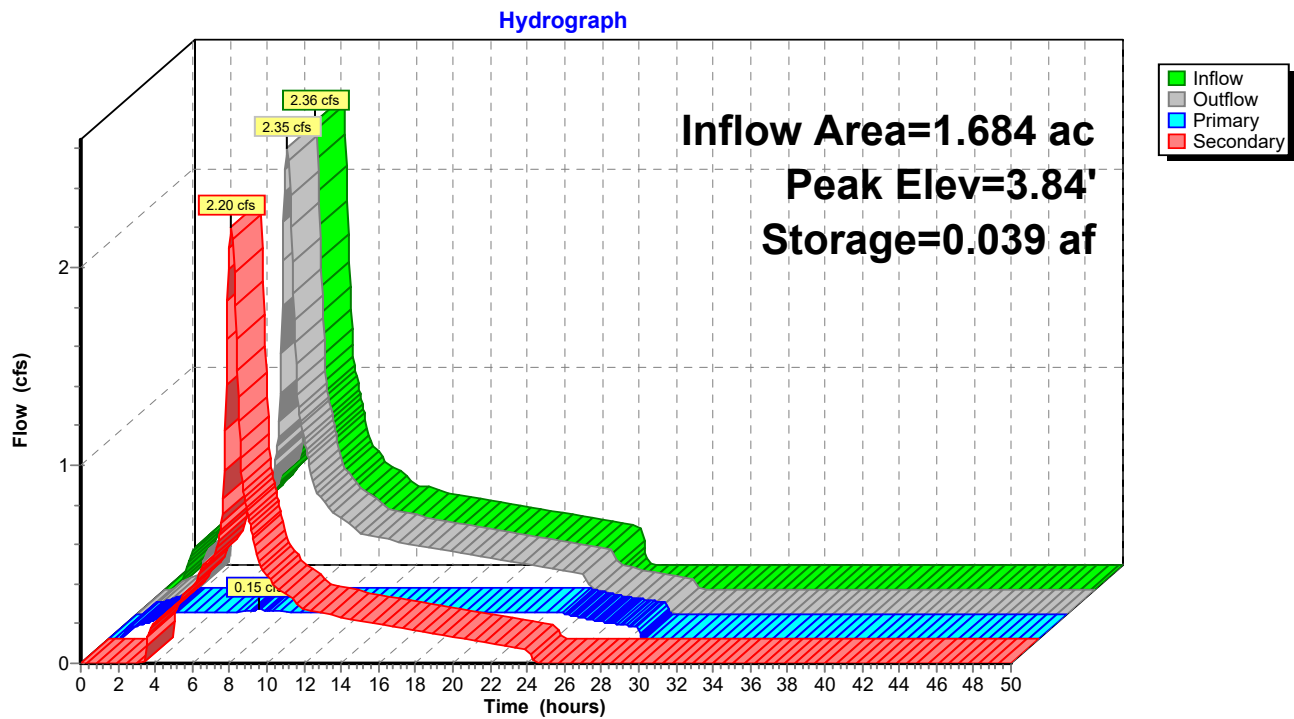
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	5.00'W x 250.00'L x 5.00'H Bioretention 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
 Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
 Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
 Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

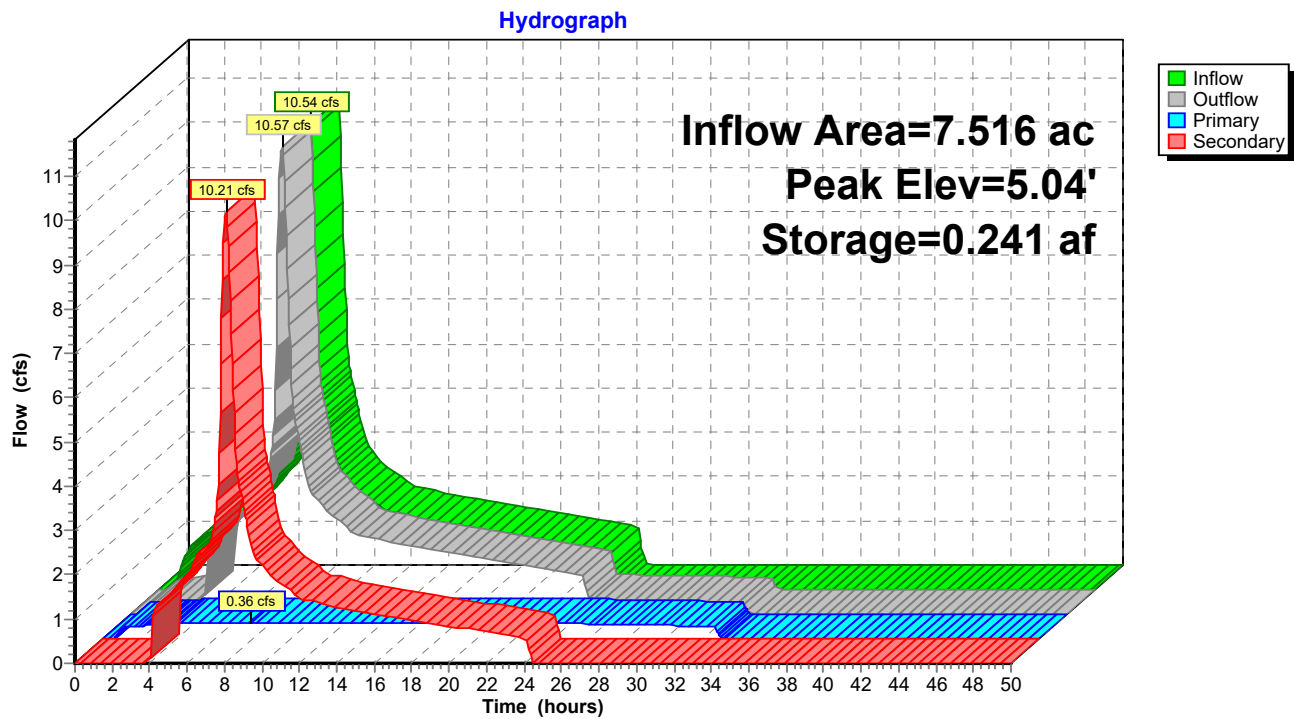
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	50.00'W x 120.00'L x 5.00'H Infiltration Trench 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.50'	30.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.68' (Flood elevation advised)
 [81] Warning: Exceeded Pond 10P by 46.47' @ 31.35 hrs
 [81] Warning: Exceeded Pond 11P by 46.47' @ 33.05 hrs
 [79] Warning: Submerged Pond N3 Primary device # 1 INLET by 8.24'

Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
 Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
 Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
 Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
 Routed to Pond N2 : Node C

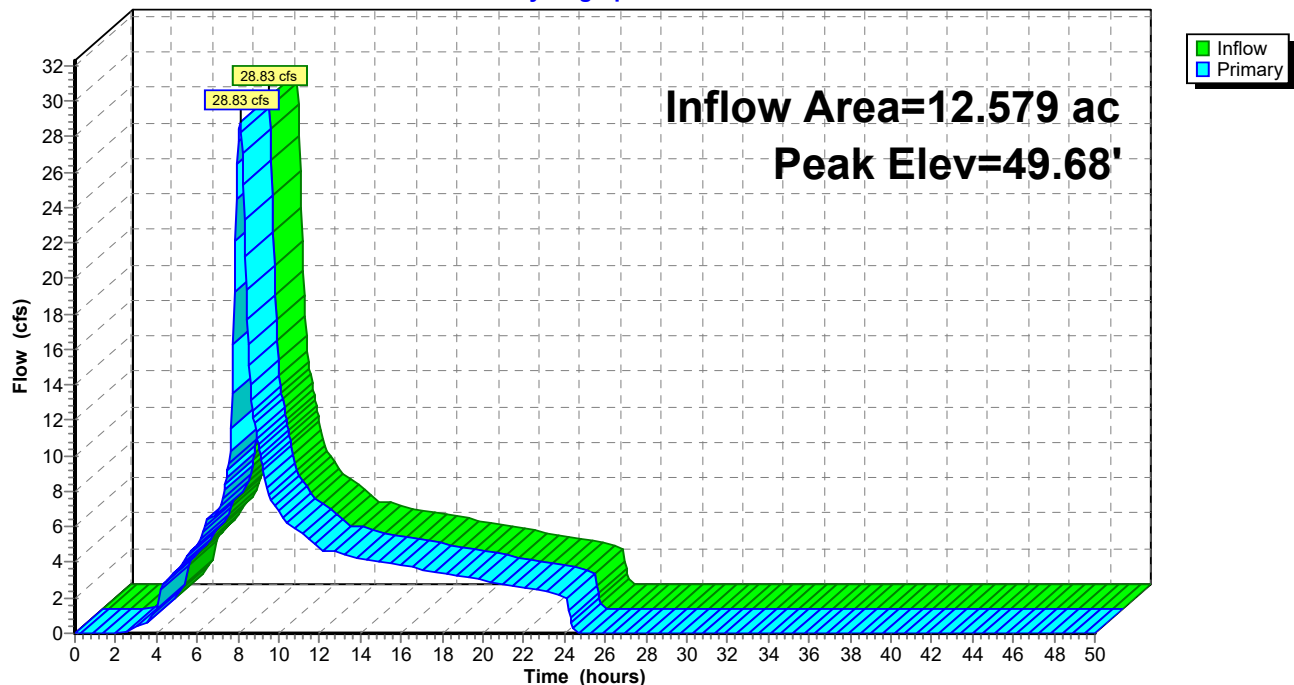
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 49.68' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	24.0" Round Culvert L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=28.70 cfs @ 8.09 hrs HW=49.68' TW=46.47' (Fixed TW Elev= 46.47')
 1=Culvert (Outlet Controls 19.75 cfs @ 6.29 fps)
 2=Sharp-Crested Rectangular Weir (Weir Controls 8.95 cfs @ 1.39 fps)

Pond 7P: Node B

Hydrograph



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
 Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
 Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
 Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	5.00'W x 40.00'L x 5.00'H Bioretention 0.023 af Overall x 35.0% Voids

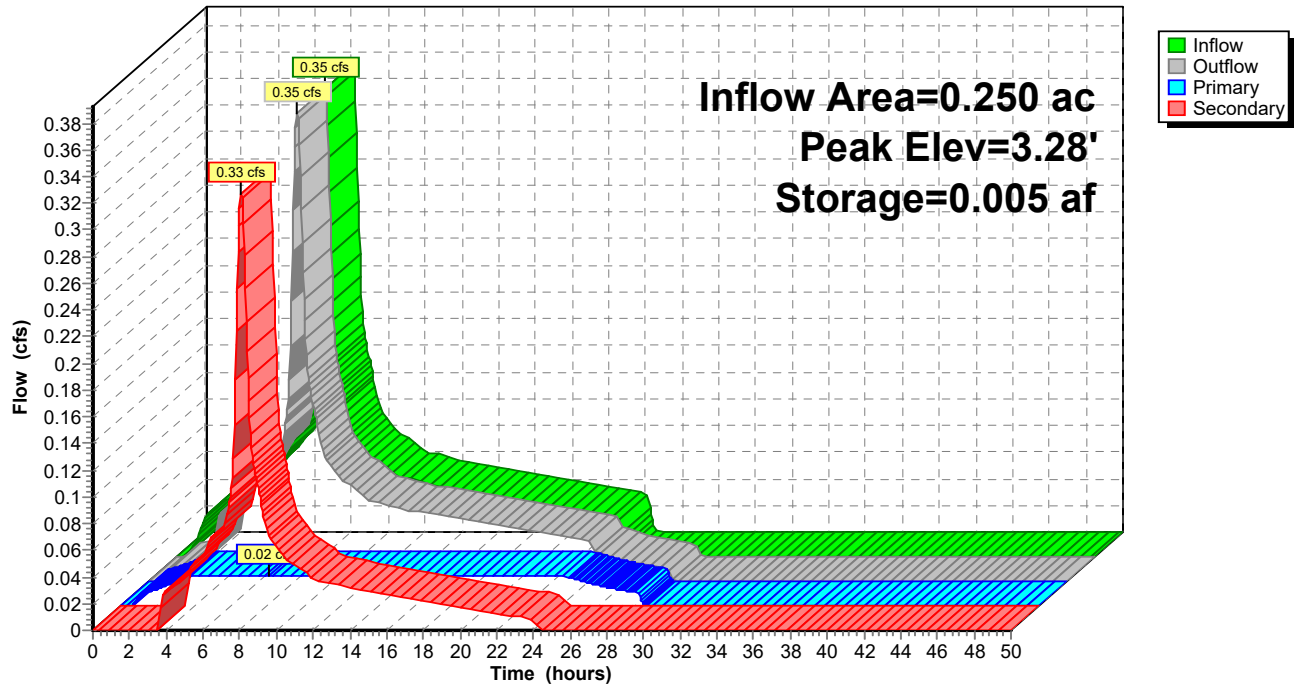
Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention

Hydrograph



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
 Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
 Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
 Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
 Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

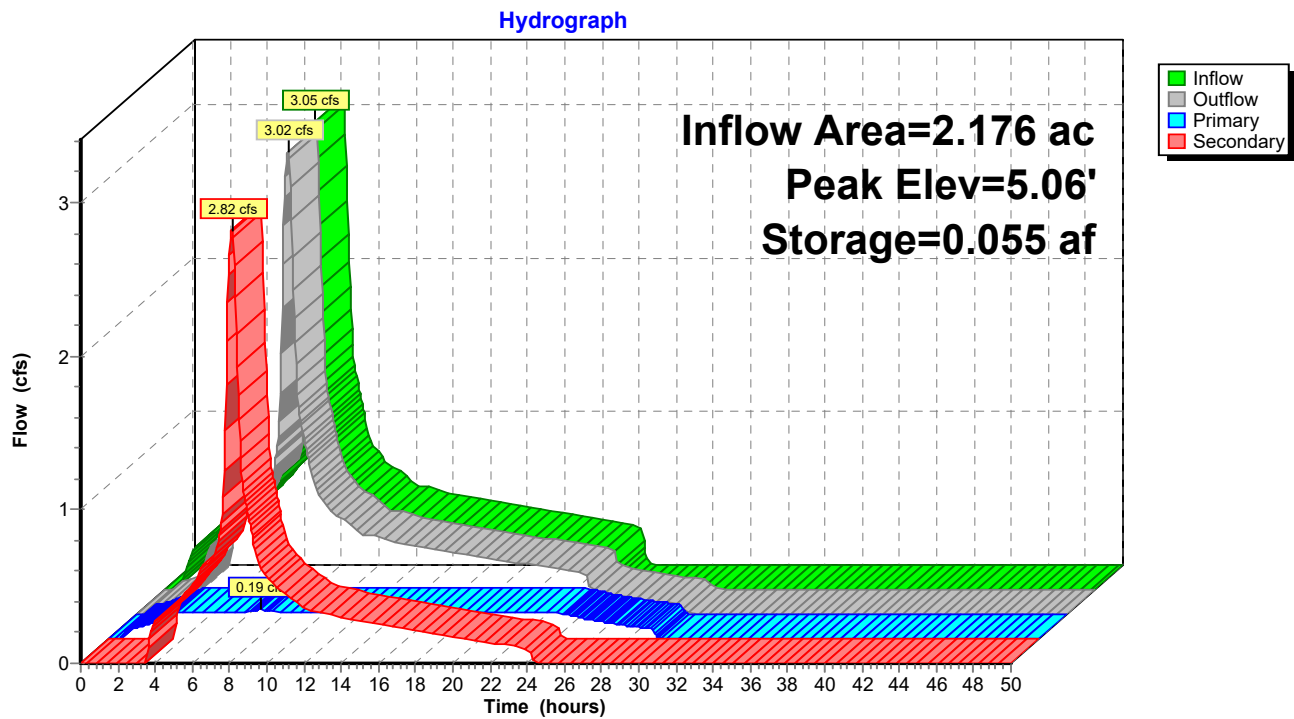
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	5.00'W x 270.00'L x 6.00'H Bioretention 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
 Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
 Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
 Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
 Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

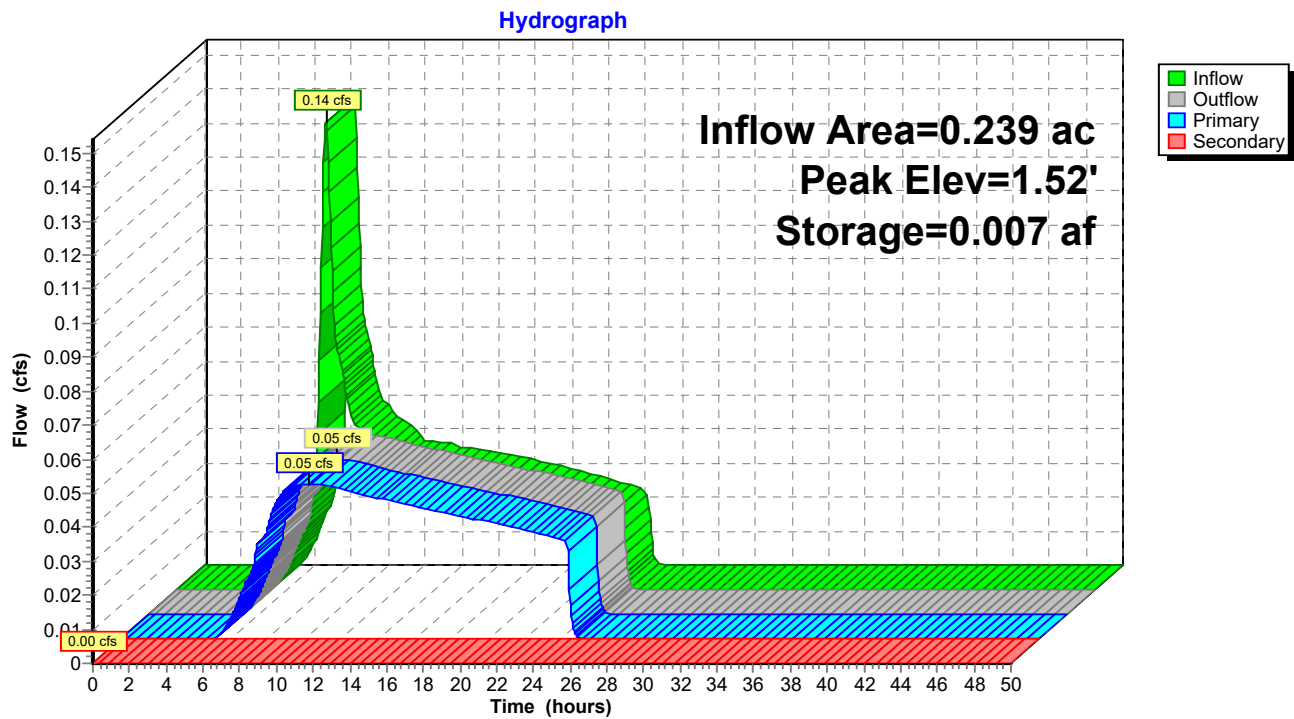
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	5.00'W x 120.00'L x 5.00'H Bioretention 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
 ↑**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
 Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
 Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
 Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
 Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
 Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

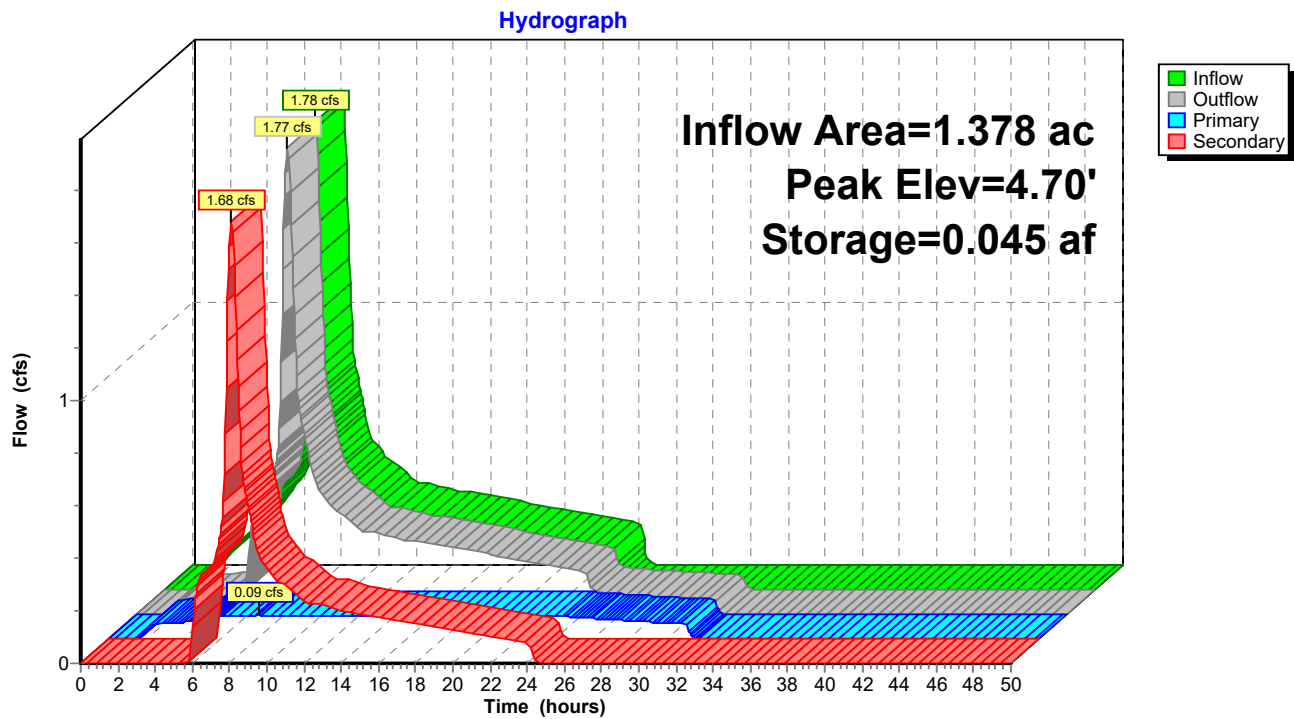
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	20.00'W x 60.00'L x 6.00'H Infiltration Trench 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth > 5.88" for 100-year event
 Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
 Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
 Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
 Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
 Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
 Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

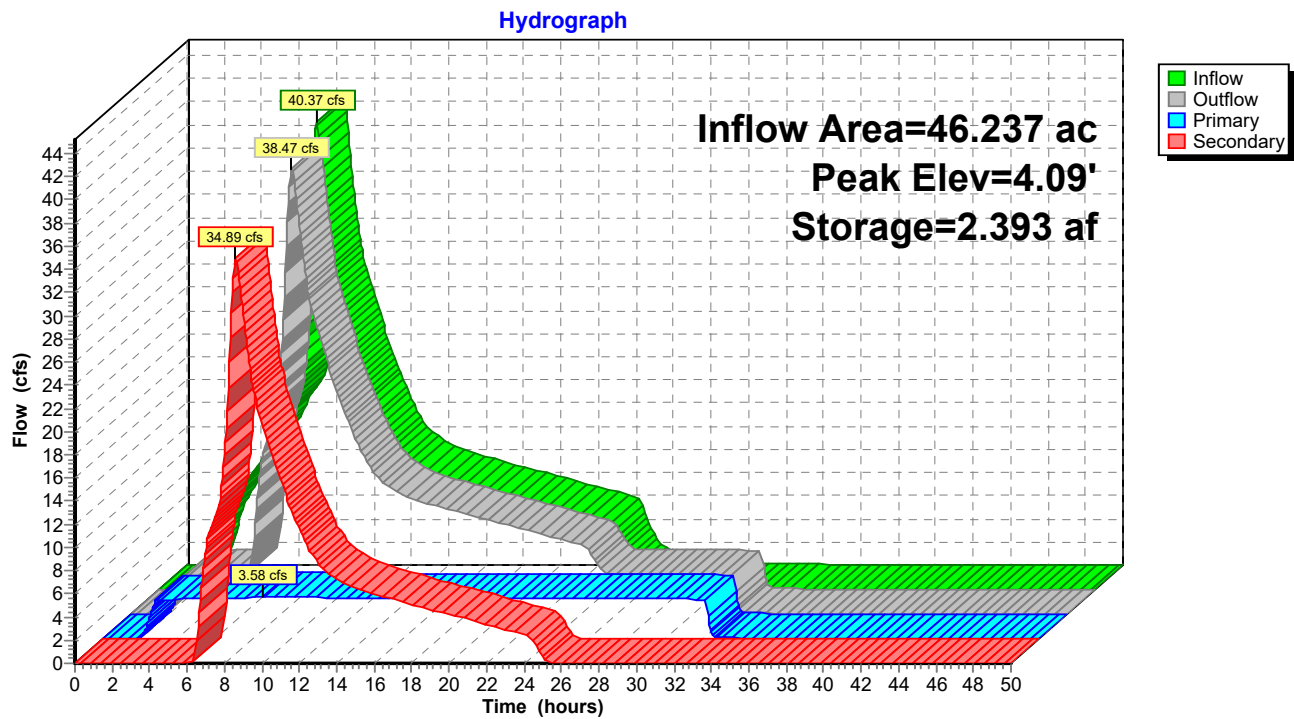
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	270.00'W x 270.00'L x 5.00'H Infiltration Trench 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	36.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=14)

[81] Warning: Exceeded Pond 19P by 41.00' @ 1.75 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
 Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
 Outflow = 67.56 cfs @ 8.57 hrs, Volume= 34.595 af, Atten= 20%, Lag= 25.8 min
 Primary = 67.56 cfs @ 8.57 hrs, Volume= 34.595 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 43.19' @ 8.57 hrs Surf.Area= 43,834 sf Storage= 45,518 cf

Plug-Flow detention time= 2.4 min calculated for 34.561 af (100% of inflow)
 Center-of-Mass det. time= 2.3 min (737.8 - 735.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

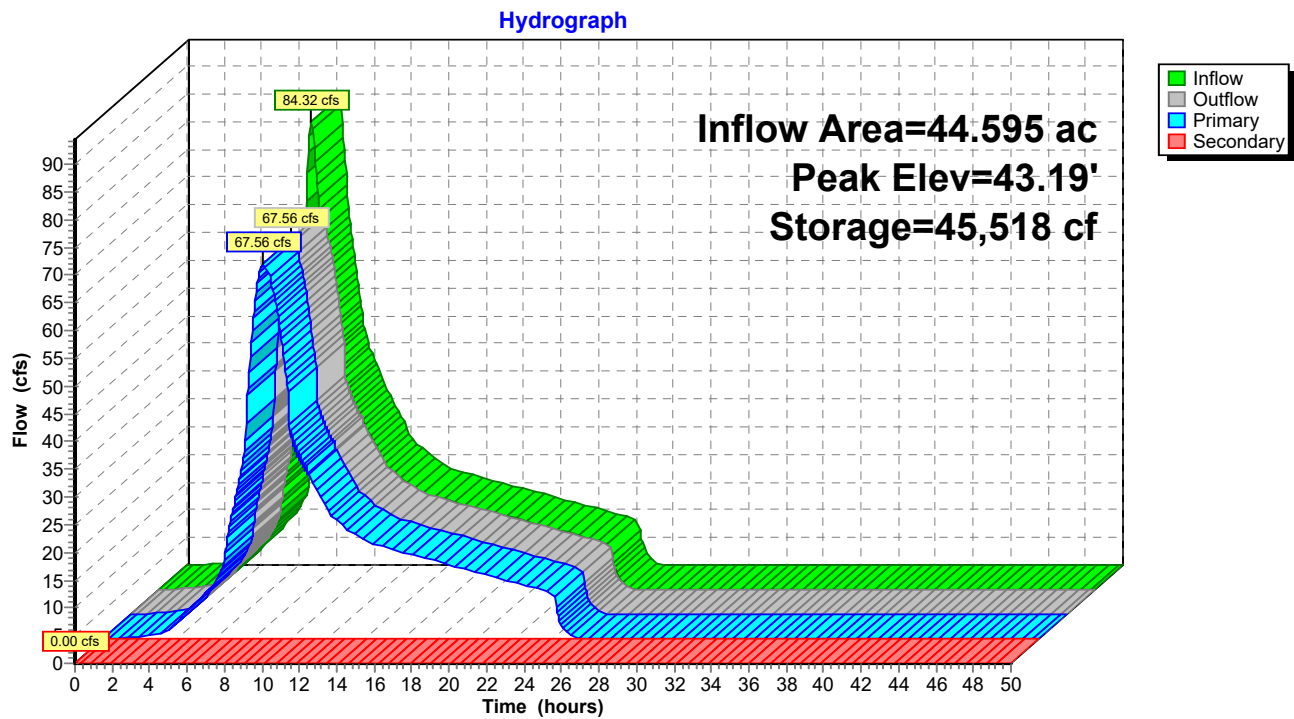
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Secondary	48.00'	30.0' long + 1.0 ' SideZ x 4.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Primary	38.00'	42.0" Round Culvert L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 ' / Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=67.54 cfs @ 8.57 hrs HW=43.19' TW=41.00' (Fixed TW Elev= 41.00')
 ↑ **2=Culvert** (Barrel Controls 67.54 cfs @ 7.02 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
 ↑ **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 46.47' (Flood elevation advised)
 [81] Warning: Exceeded Pond 7P by 2.86' @ 1.75 hrs
 [81] Warning: Exceeded Pond 15P by 45.90' @ 8.05 hrs
 [81] Warning: Exceeded Pond 16P by 43.19' @ 1.45 hrs

Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
 Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
 Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
 Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
 Routed to Pond N1 : Node D

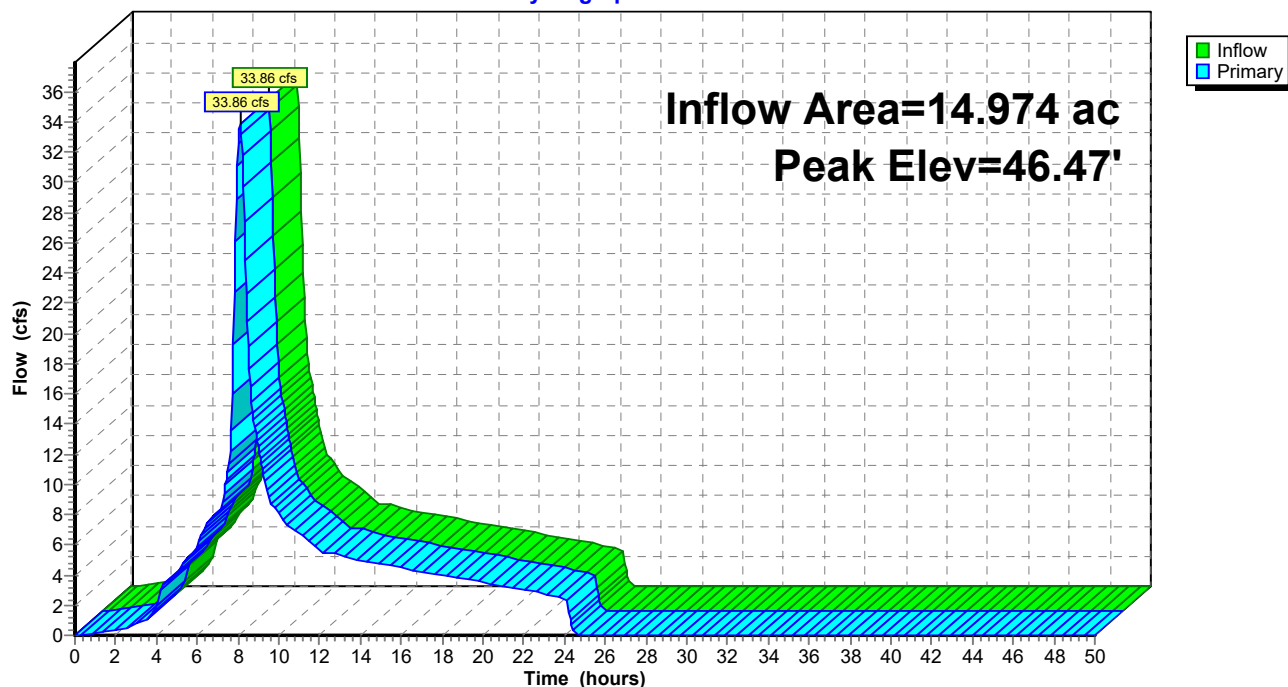
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 46.47' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	30.0" Round Culvert L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 ' S= 0.0029 ' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=33.80 cfs @ 8.09 hrs HW=46.46' TW=43.19' (Fixed TW Elev= 43.19')
 1=Culvert (Outlet Controls 33.80 cfs @ 6.88 fps)
 2=Sharp-Crested Rectangular Weir(Controls 0.00 cfs)

Pond N2: Node C

Hydrograph



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.56' (Flood elevation advised)
 [81] Warning: Exceeded Pond 4P by 49.68' @ 31.55 hrs
 [81] Warning: Exceeded Pond 5P by 49.68' @ 35.95 hrs

Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
 Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
 Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
 Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
 Routed to Pond 7P : Node B

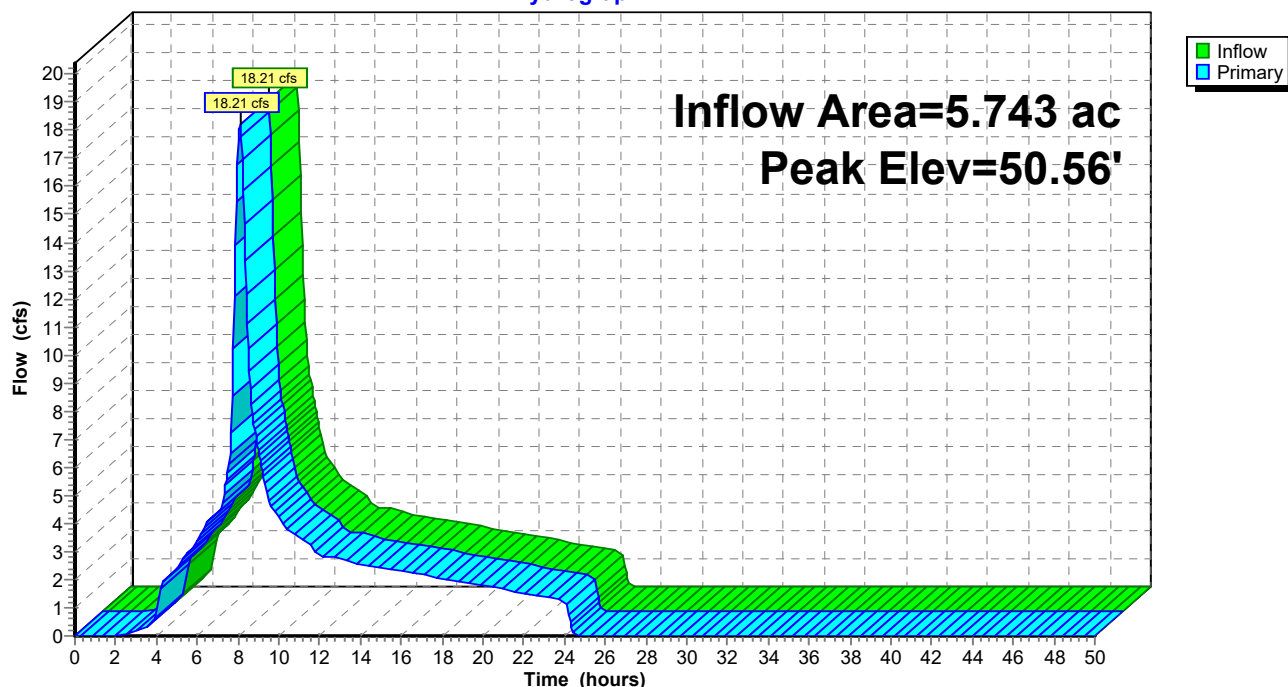
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 50.56' @ 8.09 hrs

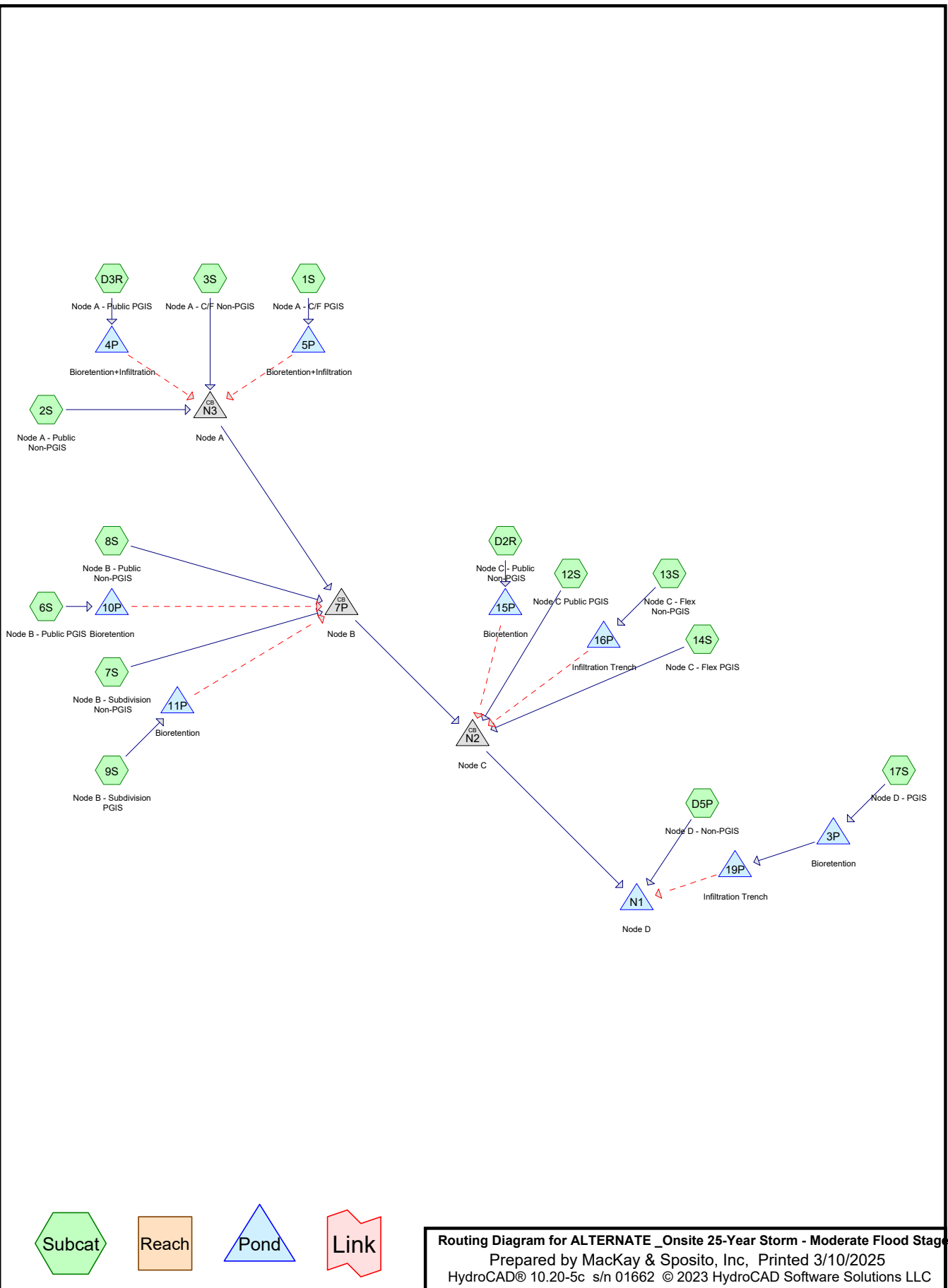
Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	24.0" Round Culvert L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=17.89 cfs @ 8.09 hrs HW=50.56' TW=49.68' (Fixed TW Elev= 49.68')
 1=Culvert (Outlet Controls 10.45 cfs @ 3.33 fps)
 2=Sharp-Crested Rectangular Weir (Weir Controls 7.44 cfs @ 1.30 fps)

Pond N3: Node A

Hydrograph





ALTERNATE _Onsite 25-Year Storm - Moderate Flood Stage

Prepared by MacKay & Sposito, Inc

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	92	TOTAL AREA

ALTERNATE _Onsite 25-Year Storm - Moderate Flood Stage

Prepared by MacKay & Sposito, Inc

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		TOTAL AREA

ALTERNATE _Onsite 25-Year Storm - Moderate Flood Stage

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	38.896	0.000	0.000	0.000	104.075	TOTAL AREA	

ALTERNATE _Onsite 25-Year Storm - Moderate Flood Stage

Prepared by MacKay & Sposito, Inc

Printed 3/10/2025

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=8.64 cfs 3.046 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.29"
 Tc=20.0 min CN=59 Runoff=0.20 cfs 0.125 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=3.76"
 Tc=20.0 min CN=88 Runoff=4.22 cfs 1.438 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=0.29 cfs 0.101 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=3.46"
 Tc=20.0 min CN=85 Runoff=5.62 cfs 1.945 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=2.89"
 Tc=20.0 min CN=79 Runoff=0.06 cfs 0.022 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=2.50 cfs 0.882 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=0.82 cfs 0.288 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=4.19"
 Tc=20.0 min CN=92 Runoff=1.42 cfs 0.481 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=1.94 cfs 0.683 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=53.15 cfs 18.738 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=1.95"
 Tc=20.0 min CN=68 Runoff=0.09 cfs 0.039 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=4.86"
 Tc=20.0 min CN=98 Runoff=1.94 cfs 0.682 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=3.17"
 Tc=20.0 min CN=82 Runoff=22.11 cfs 7.822 af

Pond 3P: Bioretention Peak Elev=54.62' Storage=2.845 af Inflow=53.15 cfs 18.738 af
 Outflow=28.78 cfs 18.424 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.73' Storage=0.037 af Inflow=1.94 cfs 0.682 af
 Primary=0.15 cfs 0.277 af Secondary=1.78 cfs 0.406 af Outflow=1.93 cfs 0.682 af

Pond 5P: Bioretention+Infiltration Peak Elev=4.97' Storage=0.240 af Inflow=8.64 cfs 3.046 af
Primary=0.36 cfs 0.882 af Secondary=8.26 cfs 2.164 af Outflow=8.62 cfs 3.046 af

Pond 7P: Node B Peak Elev=49.73' Inflow=22.70 cfs 6.681 af
Outflow=22.70 cfs 6.681 af

Pond 10P: Bioretention Peak Elev=3.25' Storage=0.005 af Inflow=0.29 cfs 0.101 af
Primary=0.02 cfs 0.045 af Secondary=0.26 cfs 0.056 af Outflow=0.29 cfs 0.101 af

Pond 11P: Bioretention Peak Elev=4.87' Storage=0.053 af Inflow=2.50 cfs 0.882 af
Primary=0.19 cfs 0.356 af Secondary=2.30 cfs 0.526 af Outflow=2.48 cfs 0.882 af

Pond 15P: Bioretention Peak Elev=0.73' Storage=0.004 af Inflow=0.09 cfs 0.039 af
Primary=0.04 cfs 0.039 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.039 af

Pond 16P: Infiltration Trench Peak Elev=4.61' Storage=0.044 af Inflow=1.42 cfs 0.481 af
Primary=0.09 cfs 0.189 af Secondary=1.32 cfs 0.292 af Outflow=1.41 cfs 0.481 af

Pond 19P: Infiltration Trench Peak Elev=3.86' Storage=2.259 af Inflow=28.78 cfs 18.424 af
Primary=3.57 cfs 8.564 af Secondary=24.41 cfs 9.860 af Outflow=27.97 cfs 18.424 af

Pond N1: Node D Peak Elev=47.56' Storage=331,489 cf Inflow=65.60 cfs 25.625 af
Primary=33.98 cfs 19.092 af Secondary=0.00 cfs 0.000 af Outflow=33.98 cfs 19.092 af

Pond N2: Node C Peak Elev=48.92' Inflow=26.76 cfs 7.943 af
Outflow=26.76 cfs 7.943 af

Pond N3: Node A Peak Elev=50.51' Inflow=14.45 cfs 4.132 af
Outflow=14.45 cfs 4.132 af

Total Runoff Area = 104.075 ac Runoff Volume = 36.290 af Average Runoff Depth = 4.18"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

Runoff = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af, Depth= 4.86"
 Routed to Pond 5P : Bioretention+Infiltration

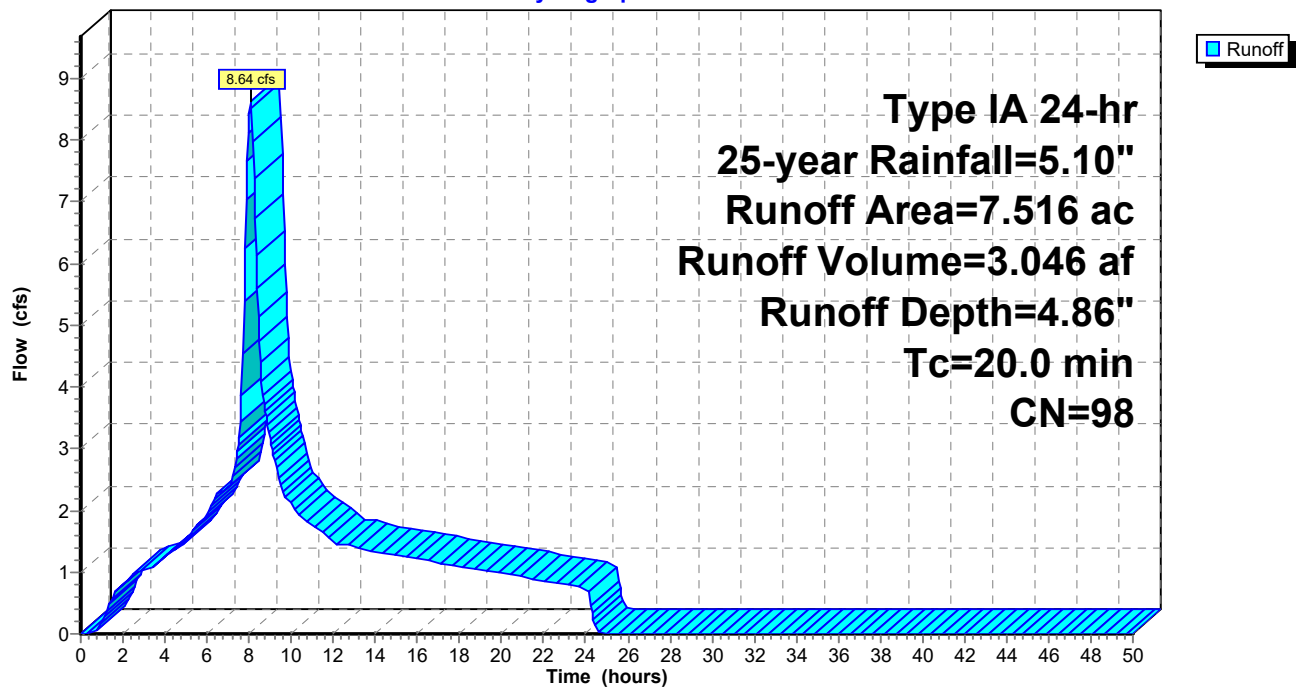
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Node A - C/F PGIS

Hydrograph



Summary for Subcatchment 2S: Node A - Public Non-PGIS

Runoff = 0.20 cfs @ 8.19 hrs, Volume= 0.125 af, Depth= 1.29"
 Routed to Pond N3 : Node A

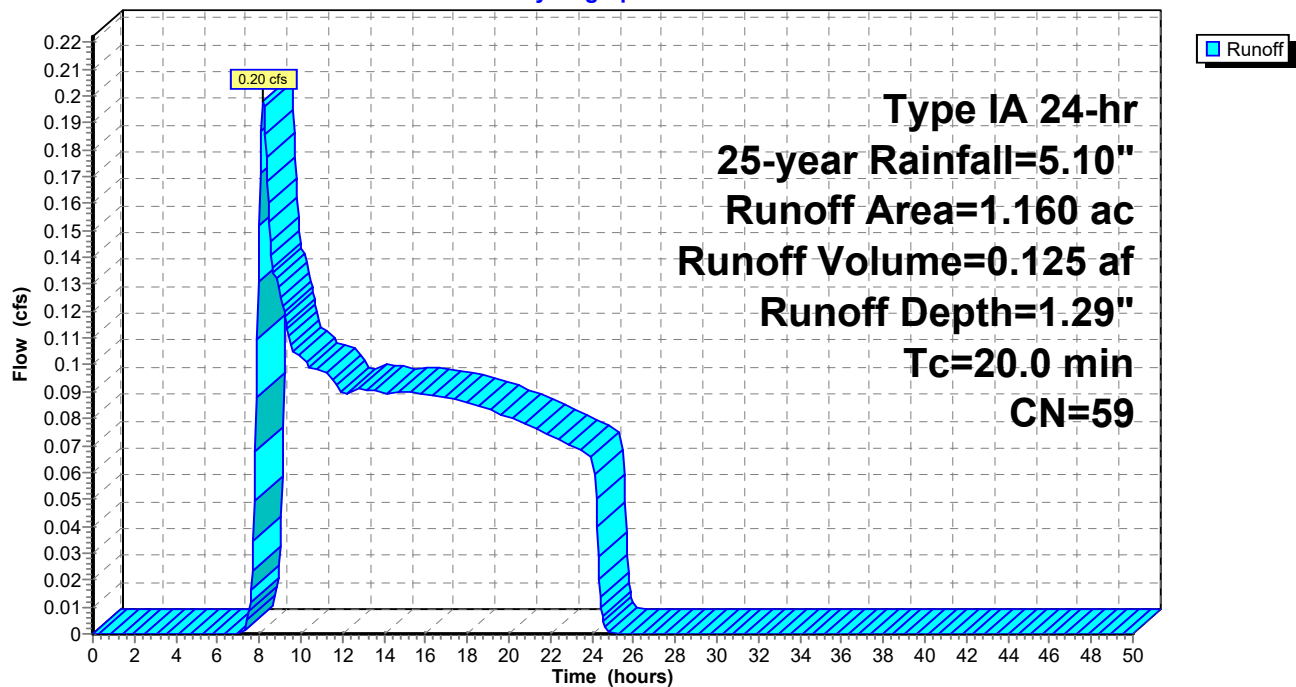
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
* 1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 2S: Node A - Public Non-PGIS

Hydrograph



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

Runoff = 4.22 cfs @ 8.09 hrs, Volume= 1.438 af, Depth= 3.76"
 Routed to Pond N3 : Node A

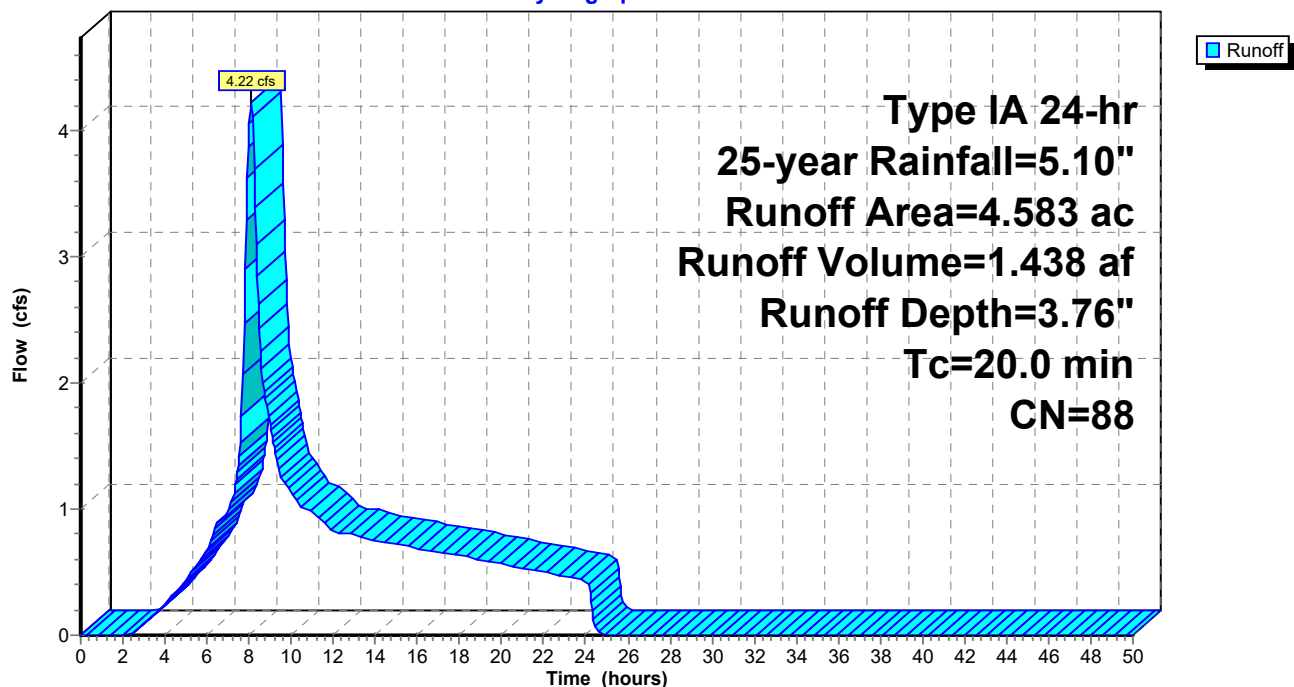
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
* 1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
3.373	98	Roofs, HSG A
4.583	88	Weighted Average
1.210		26.40% Pervious Area
3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 3S: Node A - C/F Non-PGIS

Hydrograph



Summary for Subcatchment 6S: Node B - Public PGIS

Runoff = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af, Depth= 4.86"
 Routed to Pond 10P : Bioretention

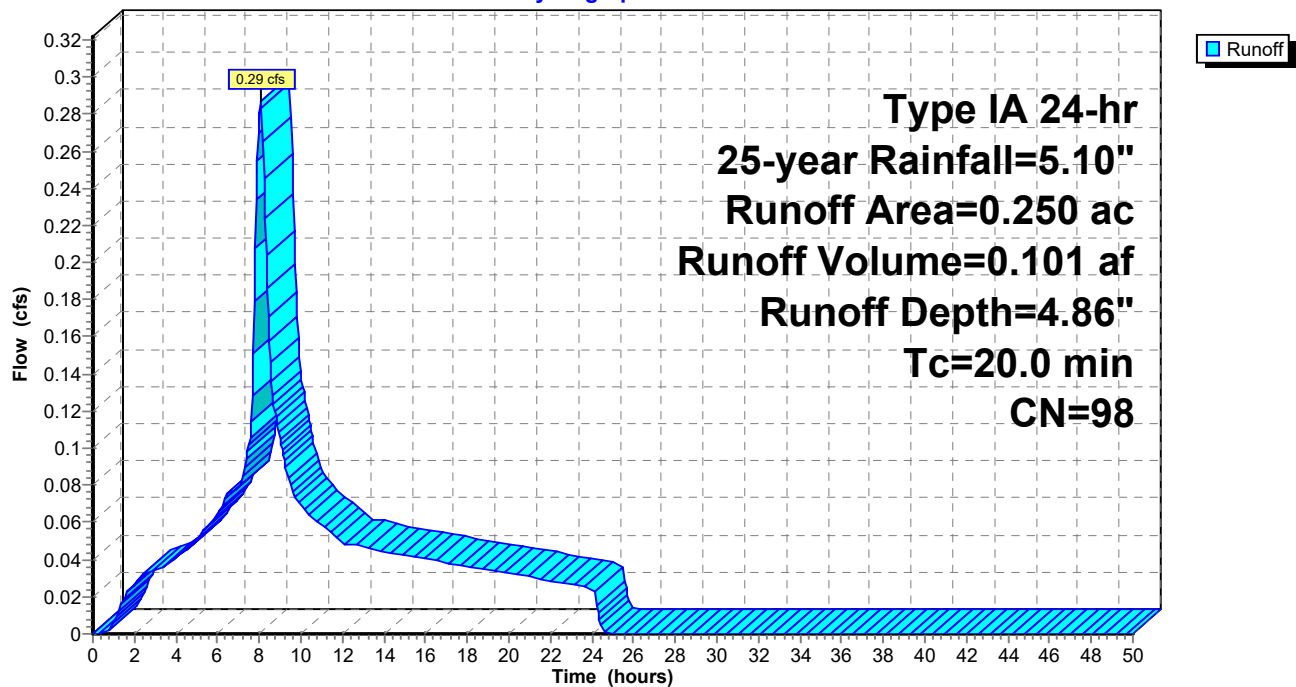
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 6S: Node B - Public PGIS

Hydrograph



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

Runoff = 5.62 cfs @ 8.10 hrs, Volume= 1.945 af, Depth= 3.46"
 Routed to Pond 7P : Node B

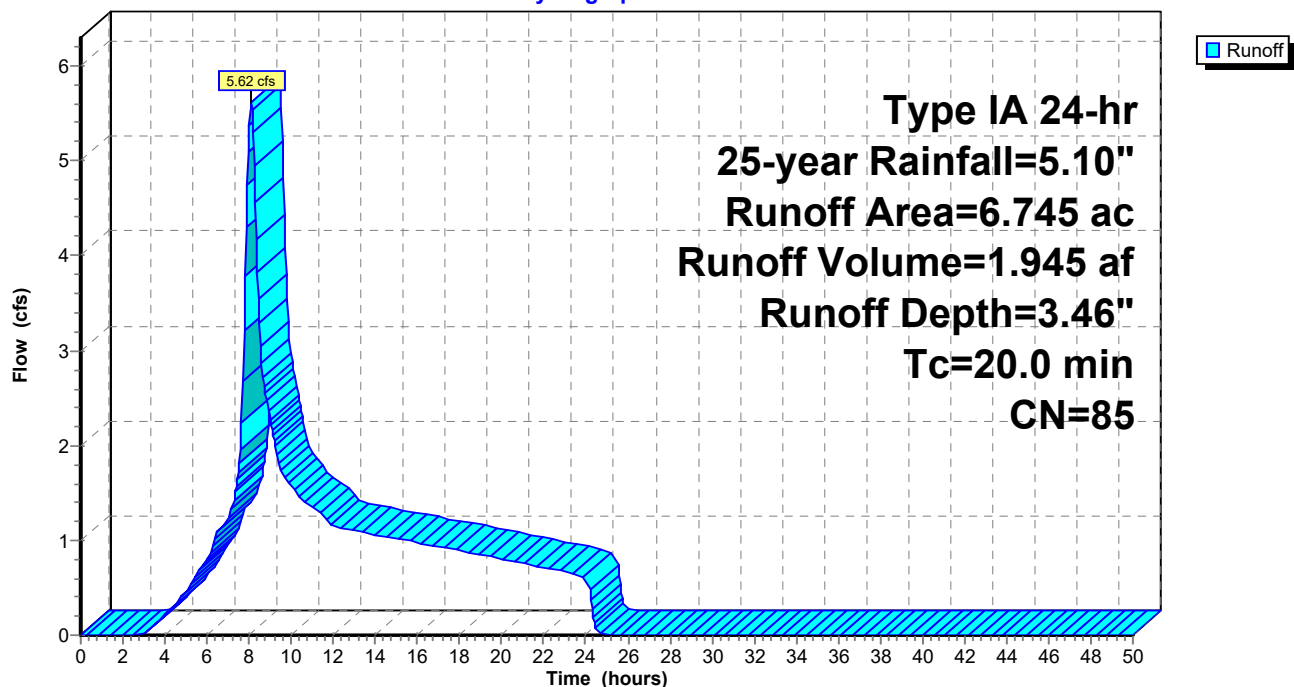
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 7S: Node B - Subdivision Non-PGIS

Hydrograph



Summary for Subcatchment 8S: Node B - Public Non-PGIS

Runoff = 0.06 cfs @ 8.11 hrs, Volume= 0.022 af, Depth= 2.89"
 Routed to Pond 7P : Node B

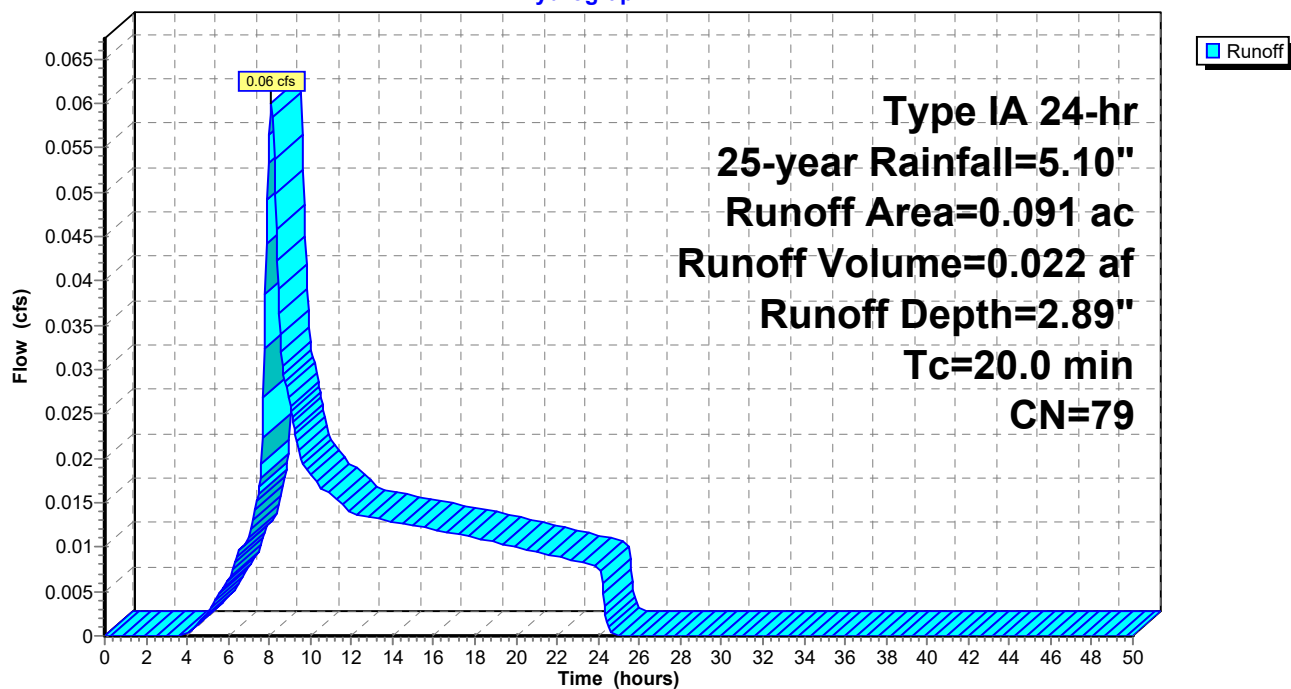
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 8S: Node B - Public Non-PGIS

Hydrograph



Summary for Subcatchment 9S: Node B - Subdivision PGIS

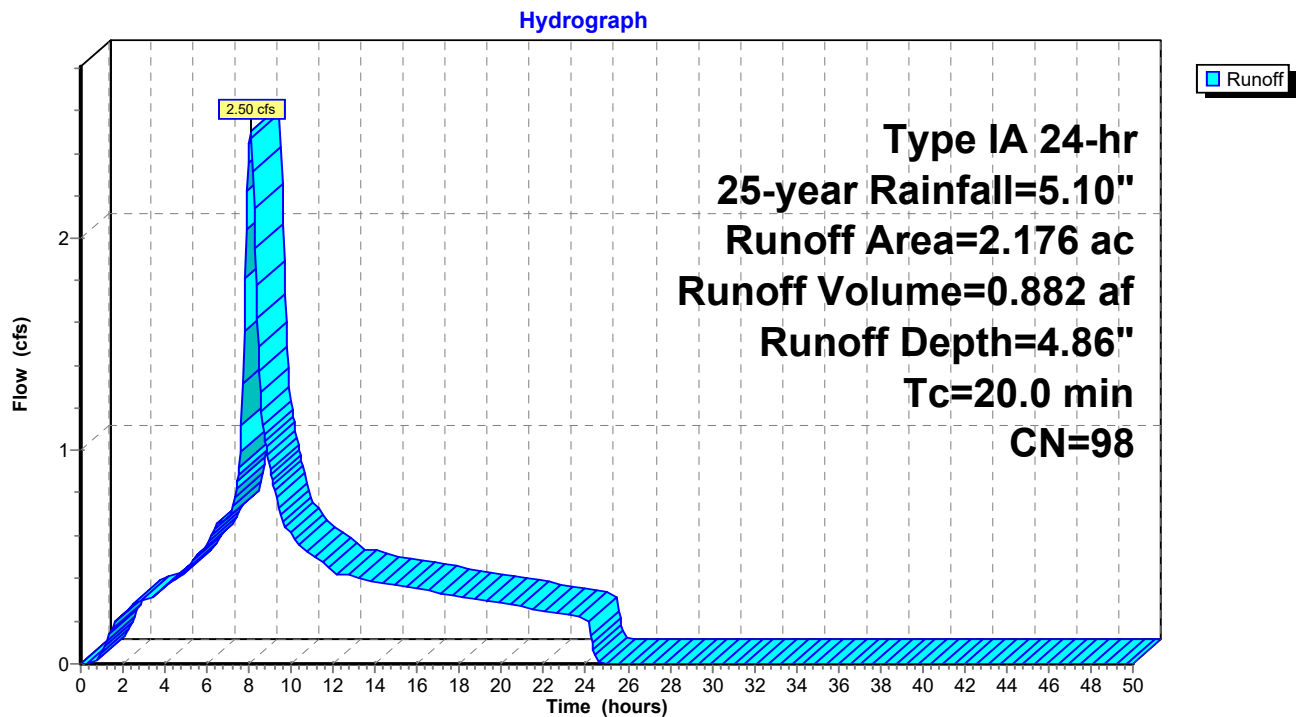
Runoff = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af, Depth= 4.86"
 Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

Runoff = 0.82 cfs @ 8.08 hrs, Volume= 0.288 af, Depth= 4.86"
 Routed to Pond N2 : Node C

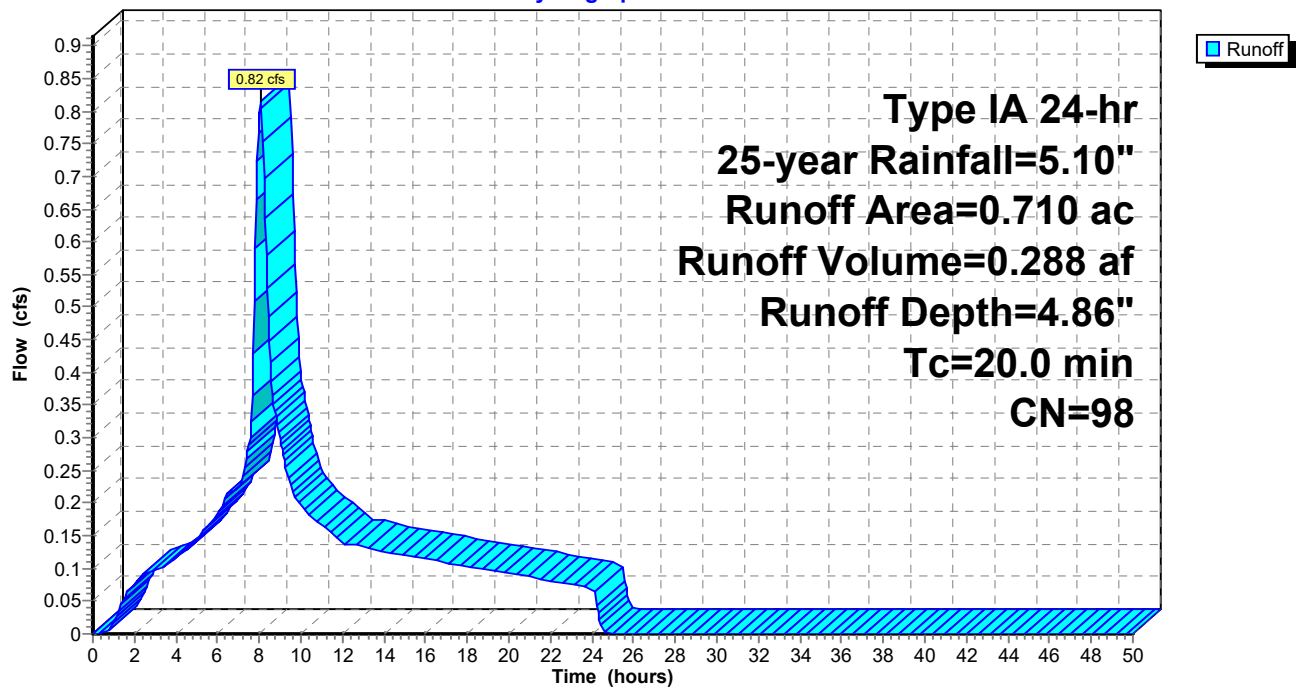
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 12S: Node C Public PGIS

Hydrograph



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

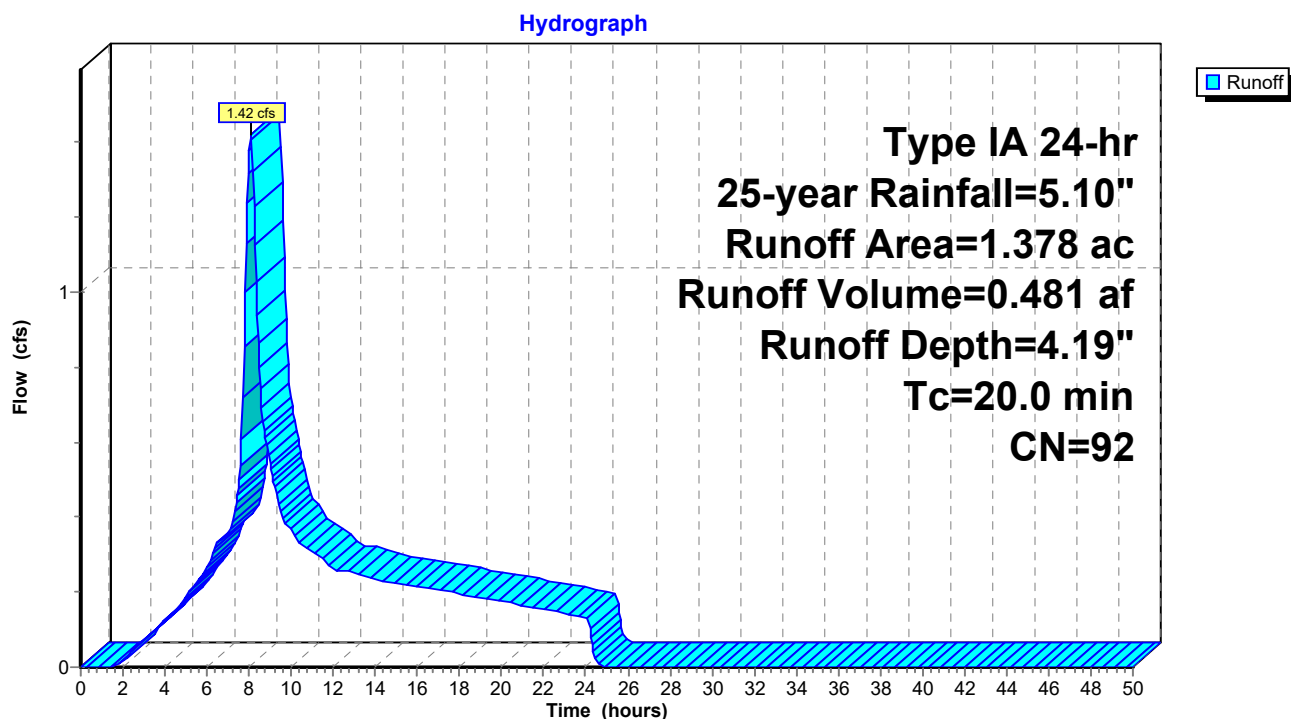
Runoff = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af, Depth= 4.19"
 Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.683 af, Depth= 4.86"
 Routed to Pond N2 : Node C

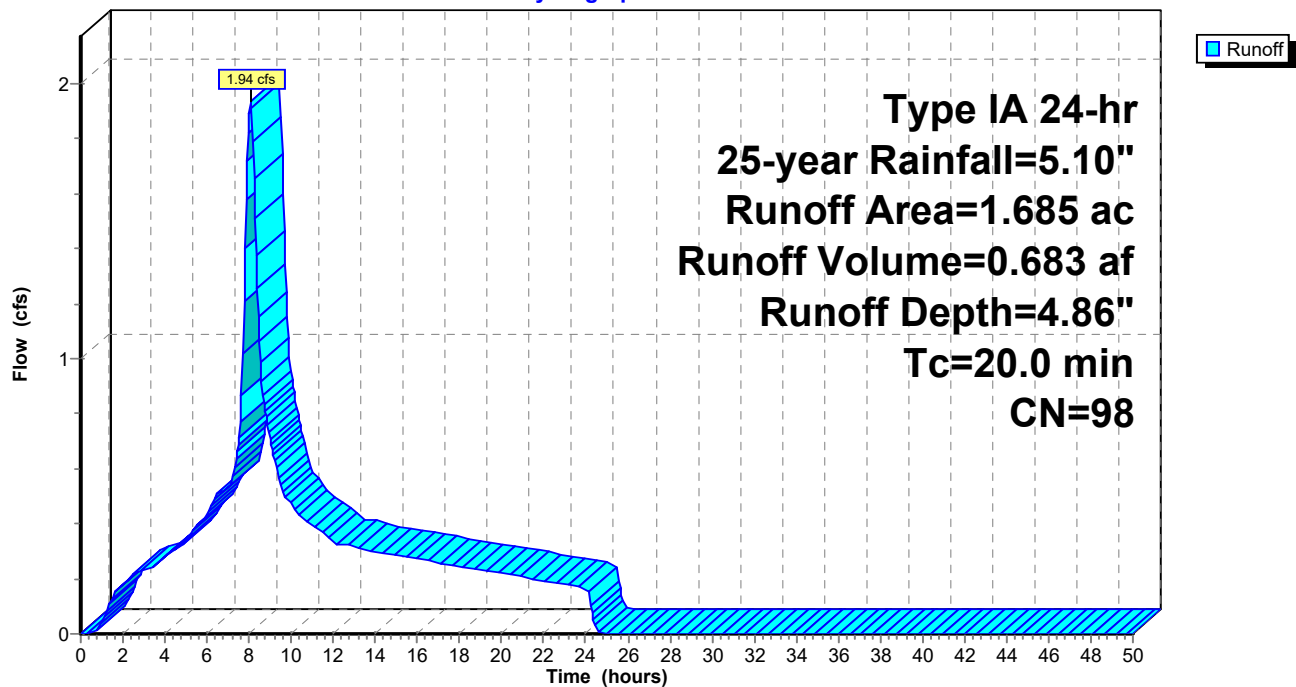
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 14S: Node C - Flex PGIS

Hydrograph



Summary for Subcatchment 17S: Node D - PGIS

Runoff = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af, Depth= 4.86"
 Routed to Pond 3P : Bioretention

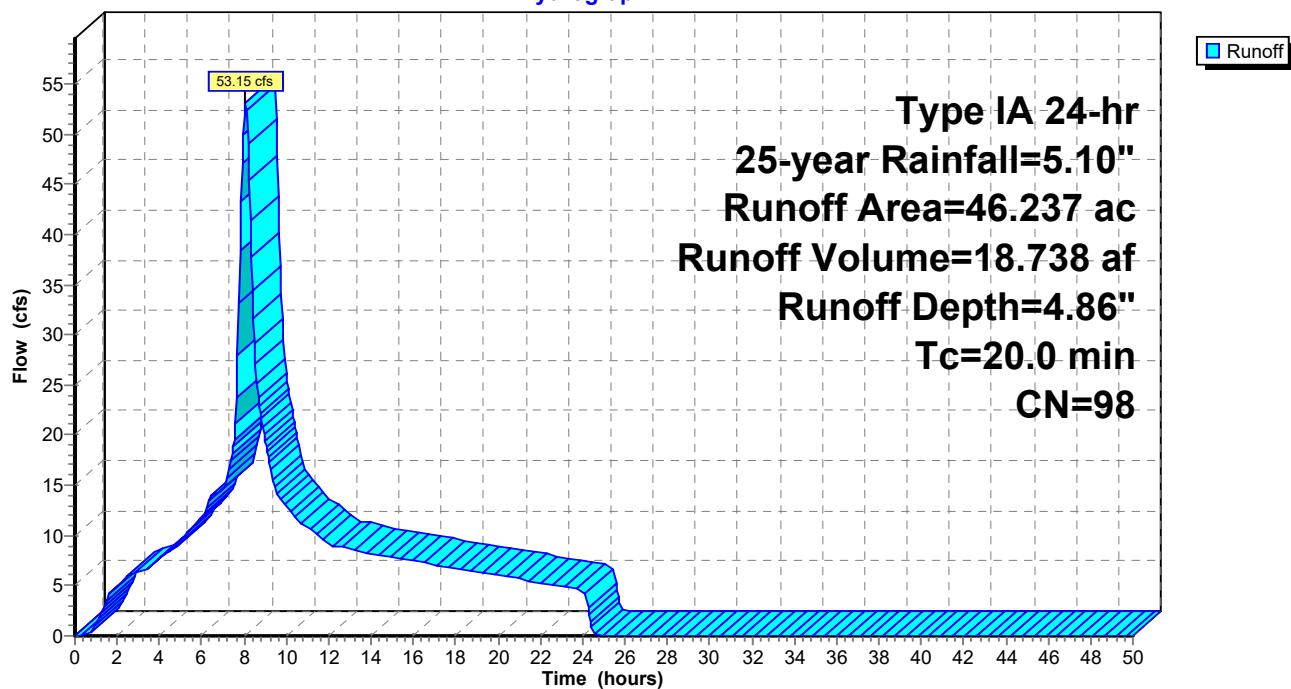
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 17S: Node D - PGIS

Hydrograph



Summary for Subcatchment D2R: Node C - Public Non-PGIS

Runoff = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af, Depth= 1.95"
 Routed to Pond 15P : Bioretention

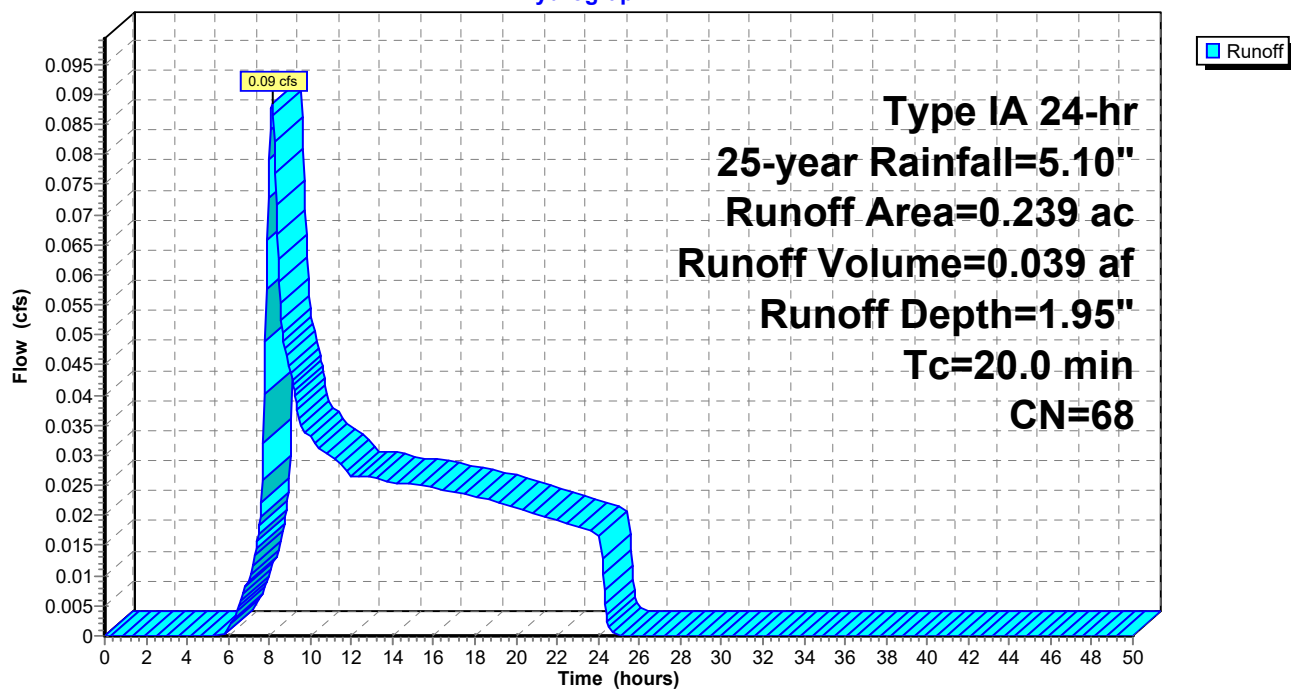
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D2R: Node C - Public Non-PGIS

Hydrograph



Summary for Subcatchment D3R: Node A - Public PGIS

Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af, Depth= 4.86"
 Routed to Pond 4P : Bioretention+Infiltration

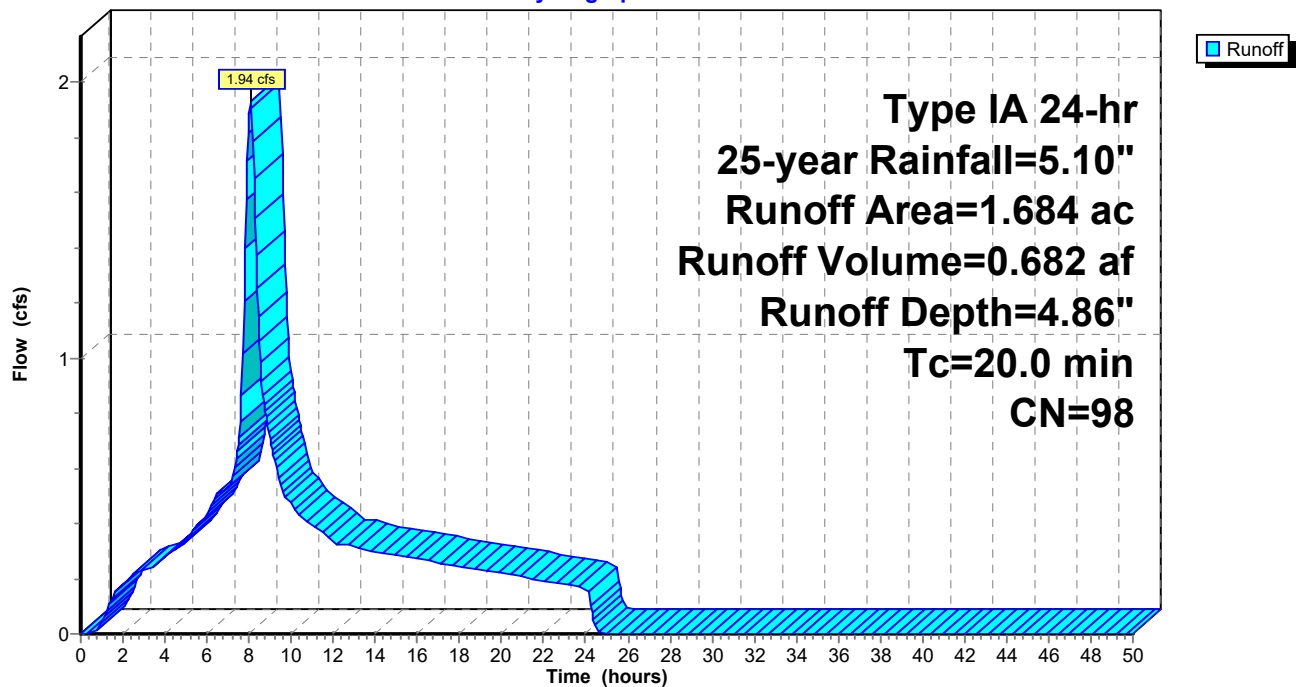
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D3R: Node A - Public PGIS

Hydrograph



Summary for Subcatchment D5P: Node D - Non-PGIS

Runoff = 22.11 cfs @ 8.11 hrs, Volume= 7.822 af, Depth= 3.17"
 Routed to Pond N1 : Node D

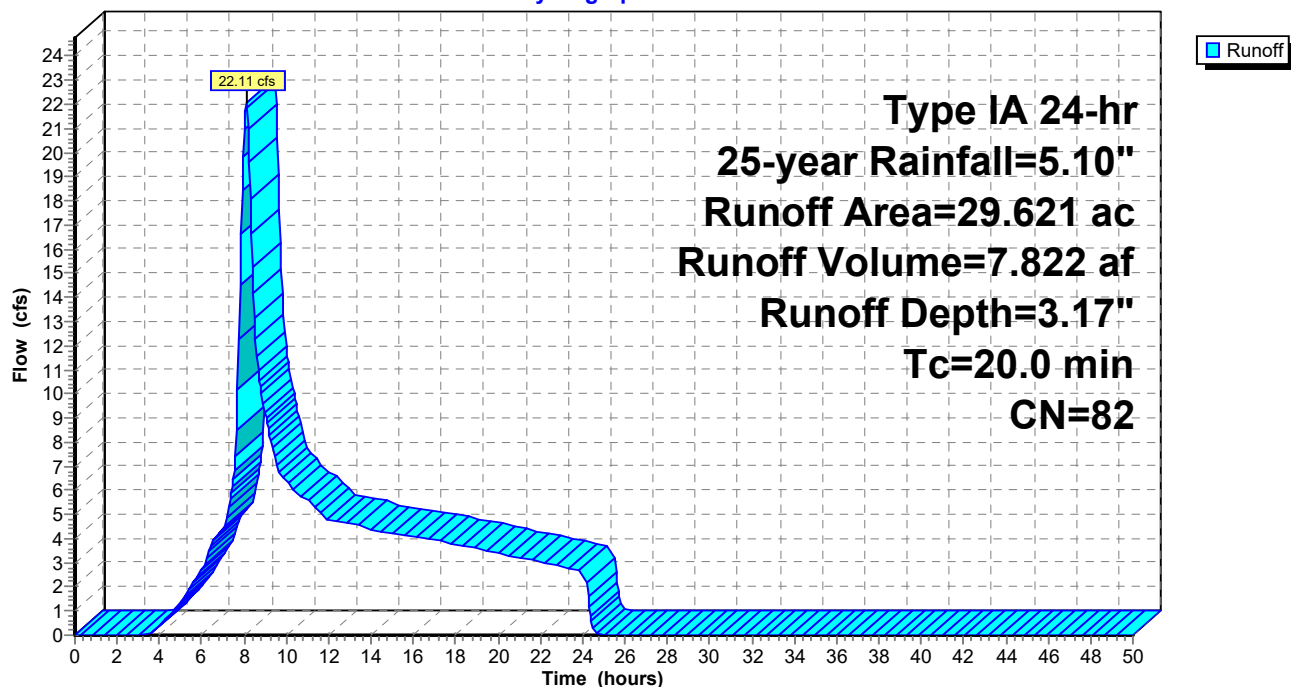
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D5P: Node D - Non-PGIS

Hydrograph



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af
 Outflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af, Atten= 46%, Lag= 25.9 min
 Primary = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
 Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 54.62' @ 8.51 hrs Surf.Area= 1.674 ac Storage= 2.845 af

Plug-Flow detention time= 90.8 min calculated for 18.424 af (98% of inflow)
 Center-of-Mass det. time= 77.7 min (745.3 - 667.6)

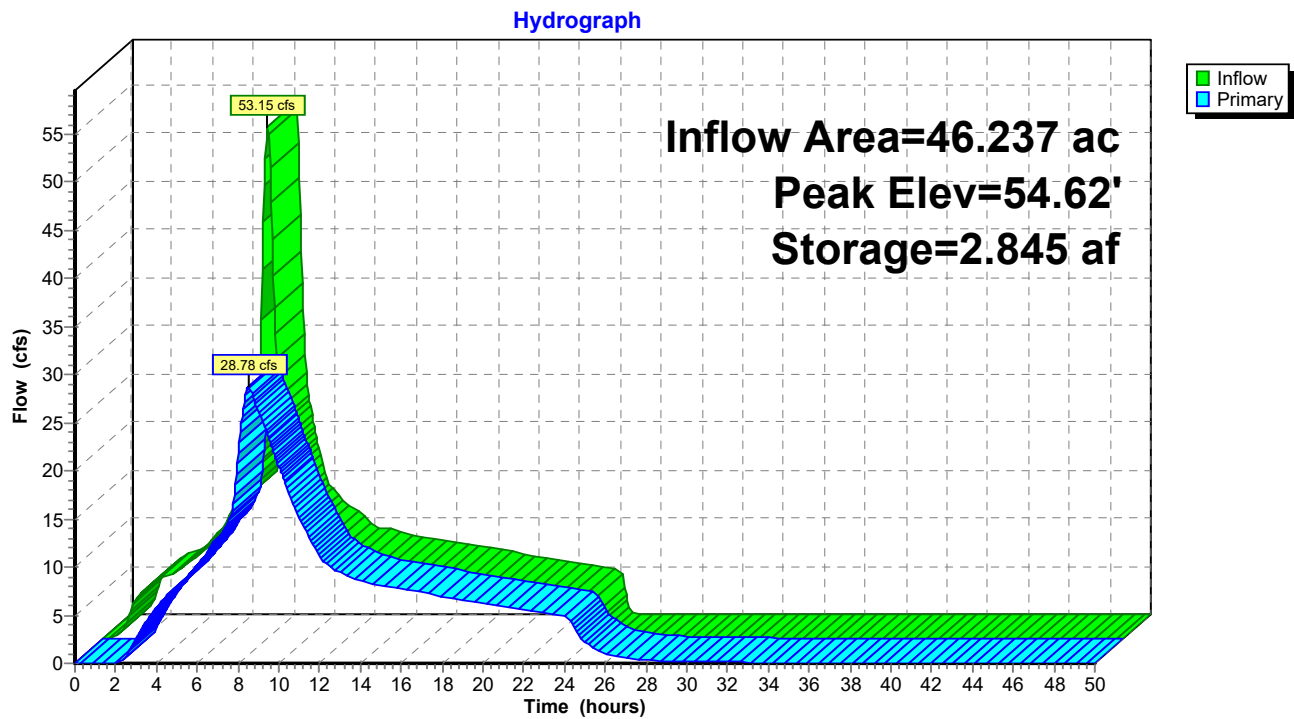
Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	270.00'W x 270.00'L x 6.50'H Prismatic 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	270.00'W x 270.00'L x 2.00'H Prismatic Inside #1
#3	50.50'	0.019 af	24.0" Round Pipe Storage Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	60.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	24.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=28.76 cfs @ 8.51 hrs HW=54.62' (Free Discharge)

↑ **1=Orifice/Grate** (Weir Controls 2.05 cfs @ 1.12 fps)
 — **2=Orifice/Grate** (Orifice Controls 26.71 cfs @ 8.50 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af
 Outflow = 1.93 cfs @ 8.11 hrs, Volume= 0.682 af, Atten= 0%, Lag= 1.7 min
 Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.277 af
 Secondary = 1.78 cfs @ 8.11 hrs, Volume= 0.406 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.73' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.037 af

Plug-Flow detention time= 65.8 min calculated for 0.682 af (100% of inflow)
 Center-of-Mass det. time= 65.7 min (733.3 - 667.6)

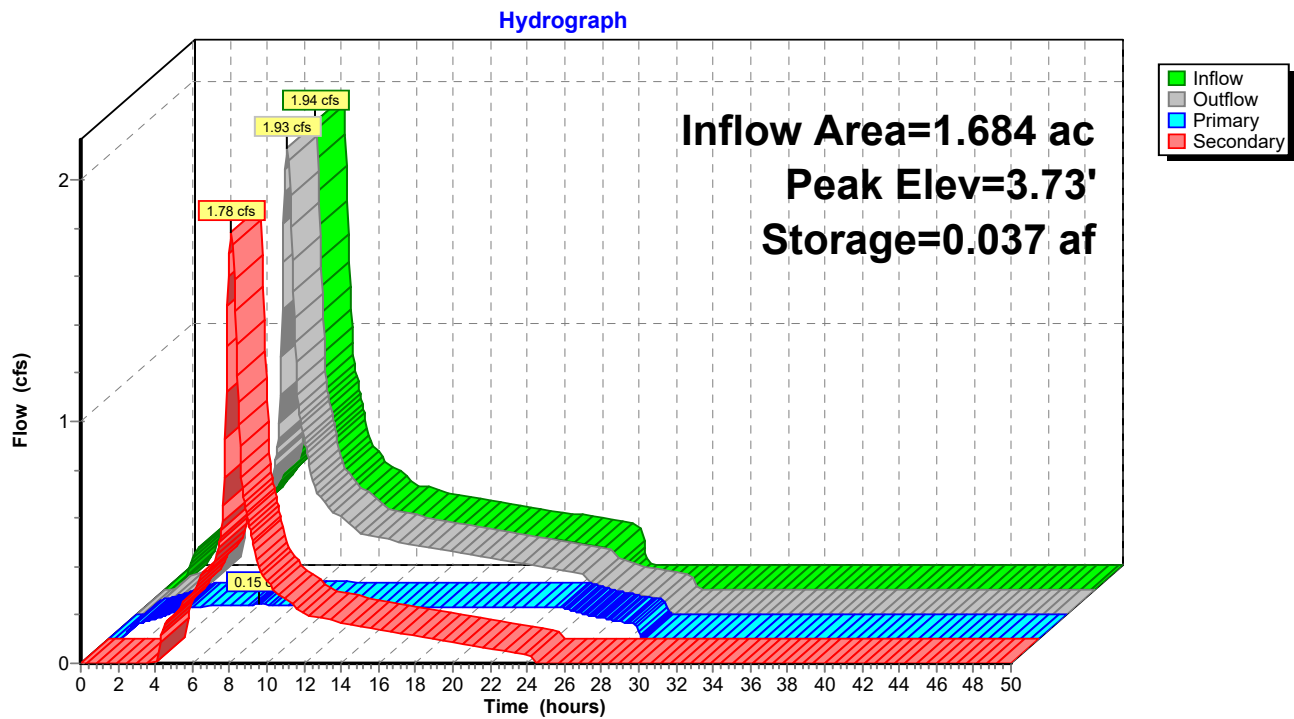
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	5.00'W x 250.00'L x 5.00'H Bioretention 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=1.78 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
 ↑2=Orifice/Grate (Orifice Controls 1.78 cfs @ 2.90 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

Inflow Area = 7.516 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af
 Outflow = 8.62 cfs @ 8.10 hrs, Volume= 3.046 af, Atten= 0%, Lag= 1.2 min
 Primary = 0.36 cfs @ 8.10 hrs, Volume= 0.882 af
 Secondary = 8.26 cfs @ 8.10 hrs, Volume= 2.164 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.97' @ 8.10 hrs Surf.Area= 0.138 ac Storage= 0.240 af

Plug-Flow detention time= 109.9 min calculated for 3.046 af (100% of inflow)
 Center-of-Mass det. time= 109.8 min (777.4 - 667.6)

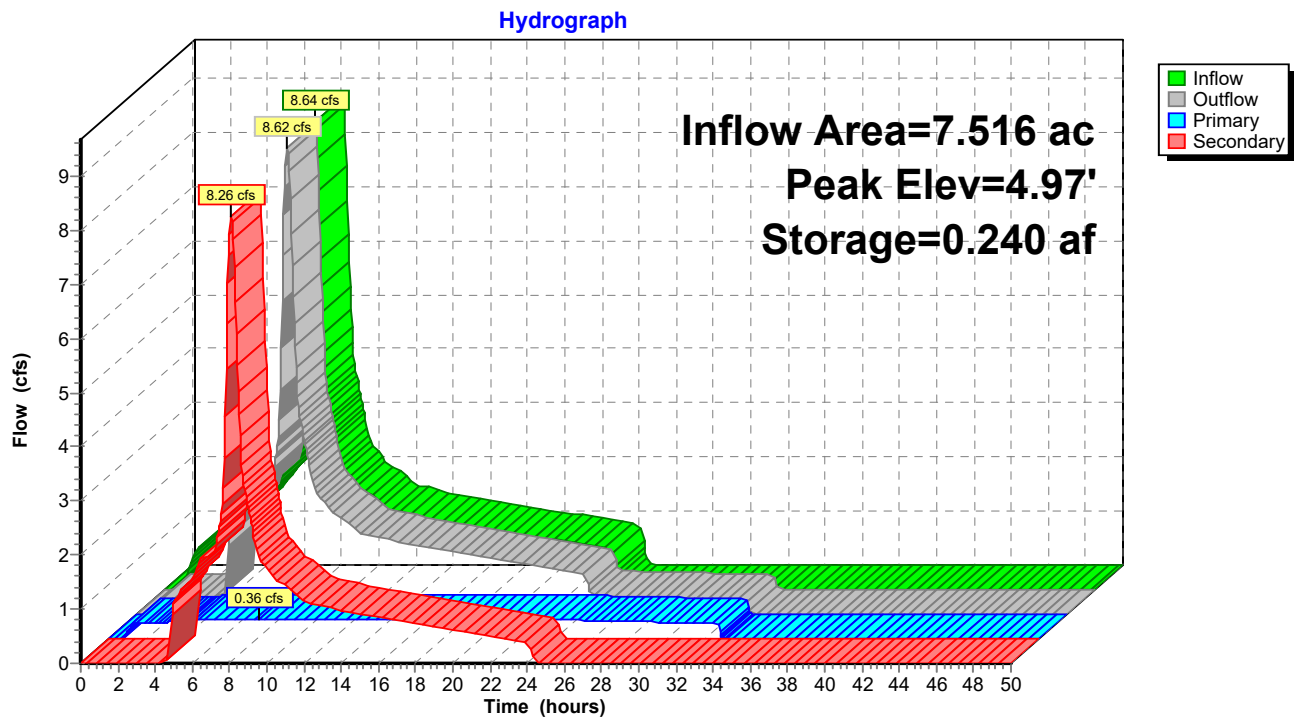
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	50.00'W x 120.00'L x 5.00'H Infiltration Trench 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.50'	30.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=8.25 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 8.25 cfs @ 2.24 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.73' (Flood elevation advised)
 [81] Warning: Exceeded Pond 10P by 48.92' @ 31.30 hrs
 [81] Warning: Exceeded Pond 11P by 48.92' @ 33.00 hrs

Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 6.37" for 25-year event
 Inflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
 Outflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af, Atten= 0%, Lag= 0.0 min
 Primary = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
 Routed to Pond N2 : Node C

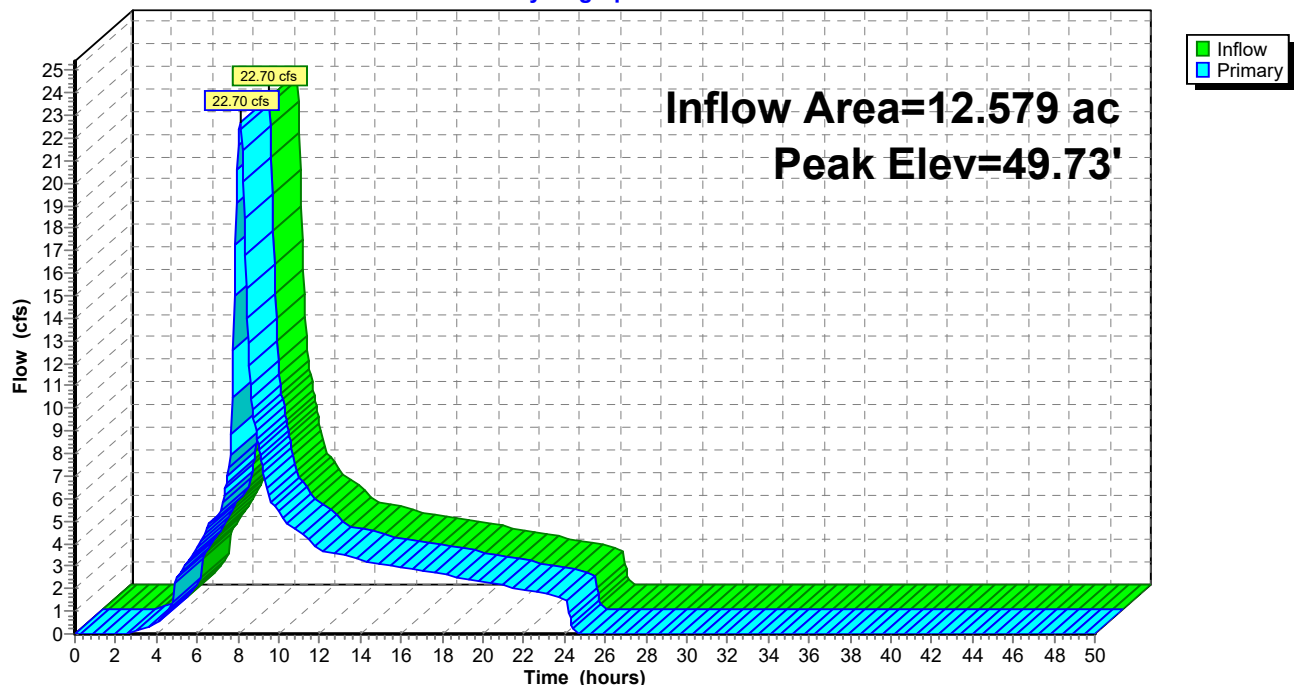
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 49.73' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	24.0" Round Culvert L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=22.48 cfs @ 8.10 hrs HW=49.73' TW=48.92' (Fixed TW Elev= 48.92')
 1=Culvert (Outlet Controls 9.89 cfs @ 3.15 fps)
 2=Sharp-Crested Rectangular Weir(Weir Controls 12.59 cfs @ 1.55 fps)

Pond 7P: Node B

Hydrograph



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af
 Outflow = 0.29 cfs @ 8.09 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.045 af
 Secondary = 0.26 cfs @ 8.09 hrs, Volume= 0.056 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.25' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 67.0 min calculated for 0.101 af (100% of inflow)
 Center-of-Mass det. time= 67.1 min (734.7 - 667.6)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	5.00'W x 40.00'L x 5.00'H Bioretention 0.023 af Overall x 35.0% Voids

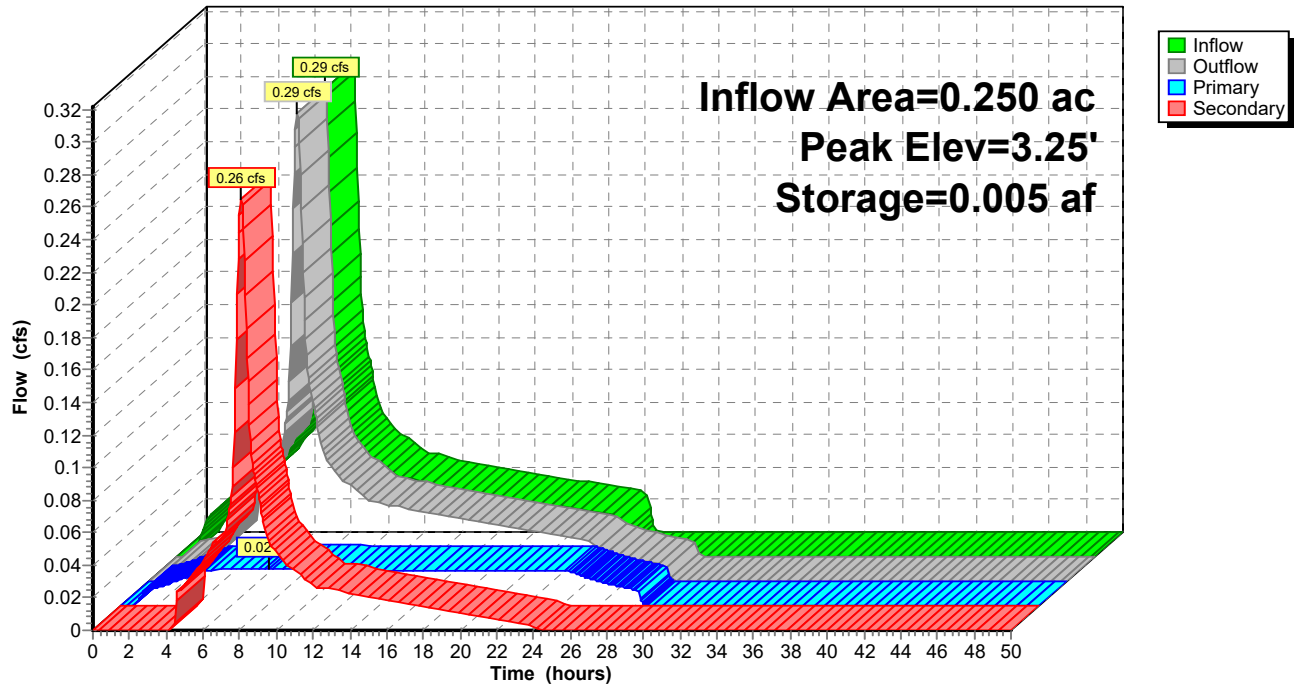
Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.26 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
 ↑2=Orifice/Grate (Orifice Controls 0.26 cfs @ 1.71 fps)

Pond 10P: Bioretention

Hydrograph



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac, 100.00% Impervious, Inflow Depth = 4.86" for 25-year event
 Inflow = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af
 Outflow = 2.48 cfs @ 8.11 hrs, Volume= 0.882 af, Atten= 1%, Lag= 2.0 min
 Primary = 0.19 cfs @ 8.11 hrs, Volume= 0.356 af
 Secondary = 2.30 cfs @ 8.11 hrs, Volume= 0.526 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.87' @ 8.11 hrs Surf.Area= 0.031 ac Storage= 0.053 af

Plug-Flow detention time= 73.2 min calculated for 0.881 af (100% of inflow)
 Center-of-Mass det. time= 73.4 min (741.0 - 667.6)

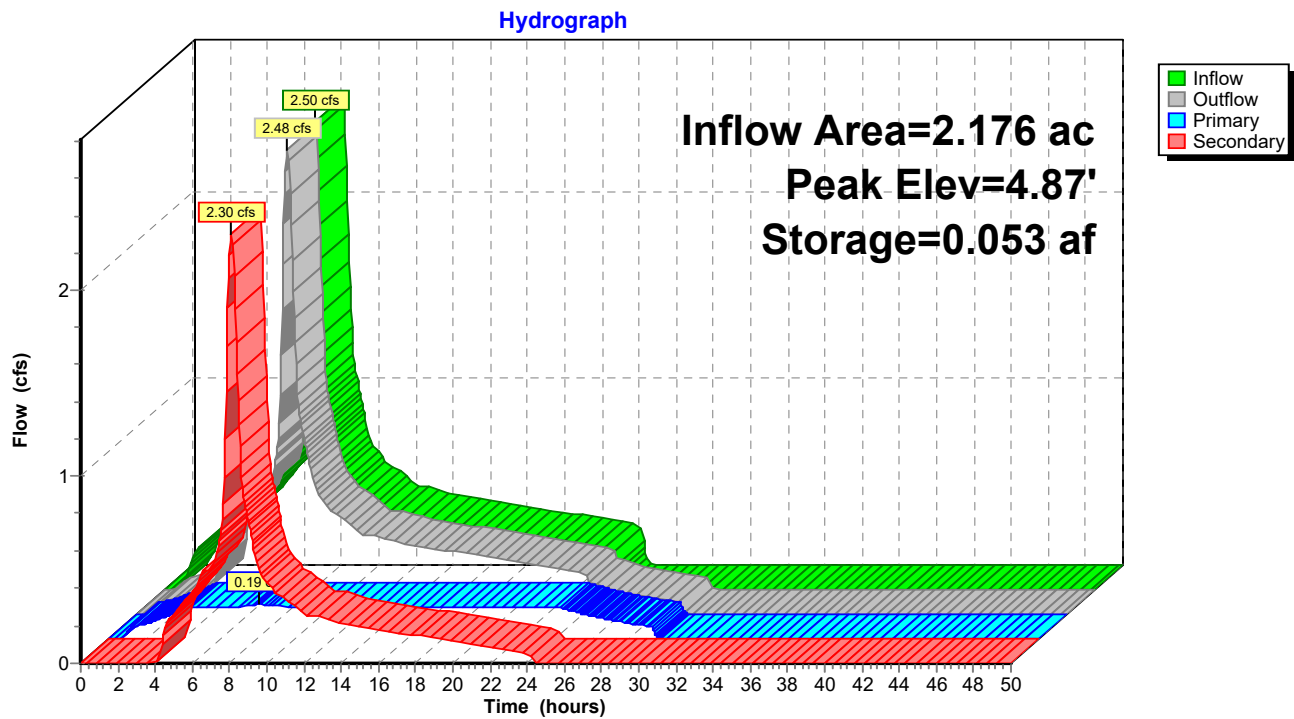
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	5.00'W x 270.00'L x 6.00'H Bioretention 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.30 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
 ↑2=Orifice/Grate (Orifice Controls 2.30 cfs @ 3.17 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 1.95" for 25-year event
 Inflow = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af
 Outflow = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af, Atten= 59%, Lag= 79.6 min
 Primary = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 0.73' @ 9.47 hrs Surf.Area= 0.014 ac Storage= 0.004 af

Plug-Flow detention time= 31.1 min calculated for 0.039 af (100% of inflow)
 Center-of-Mass det. time= 31.1 min (884.7 - 853.6)

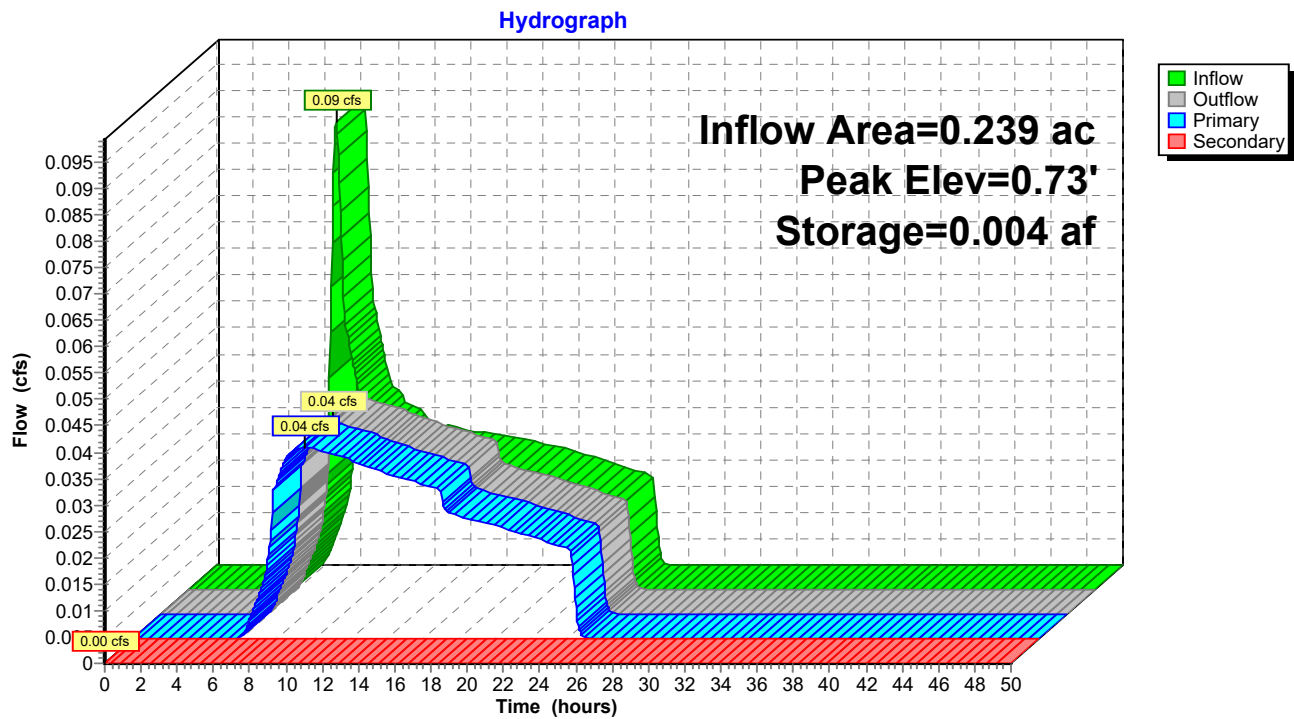
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	5.00'W x 120.00'L x 5.00'H Bioretention 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 9.47 hrs HW=0.73' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
 ↑2=Orifice/Grate (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 4.19" for 25-year event
 Inflow = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af
 Outflow = 1.41 cfs @ 8.12 hrs, Volume= 0.481 af, Atten= 1%, Lag= 1.8 min
 Primary = 0.09 cfs @ 8.12 hrs, Volume= 0.189 af
 Secondary = 1.32 cfs @ 8.12 hrs, Volume= 0.292 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.61' @ 8.12 hrs Surf.Area= 0.028 ac Storage= 0.044 af

Plug-Flow detention time= 110.7 min calculated for 0.480 af (100% of inflow)
 Center-of-Mass det. time= 111.0 min (827.2 - 716.3)

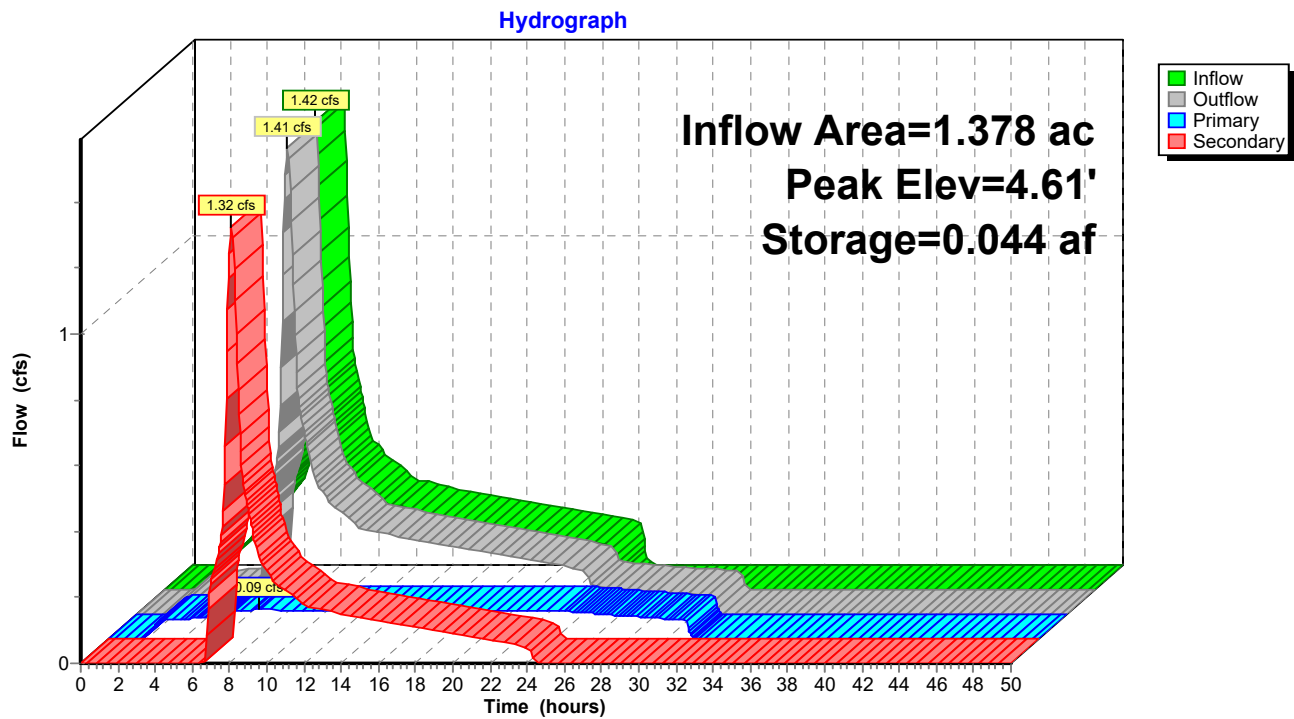
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	20.00'W x 60.00'L x 6.00'H Infiltration Trench 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.32 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
 ↑2=Orifice/Grate (Orifice Controls 1.32 cfs @ 2.65 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth > 4.78" for 25-year event
 Inflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
 Outflow = 27.97 cfs @ 8.70 hrs, Volume= 18.424 af, Atten= 3%, Lag= 11.7 min
 Primary = 3.57 cfs @ 8.70 hrs, Volume= 8.564 af
 Secondary = 24.41 cfs @ 8.70 hrs, Volume= 9.860 af
 Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.86' @ 8.70 hrs Surf.Area= 1.674 ac Storage= 2.259 af

Plug-Flow detention time= 143.4 min calculated for 18.424 af (100% of inflow)
 Center-of-Mass det. time= 143.3 min (888.6 - 745.3)

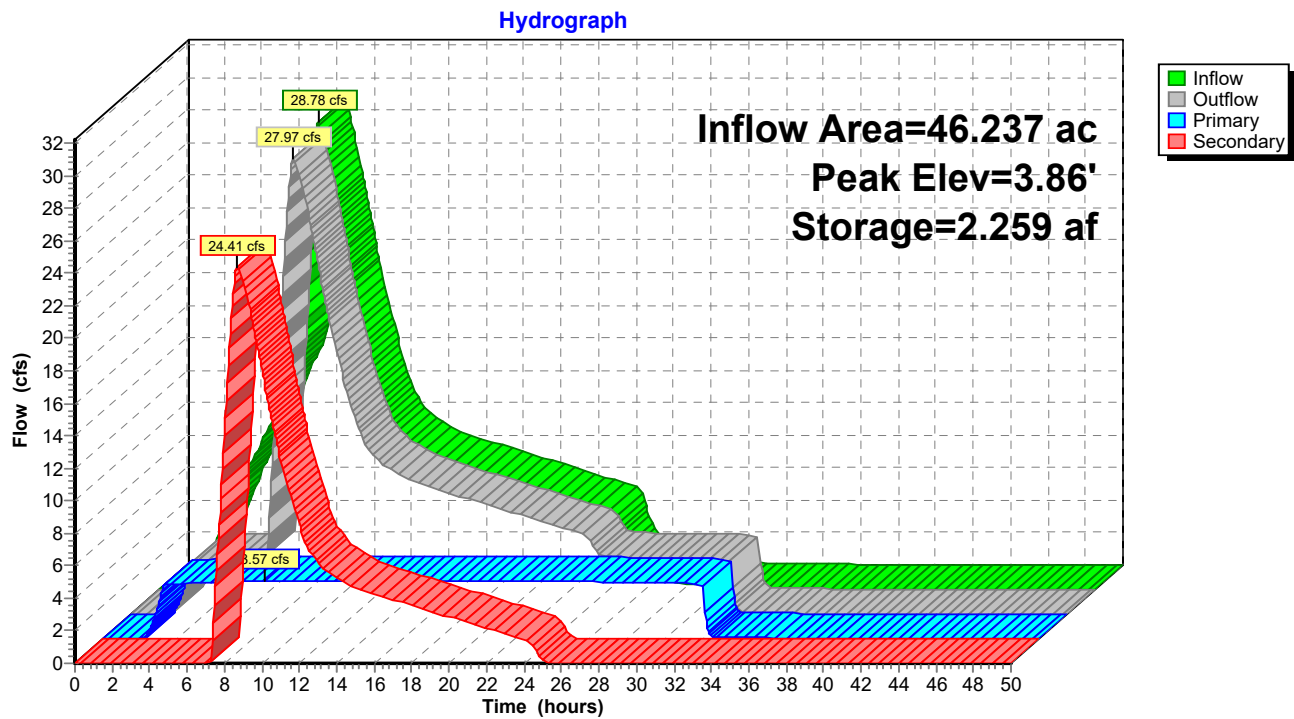
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	270.00'W x 270.00'L x 5.00'H Infiltration Trench 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	36.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.57 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 3.57 cfs)

Secondary OutFlow Max=24.40 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 24.40 cfs @ 3.03 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[81] Warning: Exceeded Pond 19P by 47.00' @ 49.95 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 6.90" for 25-year event
 Inflow = 65.60 cfs @ 8.14 hrs, Volume= 25.625 af
 Outflow = 33.98 cfs @ 9.62 hrs, Volume= 19.092 af, Atten= 48%, Lag= 88.8 min
 Primary = 33.98 cfs @ 9.62 hrs, Volume= 19.092 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 47.56' @ 9.62 hrs Surf.Area= 87,202 sf Storage= 331,489 cf

Plug-Flow detention time= 260.2 min calculated for 19.092 af (75% of inflow)
 Center-of-Mass det. time= 114.9 min (857.4 - 742.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

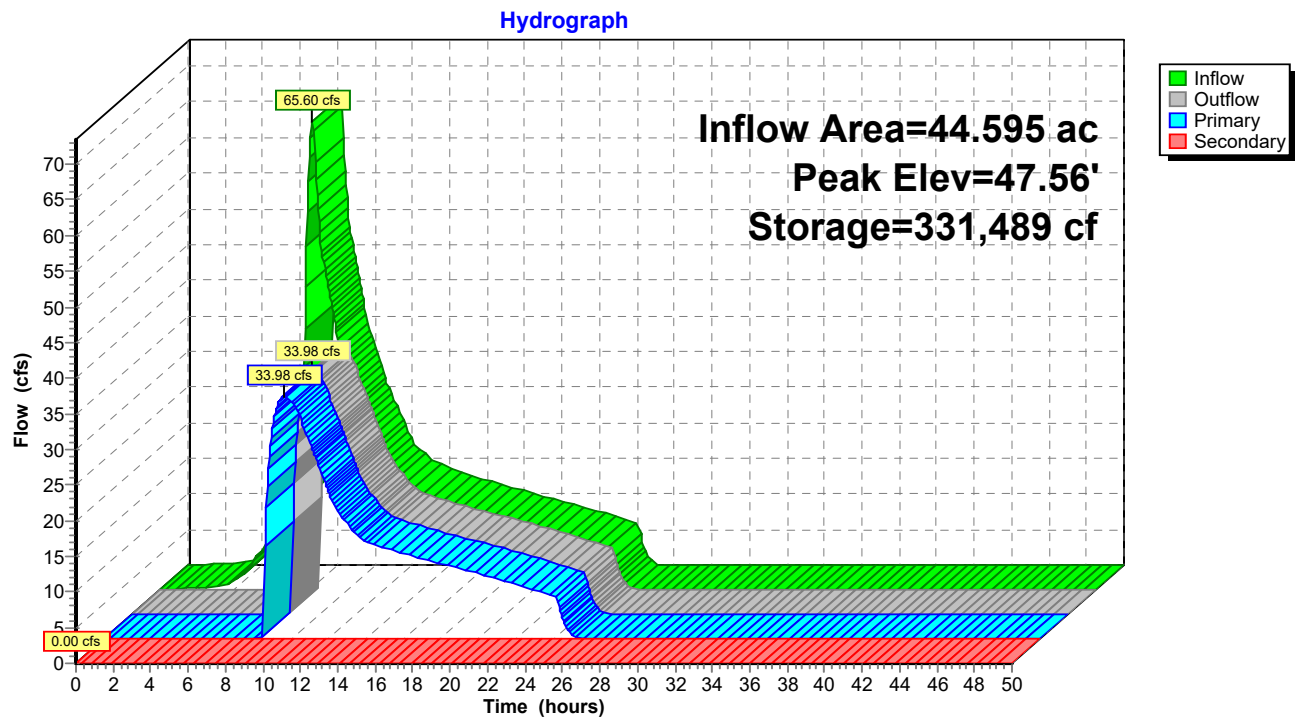
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	42.0" Round Culvert L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf
#2	Secondary	48.00'	30.0' long + 1.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=34.02 cfs @ 9.62 hrs HW=47.56' TW=47.00' (Fixed TW Elev= 47.00')
 ↑ **1=Culvert** (Outlet Controls 34.02 cfs @ 3.54 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
 ↑ **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 48.92' (Flood elevation advised)
 [81] Warning: Exceeded Pond 7P by 7.23' @ 2.10 hrs
 [81] Warning: Exceeded Pond 15P by 48.74' @ 7.90 hrs
 [81] Warning: Exceeded Pond 16P by 47.56' @ 1.60 hrs

Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 6.37" for 25-year event
 Inflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
 Outflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af, Atten= 0%, Lag= 0.0 min
 Primary = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
 Routed to Pond N1 : Node D

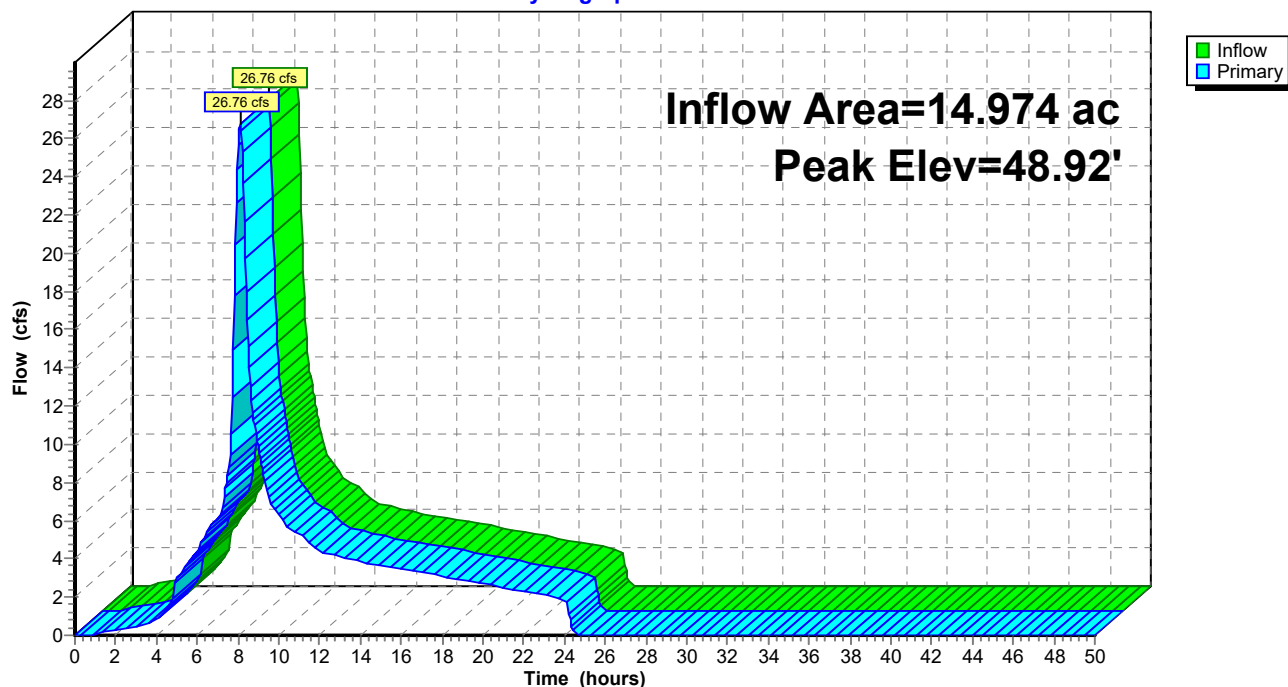
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 48.92' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	30.0" Round Culvert L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 ' S= 0.0029 ' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=26.41 cfs @ 8.10 hrs HW=48.92' TW=47.56' (Fixed TW Elev= 47.56')
 1=Culvert (Outlet Controls 21.77 cfs @ 4.44 fps)
 2=Sharp-Crested Rectangular Weir (Weir Controls 4.64 cfs @ 1.11 fps)

Pond N2: Node C

Hydrograph



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.51' (Flood elevation advised)
 [81] Warning: Exceeded Pond 4P by 49.73' @ 31.50 hrs
 [81] Warning: Exceeded Pond 5P by 49.73' @ 35.90 hrs

Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 8.63" for 25-year event
 Inflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
 Outflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af, Atten= 0%, Lag= 0.0 min
 Primary = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
 Routed to Pond 7P : Node B

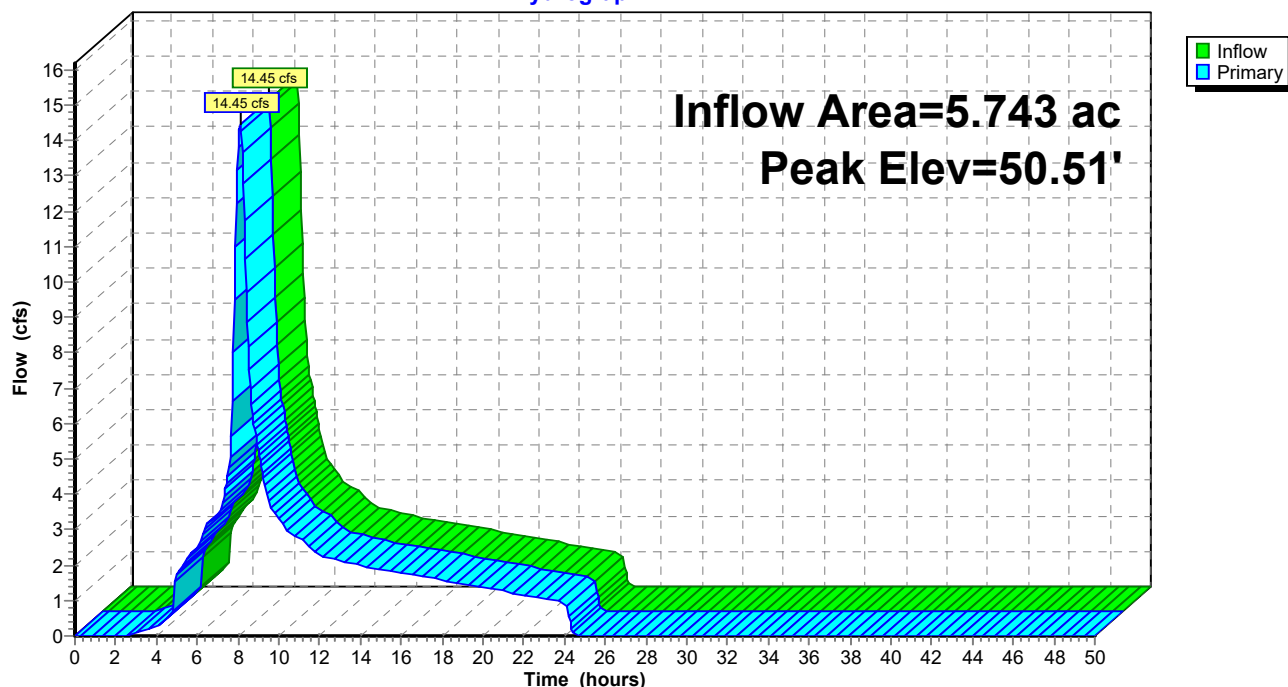
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 50.51' @ 8.10 hrs

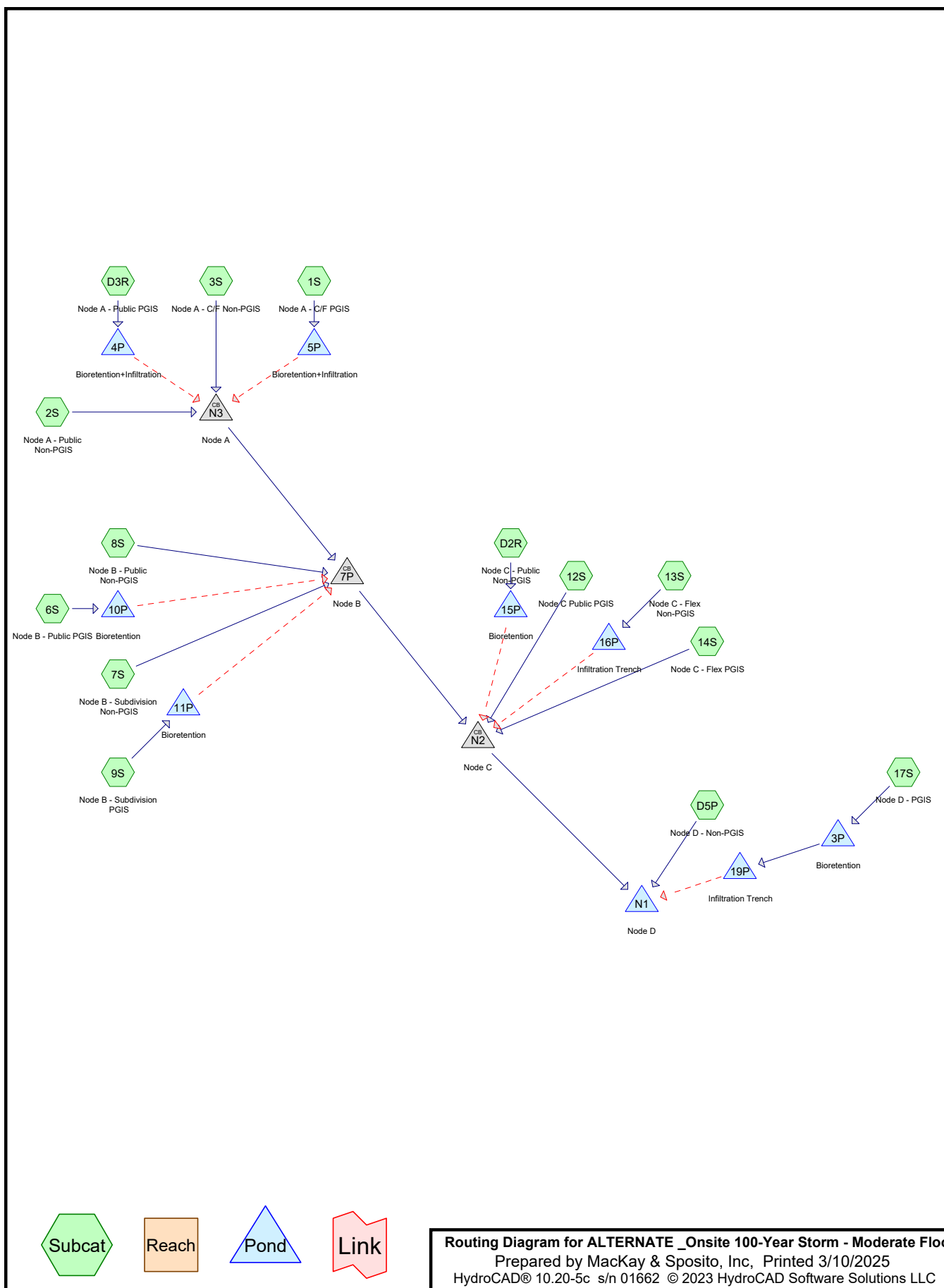
Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	24.0" Round Culvert L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=14.35 cfs @ 8.10 hrs HW=50.51' TW=49.73' (Fixed TW Elev= 49.73')
 1=Culvert (Outlet Controls 9.86 cfs @ 3.14 fps)
 2=Sharp-Crested Rectangular Weir(Weir Controls 4.48 cfs @ 1.10 fps)

Pond N3: Node A

Hydrograph





ALTERNATE _Onsite 100-Year Storm - Moderate Flood

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	92	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	38.896	0.000	0.000	0.000	104.075	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
 Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
 Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
 Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
 Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
 Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
 Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
 Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
 Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
 Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
 Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 7P: Node B Peak Elev=49.80' Inflow=28.83 cfs 8.778 af
 Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
 Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
 Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
 Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
 Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
 Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=48.12' Storage=383,550 cf Inflow=84.32 cfs 34.599 af
 Primary=48.30 cfs 27.890 af Secondary=3.24 cfs 0.176 af Outflow=51.54 cfs 28.066 af

Pond N2: Node C Peak Elev=49.06' Inflow=33.86 cfs 10.379 af
 Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.57' Inflow=18.21 cfs 5.428 af
 Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
 Routed to Pond 5P : Bioretention+Infiltration

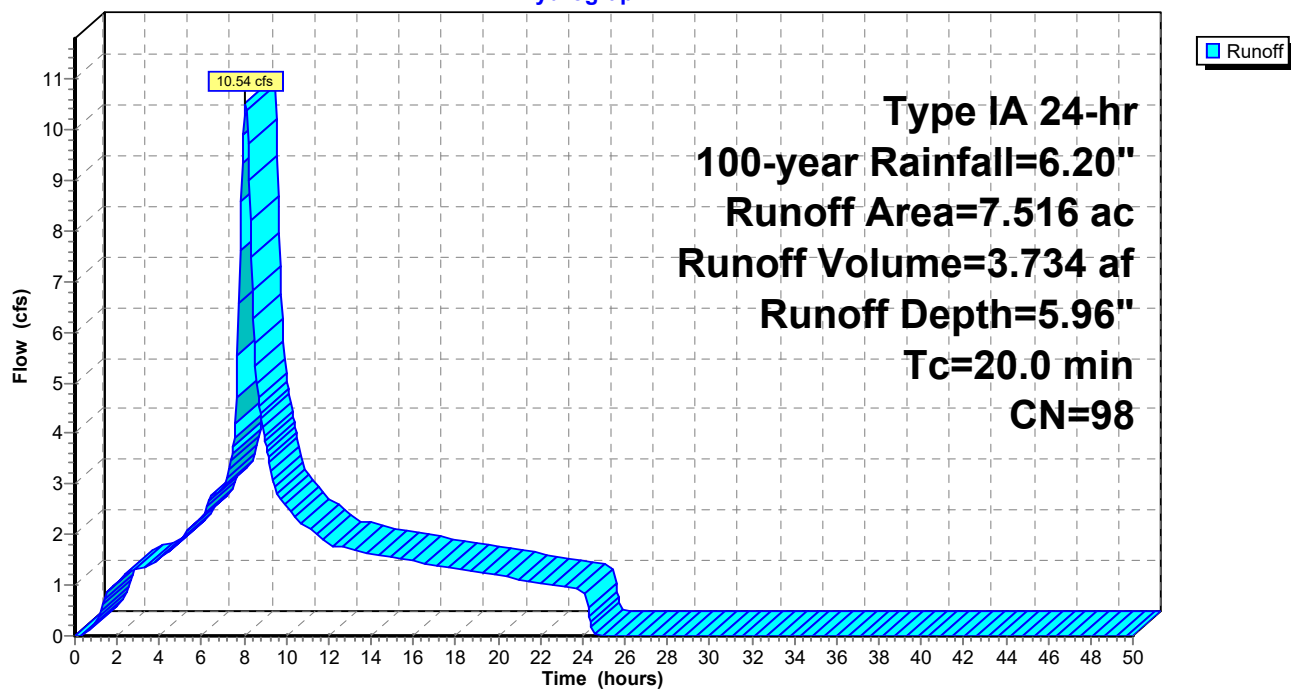
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Node A - C/F PGIS

Hydrograph



Summary for Subcatchment 2S: Node A - Public Non-PGIS

Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
 Routed to Pond N3 : Node A

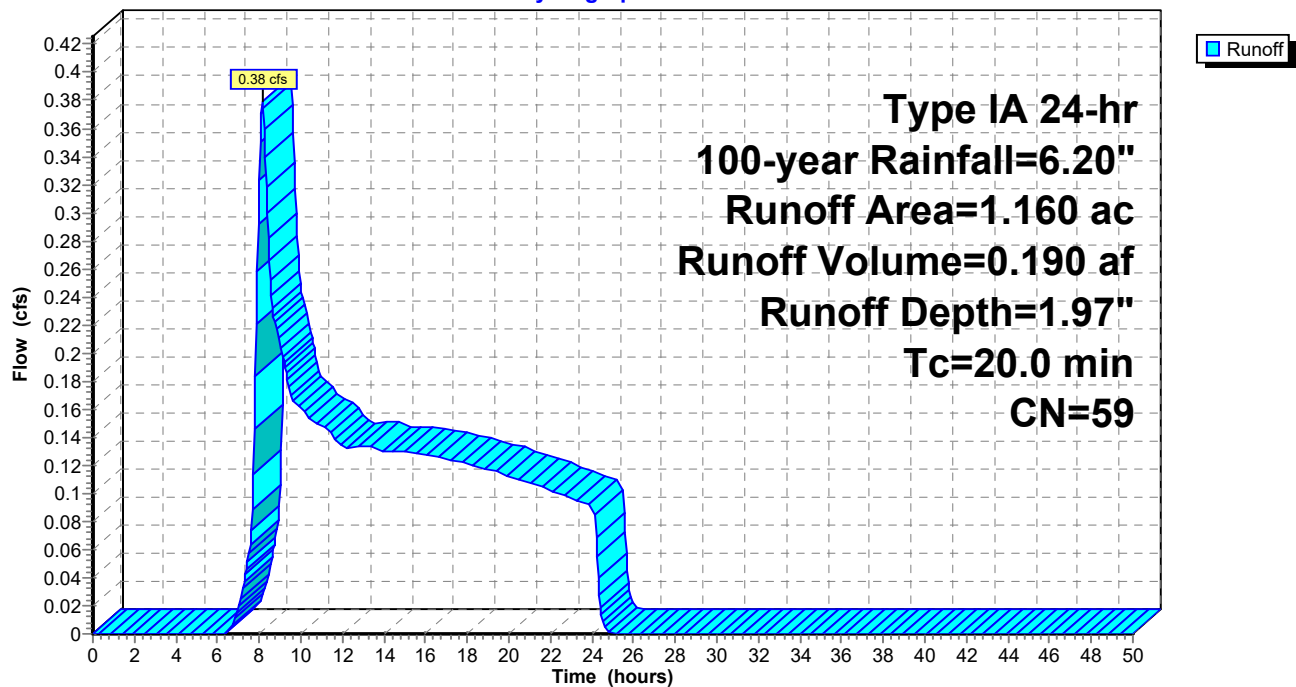
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
* 1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 2S: Node A - Public Non-PGIS

Hydrograph



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
 Routed to Pond N3 : Node A

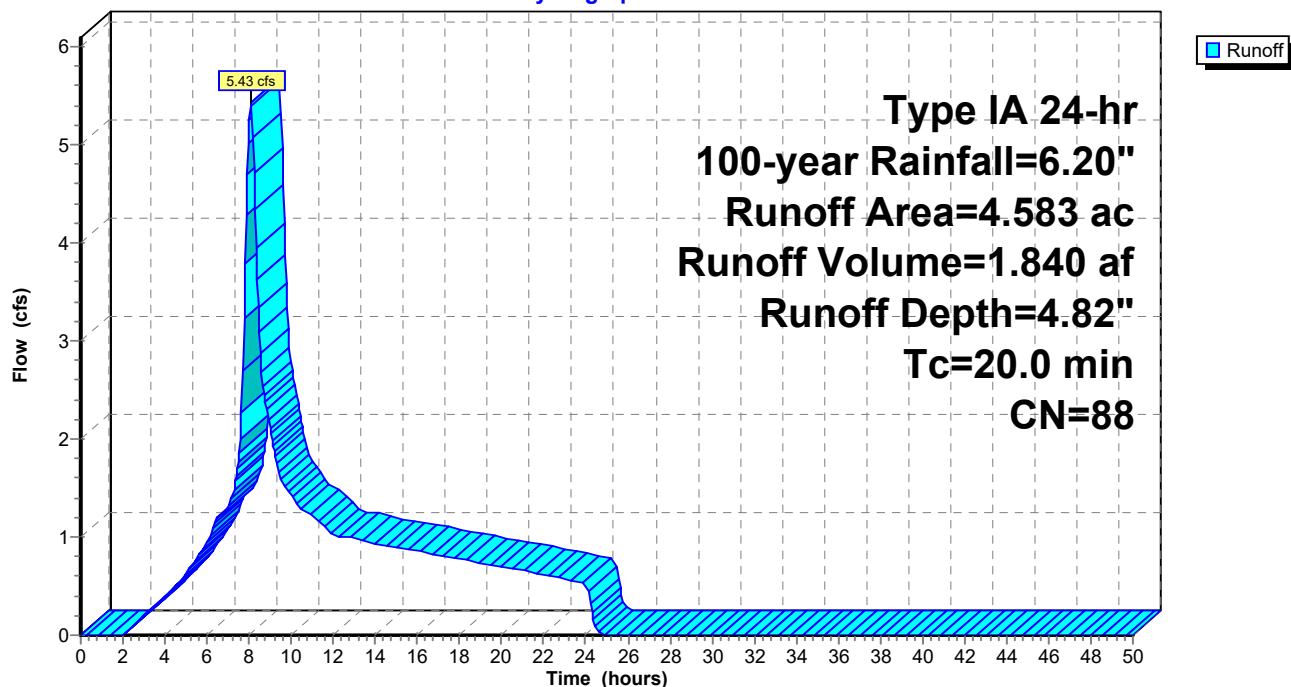
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
* 1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
3.373	98	Roofs, HSG A
4.583	88	Weighted Average
1.210		26.40% Pervious Area
3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 3S: Node A - C/F Non-PGIS

Hydrograph



Summary for Subcatchment 6S: Node B - Public PGIS

Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
 Routed to Pond 10P : Bioretention

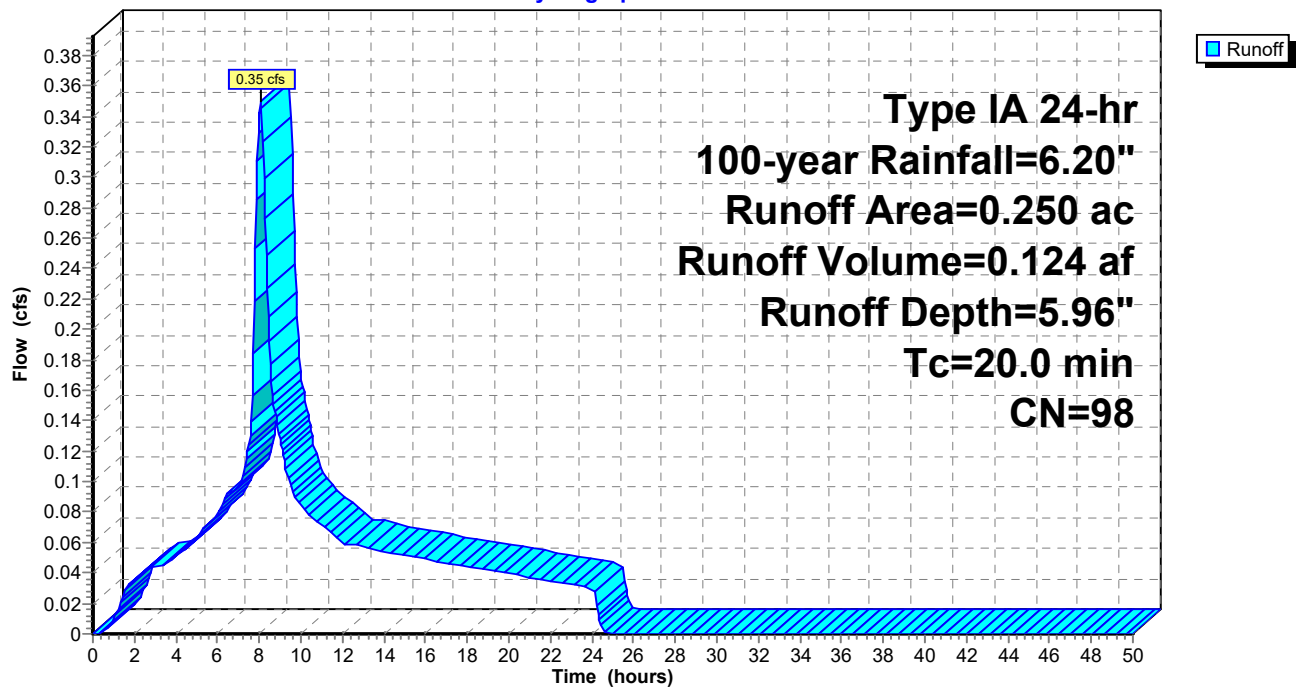
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 6S: Node B - Public PGIS

Hydrograph



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
 Routed to Pond 7P : Node B

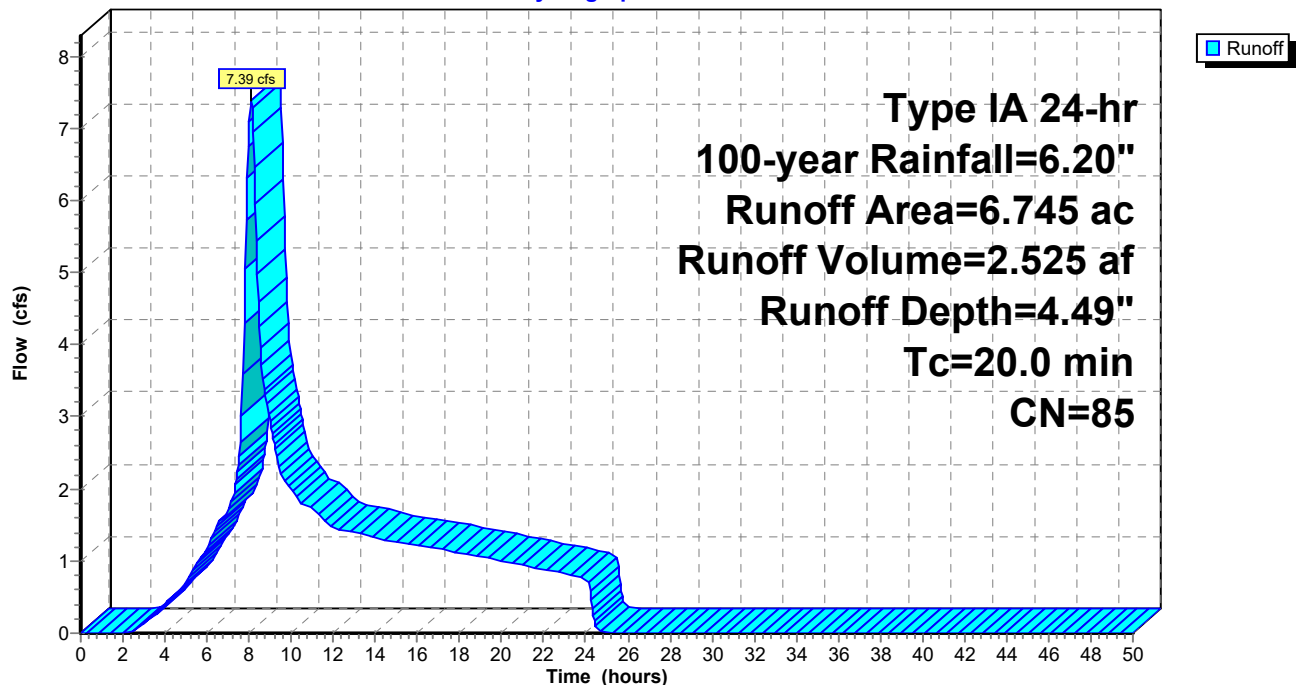
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 7S: Node B - Subdivision Non-PGIS

Hydrograph



Summary for Subcatchment 8S: Node B - Public Non-PGIS

Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
 Routed to Pond 7P : Node B

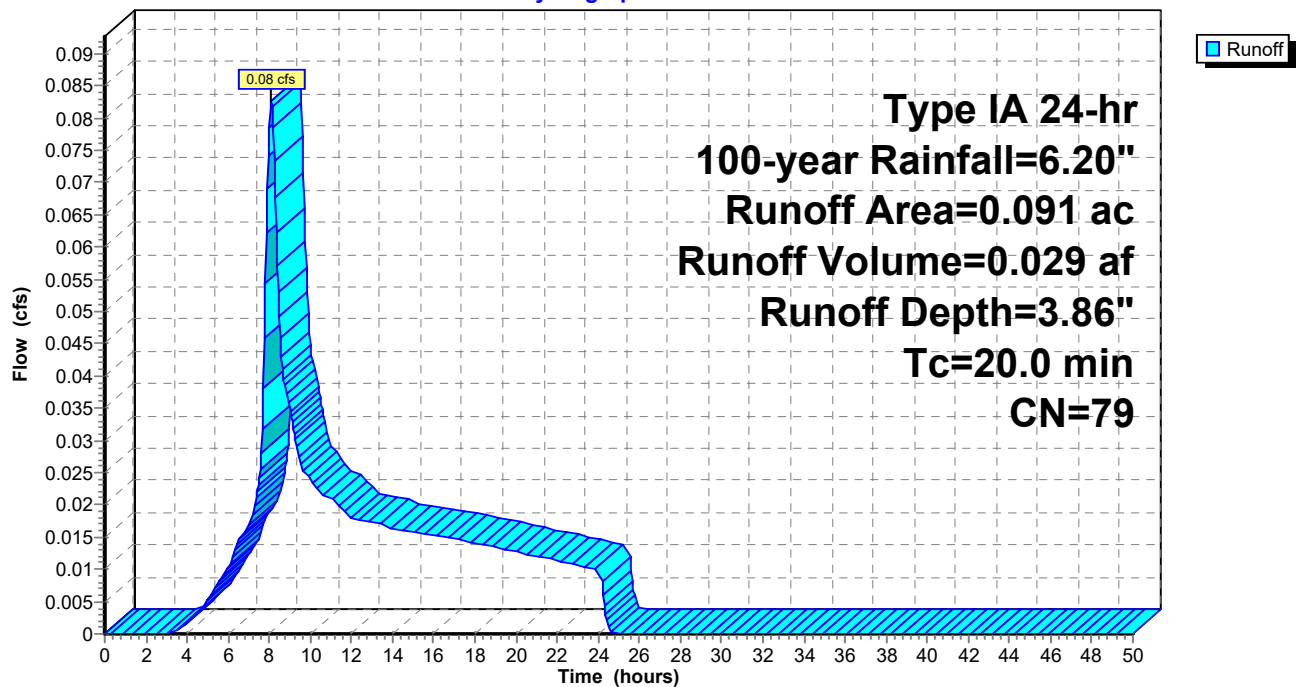
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 8S: Node B - Public Non-PGIS

Hydrograph



Summary for Subcatchment 9S: Node B - Subdivision PGIS

Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
 Routed to Pond 11P : Bioretention

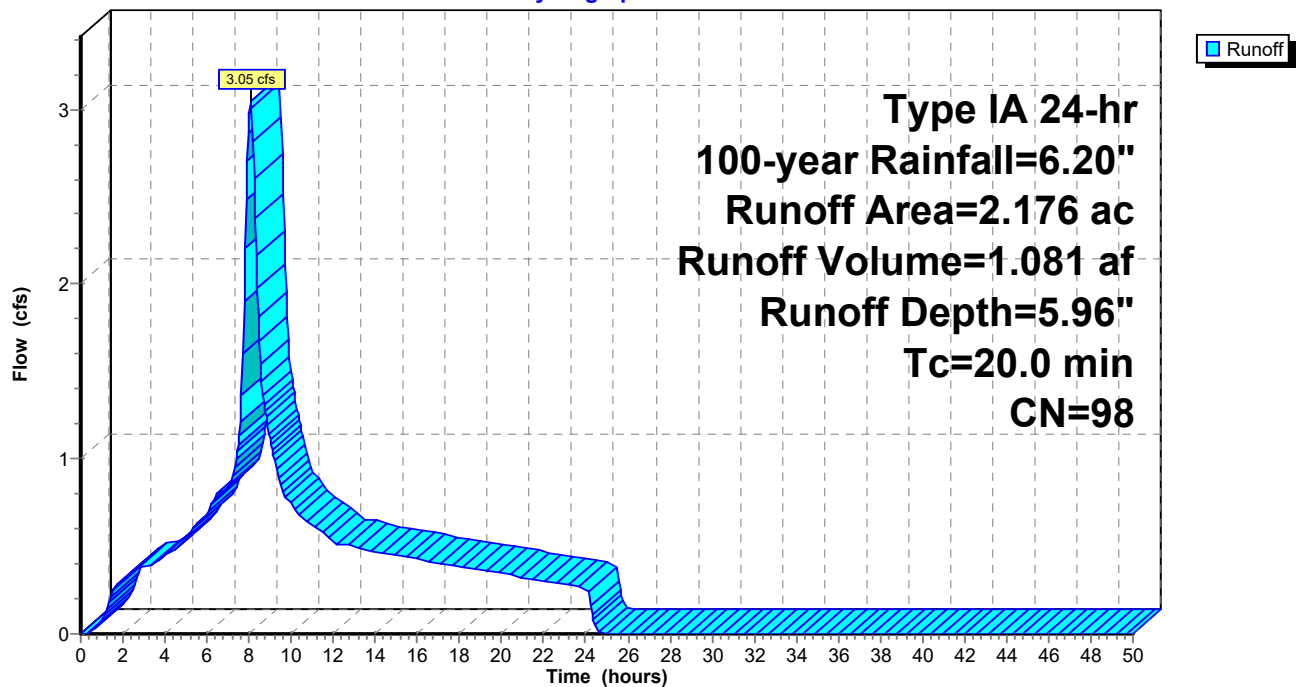
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 9S: Node B - Subdivision PGIS

Hydrograph



Summary for Subcatchment 12S: Node C Public PGIS

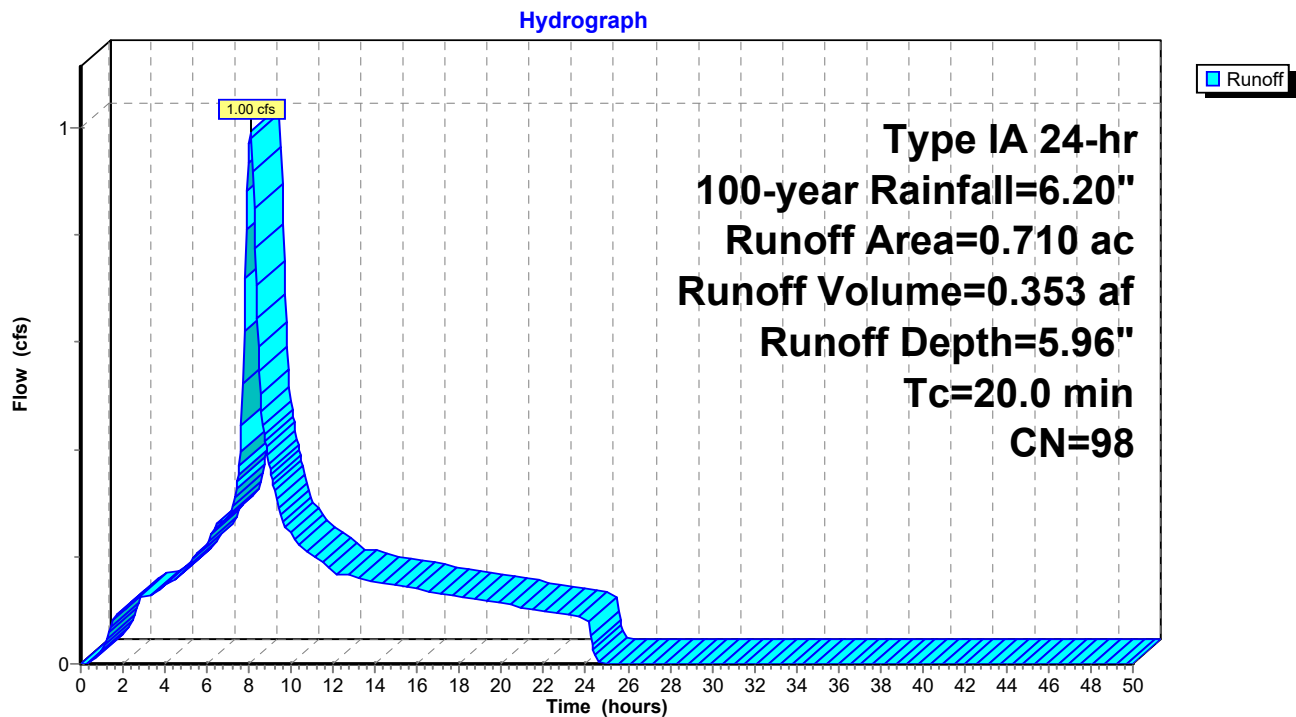
Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
 Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

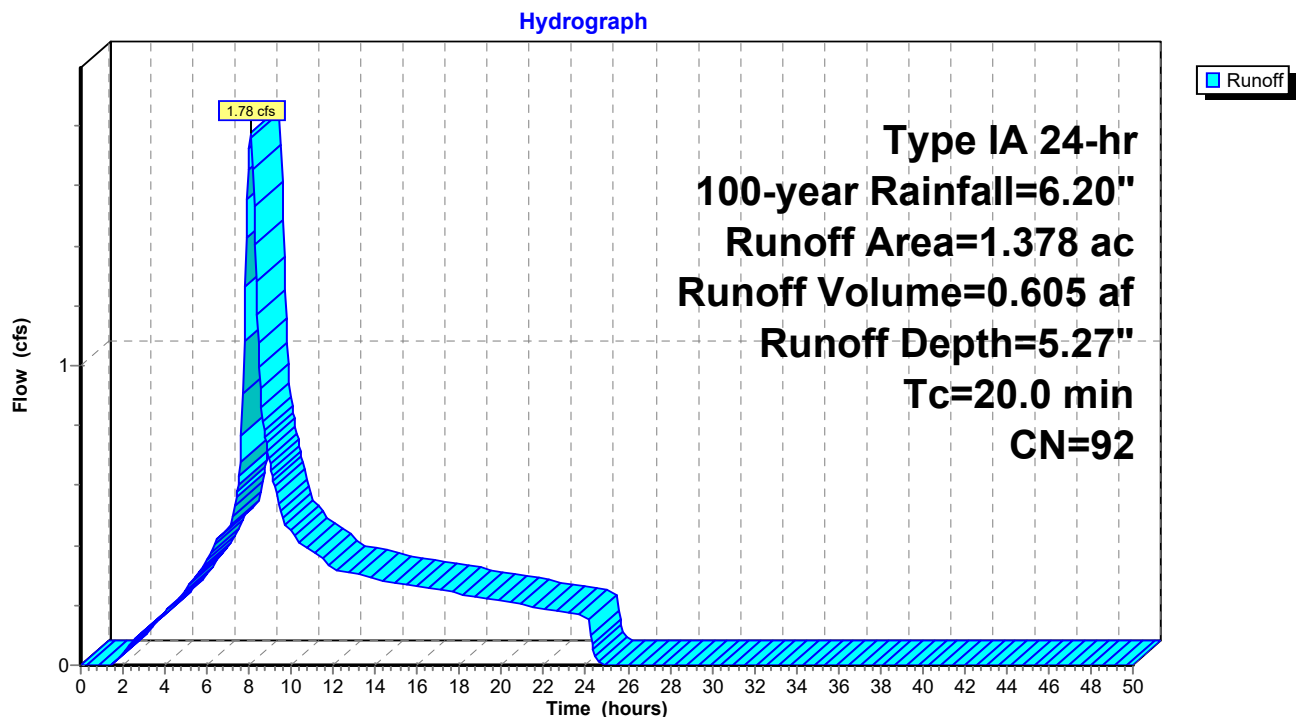
Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
 Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
 Routed to Pond N2 : Node C

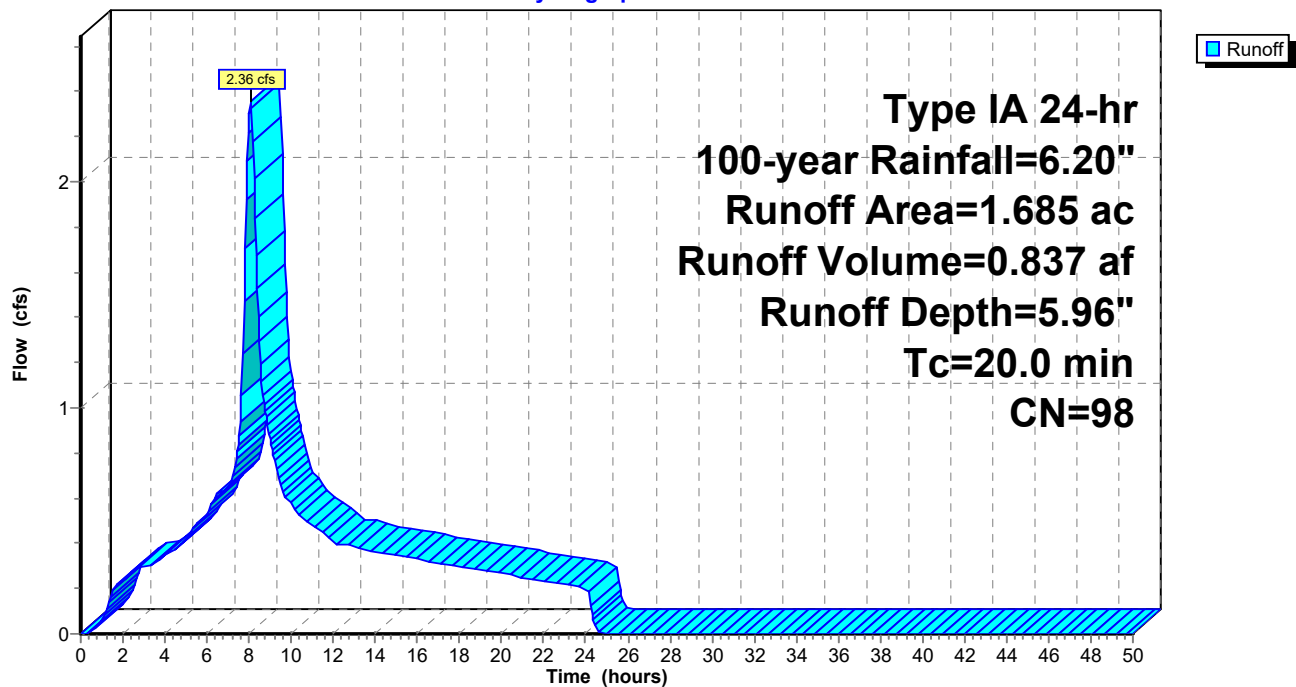
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 14S: Node C - Flex PGIS

Hydrograph



Summary for Subcatchment 17S: Node D - PGIS

Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
 Routed to Pond 3P : Bioretention

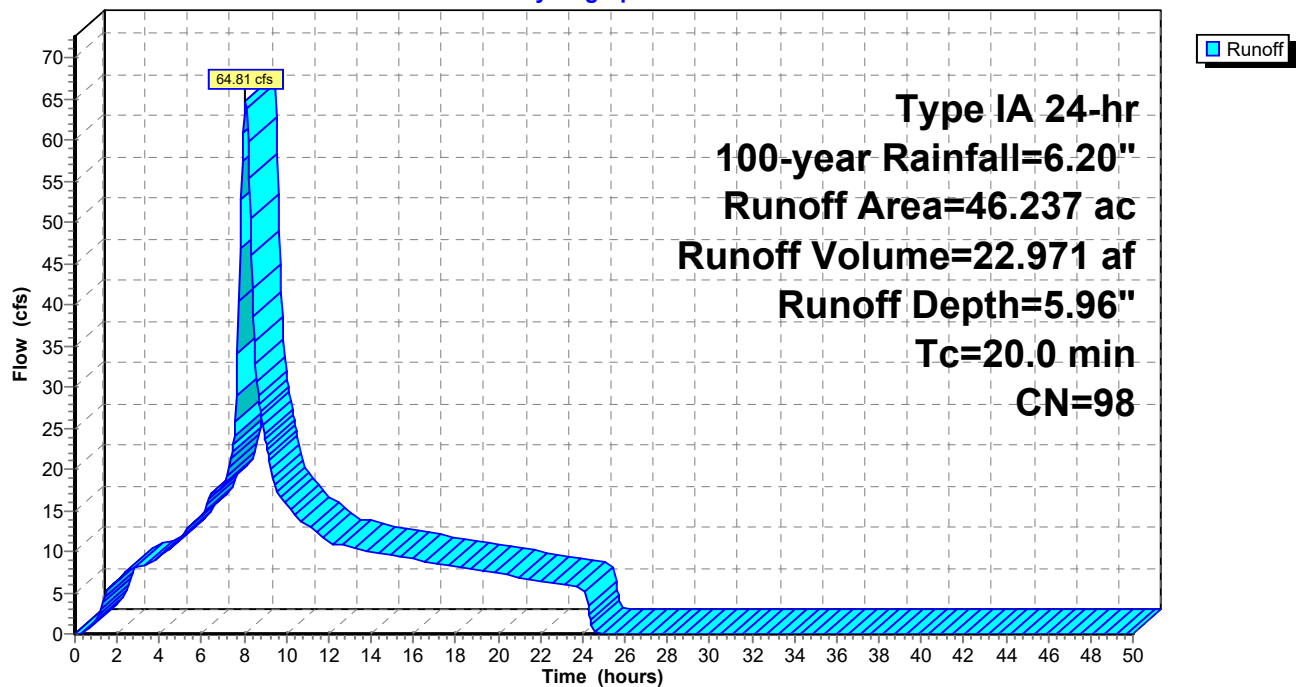
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 17S: Node D - PGIS

Hydrograph



Summary for Subcatchment D2R: Node C - Public Non-PGIS

Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
 Routed to Pond 15P : Bioretention

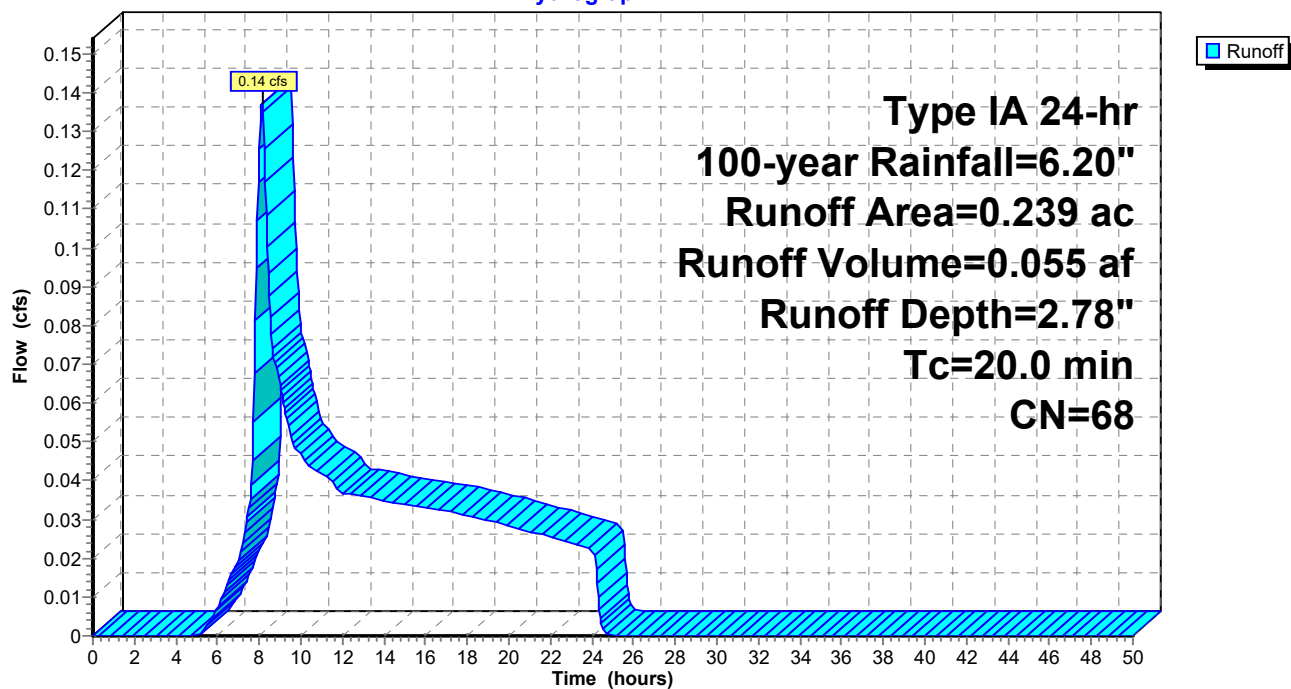
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D2R: Node C - Public Non-PGIS

Hydrograph



Summary for Subcatchment D3R: Node A - Public PGIS

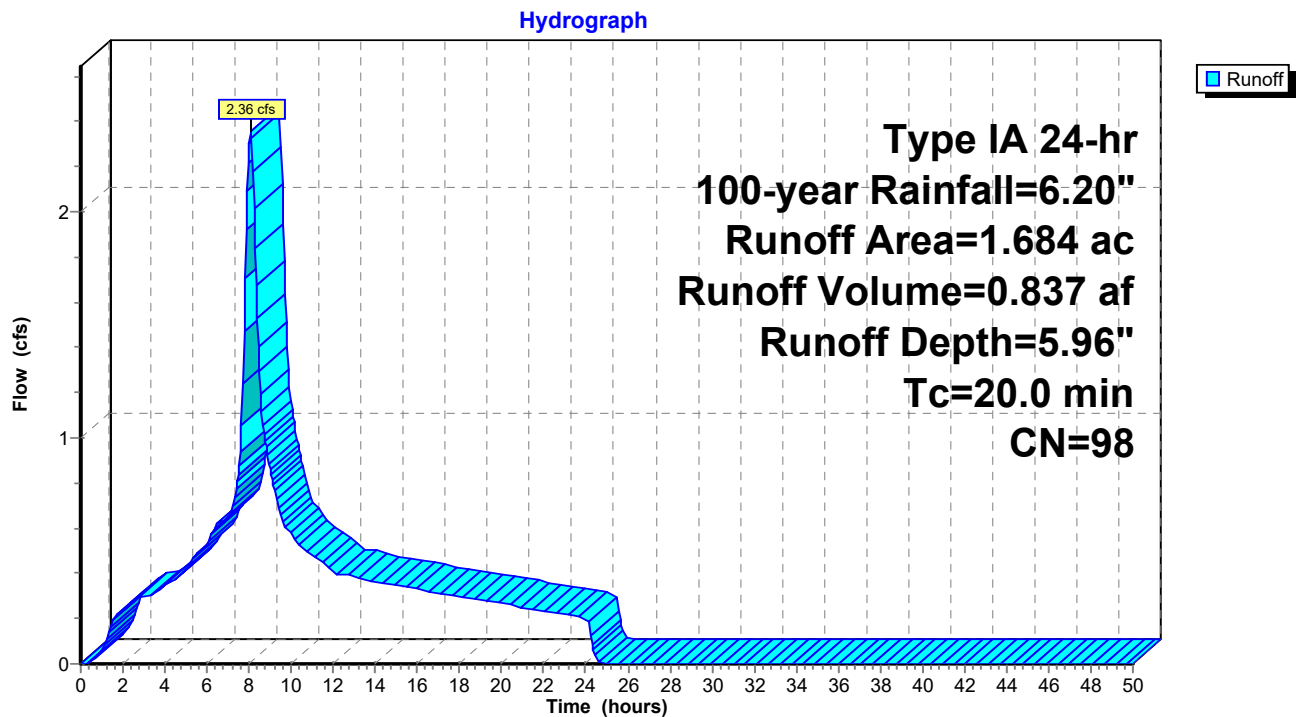
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
 Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
 Routed to Pond N1 : Node D

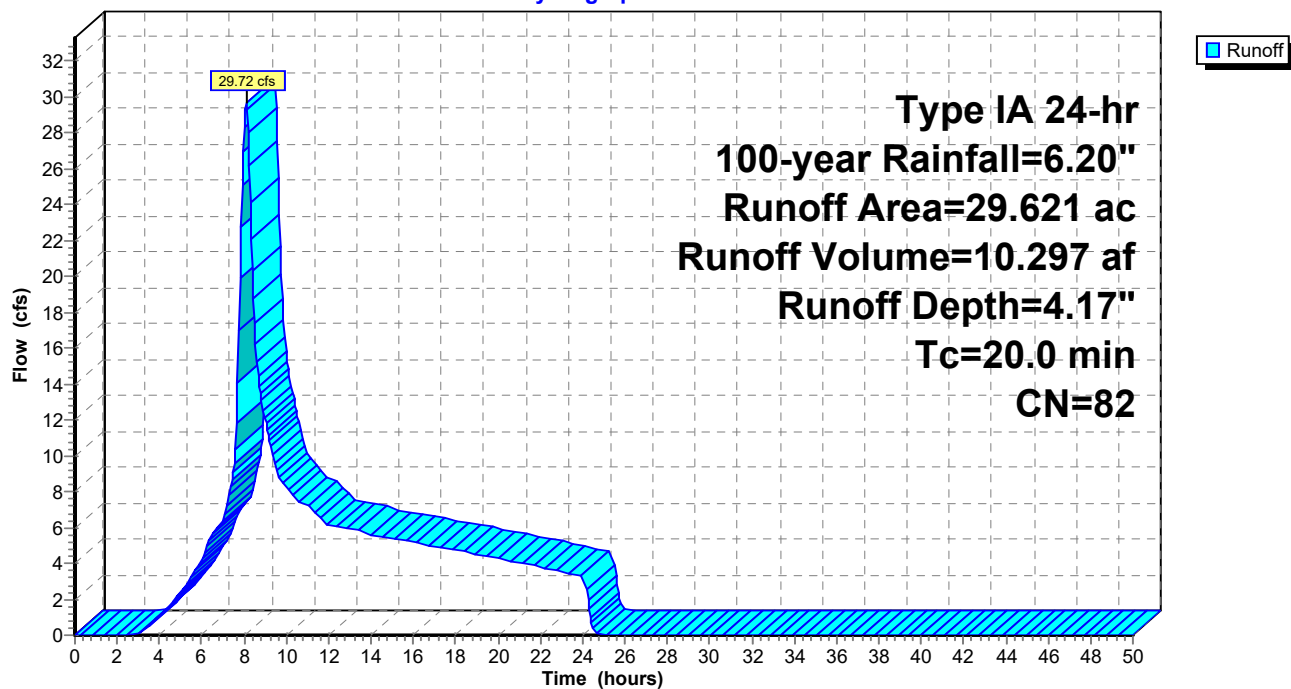
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D5P: Node D - Non-PGIS

Hydrograph



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
 Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
 Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
 Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
 Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

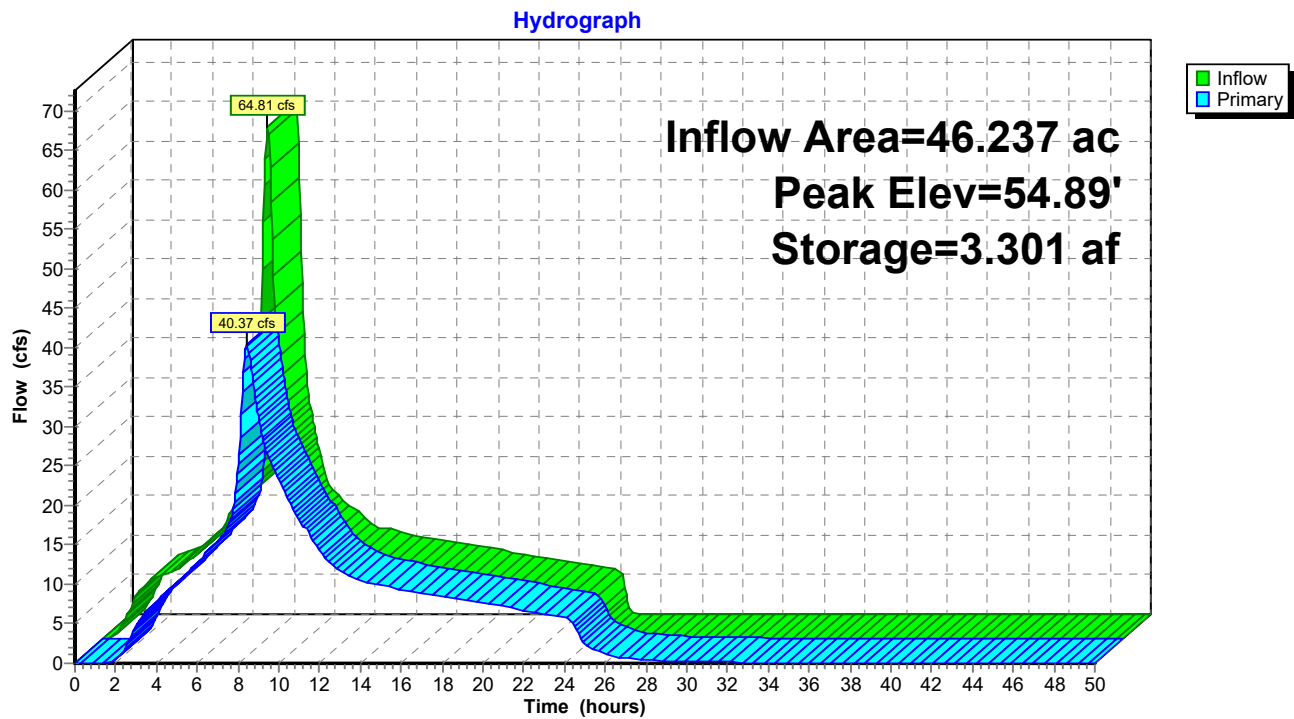
Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	270.00'W x 270.00'L x 6.50'H Prismatic 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	270.00'W x 270.00'L x 2.00'H Prismatic Inside #1
#3	50.50'	0.019 af	24.0" Round Pipe Storage Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	60.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	24.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)

1=Orifice/Grate (Weir Controls 12.44 cfs @ 2.04 fps)
 2=Orifice/Grate (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
 Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
 Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
 Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
 Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

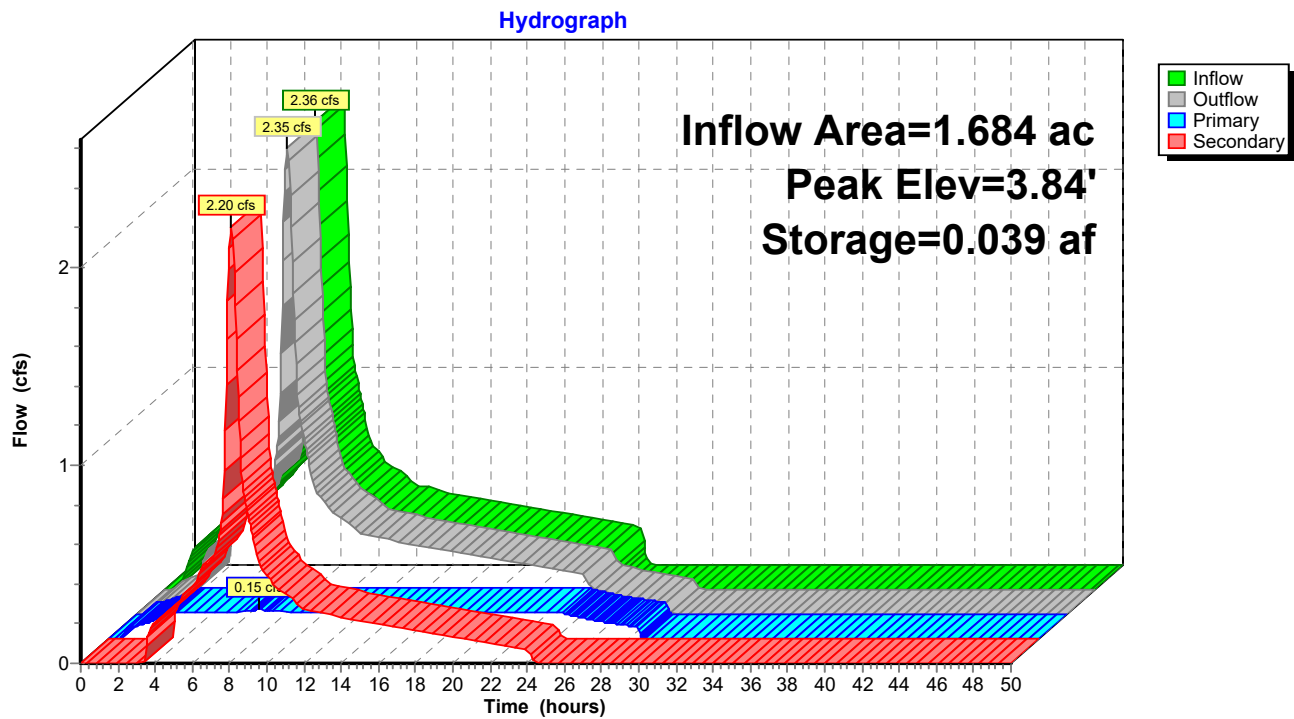
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	5.00'W x 250.00'L x 5.00'H Bioretention 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
 Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
 Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
 Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

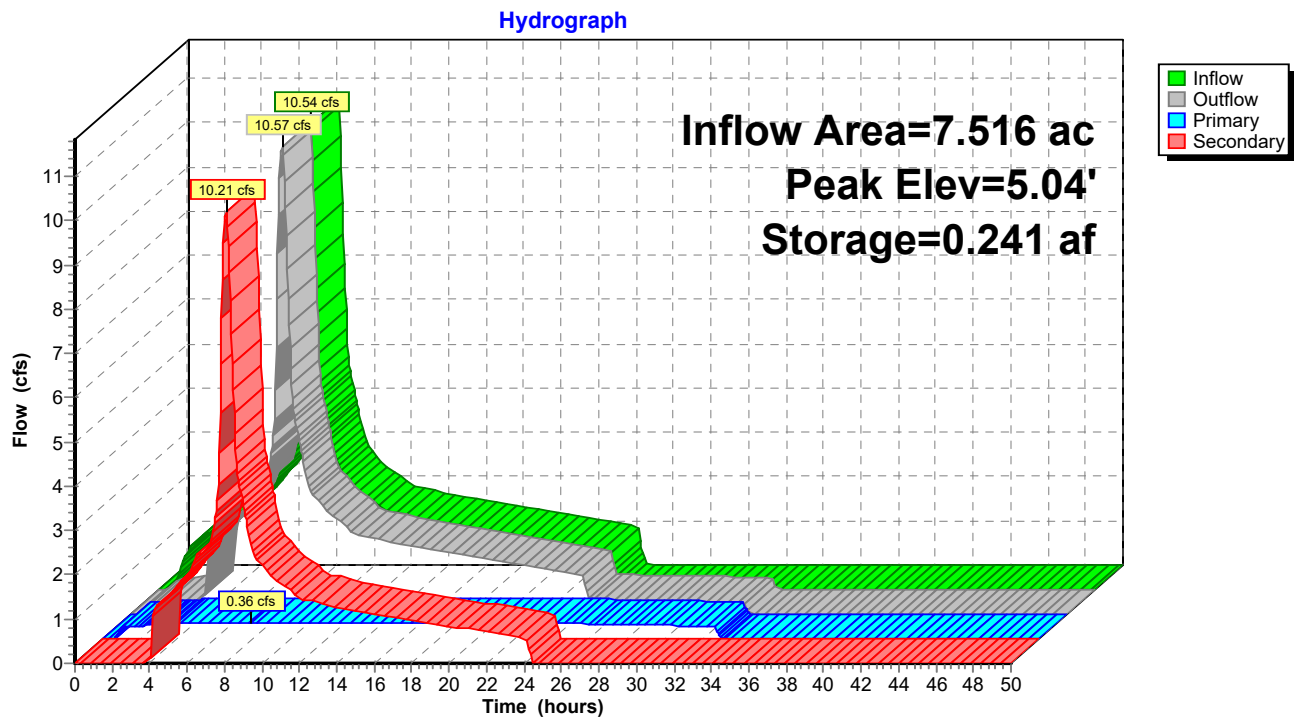
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	50.00'W x 120.00'L x 5.00'H Infiltration Trench 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.50'	30.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.80' (Flood elevation advised)
 [81] Warning: Exceeded Pond 10P by 49.06' @ 31.35 hrs
 [81] Warning: Exceeded Pond 11P by 49.06' @ 33.05 hrs

Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
 Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
 Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
 Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
 Routed to Pond N2 : Node C

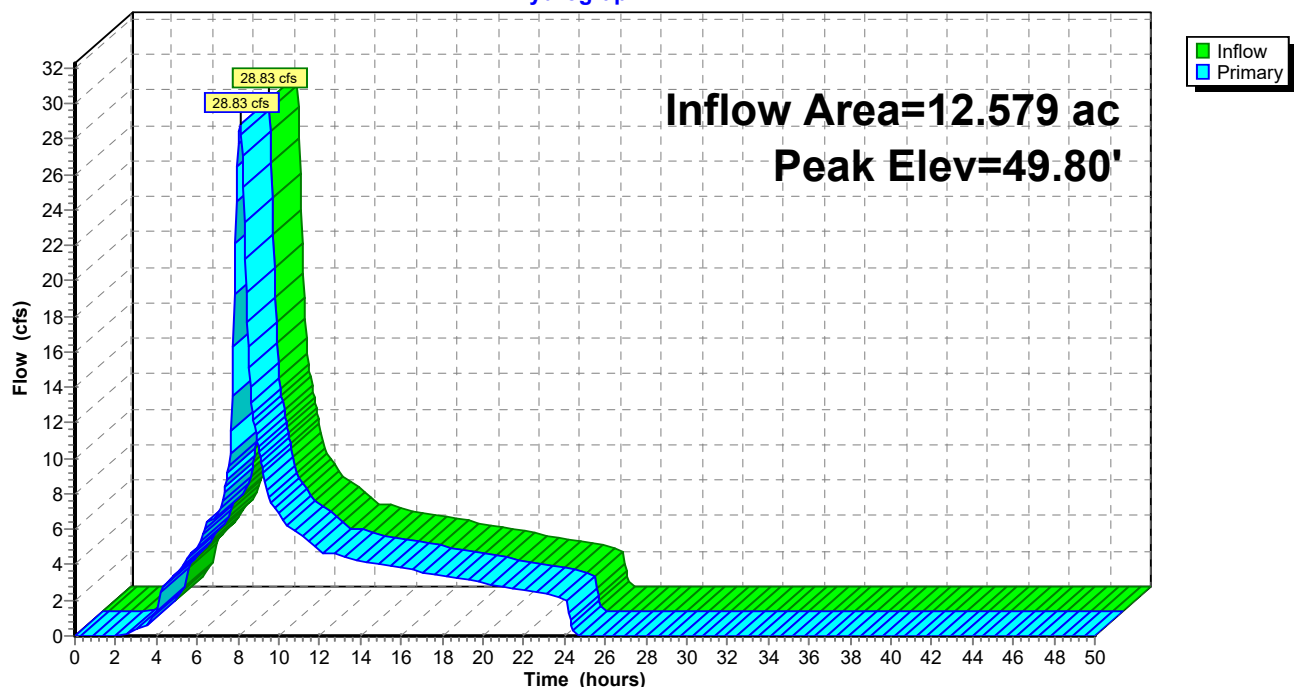
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 49.80' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	24.0" Round Culvert L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=28.70 cfs @ 8.09 hrs HW=49.80' TW=49.06' (Fixed TW Elev= 49.06')
 1=Culvert (Outlet Controls 9.48 cfs @ 3.02 fps)
 2=Sharp-Crested Rectangular Weir(Weir Controls 19.22 cfs @ 1.79 fps)

Pond 7P: Node B

Hydrograph



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
 Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
 Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
 Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	5.00'W x 40.00'L x 5.00'H Bioretention 0.023 af Overall x 35.0% Voids

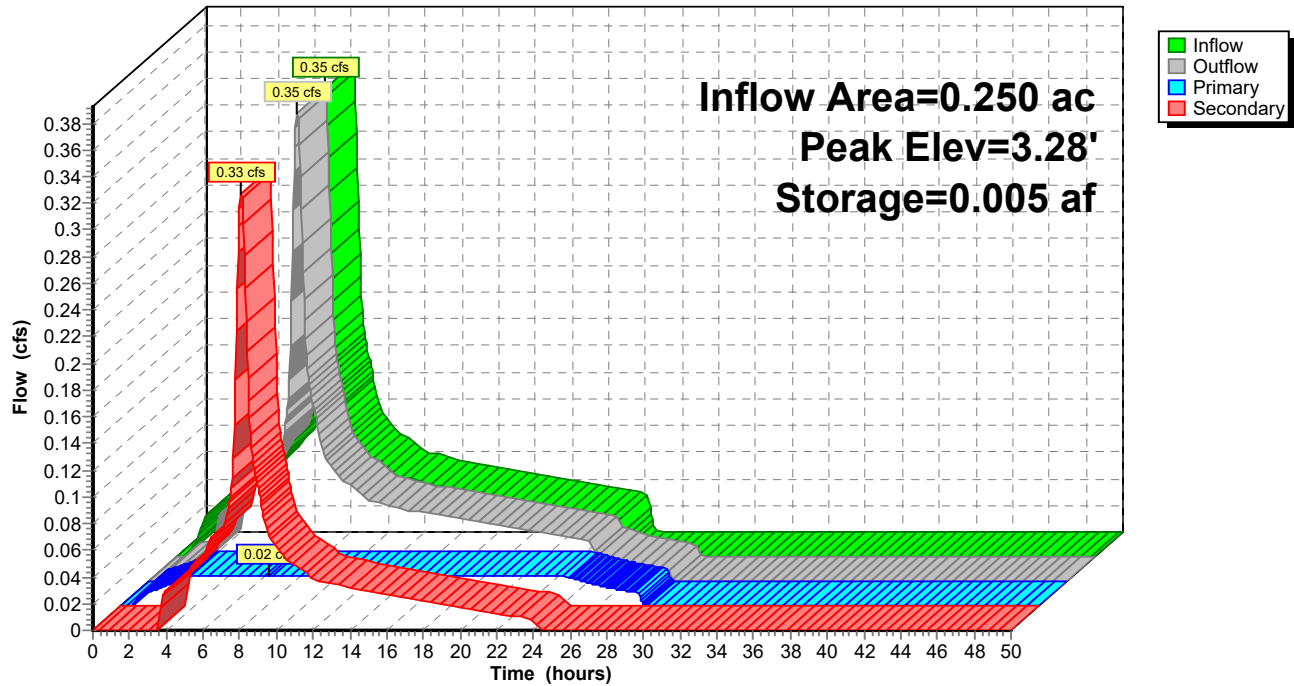
Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
 ↑2=Orifice/Grate (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention

Hydrograph



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
 Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
 Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
 Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
 Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

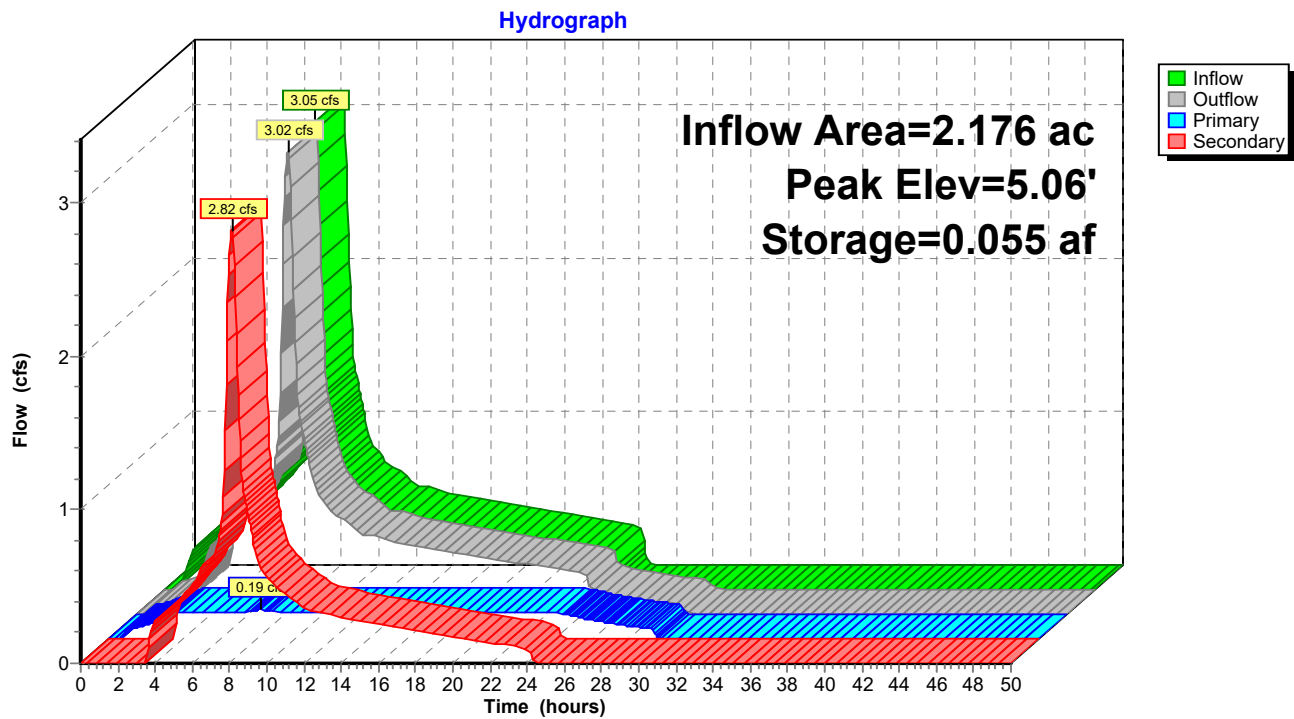
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	5.00'W x 270.00'L x 6.00'H Bioretention 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
 Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
 Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
 Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
 Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

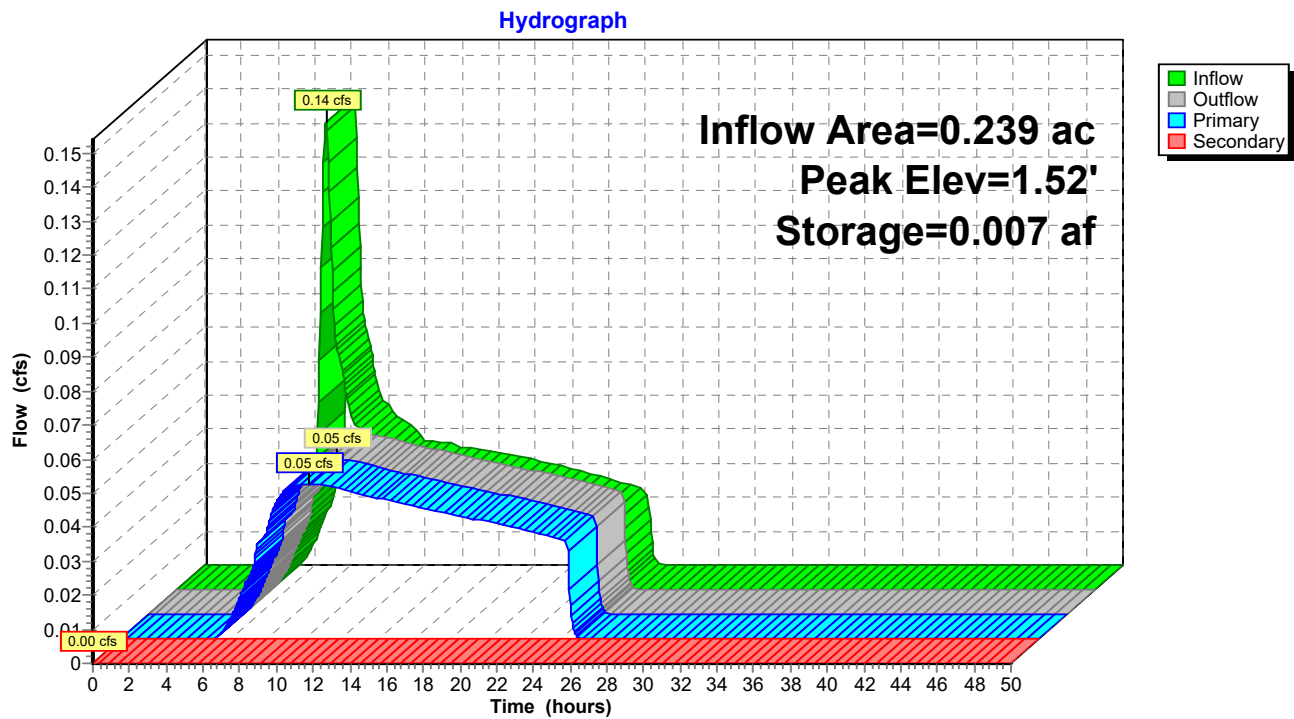
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	5.00'W x 120.00'L x 5.00'H Bioretention 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
 ↑2=Orifice/Grate (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
 Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
 Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
 Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
 Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
 Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

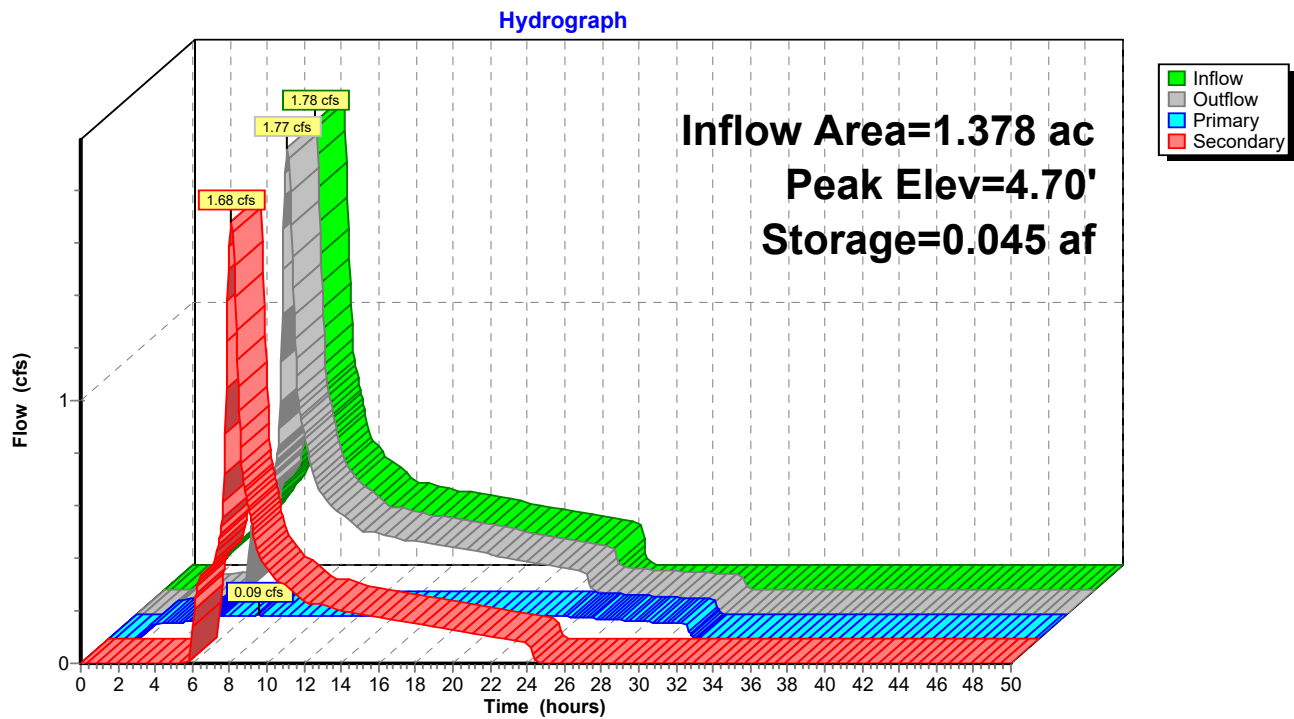
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	20.00'W x 60.00'L x 6.00'H Infiltration Trench 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth > 5.88" for 100-year event
 Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
 Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
 Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
 Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
 Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
 Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

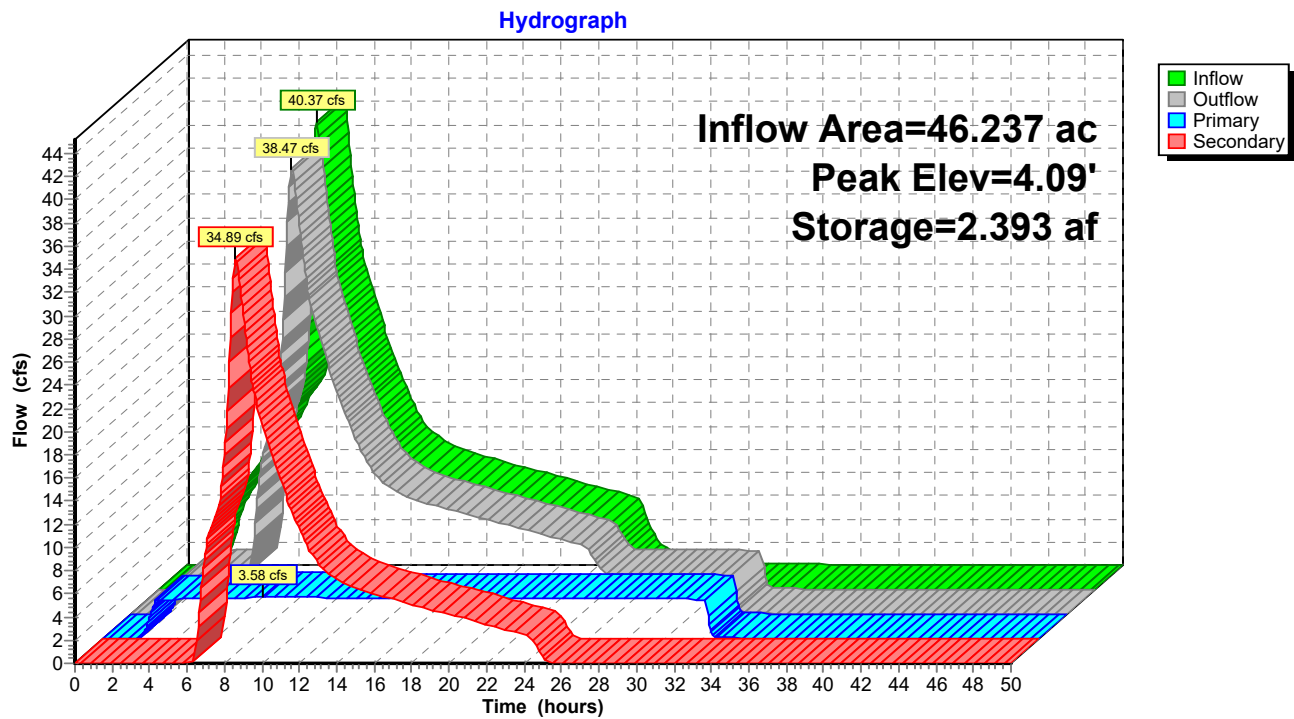
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	270.00'W x 270.00'L x 5.00'H Infiltration Trench 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	36.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[81] Warning: Exceeded Pond 19P by 47.00' @ 49.95 hrs
 [79] Warning: Submerged Pond N2 Primary device # 1 INLET by 8.93'

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
 Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
 Outflow = 51.54 cfs @ 9.11 hrs, Volume= 28.066 af, Atten= 39%, Lag= 58.0 min
 Primary = 48.30 cfs @ 9.11 hrs, Volume= 27.890 af
 Secondary = 3.24 cfs @ 9.11 hrs, Volume= 0.176 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 48.12' @ 9.11 hrs Surf.Area= 113,213 sf Storage= 383,550 cf

Plug-Flow detention time= 210.3 min calculated for 28.066 af (81% of inflow)
 Center-of-Mass det. time= 94.4 min (829.9 - 735.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

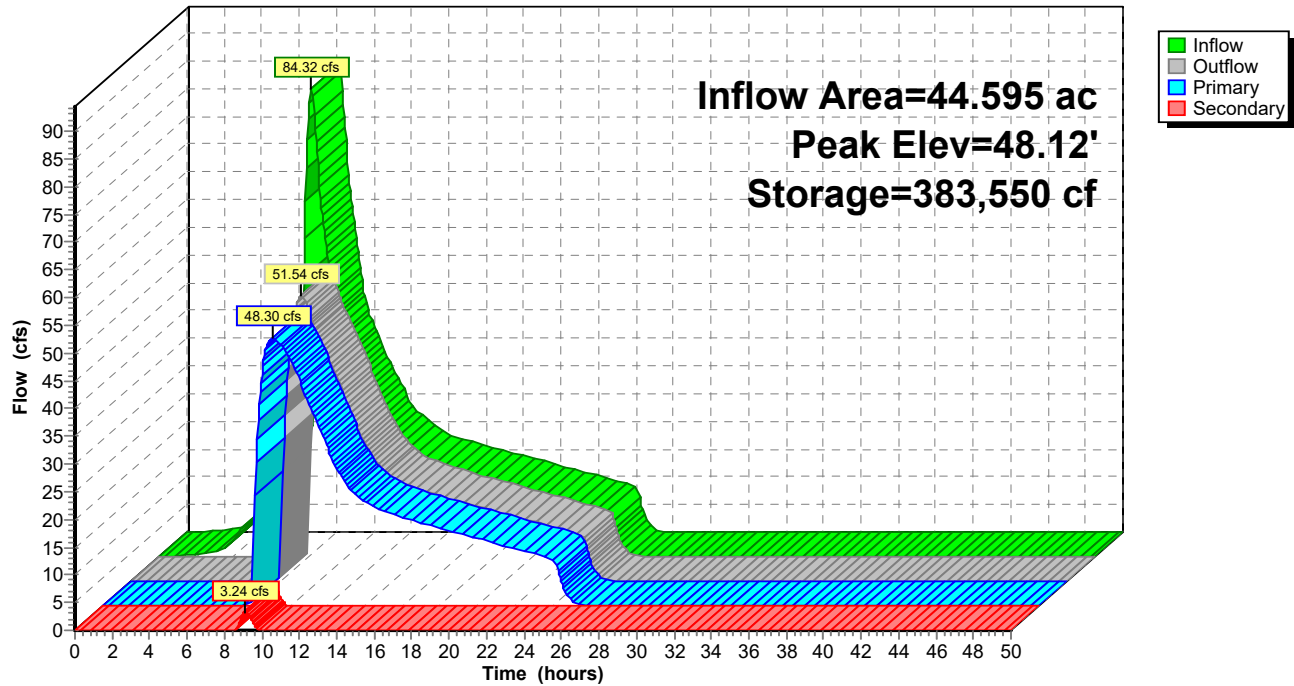
Device	Routing	Invert	Outlet Devices
#1	Secondary	48.00'	30.0' long + 1.0 ' SideZ x 4.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Primary	38.00'	42.0" Round Culvert L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 ' / Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=48.31 cfs @ 9.11 hrs HW=48.12' TW=47.00' (Fixed TW Elev= 47.00')
 ↑ **2=Culvert** (Outlet Controls 48.31 cfs @ 5.02 fps)

Secondary OutFlow Max=2.99 cfs @ 9.11 hrs HW=48.12' (Free Discharge)
 ↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 2.99 cfs @ 0.82 fps)

Pond N1: Node D

Hydrograph



Summary for Pond N2: Node C

[57] Hint: Peaked at 49.06' (Flood elevation advised)
 [81] Warning: Exceeded Pond 7P by 7.79' @ 1.75 hrs
 [81] Warning: Exceeded Pond 15P by 48.77' @ 7.80 hrs
 [81] Warning: Exceeded Pond 16P by 48.12' @ 1.45 hrs

Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
 Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
 Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
 Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
 Routed to Pond N1 : Node D

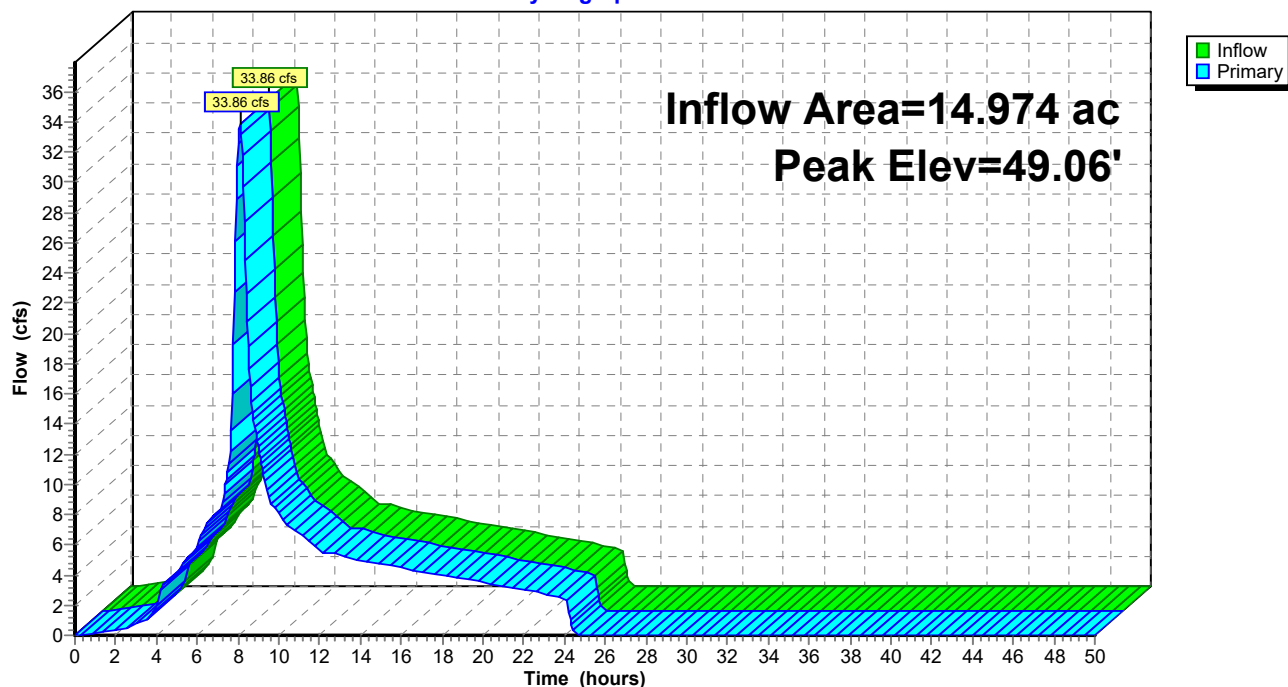
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 49.06' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	30.0" Round Culvert L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 ' S= 0.0029 ' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=33.77 cfs @ 8.09 hrs HW=49.06' TW=48.12' (Fixed TW Elev= 48.12')
 1=Culvert (Outlet Controls 18.13 cfs @ 3.69 fps)
 2=Sharp-Crested Rectangular Weir (Weir Controls 15.64 cfs @ 1.67 fps)

Pond N2: Node C

Hydrograph



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.57' (Flood elevation advised)
 [81] Warning: Exceeded Pond 4P by 49.80' @ 31.55 hrs
 [81] Warning: Exceeded Pond 5P by 49.80' @ 35.95 hrs

Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
 Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
 Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
 Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
 Routed to Pond 7P : Node B

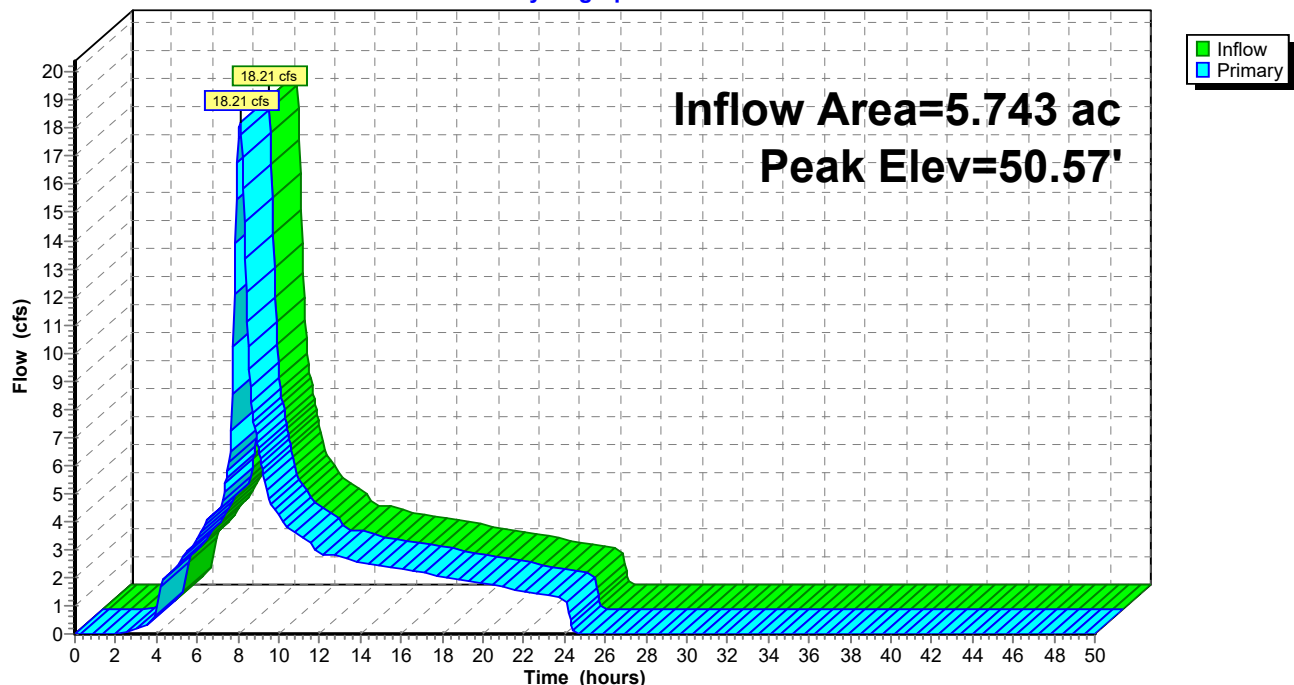
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 50.57' @ 8.09 hrs

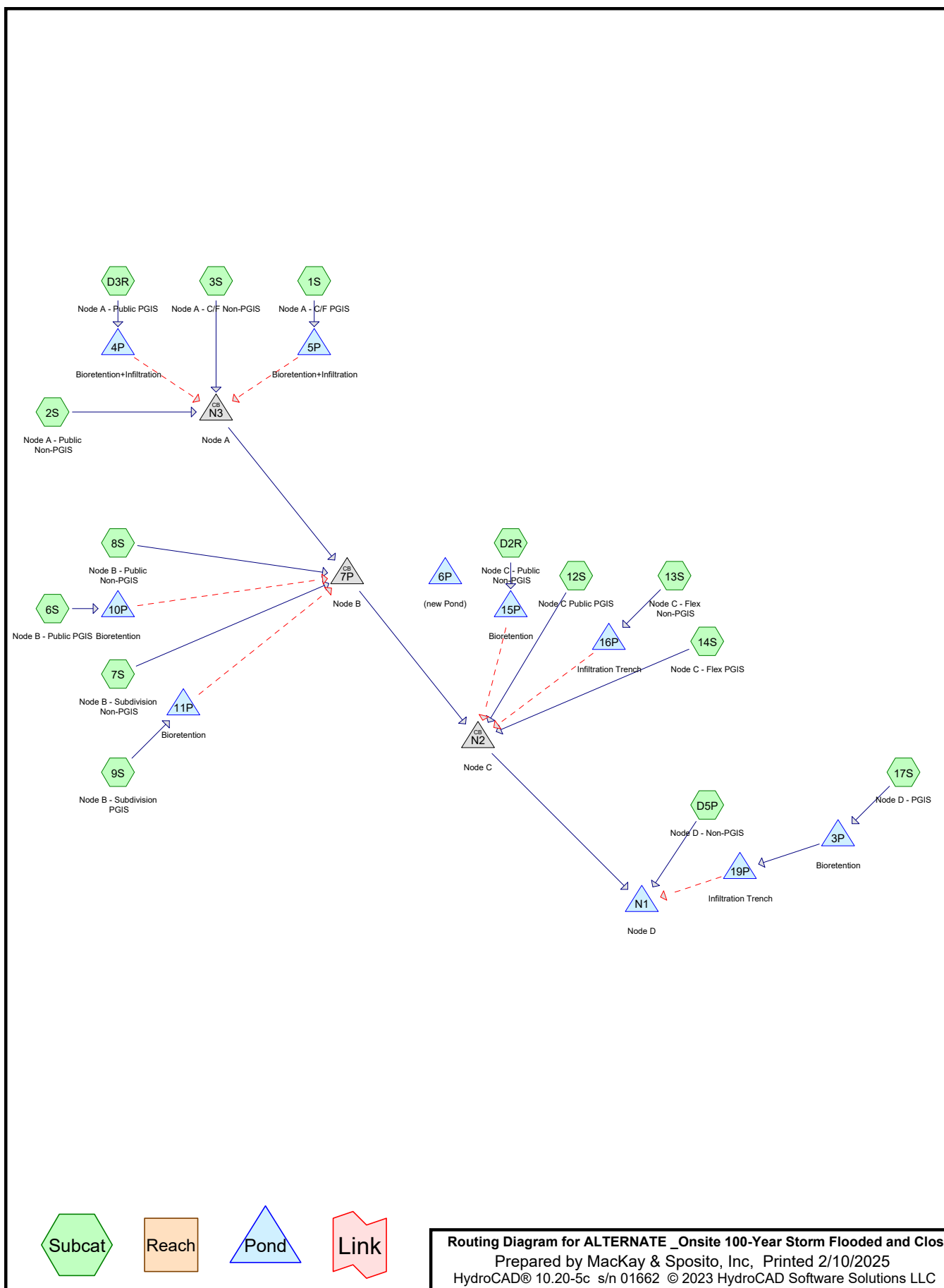
Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	24.0" Round Culvert L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=17.91 cfs @ 8.09 hrs HW=50.57' TW=49.80' (Fixed TW Elev= 49.80')
 1=Culvert (Outlet Controls 9.77 cfs @ 3.11 fps)
 2=Sharp-Crested Rectangular Weir(Weir Controls 8.14 cfs @ 1.34 fps)

Pond N3: Node A

Hydrograph





ALTERNATE _Onsite 100-Year Storm Flooded and Closed

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	92	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	38.896	0.000	0.000	0.000	104.075	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N2	39.19	37.96	410.7	0.0030	0.012	0.0	30.0	0.0	
3	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
 Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
 Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
 Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
 Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
 Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
 Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
 Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
 Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
 Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
 Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 6P: (new Pond)

Pond 7P: Node B Peak Elev=49.80' Inflow=28.83 cfs 8.778 af
Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=48.85' Storage=142,568 cf Inflow=84.32 cfs 34.599 af
Outflow=64.36 cfs 34.599 af

Pond N2: Node C Peak Elev=49.14' Inflow=33.86 cfs 10.379 af
Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.57' Inflow=18.21 cfs 5.428 af
Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
 Routed to Pond 5P : Bioretention+Infiltration

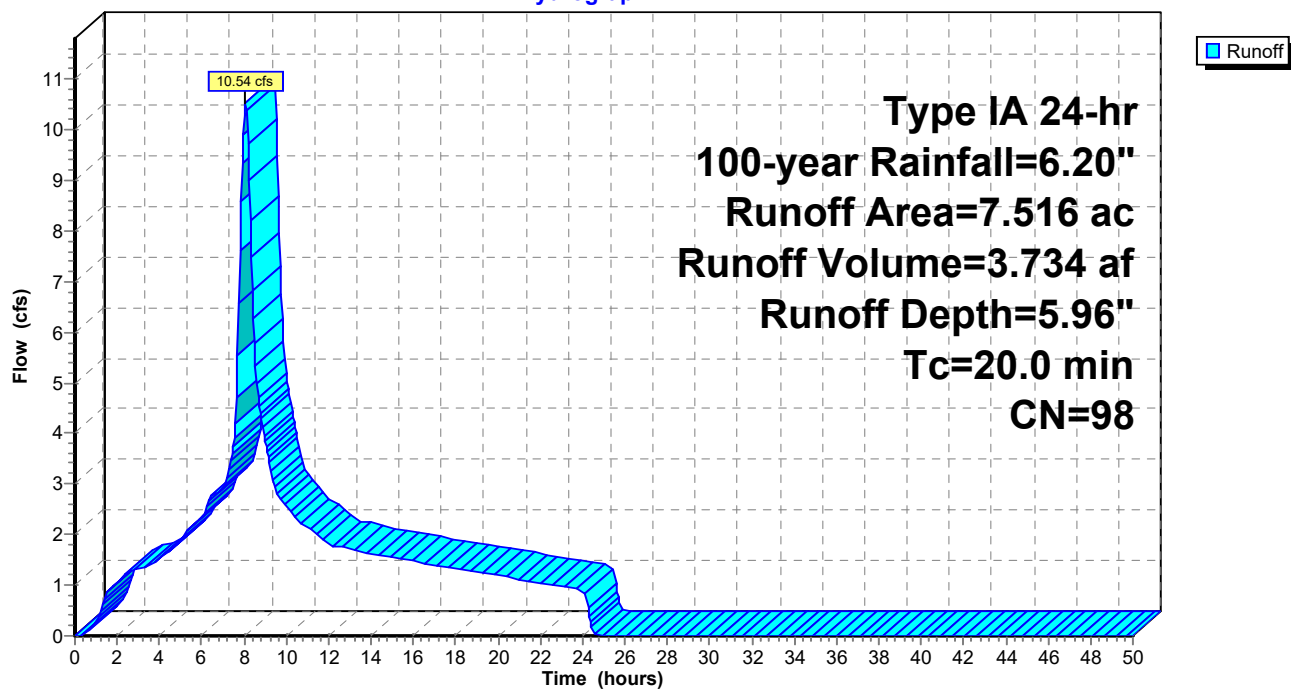
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Node A - C/F PGIS

Hydrograph



Summary for Subcatchment 2S: Node A - Public Non-PGIS

Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
 Routed to Pond N3 : Node A

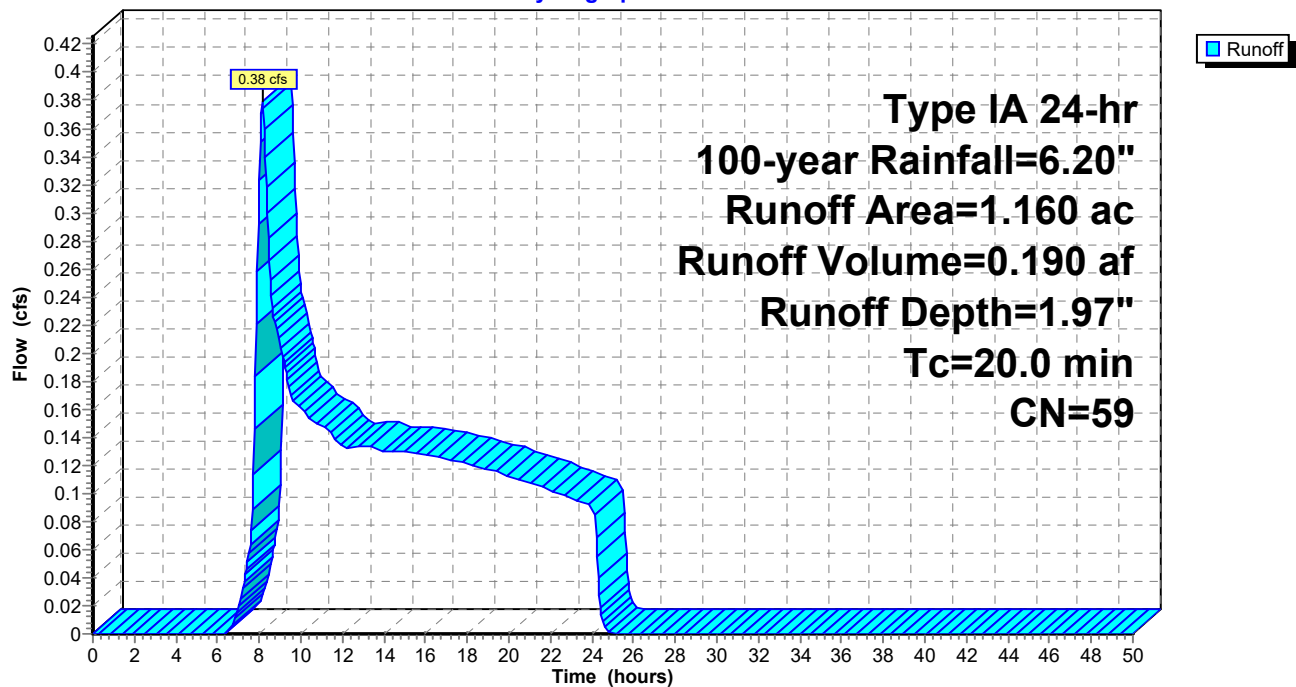
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
* 1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 2S: Node A - Public Non-PGIS

Hydrograph



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
 Routed to Pond N3 : Node A

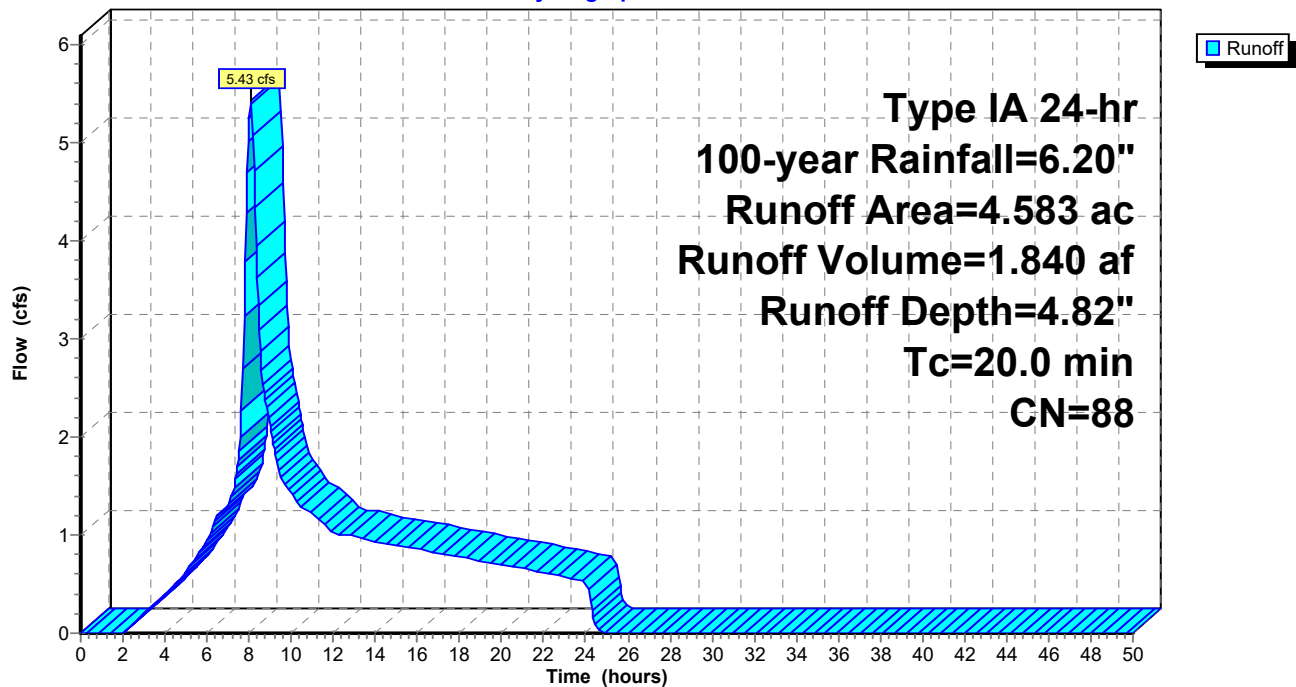
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
* 1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
3.373	98	Roofs, HSG A
4.583	88	Weighted Average
1.210		26.40% Pervious Area
3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 3S: Node A - C/F Non-PGIS

Hydrograph



Summary for Subcatchment 6S: Node B - Public PGIS

Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
 Routed to Pond 10P : Bioretention

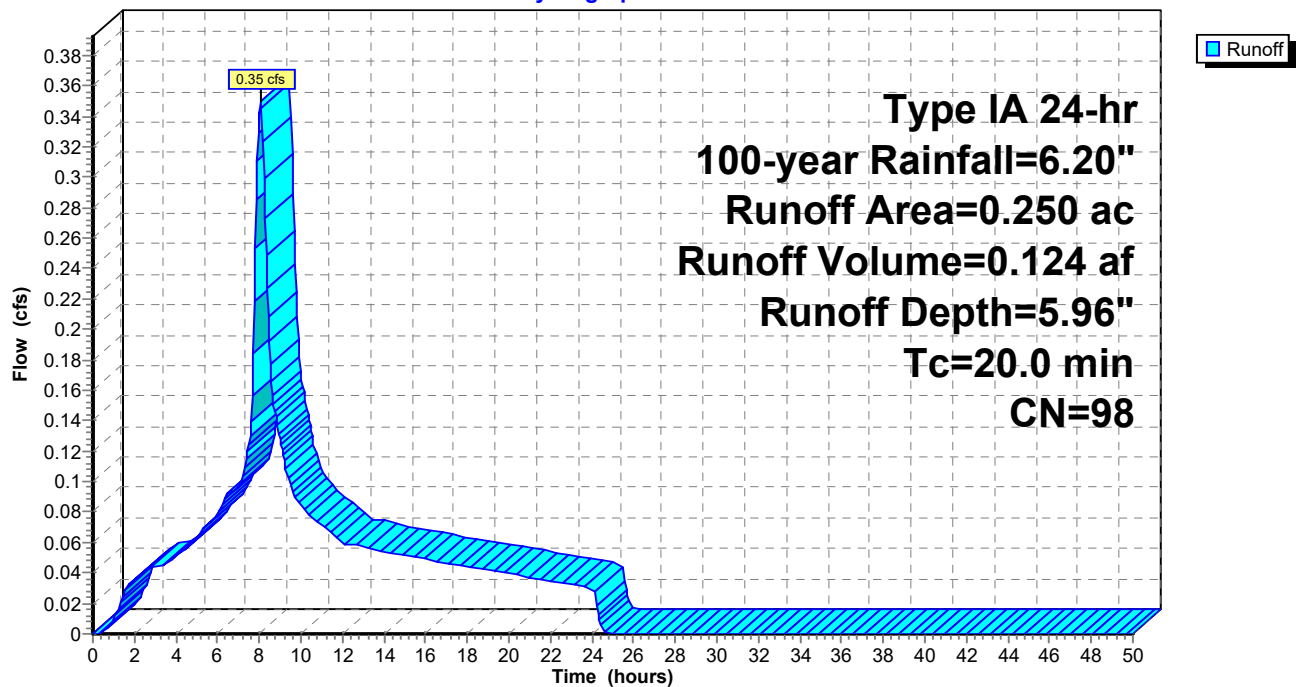
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 6S: Node B - Public PGIS

Hydrograph



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

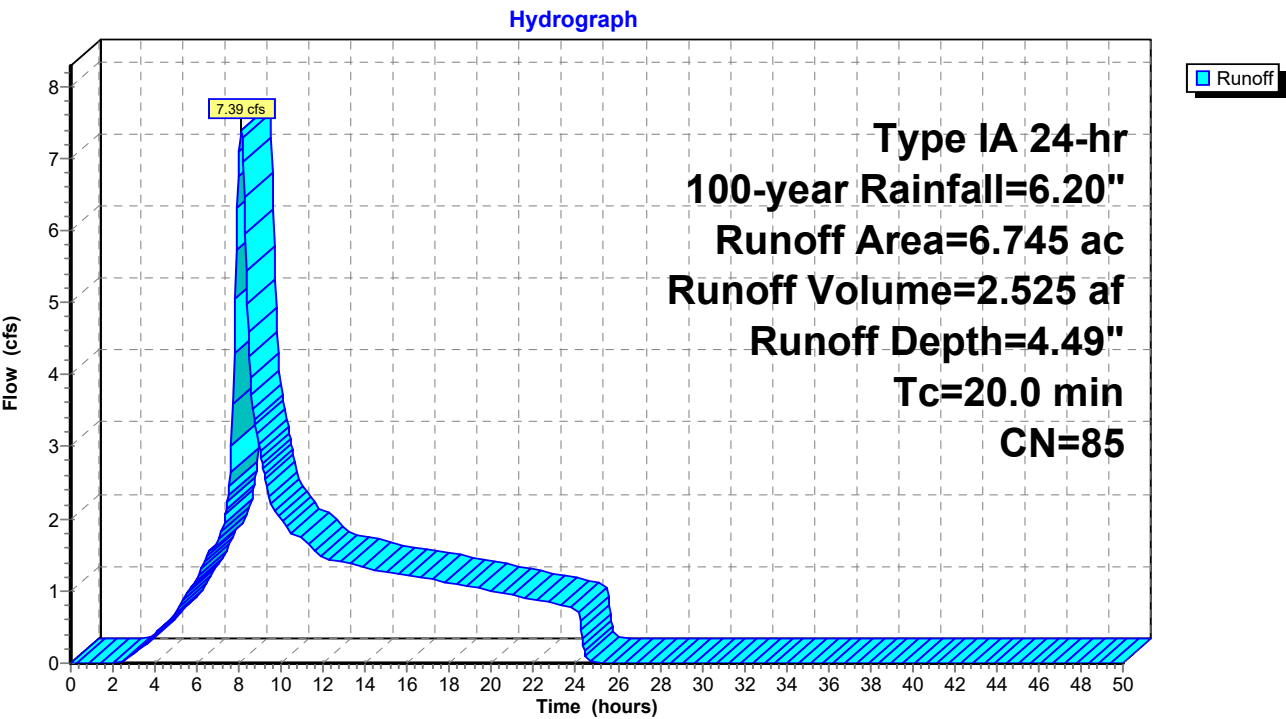
Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
 Routed to Pond 7P : Node B

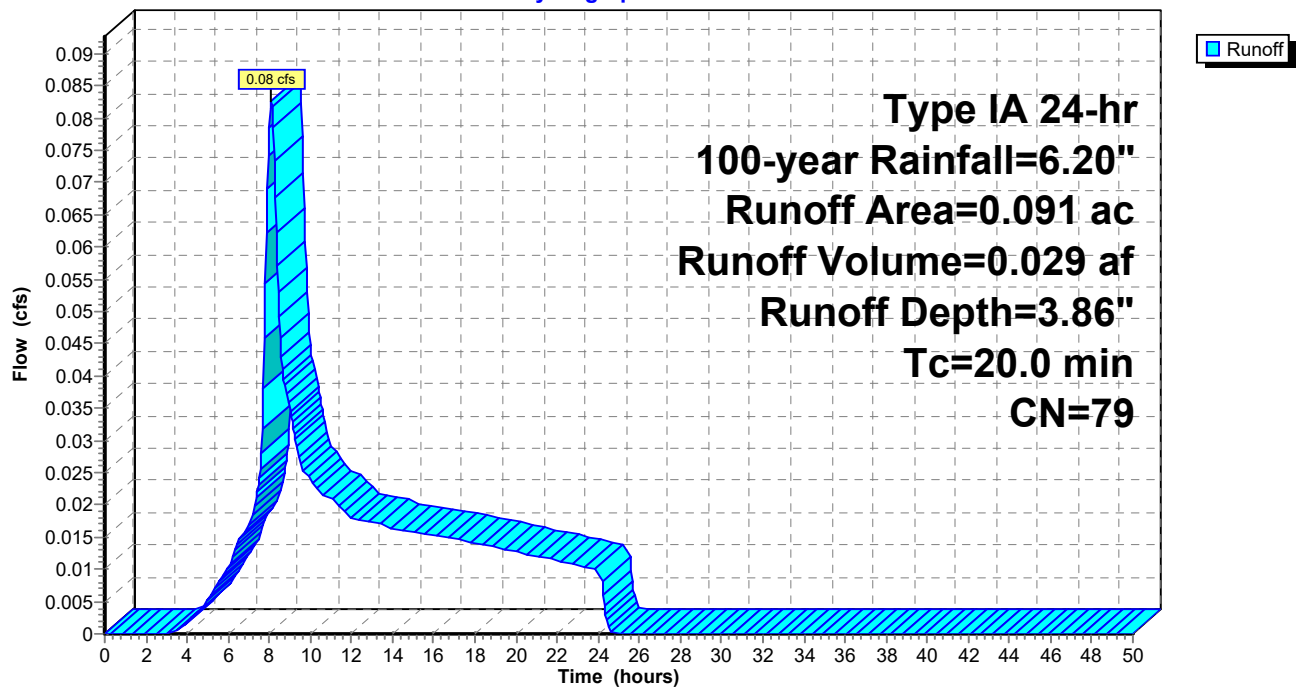
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 8S: Node B - Public Non-PGIS

Hydrograph



Summary for Subcatchment 9S: Node B - Subdivision PGIS

Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
 Routed to Pond 11P : Bioretention

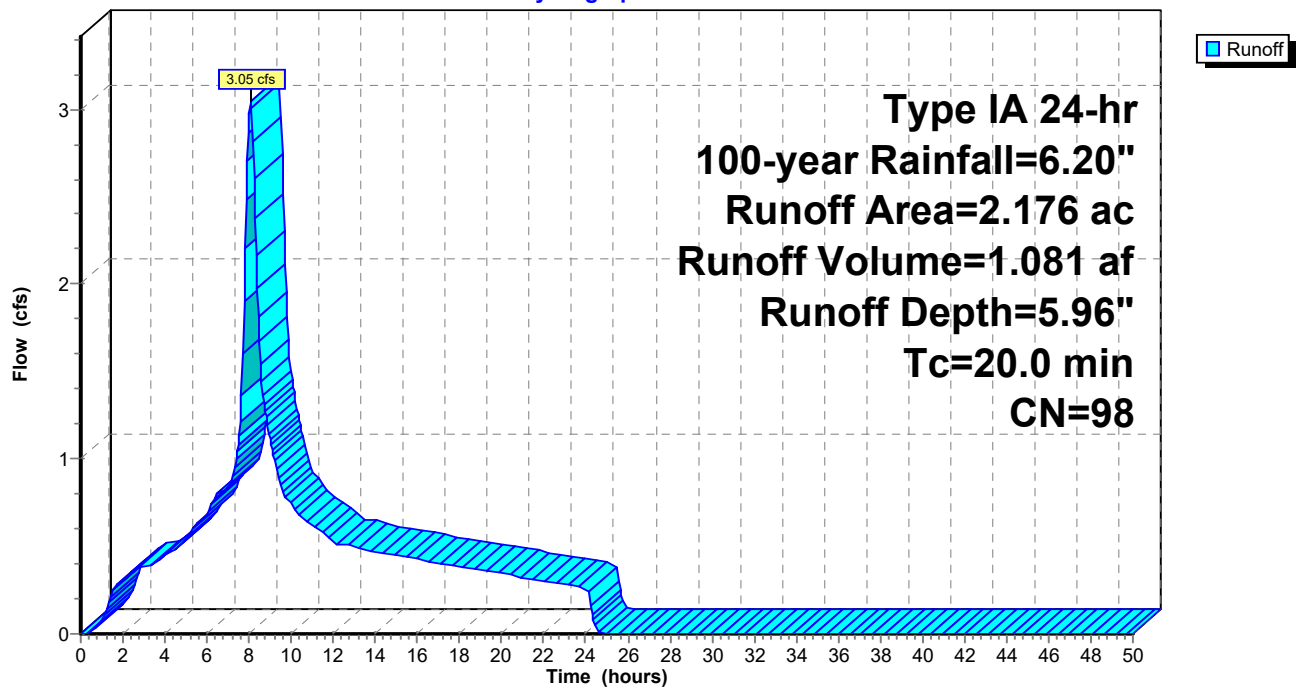
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 9S: Node B - Subdivision PGIS

Hydrograph



Summary for Subcatchment 12S: Node C Public PGIS

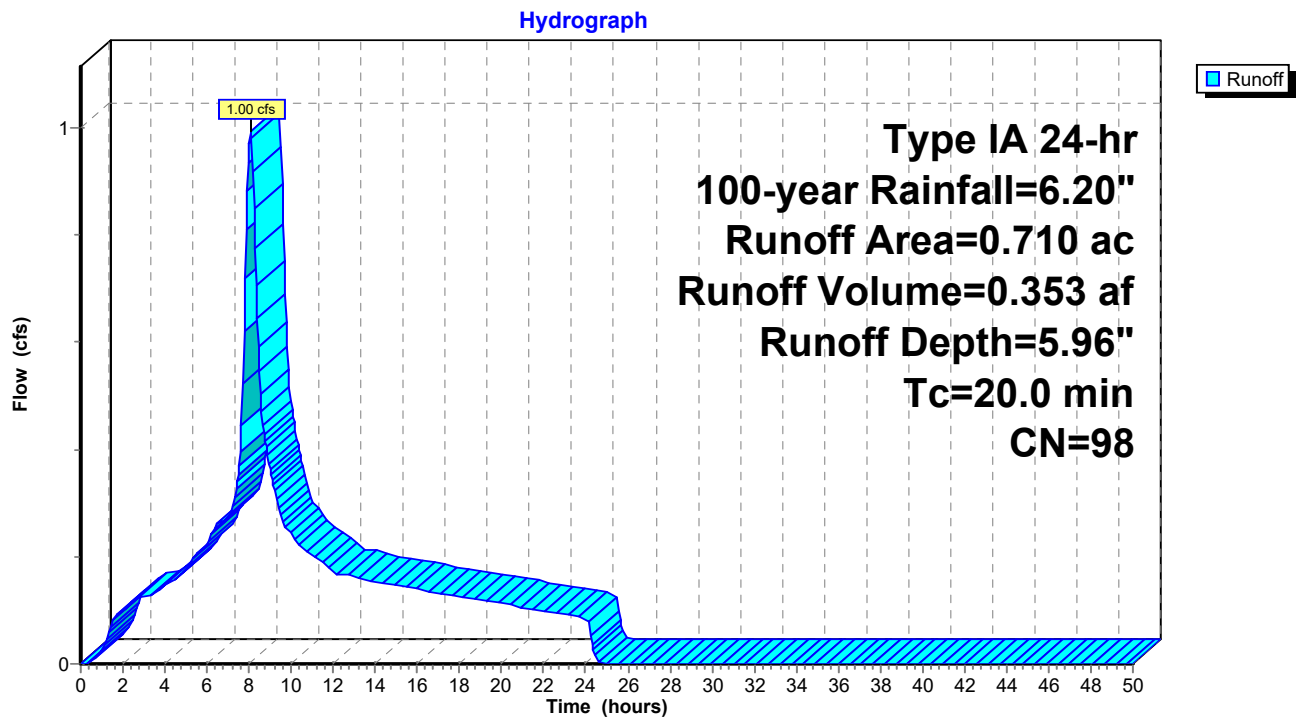
Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
 Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
 Routed to Pond 16P : Infiltration Trench

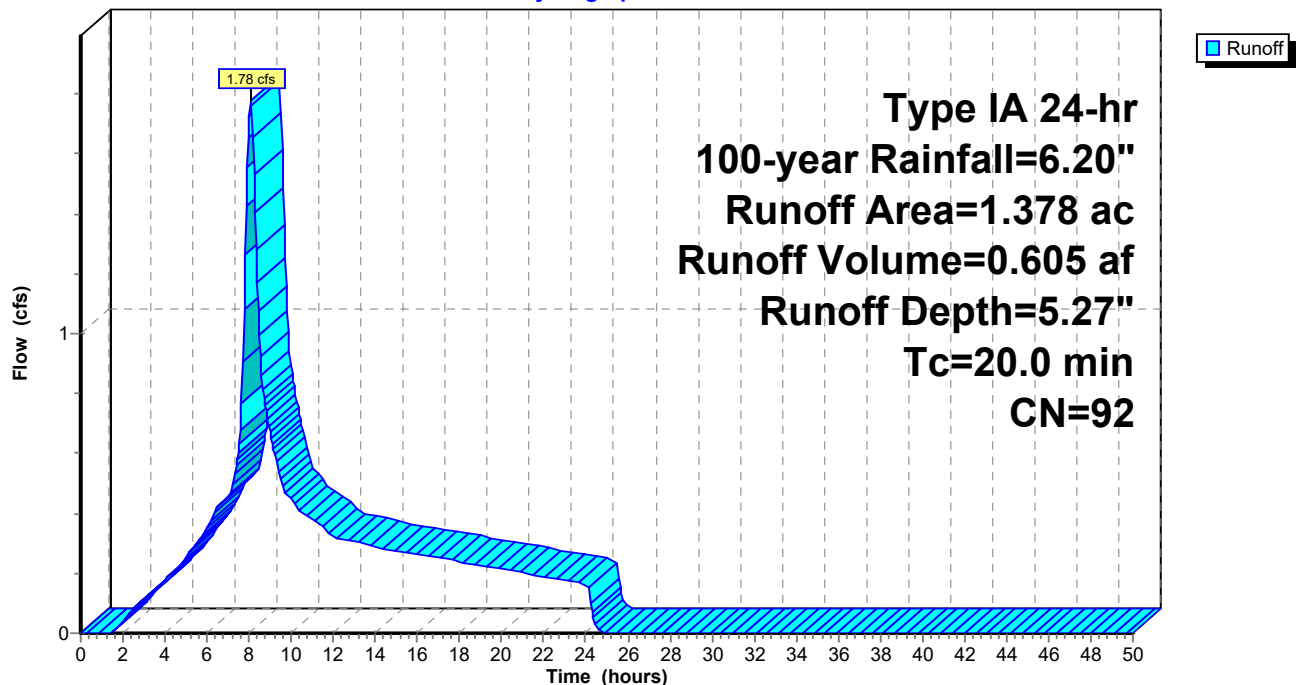
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 13S: Node C - Flex Non-PGIS

Hydrograph



Summary for Subcatchment 14S: Node C - Flex PGIS

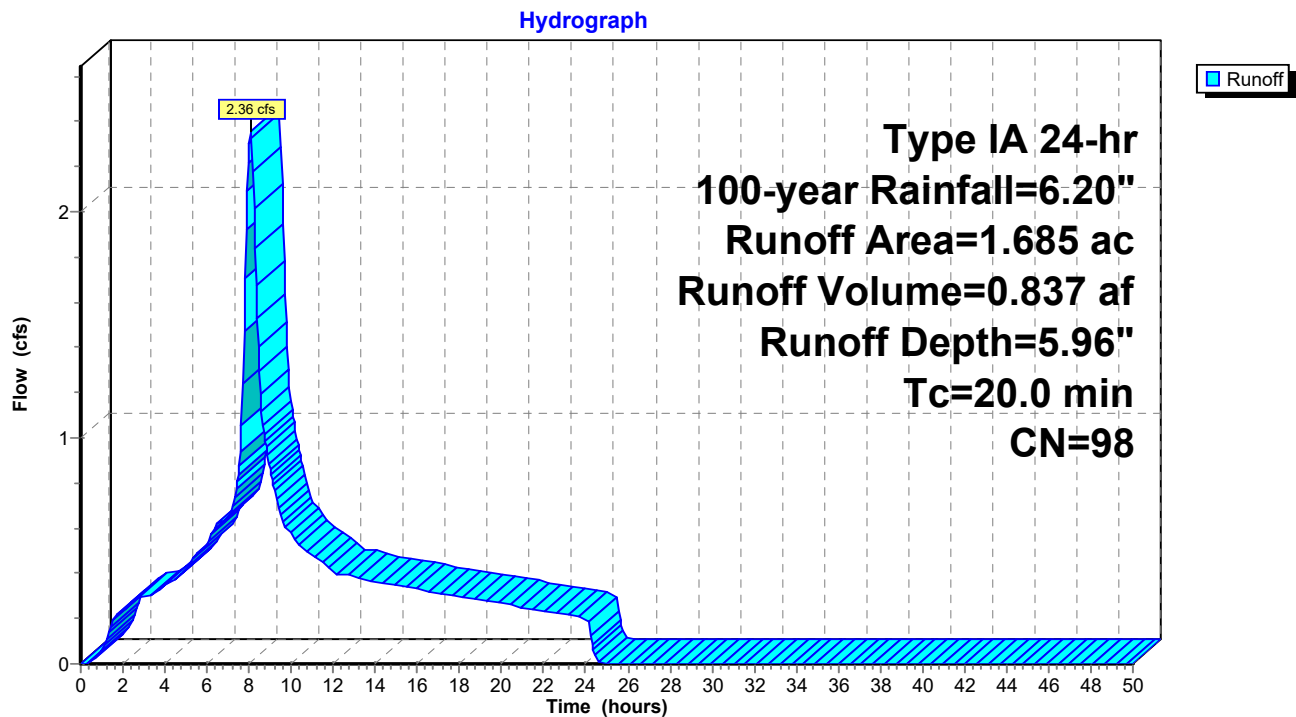
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
 Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
 Routed to Pond 3P : Bioretention

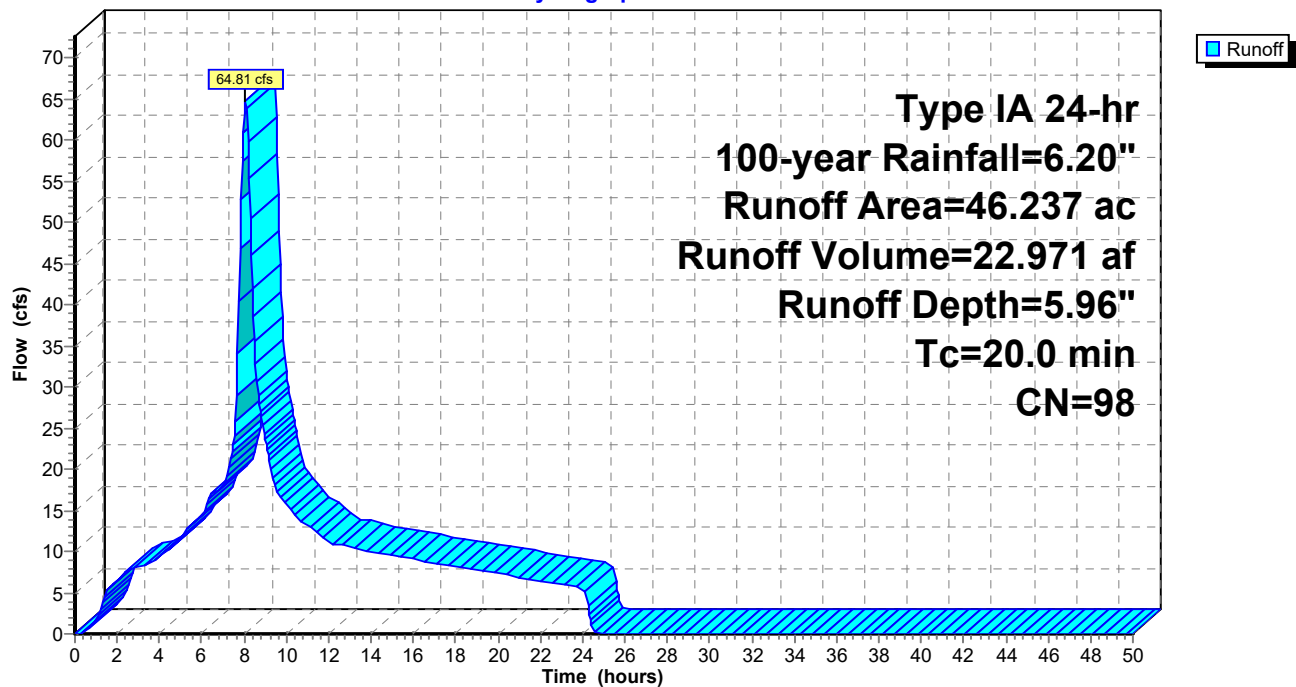
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 17S: Node D - PGIS

Hydrograph



Summary for Subcatchment D2R: Node C - Public Non-PGIS

Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
 Routed to Pond 15P : Bioretention

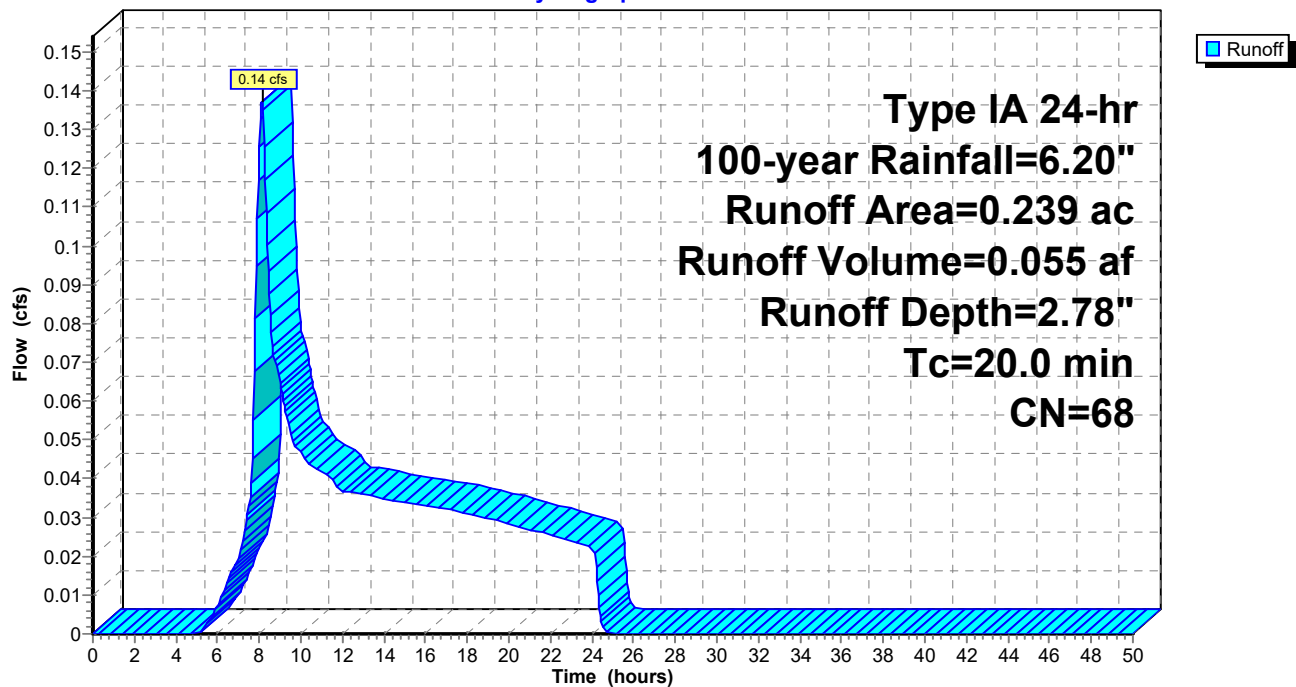
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D2R: Node C - Public Non-PGIS

Hydrograph



Summary for Subcatchment D3R: Node A - Public PGIS

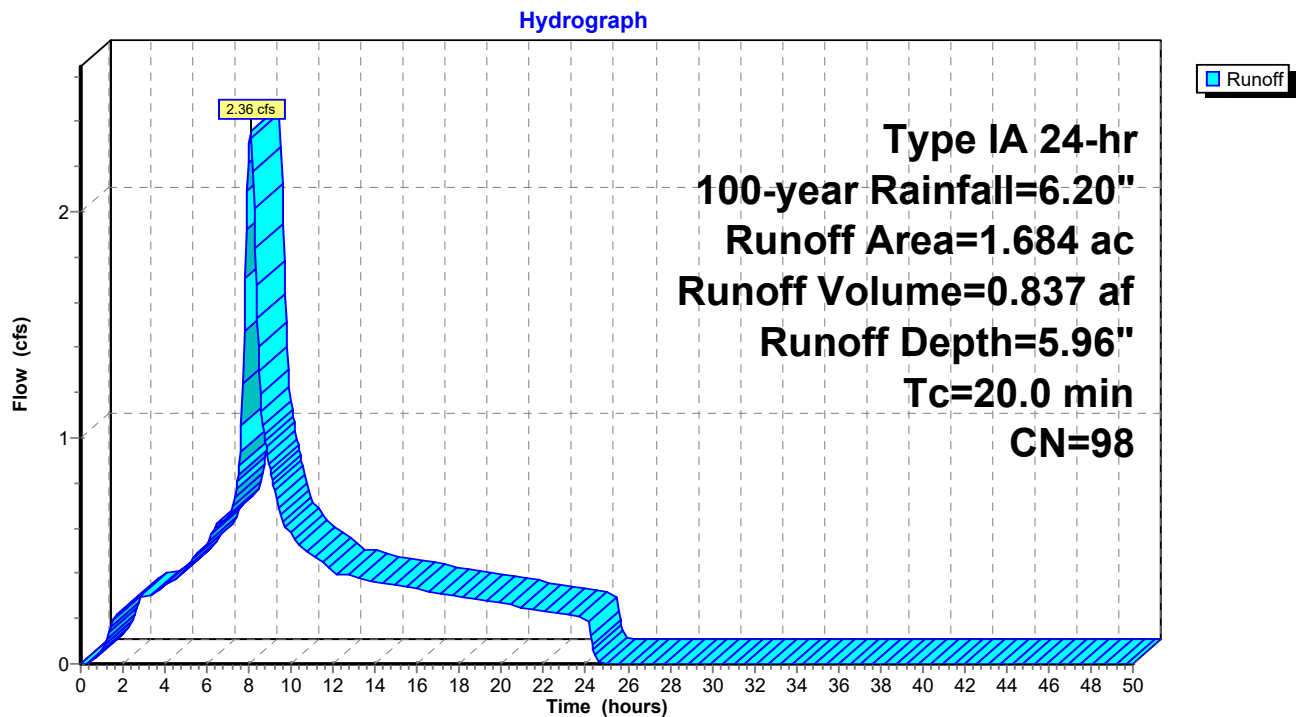
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
 Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
 Routed to Pond N1 : Node D

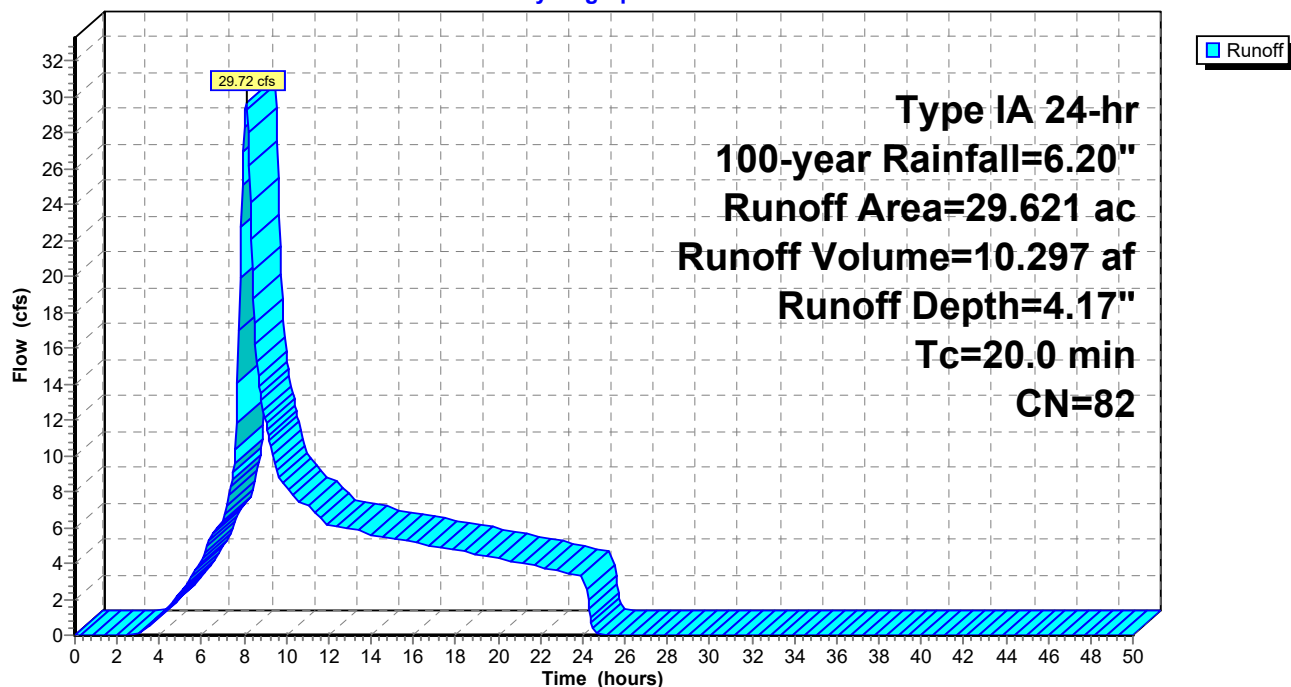
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment D5P: Node D - Non-PGIS

Hydrograph



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
 Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
 Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
 Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
 Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

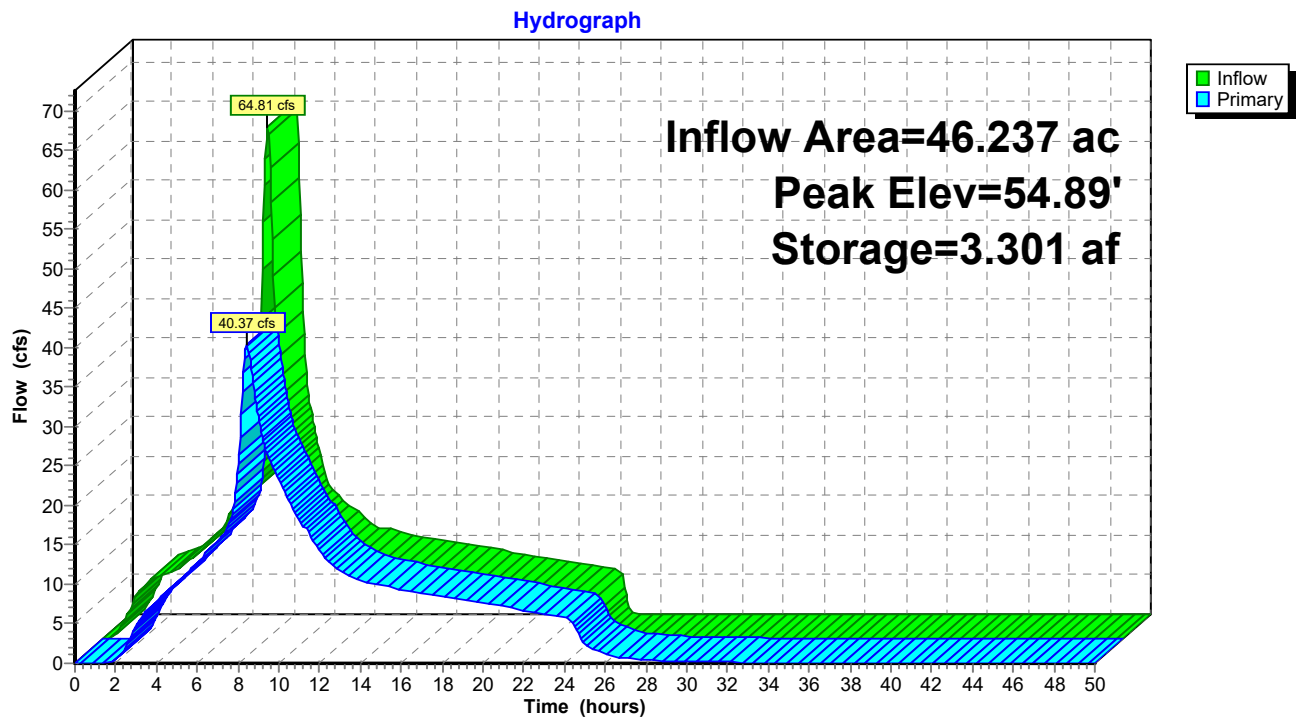
Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	270.00'W x 270.00'L x 6.50'H Prismatic 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	270.00'W x 270.00'L x 2.00'H Prismatic Inside #1
#3	50.50'	0.019 af	24.0" Round Pipe Storage Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	60.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	24.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)

↑ **1=Orifice/Grate** (Weir Controls 12.44 cfs @ 2.04 fps)
 ↓ **2=Orifice/Grate** (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
 Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
 Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
 Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
 Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

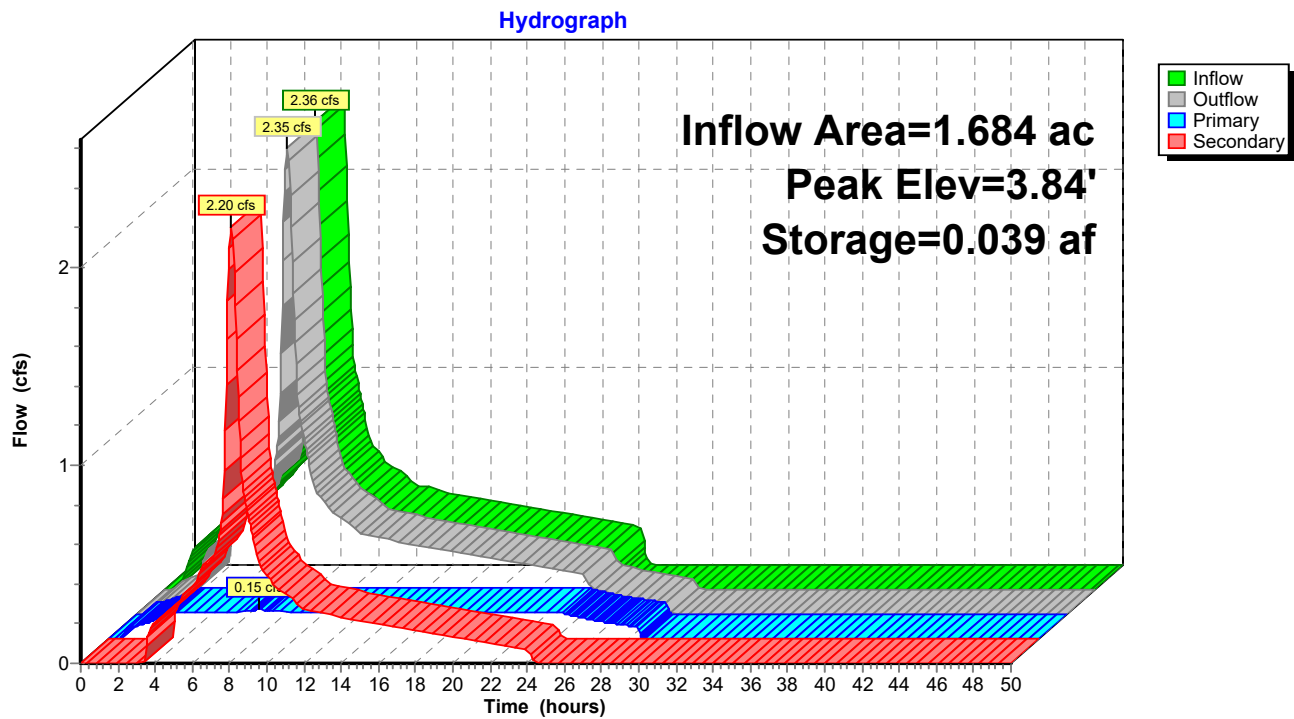
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	5.00'W x 250.00'L x 5.00'H Bioretention 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
 Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
 Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
 Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
 Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

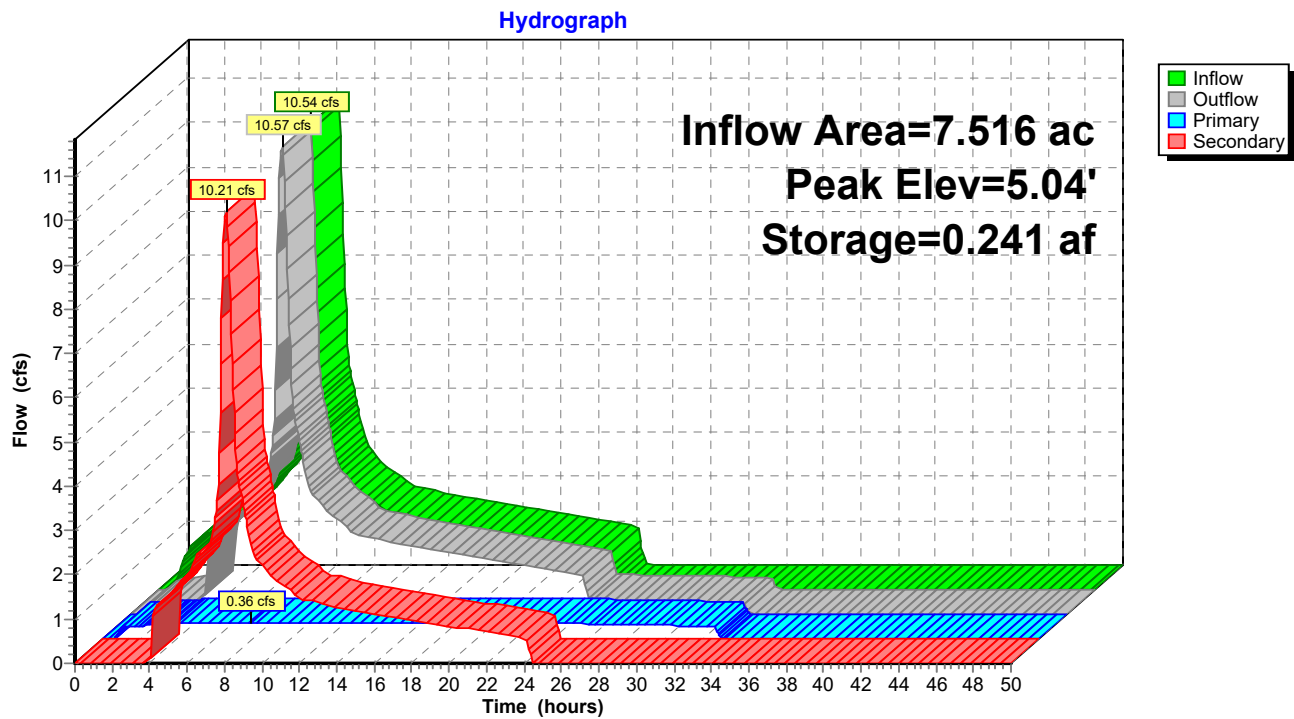
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	50.00'W x 120.00'L x 5.00'H Infiltration Trench 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.50'	30.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 6P: (new Pond)

[40] Hint: Not Described (Outflow=Inflow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' TW=0.00' (Free Discharge)

Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.80' (Flood elevation advised)
 [81] Warning: Exceeded Pond 10P by 49.14' @ 31.35 hrs
 [81] Warning: Exceeded Pond 11P by 49.14' @ 33.05 hrs
 [79] Warning: Submerged Pond N3 Primary device # 1 INLET by 8.36'

Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
 Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
 Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
 Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
 Routed to Pond N2 : Node C

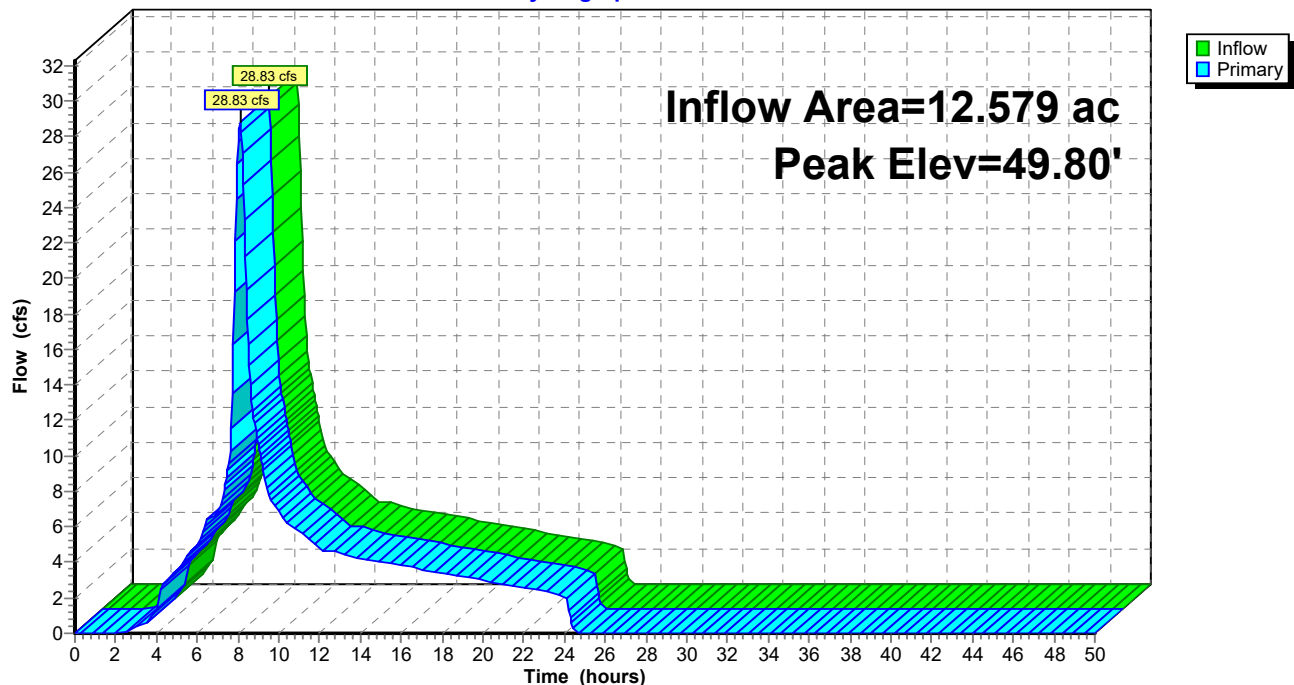
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 49.80' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	24.0" Round Culvert L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=28.67 cfs @ 8.09 hrs HW=49.80' TW=49.14' (Fixed TW Elev= 49.14')
 1=Culvert (Outlet Controls 8.98 cfs @ 2.86 fps)
 2=Sharp-Crested Rectangular Weir(Weir Controls 19.69 cfs @ 1.80 fps)

Pond 7P: Node B

Hydrograph



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
 Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
 Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
 Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	5.00'W x 40.00'L x 5.00'H Bioretention 0.023 af Overall x 35.0% Voids

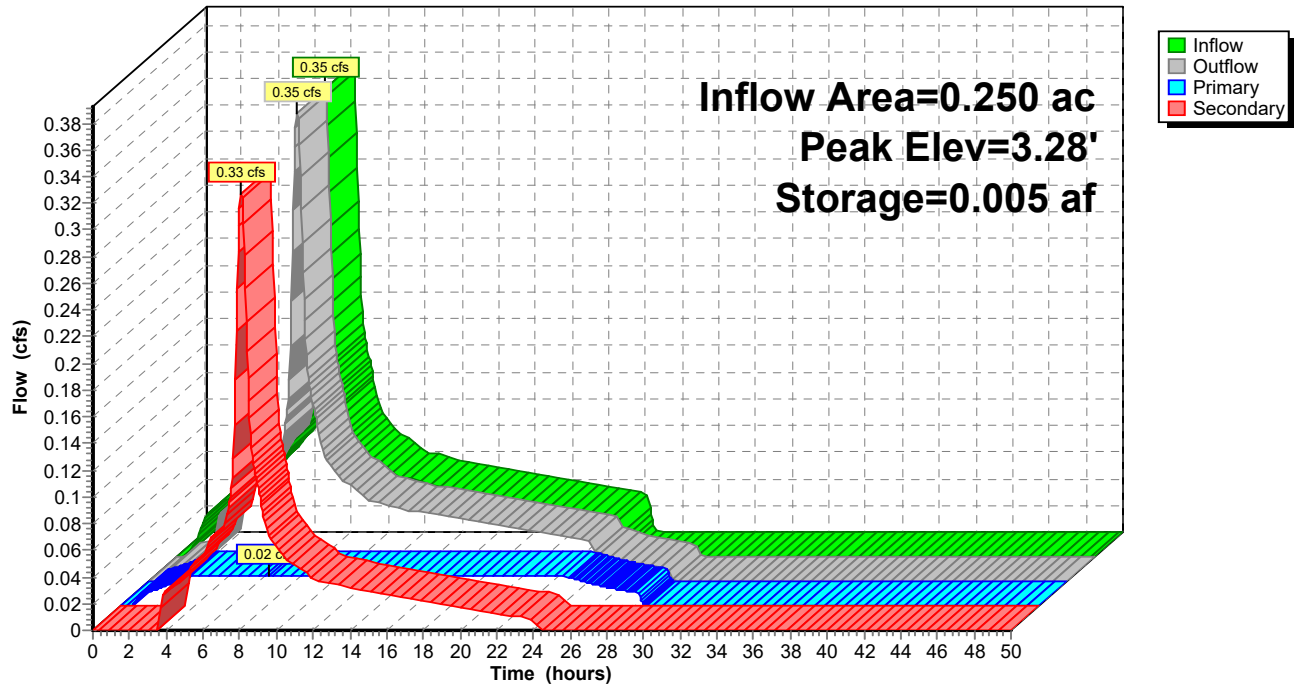
Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention

Hydrograph



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac, 100.00% Impervious, Inflow Depth = 5.96" for 100-year event
 Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
 Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
 Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
 Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
 Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
 Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

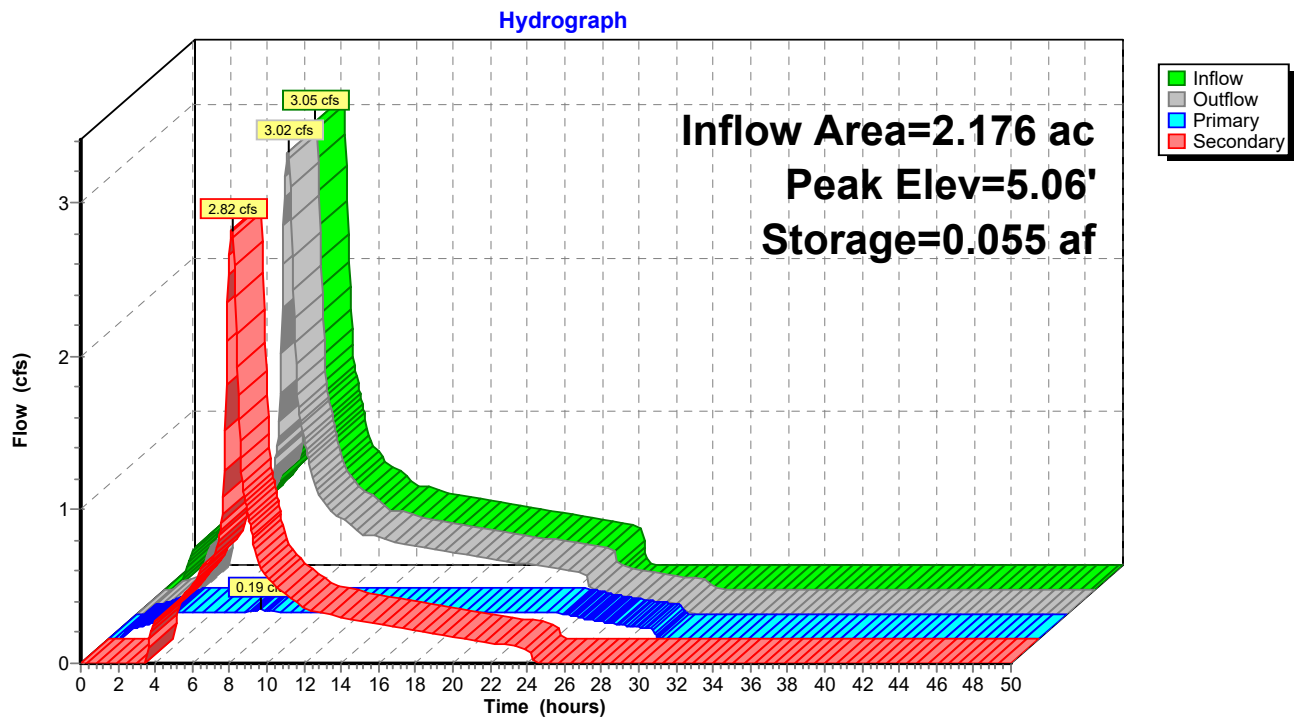
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	5.00'W x 270.00'L x 6.00'H Bioretention 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
 Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
 Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
 Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
 Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

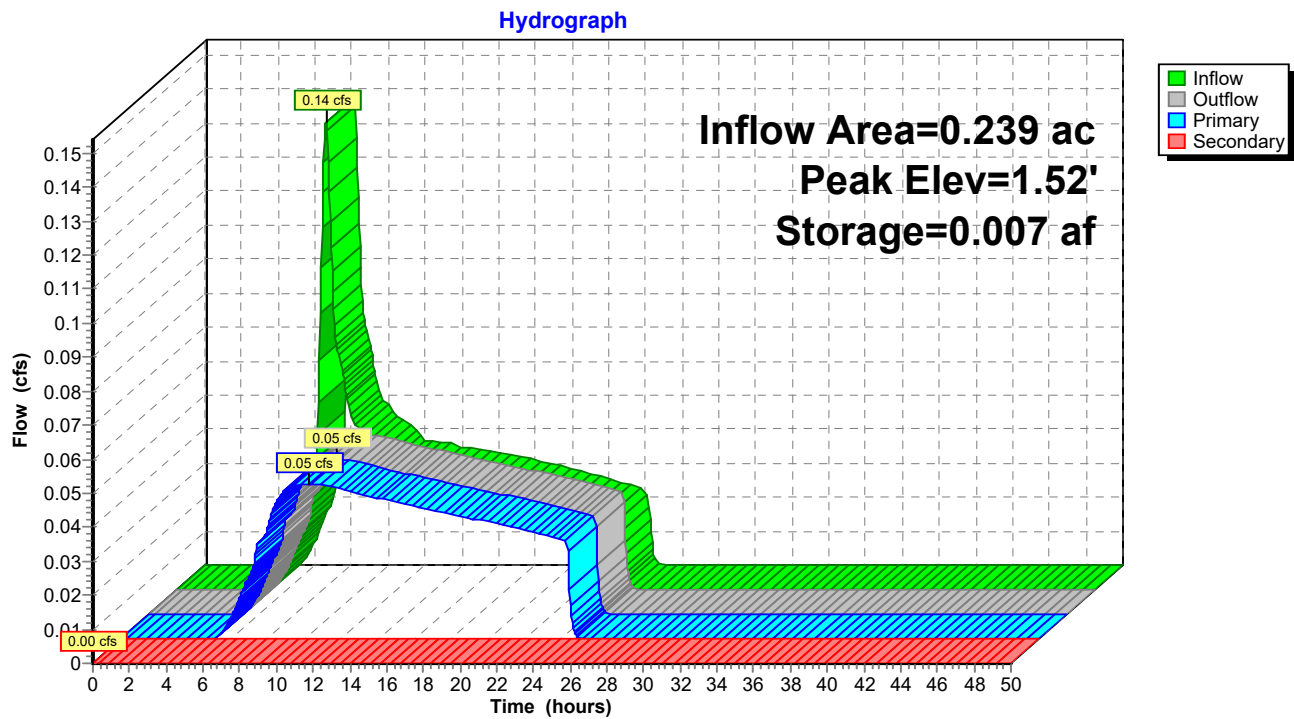
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	5.00'W x 120.00'L x 5.00'H Bioretention 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
 ↑**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
 Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
 Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
 Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
 Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
 Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
 Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

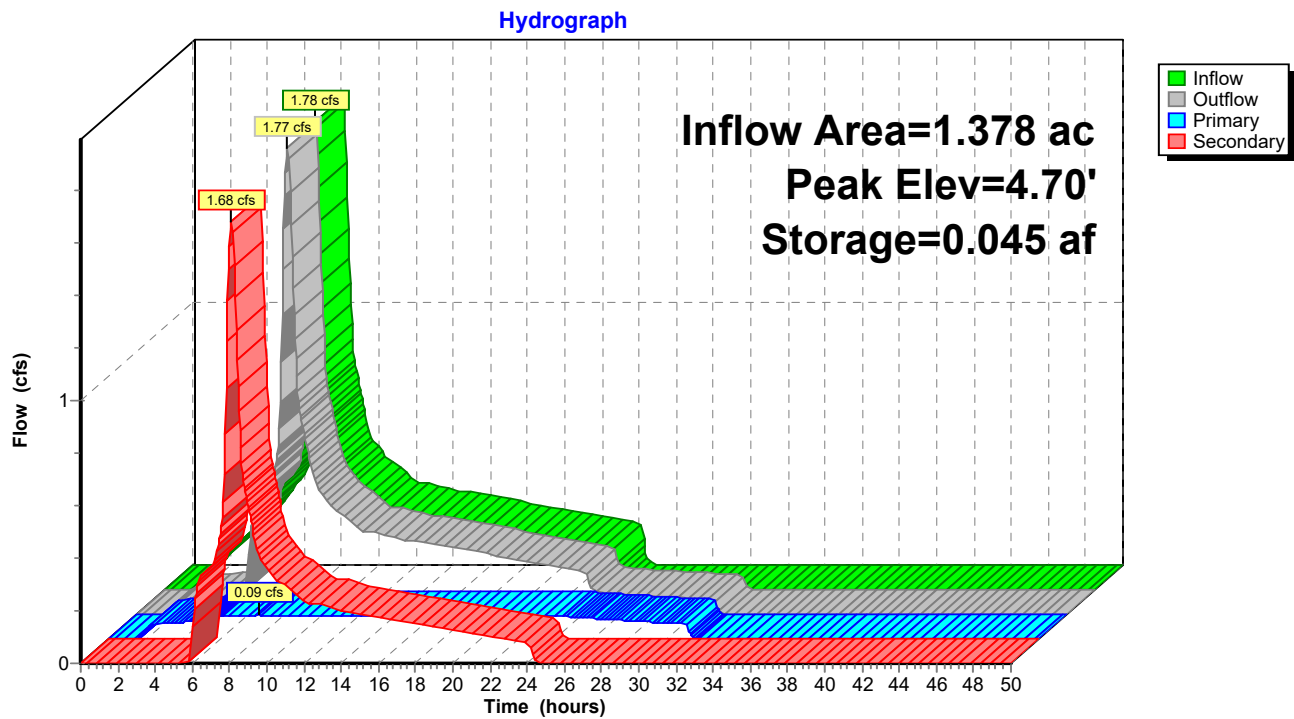
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	20.00'W x 60.00'L x 6.00'H Infiltration Trench 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	4.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
 ↑**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac, 100.00% Impervious, Inflow Depth > 5.88" for 100-year event
 Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
 Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
 Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
 Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
 Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
 Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

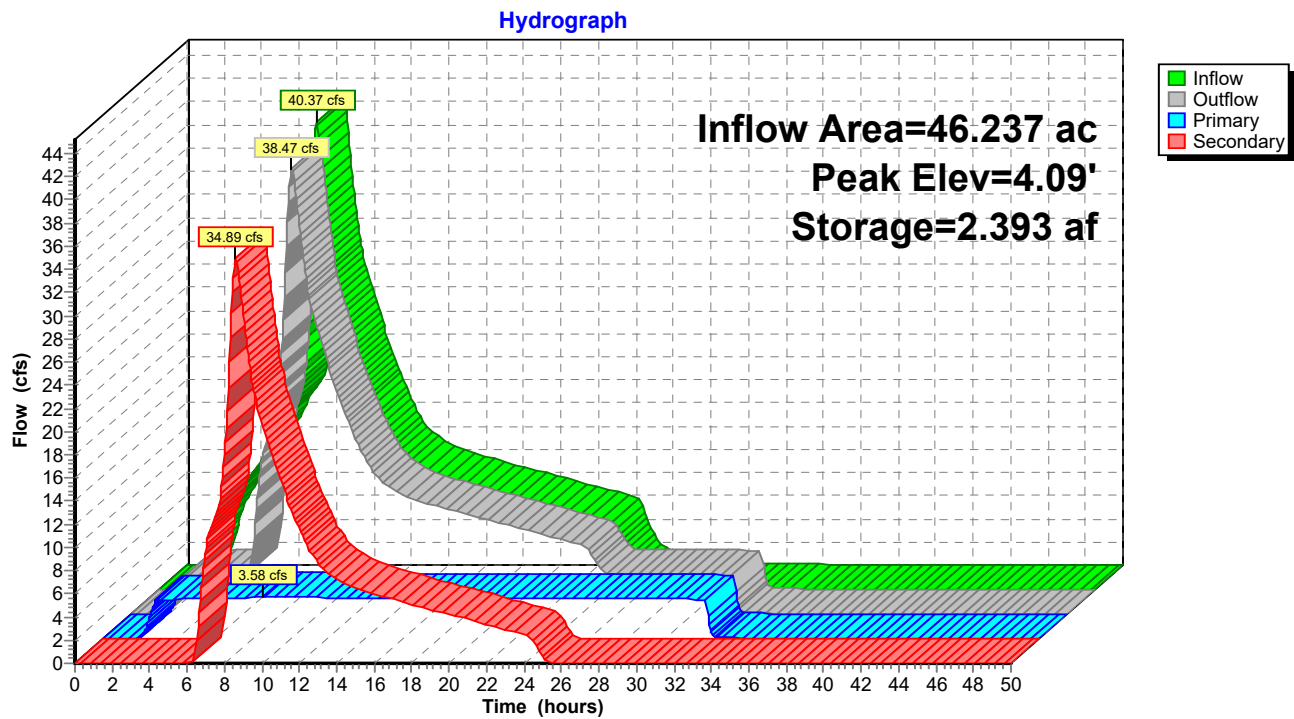
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	270.00'W x 270.00'L x 5.00'H Infiltration Trench 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	3.00'	36.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
 ↑2=Orifice/Grate (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[81] Warning: Exceeded Pond 19P by 48.01' @ 1.90 hrs

[81] Warning: Exceeded Pond N2 by 8.81' @ 0.00 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
 Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
 Outflow = 64.36 cfs @ 8.66 hrs, Volume= 34.599 af, Atten= 24%, Lag= 30.9 min
 Primary = 64.36 cfs @ 8.66 hrs, Volume= 34.599 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 48.85' @ 8.66 hrs Surf.Area= 243,905 sf Storage= 142,568 cf

Plug-Flow detention time= 43.8 min calculated for 34.599 af (100% of inflow)
 Center-of-Mass det. time= 43.3 min (778.9 - 735.5)

Volume	Invert	Avail.Storage	Storage Description
#1	48.00'	551,632 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.00	91,616	0	0
49.00	270,816	181,216	181,216
50.00	470,016	370,416	551,632

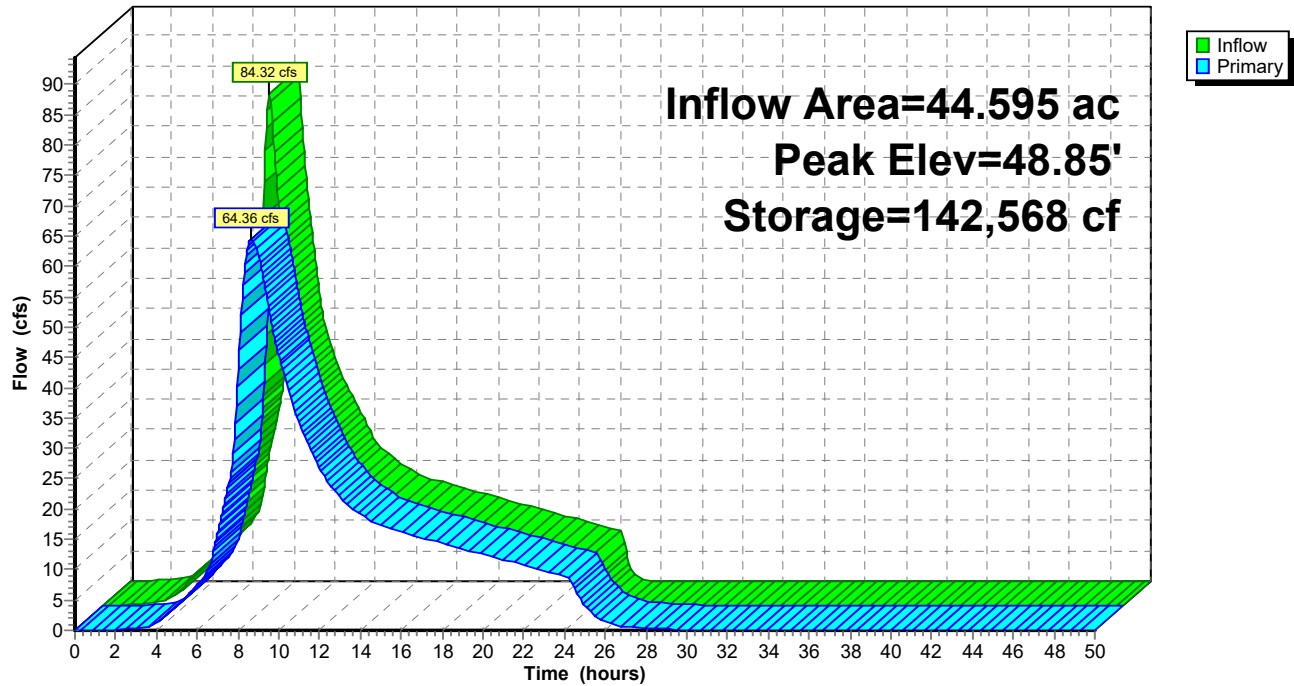
Device	Routing	Invert	Outlet Devices
#1	Primary	48.00'	30.0' long + 1.0 ' SideZ x 4.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=64.34 cfs @ 8.66 hrs HW=48.85' (Free Discharge)

↑1=**Broad-Crested Rectangular Weir**(Weir Controls 64.34 cfs @ 2.45 fps)

Pond N1: Node D

Hydrograph



Summary for Pond N2: Node C

[57] Hint: Peaked at 49.14' (Flood elevation advised)
 [81] Warning: Exceeded Pond 7P by 8.52' @ 1.75 hrs
 [81] Warning: Exceeded Pond 15P by 48.89' @ 7.75 hrs
 [81] Warning: Exceeded Pond 16P by 48.85' @ 1.40 hrs

Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
 Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
 Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
 Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
 Routed to Pond N1 : Node D

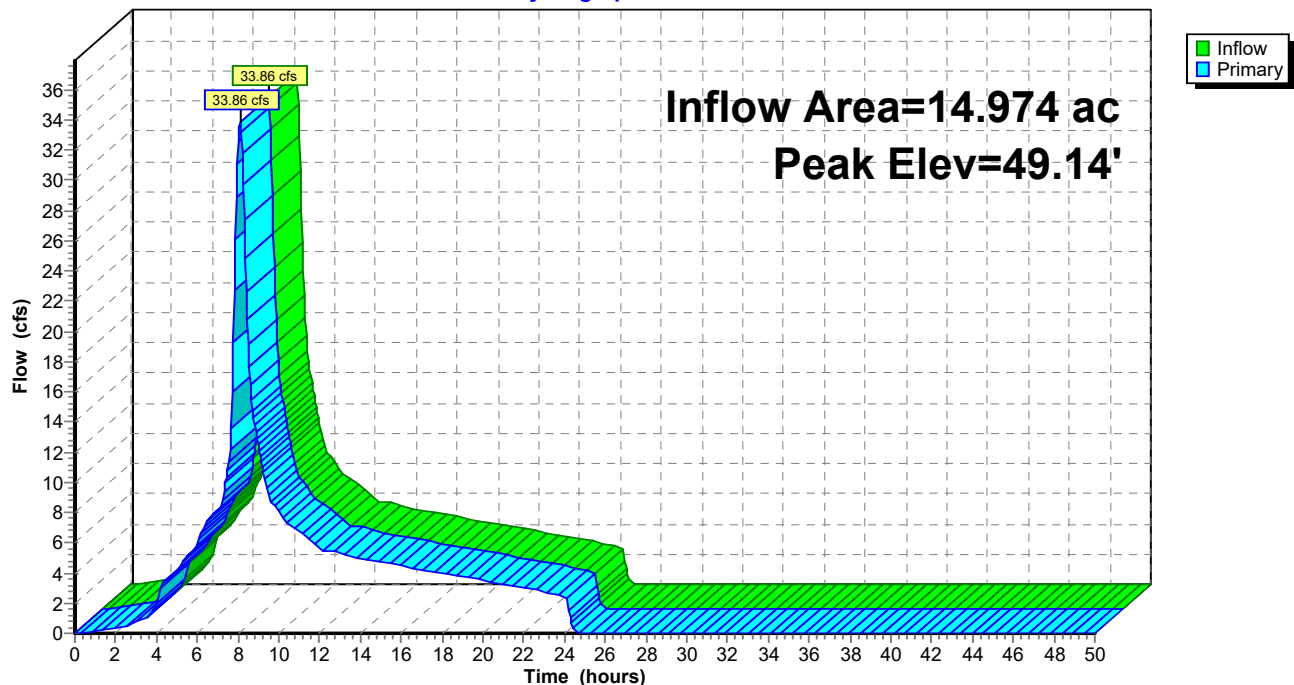
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 49.14' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	30.0" Round Culvert L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 37.96' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=33.70 cfs @ 8.09 hrs HW=49.14' TW=48.85' (Fixed TW Elev= 48.85')
 1=Culvert (Outlet Controls 10.14 cfs @ 2.07 fps)
 2=Sharp-Crested Rectangular Weir (Weir Controls 23.55 cfs @ 1.90 fps)

Pond N2: Node C

Hydrograph



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.57' (Flood elevation advised)
 [81] Warning: Exceeded Pond 4P by 49.80' @ 31.55 hrs
 [81] Warning: Exceeded Pond 5P by 49.80' @ 35.95 hrs

Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
 Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
 Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
 Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
 Routed to Pond 7P : Node B

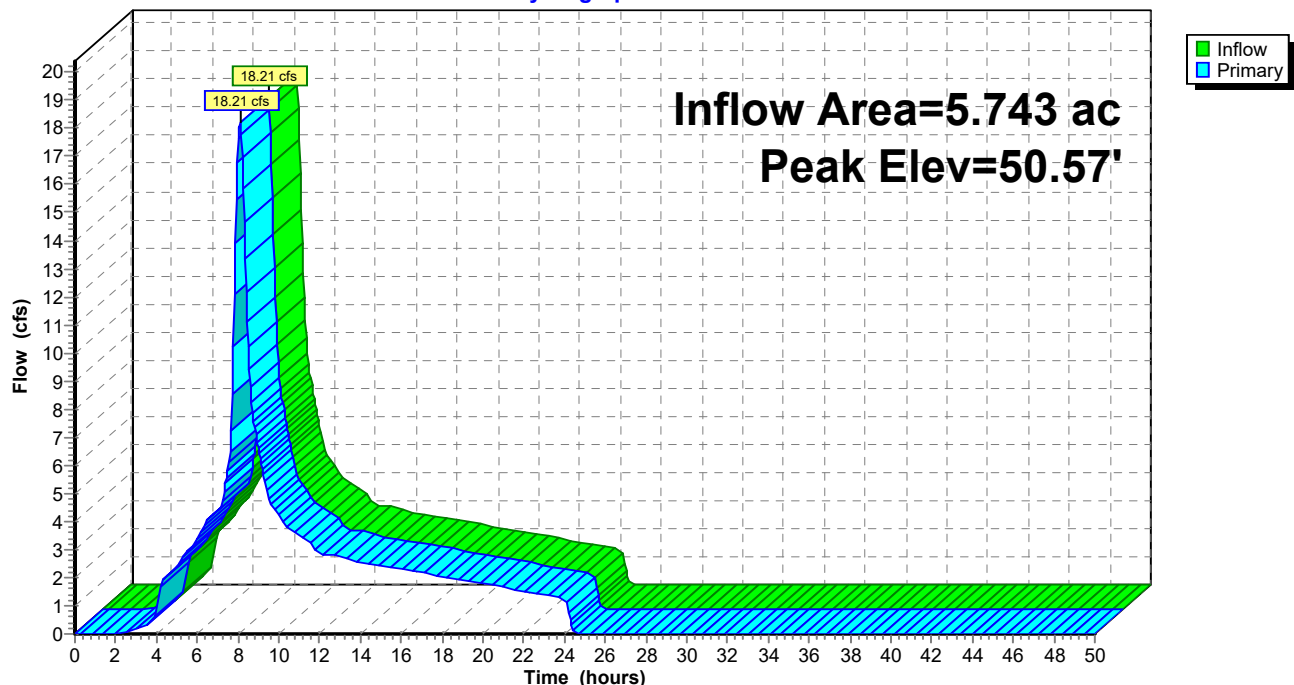
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 50.57' @ 8.09 hrs

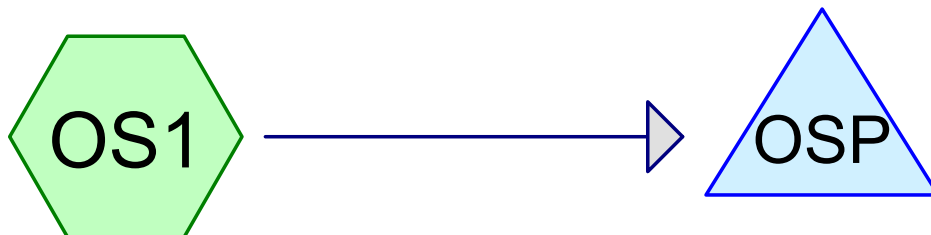
Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	24.0" Round Culvert L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	36.0' long x 1.00' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=17.91 cfs @ 8.09 hrs HW=50.57' TW=49.80' (Fixed TW Elev= 49.80')
 1=Culvert (Outlet Controls 9.77 cfs @ 3.11 fps)
 2=Sharp-Crested Rectangular Weir(Weir Controls 8.14 cfs @ 1.34 fps)

Pond N3: Node A

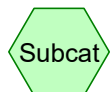
Hydrograph





Offsite Basin

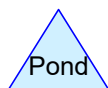
Node E



Subcat



Reach



Pond



Link

Routing Diagram for Offsite 25-Year Storm - Water @ OHHM or Below

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Offsite 25-Year Storm - Water @ OHWM or Below

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	79	TOTAL AREA

Offsite 25-Year Storm - Water @ OHWM or Below

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		TOTAL AREA

Offsite 25-Year Storm - Water @ OHWM or Below

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	25.493	0.000	0.000	0.000	31.995	TOTAL AREA	

Offsite 25-Year Storm - Water @ OHWM or Below

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	OSP	38.00	37.50	270.3	0.0018	0.012	0.0	30.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentOS1: Offsite Basin Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=21.13 cfs 7.700 af

Pond OSP: Node E Peak Elev=40.30' Storage=22,776 cf Inflow=21.13 cfs 7.700 af
Primary=16.75 cfs 7.699 af Secondary=0.00 cfs 0.000 af Outflow=16.75 cfs 7.699 af

Total Runoff Area = 31.995 ac Runoff Volume = 7.700 af Average Runoff Depth = 2.89"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Summary for Subcatchment OS1: Offsite Basin

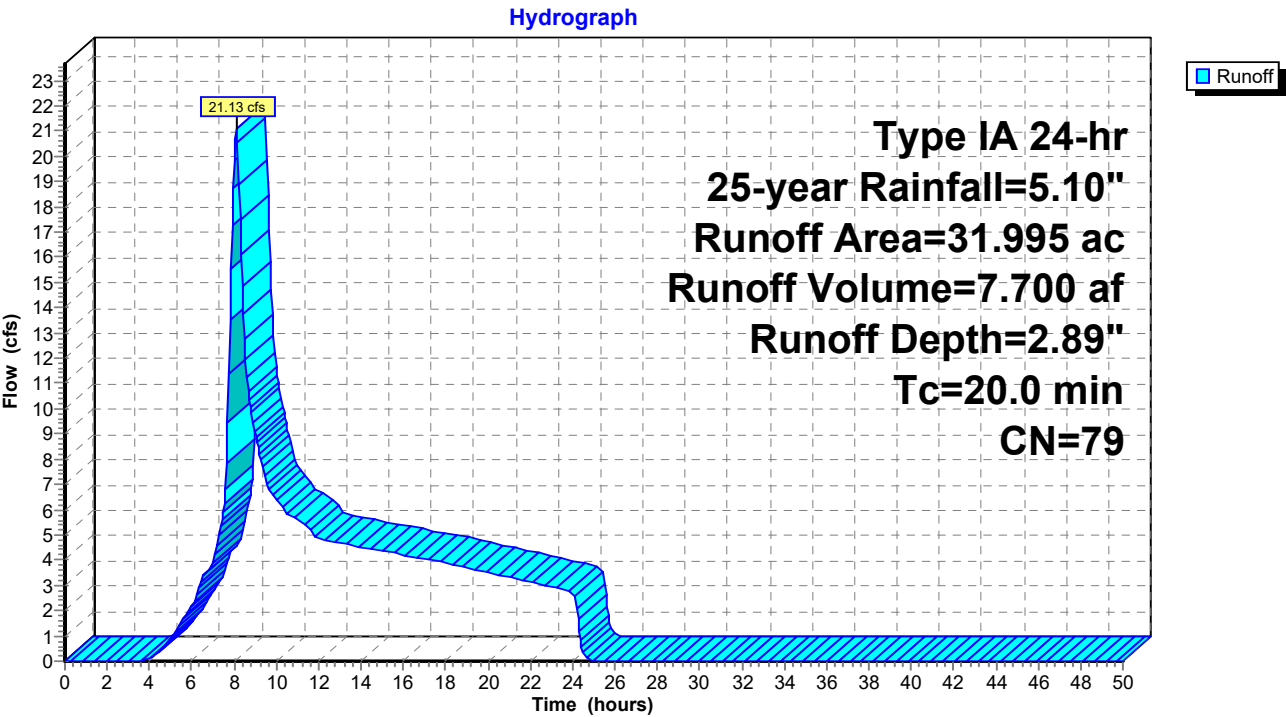
Runoff = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af, Depth= 2.89"
Routed to Pond OSP : Node E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
* 25.493	74	50-75% Grass cover, Poor/Fair, HSG B
6.502	98	Paved parking, HSG A
31.995	79	Weighted Average
25.493		79.68% Pervious Area
6.502		20.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment OS1: Offsite Basin



Summary for Pond OSP: Node E

[92] Warning: Device #1 is above defined storage

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 2.89" for 25-year event
 Inflow = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af
 Outflow = 16.75 cfs @ 8.33 hrs, Volume= 7.699 af, Atten= 21%, Lag= 12.9 min
 Primary = 16.75 cfs @ 8.33 hrs, Volume= 7.699 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 40.30' @ 8.33 hrs Surf.Area= 13,869 sf Storage= 22,776 cf

Plug-Flow detention time= 31.7 min calculated for 7.691 af (100% of inflow)
 Center-of-Mass det. time= 32.4 min (825.9 - 793.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	51,730 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	20,190	18,315	51,730

Device	Routing	Invert	Outlet Devices
#1	Secondary	45.00'	3.000 cfs Constant Flow/Skimmer Phase-In= 0.10'
#2	Primary	38.00'	30.0" Round Culvert L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 4.91 sf

Primary OutFlow Max=16.73 cfs @ 8.33 hrs HW=40.30' (Free Discharge)

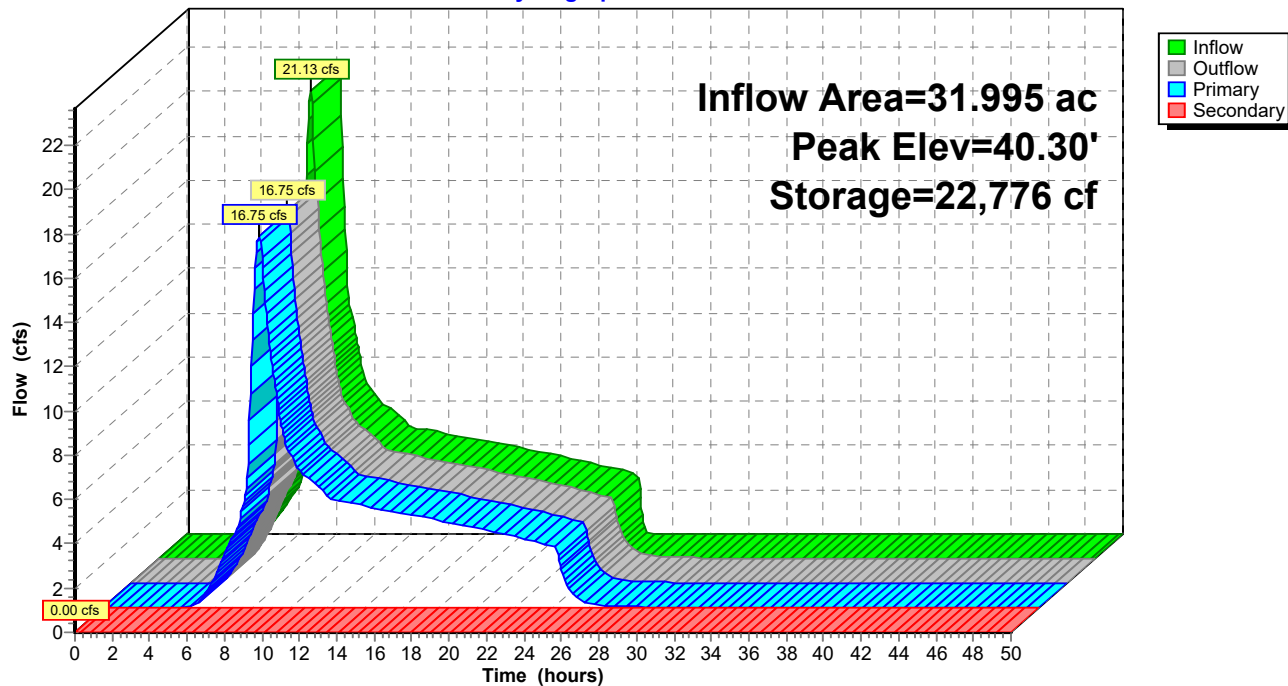
↑ **2=Culvert** (Barrel Controls 16.73 cfs @ 4.64 fps)

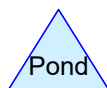
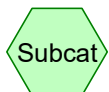
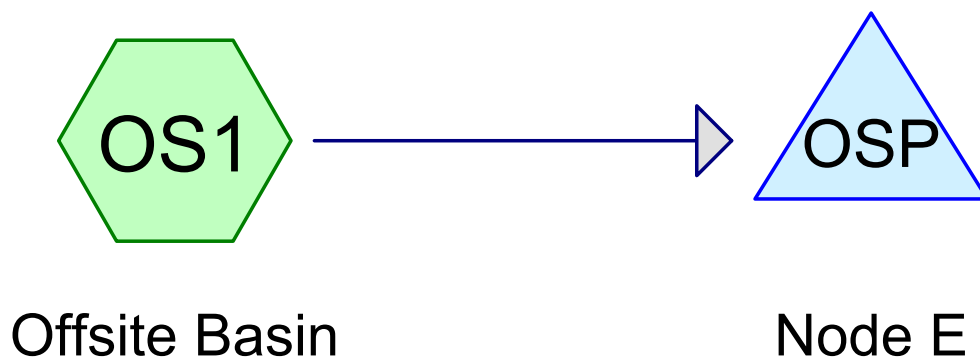
Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)

↑ **1=Constant Flow/Skimmer** (Controls 0.00 cfs)

Pond OSP: Node E

Hydrograph





Routing Diagram for Offsite 100-Year Storm - Water @ OHWM or Below
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Offsite 100-Year Storm - Water @ OHWM or Below

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	79	TOTAL AREA

Offsite 100-Year Storm - Water @ OHWM or Below

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		TOTAL AREA

Offsite 100-Year Storm - Water @ OHWM or Below

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	25.493	0.000	0.000	0.000	31.995	TOTAL AREA	

Offsite 100-Year Storm - Water @ OHWM or Below

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	OSP	38.00	37.50	270.3	0.0018	0.012	0.0	30.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentOS1: Offsite Basin Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=29.10 cfs 10.288 af

Pond OSP: Node E Peak Elev=40.85' Storage=31,017 cf Inflow=29.10 cfs 10.288 af
30.0" Round Culvert n=0.012 L=270.3' S=0.0018 '/' Outflow=22.26 cfs 10.286 af

Total Runoff Area = 31.995 ac Runoff Volume = 10.288 af Average Runoff Depth = 3.86"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Summary for Subcatchment OS1: Offsite Basin

Runoff = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af, Depth= 3.86"
Routed to Pond OSP : Node E

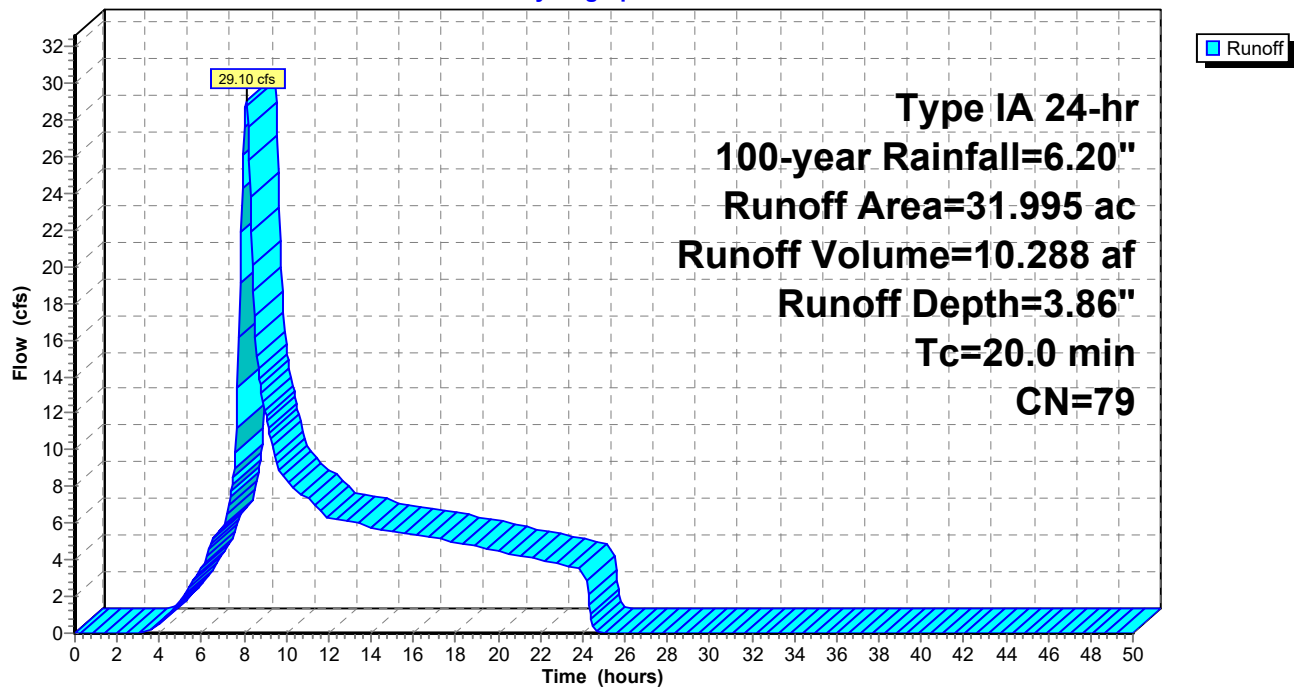
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
* 25.493	74	50-75% Grass cover, Poor/Fair, HSG B
6.502	98	Paved parking, HSG A
31.995	79	Weighted Average
25.493		79.68% Pervious Area
6.502		20.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment OS1: Offsite Basin

Hydrograph



Summary for Pond OSP: Node E

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 3.86" for 100-year event
 Inflow = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af
 Outflow = 22.26 cfs @ 8.34 hrs, Volume= 10.286 af, Atten= 23%, Lag= 14.2 min
 Primary = 22.26 cfs @ 8.34 hrs, Volume= 10.286 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 40.85' @ 8.34 hrs Surf.Area= 15,897 sf Storage= 31,017 cf

Plug-Flow detention time= 28.9 min calculated for 10.276 af (100% of inflow)
 Center-of-Mass det. time= 29.5 min (806.2 - 776.7)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	102,732 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

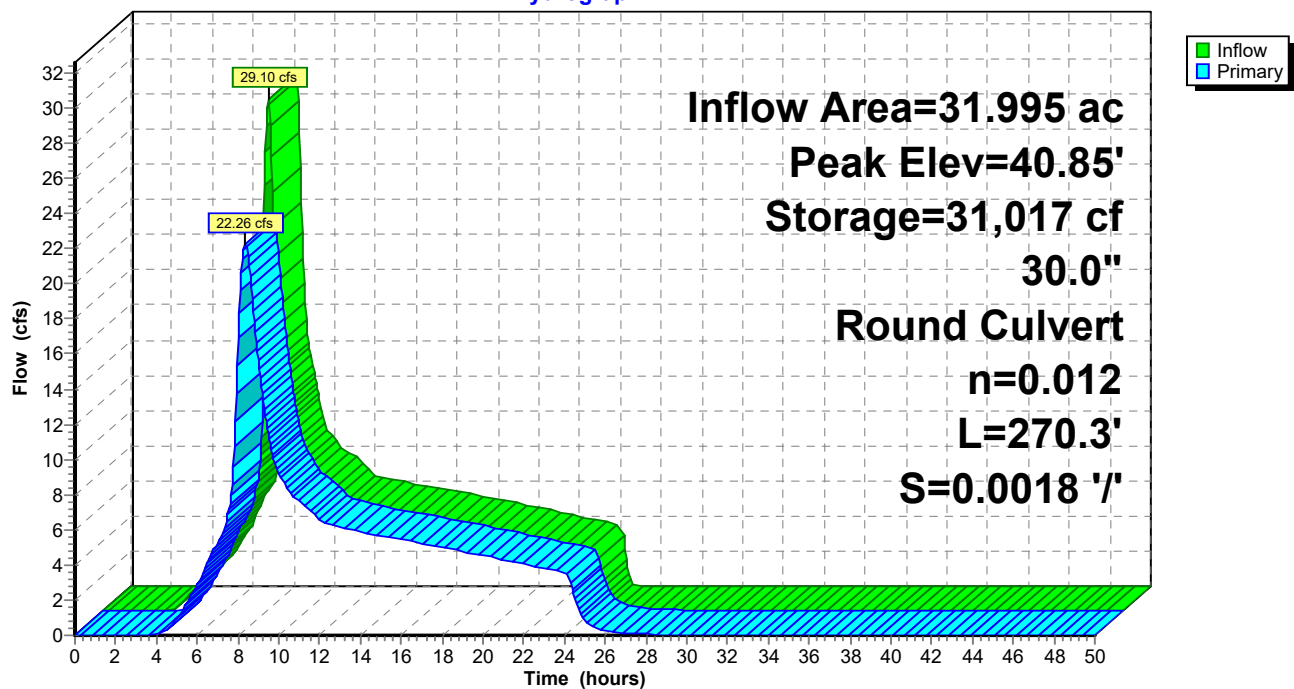
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	38,154	27,297	60,712
43.00	45,886	42,020	102,732

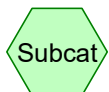
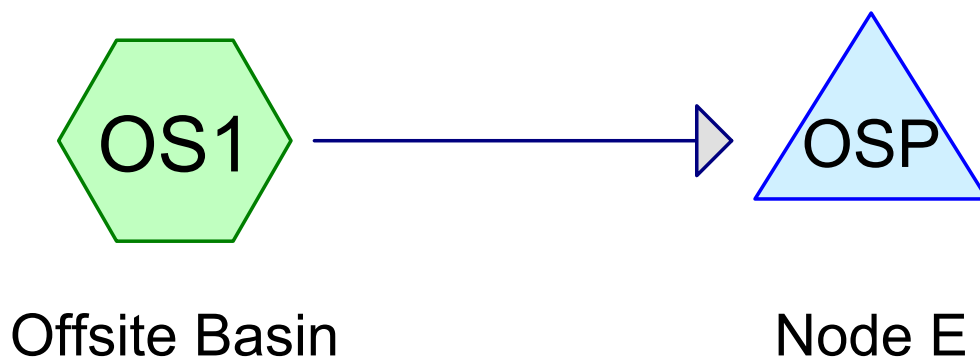
Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	30.0" Round Culvert L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=22.25 cfs @ 8.34 hrs HW=40.85' (Free Discharge)
 ↑**1=Culvert** (Barrel Controls 22.25 cfs @ 4.98 fps)

Pond OSP: Node E

Hydrograph

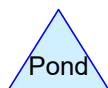




Subcat



Reach



Pond



Link

Routing Diagram for Offsite 25-Year w Vavle Closed
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Offsite 25-Year w Vavle Closed

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Page 2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	79	TOTAL AREA

Offsite 25-Year w Vavle Closed

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		TOTAL AREA

Offsite 25-Year w Vavle Closed

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	25.493	0.000	0.000	0.000	31.995	TOTAL AREA	

Offsite 25-Year w Vavle Closed*Type IA 24-hr 25-year Rainfall=5.10"*

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Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentOS1: Offsite Basin

Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=2.89"

Tc=20.0 min CN=79 Runoff=21.13 cfs 7.700 af

Pond OSP: Node E

Peak Elev=42.45' Storage=78,763 cf Inflow=21.13 cfs 7.700 af

Outflow=5.00 cfs 7.268 af

Total Runoff Area = 31.995 ac Runoff Volume = 7.700 af Average Runoff Depth = 2.89"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Offsite 25-Year w Vavle Closed

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Type IA 24-hr 25-year Rainfall=5.10"

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Summary for Subcatchment OS1: Offsite Basin

Runoff = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af, Depth= 2.89"
Routed to Pond OSP : Node E

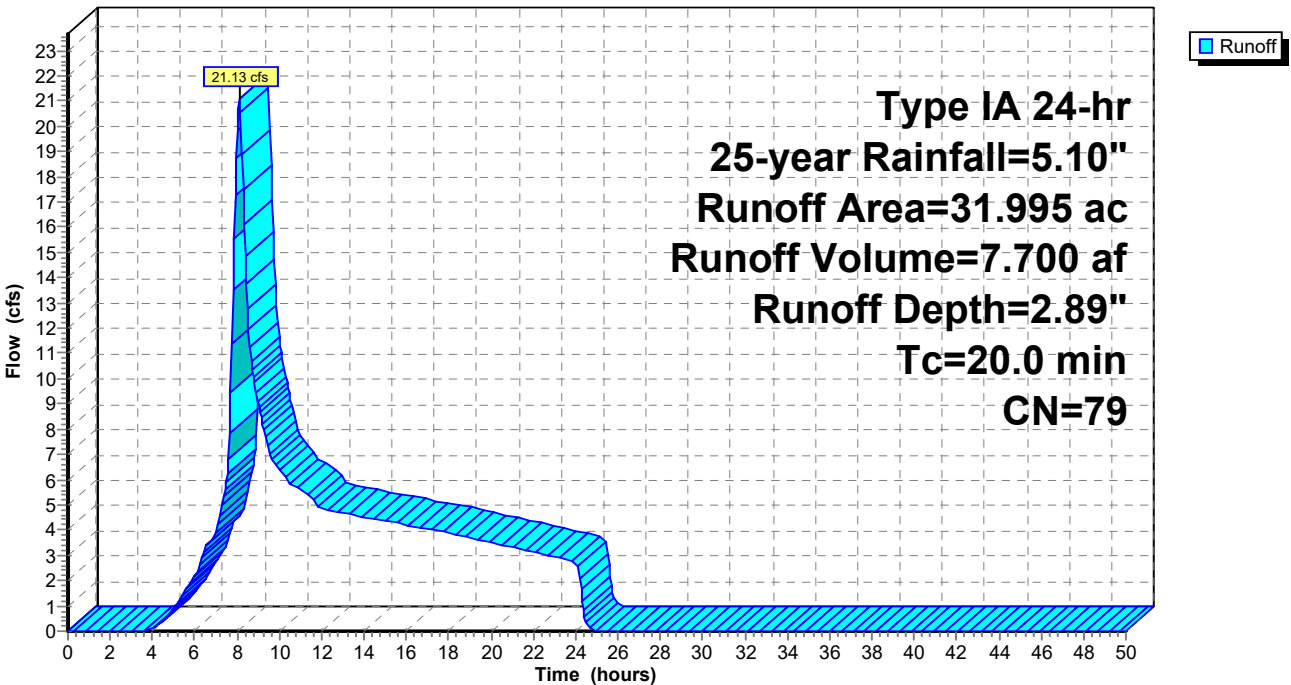
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
* 25.493	74	50-75% Grass cover, Poor/Fair, HSG B
6.502	98	Paved parking, HSG A
31.995	79	Weighted Average
25.493		79.68% Pervious Area
6.502		20.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment OS1: Offsite Basin

Hydrograph



Offsite 25-Year w Vavle Closed

Type IA 24-hr 25-year Rainfall=5.10"

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Summary for Pond OSP: Node E

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 2.89" for 25-year event
 Inflow = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af
 Outflow = 5.00 cfs @ 7.45 hrs, Volume= 7.268 af, Atten= 76%, Lag= 0.0 min
 Primary = 5.00 cfs @ 7.45 hrs, Volume= 7.268 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 42.45' @ 11.76 hrs Surf.Area= 41,652 sf Storage= 78,763 cf

Plug-Flow detention time= 197.9 min calculated for 7.268 af (94% of inflow)
 Center-of-Mass det. time= 161.8 min (955.3 - 793.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	102,732 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	38,154	27,297	60,712
43.00	45,886	42,020	102,732

Device	Routing	Invert	Outlet Devices
#1	Primary	40.00'	5.000 cfs Constant Flow/Skimmer Phase-In= 0.10'

Primary OutFlow Max=5.00 cfs @ 7.45 hrs HW=40.11' (Free Discharge)

↑ **1=Constant Flow/Skimmer** (Constant Controls 5.00 cfs)

Offsite 25-Year w Vavle Closed

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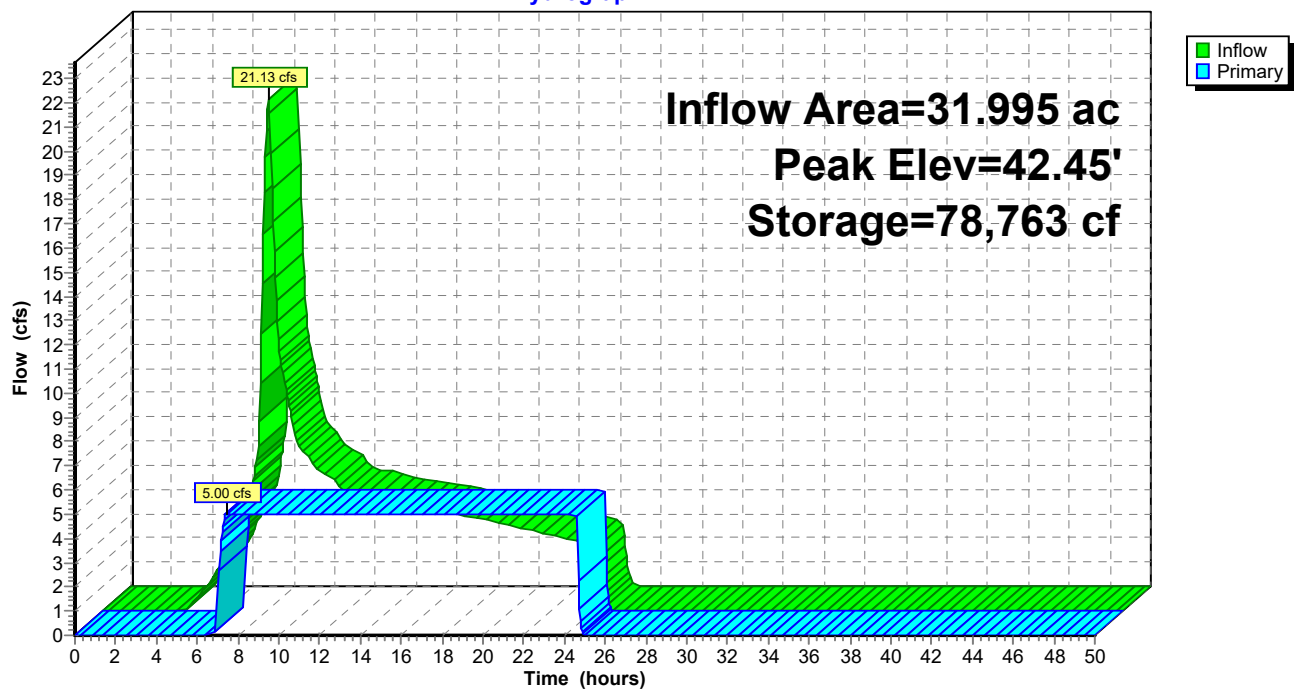
Type IA 24-hr 25-year Rainfall=5.10"

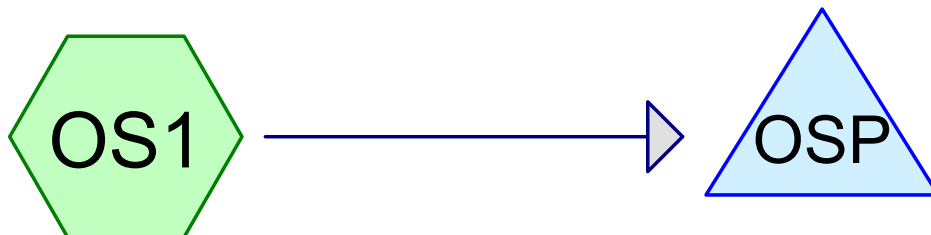
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Pond OSP: Node E

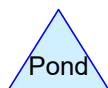
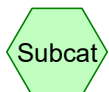
Hydrograph





Offsite Basin

Node E



Routing Diagram for Offsite 100-Year Storm w Valve Closed
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Offsite 100-Year Storm w Valve Closed

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	79	TOTAL AREA

Offsite 100-Year Storm w Valve Closed

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		TOTAL AREA

Offsite 100-Year Storm w Valve Closed

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	25.493	0.000	0.000	0.000	31.995	TOTAL AREA	

Offsite 100-Year Storm w Valve Closed*Type IA 24-hr 100-year Rainfall=6.20"*

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Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentOS1: Offsite Basin

Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=3.86"

Tc=20.0 min CN=79 Runoff=29.10 cfs 10.288 af

Pond OSP: Node E

Peak Elev=43.65' Storage=143,898 cf Inflow=29.10 cfs 10.288 af

Outflow=5.00 cfs 9.857 af

Total Runoff Area = 31.995 ac Runoff Volume = 10.288 af Average Runoff Depth = 3.86"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Offsite 100-Year Storm w Valve Closed

Prepared by MacKay & Sposito, Inc

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Type IA 24-hr 100-year Rainfall=6.20"

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Summary for Subcatchment OS1: Offsite Basin

Runoff = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af, Depth= 3.86"
Routed to Pond OSP : Node E

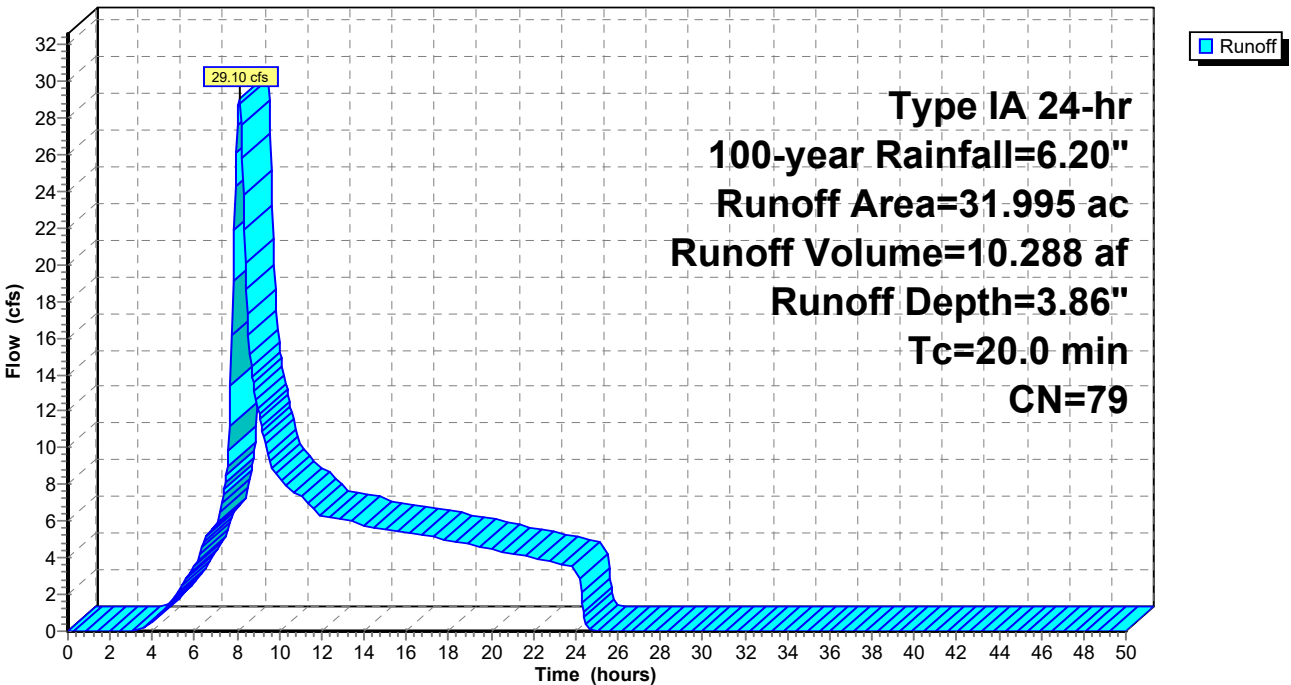
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
* 25.493	74	50-75% Grass cover, Poor/Fair, HSG B
6.502	98	Paved parking, HSG A
31.995	79	Weighted Average
25.493		79.68% Pervious Area
6.502		20.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment OS1: Offsite Basin

Hydrograph



Offsite 100-Year Storm w Valve Closed

Type IA 24-hr 100-year Rainfall=6.20"

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Summary for Pond OSP: Node E

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 3.86" for 100-year event
 Inflow = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af
 Outflow = 5.00 cfs @ 6.60 hrs, Volume= 9.857 af, Atten= 83%, Lag= 0.0 min
 Primary = 5.00 cfs @ 6.60 hrs, Volume= 9.857 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 43.65' @ 17.77 hrs Surf.Area= 81,478 sf Storage= 143,898 cf

Plug-Flow detention time= 348.7 min calculated for 9.847 af (96% of inflow)
 Center-of-Mass det. time= 321.0 min (1,097.7 - 776.7)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	176,147 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	38,154	27,297	60,712
43.00	45,886	42,020	102,732
44.00	100,944	73,415	176,147

Device	Routing	Invert	Outlet Devices
#1	Primary	40.00'	5.000 cfs Constant Flow/Skimmer Phase-In= 0.10'

Primary OutFlow Max=5.00 cfs @ 6.60 hrs HW=40.10' (Free Discharge)
 ↑1=**Constant Flow/Skimmer** (Constant Controls 5.00 cfs)

Offsite 100-Year Storm w Valve Closed

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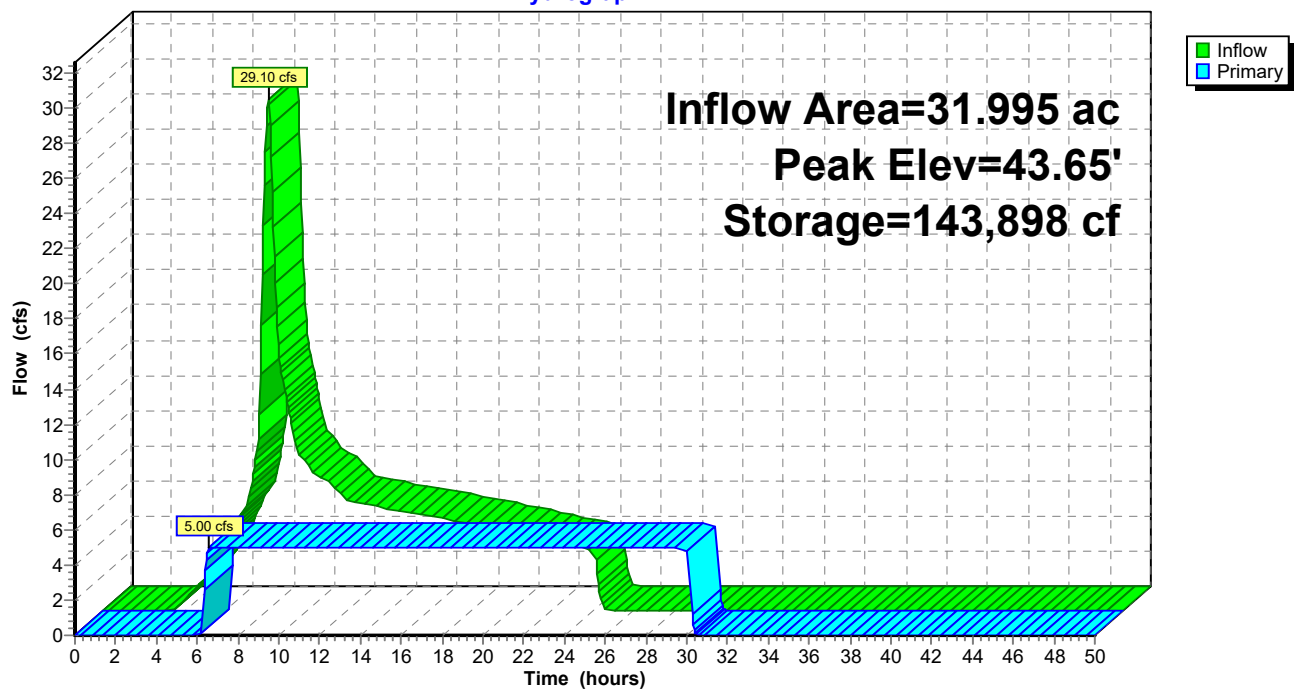
Type IA 24-hr 100-year Rainfall=6.20"

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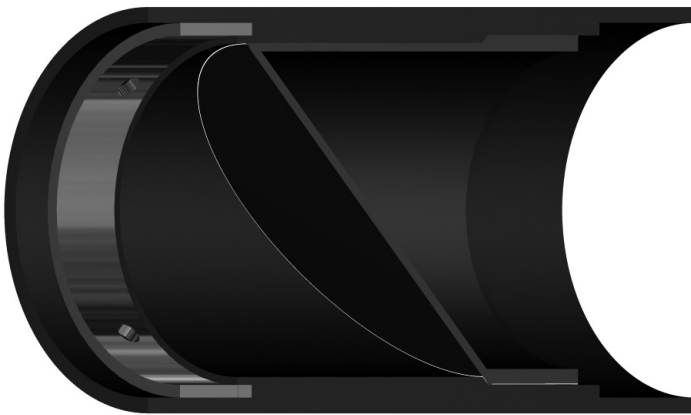
Pond OSP: Node E

Hydrograph



Tideflex® CheckMate UltraFlex® Inline Check Valve

Installation, Operation and Maintenance Manual



The revolutionary design of the CheckMate® Inline Check Valve provides superior backflow prevention and odor mitigation in stormwater, CSO and SSO outfalls. The CheckMate's® custom-engineered, all-rubber unibody design eliminates costly backflow from oceans, rivers and interceptors. The valve's unique elastomer fabric and wire reinforced design provides a proven record of maintenance-free performance, cost savings and results that no other inline check valve can match. The CheckMate® is built to suit all your site-specific and flow needs.

The CheckMate® has a 100% fabric and elastomer construction that eliminates corrosion problems. Because the CheckMate® is made with a unibody construction, there are no mechanical components that trap debris, corrode or fail.

The CheckMate® Valve's inherent flexibility virtually eliminates seating problems. The CheckMate® remains in the closed position until forward differential pressure opens it. The fabric-reinforced elastomer CheckMate® Valve seals around silt and small debris, preventing unwanted backflow.

The major advantage of the CheckMate® Valve is its extremely low headloss. The CheckMate® can open to a near full pipe diameter. This maximizes flow capacity of the outfall, which is particularly beneficial in low-lying areas where limited driving head is available.

Tideflex® recommends pinning all CheckMate® Valves for added security and stability. CheckMate's® effectively have a zero face-to-face dimension because they fit completely inside of the pipe. No modification of piping is required provided adequate pipe length exists.

IMPORTANT

Please take a moment to review this manual. The improper installation or use of this product may result in personal injury, product failure, or reduced product life. Tideflex® can accept NO liability resulting from the improper use or installation of this product. If you have any questions or problems, please call the customer service department at (412) 279-0044. We appreciate your comments. Thank you for choosing Tideflex®.

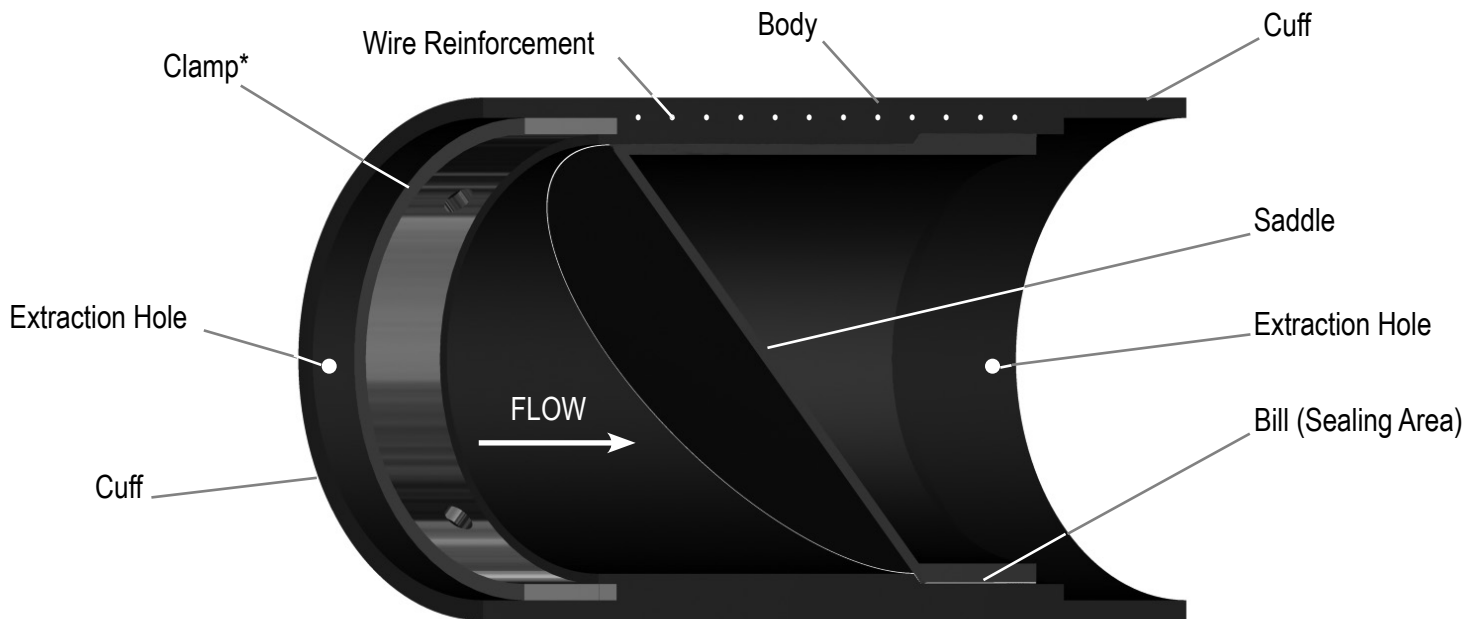
CheckMate® Installation Procedure

NEVER...
Install the valve at an angle

NEVER...
Use Sharp Tools on Rubber

NEVER...
Exceed Design Back Pressure

NEVER...
Install the Valve Backwards



*Clamps are installed in the upstream or downstream cuff, depending upon the application. The illustration above is shown clamped upstream.

CHECKMATE® INSTALLATION

1. Product Shipping

Valve sizes 3" - 18" are furnished with one clamp. Valves 20" - 60" ship with two clamps. 72" valves ship with three clamps.

NOTE: A clamp is installed on each end of the valve to keep the valve's shape during transit and storage. Once the installation orientation is determined the CheckMate® valve will be clamped from either the upstream or downstream side. **For valves with two or three clamps, they can be installed onto the same side of the valve and offset from each other, as illustrated in Figure 1.**

2. Unpacking & Lifting

Do not use sharp tools when unpacking this product as it may damage the valve.

For larger CheckMate® valves, the valve should be lifted with either a sling or with supports around the O.D. at each side of the valve to ease the installation procedure. Do not place an object through the valve in order to lift.

CAUTION: Do not try to bend, collapse or fold the valve in order to facilitate the installation as this will cause permanent damage and will not allow the valve to return to a fully round shape.

3. Inspection of Pipe I.D.

Check the inside diameter (I.D.) of the pipe section for rough or damaged areas. The inside surface should be uniform and relatively smooth. Long gouges or cracks in the pipe may allow water to pass and should be filled prior to installation. Do not attempt to install a CheckMate® in a smaller pipe I.D.

4. Pipe I.D. Measurements

The pipe I.D. is to be checked in the field. It should be a consistent diameter for the length of valve and should not be out of round. When there is a +/- tolerance on the pipe I.D., the CheckMate® Valve should be ordered to the smallest pipe I.D.. Then, rubber adhesive strip can be applied to both CheckMate® cuffs to build the cuff O.D. up to the actual pipe I.D. See procedure in #5.

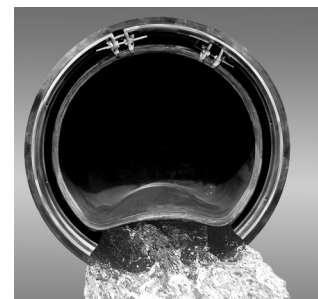


Figure 1 – Clamps shown installed on the same side of valve

CheckMate® Rubber Adhesive Strip Build Up Procedure

5. Rubber Adhesive Strip Build up

When valve O.D. is smaller than the pipe I.D., one-sided rubber adhesive strip is used to build up the O.D. of both CheckMate® cuffs to the actual pipe I.D.

NOTICE: Clean and dry the exterior of the valve prior to beginning rubber adhesive strip build up procedure.



STEP A: Place the valve on a solid, flat surface with the clamped end hanging slightly over the edge of the surface.



STEP B: Slowly rotate the valve while firmly pressing the rubber adhesive strip onto itself in concentric layers until valve O.D. is equal to or a fraction smaller than pipe I.D.



STEP C: Repeat steps A and B on the opposite side of the valve to ensure uniformity of the CheckMate's® O.D. is consistent and matches the pipe I.D.



STEP D: Lubricate the valve and rubber adhesive strip surface. Slide valve into pipe. Ensure the area marked TOP is in the 12:00 position.



STEP E: Check O.D. of the valve to ensure it fits snugly into the I.D. of pipe. If loose, add another layer(s) of the rubber adhesive strip.



STEP F: Once in place, tighten the clamp to secure it against the pipe and compress the rubber adhesive strip.

CheckMate® Installation Procedure

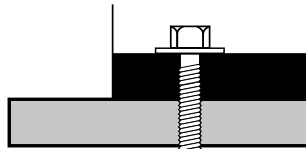
6. Preparation

The CheckMate® Valve uses expanding clamp(s) to exert pressure outwards on the walls of the valve to wedge it in place within the pipe. The walls of the pipe should be clean and free of debris prior to installation.

The valve should be inserted fully into the pipe so that no part of the cuff or bill extends outside the pipe. Ensure that the valve is not slanted at an angle with the bill pointing upwards or downwards. The valve centerline should be parallel to the pipe centerline.

Tideflex® Technologies recommends pinning the CheckMate® Valve on all installations. See below.

Four pre-drilled holes are provided in each expansion clamp. At least one clamp should be pinned. On exposed pipe, holes can be drilled through the valve and pipe, and a bolt run through secured with a nut. For buried pipe, silicon or similar sealant should be used to seal bolts.



7. Lubrication

The outside of the valve can be lubricated with a water-based lubricant prior to inserting the valve into the pipe. If the taping procedure has been used, the surface of the tape can be lubricate to aid insertion.

CAUTION: Do not use petroleum-based lubricants on this product or on the vulcanized rubber tape.

8. Plumb Lines and Arrows

The CheckMate® Valve arrives with a “top” arrow, “flow” arrow and plumb lines, marked in white, at the 12:00 and 6:00 position of the valve. Utilize this marking to orient the valve in the pipe, as well as to ensure the valve is oriented correctly in pipe section.

9. Valve Orientation

The CheckMate® Valve must be installed in a horizontal pipe. Valves 4" – 18" (nominal) are supplied with a single clamp. The clamp turnbuckle should be oriented at top dead center as delineated by the plumb line.

Valves 20" – 60" (nominal) are supplied with two clamps. The turnbuckles should be oriented 45° from the top center plumb line.

The 72" is supplied with three clamps. The turnbuckle for one clamp to be at top center. The other clamps to be 45° to each side of top center.

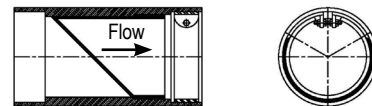
10. Insertion Into Pipe

Clamp to support the shape of the cuff should be hand tight and should be extended outward, but only tight enough to loosely keep the shape of the cuff during installation.

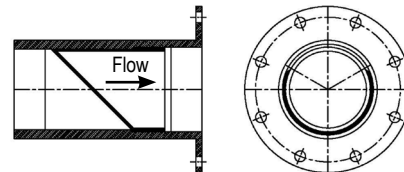
CAUTION: If you expand the clamp excessively at this step it will hinder or prevent the CheckMate® valve being fully inserted into the pipe.

CheckMate® Clamping Diagrams

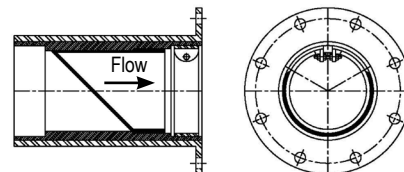
Downstream Clamp



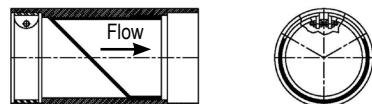
Downstream Flanged



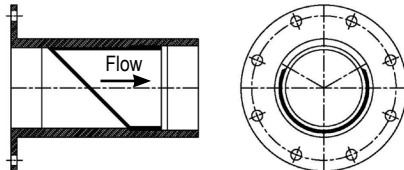
Downstream Flanged Thimble Insert



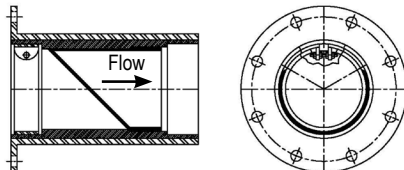
Upstream Clamp



Upstream Flanged



Upstream Flanged Thimble Insert



11. Pallet Push for Larger CheckMate® Valves

Larger CheckMate® valves can be pushed into the pipe utilizing the shipping pallet. The pallet should be placed perpendicular to the valve being inserted into the pipe. Then, with assistance from an excavator, push with consistent even force against the shipping pallet to insert the CheckMate® valve into the pipe.

See the image to the right for the suggested positioning and usage of the excavator's shovel assistance for larger-sized CheckMate® valves. Clamps must be installed to prevent damage to cuff.

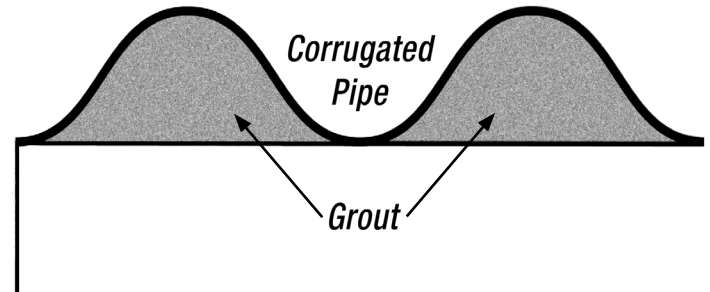


Pallet Push method for installing CheckMate® Valve

12. Corrugated Pipe and Smooth Wall (PVC, HDPE) Pipe Installation

For installation on corrugated pipe, it is recommended that the corrugations be filled with hydraulic cement (or similar material) that will provide a smooth I.D.

For smooth wall pipe, it is recommended that the valve be pinned.



CheckMate® can be made for any pipe I.D. Built to fit in sizes from 3-72" (75-1800mm).

Flange shape and bolt pattern can be customized. Flangeless thimble inserts are available.

DIMENSIONS											
	NOMINAL PIPE SIZE I.D.		OVERALL LENGTH*		NUMBER OF CLAMPS	CUFF DEPTH		BACK PRESSURE RATING**		WEIGHT***	
	Inches	Millimeters	Inches	Millimeters		Inches	Millimeters	Feet	Meters	Lbs	Kg
Low Pressure	3	75	5.1	130	1	1.5	38	10	3.0	0.7	0.3
	4	100	7.9	201	1	1.5	38	10	3.0	1.5	0.7
Standard Pressure	4	100	7.9	201	1	1.5	38	85	26.0	3	1.5
	5	125	9.5	241	1	1.5	38	83	25.3	4	2
	6	150	11.0	279	1	2.0	51	83	25.3	9	4
	7	175	12.8	325	1	2.0	51	79	24.1	11	5
	8	200	15.2	386	1	2.0	51	79	24.1	13	6
	9	225	15.4	391	1	2.0	51	75	22.9	17	8
	10	250	16.1	409	1	2.0	51	71	21.6	20	10
	12	300	19.8	503	1	2.0	51	68	20.1	37	17
	14	350	25.8	655	1	4.0	102	64	20.0	110	50
	15	381	25.8	655	1	4.0	102	62	18.9	120	55
	16	400	28.6	726	1	4.0	102	60	18.3	133	52
	18	450	31.0	787	1	4.0	102	56	17.1	143	65
	20	500	42.1	1069	2	8.0	203	53	16.2	223	102
	24	600	47.5	1207	2	8.0	203	45	13.7	304	137
	26	650	50.0	1270	2	8.0	203	42	12.8	370	168
	28	700	52.0	1321	2	8.0	203	40	12.2	434	197
	30	750	54.9	1395	2	8.0	203	38	11.6	500	227
	36	900	62.3	1582	2	8.0	203	30	9.1	828	376
	42	1050	70.6	1793	2	8.0	203	28	8.5	1423	646
	48	1200	79.0	2007	2	8.0	203	26	7.9	1801	817
	54	1350	86.4	2195	2	8.0	203	20	6.1	2700	1225
	60	1500	96.8	2459	2	9.0	229	18	5.5	3315	1504
	72	1800	119.0	3023	3	12.0	305	15	4.6	6100	2767

*Shorter lengths available.

**Back pressure measured from pipe invert. Higher back pressure ratings available. Consult factory.

***Weights are approximate and do not include crating.

13. Flanged Valve Bolt Torques

The valve end with the rubber flange shall be installed using the backup rings provided. The sleeve split should be installed facing downstream, with the split in the vertical position.

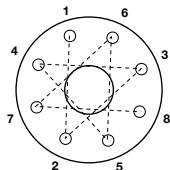
The installation bolt torque on the end flange bolts are listed in the table below.

RECOMMENDED MINIMUM BOLT TORQUE

Valve Size	Bolt Size	Torque (ft*lb.)
1"	1/2" - 13NC	20
1-1/2"	1/2" - 13NC	20
2"	5/8" - 11NC	30
2-1/2"	5/8" - 11NC	40
3"	5/8" - 11NC	40
4"	5/8" - 11NC	30
5"	3/4" - 10NC	40
6"	3/4" - 10NC	30
8"	3/4" - 10NC	40
10"	7/8" - 9NC	40
12"	7/8" - 9NC	50
14"	1" - 8NC	50
16"	1" - 8NC	50
18"	1-1/8" - 7NC	30
20"	1-1/8" - 7NC	30
24"	1-1/4" - 7NC	40
30"	1-1/4" - 7NC	30
36"	1-1/2" - 6NC	40
42"	1-1/2" - 6NC	50
48"	1-1/2" - 6NC	55
54"	1-3/4" - 5NC	60
60"	1-3/4" - 5NC	80
72"	1-3/4" - 5NC	100

Torque values are suggested minimum values.

Torque all flange bolts in a star pattern, first to 50% of tabulated values, then retorque to 100% of tabulated values. If greater torque is required, continue retorquing in increments of 50% of tabulated values. Use of a high quality anti-seize compound on all bolt threads is recommended.



Always use a "star" pattern when bolting a check valve.

Variables such as the surface finish on bolt threads, type of anti-seize compound used, and surface finish of the mating flanges all have an effect on the minimum torque required to obtain a leak-tight flange seal.

During installation you may need to retorque the flange bolts several times for a proper seal. This will overcome any leaks due to the cold flow of the rubber sleeve flange.

CheckMate® Installation Notes

1. It is important that the CheckMate® is installed level within the pipe. The CheckMate® may "gap open" if installed improperly.
2. The sealing area of the CheckMate® must have room to expand outwards, while bottom of the sealing area rises. The area around the sealing area must be kept free of debris to allow the bill to close in order for the valve to seal properly.
3. The CheckMate® effectively reduces the inside diameter of the pipe in which it is installed, creating a restriction. It may also create a "ledge" inside the pipe, causing standing water.
4. Back pressure in excess of the back pressure rating may cause valve failure.
5. Should the conditions that the CheckMate® was designed for change, (line pressure, back pressure, chemical compatibility) the performance of the valve may suffer.
6. CheckMate® Valves must be installed in true round pipe which is concentric across the entire length. Out of round pipe may cause the sealing area of the valve to distort and gap, which will cause the valve to leak.

MAINTENANCE

Inspection

Valves should occasionally be inspected for damage, wear, and buildup of debris. The frequency of the inspections should be determined by the severity of the service and the environment in which it operates.

The clamps should be checked for proper tension, and be sure that the inside of the valve is free of debris. Soft marine growth is normal on valves in submerged applications. Because hard marine growth such as barnacles will not bond well to the CheckMate® they can be easily removed. Also insert pins to ensure they are tight.

STORAGE

If your CheckMate® is to be stored for a period of time prior to installation, the following storage guidelines will help to preserve the valve and assure a trouble-free installation:

1. Store in a clean, cool, dry location. Avoid exposure to light, electric motors, dirt, or chemicals.
2. Store valve vertically on floor or pallet.
3. Store valve to prevent other items from contacting check sleeve to prevent possible damage.
4. Store this manual with the valve, so that it is readily available at time of installation.

TROUBLESHOOTING GUIDE

Sleeve Inverted or Distorted

1. Excessive back pressure, water surge, or water hammer.

Leaking Around Perimeter of Valve

1. Tighten clamp.
2. Check for cracks and holes in surface of pipe.
3. If taped, check tape to ensure the pipe I.D. has been fully sealed

Backflow

1. Debris lodged inside bill.



Limited Warranty

Red Valve Company ("Seller") manufactured products, auxiliaries and parts thereof that we manufacture for a period of twenty-four (24) months from date of shipment from Seller's factory, are warranted to the original purchaser only against defective workmanship and material, but only if properly stored, installed, operated, and serviced in accordance with Seller's recommendations and instructions.

For items proven to be defective within the warranty period, your exclusive remedy under this limited warranty is repair or replacement of the defective item, at Seller's option, FCA Incoterms 2020 Seller's facility with removal, transportation, and installation at your cost.

Products or parts manufactured by others but furnished by Seller are not covered by this limited warranty. Seller may provide repair or replacement for other's products or parts only to the extent provided in and honored by the original manufacturer's warranty to Seller, in each case subject to the limitations contained in the original manufacturer's warranty.

No claim for transportation, labor, or special or consequential damages or any other loss, cost or damage is being provided in this limited warranty. You shall be solely responsible for determining suitability for use and in no event shall Seller be liable in this respect.

This limited warranty does not warrant that any Seller product or part is resistant to corrosion, erosion, abrasion or other sources of failure, nor does Seller warrant a minimum length of service.

Your failure to give written notice to us of any alleged defect under this warranty within twenty (20) days of its discovery, or attempts by someone other than Seller or its authorized representatives to remedy the alleged defects therein, or failure to return product or parts for repair or replacement as herein provided, or failure to store, install, or operate said products and parts according to the recommendations and instructions furnished by Seller shall be a waiver by you of all rights under this limited warranty.

This limited warranty is voided by any misuse, modification, abuse or alteration of Seller's product or part, accident, fire, flood or other Act of God, or your failure to pay entire contract price when due.

The foregoing limited warranty shall be null and void if, after shipment from our factory, the item is modified in any way or a component of another manufacturer, such as but not limited to; an actuator is attached to the item by anyone other than a Seller factory authorized service personnel.

All orders accepted shall be deemed accepted subject to this limited warranty, which shall be exclusive of any other or previous warranty, and this shall be the only effective guarantee or warranty binding on Seller, despite anything to the contrary contained in the purchase order or represented by any agent or employee of Seller in writing or otherwise, notwithstanding, including but not limited to implied warranties.

THE FOREGOING REPAIR AND REPLACEMENT LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, OBLIGATIONS AND LIABILITIES, INCLUDING, BUT NOT LIMITED TO, ALL WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR OF MERCHANTABILITY OR OTHERWISE, EXPRESSED OR IMPLIED IN FACT OR BY LAW, AND STATE SELLER'S ENTIRE AND EXCLUSIVE LIABILITY AND YOUR EXCLUSIVE REMEDY FOR ANY CLAIM IN CONNECTION WITH THE SALE AND FURNISHING OF SERVICES, GOODS OR PARTS, THEIR DESIGN, SUITABILITY FOR USE, INSTALLATION OR OPERATIONS. NEITHER ANY PERFORMANCE OR OTHER CONDUCT, NOR ANY ORAL OR WRITTEN INFORMATION, STATEMENT, OR ADVICE PREPARED BY SELLER OR ANY OF OUR EMPLOYEES OR AGENTS WILL CREATE A WARRANTY, OR IN ANY WAY INCREASE THE SCOPE OR DURATION OF THIS LIMITED WARRANTY.

Limitation of Liability

IN NO EVENT SHALL SELLER BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, PUNITIVE, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, DAMAGE TO OR LOSS OF OTHER PROPERTY OR EQUIPMENT, BUSINESS INTERRUPTION, COST OF SUBSTITUTE PRODUCTS, LOSS OF TIME, LOSS PROFITS OR REVENUE, COST OF CAPITAL, LOSS OF USE, OR DIMINUTION IN VALUE) WHATSOEVER, AND SELLER'S LIABILITY, UNDER NO CIRCUMSTANCES, WILL EXCEED THE CONTRACT PRICE FOR THE GOODS AND/OR SERVICES FOR WHICH LIABILITY IS CLAIMED. ANY ACTION FOR BREACH OF CONTRACT BY YOU, OTHER THAN RIGHTS RESPECTING OUR LIMITED WARRANTY DESCRIBED ABOVE, MUST BE COMMENCED WITHIN 12 MONTHS AFTER THE DATE OF SALE.

Sales and Service

For information about our worldwide locations, approvals, certifications and local representative:

Web site: RedValve.com

E-Mail: support@redvalve.com



750 Holiday Drive, Suite 400, Pittsburgh, PA 15220 • Phone: 412-279-0044

Red Valve Company reserves the right to incorporate our latest design and material changes without notice or obligation. Design features, materials of construction and dimensional data, as described in this manual, are provided for your information only and should not be relied upon unless confirmed in writing by Red Valve Company. Certified drawings are available upon request.

CD150M Dri-Prime® Pump

WITH FINAL TIER 4 (FT4) DIESEL ENGINE

The Godwin Dri-Prime CD150M pump offers flow rates to 2290 USGPM and has the capability of handling solids up to 3.0" in diameter.

The CD150M is able to automatically prime to 28' of suction lift from dry. Automatic or manual starting/stopping available through integral mounted control panel or optional wireless-remote access.

Indefinite dry-running is no problem due to the unique Godwin liquid bath mechanical seal design. Solids handling, dry-running, and portability make the CD150M the perfect choice for dewatering and bypass applications.



Features and Benefits

- Simple maintenance normally limited to checking fluid levels and filters.
- Dri-Prime (continuously operated Venturi air ejector priming device) requiring no periodic adjustment. Optional compressor clutch available.
- Extensive application flexibility handling sewage, slurries, and liquids with solids up to 3.0" in diameter.
- Dry-running high pressure liquid bath mechanical seal with high abrasion resistant solid silicon carbide faces.
- Close-coupled centrifugal pump with Dri-Prime system coupled to a diesel engine or electric motor.
- All cast iron construction (stainless steel construction option available) with cast steel impeller.
- Also available in a critically silenced unit which reduces noise levels to less than 70 dBA at 30'.
- Standard engine JCB TCAE-55 (FT4). Also available with John Deere 4045TFC03 (FT4).

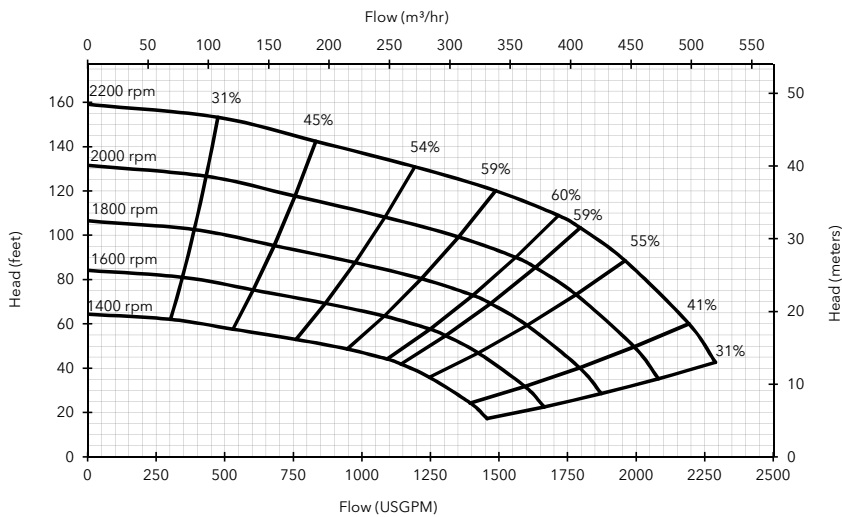
Specifications

Suction connection	6" 150# ANSI B16.5
Delivery connection	6" 150# ANSI B16.5
Max capacity	2290 USGPM †
Max solids handling	3.0"
Max impeller diameter	11.0"
Max operating temp	176°F*
Max working pressure	70 psi
Max suction pressure	58 psi
Max casing pressure	104 psi
Max operating speed	2200 rpm

* Please contact our office for applications in excess of 176°F.

† Larger diameter pipes may be required for maximum flows.

Performance Curve



Engine option 1

JCB TCAE-55 (FT4), 74 HP @ 2200 rpm

Impeller diameter 11.0"

Pump speed 2200 rpm

Suction Lift Table

Total Suction Head (feet)	Total Delivery Head (feet)				
	30	46	62	81	121
Output (USGPM)					
10	2179	2131	2083	1889	1356
15	2058	1937	1816	1574	1162
20	1453	1453	1453	1332	848
25	1259	1211	1114	969	484

Fuel capacity: 60 US Gal

Max fuel consumption @ 2200 rpm: 4.5 US Gal/hr

Max fuel consumption @ 1800 rpm: 2.4 US Gal/hr

Weight (Dry): 3,200 lbs

Weight (Wet): 3,630 lbs

Dim.: (L) 119" x (W) 66" x (H) 77"

Performance data provided in tables is based on water tests at sea level and 20°C ambient. All information is approximate and for general guidance only. Please contact the factory or office for further details.

Materials

Pump casing & suction cover	Cast iron BS EN 1561 - 1997
Wearplates	Cast iron BS EN 1561 - 1997
Pump Shaft	Carbon steel BS 970 - 1991 817M40T
Impeller	Cast Steel BS3100 A5 Hardness to 200 HB Brinell
Non-return valve body	Cast iron BS EN 1561 - 1997
Mechanical seal	Silicon carbide face; Viton elastomers; Stainless steel body

Engine option 2

John Deere 4045TFC03 (FT4), 74 HP @ 2200 rpm

Impeller diameter 11.0"

Pump speed 2200 rpm

Suction Lift Table

Total Suction Head (feet)	Total Delivery Head (feet)				
	30	46	62	81	121
Output (USGPM)					
10	2179	2131	2083	1889	1356
15	2058	1937	1816	1574	1162
20	1453	1453	1453	1332	848
25	1259	1211	1114	969	484

Fuel capacity: 60 US Gal

Max fuel consumption @ 2200 rpm: 5.2 US Gal/hr

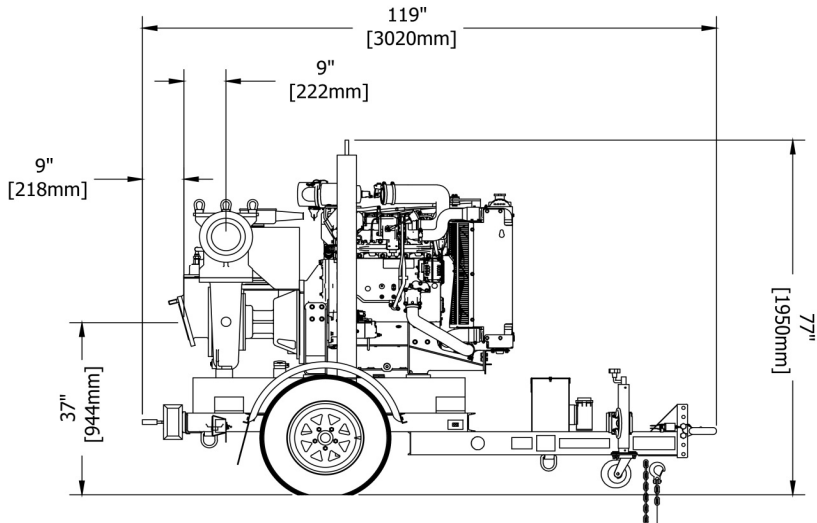
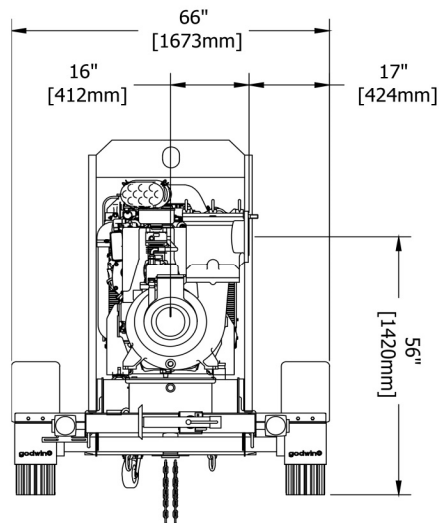
Max fuel consumption @ 1800 rpm: 2.6 US Gal/hr

Weight (Dry): 3,180 lbs

Weight (Wet): 3,610 lbs

Dim.: (L) 119" x (W) 66" x (H) 91"

Performance data provided in tables is based on water tests at sea level and 20°C ambient. All information is approximate and for general guidance only. Please contact the factory or office for further details.



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Reference number : 200GPA0000980
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Issue : -

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Appendix E: Geotechnical Report

Geotechnical Report (prepared by Columbia West)

Initial Infiltration Testing Map and Results

Additional Infiltration Testing Preliminary Results

Additional Infiltration Test Pit Logs

Additional Infiltration Testing Map and Results

Geotechnical Site Investigation

Landing on the Cowlitz

Castle Rock, Washington

March 30, 2023

Geotechnical ■ Environmental ■ Special Inspections

Columbia West
Engineering, Inc



11917 NE 95th Street
Vancouver, Washington
98682
Phone: 360-823-2900



GEOTECHNICAL SITE INVESTIGATION LANDING ON THE COWLITZ CASTLE ROCK, WASHINGTON

Prepared For:

**CT6, LLC
Attn: Janette Pipkin
PO Box 1419
Battle Ground, Washington 98604**

Site Location:

**2542 SW Larson Lane
Parcel Nos. 3092824, 3040258, 3040259,
3040322, 3014867, & 3045031
Castle Rock, Washington**

Prepared By:

**Columbia West Engineering, Inc.
11917 NE 95th Street
Vancouver, Washington 98682
Phone: 360-823-2900**

Date Prepared:

March 30, 2023

EXECUTIVE SUMMARY

This executive summary presents the primary geotechnical considerations associated with the proposed Landing on the Cowlitz project located in Castle Rock, Washington. Our conclusions and recommendations are based upon the subsurface information presented in this report and proposed development information provided by the design team. Detailed discussion of the geotechnical considerations summarized here is presented in respective sections of the report.

- Based on subsurface exploration and testing, liquefiable soil is present at the site. Maximum total liquefaction settlement is estimated to range from approximately 4 to 7 inches. Differential settlement is estimated to be approximately one-half of the total over a 50-foot span. Detailed discussion of site liquefaction potential is presented in Section 6.1, *Liquefaction*.
- Review of *Table 12.13-3* of ASCE 7-16 indicates that anticipated seismic differential settlement will be near the upper bound, tolerable limit for typical structures that may be proposed on the site. Provided that proposed structures can tolerate the estimated seismic settlement, the buildings can be supported on conventional spread footings bearing on firm native soil or engineered structural fill. Shallow foundations, if proposed, will require foundations ties if differential settlement exceeds one-quarter of the thresholds presented in *Table 12.13-3*. Ground improvement or deep foundations may be necessary if buildings cannot tolerate the estimated seismic settlement or if project stakeholders desire to minimize risk of building damage following a seismic event.
- Groundwater was observed in site explorations at depths ranging from 9 to 35 feet below ground surface (bgs). The shallow depth to groundwater may impact site cuts for foundations, utilities, pump stations, and stormwater detention ponds. Dewatering should be assumed where proposed excavations extend more than a few feet below existing grade. Significant excavation depths for the proposed pump station and potential for rapid groundwater flow through permeable sand and gravel deposits will dictate the need for a robust dewatering plan designed by a licensed professional engineer.
- Based on groundwater conditions and expected site grading, cut off drains may be required to intercept water in areas of significant cut. Our experience indicates that installation of cut-off drains prior to site grading activity will assist in dewatering during site construction, particularly during the wet-weather season.
- Perimeter building foundation drains can reduce the potential for water intrusion below structures. Perimeter footing drains are recommended for shallow foundations constructed 5 or more feet below existing site grades. Foundations constructed less than 5 feet below existing grades do not require drains, however,

it may be prudent to install foundations drains to collect incidental or perched water. The final decision for foundations drains should be made by the owner and architect.

- Moisture conditioning will be required to use onsite soil as structural fill. If moisture conditioning is not feasible due to weather conditions or other factors, soils may require cement-amendment to be used as structural fill.
- Near-surface native soils will be sensitive to disturbance and softening when at a moisture content that is above optimum. Haul roads and staging areas will be necessary to minimize damage to exposed subgrade soils during construction. Subgrade protection is discussed in Section 8.2, *Construction Traffic and Staging*.
- Design and construction of proposed stormwater management facilities should account for shallow groundwater conditions observed at the site.
- This report has been prepared to provide general recommendations for overall site development. We recommend additional explorations and geotechnical reports be completed for specific developments/structures prior to design and construction.

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A	Subsurface Exploration Logs
B	Soil Classification Information
C	Pertinent Subsurface Information Collected by Others
D	Report Limitations and Important Information

GEOTECHNICAL SITE INVESTIGATION

LANDING ON THE COWLITZ

CASTLE ROCK, WASHINGTON

1.0 INTRODUCTION

Columbia West Engineering, Inc. (Columbia West) was retained by CT6, LLC to conduct a geotechnical site investigation for the proposed Landing on the Cowlitz master development project located in Castle Rock, Washington. The purpose of the investigation was to provide geotechnical engineering recommendations for use during design and construction of the proposed development. This report summarizes the investigation and provides field assessment documentation. This report is subject to the limitations expressed in Section 9.0, *Conclusion and Limitations*, and Appendix D, *Report Limitations and Important Information*.

1.1 General Site Information

As indicated on Figures 1 and 2, the subject site is located at 2542 Larson Lane in Castle Rock, Washington. The site is comprised of tax parcels 3092824, 3040258, 3040259, 3040322, 3014867, and 3045031 totaling approximately 118.2 acres. The approximate latitude and longitude are N 45° 15' 25" and W 122° 53' 30", and the legal description includes portions of the SE ¼ of Section 14, the NE ¼ of Section 23, and the NW ¼ of Section 24, T9N, R2W, Willamette Meridian. The regulatory jurisdictional agency is the City of Castle Rock.

1.2 Project Understanding

Based on client correspondence and review of the preliminary master development plan shown on Figure 3, Columbia West understands that proposed development consists of a mixed-use district with approximately 7.8 acres of residential zoning, 9.5 acres of commercial zoning, 18.3 acres of recreational zoning, and 55.9 acres of light industrial and office space zoning. Proposed development also includes public roadway construction, installation of underground utilities, and stormwater management facilities. A sanitary sewer pump station is also proposed approximately 35 feet below ground surface. The *Phase 1 Rough Grading Plan*, presented on Figure 4, includes cuts and fills up to 10 feet.

Lot- and zoning-specific building plans were not available at the time this report was prepared. In general, buildings on the site are expected to be lightly-loaded and less than three stories in height. We anticipate that commercial, recreational, and light industrial areas will include concrete tilt-up or metal-framed buildings. Residential structures will likely be of wood-framed construction. We should be contacted to revise our recommendations if the assumptions stated above are incorrect.

1.3 Site Background Information

Columbia West was retained by CT6, LLC in October, 2022 to provide on-call geotechnical construction monitoring and material testing services during Phase I rough grading as shown

on Figure 4. On-call geotechnical services conducted between October, 2022 and January, 2023 included organic stripping observations, moisture-density testing of structural fill, proof-roll observations, bearing probe analysis, and laboratory testing. Field reports documenting Phase I grading activity were submitted to project team members under separate cover. Columbia West also prepared preliminary grading recommendations for the Phase I rough grading plan which is presented in a technical memorandum dated November 8, 2022 (Columbia West, 2022). At the time this report was prepared, Phase I rough grading was in progress with expected completion in summer of 2023.

To characterize site groundwater conditions and facilitate stormwater management design by others, Columbia West oversaw five borings at the site with piezometer installations (BP-1 through BP-5) on January 31, February 1, and February 2, 2023. Piezometers extended up to 35 feet below existing grade, were backfilled with silica sand, sealed with bentonite, and completed with flush mount monuments. Monitoring of the piezometers commenced in February, 2023 and continues on a bi-weekly basis at the direction of the design team. Piezometer monitoring results are discussed in greater detail in Section 5.2.2, *Groundwater*.

Prior to Phase I rough grading, a geotechnical due-diligence study of the site was conducted by others in 2020. Field exploration and testing conducted as part of the due-diligence study included six test pits (TP-1 through TP-6), two borings (B-1 and B-2), and five cone penetration tests (CPT-1 through CPT-5) extending to a maximum depth of 81.5 feet bgs. Exploration locations are shown on Figure 2. Exploration logs and CPT soundings are presented in Appendix C, *Pertinent Subsurface Information Collected by Others*. Subsurface conditions observed by others during the due-diligence study are discussed in Section 5.2.1, *Soil Type Description*.

2.0 SCOPE OF SERVICES

Columbia West's scope of services was outlined in a proposal dated November 8, 2022. In accordance with our proposal, we performed the following geotechnical services:

- Reviewed information available in our files from previous geological and geotechnical studies conducted at and in the vicinity of the site. Our review included the following site explorations conducted by others and presented in Appendix C, *Pertinent Subsurface Information Collected by Others*:
 - Five CPT soundings explored to a maximum depth of 35.43 feet bgs.
 - Two borings explored to a maximum depth of 81.5 feet bgs.
 - Six test pits explored to a maximum depth of 13 feet bgs.
- Reviewed the preliminary master development plan, the Phase I rough grading plan, and a conceptual stormwater management plan provided by the design team.
- Conducted subsurface exploration at the site, to include:
 - Drilled five borings to a maximum depth of 45 feet bgs and installed piezometers in each borehole.
- Classified and logged observed soil and groundwater conditions.

- Prepared this geotechnical site investigation report for the proposed development, which includes:
 - Summary of soil index properties, regional geology, soil conditions, and observed groundwater conditions
 - Summary of geologic and seismic literature research used to evaluate relevant seismic risks, including locations of faults, earthquake magnitudes, and seismic factors from the 2018 IBC and ASCE 7-16
 - Liquefaction analysis, predicted seismic settlement, and mitigation discussion
 - Foundation settlement potential
 - Geotechnical design and construction recommendations for:
 - Shallow foundations
 - Slab subgrade preparation
 - Retaining walls, including drainage, backfill, and lateral earth pressures
 - Site preparation and grading, organic stripping, fill placement and compaction, over-excavation, wet/dry weather earthwork, and construction monitoring and testing
 - Structural fill materials, onsite soil suitability, and import aggregate specifications
 - Utility trench excavation and backfill
 - Drainage and management of groundwater conditions
 - Asphaltic concrete pavement construction for private access roads and parking lots, including section thicknesses for base aggregate and asphalt layers
 - Portland cement concrete pavement construction for loading docks, including section thicknesses for base aggregate and PCC layers
 - Code-based seismic design parameters in accordance with ASCE 7-16

3.0 REGIONAL GEOLOGY AND SOIL CONDITIONS

The subject site lies within the Cowlitz River drainage basin, a physiographic river valley flanked to the east and west by mountainous foothills of the western Cascade Range. The site is located along the east bank of the Cowlitz River, approximately 11 miles north of the confluence with the Columbia River in Longview, Washington.

According to the *Geologic Map of the Mount St. Helens Quadrangle, Washington and Oregon* (Phillips, USGS Open File Report 87-4, 1987), near-surface soils are expected to consist of Quaternary-aged alluvium of silt, sand, and gravel deposited by the Cowlitz River. The Cowlitz Formation is mapped below the alluvium and consists of Eocene-aged sandstone, siltstone, and shale with interbeds of basalt and conglomerate.

In areas proposed for development, the *Web Soil Survey* (USDA, NRCS, 2023 Website) identifies various loamy sands, fine sandy loams, and gravelly sands of the Newberg, Carrolls, Pilchuck, Panamaker, and Cowlitz soil series. The mapped soils generally consist of silts, sands, and gravels with moderately rapid to rapid permeability, low to moderate

water capacity, and low shrink-swell potential. These soils exhibit a slight to severe erosion hazard based primarily on slope grade. As discussed in Section 1.3, *Site Background Information*, surface soils at the site have been disturbed, moved, or manipulated as part of Phase I rough grading activity and may no longer be representative of the NRCS soil survey mapping.

4.0 REGIONAL SEISMOLOGY

Recent research and subsurface mapping investigations within the Pacific Northwest appear to suggest the historic potential risk for a large earthquake event with strong localized ground movement may be underestimated. Past earthquakes in the Pacific Northwest appear to have caused landslides and ground subsidence, in addition to severe flooding near coastal areas. Earthquakes may also induce soil liquefaction, which occurs when elevated horizontal ground acceleration and velocity cause soil particles to interact as a fluid as opposed to a solid. Liquefaction of soil can result in lateral spreading and temporary loss of bearing capacity and shear strength. Liquefaction is discussed later in Section 5.9, *Liquefaction*.

Three scenario earthquakes are possible with the local seismic setting. Two of the possible earthquake sources are associated with the CSZ, and the third event is a shallow, local crustal earthquake that could occur in the North American Plate. The three earthquake scenarios are discussed below.

Cascadia Subduction Zone

The Cascadia Subduction Zone is a potential source of strong earthquake activity in the Portland/Vancouver Basin. This phenomenon is the result of the earth's large tectonic plate movement. Geologic evidence indicates that volcanic ocean floor activity along the Juan de Fuca ridge in the Pacific Ocean causes the Juan de Fuca Plate to perpetually move east and subduct under the North American Continental Plate. The subduction zone results in historic volcanic and potential earthquake activity in proximity to the plate interface, believed to lie approximately 20 to 50 miles west of the general location of the Oregon and Washington coast (Geomatrix Consultants, 1995).

Evidence suggests that this subduction zone has generated eight great earthquakes in the last 4,000 years, with the most recent event occurring approximately 300 years ago (Weaver and Shedlock, 1991).

Two types of subduction zone earthquakes are possible and considered in this report:

1. An interface event earthquake on the seismogenic part of the interface between the Juan de Fuca Plate and the North American Plate on the CSZ. This source is capable of generating earthquakes with a moment magnitude of 9.0.
2. A deep intraplate earthquake on the seismogenic part of the subducting Juan de Fuca Plate. These events typically occur at depths of between 30 and 60 km. This source is capable of generating an event with a moment magnitude of up to 8.0.

Crustal Events

An earthquake could also occur on a local fault within the North American Plate. The nearest mapped crustal faults are more than 40 miles from the site, and based on deaggregation at the anticipated fundamental period of planned structures, contribute less than one percent of the overall seismic hazard at the site. Therefore, significant ground shaking as a result of crustal faults is anticipated to be minimal.

5.0 GEOTECHNICAL AND GEOLOGIC FIELD INVESTIGATION

This geotechnical site investigation is based upon five borings drilled by Columbia West (BP-1 through BP-5), visual site reconnaissance, construction monitoring observations as previously described, and review of pertinent subsurface information collected by others. Borings BP-1 through BP-5 were explored with a track-mounted drill rig on January 31, February 1, and February 2, 2023. Subsurface soil profiles were logged in accordance with Unified Soil Classification System (USCS) specifications. Disturbed soil samples were collected at representative depth intervals. Exploration locations are shown on Figure 2. Subsurface exploration logs are presented in Appendix A, *Subsurface Exploration Logs*. Soil descriptions and classification information are provided in Appendix B, *Soil Classification Information*.

Subsurface information collected by others and reviewed as part of this investigation included six test pit logs (TP-1 through TP-6), two boring logs (B-1 and B-2), and results from five cone penetrations tests (CPT-1 through CPT-5). As reported on the logs provided in Appendix C, *Pertinent Subsurface Information Collected by Others*, test pits TP-1 through TP-6 were explored with a mini-excavator on January 14, 2020. Borings B-1 and B-2 were explored with a truck-mounted, mud-rotary drill rig on February 13 and 14, 2020. CPT-1 through CPT-5 were explored on January 13 and 14, 2020 with a cone penetrometer rig.

5.1 Surface Investigation and Site Description

The approximate 108.2-acre subject site consists of six tax parcels located at 2542 Larson Lane in Castle Rock, Washington. The site is generally flat to gently rolling and situated on an alluvial plain between the Cowlitz River and Interstate 5. As discussed in Section 1.3, *Site Background Information*, the site is currently under construction and being actively graded per the Phase I rough grading plan shown on Figure 4.

Surface conditions in large portions of the site consist of exposed sand and gravel associated with recent cuts and fills throughout the property. Other areas of the site remain unstripped and covered with grass. Observed trees on the site were generally limited to the site perimeter or wetland area. In the central portion of the site, a single-family residential structure and several agricultural outbuildings were observed. Stockpiles of soil, organic material, and demolition debris were observed in the vicinity of the existing structures.

As indicated on Figures 3 and 4, the proposed stormwater conveyance channel along the southern and eastern portion of the site is currently under construction. Surface water flow was observed in the channel during drilling of BP-1 through BP-5. Surface water flow appeared to trend east and north towards a temporary sediment pond located adjacent to

the wetland. Standing water was observed within the pond cells at the time of drilling. Stockpiles of organic material and disturbed soil were also observed near the temporary ponds.

5.2 Subsurface Conditions

Borings were advanced to a maximum depth of 81.5 feet bgs. CPTs were advanced to a maximum depth of 35.43 feet bgs. Test pits were advanced to a maximum depth of 13 feet bgs. Exploration locations are shown on Figure 2. Field logs and observed stratigraphy for encountered materials are presented in Appendix A, *Subsurface Exploration Logs* and Appendix C, *Pertinent Subsurface Information Collected by Others*.

5.2.1 Soil Type Description

As previously described, large portions of the site have been stripped of vegetation as part of Phase I rough grading activity. Boring BP-1 was explored through fill material consisting of sand with gravel. Borings BP-2, BP-3, and BP-5 were explored through apparent native soil consisting of sand with gravel. Boring BP-4 was explored through grass and a three-inch-thick root zone underlain by approximately 12 inches of topsoil. Below surface soil, fill material, and the topsoil layer, alluvial silt, sand, and gravel was observed to an approximate depth 45 feet. Review of boring logs B-1 and B-2 indicates that the alluvium extends up to 81.5 feet bgs. Subsurface lithology may generally be described by the soil units identified in the following text.

Topsoil

Topsoil below the vegetation root zone generally consists of silty sand with a low organic content. Review of test pits logs TP-1 through TP-6 indicates that organic topsoil may extend up to 36 inches below existing grade in unstripped portions of the site.

Structural Fill

Structural fill associated with Phase I rough grading is present on the site and generally consists of dense sand with gravel. The depth of fill is variable and actively changing during site improvements construction. Upon completion of Phase I rough grading, fill thickness, site topography, and finished grade elevations may be represented by the contours shown on Figure 4. As the on-call construction monitoring and material testing firm for the project, Columbia West has conducted moisture-density testing, proof-roll observations, and third-party oversight during Phase I rough grading. Observed and tested fill materials meet typical specifications for engineering structural fill and were placed in general conformance with the recommendations outlined in Columbia West's preliminary grading memorandum (Columbia West, 2022).

Upper Sand

Underlying surface soils, topsoil layers, and structural fill, loose to medium dense sand was encountered and extended to approximate depths of 17 to 35 feet bgs. The sand is moist to wet and contains interbedded layers and lenses of silt and clay. The silt and clay interbeds range from very soft to medium stiff in consistency.

Upper Gravel

The upper sand layer is underlain by medium dense to very dense gravel with varying proportions of sand, silt, and clay. The gravel is wet and rounded to sub-rounded. Review of boring logs B-1 and B-2 indicate that the gravel layer is approximately 20 to 25 feet thick and extends to depths of 38 to 40 feet bgs in the drilled locations. Cone penetration tests CPT-1 through CPT-5 encountered practical refusal on the upper gravel unit.

Lower Sand and Gravel

The upper gravel layer is underlain by medium dense to dense sand with gravel and trace silt. The sand is fine-textured and wet and extends to depths of 66 and 55.5 feet bgs respectively in borings B-1 and B-2. The sand is underlain by dense to very dense gravel with sand and trace silt. The gravel extends to the maximum explored depth of 81.5 feet bgs in B-1 and to a depth of 63.5 feet bgs in B-2.

Silt

Underlying the lower gravel layer in B-2, medium stiff to very stiff silt was encountered and extended to the maximum explored depth of 81.5 feet bgs. The silt is wet with trace clay and organic debris.

5.2.2 Groundwater

Groundwater was encountered in borings BP-1 through BP-5 at depths ranging from 15 to 35 feet bgs. Groundwater was reported at depths between 9 and 15 feet bgs on the exploration logs prepared by others and presented in Appendix C, *Pertinent Subsurface Information Collected by Others*. As discussed in Section 1.3, *Site Background Information*, Columbia West installed open standpipe piezometers in BP-1 through BP-5 to further characterize site groundwater conditions. Monitoring of the piezometers commenced in February, 2023 and continues on a bi-weekly basis at the direction of the design team. Groundwater monitoring results collected to date are presented in Table 1. Groundwater elevations are based upon piezometer rim survey data provided by Mackay Sposito. Upon completion of groundwater monitoring, the piezometers should be decommissioned by a licensed contractor in accordance with Washington Department of Ecology regulations.

Table 1. Piezometer Monitoring Data

Location	Measurement Date			
	2-13-23	2-20-23	3-2-23	3-20-23
BP-1	18.8 ft bgs Elev. 27.6 ft	18.1 ft bgs Elev. 28.3 ft	18.0 ft bgs Elev. 28.4 ft	18.0 ft bgs Elev. 28.4 ft
BP-2	36.5 ft bgs Elev. 28.1 ft	36.6 ft bgs Elev. 28.0 ft	36.6 ft bgs Elev. 28.0 ft	37.7 ft bgs Elev. 26.9 ft
BP-3	12.3 ft bgs Elev. 28.4 ft	12.4 ft bgs Elev. 28.3 ft	12.3 ft bgs Elev. 28.4 ft	12.2 ft bgs Elev. 28.5 ft

BP-4	12.1 ft bgs Elev. 29.3 ft	12.3 ft bgs Elev. 29.1 ft	12.5 ft bgs Elev. 28.9 ft	12.5 ft bgs Elev. 28.9 ft
BP-5	18.8 ft bgs Elev. 27.4 ft	17.3 ft bgs Elev. 28.9 ft	16.3 ft bgs Elev. 29.9 ft	17.3 ft bgs Elev. 28.9 ft

Note that groundwater levels are subject to seasonal variance and may rise during extended periods of increased precipitation. Groundwater elevations may also be influenced by fluctuations of the adjacent Cowlitz River. Perched groundwater may also be present in localized areas. Seeps and springs may become evident during site grading, primarily along slopes or in areas cut below existing grade. Structures, pavements, and drainage design should be planned accordingly.

6.0 SEISMIC HAZARDS

6.1 Liquefaction

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. In general, loose, saturated sand with low silt and clay content is most susceptible to liquefaction. Silty soil with low plasticity is moderately susceptible to liquefaction under relatively higher levels of ground shaking.

Liquefaction analysis at the site was performed by evaluating CPT data in the upper sand layer and standard penetration test (SPT) data in the lower sand layer. Results were combined to estimate the total anticipated seismic settlement. Analysis was conducted using methods developed by Boulanger and Idriss (2014) and Robertson (2009) with application of the depth weighting method published by Cetin (2009). A static groundwater level of 9 feet bgs was used in the liquefaction analysis.

Liquefaction analysis indicates that the upper sand layer and portions of the lower sand layer are susceptible to liquefaction under design levels of ground shaking. Total estimated seismic settlement at ground surface in the locations of CPT-1 through CPT-3 and CPT-5 is 4 to 5 inches. Total estimated seismic settlement at the location of CPT-4 is 7 inches. Differential settlement is estimated to be approximately one-half of the total settlement over a 50-foot span. Most of the seismic settlement is in the upper sand layer with the lower sand layer contributing approximately 0.5 to 1.0 inch to the total estimate. Note that the increased magnitude of settlement at CPT-4 reflects that the upper sand layer was observed to be approximately 10 to 15 feet thicker than elsewhere on the site.

Total seismic settlement estimates are likely near the upper bound tolerable limit for typical buildings that may be proposed on the site. Differential settlement thresholds for various building types and risk categories are provided in *Table 12.13-3* of *ASCE 7-16*. The thresholds presented in *Table 12.13-3* are code-specified minimum requirements and buildings may remain susceptible to damage if designed near the upper limits. Structural engineers on the project should calculate the allowable settlement tolerance and expected

performance based upon the specific building types proposed. Provided a building can tolerate the seismic settlement presented above, the structure may be supported by conventional spread footings bearing on firm native soil or engineered structural fill. Shallow foundations, if proposed, will require foundation ties if differential seismic settlement exceeds one-quarter of the thresholds presented in *Table 12.13-3*.

6.1.1 Liquefaction Mitigation

If proposed buildings cannot tolerate the estimated seismic settlement or project stakeholders desire to minimize risk of building damage, the upper sand layer may be improved to reduce the total seismic settlement. Rammed aggregate piers (RAPs) that extend to, and bear on the upper gravel layer are a viable option for ground improvement. RAPs are proprietary technology that are designed and constructed by design-build specialty contractors. The RAPs would need to be at least 17 to 35 feet long to penetrate through the upper sand layer and bear on the upper gravel unit. Additionally, the design-build contractor should provide analysis that shows rammed aggregate piers will support the structures when surrounding soil strength is reduced as a result of liquefaction. A design-build contractor should be contacted to provide the actual RAP configurations based on building serviceability and performance requirements. We anticipate that a RAP foundation system can be installed to meet the settlement criteria for site buildings. Installation of driven grout piles or standard steel or concrete piles may also be considered to mitigate seismic settlement at the site.

Soil improvements may reduce potential seismic settlement to an acceptable level of risk. If ground improvement utilizing RAPs is selected, additional in-situ testing and liquefaction analysis should be conducted following installation to determine the level of improvement achieved. Improved seismic settlement in the upper sand layer should be combined with results from the unimproved lower sand layer to determine the total seismic settlement following mitigation.

Selection of an appropriate mitigation plan may depend upon site planning, architectural, and structural engineering factors in addition to geotechnical concerns. All parties involved should work closely together to develop a suitable improvement plan with a clear understanding of the risks.

6.2 Lateral Spreading

Lateral spreading is a liquefaction-related seismic hazard that occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement.

Due to the presence of liquefiable soils at the site, lateral spreading is possible near the Cowlitz River. The magnitude of lateral spreading will be based on the depth of the river channel and distance between proposed structural improvements and the river. Tolerable lateral spread limits for shallow foundations in specific risk categories are presented in *ASCE 7-16, Table 12.13-2*. Lateral spreading is not anticipated to be a design consideration within approximately 300 feet of the riverbank because structures are not proposed in this

area. If structures are planned within 300 feet of the riverbank, Columbia West should be contacted to conduct additional analysis.

7.0 DESIGN RECOMMENDATIONS

The geotechnical site investigation suggests the proposed development is generally compatible with surface and subsurface soils, provided the recommendations presented in this report are incorporated in design and implemented during construction. The primary geotechnical considerations for the project were summarized previously in the *Executive Summary*. Specific design and construction recommendations are presented in the following sections.

7.1 Shallow Foundation Support

As discussed in Section 1.2, *Project Understanding*, lot- and zoning-specific building plans were not available at the time this report was prepared. We anticipate that future buildings will be lightly-loaded, less than three stories in height, and will consist of metal-framed, wood-framed, or concrete tilt-up construction. Provided that proposed buildings can tolerate the seismic settlement estimates presented in Section 6.1, *Liquefaction*, structures may be supported by shallow foundations bearing on firm native soil or engineered structural fill.

We anticipate maximum column and wall loads for future buildings will be less than 200 kips and 5 kips per foot, respectively. Floor slab loading is expected to be less than 200 psf. If actual loading exceeds anticipated loading, additional analysis should be conducted for the specific load conditions and proposed footing dimensions.

Foundations should not be supported by topsoil, agricultural till zones, or undocumented fill material. If encountered, these materials should be improved or removed and replaced with structural fill. If footings are constructed during wet-weather conditions or when footing subgrade soils are above their optimum moisture content, we recommend that a minimum of 6 inches of compacted aggregate be placed over exposed subgrade soils. The aggregate pad should extend 6 inches beyond the edge of the foundations and consist of imported granular material as described in Section 8.1.1, *Structural Fill*. Columbia West should observe exposed subgrade conditions prior to placement of crushed aggregate to verify adequate subgrade support.

Perimeter foundation drains are recommended for shallow foundations constructed five or more feet below existing site grades. Foundation drainage is discussed later in Section 7.5, *Drainage*.

7.1.1 Footing Dimensions and Bearing Capacity

Continuous perimeter wall and isolated spread footings should have minimum width dimensions of 18 and 24 inches, respectively. The base of exterior footings should bear at least 18 inches below the lowest adjacent exterior grade. The base of interior footings should bear at least 12 inches below the base of the floor slab.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 2,500 psf. As the allowable bearing pressure is a net bearing pressure, the weight of the footing and associated backfill may be ignored when

calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be increased by 50 percent for transient lateral forces such as seismic or wind.

7.1.2 Shallow Foundation Settlement

Foundation settlement is a significant structural design consideration. Provided subgrade soils are prepared as described in Section 8.1, *Site Preparation and Grading*, we anticipate that total post-construction static foundation settlement will be less than approximately 1 inch. Differential settlement between comparably-loaded footing elements is not expected to exceed approximately 0.5 inch over a span of 50 feet.

Estimated post-construction settlement assumes that settlement will occur after site grading and slab construction and before establishing structural connections between the building roof and foundation elements. In areas of large column spacing (greater than 50 feet) or where building footprints span significant differences in cut and fill, the potential for differential settlement exceeding the predicted settlement should be understood.

As discussed in Section 6.1, *Liquefaction*, site soils are also susceptible to settlement during a seismic event. Total seismic settlement at the analyzed locations is expected to range from 4 to 7 inches. Differential settlement is estimated to be approximately one-half the total settlement over a 50-foot span. If shallow foundations are proposed and meet the differential settlement thresholds of ASCE 7-16, project stakeholders and the structural engineer should discuss risk associated with seismic settlement and be willing to accept the potential for building damage during a seismic event. If the risk of damage cannot be accepted, liquefaction mitigation through soil improvements or deep foundations will be required.

7.1.3 Resistance to Sliding

Lateral foundation loads can be resisted by passive earth pressure on the sides of the footing and by friction at the base of the footings. Recommended passive earth pressure for footings confined by native soil or engineered structural fill is 350 pcf. The upper 12 inches of soil should be neglected when calculating passive pressure resistance. Adjacent floor slabs and pavement, if present, should also be neglected from the analysis. The recommended passive pressure resistance assumes that a minimum horizontal clearance of 10 feet is maintained between the footing face and adjacent downgradient slopes.

The estimated coefficient of friction between in situ native soil or engineered structural fill and in-place poured concrete is 0.35. The estimated coefficient of friction between compacted crushed aggregate and in-place poured concrete is 0.4.

7.1.4 Subgrade Observation

Footing and floor slab subgrade soils should be evaluated by Columbia West prior to placing forms or reinforcing bar to verify subgrade support conditions are as anticipated in this report. Subgrade observation should confirm that all disturbed material, organic debris, unsuitable fill, remnant topsoil zones, and softened subgrades (if present) have been removed. Over-excavation of footing subgrade soils may be required to remove deleterious material, particularly if footings are constructed during wet-weather conditions.

7.1.5 Floor Slabs

Floor slabs can be supported on firm, competent, native soil or engineered structural fill prepared as described in this report. Disturbed soils and unsuitable fills in proposed slab locations, if encountered, should be removed and replaced with structural fill.

To reduce slab shifting and moisture transmission, slabs should be underlain by at least 6 inches of compacted crushed aggregate. Geotextile may be used below the crushed aggregate layer to increase subgrade support. Recommendations for floor slab base aggregate and subgrade geotextile are discussed in Section 8.6, *Materials*.

Elevated soil moisture was observed within near-surface soil at the time of exploration. In areas where moisture-sensitive flooring will be installed, slab waterproofing or a vapor barrier should be installed according to the flooring manufacturers' recommendations. In our experience, 10- to 15-mil vapor barriers are often required by flooring manufacturers to maintain product warranties. Selection and design of an appropriate vapor barrier should be determined by architectural and structural design team members.

Slab thickness and reinforcement should be designed by an experienced structural engineer in accordance with anticipated loads. Load-bearing concrete slabs with maximum loading of 200 psf may be designed assuming a modulus of subgrade reaction, k , of 150 pci. If slab subgrade soil is cement-amended to a minimum depth of 12 inches, the modulus of subgrade reaction can be increased to 200 pci.

7.2 Seismic Design Considerations

Seismic design for proposed structures is prescribed by *ASCE 7-16*. Based upon site-specific test results, site soils meet the criteria for Site Class E. Seismic design parameters for Site Class E are presented in Table 2.

Table 2. ASCE 7-16 Seismic Design Parameters¹

	Short Period ($T_s = 0.2$ s)	1 Second Period ($T_1 = 1.0$ s)
MCE Spectral Acceleration	0.84	0.40
Site Class	E ²	
Site Coefficient	$F_a = 1.3$	$F_v = 2.4$
Adjusted Spectral Response Acceleration	$S_{MS} = 1.1$	$S_{M1} = 0.96$
Design Spectral Response Acceleration	$S_{DS} = 0.73$	$S_{D1} = 0.64$

1. The structural engineer should evaluate *ASCE 7-16* code requirements and exceptions to determine if these parameters are valid for design.
2. Seismic site class, site coefficients, and spectral acceleration parameters assume that the fundamental period for proposed structures will be less than 0.5 second.

For Site Class E sites with mapped maximum considered earthquake spectral response acceleration parameter S_s greater than or equal to 1.0 or S_1 greater than or equal to 0.2, a ground motion hazard analysis may be required according to *ASCE 7-16, Section 11.4.8* unless exemption criteria are met. According to *ASCE 7-16, Section 11.4.8 Exception 3*, a ground

motion hazard analysis is not required for Site Class E sites with S_1 greater than or equal to 0.2, provided that T is less than or equal to T_s , where T is the fundamental period of the structure and T_s is equal to the design spectral response acceleration parameter at a one second period (SD_1) divided by the design spectral response acceleration parameter at short periods (SD_s).

Columbia West recommends that structural engineers on the project evaluate code requirements and exceptions to determine if a site-specific ground motion hazard evaluation will be required for proposed structures.

Due to the presence of liquefiable soils at the site and potential for bearing capacity loss at ground surface, Site Class F criteria may be met if the fundamental period of vibration for proposed structures is greater than 0.5 second. If Site Class F criteria is met, a site-specific ground motion response analysis is required in accordance with *Section 21.1 of ASCE 7-16*. If structures have a fundamental period of less than 0.5 second, seismic design parameters may be determined using the pre-liquefaction seismic site class. In our experience, conventional structures less than three-stories in height will likely have a fundamental period less than 0.5 second, and seismic design parameters may be based on the pre-liquefaction site class designation as provided in Table 2.

7.3 Retaining Structures

Lateral earth pressures should be considered during design of retaining walls and below-grade structures. Hydrostatic pressure and additional surcharge loading should also be considered. Wall foundation construction and bearing capacity should adhere to specifications provided previously in Section 7.1, *Shallow Foundation Support*.

Permanent retaining walls that are not restrained from rotation should be designed for active earth pressures using an equivalent fluid pressure of 35 pcf. Walls that are restrained from rotation should be designed for an at-rest, equivalent fluid pressure of 55 pcf. The recommended earth pressures assume a maximum wall height of 10 feet with well-drained, level backfill. These values also assume that adequate drainage is provided behind retaining walls to prevent hydrostatic pressures from developing. Lateral earth pressures induced by surcharge loads may be estimated using the criteria presented on Figure 5.

Seismic forces may be calculated by superimposing a uniform lateral force of $7H^2$ pounds per lineal foot of wall, where H is the total wall height in feet. The force should be applied as a distributed load with the resultant located at $0.6H$ from the base of the wall.

7.3.1 Wall Drainage and Backfill

A minimum 6-inch-diameter, perforated collector pipe should be placed at the base of retaining walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of finished grade. The drain rock and geotextile drainage fabric should meet the specifications provided in Section 8.6, *Materials*. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into stormwater drainage systems, unless measures are taken to prevent backflow into the drainage system of the wall.

Backfill material placed behind the walls and extending a horizontal distance of $\frac{1}{2} H$, where H is the height of the retaining wall, should consist of select granular material placed and compacted as described in Section 8.6.1, *Structural Fill*.

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flatwork adjacent to retaining walls be delayed at least four weeks after placement of wall backfill, unless survey data indicates that settlement is complete prior to that time.

7.4 Pavement Design

7.4.1 Design Parameters and Traffic

Private asphalt concrete access drives and parking areas may be proposed on individual lots within the master development. Columbia West recommends adherence to City of Castle Rock roadway standards for street improvements in the public right-of-way. Pavement should be installed on firm, competent native subgrade soil or engineered structural fill prepared as described in this report. Our recommendations for private pavement are based on the following design parameters and assumptions:

- 12 inches of subgrade soil directly below the pavement sections are compacted to at least 95 percent of maximum dry density, as determined by *ASTM D1557*.
- Resilient moduli for subgrade soil and aggregate base materials were assumed to be 4,500 psi and 20,000 psi, respectively.
- Pavement design life of 20 years with no expected traffic growth.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability of 85 percent and standard deviation of 0.4.
- Pavement may be exposed to a fire apparatus load of 75,000 pounds on an infrequent basis.

The specific type and frequency of traffic was not available at the time we prepared this report. Based on experience, we assume that heavy truck traffic will consist of approximately 40 percent FHWA Class Group 7 type trucks (4-axle, single unit) and 60 percent FHWA Class Group 8 type trucks (tractor/trailer 2- to 3-axle). Lightly-loaded drive aisles and parking stalls are expected to service typical passenger vehicle traffic.

7.4.2 Asphaltic Concrete (AC) Pavement Design Sections

Design recommendations for private pavement across a range of traffic conditions and loading scenarios are presented in Table 3. Material properties and compaction recommendations for asphalt surfacing and crushed aggregate base layers are presented in Section 8.6, *Materials*.

Table 3. Recommended AC Pavement Sections Constructed over Native Soil or Engineered Fill

Traffic	Trucks Per Day	Equivalent Single-Axle Loads (ESALs)	AC Thickness (in)	Base Aggregate Thickness (in)
Passenger Vehicle Parking	0	10,000	2.5	8
Passenger Vehicle Drive Aisles	0	20,000	3	9
Heavy Truck Areas	10	92,000	4	10.5
	25	229,000	4.5	12.5
	50	458,000	5	14
	100	916,000	5.5	16.5

Pavement sections may be reduced in areas where subgrade soils are cement-amended to a minimum depth of 12 inches with a minimum of 6 percent cement by weight. Provided the cement-amended subgrade soil achieves a seven-day unconfined compressive strength of 100 psi, AC pavement sections may be constructed as presented in Table 4.

Table 4. Recommended AC Pavement Sections Constructed over Cement-Amended Subgrade Soil

Traffic	Trucks Per Day	Equivalent Single-Axle Loads (ESALs)	AC Thickness (in)	Base Aggregate Thickness (in)	Cement-Amendment Thickness (in)
Passenger Vehicle Parking	0	10,000	2.5	4	12
Passenger Vehicle Drive Aisles	0	20,000	3	4	
Heavy Truck Areas	10	92,000	4	4	
	25	229,000	4.5	4	
	50	458,000	5	4.5	
	100	916,000	5.5	6.5	

7.4.3 Portland Cement Concrete (PCC) Pavement Design Sections

Portland cement concrete pavements may be proposed in future loading dock areas. Loading docks are expected to primarily service heavy truck traffic. Material properties and recommendations for PCC, base aggregate, and cement-amended subgrade layers are presented in Section 8.6, *Materials*. Pavement design recommendations for PCC loading docks constructed over firm native soil or engineered structural fill are presented in Table 5.

Table 5. Recommended PCC Pavement Sections Constructed over Native Soil or Engineered Fill

Traffic	Trucks Per Day	PCC Thickness (in)	Base Aggregate Thickness (in)
Loading Dock Areas	Up to 25	6.5	7
	Up to 50	7	8
	Up to 100	7.5	8

Recommended PCC pavement sections constructed over cement-amended soil meeting the treatment depth, cement content, and strength requirements outlined above are presented in Table 6.

Table 6. Recommended PCC Pavement Sections Constructed over Cement-Amended Subgrade Soil

Traffic	Trucks Per Day	PCC Thickness (in)	Base Aggregate Thickness (in)	Cement-Amendment Thickness (in)
Loading Dock Areas	Up to 25	6.5	4	12
	Up to 50	7	4	
	Up to 100	7.5	4	

7.4.4 General Pavement Recommendations

Recommended pavement section thicknesses are intended to be minimum acceptable values and do not include construction traffic loading. The recommendations assume that pavement construction will be completed during an extended period of warm, dry weather. Wet weather construction may require an increased thickness of base aggregate as discussed later in Section 8.2, *Construction Traffic and Staging*.

Cement-amended soil should be allowed to cure for at least four days prior to aggregate base placement or exposure to construction traffic. Prior to construction traffic access, the cement-amended subgrade should be protected by a minimum 4-inch-thick layer of compacted crushed aggregate. Construction traffic should be limited to dedicated haul roads or non-structural, unpaved portions of the site. Construction traffic should not be permitted on new pavement, unless accounted for in the pavement design section. Base aggregate and cement-amended soils supporting pavement are also not intended for construction traffic. Haul roads and staging areas supporting construction traffic are discussed later in Section 8.2, *Construction Traffic and Staging*.

Asphalt paving is generally not recommended during cold weather conditions where ambient air temperatures are less than 40 degrees Fahrenheit. Compacting asphalt in low-temperature conditions can result in low relative density of the asphalt layer and premature pavement distress.

Asphalt mix designs have a recommended compaction temperature range that is specific to the AC binder used. In low-temperature conditions, maintaining the temperature of the AC mix is difficult as heat can be lost during transport, placement, and compaction. The ambient air temperature during paving should be at least 40 degrees Fahrenheit for a lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for a lift thickness between 2 and 2.5 inches. If AC paving must take place during cold-weather construction as defined in this section, the contractor and design team should discuss options for minimizing risk to pavement serviceability.

7.5 Drainage

At a minimum, site drainage should include surface water collection and conveyance to properly designed stormwater management structures and facilities. Drainage design in

general should conform to City of Castle Rock regulations. Finished site grading should be conducted with positive drainage away from structures at a minimum 2 percent slope for a distance of at least 10 feet. Depressions or shallow areas that may retain ponding water should be avoided.

Recommendations for foundation drains, subdrains, and drainage mats are presented in the following sections. Drain rock and geotextile drainage fabric should meet the requirements presented in Section 8.6, *Materials*. Drains should be closely monitored after construction to assess their effectiveness. If additional surface or shallow subsurface seeps become evident, the drainage provisions may require modification or additional drains. We should be consulted to provide appropriate recommendations.

7.5.1 Foundation Drains

Roof drains are recommended for all structures. Perimeter building foundation drains can reduce the potential for water intrusion below structures. Perimeter footing drains are recommended for shallow foundations constructed 5 or more feet below existing site grades. Foundations constructed less than 5 feet below existing grades do not require drains, however, it may be prudent to install foundations drains to collect incidental or perched water. The final decision for foundations drains should be made by the owner and architect.

Foundation and roof drains, where installed, should consist of separate systems that gravity flow away from foundations to an approved discharge location. Perimeter foundation drains, where installed, should consist of 4-inch perforated PVC pipe surrounded by a minimum 2-foot-wide zone of clean, washed drain rock wrapped with geotextile drainage fabric. The wrapped drain rock zone should extend up the sides of embedded walls to within 12 inches of proposed finished grade. Foundation drains should be constructed with a minimum slope of ½ percent. The drainpipe's invert elevation should be at least 18 inches below the elevation of the floor slab. Figure 6 presents a typical foundation drain detail.

7.5.2 Subdrains

Subdrains should be considered if portions of the site are cut below surrounding grades. Shallow groundwater, springs, or seeps should be conveyed via drainage channel or perforated pipe into an approved discharge. Recommendations for design and installation of perforated drainage pipe may be performed on a case-by-case basis by Columbia West during construction. Failure to provide adequate surface and sub-surface drainage may result in soil slumping or unanticipated settlement of structures exceeding tolerable limits. A typical perforated drainpipe trench detail is presented in Figure 7.

7.5.3 Drainage Mat

Site improvements construction in some areas may occur at or near the shallow groundwater table, particularly if work is conducted during wet-weather conditions. Dewatering may be necessary, and a drainage mat may be required to achieve sufficient elevation for fill placement. A typical drainage mat is shown on Figure 8. Columbia West should determine drainage mat location, extent, and thickness when subsurface conditions are exposed.

Drainage mats may need to be constructed in conjunction with subdrains to convey captured water to an approved discharge location.

8.0 CONSTRUCTION RECOMMENDATIONS

8.1 Site Preparation and Grading

Vegetation, organic material, unsuitable fill, and deleterious material that may be encountered should be cleared from areas identified for structures and site grading. Vegetation, root zones, organic material, and debris should be removed from the site. Stripped topsoil should also be removed, or used only as landscape fill in nonstructural areas with slopes less than 25 percent. The stripping depth for sod and highly organic topsoil is anticipated to be approximately 4 inches. Following removal of surface vegetation and topsoil, underlying low-organic till zone soils, if present, may be acceptable for stockpiling and reuse as structural fill. Actual stripping depths and suitability of till zone soil for reuse should be determined based upon visual observations made during construction when soil conditions are exposed. The post-construction maximum depth of landscape fill placed or spread at any location onsite should not exceed one foot.

Previously disturbed soil, debris, or undocumented fill encountered during grading or construction activities should be removed completely and thoroughly from structural areas. This includes old remnant foundations, basement walls, utilities, associated soft soils, and debris. Excavation areas should be backfilled with engineered structural fill.

Trees, stumps, and associated roots should also be removed from structural areas, individually and carefully. Resulting cavities and excavation areas should be backfilled with engineered structural fill.

Site grading activities should be performed in accordance with requirements specified in the *2018 International Building Code (IBC)*, Chapter 18 and Appendix J, with exceptions noted in the text herein. Site preparation, soil stripping, and grading activities should be observed and documented by Columbia West.

8.1.1 Subgrade Evaluation

Upon completion of stripping and prior to the placement of structural fill or pavement improvements, exposed subgrade soil should be evaluated by proof rolling with a fully-loaded dump truck or similar heavy, rubber tire construction equipment. When the subgrade is too wet for proof rolling, a foundation probe may be used to identify areas of soft, loose, or unsuitable soil. Subgrade evaluation should be performed by Columbia West. If soft or yielding subgrade areas are identified during evaluation, we recommend the subgrade be over-excavated and backfilled with compacted imported granular fill.

8.2 Construction Traffic and Staging

Near-surface silty soil will be easily disturbed during construction. If not carefully executed, site preparation, excavation, and grading can create extensive soft areas resulting in significant repair costs. Earthwork planning should include considerations for minimizing subgrade disturbance, particularly during wet-weather conditions.

If construction occurs during wet-weather conditions, or if the moisture content of the surficial soil is more than a few percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Under these conditions, granular haul roads and staging areas will also be necessary provide a firm support base and sustain construction equipment.

The recommended base aggregate thickness for pavement sections is intended to support post-construction design traffic loads and will not provide adequate support for construction traffic. Staging areas and haul roads will require an increased base thickness during wet weather conditions. The configuration of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor's means and methods. Therefore, design and construction of staging areas and haul roads should be the responsibility of the contractor. Based on our experience, between 12 and 18 inches of imported granular material is generally required in staging areas and between 18 and 24 inches in haul road areas. In areas of heavy construction traffic, geotextile separation fabric may be placed between the subgrade soil and imported granular material to increase subgrade support and minimize silt migration into the base aggregate layer.

As an alternative to thickened aggregate sections, haul roads and staging areas may be constructed using a combination of cement-amended subgrade and crushed aggregate surfacing. If cement-amendment is used, the base aggregate thickness for staging areas and haul roads can typically be reduced to between 6 and 9 inches, respectively. This recommendation is based on a minimum seven-day unconfined compressive strength of 100 psi for the cement-amended soil with a treatment depth of 12 to 16 inches. Based on experience, 6 to 7 percent cement by weight is typically required to achieve the indicated compressive strength.

Project stakeholders should understand that wet weather construction is risky and costly. Proper construction methods and techniques are critical to overall project integrity and should be observed and documented by Columbia West.

8.3 Cut and Fill Slopes

Fill slopes should consist of structural fill material as discussed in Section 8.1.1, *Structural Fill*. Fill placed on existing grades steeper than 5H:1V should be horizontally benched at least 10 feet into the slope. Fill slopes greater than six feet in height should be vertically keyed into existing subsurface soil. A typical fill slope cross-section is shown in Figure 9. Drainage implementations, including subdrains or perforated drainpipe trenches, may also be necessary in proximity to cut and fill slopes if seeps or springs are encountered. Drainage design may be performed on a case-by-case basis. Extent, depth, and location of drainage may be determined in the field by Columbia West during construction when soil conditions are exposed. Failure to provide adequate drainage may result in soil sloughing, settlement, or erosion.

Final cut or fill slopes at the site should not exceed 2H:1V or 20 feet in height without individual slope stability analysis. The values above assume a minimum horizontal setback for loads of 10 feet from top of cut or fill slope face or overall slope height divided by three

(H/3), whichever is greater. A minimum slope setback detail for structures is presented in Figure 10.

Concentrated drainage or water flow over the face of slopes should be prohibited, and adequate protection against erosion is required. Fill slopes should be overbuilt, compacted, and trimmed at least two feet horizontally to provide adequate compaction of the outer slope face. Proper cut and fill slope construction is critical to overall project stability and should be observed and documented by Columbia West.

8.4 Excavation

The site was explored by Columbia West and others to a maximum depth of 81.5 feet with a drill rig. Conventional earthmoving equipment in proper working condition should be capable of making necessary site excavations.

Groundwater was encountered at depths ranging from 9 and 35 feet bgs in site explorations. Perched groundwater at shallower depths may also be present. Recommendations as described in Section 8.5, *Dewatering*, should be considered where subsurface construction activities intersect the shallow groundwater table.

Excavations in near-surface sandy soil will likely slough and cave, even at shallow depths. Open-cut excavation techniques may be used to excavate trenches between 4 and 8 feet deep, provided the walls of the excavation are cut at a maximum slope of 1H:1V and groundwater seepage is not present. Excavation slopes should be reduced to 1.5H:1V or 2H:1V if excessive sloughing or raveling occurs.

Shoring may be required if open-cut excavations are infeasible or if excavations are proposed adjacent to existing infrastructure. Typical methods for stabilizing excavations consist of soldier piles and timber lagging, sheet pile walls, tiebacks and shotcrete, or pre-fabricated hydraulic shoring. As a wide variety of shoring and dewatering systems are available, we recommend that the contractor be responsible for selecting the appropriate shoring and dewatering systems.

The contractor should be held responsible for site safety, sloping, and shoring. All excavation activity should be conducted in accordance with applicable OSHA requirements. Columbia West is not responsible for contractor activities and in no case should excavation be conducted in excess of applicable local, state, and federal laws.

8.5 Dewatering

Based on site observations and piezometer monitoring data, groundwater will likely be encountered in utility trenches, pump station excavations, and in areas of significant cut. Generalized recommendations for temporary construction dewatering are presented in the following section.

8.5.1 Construction Dewatering

The contractor should be responsible for temporary drainage of surface water, perched water, and groundwater. Dewatering should be performed to the extent necessary to prevent standing water and/or erosion of exposed site soils. During rough and finished grading of

building pad areas, the contractor should keep all footing excavations and slab subgrade soils free of standing water.

The contractor's proposed dewatering plan should be capable of maintaining groundwater levels at least two feet below the base of proposed excavations. Without adequate excavation dewatering, running soil, caving, and sloughing will increase backfill volumes and may result in damage to adjacent structures or utilities. Significant pumping and dewatering may be required to temporarily reduce the groundwater elevation to the recommended depth. Dewatering via a sump within excavation zones may be insufficient to control groundwater and provide excavation side slope stability. Dewatering may be more feasibly conducted by installing a system of temporary well points and pumps around proposed excavation areas or utility trenches.

As indicated previously, a sanitary sewer pump station is proposed up to 35 feet below existing grade. Due to the significant depth of excavation and potential for rapid groundwater flow through permeable sand and gravel deposits, the contractor should be required to prepare and present a detailed dewatering plan. The contractor should consult with a licensed professional engineer to provide an adequate dewatering plan for site conditions. If additional subsurface information not provided in this geotechnical report is necessary to complete the dewatering plan, the contractor shall be responsible for securing all the required information necessary for the design of the system.

If groundwater is present at the base of excavations, we recommend placing 18 to 24 inches of stabilization material at the base of the excavation. Subgrade geotextile placed directly over trench subgrade soils may reduce the required thickness of the stabilization material. The actual thickness of stabilization material should be determined at the time of construction based on observed field conditions. The stabilization material should be placed in one lift and compacted until well keyed. Stabilization material and geotextile fabric should meet the requirements presented in Section 8.6, *Materials*.

8.6 Materials

8.6.1 Structural Fill

Areas proposed for fill placement should be appropriately prepared as described in Section 8.1, *Site Preparation and Grading*. Engineered fill placement should be observed by Columbia West. Compaction of engineered structural fill should be verified by nuclear gauge field compaction testing performed in accordance with *ASTM D6938*. Field compaction testing should be performed for each vertical foot of engineered fill placed.

Various materials may be acceptable for use as structural fill. Structural fill should be free of organic material or other unsuitable material and meet specifications provided in the following sections. Representative samples of proposed engineered structural fill should be submitted for laboratory analysis and approval by Columbia West prior to placement.

8.6.1.1 Onsite Soil

Most onsite native soil (silt, sand, and gravel) will be suitable for use as structural fill if adequately dried or moisture-conditioned to achieve recommended compaction

specifications. Moisture conditioning will likely be necessary to achieve the optimum moisture content required for compaction. In addition, near-surface silty soil will be moisture sensitive and difficult to compact during wet weather conditions. Therefore, structural fill placement using onsite soil should be performed during dry summer months if possible. Onsite soil may also require addition of moisture during extended periods of dry weather.

Onsite soil used as structural fill should be placed in loose lifts not exceeding 8 inches in depth and compacted using standard conventional compaction equipment. The soil moisture content should be within a few percentage points of optimum conditions. The soil should be compacted to at least 95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test (*ASTM D1557*). Compacted onsite fill soils should be covered shortly after placement.

Onsite soil will likely expand during excavation and transport and consolidate during compaction. Development of site-specific expansion and consolidation factors is beyond the scope of this investigation. We can provide site-specific factors upon request.

8.6.1.2 Imported Granular Material

Imported granular material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand meeting *WSDOT 9-03.14(1)* specifications for *Gravel Borrow*. Imported granular material should be placed in loose lifts not exceeding 12 inches in depth and compacted to at least 95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test (*ASTM D1557*). During wet-weather conditions or where wet subgrade conditions are present, the initial loose lift of granular fill should be approximately 18 inches thick and should be compacted with a smooth-drum roller operating in static mode.

8.6.1.3 Stabilization Material

Stabilization material should consist of durable, 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is free of organics and other deleterious material. The material should have a maximum particle size of 6 inches with less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve. The material should have at least two mechanically-fractured faces.

Stabilization material should be placed in loose lifts between 12 and 24 inches thick and be compacted to a firm, unyielding condition. Equipment with vibratory action should not be used when compacting stabilization material over wet, fine-textured soils. If stabilization material is used to stabilize soft subgrade below pavement or construction haul roads, a subgrade geotextile should be placed as a separation barrier between the soil subgrade and the stabilization material.

8.6.1.4 Trench Backfill

Trench backfill placed below, adjacent to, and up to at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material meeting *WSDOT 9-03.12(3)* specifications for *Gravel Backfill for Pipe Zone Bedding*. Pipe zone backfill should be compacted to at least 90 percent of maximum dry density, as determined by the modified

Proctor moisture-density relationship test (*ASTM D1557*), or as required by the local jurisdictional agency or pipe manufacturer.

Within structural areas (below pavement and building pads), trench backfill above the pipe zone should consist of *WSDOT 9-03.19 Bank Run Gravel for Trench Backfill* or *WSDOT 9-03.14(2) Select Borrow* with a maximum particle size of 2 ½-inches. Trench backfill material within 18 inches of the top of utility pipes should be hand compacted (i.e., no heavy compaction equipment). Remaining trench backfill should be compacted to at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test (*ASTM D1557*), or as required by the local jurisdictional agency or pipe manufacturer.

Outside of structural areas, trench backfill placed above the pipe zone should be compacted to at least 90 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test (*ASTM D1557*), or as required by the local jurisdictional agency or pipe manufacturer.

8.6.1.5 Floor Slab Base Aggregate

Base aggregate for building floor slabs should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Slab base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test (*ASTM D1557*).

8.6.1.6 Pavement Base Aggregate

Base aggregate for pavement should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Pavement base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test (*ASTM D1557*).

8.6.1.7 Retaining Wall Backfill

Backfill material placed behind retaining walls and extending a horizontal distance of ½ H, where H is the height of the retaining wall, should consist of free-draining granular material meeting *WSDOT 9-03.12(2)* specifications for *Gravel Backfill for Walls*. The wall backfill should be separated from structural fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

Wall backfill located within a horizontal distance of 3 feet from the face of a retaining wall should be compacted to 90 percent of the maximum dry density, as determined by *ASTM D1557*. Backfill placed within 3 feet of the wall should be compacted in loose lifts less than 6 inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactor). Remaining wall backfill should be compacted to at least 95 percent of the maximum dry density, as determined by *ASTM D1557*.

8.6.1.8 Retaining Wall Leveling Pad

Crushed aggregate used as a leveling pad for retaining wall footings should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. The leveling pad material should be compacted to at least 95 percent of the

maximum dry density as determined by the modified Proctor moisture-density relationship test (ASTM D1557).

8.6.1.9 Drain Rock

Drain rock should consist of open-graded, angular aggregate meeting WSDOT 9-03.12(4), *Gravel Backfill for Drains*. Drain rock should be free of roots, organic debris, and other unsuitable material and should have at least two mechanically-fractured faces. Drain rock should be compacted to a firm, unyielding condition. Drain rock should be completely wrapped in a geotextile drainage fabric meeting the requirements presented below.

8.6.2 Geotextile Fabric

8.6.2.1 Subgrade Geotextile

Subgrade geotextile should meet the specifications provided in WSDOT 9-33.2(1), *Table 3, Geotextile for Separation or Soil Stabilization*. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles. All stabilization material should be underlain by a subgrade geotextile.

8.6.2.2 Drainage Geotextile

Subgrade geotextile should meet the specifications provided in WSDOT 9-33.2(1), *Table 2, Geotextile for Underground Drainage Filtration Properties*. The AOS should be between the No. 70 and No. 100 sieve. The water permittivity should be greater than 1.5/sec. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles.

8.6.3 Soil Amendment with Cement

The on-site soil can be amended with Portland cement to obtain suitable properties for use as wet-weather structural fill or subbase for pavement. The effectiveness of soil amendment is highly dependent on proper mixing techniques, soil moisture conditioning, and the quantity of cement. The quantity of cement applied during amendment should be based on an assumed dry unit weight of 100 pcf for site soil.

8.6.3.1 Subbase Stabilization

Specific recommendations for soil amendment should be based on exposed site conditions at the time of construction. For preliminary design purposes, we recommend cement-amended subgrade for building pads and pavement subbase (below the base aggregate layer) achieve a target strength of 100 psi. The quantity of cement required to achieve the target strength will vary with moisture content and soil type. Laboratory testing of cement-amended soil should be used to confirm design expectations.

Based on our experience, near-surface silt and sand will require approximately 6 to 7 percent cement by weight to achieve the target strength of 100 psi. This cement percentage assumes that the soil moisture content does not exceed 20 percent at the time of amendment. If the soil moisture content is in the range of 25 to 35 percent, 7 to 8 percent cement by weight may be required to achieve the target strength. The amount of cement

added to the soil at the time of construction should be based on observed field conditions and subgrade performance. During extended periods of dry weather, water may need to be applied during the amendment and tilling process to achieve the optimum moisture content required for compaction.

Cement-amendment equipment should have balloon tires to minimize softening, rutting, and disturbance of fine-grained site soil. A sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds should be used for initial compaction. Rollers with vibratory action should not be used to compact fine-grained, cement-amended soil. Final compaction should be conducted with a smooth-drum roller with a minimum applied linear force of 700 pounds per inch. The amended soil should be compacted to at least 95 percent of the maximum dry density as determined by *ASTM D558*.

Following cement amendment, a minimum curing time of four days is required prior to exposure to construction traffic. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect cement-amended areas from damage, the finished surface should be covered with 4 to 6 inches of imported granular material. The protective layer of crushed rock often becomes contaminated with soil during construction, particularly in staging and haul road areas. Contaminated aggregate, where present, should be removed and replaced with clean crushed aggregate prior to construction of pavement or other permanent site improvements supported by base aggregate.

Cement amendment should not be attempted during moderate to heavy precipitation or when the ambient air temperature is below 40 degrees Fahrenheit. Cement should not be placed in areas of standing water or where saturated subgrade conditions exist.

8.6.3.2 Cement-Amended Structural Fill

If adequate compaction is not achievable with onsite soil due to moisture or weather conditions, the soil may be cement-amended and placed as general structural fill. Prior to placement of cement-amended fill, subgrade soils should be prepared as described in Section 8.1, *Site Preparation and Grading*. Where multiple lifts of cement-amended fill are necessary to meet finished grade, consecutive lifts may be placed immediately following amendment and compaction of the underlying lift. However, where the final lift of cement-amended fill will serve as building pad or pavement subbase material, the four-day cure period as discussed above is recommended.

8.6.3.3 QA/QC Testing and Inspection

Cement-amendment of site soils should be observed and tested by Columbia West to document conformance with design recommendations. Cement spread rate should be verified with a pan sample test conducted at one random location per lift per 20,000 square-feet of cement-amended fill. Treatment depth should be verified through excavation of a small test pit and measurement at one random location per lift of cement-amended fill. Adequate compaction and moisture content should be verified by conducting nuclear gauge density testing at a frequency of approximately one test per 5,000 square feet of cement-amended fill in accordance with *ASTM D6938*. At least one representative sample should be collected per day of cement-amendment, cured for 7 days, and tested for

unconfined compressive strength in accordance with ASTM D1633. The tested samples should have a minimum 7-day, unconfined compressive strength of 100 psi.

8.6.3.4 Drainage Considerations

Cement-amended soil will be poorly-drained and will not be suitable for planting areas. The material may also be difficult to excavate with light-duty landscaping equipment. Proposed landscape areas should not be cement-amended unless accommodations are made for drainage and planting.

Cement-amendment within building pad areas should consider the potential for trapped water below the floor slab. Columbia West should be consulted to provide appropriate recommendations if cement-amendment is proposed within building pad areas.

8.6.4 Pavement

8.6.4.1 Asphaltic Concrete

Asphaltic concrete should consist of HMA Class ½" adhering to *WSDOT 9-03.8(6), HMA Proportions of Materials*. The asphalt binder should consist of PG 58-22 meeting *WSDOT 9-02.1(4), Performance Graded (PG) Asphalt Binder*. Asphalt should be compacted to 91 percent of the theoretical maximum density as determined by *ASTM D2041*. Minimum and maximum asphalt lift thicknesses should be 2 and 3 inches, respectively. Nuclear gauge density testing should be conducted to verify adherence to recommended specifications. Testing frequency should be in accordance with WSDOT and City of Castle Rock specifications.

8.6.4.2 Portland Cement Concrete

Portland cement concrete should meet *WSDOT 5-05, Cement Concrete Pavement* with a minimum 28-day compressive strength of 4,000 psi and an air content between 3 and 7 percent. PCC should be placed in general accordance with *WSDOT 5-05.3(7), Placing, Spreading, and Compacting Concrete*. Dowel bars and placement should adhere to *WSDOT 5-05.3(10), Tie Bars and Corrosion Resistant Dowel Bars*. Joints should be constructed in general accordance with *WSDOT 5-05.3(8), Joints* with a maximum transverse joint spacing of 15 feet. The length-to-width ratio for any PCC panel should be between 0.80 and 1.25.

Concrete should be tested during installation in accordance with ASTM C171, C138, C231, C143, C1064, and C31. This includes casting of cylinder specimen at a frequency of four cylinders per 100 cubic yards of poured concrete. Recommended field concrete testing includes slump, air entrainment, temperature, and unit weight.

8.7 Erosion Control Measures

Soil at this site is susceptible to erosion by wind and water; therefore, erosion control measures should be carefully planned and installed. Surface water runoff should be collected and directed away from sloped areas to prevent water from running down the slope face. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads. All erosion control methods should be in accordance with local jurisdiction standards.

9.0 CONCLUSION AND LIMITATIONS

This geotechnical site investigation report was prepared in accordance with accepted standard conventional principles and practices of geotechnical engineering. This investigation pertains only to material tested and observed as of the date of this report and is based upon proposed site development as described in the text herein. This report is a professional opinion containing recommendations established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. Soil conditions may differ between tested locations or over time. Slight variations may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions are as anticipated in this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Columbia West cannot accept responsibility for deviations from recommendations described in this report. Future performance of structural facilities is often related to the degree of construction observation by qualified personnel. These services should be performed to the full extent recommended.

This report is not an environmental assessment and should not be construed as a representative warranty of site subsurface conditions. The discovery of adverse environmental conditions, or subsurface soils that deviate from those described in this report, should immediately prompt further investigation. The above statements are in lieu of all other statements expressed or implied.

This report was prepared solely for the client and is not to be reproduced without prior authorization from Columbia West. Final engineering plans and specifications for the project should be reviewed and approved by Columbia West as they relate to geotechnical and grading issues prior to final design approval. Columbia West is not responsible for independent conclusions or recommendations made by other parties based upon information presented in this report. Unless a particular service was expressly included in the scope, it was not performed and there should be no assumptions based upon services not provided. Additional report limitations and important information about this document are presented in Appendix D, *Report Limitations and Important Information*. This information should be carefully read and understood by the client and other parties reviewing this document.

Sincerely,

COLUMBIA WEST ENGINEERING, Inc.



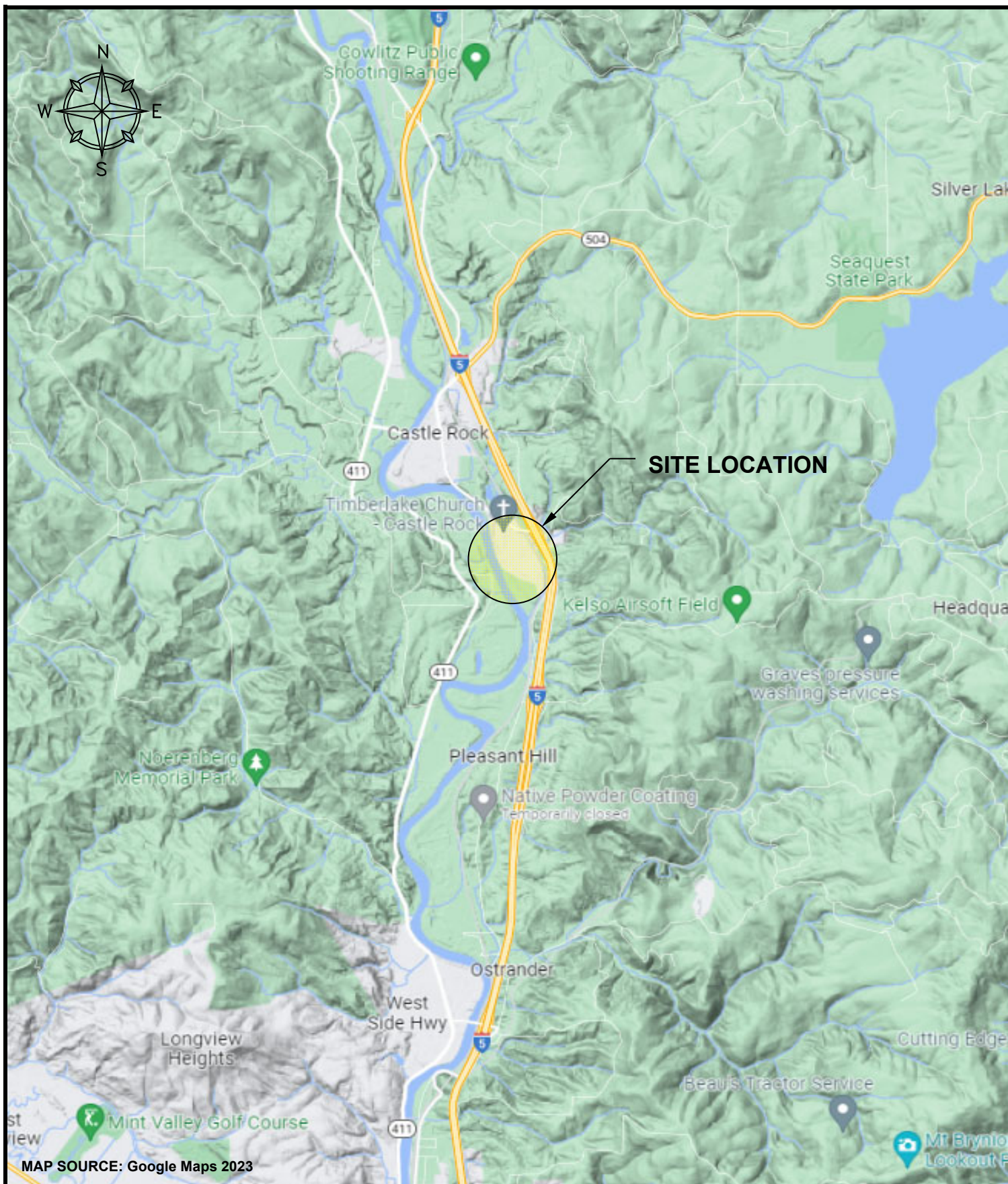
Lance V. Lehto, PE, GE
President

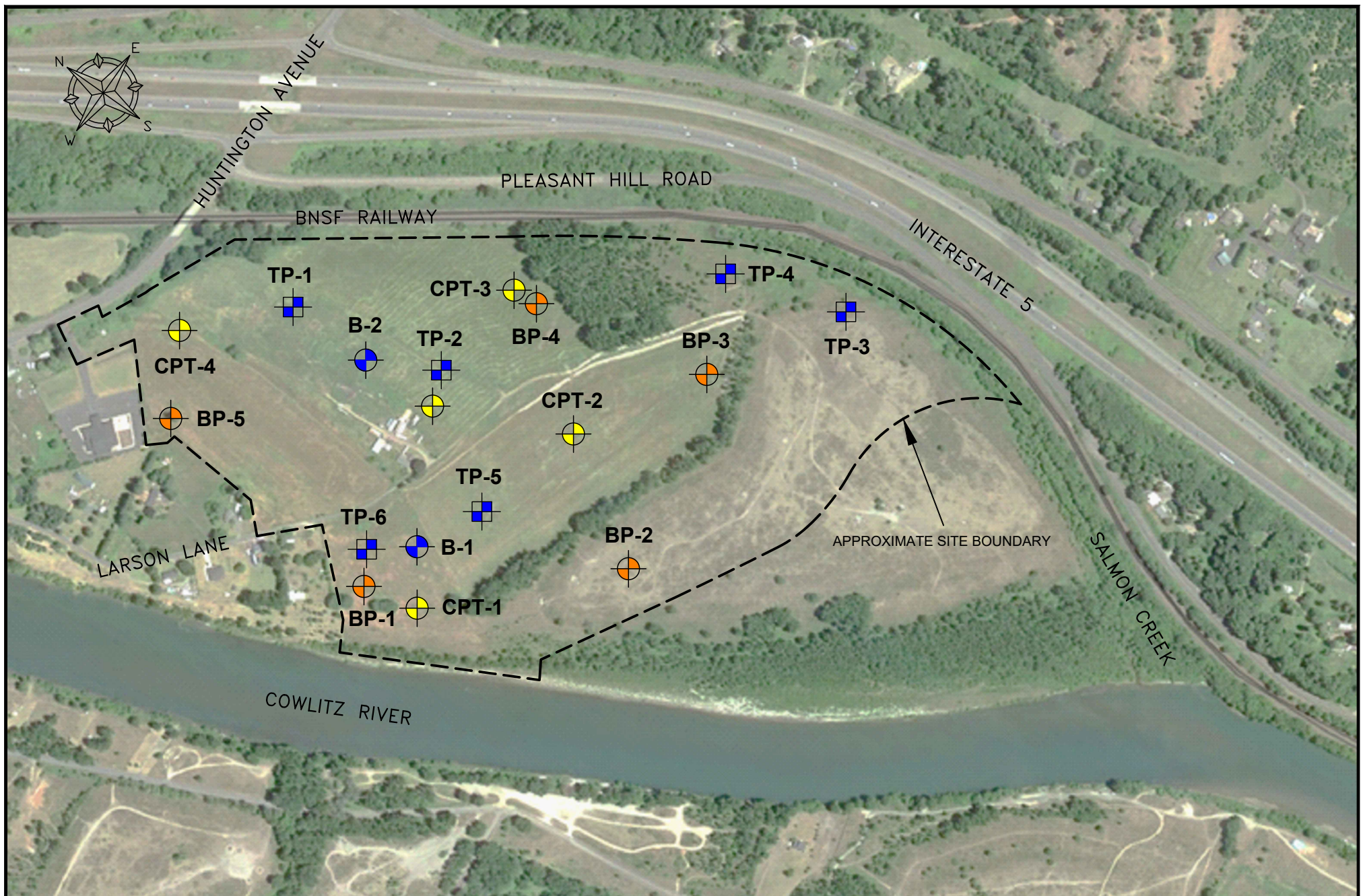


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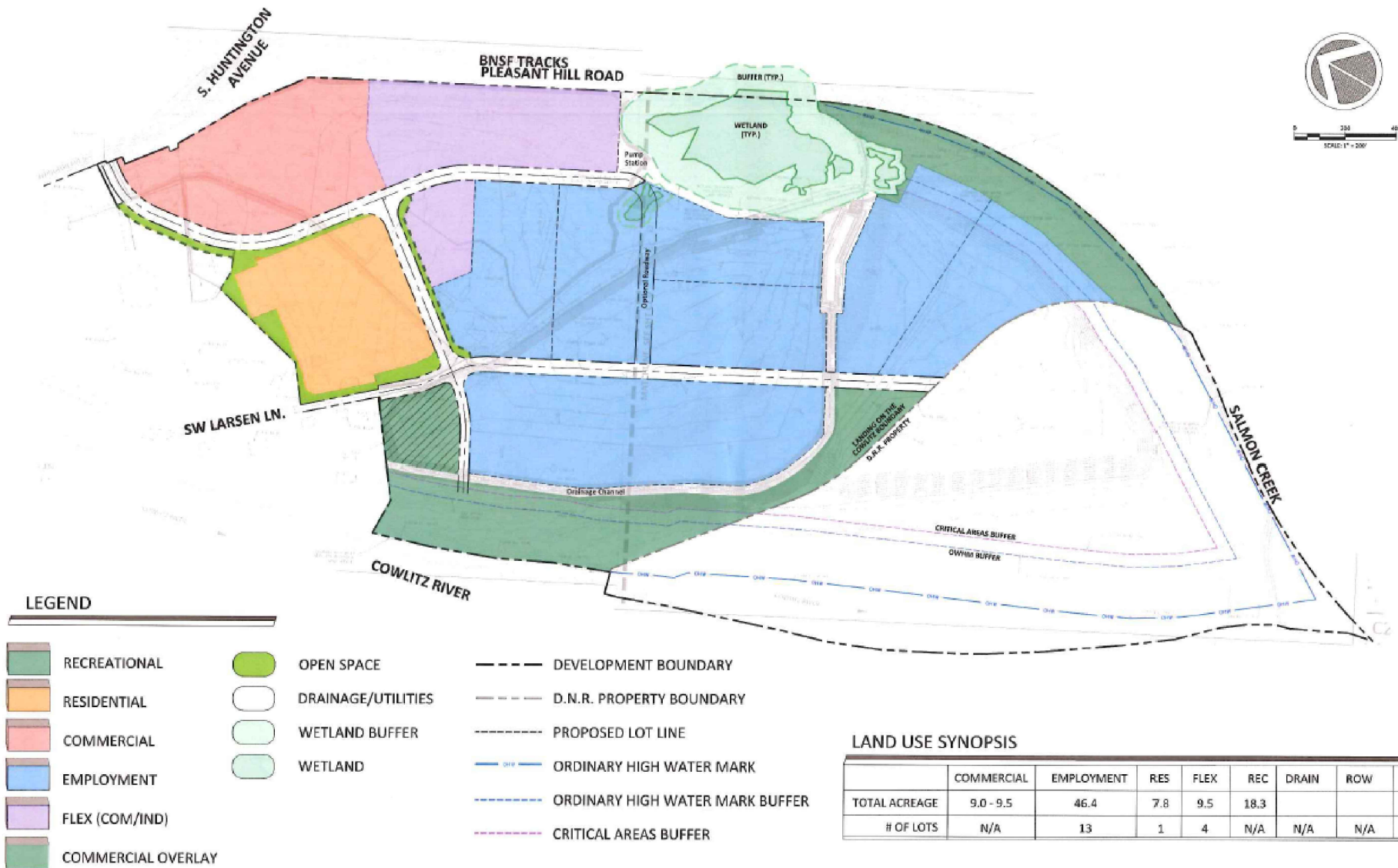
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- Wong, Ivan, et al, *Earthquake Scenario and Probabilistic Earthquake Ground Shaking Maps for the Portland, Oregon, Metropolitan Area*, IMS-16, Oregon Department of Geology and Mineral Industries, 2000.

FIGURES





 BORING AND PIEZOMETER (COLUMBIA WEST, 2023)
  BORING (BY OTHERS, 2020)
  CONE PENETRATION TEST (BY OTHERS, 2020)
  TEST PIT (BY OTHERS, 2020)

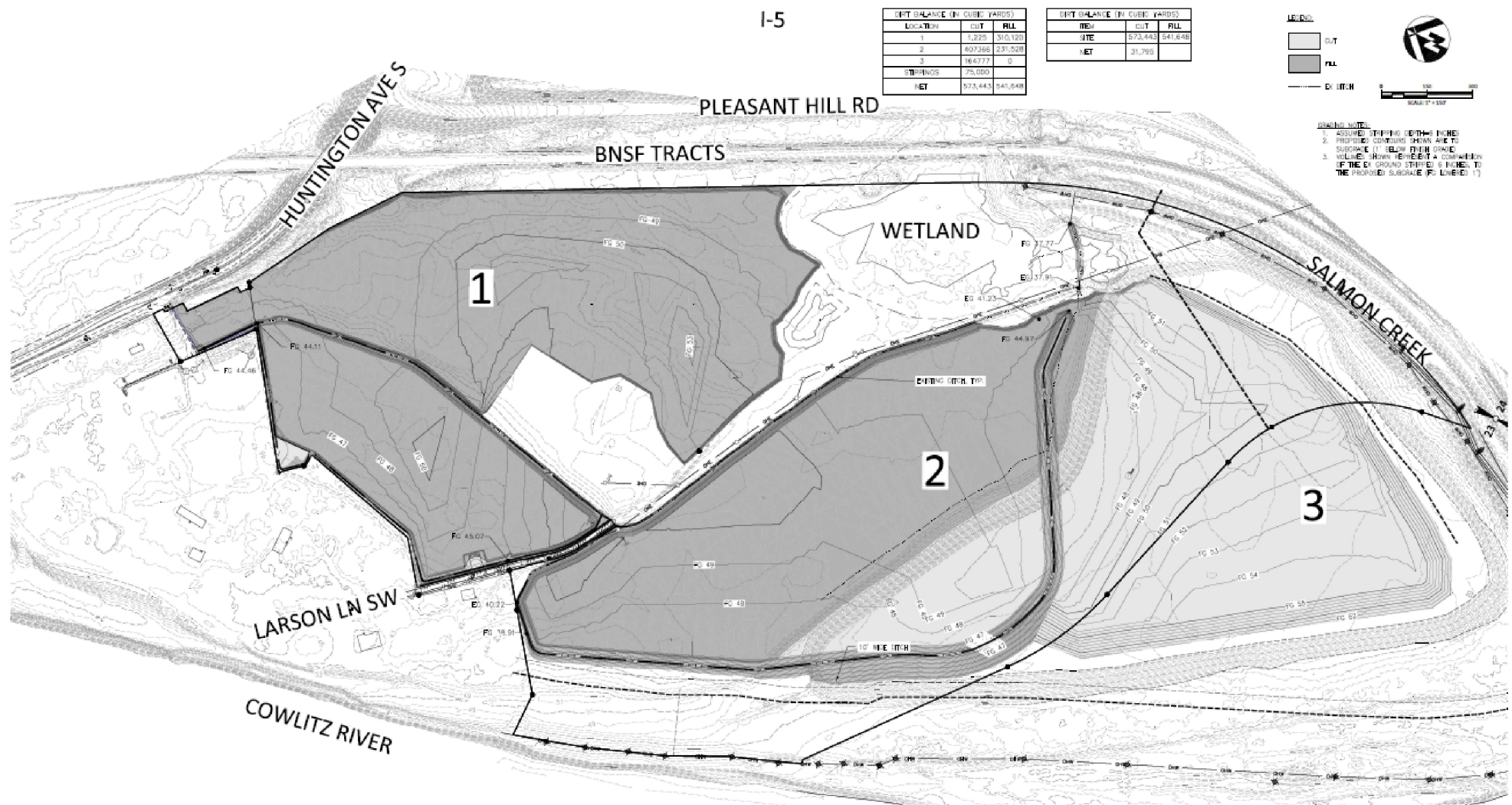


LANDING ON THE COWLITZ - DYNAMIC MASTER PLAN

OCTOBER 2022

MacKay Sposito

ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

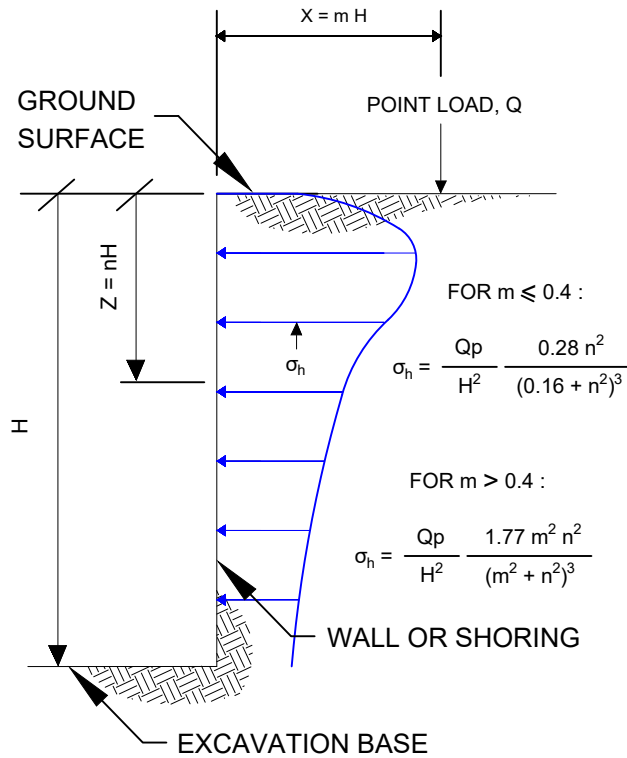


CASTLE ROCK LANDING ON THE COWLITZ - PHASE 1 ROUGH GRADING PLAN

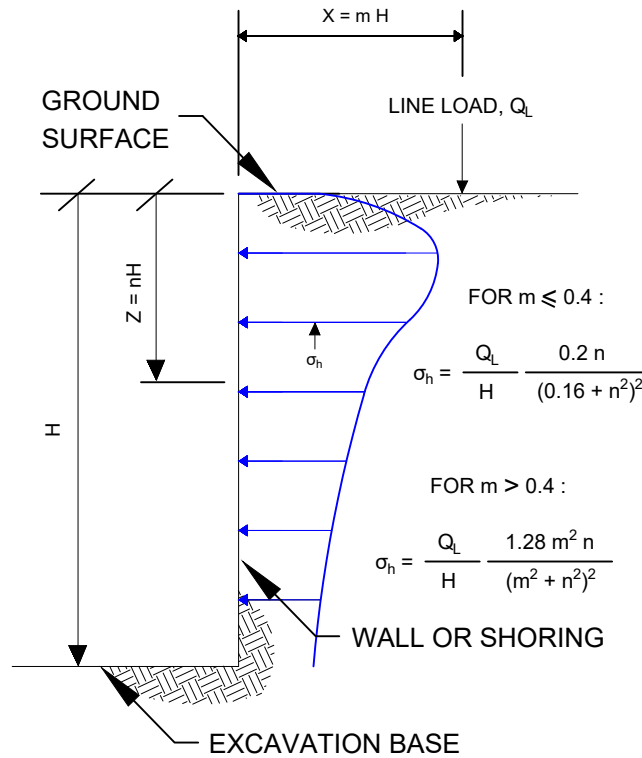
Mackay + Spósito

ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

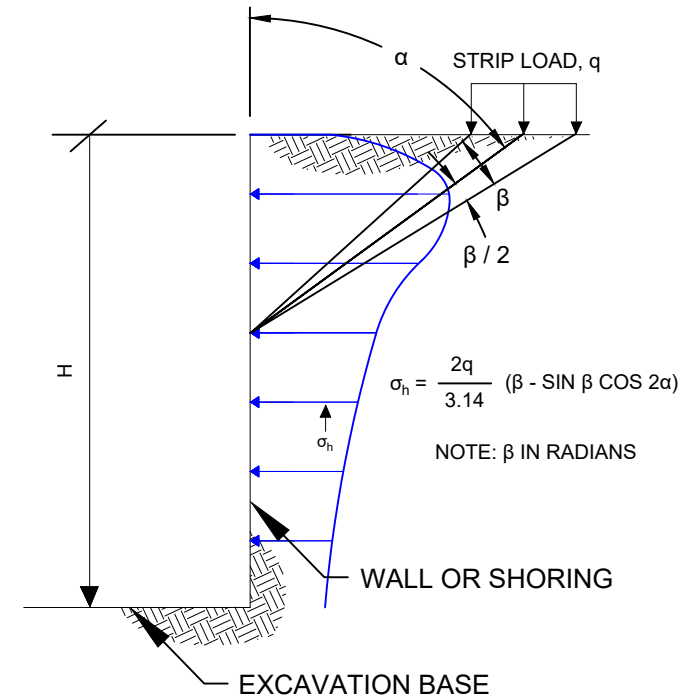
VERTICAL POINT LOAD



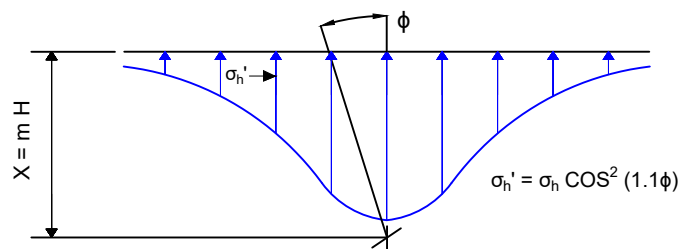
LINE LOAD PARALLEL TO WALL



STRIP LOAD PARALLEL TO WALL

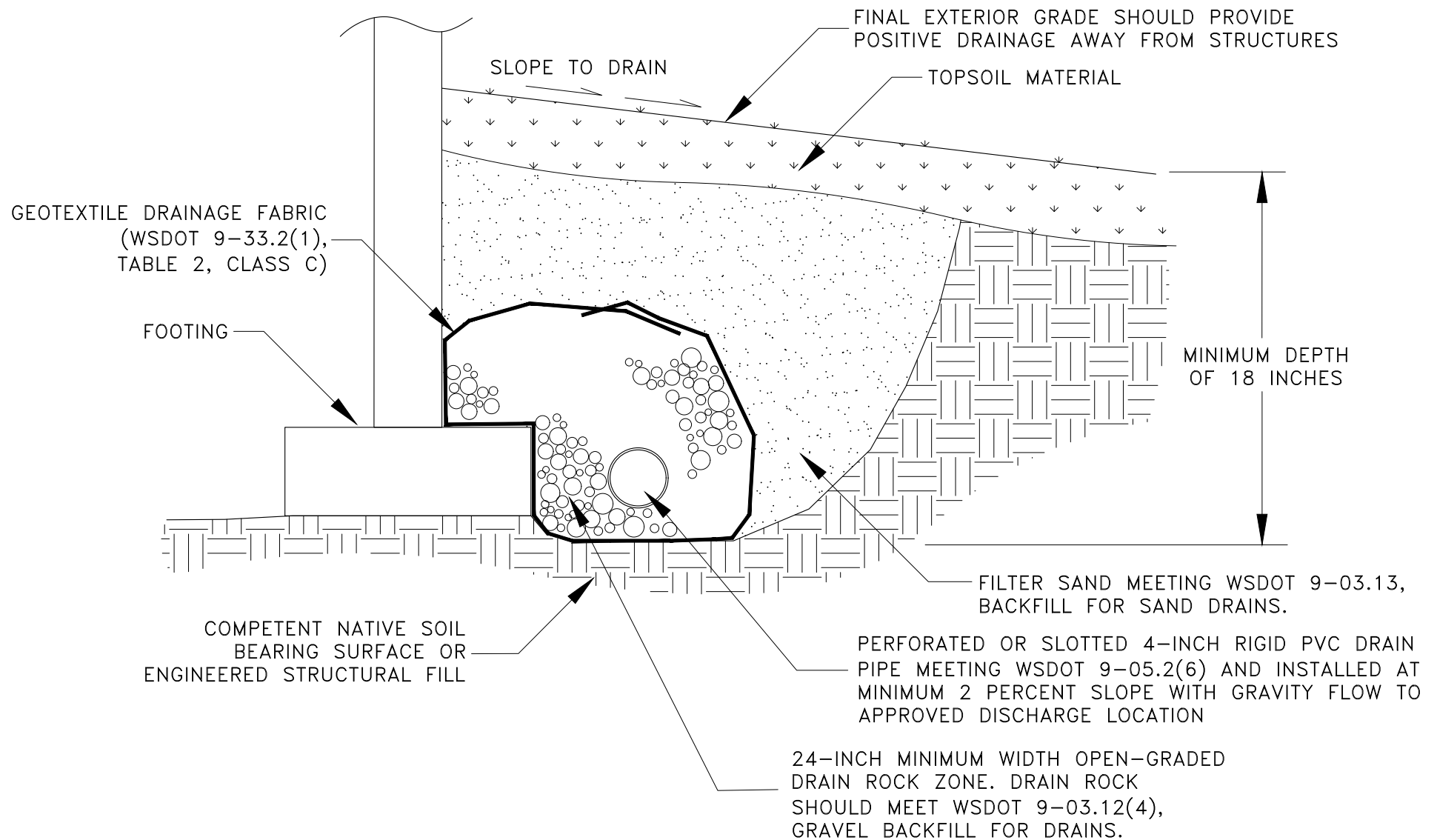


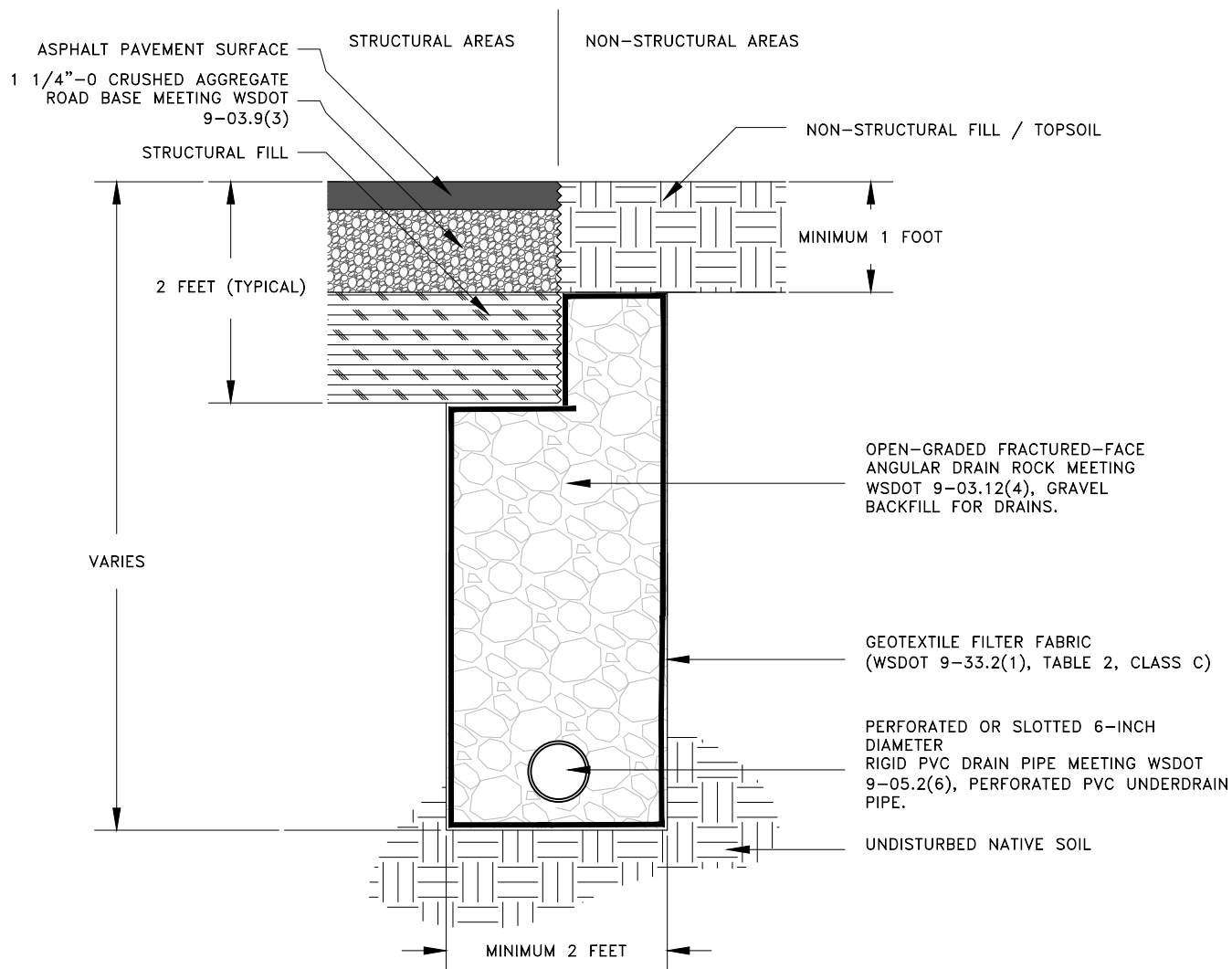
VERTICAL POINT LOAD HORIZONTAL PRESSURE DISTRIBUTION



NOTES:

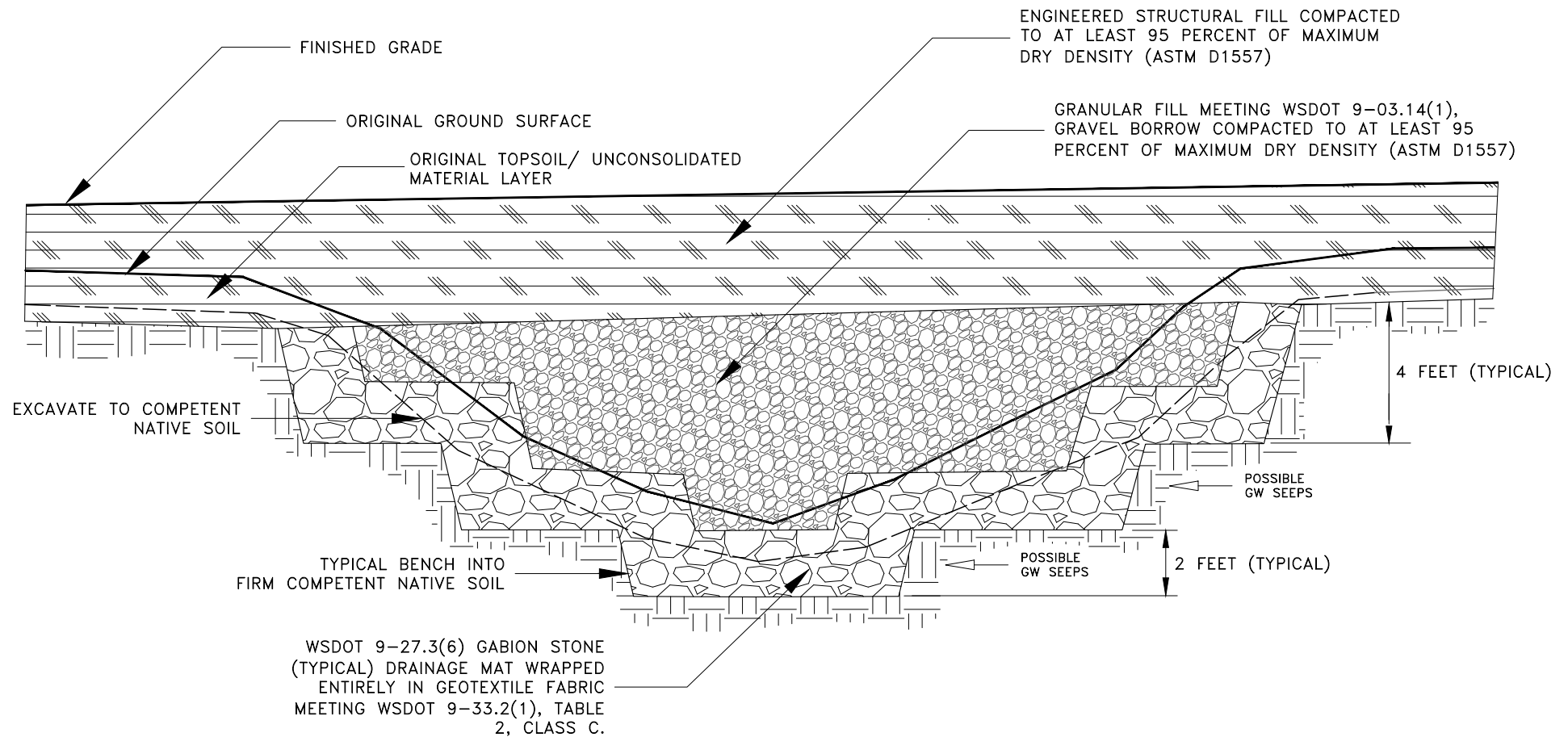
1. FIGURE SHOULD BE USED JOINTLY WITH RECOMMENDATIONS PRESENTED IN THE REPORT TEXT.
2. LATERAL EARTH PRESSURES ASSUME RIGID WALLS WITH BACKFILL MATERIALS HAVING A POISSON'S RATIO OF 0.5.
3. TOTAL LATERAL EARTH PRESSURES RESULTING FROM COMBINED LOADS MAY BE CALCULATED USING SUPERPOSITION.
4. DRAWING IS NOT TO SCALE.

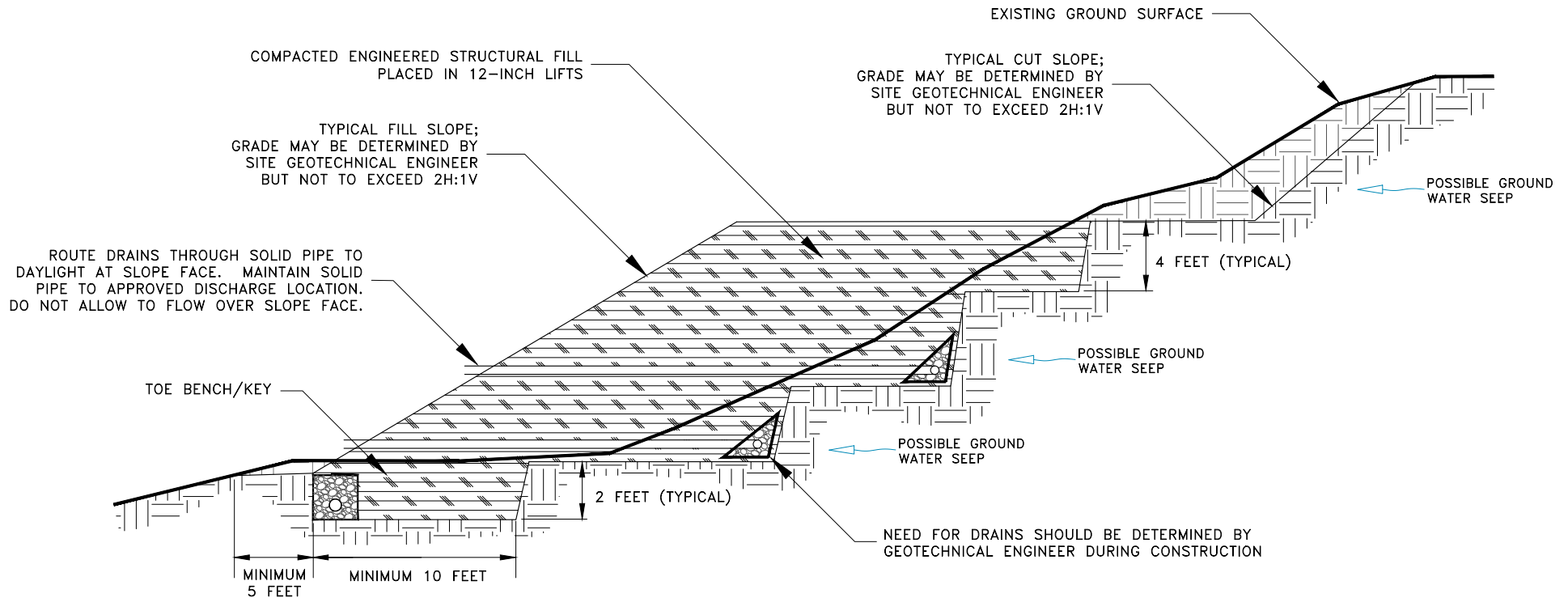




NOTE: LOCATION, INVERT ELEVATION, DEPTH OF TRENCH, AND EXTENT OF PERFORATED PIPE REQUIRED MAY BE MODIFIED BY THE GEOTECHNICAL ENGINEER DURING CONSTRUCTION BASED UPON FIELD OBSERVATION AND SITE-SPECIFIC SOIL CONDITIONS.

TYPICAL DRAINAGE MAT CROSS-SECTION





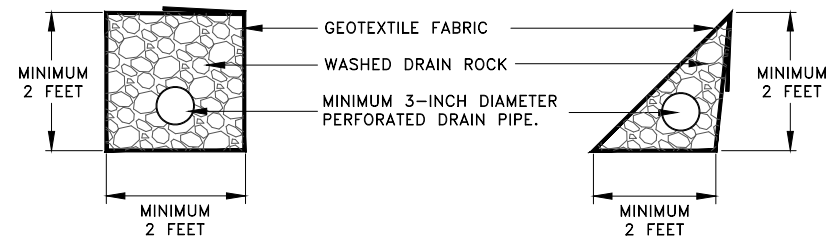
DRAIN SPECIFICATIONS

GEOTEXTILE FABRIC SHALL MEET WSDOT 9-33.2(1), TABLE 2, CLASS C.

WASHED DRAIN ROCK SHALL BE OPEN-GRADED ANGULAR DRAIN ROCK MEETING WSDOT 9-03.12(4), GRAVEL BACKFILL FOR DRAINS.

DRAIN PIPE SHOULD MEET WSDOT 9-05.2(6), PERFORATED PVC UNDERDRAIN PIPE.

TYPICAL DRAIN SECTION DETAIL



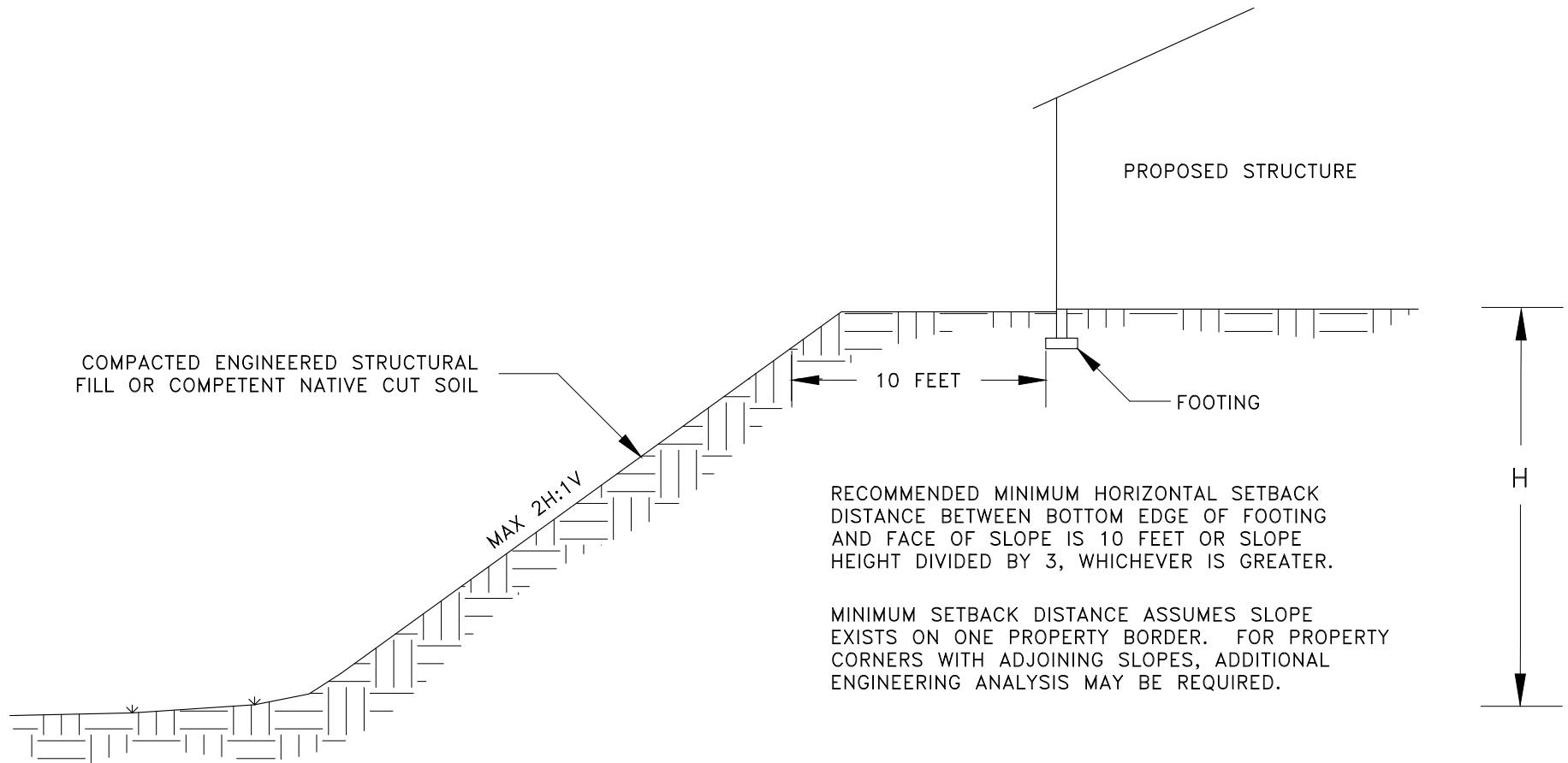
TYPICAL CUT AND FILL SLOPE CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL CUT AND FILL SLOPE CROSS SECTION AND MAY NOT BE SITE-SPECIFIC.

FIGURE

9

Page 962 of 1122



APPENDIX A

SUBSURFACE EXPLORATION LOGS

BORING LOG

PROJECT NAME Landing on the Cowlitz	CLIENT CT6, LLC	PROJECT NO. 22310	BORING NO. BP-1
PROJECT LOCATION Castle Rock, Washington	DRILLING CONTRACTOR Western States	DRILL RIG CME Track	TECHNICIAN MAC
BORING LOCATION See Figure 2	DRILLING METHOD HSA	SAMPLING METHOD SPT	START DATE 1/31/23
REMARKS None	APPROX. SURFACE ELEVATION Not surveyed	GROUNDWATER DEPTH 20 feet bgs on 1/31/23	START TIME 0900
		FINISH DATE 1/31/23	FINISH TIME 1030

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Fill. Gray poorly-graded SAND with silt and trace gravel, moist, fine-textured.					
2											
4											
6	SPT BP1.1	5	SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
8											
10	SPT BP1.2	4				Becomes very loose.					
12											
14											
16	SPT BP1.3	9				Becomes loose.					
18											
20	SPT BP1.4	16				Becomes medium dense, wet.					
22											
24											
26											
28											
30											
32						Bottom of boring at 30 feet bgs. Groundwater encountered at 20 feet bgs on 1/31/23. Piezometer installed at 30 feet and completed with flush mount monument on 1/31/23.					
34											
36											

BORING LOG

PROJECT NAME Landing on the Cowlitz	CLIENT CT6, LLC	PROJECT NO. 22310	BORING NO. BP-2
PROJECT LOCATION Castle Rock, Washington	DRILLING CONTRACTOR Western States	DRILL RIG CME Track	TECHNICIAN MAC
BORING LOCATION See Figure 2	DRILLING METHOD HSA	SAMPLING METHOD SPT	START DATE 1/31/23
REMARKS None	APPROX. SURFACE ELEVATION Not surveyed	GROUNDWATER DEPTH 35 feet bgs on 1/31/23	FINISH DATE 1/31/23
			FINISH TIME 1600

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, moist, fine-textured.					
2											
4											
6											
8											
10											
12											
14											
16											
18											
20						Becomes very dense with reduced silt content and trace to some gravel.					
22	SPT BP2.1	57									
24											
26	SPT BP2.2	11				Becomes medium dense, very moist.					
28											
30	SPT BP2.3	10									
32											
34											
36	SPT BP2.4	30	GP-GM			Gray to reddish gray poorly-graded GRAVEL with silt and sand, medium dense, wet.					
38											
40	SPT BP2.5	REFUSAL 50(3")				Becomes very dense.					
42											
44											
46						Bottom of soil boring at 45 feet bgs.					
48						Groundwater encountered at 35 feet bgs on 1/31/23. Piezometer installed at 45 feet and completed with flush mount monument on 1/31/23.					
50											
52											

BORING LOG

PROJECT NAME Landing on the Cowlitz	CLIENT CT6, LLC	PROJECT NO. 22310	BORING NO. BP-3
PROJECT LOCATION Castle Rock, Washington	DRILLING CONTRACTOR Western States	DRILL RIG CME Track	TECHNICIAN MAC
BORING LOCATION See Figure 2	DRILLING METHOD HSA	SAMPLING METHOD SPT	START DATE 2/1/23
REMARKS None	APPROX. SURFACE ELEVATION Not surveyed	GROUNDWATER DEPTH 15 feet bgs on 2/1/23	FINISH DATE 2/1/23
			START TIME 0900
			FINISH TIME 1245

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
2											
4											
6	SPT BP3.1	6									
8											
10	SPT BP3.2	0				Becomes very loose.					
12											
14											
16	SPT BP3.3	1	ML			Dark gray SILT with sand, very soft, wet, low plasticity.					
18											
20	SPT BP3.4	37	SP			Gray poorly-graded SAND, medium dense, wet.					
22											
24											
26						Bottom of soil boring at 25 feet bgs. Groundwater encountered at 15 feet bgs on 2/1/23. Piezometer installed at 25 feet and completed with flush mount monument on 2/1/23.					
28											
30											

BORING LOG

PROJECT NAME Landing on the Cowlitz	CLIENT CT6, LLC	PROJECT NO. 22310	BORING NO. BP-4
PROJECT LOCATION Castle Rock, Washington	DRILLING CONTRACTOR Western States	DRILL RIG CME Track	TECHNICIAN MAC
BORING LOCATION See Figure 2	DRILLING METHOD HSA	SAMPLING METHOD SPT	START DATE 2/1/23
REMARKS None	APPROX. SURFACE ELEVATION Not surveyed	GROUNDWATER DEPTH 17 feet bgs on 2/2/23	FINISH DATE 2/2/23
			START TIME 1300
			FINISH TIME 1045

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0						Grass and three-inch-thick root zone underlain by 12 inches of topsoil.					
2			SP-SM			Brown silty SAND to poorly-graded SAND with silt, very loose, moist, fine-textured.					
4											
6	SPT BP4.1	4									
8											
10	SPT BP4.2	1									
12											
14											
16	SPT BP4.3	1									
18						Becomes wet.					
20											
22											
24											
26											
28											
30											
32											
34											
36						Bottom of soil boring at 35 feet bgs. Groundwater encountered at 17 feet bgs on 2/2/23. Piezometer installed at 35 feet and completed with flush mount monument on 2/2/23.					
38											
40											

BORING LOG

PROJECT NAME Landing on the Cowlitz	CLIENT CT6, LLC	PROJECT NO. 22310	BORING NO. BP-5
PROJECT LOCATION Castle Rock, Washington	DRILLING CONTRACTOR Western States	DRILL RIG CME Track	TECHNICIAN MAC
BORING LOCATION See Figure 2	DRILLING METHOD HSA	SAMPLING METHOD SPT	START DATE 2/2/23
REMARKS None	APPROX. SURFACE ELEVATION Not surveyed	GROUNDWATER DEPTH 17.5 feet bgs on 2/2/23	FINISH DATE 2/2/23
			FINISH TIME 1600

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
2											
4											
6	SPT BP5.1	7									
8											
10	SPT BP5.2	10				Becomes medium dense.					
12											
14											
16	SPT BP5.3	5				Becomes loose.					
18						Becomes wet.					
20	SPT BP5.4	REFUSAL 50(3")	GP-GM			Gray to reddish gray poorly-graded GRAVEL with silt and sand, very dense, wet.					
22											
24											
26	SPT BP5.5	REFUSAL 50(5")									
28											
30	SPT BP5.6	16				Becomes medium dense.					
32						Bottom of soil boring at 31.5 feet bgs. Groundwater encountered at 17.5 feet bgs on 2/2/23. Piezometer installed at 30 feet and completed with flush mount monument on 2/2/23.					
34											
36											

APPENDIX B

SOIL CLASSIFICATION INFORMATION

SOIL DESCRIPTION AND CLASSIFICATION GUIDELINES

Particle-Size Classification

COMPONENT	ASTM/USCS		AASHTO	
	size range	sieve size range	size range	sieve size range
Cobbles	> 75 mm	greater than 3 inches	> 75 mm	greater than 3 inches
Gravel	75 mm – 4.75 mm	3 inches to No. 4 sieve	75 mm – 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm – 19.0 mm	3 inches to 3/4-inch sieve	-	-
Fine	19.0 mm – 4.75 mm	3/4-inch to No. 4 sieve	-	-
Sand	4.75 mm – 0.075 mm	No. 4 to No. 200 sieve	2.00 mm – 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm – 2.00 mm	No. 4 to No. 10 sieve	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve	-	-
Fine	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	< 0.075 mm	Passing No. 200 sieve	< 0.075 mm	Passing No. 200 sieve

Consistency for Cohesive Soil

CONSISTENCY	SPT N-VALUE (BLOWS PER FOOT)	D&M N-VALUE (BLOWS PER FOOT)	POCKET PENETROMETER (UNCONFINED COMPRESSIVE STRENGTH, tsf)
Very Soft	Less than 2	Less than 3	less than 0.25
Soft	2 to 4	3 to 6	0.25 to 0.50
Medium Stiff	4 to 8	6 to 12	0.50 to 1.0
Stiff	8 to 15	12 to 25	1.0 to 2.0
Very Stiff	15 to 30	25 to 65	2.0 to 4.0
Hard	30 to 60	65 to 145	greater than 4.0
Very Hard	greater than 60	greater than 145	-

RELATIVE DENSITY	SPT N-VALUE (BLOWS PER FOOT)	D&M N-VALUE (BLOWS PER FOOT)
Very Loose	0 to 4	0 to 11
Loose	4 to 10	11 to 26
Medium Dense	10 to 30	26 to 74
Dense	30 to 50	74 to 120
Very Dense	more than 50	More than 120

Relative Density for Granular Soil

Moisture Designations

TERM	FIELD IDENTIFICATION
Dry	No moisture. Dusty or dry.
Damp	Some moisture. Cohesive soils are usually below plastic limit and are moldable.
Moist	Grains appear darkened, but no visible water is present. Cohesive soils will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grains. Sand and silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is much wetter than optimum moisture content and is above plastic limit.

Additional Constituents

Silt and Clay In:		Sand and Gravel In:	
Percent	Fine-Grained Soil	Percent	Coarse-Grained Soil
< 5	trace	< 5	trace
5 – 12	minor	5 – 15	minor
> 12	some	15 – 30	with
		> 30	sandy/gravelly
			Indicate approx. percentage

AASHTO SOIL CLASSIFICATION SYSTEM

TABLE 1. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing .075 mm)				Silt-Clay Materials (More than 35 Percent Passing 0.075)		
Group Classification	A-1	A-3	A-2	A-4	A-5	A-6	A-7
Sieve analysis, percent passing:							
2.00 mm (No. 10)	-	-	-	-	-	-	-
0.425 mm (No. 40)	50 max	51 min	-	-	-	-	-
0.075 mm (No. 200)	25 max	10 max	35 max	36 min	36 min	36 min	36 min
<u>Characteristics of fraction passing 0.425 mm (No. 40)</u>							
Liquid limit				40 max	41 min	40 max	41 min
Plasticity index	6 max	N.P.		10 max	10 max	11 min	11 min
General rating as subgrade	Excellent to good				Fair to poor		

Note: The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

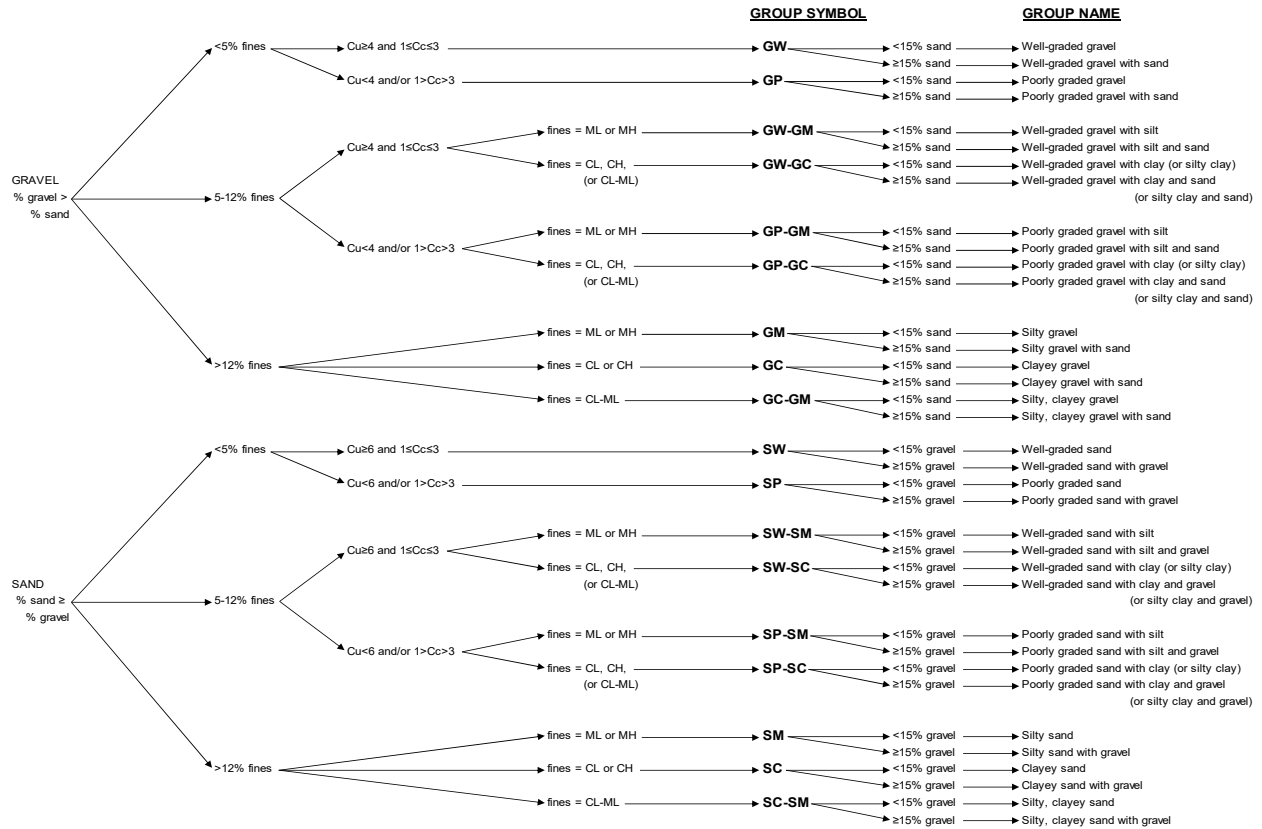
TABLE 2. Classification of Soils and Soil-Aggregate Mixtures

	Granular Materials							Silt-Clay Materials			
General Classification	(35 Percent or Less Passing 0.075 mm)							(More than 35 Percent Passing 0.075 mm)			
	A-1			A-2				A-7			
								A-7-5, A-7-6			
Group Classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-6
<u>Sieve analysis, percent passing:</u>											
2.00 mm (No. 10)	50 max	-	-	-	-	-	-	-	-	-	-
0.425 mm (No. 40)	30 max	50 max	51 min	-	-	-	-	-	-	-	-
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
<u>Characteristics of fraction passing 0.425 mm (No. 40)</u>											
Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General ratings as subgrade	Excellent to Good							Fair to poor			

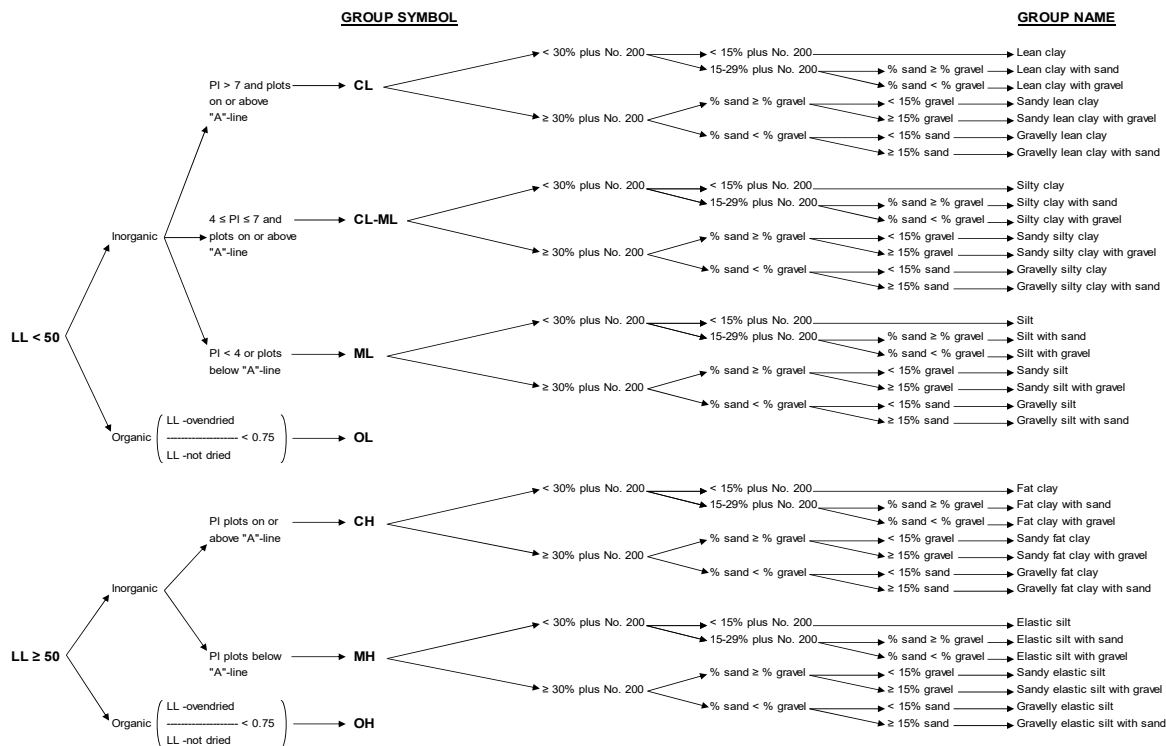
Note: Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30 (see Figure 2).

AASHTO = American Association of State Highway and Transportation Officials

USCS SOIL CLASSIFICATION SYSTEM



Flow Chart for Classifying Coarse-Grained Soils (More Than 50% Retained on No. 200 Sieve)

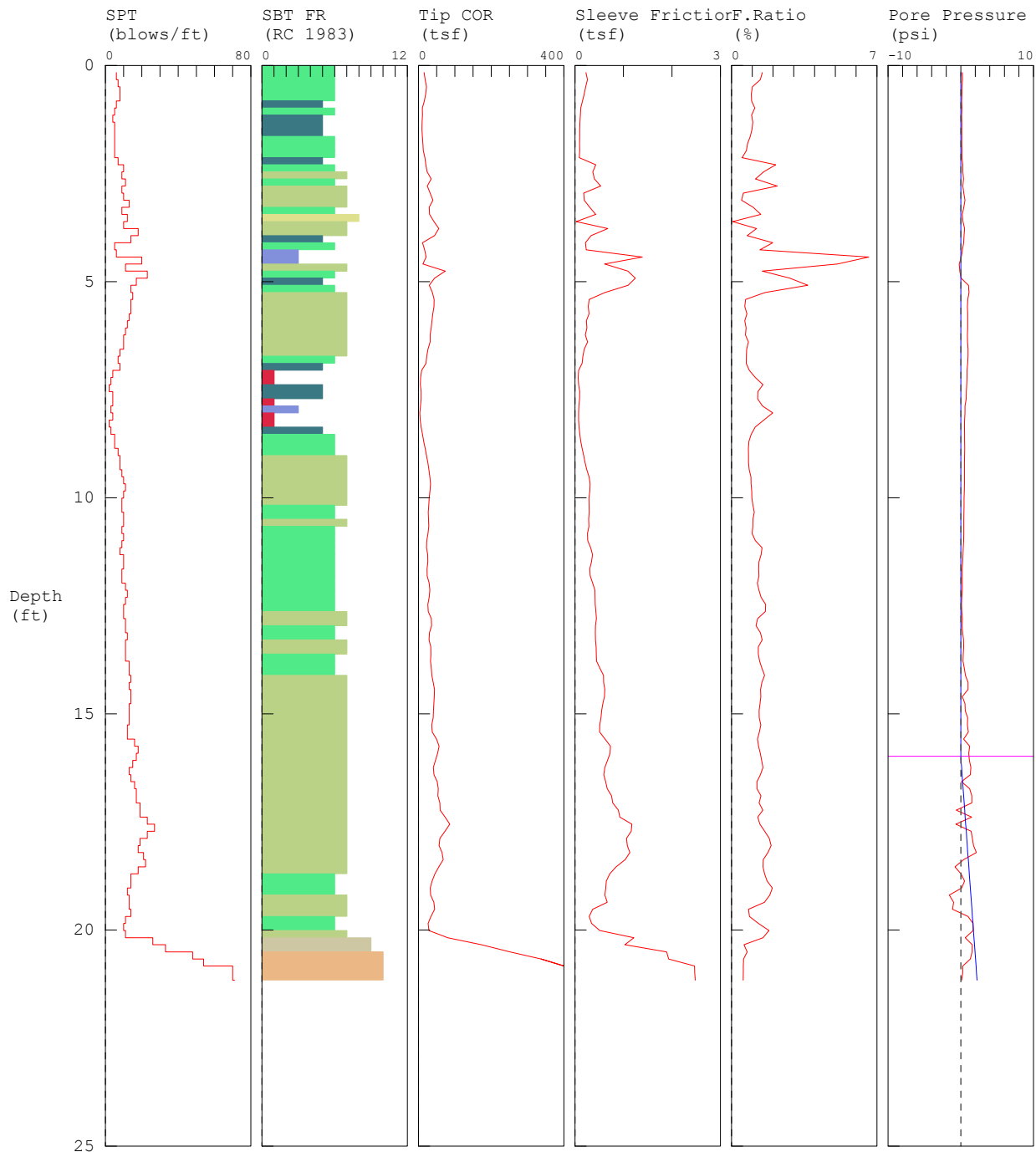


Flow Chart for Classifying Fine-Grained Soil (50% or More Passes No. 200 Sieve)

APPENDIX C
PERTINENT SUBSURFACE INFORMATION
COLLECTED BY OTHERS

GeoDesign / CPT-1 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
 CONE ID: DDG1296
 HOLE NUMBER: CPT-1
 TEST DATE: 1/13/2020 10:33:34 AM
 TOTAL DEPTH: 21.161 ft

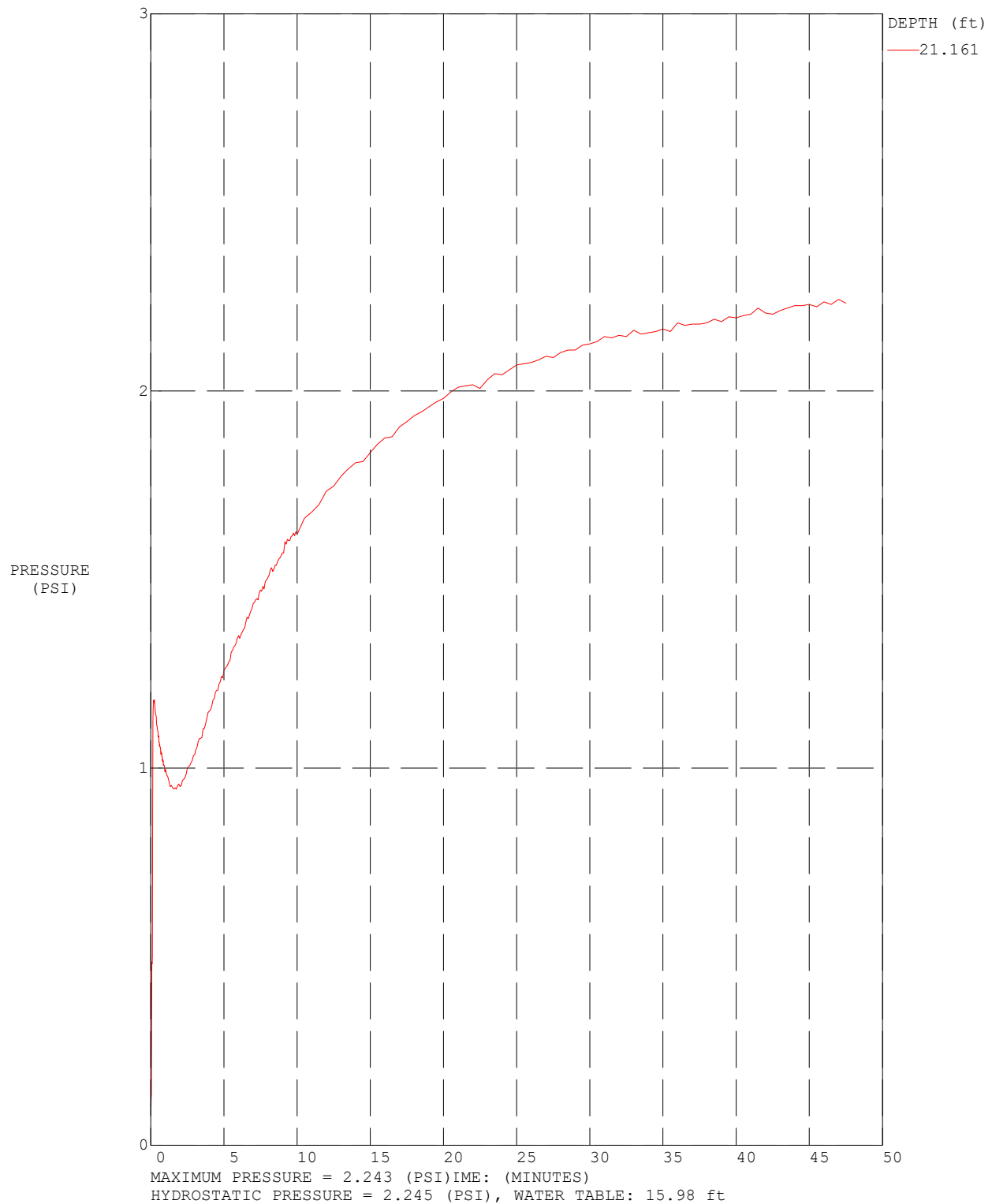


1 sensitive fine grained clay	4 silty clay to clay	7 silty sand to sandy clay	10 gravelly sand to sand
2 organic material	5 clayey silt to silt	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clay	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

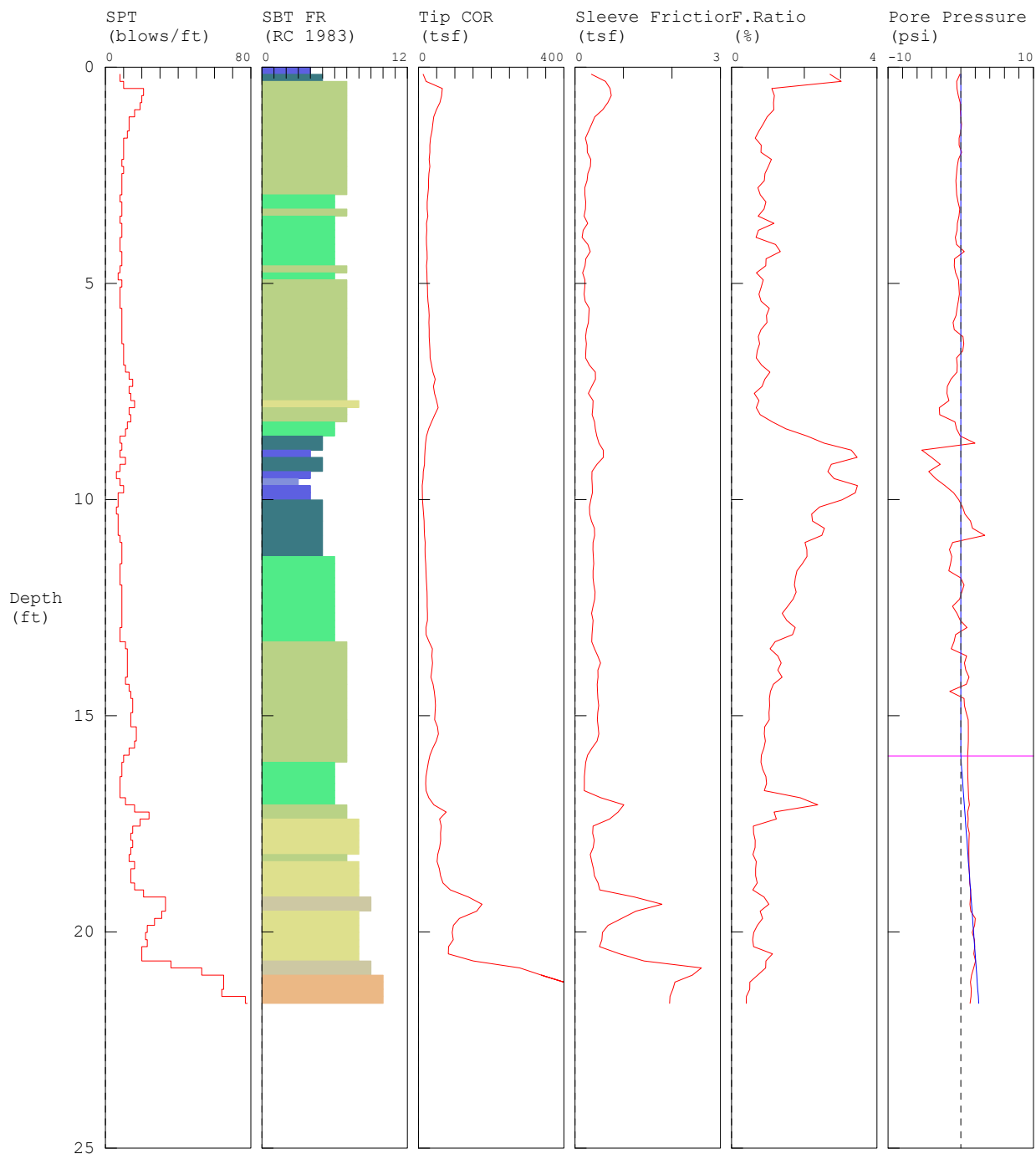
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TEST DATE: 1/13/2020 10:33:34 AM



GeoDesign / CPT-2 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
 CONE ID: DDG1296
 HOLE NUMBER: CPT-2
 TEST DATE: 1/13/2020 12:14:29 PM
 TOTAL DEPTH: 21.654 ft

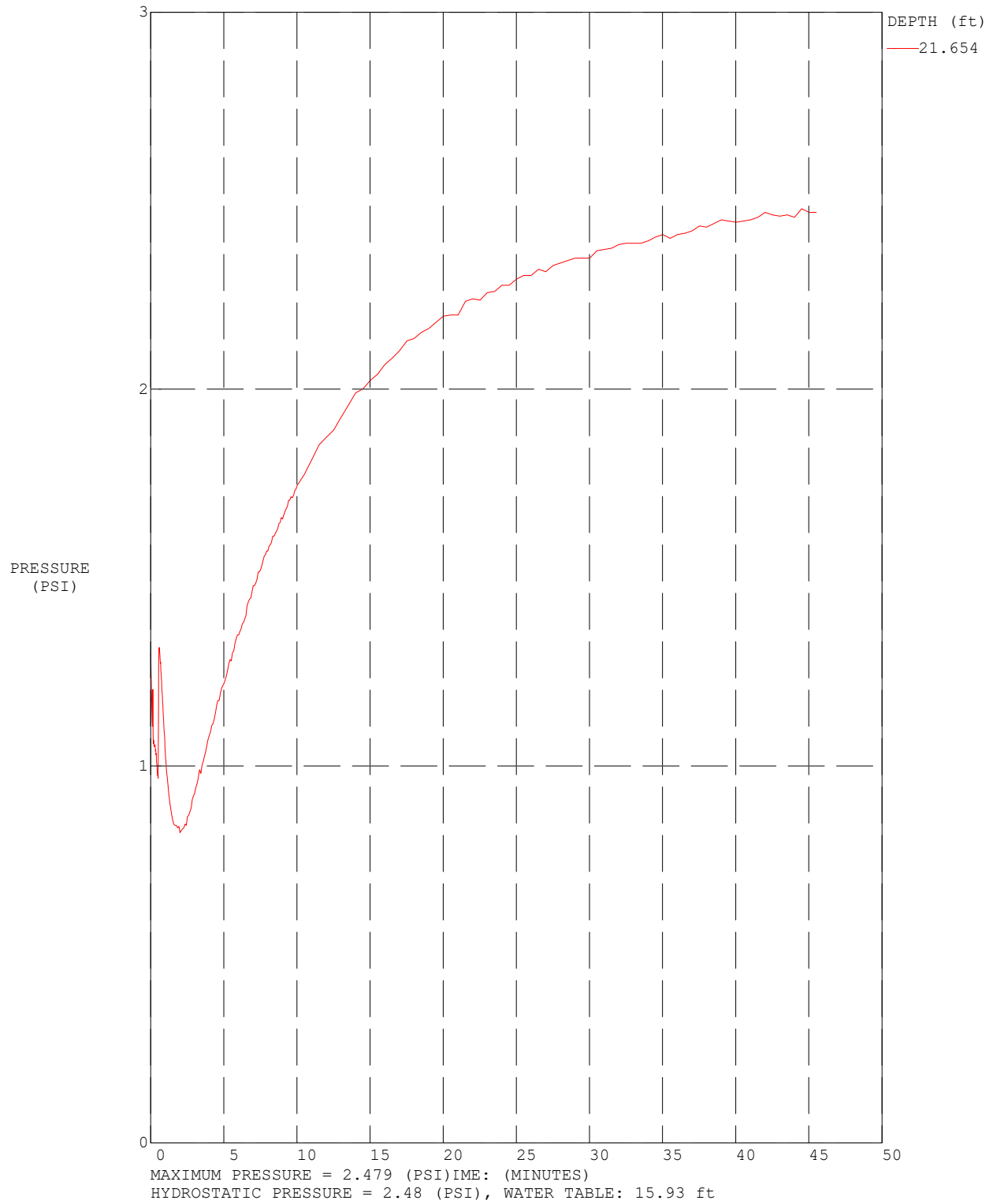


1 sensitive fine grained clay	4 silty clay to clay	7 silty sand to sandy clay	10 gravelly sand to sand
2 organic material	5 clayey silt to silt	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

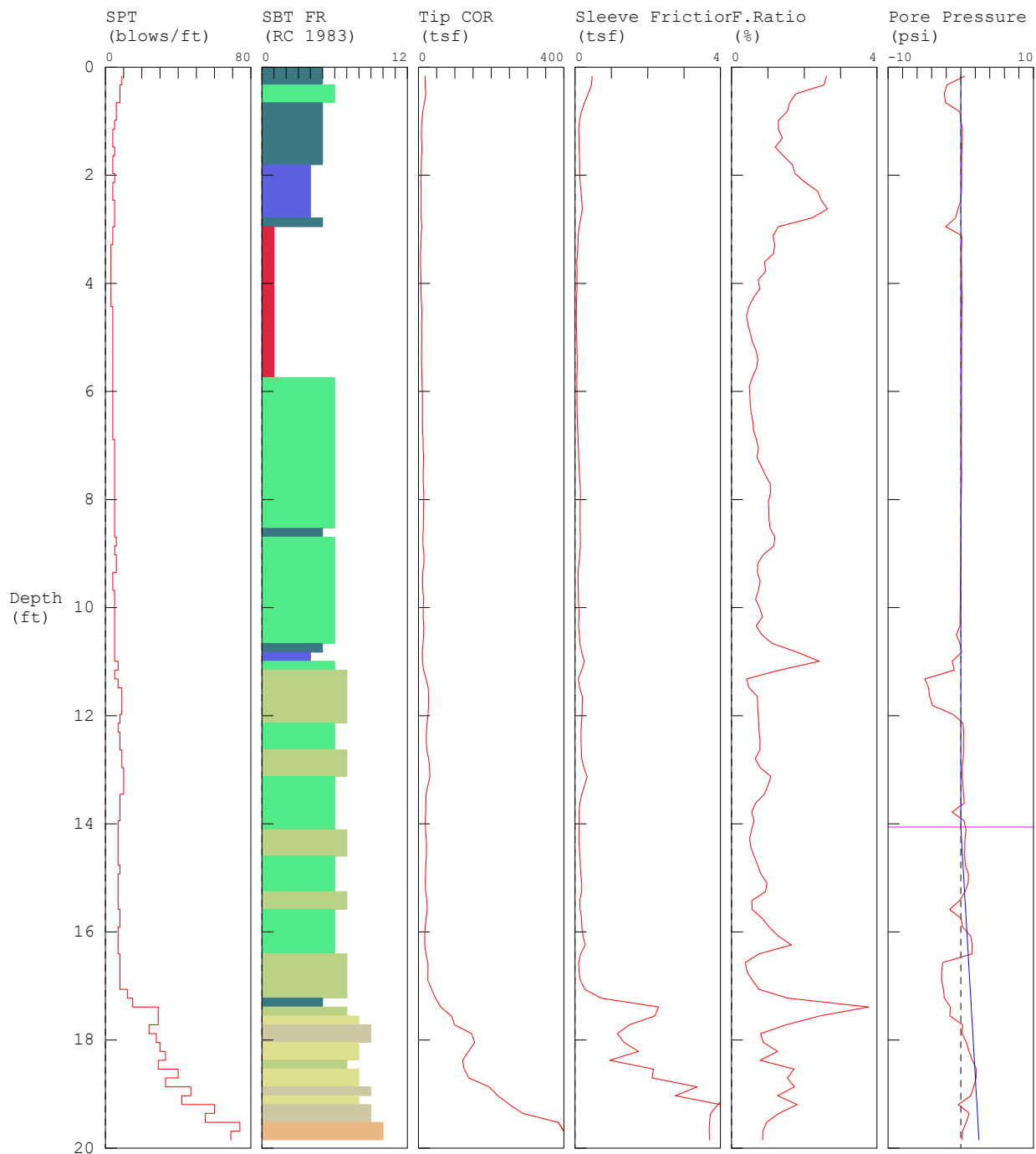
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TEST DATE: 1/13/2020 12:14:29 PM



GeoDesign / CPT-3 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
 CONE ID: DDG1296
 HOLE NUMBER: CPT-3
 TEST DATE: 1/13/2020 1:40:18 PM
 TOTAL DEPTH: 19.849 ft

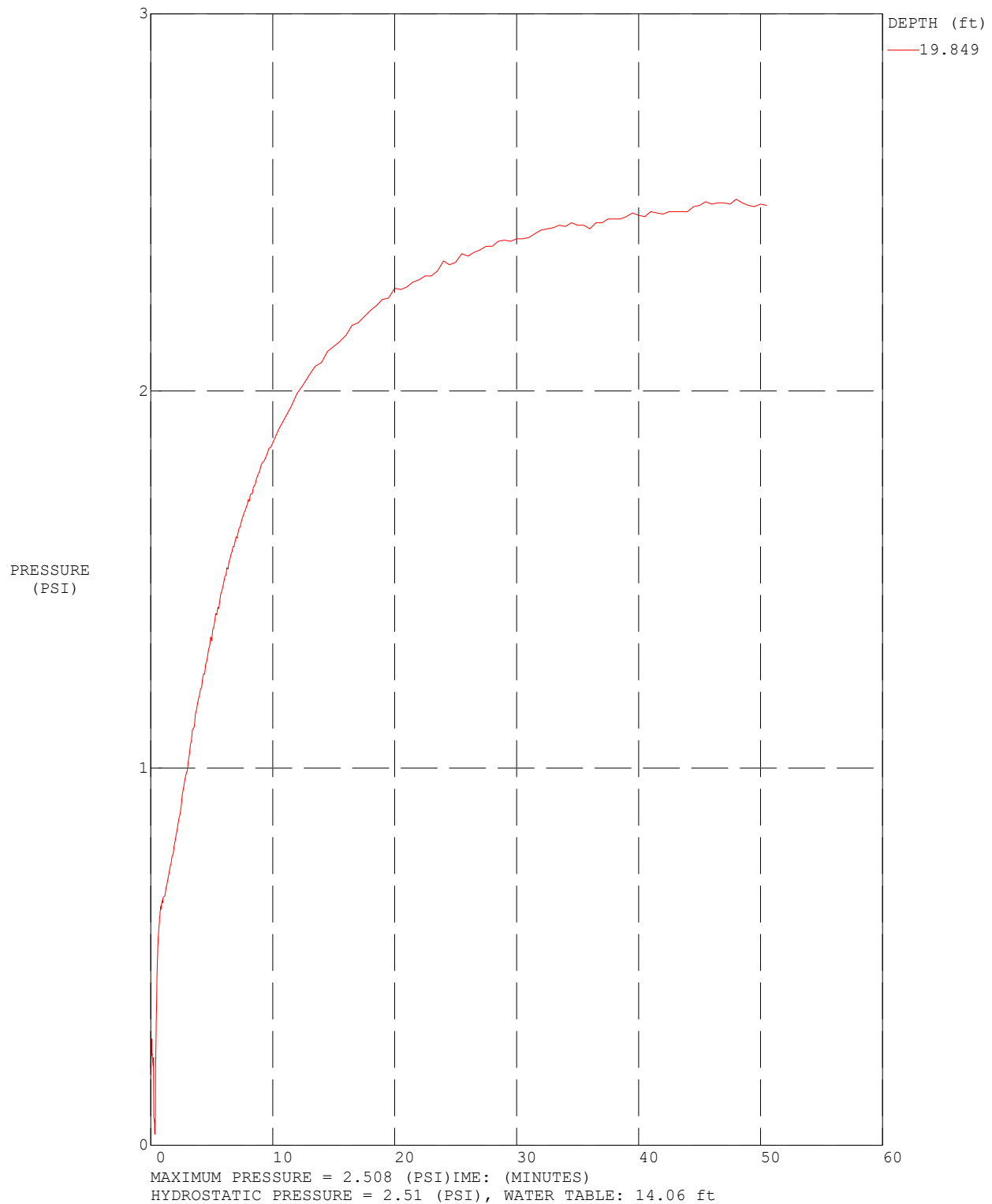


1	sensitive fine gr	4	silty clay to cl	7	silty sand to sandy	10	gravelly sand to sand
2	organic materia	5	clayey silt to silt	8	sand to silty sa	11	very stiff fine grained (*)
3	clay	6	sandy silt to claye	9	sand	12	sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

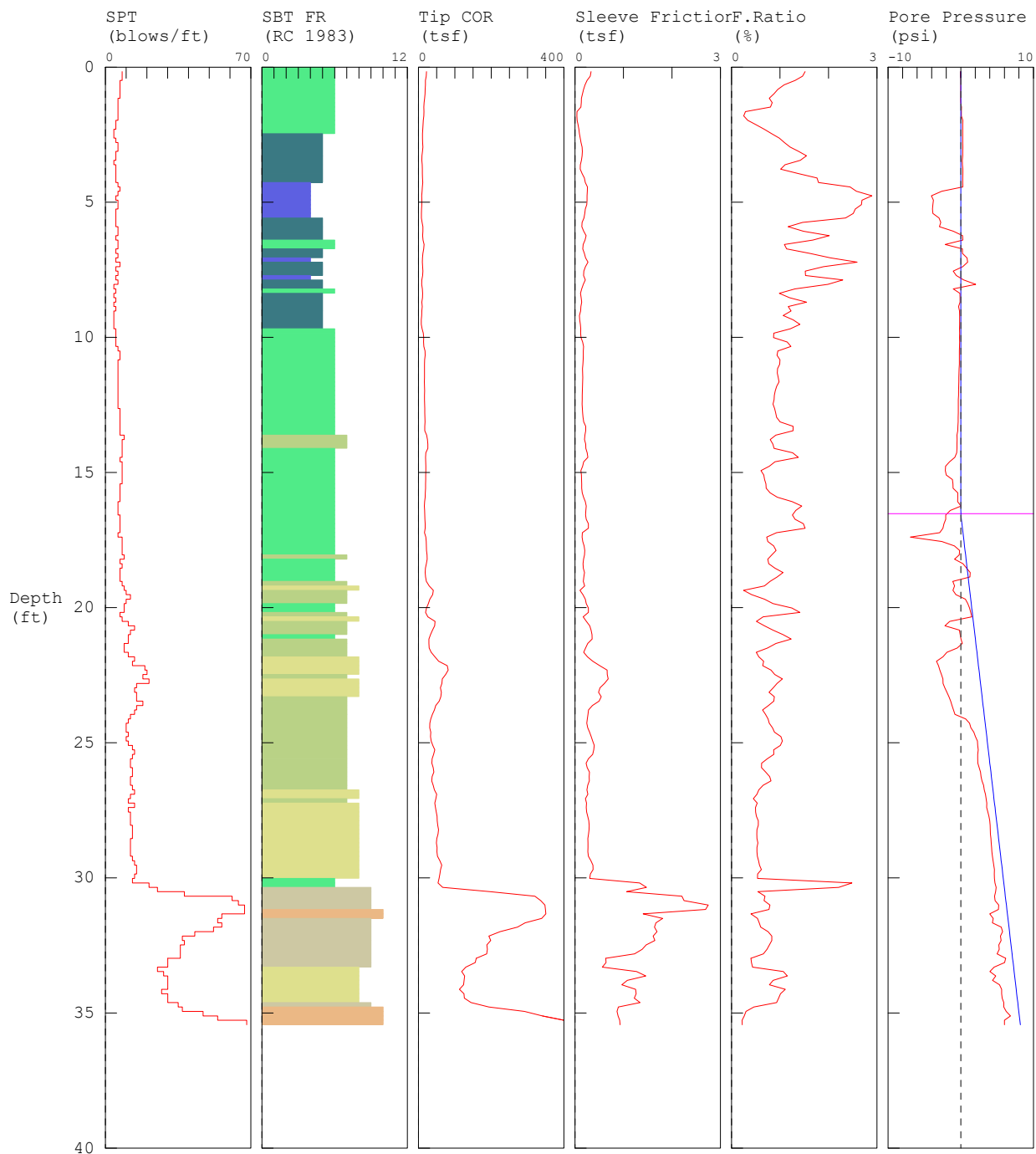
COMMENT: GeoDesign / CPT-3 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 10:33:34 AM



GeoDesign / CPT-4 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
 CONE ID: DDG1296
 HOLE NUMBER: CPT-4
 TEST DATE: 1/13/2020 3:11:15 PM
 TOTAL DEPTH: 35.433 ft

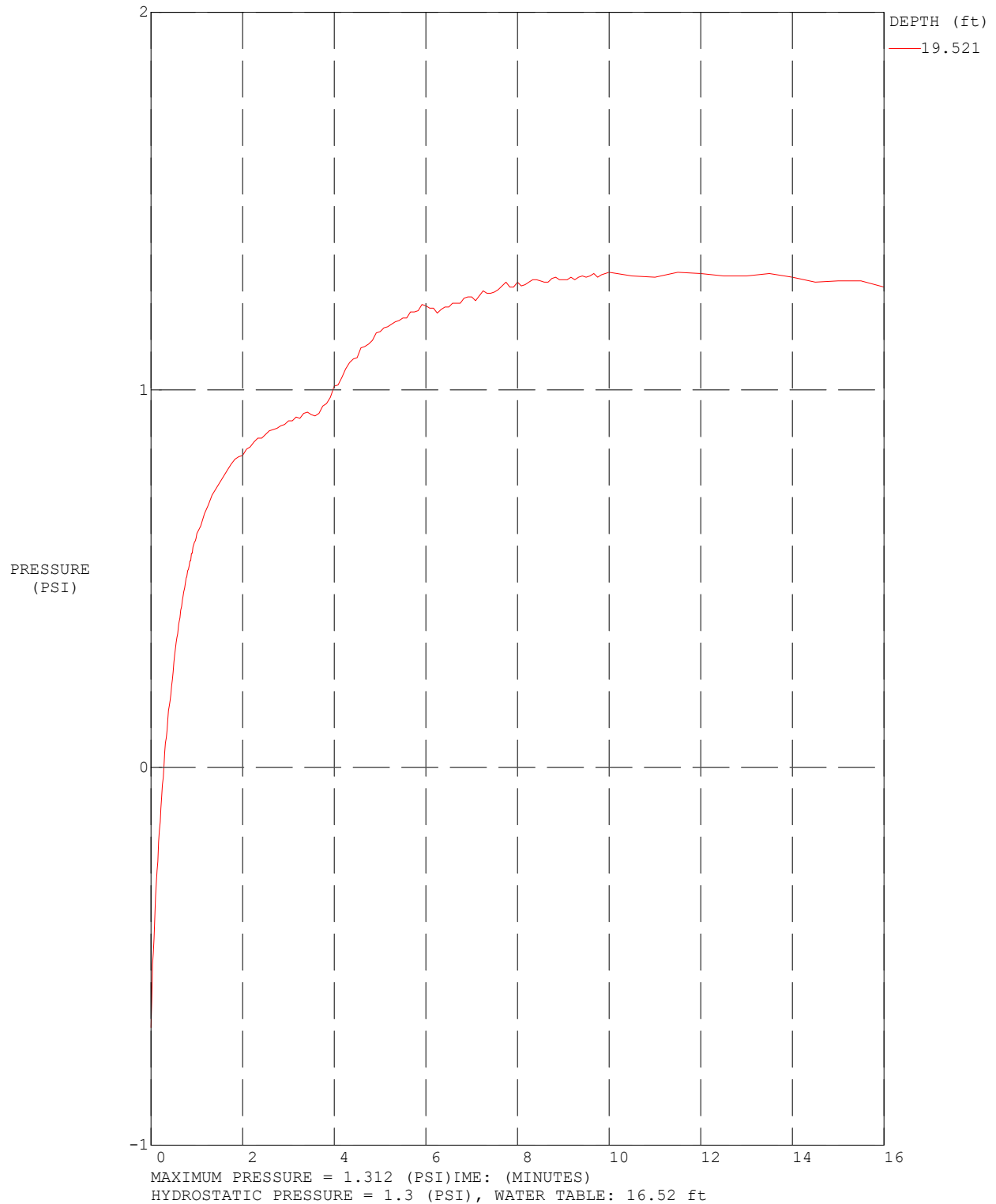


1 sensitive fine grained clay	4 silty clay to clay	7 silty sand to sandy sand	10 gravelly sand to sand
2 organic material	5 clayey silt to silt	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey sand	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

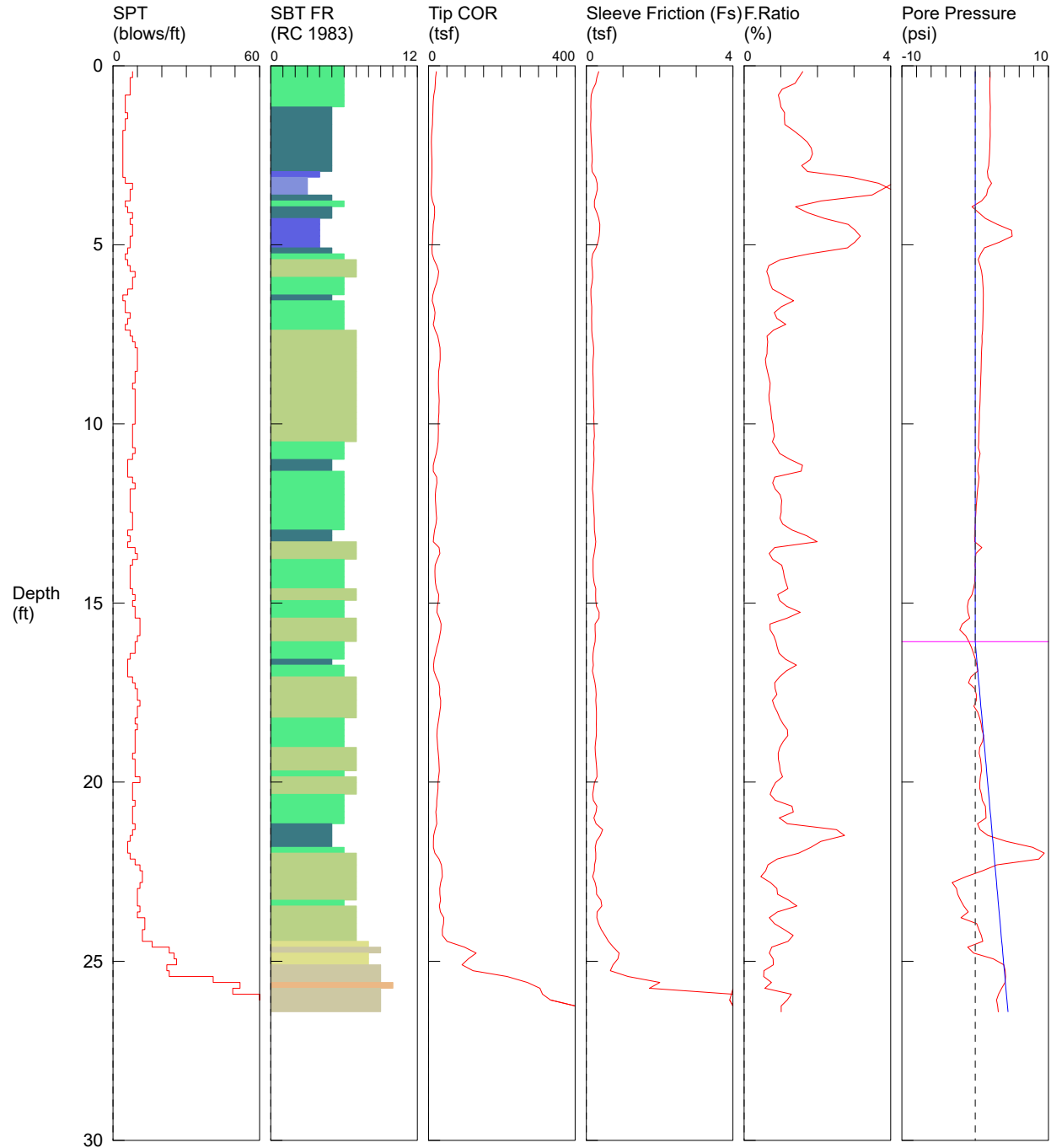
COMMENT: GeoDesign / CPT-4 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 3:11:15 PM



GeoDesign / CPT-5 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
 CONE ID: DDG1296
 HOLE NUMBER: CPT-5
 TEST DATE: 1/14/2020 8:44:26 AM
 TOTAL DEPTH: 26.411 ft

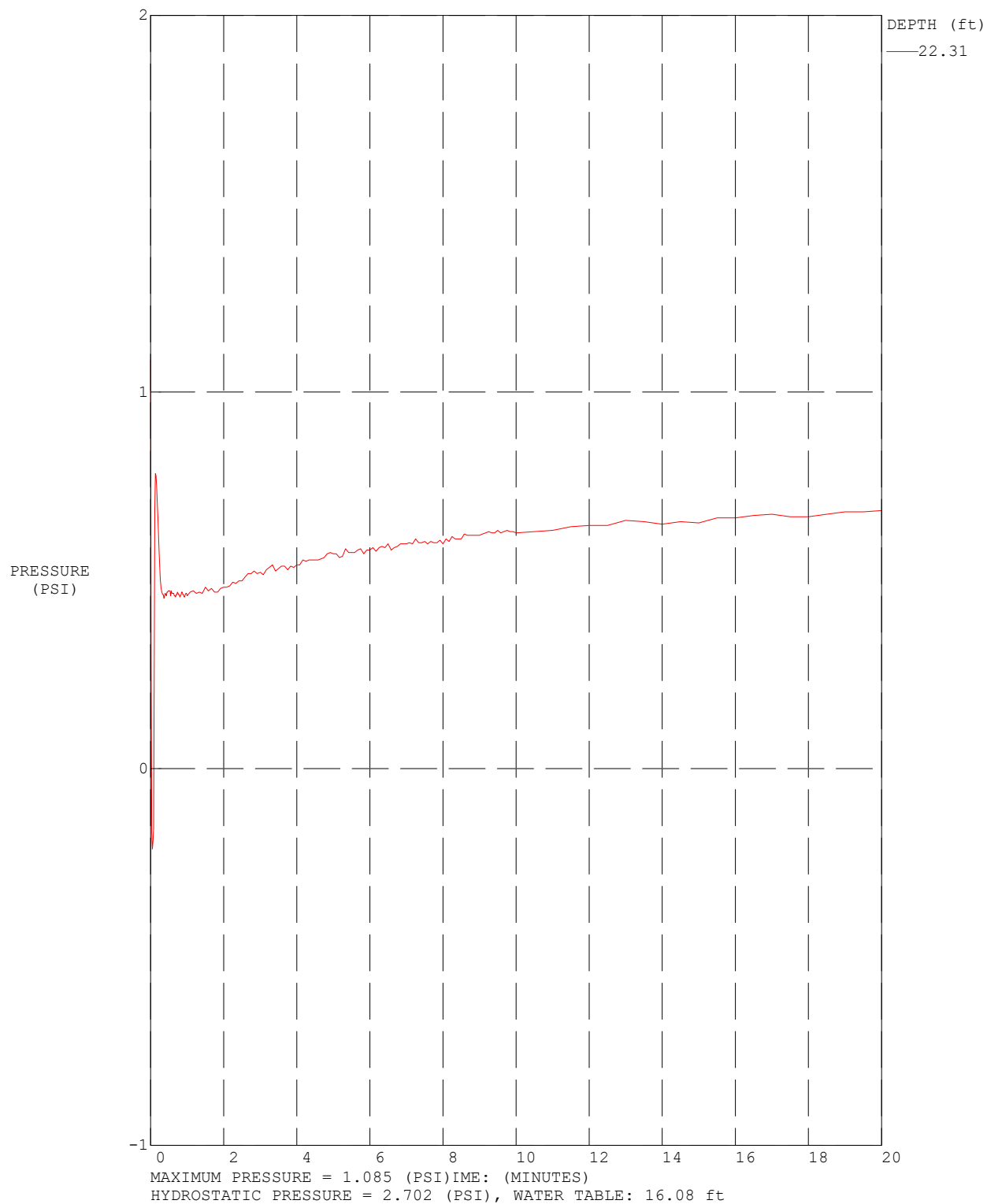


1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

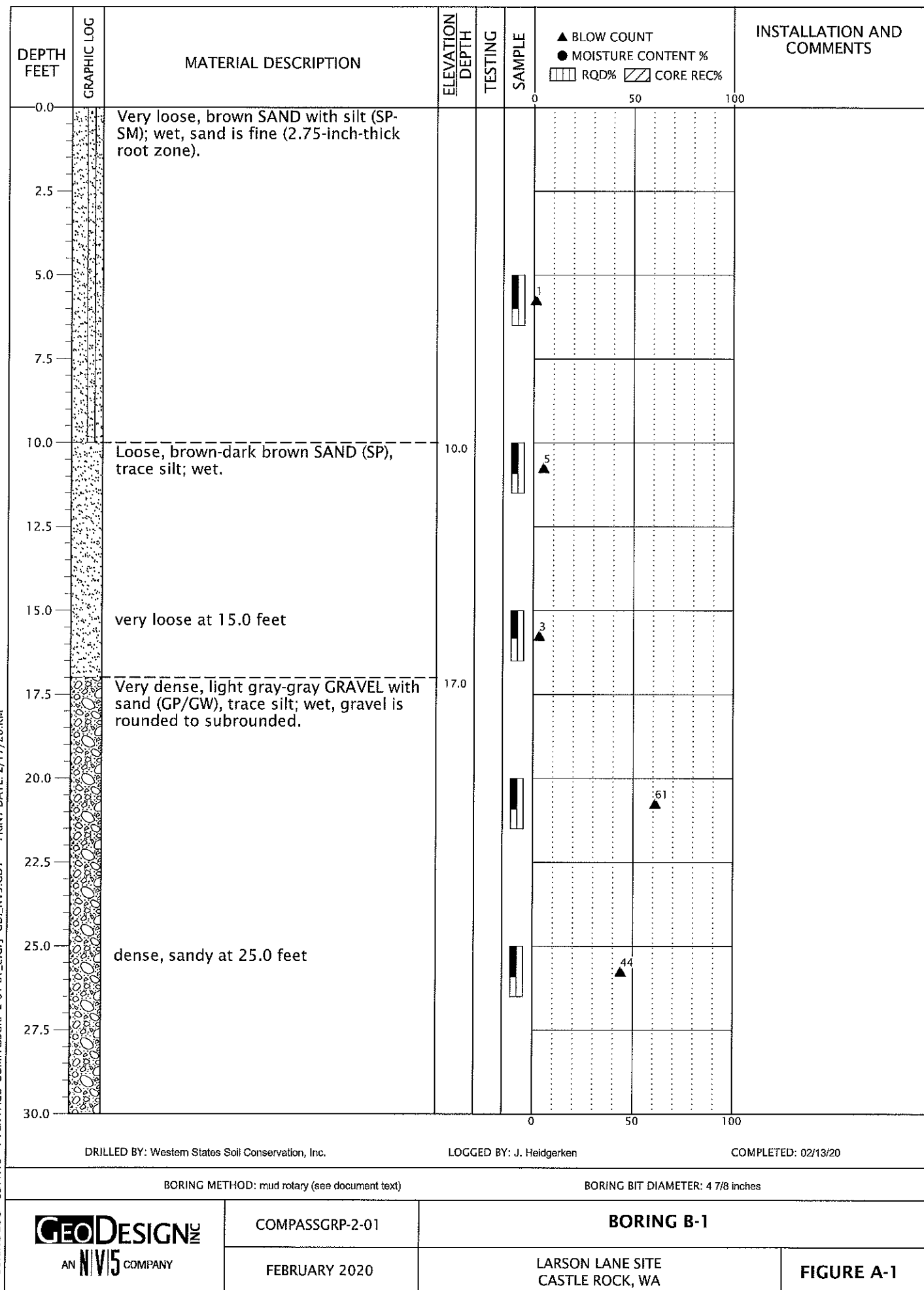
*SBT/SPT CORRELATION: UBC-1983

COMMENT: GeoDesign / CPT-5 / SW Larson Lane Castle Rock

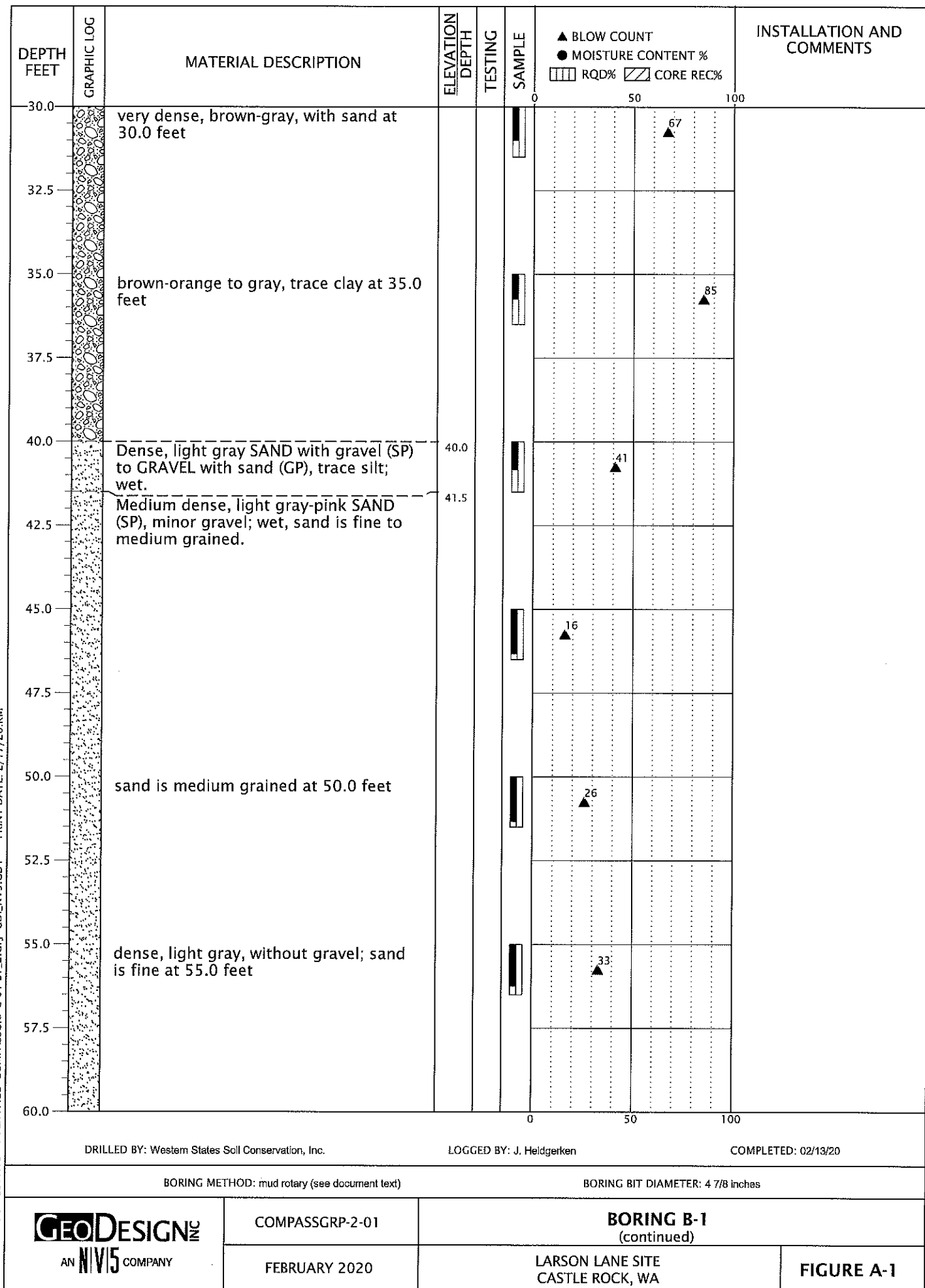
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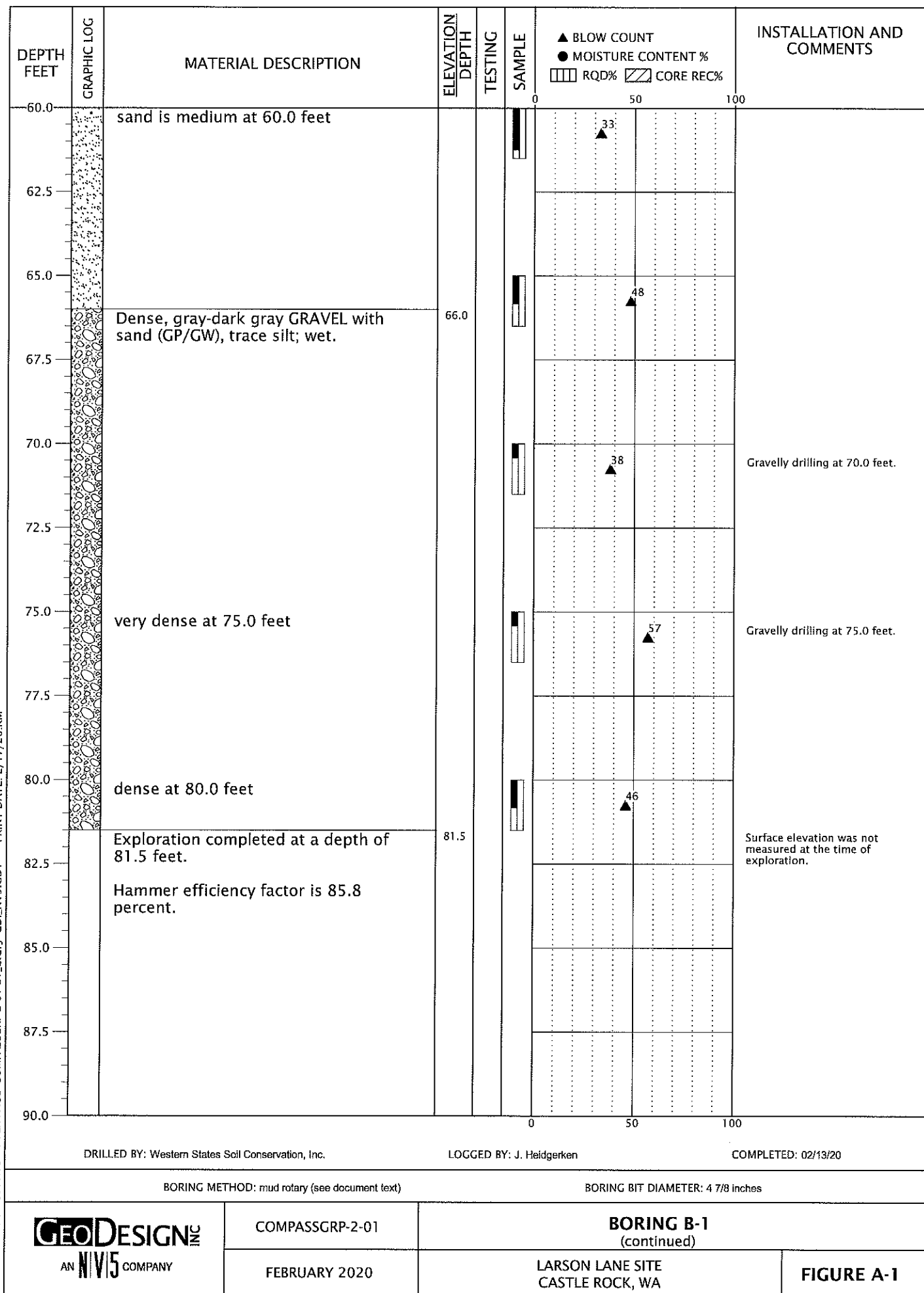
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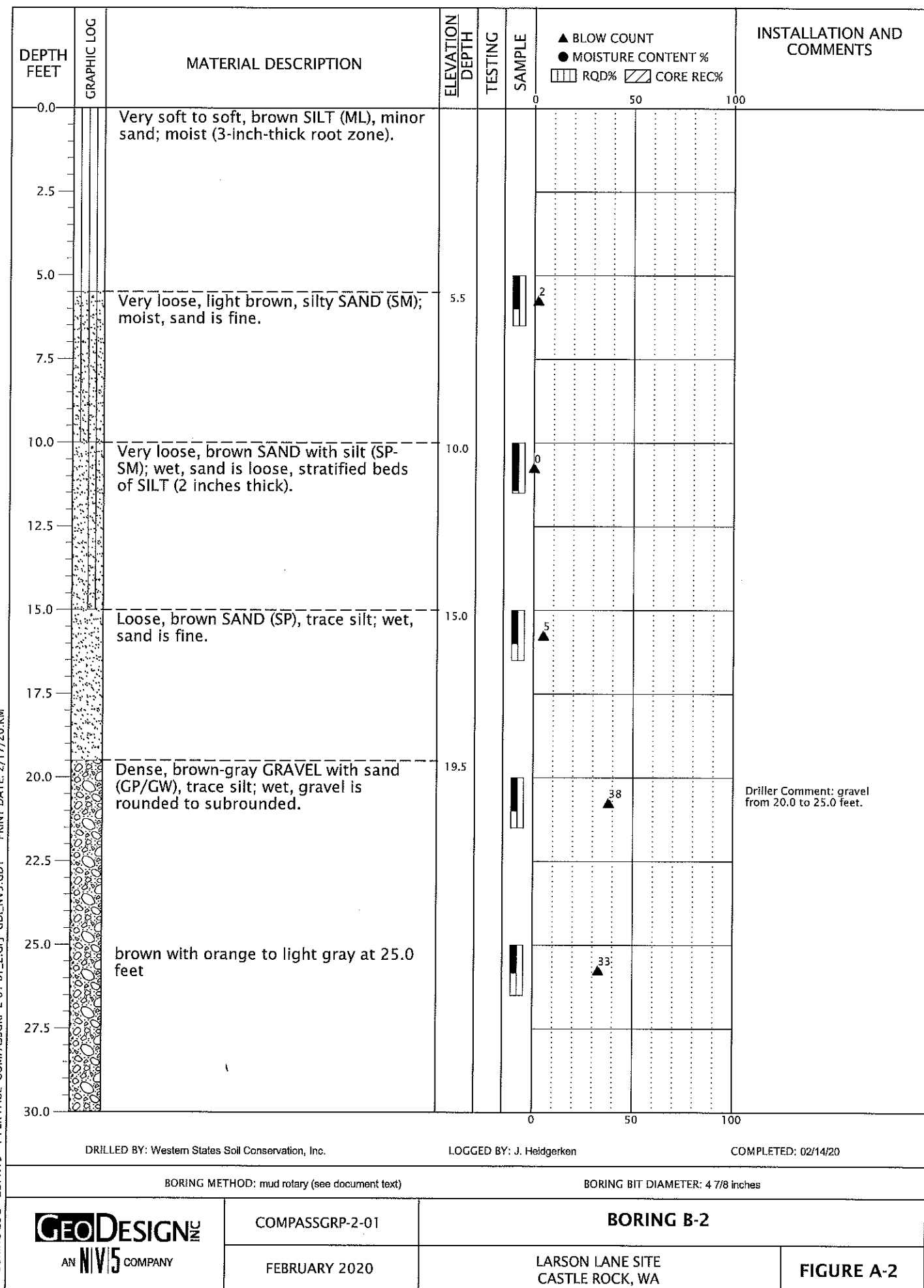
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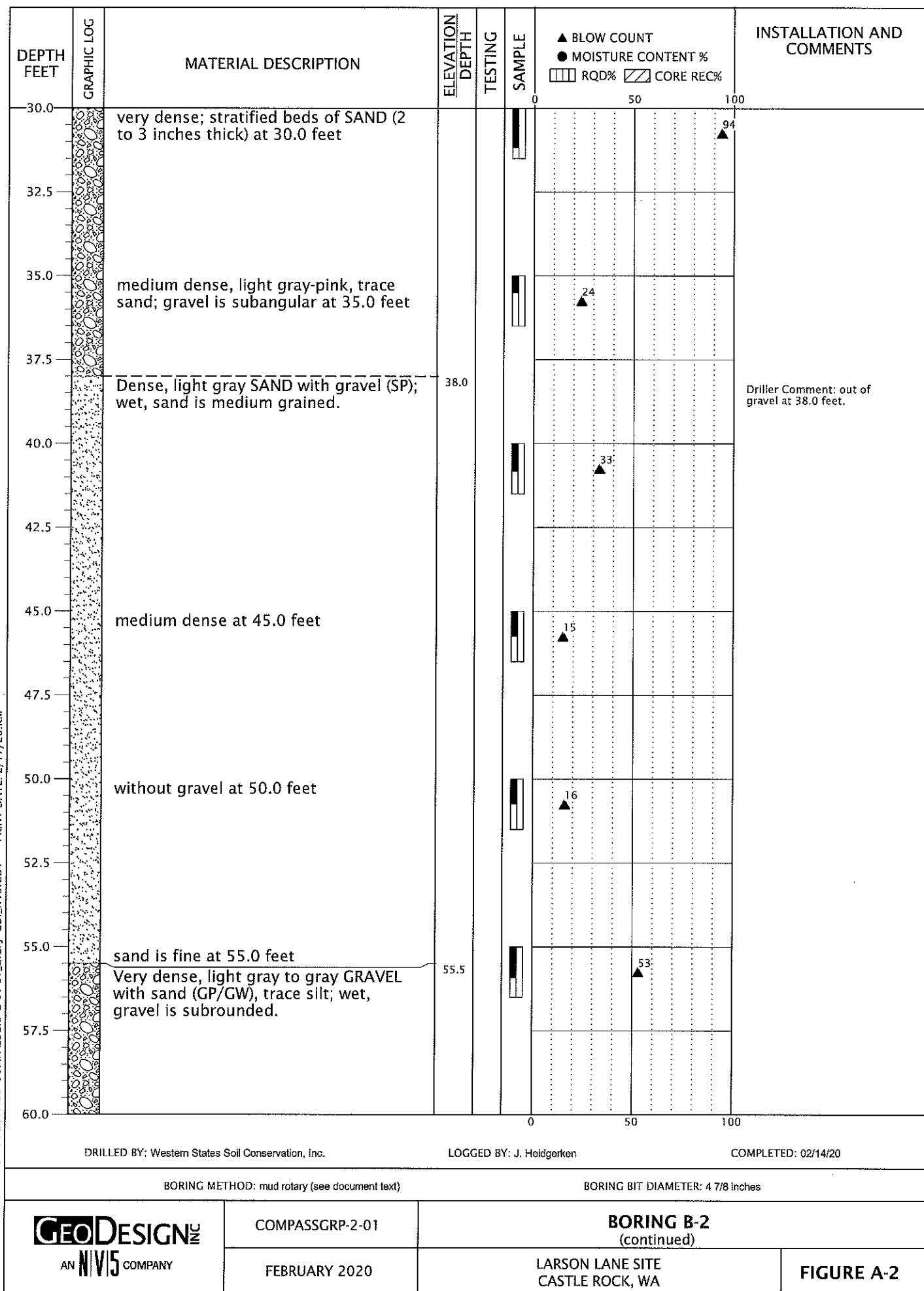
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BORING LOG - CDI-HV5 - 1 PER PAGE COMPASSGRP-2-01-81-2.GPJ GDLNV5.GDT PRINT DATE: 2/17/20:KM



BORING LOG - CDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20-KM



BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-BT_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20-KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % □ RQD% ▨ CORE REC%	INSTALLATION AND COMMENTS
60.0		(continued from previous page)					
60.5		Medium dense, light gray-gray SAND (SP), trace silt; wet, sand is fine to medium.	60.5			29	
62.5							
63.5		Medium stiff, gray SILT (ML), some clay, trace organics (woody debris); moist, woody debris is less than 0.125-inch thick.	63.5			6	
65.0							
67.5							
70.0		stiff, trace clay at 70.0 feet				10	
72.5							
75.0		stiff to very stiff, gray-brown, without clay; laminated beds of organics at 75.0 feet				15	
77.5							
80.0		stiff at 80.0 feet				10	
81.5		Exploration completed at a depth of 81.5 feet. Hammer efficiency factor is 85.8 percent.	81.5				Surface elevation was not measured at the time of exploration.
82.5							
85.0							
87.5							
90.0							
DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/14/20							
BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches							
GEO DESIGN INC. AN NVIS COMPANY		COMPASSGRP-2-01	BORING B-2 (continued)				
		FEBRUARY 2020	LARSON LANE SITE CASTLE ROCK, WA				FIGURE A-2

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT %	COMMENTS
0.0					050100		
0.8		Loose, dark brown, silty SAND (SM), trace organics; moist to wet, sand is fine (3-inch-thick root zone).	0.8		☒		
2.5		Loose, brown SAND with silt (SP-SM), trace organics; moist, sand is fine. without organics at 1.5 feet			☒		
5.0							
7.5							
10.0		Loose, brown SAND (SP), trace silt; wet, sand is medium.	10.0		☒		Severe caving observed at 9.5 feet. Rapid groundwater seepage observed at 10.5 feet.
12.5		Exploration completed at a depth of 12.5 feet.	12.5				Surface elevation was not measured at the time of exploration.
15.0							
17.5							
20.0					050100		
EXCAVATED BY: Tapani, Inc.		LOGGED BY: J. Guenther		COMPLETED: 01/14/20			
EXCAVATION METHOD: mini excavator (see document text)							
GEO DESIGN AN NV5 COMPANY		COMPASSGRP-2-01	TEST PIT TP-1				
		MARCH 2020	LARSON LANE SITE CASTLE ROCK, WA			FIGURE A-3	

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT %	COMMENTS
0.0		Loose, dark brown, silty SAND (SM), trace organics; moist, sand is fine (3-inch-thick root zone).			0	50	100
1.5		Loose, light brown SAND with silt (SP-SM), trace organics; moist, sand is fine.	1.5		0	50	100
2.5		without organics at 2.5 feet			0	50	100
5.0					0	50	100
7.5					0	50	100
10.0					0	50	100
11.5		Loose, brown SAND (SP), trace silt; moist, sand is medium.	11.5		0	50	100
13.0		Exploration completed at a depth of 13.0 feet.	13.0		0	50	100
15.0					0	50	100
17.5					0	50	100
20.0					0	50	100
EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20							
EXCAVATION METHOD: mini excavator (see document text)							
GEO DESIGN AN NV5 COMPANY		COMPASSGRP-2-01	TEST PIT TP-2				
		MARCH 2020	LARSON LANE SITE CASTLE ROCK, WA				FIGURE A-4

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI-NV5.GDT PRINT DATE: 3/3/20KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT %	COMMENTS
0.0		Medium dense, dark brown SAND with silt (SP-SM), trace gravel and organics; moist to wet, sand is fine to coarse, gravel is fine and subrounded (4-inch-thick root zone). gray-brown, minor gravel; sand is medium to coarse at 0.4 foot without organics at 1.5 feet			0	50	100
2.5							Minor caving observed between 1.0 and 4.0 feet.
5.0		gray at 5.5 feet					
7.5							
10.0							Slow groundwater seepage observed at 9.0 feet.
10.5		Stiff, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	10.5				
11.5		Exploration completed at a depth of 11.5 feet.	11.5				Surface elevation was not measured at the time of exploration.
12.5							
15.0							
17.5							
20.0							
EXCAVATED BY: Tapani, Inc.		LOGGED BY: J. Guenther		COMPLETED: 01/14/20			
EXCAVATION METHOD: mini excavator (see document text)							
GEO DESIGN AN NV5 COMPANY		COMPASSGRP-2-01	TEST PIT TP-3				
		MARCH 2020	LARSON LANE SITE CASTLE ROCK, WA				FIGURE A-5

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT %	COMMENTS
0.0		Very loose to loose, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is medium to coarse.				050100	Severe caving observed from 0.0 to 10.5 feet.
2.5		without organics at 1.5 feet			☒		
5.0							
7.5							
10.0		gray at 9.5 feet			☒		Slow groundwater seepage observed at 10.0 feet.
10.5		Medium stiff, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	10.5		☒		
12.0		Exploration completed at a depth of 12.0 feet.	12.0				Surface elevation was not measured at the time of exploration.
12.5							
15.0							
17.5							
20.0						050100	
EXCAVATED BY: Tapani, Inc.		LOGGED BY: J. Guenther		COMPLETED: 01/14/20			
EXCAVATION METHOD: mini excavator (see document text)							
 AN NVIS COMPANY		COMPASSGRP-2-01		TEST PIT TP-4			
		MARCH 2020		LARSON LANE SITE CASTLE ROCK, WA		FIGURE A-6	

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT %	COMMENTS
0.0		Loose, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is fine to coarse, gravel is fine to coarse and subrounded (4-inch-thick root zone). without organics at 1.5 feet				0 50 100	Severe caving observed from 0.0 to 8.0 feet.
2.5					☒		
5.0							
7.5		Soft to very soft, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	7.5		☒		Numerous sticks and roots from 8.0 to 9.0 feet.
10.0							
12.5							Moderate groundwater seepage observed at 12.0 feet.
13.0		Exploration completed at a depth of 13.0 feet.	13.0				Surface elevation was not measured at the time of exploration.
15.0							
17.5							
20.0						0 50 100	
EXCAVATED BY: Tapani, Inc.		LOGGED BY: J. Guenther		COMPLETED: 01/14/20			
EXCAVATION METHOD: mini excavator (see document text)							
 AN NVIS COMPANY		COMPASSGRP-2-01		TEST PIT TP-5			
		MARCH 2020		LARSON LANE SITE CASTLE ROCK, WA		FIGURE A-7	

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT %	COMMENTS
0.0		Medium dense to dense, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is fine to coarse, gravel is fine to coarse and subrounded.				050100	Severe caving observed from 0.0 to 11.0 feet.
2.5		brown, without gravel and organics; sand is fine at 3.0 feet			☒		
5.0					☒		
7.5							
10.0		Loose, dark brown SAND (SP), trace silt; wet, sand is medium.	10.0		☒		Rapid groundwater seepage observed at 10.0 feet.
		Exploration terminated at a depth of 11.0 feet due to caving.	11.0		☒		Surface elevation was not measured at the time of exploration.
12.5							
15.0							
17.5							
20.0						050100	
EXCAVATED BY: Tapani, Inc.		LOGGED BY: J. Guenther		COMPLETED: 01/14/20			
EXCAVATION METHOD: mini excavator (see document text)							
 AN NVI5 COMPANY		COMPASSGRP-2-01		TEST PIT TP-6			
		MARCH 2020		LARSON LANE SITE CASTLE ROCK, WA		FIGURE A-8	

APPENDIX D

REPORT LIMITATIONS AND IMPORTANT INFORMATION

Date: March 30, 2023
Project: Landing on the Cowlitz
Castle Rock, Washington

Geotechnical and Environmental Report Limitations and Important Information

Report Purpose, Use, and Standard of Care

This report has been prepared in accordance with standard fundamental principles and practices of geotechnical engineering and/or environmental consulting, and in a manner consistent with the level of care and skill typical of currently practicing local engineers and consultants. This report has been prepared to meet the specific needs of specific individuals for the indicated site. It may not be adequate for use by other consultants, contractors, or engineers, or if change in project ownership has occurred. It should not be used for any other reason than its stated purpose without prior consultation with Columbia West Engineering, Inc. (Columbia West). It is a unique report and not applicable for any other site or project. If site conditions are altered, or if modifications to the project description or proposed plans are made after the date of this report, it may not be valid. Columbia West cannot accept responsibility for use of this report by other individuals for unauthorized purposes, or if problems occur resulting from changes in site conditions for which Columbia West was not aware or informed.

Report Conclusions and Preliminary Nature

This geotechnical or environmental report should be considered preliminary and summary in nature. The recommendations contained herein have been established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. The exploration and associated laboratory analysis of collected representative samples identifies soil conditions at specific discreet locations. It is assumed that these conditions are indicative of actual conditions throughout the subject property. However, soil conditions may differ between tested locations at different seasonal times of the year, either by natural causes or human activity. Distinction between soil types may be more abrupt or gradual than indicated on the soil logs. This report is not intended to stand alone without understanding of concomitant instructions, correspondence, communication, or potential supplemental reports that may have been provided to the client.

Because this report is based upon observations obtained at the time of exploration, its adequacy may be compromised with time. This is particularly relevant in the case of natural disasters, earthquakes, floods, or other significant events. Report conclusions or interpretations may also be subject to revision if significant development or other manmade impacts occur within or in proximity to the subject property. Groundwater conditions, if presented in this report, reflect observed conditions at the time of investigation. These conditions may change annually, seasonally or as a result of adjacent development.

Additional Investigation and Construction QA/QC

Columbia West should be consulted prior to construction to assess whether additional investigation above and beyond that presented in this report is necessary. Even slight variations in soil or site conditions may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions do not differ materially or significantly from the interpreted conditions utilized for preparation of this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Actual subsurface conditions are more readily observed and discerned during the earthwork phase of construction when soils are exposed. Columbia West cannot accept responsibility for deviations from recommendations described in this report or future

performance of structural facilities if another consultant is retained during the construction phase or Columbia West is not engaged to provide construction observation to the full extent recommended.

Collected Samples

Uncontaminated samples of soil or rock collected in connection with this report will be retained for thirty days. Retention of such samples beyond thirty days will occur only at client's request and in return for payment of storage charges incurred. All contaminated or environmentally impacted materials or samples are the sole property of the client. Client maintains responsibility for proper disposal.

Report Contents

This geotechnical or environmental report should not be copied or duplicated unless in full, and even then only under prior written consent by Columbia West, as indicated in further detail in the following text section entitled *Report Ownership*. The recommendations, interpretations, and suggestions presented in this report are only understandable in context of reference to the whole report. Under no circumstances should the soil boring or test pit excavation logs, monitor well logs, or laboratory analytical reports be separated from the remainder of the report. The logs or reports should not be redrawn or summarized by other entities for inclusion in architectural or civil drawings, or other relevant applications.

Report Limitations for Contractors

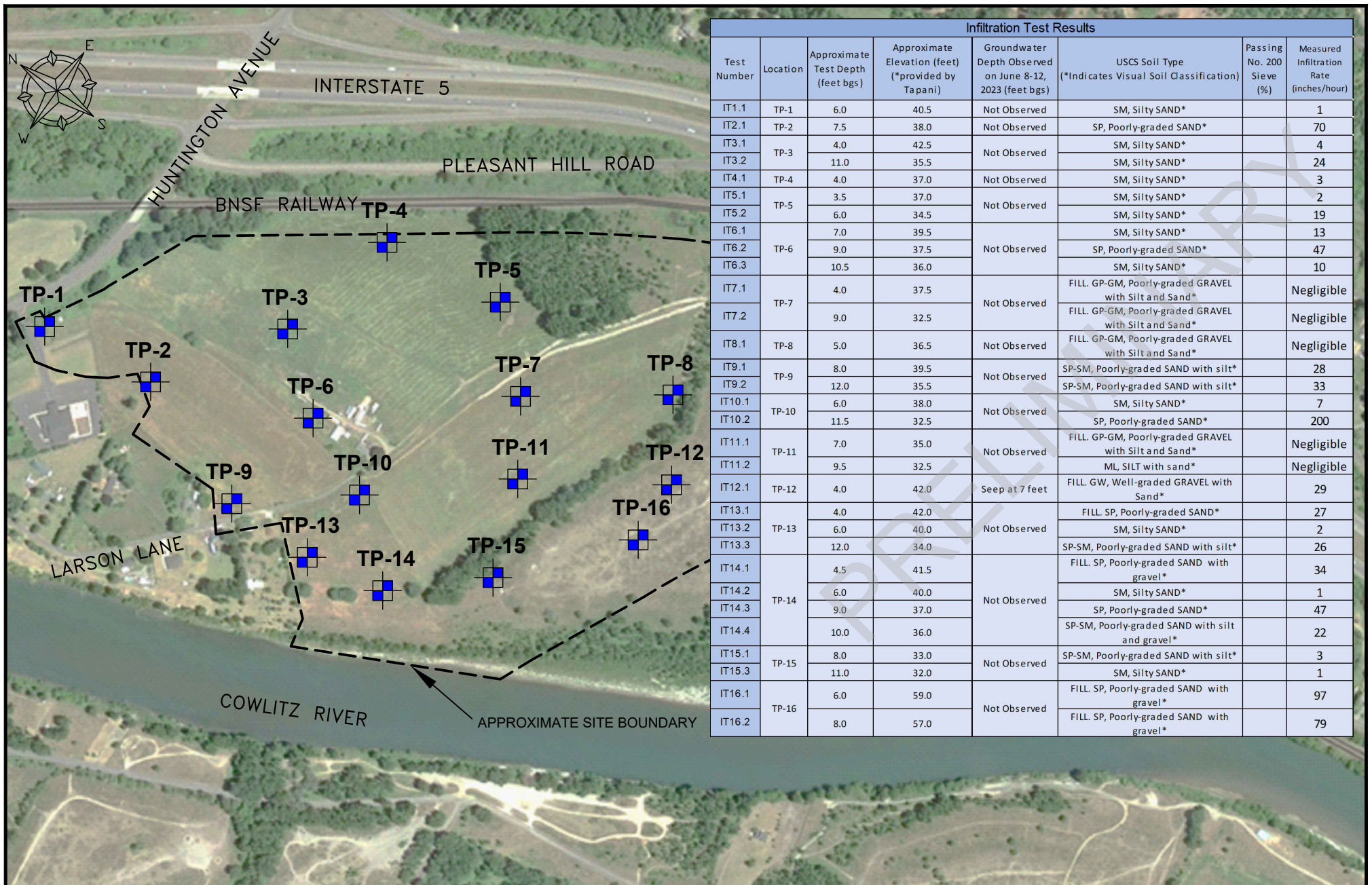
Geotechnical or environmental reports, unless otherwise specifically noted, are not prepared for the purpose of developing cost estimates or bids by contractors. The extent of exploration or investigation conducted as part of this report is usually less than that necessary for contractor's needs. Contractors should be advised of these report limitations, particularly as they relate to development of cost estimates. Contractors may gain valuable information from this report, but should rely upon their own interpretations as to how subsurface conditions may affect cost, feasibility, accessibility and other components of the project work. If believed necessary or relevant, contractors should conduct additional exploratory investigation to obtain satisfactory data for the purposes of developing adequate cost estimates. Clients or developers cannot insulate themselves from attendant liability by disclaiming accuracy for subsurface ground conditions without advising contractors appropriately and providing the best information possible to limit potential for cost overruns, construction problems, or misunderstandings.

Report Ownership

Columbia West retains the ownership and copyright property rights to this entire report and its contents, which may include, but may not be limited to, figures, text, logs, electronic media, drawings, laboratory reports, and appendices. This report was prepared solely for the client, and other relevant approved users or parties, and its distribution must be contingent upon prior express written consent by Columbia West. Furthermore, client or approved users may not use, lend, sell, copy, or distribute this document without express written consent by Columbia West. Client does not own nor have rights to electronic media files that constitute this report, and under no circumstances should said electronic files be distributed or copied. Electronic media is susceptible to unauthorized manipulation or modification, and may not be reliable.

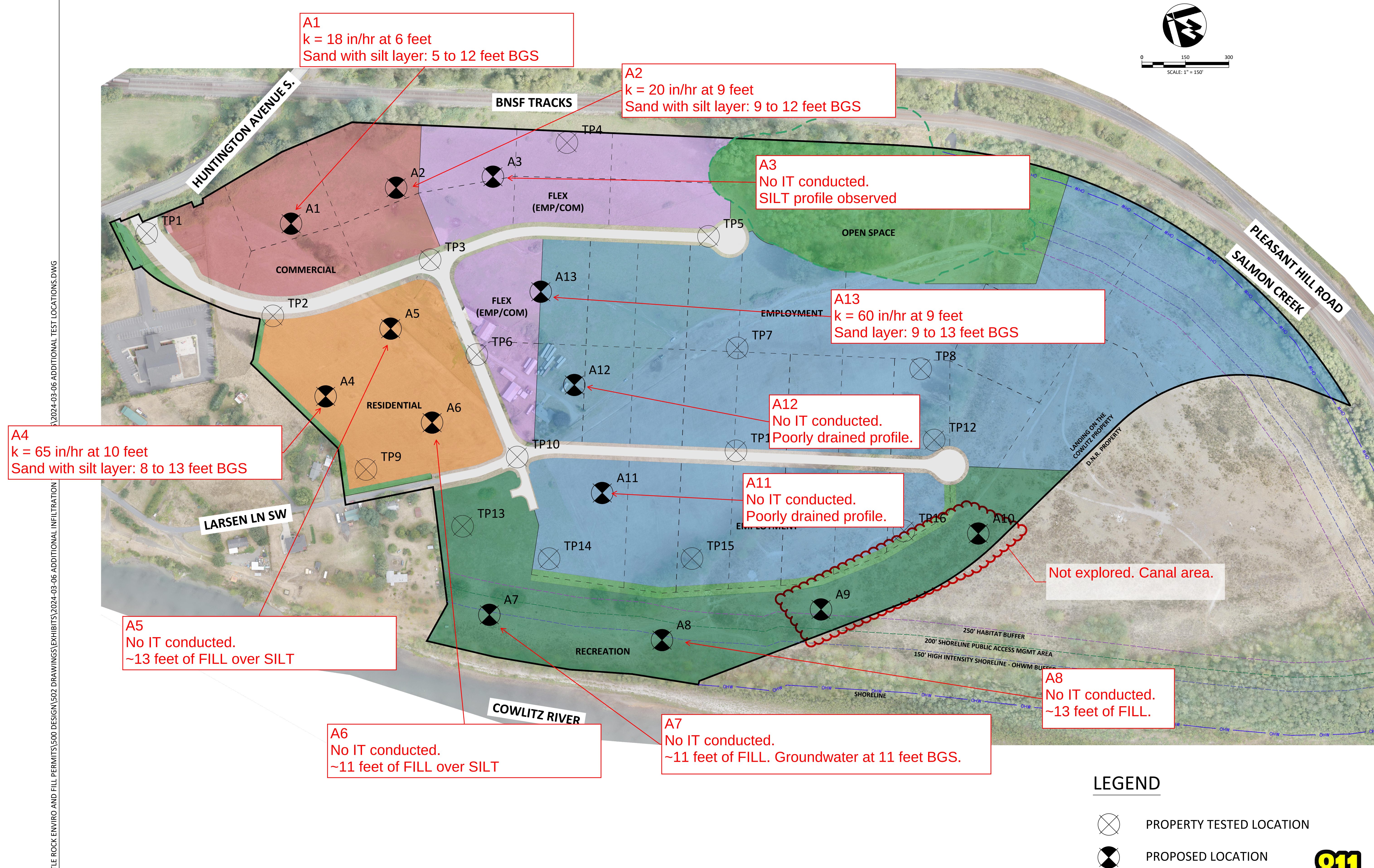
Consultant Responsibility

Geotechnical and environmental engineering and consulting is much less exact than other scientific or engineering disciplines, and relies heavily upon experience, judgment, interpretation, and opinion often based upon media (soils) that are variable, anisotropic, and non-homogenous. This often results in unrealistic expectations, unwarranted claims, and uninformed disputes against a geotechnical or environmental consultant. To reduce potential for these problems and assist relevant parties in better understanding of risk, liability, and responsibility, geotechnical and environmental reports often provide definitive statements or clauses defining and outlining consultant responsibility. The client is encouraged to read these statements carefully and request additional information from Columbia West if necessary.



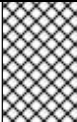
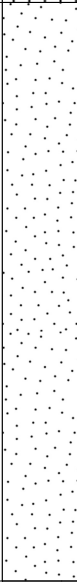
Test Number	Location	Approximate Test Depth (feet bgs)	Approximate Elevation (feet) (*provided by Tapani)	Groundwater Depth Observed on June 8-12, 2023 (feet bgs)	USCS Soil Type (*Indicates Visual Soil Classification)	Passing No. 200 Sieve (%)	Measured Infiltration Rate (inches/hour)
IT1.1	TP-1	6.0	40.5	Not Observed	SM, Silty SAND*		1
IT2.1	TP-2	7.5	38.0	Not Observed	SP, Poorly-graded SAND*		70
IT3.1	TP-3	4.0	42.5	Not Observed	SM, Silty SAND*		4
IT3.2		11.0	35.5		SM, Silty SAND*		24
IT4.1	TP-4	4.0	37.0	Not Observed	SM, Silty SAND*		3
IT5.1	TP-5	3.5	37.0	Not Observed	SM, Silty SAND*		2
IT5.2		6.0	34.5		SM, Silty SAND*		19
IT6.1	TP-6	7.0	39.5	Not Observed	SM, Silty SAND*		13
IT6.2		9.0	37.5		SP, Poorly-graded SAND*		47
IT6.3		10.5	36.0		SM, Silty SAND*		10
IT7.1	TP-7	4.0	37.5	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT7.2		9.0	32.5		FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT8.1	TP-8	5.0	36.5	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT9.1	TP-9	8.0	39.5	Not Observed	SP-SM, Poorly-graded SAND with silt*		28
IT9.2		12.0	35.5		SP-SM, Poorly-graded SAND with silt*		33
IT10.1	TP-10	6.0	38.0	Not Observed	SM, Silty SAND*		7
IT10.2		11.5	32.5		SP, Poorly-graded SAND*		200
IT11.1	TP-11	7.0	35.0	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT11.2		9.5	32.5		ML, SILT with sand*		Negligible
IT12.1	TP-12	4.0	42.0	Seep at 7 feet	FILL. GW, Well-graded GRAVEL with Sand*		29
IT13.1	TP-13	4.0	42.0	Not Observed	FILL. SP, Poorly-graded SAND*		27
IT13.2		6.0	40.0		SM, Silty SAND*		2
IT13.3		12.0	34.0		SP-SM, Poorly-graded SAND with silt*		26
IT14.1	TP-14	4.5	41.5	Not Observed	FILL. SP, Poorly-graded SAND with gravel*		34
IT14.2		6.0	40.0		SM, Silty SAND*		1
IT14.3		9.0	37.0		SP, Poorly-graded SAND*		47
IT14.4		10.0	36.0		SP-SM, Poorly-graded SAND with silt and gravel*		22
IT15.1	TP-15	8.0	33.0	Not Observed	SP-SM, Poorly-graded SAND with silt*		3
IT15.3		11.0	32.0		SM, Silty SAND*		1
IT16.1	TP-16	6.0	59.0	Not Observed	FILL. SP, Poorly-graded SAND with gravel*		97
IT16.2		8.0	57.0		FILL. SP, Poorly-graded SAND with gravel*		79

 TEST PIT WITH INFILTRATION TESTING

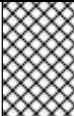
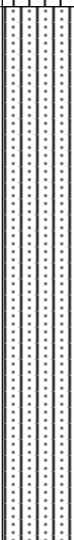
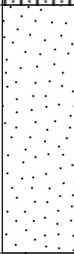


PRELIMINARY RESULTS FROM TESTING CONDUCTED ON MARCH 13, 2024

TEST PIT LOG

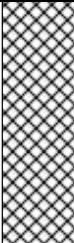
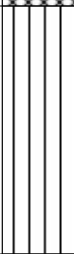
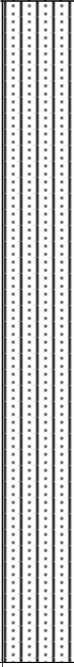
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PROJECT LOCATION Castle Rock, Washington						CONTRACTOR Tapani		EQUIPMENT CAT 215 Excavator		ENGINEER MAC	
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Not Observed		START TIME 0800	
FINISH TIME 0905											
Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0	TP17.1					FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Orange-tan sandy SILT, moist to wet, medium dense, sand is fine.					
5				SP-SM		Light brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
10											
15						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
Preliminary 03/20/2024 3:58:36 PM											

TEST PIT LOG

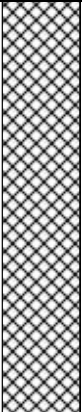
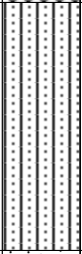
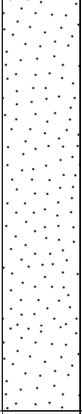
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PROJECT LOCATION Castle Rock, Washington						CONTRACTOR Tapani		EQUIPMENT CAT 215 Excavator		ENGINEER MAC	
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Not Observed		START TIME 0905	
FINISH TIME 0935											
Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0	TP18.1					FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Gray SILT with sand, moist, soft, sand is fine.					
				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-to medium-grained and subangular.					
5											
				SP-SM		Light brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
10						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
15											

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TEST PIT LOG

PROJECT NAME Landing at Cowlitz						CLIENT CT6, LLC		PROJECT NO. 22310		TEST PIT NO. TP-19	
PROJECT LOCATION Castle Rock, Washington						CONTRACTOR Tapani		EQUIPMENT CAT 215 Excavator		ENGINEER MAC	
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Not Observed		START TIME 1010	
FINISH TIME 1040											
Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						Organic strippings.					
5				ML		Brown SILT, moist, soft, low to medium plasticity.					
10				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
15						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					
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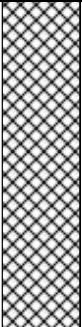
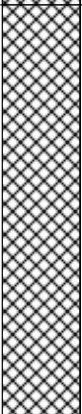
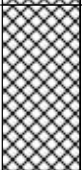
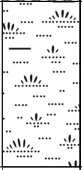
TEST PIT LOG

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PROJECT LOCATION Castle Rock, Washington						CONTRACTOR Tapani		EQUIPMENT CAT 215 Excavator		ENGINEER MAC	
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Not Observed		START TIME 0935	
FINISH TIME 1010											
Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0	TP20.1					FILL. Gray poorly-graded SAND and gravel, dense.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
10				SP-SM		Gray and brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
15						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					
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TEST PIT LOG

PROJECT NAME Landing at Cowlitz						CLIENT CT6, LLC		PROJECT NO. 22310		TEST PIT NO. TP-21	
PROJECT LOCATION Castle Rock, Washington						CONTRACTOR Tapani		EQUIPMENT CAT 215 Excavator		ENGINEER MAC	
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Not Observed		START TIME 1040	
FINISH TIME 1105											
Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
10						FILL. Gray poorly-graded SAND and gravel, dense.					
				OH		Black organic SILT, moist, soft.					
15						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					
						Preliminary 03/20/2024 3:58:49 PM					

TEST PIT LOG

PROJECT NAME Landing at Cowlitz						CLIENT CT6, LLC		PROJECT NO. 22310		TEST PIT NO. TP-22	
PROJECT LOCATION Castle Rock, Washington						CONTRACTOR Tapani		EQUIPMENT CAT 215 Excavator		ENGINEER MAC	
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Not Observed		START TIME 1105	
FINISH TIME 1130											
Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
10						FILL. Gray poorly-graded SAND and gravel, dense.					
				OH		Black organic SILT, moist, soft.					
15						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					
						Preliminary 03/20/2024 3:58:49 PM					

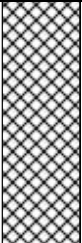
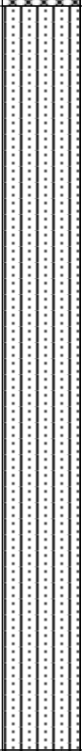
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PROJECT LOCATION Castle Rock, Washington						CONTRACTOR Tapani		EQUIPMENT CAT 215 Excavator		ENGINEER MAC		
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Observed at 11 feet BG		START TIME 1530 FINISH TIME 1500		
Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS		Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						3 inch root zone contained in 10 inches of sandy silt topsoil.						
5						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.						
10						Becomes wet.						
15						Bottom of test pit at 11 feet bgs. Groundwater encountered at 11 feet on 3/13/24.						
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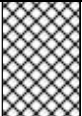
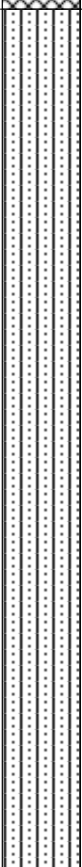
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PROJECT NAME Landing at Cowlitz						CLIENT CT6, LLC		PROJECT NO. 22310		TEST PIT NO. TP-24		
PROJECT LOCATION Castle Rock, Washington						CONTRACTOR Tapani		EQUIPMENT CAT 215 Excavator		ENGINEER MAC		
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Not Observed		START TIME 1500		
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Not Observed		FINISH TIME 1555		
Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS		Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						3 inch root zone contained in 10 inches of sandy silt topsoil.						
5						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.						
10												
15						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.						
						Preliminary 03/20/2024 3:58:49 PM						

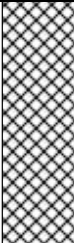
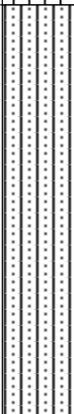
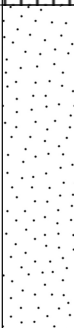
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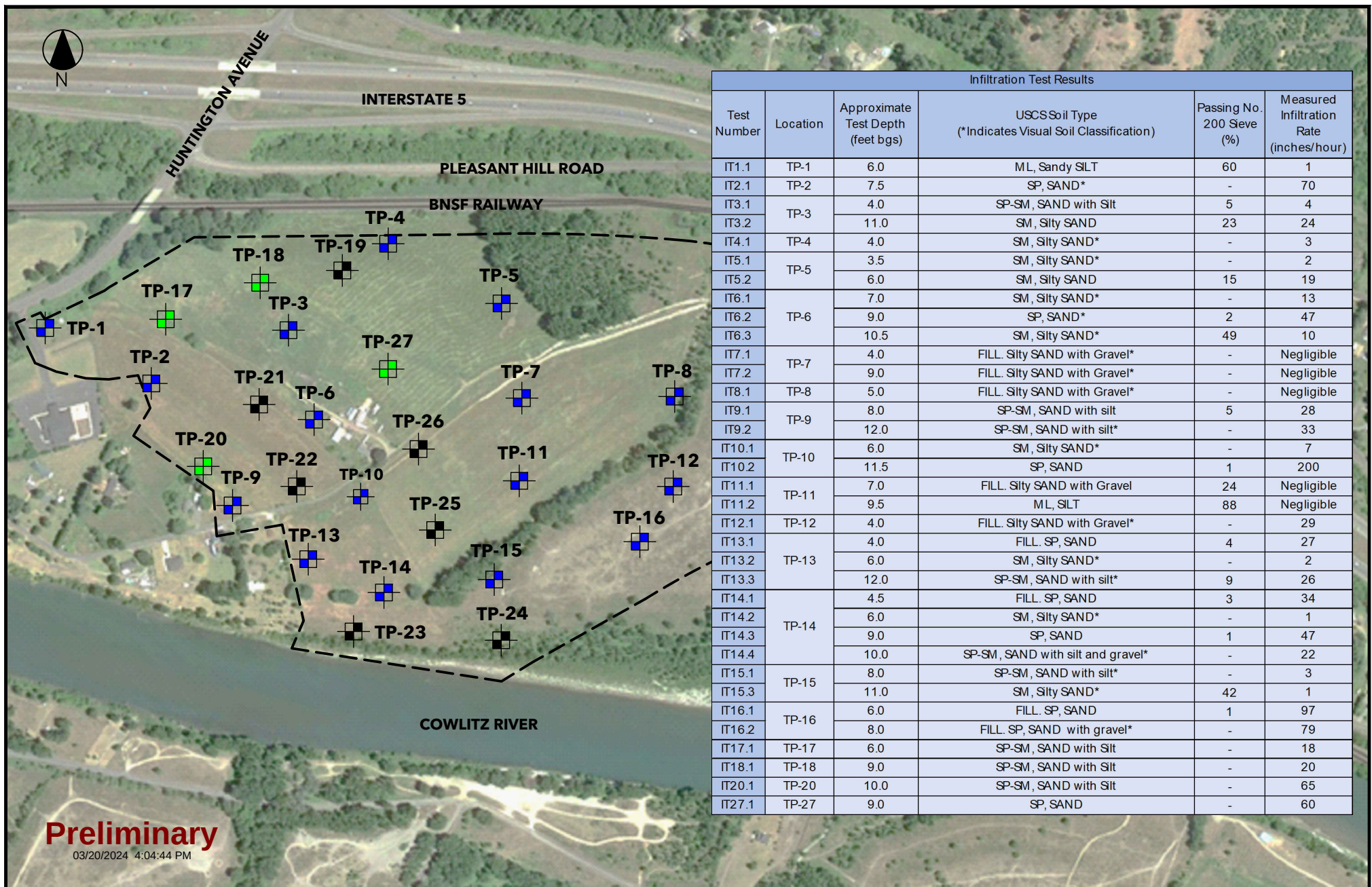
PROJECT NAME Landing at Cowlitz						CLIENT CT6, LLC		PROJECT NO. 22310		TEST PIT NO. TP-25	
PROJECT LOCATION Castle Rock, Washington						CONTRACTOR Tapani		EQUIPMENT CAT 215 Excavator		ENGINEER MAC	
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Not Observed		START TIME 1130	
FINISH TIME 1215											
Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
10											
15						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
						Preliminary 03/20/2024 3:58:49 PM					

TEST PIT LOG

PROJECT NAME Landing at Cowlitz						CLIENT CT6, LLC		PROJECT NO. 22310		TEST PIT NO. TP-26	
PROJECT LOCATION Castle Rock, Washington						CONTRACTOR Tapani		EQUIPMENT CAT 215 Excavator		ENGINEER MAC	
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Not Observed		START TIME 1245	
FINISH TIME 1330											
Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
10											
15						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					
						Preliminary 03/20/2024 3:58:49 PM					

TEST PIT LOG

PROJECT NAME Landing at Cowlitz						CLIENT CT6, LLC		PROJECT NO. 22310		TEST PIT NO. TP-27	
PROJECT LOCATION Castle Rock, Washington						CONTRACTOR Tapani		EQUIPMENT CAT 215 Excavator		ENGINEER MAC	
TEST PIT LOCATION See Figure 2						APPROX. SURFACE ELEVATION Not Surveyed		GROUNDWATER DEPTH Not Observed		START TIME 1215	
FINISH TIME 1245											
Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Orange-tan sandy SILT, moist to wet, medium dense, sand is fine.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
10	TP27.1			SP-SM		Gray and brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
15						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					
						Preliminary 03/20/2024 3:58:49 PM					



Infiltration Test Results					
Test Number	Location	Approximate Test Depth (feet bgs)	USCS Soil Type (* Indicates Visual Soil Classification)	Passing No. 200 Sieve (%)	Measured Infiltration Rate (inches/hour)
IT1.1	TP-1	6.0	ML, Sandy SILT	60	1
IT2.1	TP-2	7.5	SP, SAND*	-	70
IT3.1	TP-3	4.0	SP-SM, SAND with Silt	5	4
IT3.2		11.0	SM, Silty SAND	23	24
IT4.1	TP-4	4.0	SM, Silty SAND*	-	3
IT5.1	TP-5	3.5	SM, Silty SAND*	-	2
IT5.2		6.0	SM, Silty SAND	15	19
IT6.1	TP-6	7.0	SM, Silty SAND*	-	13
IT6.2		9.0	SP, SAND*	2	47
IT6.3		10.5	SM, Silty SAND*	49	10
IT7.1	TP-7	4.0	FILL. Silty SAND with Gravel*	-	Negligible
IT7.2		9.0	FILL. Silty SAND with Gravel*	-	Negligible
IT8.1	TP-8	5.0	FILL. Silty SAND with Gravel*	-	Negligible
IT9.1	TP-9	8.0	SP-SM, SAND with silt	5	28
IT9.2		12.0	SP-SM, SAND with silt*	-	33
IT10.1	TP-10	6.0	SM, Silty SAND*	-	7
IT10.2		11.5	SP, SAND	1	200
IT11.1	TP-11	7.0	FILL. Silty SAND with Gravel	24	Negligible
IT11.2		9.5	ML, SILT	88	Negligible
IT12.1	TP-12	4.0	FILL. Silty SAND with Gravel*	-	29
IT13.1	TP-13	4.0	FILL. SP, SAND	4	27
IT13.2		6.0	SM, Silty SAND*	-	2
IT13.3		12.0	SP-SM, SAND with silt*	9	26
IT14.1	TP-14	4.5	FILL. SP, SAND	3	34
IT14.2		6.0	SM, Silty SAND*	-	1
IT14.3		9.0	SP, SAND	1	47
IT14.4		10.0	SP-SM, SAND with silt and gravel*	-	22
IT15.1	TP-15	8.0	SP-SM, SAND with silt*	-	3
IT15.3		11.0	SM, Silty SAND*	42	1
IT16.1	TP-16	6.0	FILL. SP, SAND	1	97
IT16.2		8.0	FILL. SP, SAND with gravel*	-	79
IT17.1	TP-17	6.0	SP-SM, SAND with Silt	-	18
IT18.1	TP-18	9.0	SP-SM, SAND with Silt	-	20
IT20.1	TP-20	10.0	SP-SM, SAND with Silt	-	65
IT27.1	TP-27	9.0	SP, SAND	-	60

- - - - SITE BOUNDARY
 TEST PIT WITH INFILTRATION TEST (2023)
 TEST PIT WITH INFILTRATION TEST (2024)
 TEST PIT (2024)



HABITAT MANAGEMENT, MITIGATION AND MONITORING PLAN

February 19, 2025



Castle Rock Business Park Permitting Outfall Castle Rock, Washington

Prepared for

CT6

PO Box 1419

Battle Ground, Washington 98604

(360) 687-1148

Prepared by

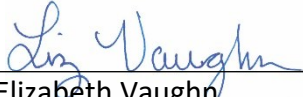
Ecological Land Services

1157 3rd Avenue, Suite 220A • Longview, WA 98632

(360) 578-1371 • Project Number 1098.11

SIGNATURE PAGE

The information in this report was compiled and prepared under the supervision and direction of the undersigned.



Elizabeth Vaughn
Biologist II



Lacey Hoffmann
Senior Biologist

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FIGURES

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Figure 6	30 Inch Stormwater Outfall – Cross Section
Figure 7	Mitigation Plan

INTRODUCTION

CT6, LLC has contracted Ecological Land Services, Inc. (ELS) to prepare a Habitat Management and Mitigation Plan for impacts associated with the development of a proposed stormwater outfall within the Phase 1a boundary of infrastructure included in the Landing on the Cowlitz Master Plan (Phase 1). Phase 1a boundary consists of a portion of Cowlitz County parcel numbers 308640100, 6143802, and 30864 which are presently subject to a boundary line adjustment (City Application No. CR-BLA-24-01). Phase 1a boundary is located south of 2542 South West Larsen Lane in Castle Rock, Washington within a portion of Section 23, Township 9 North, and Range 2 West of the Willamette Meridian (Figure 1). This report has been prepared in accordance with the *City of Castle Rock Municipal Code (CRMC) Chapter 18.10.130, Fish and Wildlife Habitat Conservation Areas* (CMC 2024), and the City of Castle Rock, Washington Shoreline Master Program (SMP)(SMP 2022).

PROJECT HISTORY, STUDY AREA, AND PHASE 1A DESCRIPTION

A SEPA Threshold Determination Staff Report was released on July 28, 2021 for a master planned, mixed-use development known as, the LOTC Master Plan. ELS was contracted to assess all critical areas including wetlands and fish and wildlife habitats within the study area and within 300 feet of the study area for the LOTC project. An amended report summarizing methodology and critical areas known as, *Castle Rock Business Park Amended Critical Areas Report* (ELS 2022) was prepared by ELS and submitted to Mr. James Carsner of the U.S. Army Corps of Engineers (Corps) and to the appropriate Washington Department of Ecology (Ecology) staff for the purpose of a formal wetland boundary verification and verification of the ordinary high water mark (OHWM) flagging on the Cowlitz River and Salmon Creek. Wetland and stream boundaries and the OHWM of the Cowlitz River were verified by Ecology via email on August 25, 2022 and by Corps on September 16, 2022 (Corps Reference Number NWS-2022-557). An additional study area visit was conducted with Ecology on August 29, 2024 to revise the OHWM within the Phase 1a boundary. Ecology verified the proposed changes via email the same day. A memorandum reflecting the verified changes to the OHWM of the Cowlitz River within the updated Phase 1a boundary known as, *Castle Rock Business Park Memorandum* (ELS 2024) was prepared by ELS and submitted to the client and to the City of Castle Rock.

The approximate 18-acre study area is located on the eastern bank of the Cowlitz River, Type S (shoreline) of the state, and can be accessed from an existing gravel road off Huntington Avenue S (Figure 2). Most of Phase 1a consists of dredged mudflow deposits from the 1980 Mt. St. Helens eruption. Vegetation is limited to mainly sporadic deciduous native trees, herbaceous grasses and weeds, and non-native, invasive species including scotch broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus armeniacus*). A maintained drainage ditch, known as Ditch 4, is present along the northeast portion of the Phase 1a boundary. Ditch 4 conveys surface runoff from upslope areas and Laren Lane SW in a southwesterly direction along the northern boundary of Phase 1a. Additionally, it conveys runoff from upslope areas along the western boundary of Phase 1a in a northerly direction. All parcels within the Phase 1a boundary are zoned Industrial.

A small portion of forested vegetation is present along the western portion of Phase 1a bordering the eastern bank of the Cowlitz River. The OHWM of the Cowlitz River is well-defined along the western portion of the Phase 1a boundary, with cut banks and the presence of large woody material and wrack deposits. The proposed project is located in the Shoreline Environmental Designation (SED) High-Intensity and is within a portion of the 100-year floodplain and regulatory floodway of the Cowlitz River.

According to the SMP and *RCW 90.58*, shoreline jurisdiction includes all shorelands and waters within the City of Castle Rock that fall under this statute. This jurisdiction encompasses lands extending 200 feet landward in all directions from the OHWM of the Cowlitz River, as measured on a horizontal plane. Additionally, it includes floodways, contiguous floodplain areas landward 200 feet from such floodways, associated wetlands, critical areas with their respective buffer zones, and river deltas associated with streams subject to the program

Within Phase 1a, the Cowlitz River is classified under Code Reach Number CR-01, with a High-Intensity SED. Based on SMP *Table 8: Shoreline Reach Based RHA¹ Buffers*, the shoreline buffer for the Cowlitz River within the Phase 1a boundary is defined as 150 feet measured landward from the OHWM (Figure 2). Furthermore, SMP *Section 3.1.A* specifies Type S waters, including the Cowlitz River, fall under the jurisdiction of *RCW 90.58*, affirming shoreline jurisdiction within the Phase 1a boundary extends 200 feet from the OHWM, as well as floodways and contiguous floodplain areas (Figure 2).

METHODOLOGY

The ordinary high water mark (OHWM) delineation of the Cowlitz River was conducted following *RCW 90.58.030 and Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State* (Ecology 2016). The OHWM along the east bank of the Cowlitz River was recorded using a hand-held GPS unit capable of sub-meter accuracy. The OHWM was then surveyed by Mackay Sposito on September 5, 2024.

PROJECT DESCRIPTION

Phase 1a of the LOTC Master Plan consists of installing a stormwater outfall within a portion of the Cowlitz River's shoreline buffer and shoreline jurisdiction. Installation of a temporary gravel road, positioned outside all critical areas and shorelines, is proposed to provide access to the project footprint; the gravel will be removed upon completion of the proposed outfall installation and mitigation efforts. Stormwater will be conveyed to the outfall through one 30-inch corrugated polypropylene pipe (CPP) within Ditch 4, one 42-inch high-density polyethylene (HDPE) pipe east of Ditch 4 which widens to 48-inch CPP west of Ditch 4, and one 30-inch CPP pipe west of Ditch 4 (Figures 3 and 4). Details of the 30-inch CPP west of Ditch 4 and the 42-to 48-inch HDPE and CPP outfall profiles can be seen on Figures 5 and 6, respectively. The primary

¹With respect to Type S Waters, the term riparian habitat area (RHA) is interchangeable with the term "shoreline buffer" used in the City of Castle Rock's SMP.

outfall is designated as the centralized discharge point for all stormwater within the project scope. Runoff intercepted from roadway surfaces will undergo preliminary water quality treatment through bioretention planters positioned along the roadways. For each individual phase of the LOTC Master Plan, final treatment methodologies will be specified at the development stage integrating bioretention systems and mechanical filtration via catch basins to achieve regulatory compliance. The treated stormwater will be directed into an onsite conveyance system, channeling flows towards the outfall and facilitating discharge into the shoreline buffer of the Cowlitz River. Additionally, an integrated infiltration strategy will be implemented at each capture point, optimizing upland infiltration and minimizing runoff volumes entering the conveyance system.

Stormwater infrastructure will be installed primarily through trenching for accurate pipeline placement. All onsite runoff will receive treatment through roadside bioretention rain gardens before discharge. Outfall construction will be completed with landward-based excavation, beginning at the OHWM of the Cowlitz River and moving progressively away from the river. Biodegradable jute erosion matting will be placed within the proposed restoration and enhancement area to stabilize soils prior to habitat features such as rootwads and rootwad logs are installed reducing the need for further equipment access for final planting. Construction traffic will use the existing gravel road northeast of the Phase 1a boundary which can be accessed from Huntington Avenue S, avoiding access from Larson Lane SW.

A portion of the Phase 1a boundary currently lies within the regulatory floodway and the 100-year floodplain of the Cowlitz River. The proposed outfall will require 121 cubic yards of cut and 113 cubic yards of fill, resulting in a net export of 8 cubic yards in the regulatory floodway. This comparison is based on existing versus proposed surface levels and does not include additional materials from trenching, planting, or gabion wall construction. Grading quantities within and outside the floodplain are approximately balanced.

Stormwater Treatment

No stormwater treatment facility is proposed within the shoreline buffer or shoreline jurisdiction of the Cowlitz River. The primary point of discharge for the project will be the outfall, which will serve as the terminal conveyance for stormwater runoff across the entirety of the Phase 1a boundary. Runoff from roadways will be treated through bioretention planters designed to filter and treat stormwater before discharge. For the individual future phases of the LOTC Master Plan, stormwater treatment methods will be determined during the development phase, with anticipated approaches including bioretention systems or mechanical filtration via treatment catch basins. A centralized stormwater system will capture and convey treated runoff from these areas to the outfall for discharge into the shoreline buffer of the Cowlitz River. Additionally, infiltration measures will be implemented to maximize onsite infiltration of runoff at the point of capture, reducing the volume of stormwater conveyed to the river system. All components of the proposed project will be sized and designed per the *Stormwater Management Manual for the Puget Sound Basin* (Ecology 1992) and the *Stormwater Management Manual for Western Washington Volume V – Chapter 5* standards (Ecology 2024).

Cut and Fill

The proposed grading within the project area will involve approximately 113 cubic yards of fill, balanced by 121 cubic yards of cut, resulting in only 8 cubic yards of net cut within shoreline jurisdiction. Temporary stockpile areas will be designated outside of shoreline jurisdiction onsite and will be surrounded with silt fencing and covered with plastic sheeting as necessary, ensuring compliance with WSDOT standards. All steep slopes (3:1 or greater) will be stabilized using jute matting, while gentler slopes will be treated with native upland seeding and certified weed-free straw. If sediment tracking from the Phase 1a boundary becomes an issue, a wheel wash will be installed at the construction entrance to minimize offsite sediment transport.

CONSTRUCTION METHODS

To construct the proposed stormwater outfall conveyance system, equipment to be used may include, but is not limited to, excavators, bull dozers, dump trucks, concrete trucks, compacting equipment, and hand tools. All staging and stockpile areas will be located outside of critical areas and buffers, and all project construction is proposed to be completed in a single phase during the dry season. All plant installation will be conducted during the appropriate planting windows as specified in this report.

The following details the general construction sequence:

1. All work limits will be clearly demarcated with silt fencing or construction fencing.
2. All appropriate best management practices (BMPs) will be installed.
3. Topsoil will be cleared and grubbed.
4. Infiltration areas will be marked to avoid heavy equipment from compacting soils and affecting infiltration.
5. Stormwater outfall will be graded to designed elevations.
6. Install signage prohibiting access to mitigation area.
7. Install biodegradable erosion control jute matting.
8. Install habitat features in shoreline jurisdiction.
9. Install riparian habitat and shoreline vegetation enhancement and restoration plantings.

IMPACT AVOIDANCE AND MINIMIZATION MEASURES

The project has been designed to avoid impacts to the shoreline buffer and shoreline jurisdiction to the greatest extent practicable. Due to the landscape position of the Phase 1a boundary and the water-related/water orientated nature of the stormwater outfall, complete avoidance of impacts to shorelines was not possible. Permanent impacts from the proposed gabion wall are limited to 0.002 acres (108 sq. ft.) and will be offset with a 2:1 onsite mitigation ratio. Additionally, permanent impacts from grading and installation of the outfall system within the shoreline buffer necessitates the proposed removal of three black cottonwood (*Populus trichocarpa*) trees. Neither of these permanent impacts could be avoided to accommodate project design. Alternative locations for the outfall would result in the same amount of vegetation removal or more.

Vegetation in the proposed impact areas consists of deciduous trees, grasses, weedy forbs and non-native, invasive vegetation. Temporary physical impacts to native shoreline vegetation due to grading and installation of the dual stormwater outfall pipe was limited to 0.257 acres (11,191 square feet) in the shoreline buffer and shoreline jurisdiction.

The following BMPs will be utilized during construction and operation to further minimize impacts to habitat:

Construction BMPs

1. Construction will occur mainly during the dry season (May-October) as feasible.
2. Native vegetation will be retained to the greatest extent possible within shoreline jurisdiction where improvements are not proposed.
3. Only three trees within the project area will be removed to accommodate the installation of the outfall system.
4. Clearly demarcate the job site and critical areas that must be avoided prior to ground disturbing activities.
5. Install silt fencing on the waterward side of land disturbing activities in shoreline jurisdiction.
6. No equipment will enter below the OHWM of the Cowlitz River.
7. Vehicle and equipment maintenance, repair, and/or service will be performed at designated repair facilities whenever possible.
8. All equipment will be maintained or fueled up, a minimum of 200 feet from the Cowlitz River.
9. All bare soils within shoreline jurisdiction will be mulched with certified weed-free straw after ground disturbing activities.
10. Signage will be installed along the boundary of Area 1 and Area 3 to notify the public of mitigation locations and access restrictions (Figure 7).
11. Install large woody material rootwads and horizontal logs to deter entrance from the public to the stormwater outfall.

PROJECT IMPACT SUMMARY

All impacts have been minimized to the greatest extent possible. All mitigation for impacts to the shoreline buffer and shoreline jurisdiction of the Cowlitz River is proposed onsite (Figure 7). Most project impacts come from the proposed grading and fill, and the installation of the proposed dual outfall piping system. Proposed impacts to critical areas onsite are included in Table 1.

Table 1. Stormwater Outfall Impact Summary

Shoreline Buffer Impacts		
Habitat Area	Proposed Impact	Size of Impact
Shoreline Buffer for Cowlitz River (RHA)	Permanent Shoreline Buffer Impact	0.002 acres/108 square feet
	Temporary Shoreline Buffer Impact	0.217 acres/9,444 square feet
Shoreline Impacts		
Habitat Area	Proposed Impact	Size of Impact
Shoreline Jurisdiction for the Cowlitz River (outside of RHAs)	Temporary Shoreline Jurisdiction Impact	0.014 acres/629 square feet

ONSITE MITIGATION

The applicant is proposing project impacts be compensated for through onsite, in-kind mitigation (Figure 7). The goal of onsite mitigation is to ensure no net loss of ecological functions and meet vegetation conservation standards established in the SMP. The generally accepted mitigation ratio for permanent impacts and temporary impacts to shoreline buffers and shoreline jurisdiction impacts, in ELS experience, has been generally accepted at 1:1 mitigation ratio. CT6, LLC proposes a comprehensive onsite mitigation plan to address project impacts within the shoreline buffer and shoreline jurisdiction of the Cowlitz River. The plan includes:

- Permanent Impacts: Mitigation at a 2:1 ratio for permanent impacts to the shoreline buffer resulting from the installation of a gabion wall.
- Temporary Impacts: Mitigation at a 1:1 ratio for temporary impacts to the shoreline buffer and shoreline jurisdiction caused by grading and the installation of an outfall pipe system.
- Tree Removal: Mitigation at a 4:1 stem count ratio for the removal of three black cottonwood trees within the shoreline buffer to accommodate the outfall system installation.

Mitigation includes a combination of restoration and enhancement with an upland native grass seed application and installing native trees and shrubs. In addition to these measures, CT6, LLC will install habitat features within the shoreline buffer of the Cowlitz River to ensure no net loss of ecological function. Performance standards, monitoring, maintenance, and contingency methods will be discussed in subsequent sections of this report to ensure the mitigation areas are successful.

Table 2. Proposed Outfall Onsite Mitigation Summary

Impact Area	Impact Amount	Proposed Impact Type and Area	Proposed Mitigation	Mitigation Ratio	Total Mitigation Proposed	Total Enhancement per Area
Shoreline Buffer	0.002 ac. (108 sq. ft.)	Permanent Impacts (Area 1)	Restore & Enhance	2:1	0.050 ac. (216 sq. ft.)	Area 1 0.172 ac. (7,487 sq. ft.)
	0.217 ac. (9,444 sq. ft.)	Temporary Impacts (Area 2)	Restore & Enhance	1:1	0.217 ac. (9,444 sq. ft.)	Area 2 0.050 ac. (2,173 sq. ft.)
	3 Black Cottonwood Trees	Permanent Vegetation Impacts (Area 1)	Stem Replacement & Enhance	4.67:1 Stem Replacement	0.032 ac. (1,400 sq. ft.)	Area 3 0.032 ac. (1,400 sq. ft.)
Shorelines Jurisdiction (outside of buffer)	0.014 ac. 629 sq. ft.	Temporary Impacts	Restore & Enhance	1:1	0.014 ac. (629 sq. ft.)	Shoreline Jurisdiction 0.014 ac. (629 sq. ft.)
Total Onsite Mitigation and Restoration:						0.268 ac. (11,689 sq. ft.)

LISTED SPECIES AND PRIORITY HABITATS IN THE PROJECT VICINITY

This fish and wildlife habitat management will address the species and habitats present within and adjacent to the project area according to *CRMC Table 7 Fish and Wildlife Conservation Area Classifications*, which lists ten classifications of fish and wildlife habitat. The project vicinity has Classification 1 (areas with which federal or state designated endangered, threatened, or sensitive species have a primary association), Classification 2 (state priority habitats and areas associated with state priority species), Classification 7 (Waters of the State, which includes Type S water), and Classification 8 (rivers planted with game fish by a governmental or tribal entity). All of the other classifications listed in the table are not present and will not be discussed further in this assessment (Classifications 3, 4, 5, 6, 9, and 10).

SUITABLE HABITAT FOR FISH AND WILDLIFE

The following table includes state priority habitats and federally listed or state-listed species as well as state sensitive species that have a primary association with habitat or suitable habitat within 300 feet of disturbance areas. The table was compiled using the most recent state and federal species lists (WDFW 2024, 2025a, 2025b; WDNR 2025a and 2025b; NMFS 2025; and USFWS 2025). The following table lists the species that have suitable habitat in the project vicinity.

Table 3. Endangered, Threatened, Candidate, and Sensitive Species and Priority Habitat that have Primary Habitat or Association with/on or Adjacent to the Project Site

Species or State Priority Habitat	State Status	Federal Status	Designated Critical Habitat in Project Vicinity?
Fish			
Bull Trout (<i>Salvelinus confluentus</i>)			
Columbia River DPS	Candidate	Threatened	No
Chum Salmon (<i>Oncorhynchus keta</i>)			
Columbia River Chum Salmon ESU	--	Threatened	Designated
Chinook Salmon (<i>Oncorhynchus tshawytscha</i>)			
Lower Columbia River Chinook ESU	--	Threatened	Designated
Coho Salmon (<i>Oncorhynchus kisutch</i>)			
Lower Columbia River Coho Salmon ESU	--	Threatened	Designated
Steelhead (<i>Oncorhynchus mykiss</i>)			
Lower Columbia River Steelhead DPS	Candidate	Threatened	Designated
Eulachon (Columbia River Smelt) (<i>Thaleichthys pacificus</i>)			
Eulachon Southern DPS	--	Threatened	Designated
Plants			
Western Wahoo (<i>Euonymus occidentalis</i> var. <i>occidentalis</i>)	Sensitive	--	--
Soft-leaved willow (<i>Salix sessilifolia</i>)	Sensitive	--	--
Priority Habitats			
Riverine	Priority Habitat	--	--

Although critical habitat is designated for some listed fish species in the project vicinity, suitable habitat for fish species is not present within the project footprint and all permanent and temporary project impacts will occur landward of the OHWM of the Cowlitz River. All permanent and temporary shoreline buffer impacts to the Cowlitz River will be mitigated using enhancement and restoration; therefore, the proposed project will avoid impacts to critical and suitable habitat for listed fish.

ELS recorded observations of surrounding topography, wildlife use, and habitat functions in Phase 1a boundary according to *CRMC Appendix 18.10F*. The listed plant species in Table 3 could occur within the project vicinity because they have suitable habitat provided by riparian areas.

MANAGEMENT RECOMMENDATIONS

Effects to species are generally avoided or minimized if the project meets management recommendations discussed below. Species detailed in Table 3 that do not have state or federal management recommendations will not be discussed.

Bull Trout

Federal

Federal management recommendations are not explicit, but state that for the Olympic Management Unit, recovery of bull trout includes protecting, restoring, and maintaining suitable habitat conditions and water quality with actions such as removing fish-passage barriers, maintaining and improving water quality, and improving habitat conditions in and along mainstem rivers (USFWS 2004).

State

WDFW (Rodrick and Milner 1991) advises the following management recommendations for streams that contain bull trout and steelhead: 1) maintain buffer zones along stream banks of at least the width of the height of the tallest tree or 50 feet, whichever is wider, 2) avoid road construction and maintenance activities, and 3) avoid in-stream structures, such as bridges, trestles, boat ramps, or culverts, that impede the natural movements of fish.

The proposed project will limit tree removal to three trees in the shoreline buffer and shoreline jurisdiction of the Cowlitz River. These trees will be replaced at a 4:1 ratio for stem count. Permanent and temporary impacts within the project area will be fully mitigated onsite through enhancement and restoration of the shoreline buffer and shoreline jurisdiction of the Cowlitz River. Mitigation onsite will result in an overall functional lift of riparian habitat when compared to current conditions. All other proposed impacts are placed outside of the shoreline buffer and shoreline jurisdiction to avoid any impacts to the Cowlitz River and its associated listed species. The project, as designed, is consistent with both federal and state management recommendations.

Salmon and Steelhead

Federal

The Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan (LCFRB 2010) is being used as a recovery plan for salmon and steelhead by the National Marine Fisheries Service. This plan gives the following key recovery priorities in the lower Cowlitz subbasin to attain recovery of listed salmon and steelhead:

1. Manage regulated stream flows through the hydropower system.
2. Restore floodplain function, riparian function, and stream habitat diversity.
3. Protect intact forest in headwater basins.
4. Manage growth and development to protect watershed processes and habitat conditions.
5. Address immediate risks with short-term habitat fixes.
6. Manage forest lands to protect and restore watershed processes.
7. Restore passage at culverts and other artificial barriers.
8. Align hatchery priorities consistent with conservation objectives.
9. Manage fishery impacts so they do not impede progress toward recovery.
10. Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized.

State

WDFW does not have specific documents that have a short list of management recommendations for salmon; however, they do provide them for rainbow trout/steelhead (Rodrick and Milner 1991). Steelhead and salmon have similar life histories and habitat needs, so they are expected to be similar, if not identical. The following are management recommendations for steelhead:

1. Buffer zones of at least the width of the height of the tallest tree should be maintained along stream banks, which provide rainbow trout and steelhead habitat, and any other stream which directly or indirectly influences rainbow trout and steelhead habitat.
2. Road construction and maintenance activities should be avoided adjacent to streams which provide rainbow trout and steelhead habitat.
3. Instream structures, such as bridges, piers, boat ramps, or culverts must not impede the natural movements of rainbow trout and steelhead.
4. Waters inhabited by steelhead parr should not be treated with metal-based herbicides during the period March 1 through June 15.

The proposed project will limit tree removal to three trees in the shoreline buffer and shoreline jurisdiction of the Cowlitz River. These trees will be replaced at a 4:1 ratio for stem count. The project is proposing to offset permanent and temporary impacts within the project area by fully mitigating impacts onsite within the shoreline buffer and shoreline jurisdiction of the Cowlitz River. Mitigation onsite will result in an overall functional lift of riparian habitat when compared to current conditions. All other proposed impacts are placed outside of the shoreline buffer and shoreline jurisdiction to avoid any impacts to the Cowlitz River and its associated listed species. The project, as designed, is consistent with both federal and state management recommendations. The project, as designed, is consistent with both federal and state management recommendations.

Riparian Habitat

The WDFW management recommendation for riparian habitat (Knutson and Naef 1997) is to “protect riparian habitat areas”. Standard recommended buffer widths for areas with typed and non-typed streams are somewhat different than widths required in the CRMC and further in the SMP. This project has been designed to avoid and minimize impacts to the shoreline buffer of the Cowlitz River within the Phase 1a boundary to the greatest extent possible, and where impacts to the shoreline buffer could not be avoided, onsite mitigation will be performed. Onsite mitigation will include the removal of non-native, invasive species, excluding reed canarygrass (*Phalaris arundinacea*), installation of geotextile erosion control fabric, installation of large woody material for habitat enhancement and riparian bank stabilization, installation of native shrubs, and spreading native seed mix, resulting in no net loss of ecological function.

HABITAT MANAGEMENT PLAN

This project requires a Habitat Management Plan in accordance with *CRMC.18.10.130.E* because the project proposes impacts within 250 feet of a Classification 1, 2, 7, and 8 habitat area, which

includes species management recommendations (above) and development performance standards that are included below.

CRMC 18.10.130(D) – DEVELOPMENT PERFORMANCE STANDARDS

The following are development standards applicable to this project (in *italics*) as listed in CRMC 18.10.130(D), followed by a discussion of how they are met (in regular font).

1. *Best available science shall be used to conduct any biological assessments of fish and wildlife habitats and to propose mitigation steps required for specific developments.*

Best available science and the most recent available data were used in preparing this document and the mitigation plan.

2. *Locate buildings and structures in a manner that preserves the habitat or minimizes adverse impact.*

No permanent buildings are proposed within the shoreline buffer or shoreline jurisdiction of the Cowlitz River. The proposed outfall structure will be located landward of the OHWM and will be limited to 108 square feet of permanent impacts. Both permanent and temporary impacts associated with the outfall installation will be fully mitigated onsite through enhancement and restoration to maintain existing habitat quality. Mitigation measures will also focus on enhancing the ecological function of the area, preserving habitat integrity while contributing to overall ecological improvement.

3. *Consolidate habitat and vegetated open space in contiguous blocks, and where possible locate habitat contiguous to other habitat, open space or landscaped areas to contribute to a continuous system or corridor that provides connections to adjacent habitat areas.*

All proposed impacts within the shoreline buffer and shoreline jurisdiction of the Cowlitz River will be fully mitigated, restored, or enhanced, with no access-related disturbance to critical areas. This approach will ensure the continuity and integrity of the habitat, preserving essential ecological functions.

4. *Use native species in any landscaping of disturbed or undeveloped areas and in any enhancement of habitat or buffers. Emphasize diversity in selection of plant materials and structure of landscaping.*

Mitigation plantings and upland seed mix proposed for critical habitats onsite will consist of native species tailored to the specific hydrological regime of the area.

5. *Remove and/or control any noxious or undesirable species of plants as identified by the Cowlitz County weed control board.*

A mitigation and monitoring plan will be implemented to identify, remove, and control non-native, invasive species excluding reed canarygrass as designated by the Cowlitz County weed control board. Regular monitoring will be conducted to assess the effectiveness of these measures and address any resurgence of problematic species. See the section titled *Goals, Objectives, and Performance Standards* for specific information regarding noxious species.

6. *Demonstrate how existing trees will be preserved, preferably in groves.*

Only three trees are proposed to be removed within the shoreline buffer of the Cowlitz River. The removal of these trees will be mitigated within the shoreline buffer of the Cowlitz River at a 4:1 stem count ratio.

7. *Preserve and introduce native plant species which serve as a food source for wildlife; provide shelter from climatic extremes and predators; provide structure and cover for reproduction and rearing of young.*

The proposed mitigation trees and shrubs are known to produce cones, fruits, and leaves that serve as a food source for various wildlife species, including birds and insects. The trees and shrubs will provide dense growth for habitat and the large woody material placed throughout the mitigation area will provide nesting opportunities. The proposed native trees, shrubs, and herbaceous species will create a multi-layered canopy that provides various microhabitats to support species through their lifecycle.

8. *Preserve the natural hydraulic and ecological functions of drainage systems.*

The proposed stormwater outfall system will be installed landward of the OHWM of the Cowlitz River to preserve the natural hydraulic and ecological functions of the drainage system. Runoff from upslope areas will be managed by regulating flow through native vegetation in the enhancement and restoration area, Area 1, which will allow for infiltration into the uplands of the shoreline buffer. This process will help prevent excessive erosion and sedimentation from entering the Cowlitz River. Upland infiltration of stormwater runoff will capture sediments, nutrients, and pollutants, supporting water quality and recharging groundwater.

9. *Preserve critical fish and wildlife habitat areas through maintenance of stable channels, adequate low flows, management of stormwater runoff, erosion, and sedimentation.*

The project will preserve critical fish and wildlife habitats by maintaining stable channels, managing stormwater runoff, and minimizing erosion and sedimentation. Geotextile fabric and large woody material placed in the enhancement and restoration area will stabilize the bank and create habitat complexity, benefiting fish and other aquatic species. Native vegetation will further aid in filtering runoff and reducing sediment flow into the Cowlitz River, supporting habitat health.

10. Manage access to critical fish and wildlife habitat areas to protect species which are sensitive to human disturbance.

Access to critical fish and wildlife habitat areas will be managed to protect species sensitive to human disturbance. Signage will be installed along the boundary of Area 1 and Area 3 to reduce access to the mitigation area and minimize human impact to critical fish and wildlife habitat areas (Figure 7).

11. Maintain or enhance water quality through control of runoff and use of best management practices.

Water quality will be maintained and enhanced by minimizing the removal of trees within the shoreline buffer of the Cowlitz River and mitigating onsite within the shoreline buffer of the Cowlitz River at a 4:1 stem count ratio. The project heavily focuses on removing all non-native, invasive species excluding reed canarygrass. Mitigation and enhancement plantings, all located landward of the OHWM of the Cowlitz River, will help reduce erosion and prevent sediment from entering the river. No fill will be placed below the OHWM. Additionally, biodegradable erosion control jute matting and willow cuttings in the enhancement and restoration area will reduce erosion and filter runoff, promoting infiltration within the upland riparian habitat. Mitigation proposed will result in no net loss of ecological functions provided by shoreline buffer, as well as within shoreline jurisdiction of the Cowlitz River.

ONSITE ENHANCEMENT AND RESTORATION PLAN

To determine how mitigation measures should be applied to ensure no net loss of ecological function, ELS biologists first considered the location of impact should be at least functionally equivalent to the location where mitigation takes place. The goal of onsite mitigation is to result in an overall lift of ecological function when compared to existing riparian and shoreline habitat functions. Proposed project impacts are from permanent and temporary loss of habitat due to removing native vegetation. A total of 0.002 acres (108 square feet) of permanent impacts and 0.271 acres (9,444 square feet) of temporary impacts to the shoreline buffer landward of the OHWM of the Cowlitz River are proposed. Additionally, 0.014 acres (629 square feet) of temporary impacts to shoreline jurisdiction of the Cowlitz River is proposed. Temporary impacts are due to trenching and grading for the installation of a stormwater conveyance system and permanent impacts result from the installation of a gabion wall for the outfall. These shoreline vegetation impacts include the permanent and temporary loss of habitat availability within the shoreline buffer and shoreline jurisdiction. All permanent and temporary impacts will be mitigated onsite through removal of non-native, invasive species, excluding reed canarygrass, placing large woody material within the project area, planting native trees and shrubs, and seeding all proposed mitigation areas to provide no net loss of ecological function. Table 4 summarizes proposed project impacts, and Table 5 summarizes proposed onsite mitigation through restoration and enhancement.

Table 4. Summary of Shoreline Buffer and Shoreline Jurisdiction Impacts to the Cowlitz River

Shoreline Buffer Impacts		
Habitat Area	Proposed Impact	Size of Impact
Shoreline Buffer (Cowlitz River RHA)	Permanent	0.002 ac. (108 sq. ft.)
	Temporary	0.217 ac (9,444 sq. ft.)
Shoreline Jurisdiction impacts		
Habitat Area	Proposed Impact	Size of Impact
Shoreline Jurisdiction (Cowlitz River)	Temporary	0.014 ac. (629 sq. ft.)

Table 5. Onsite Restoration and Enhancement Summary

Impact Area	Impact Amount	Proposed Impact Type and Area	Proposed Mitigation	Mitigation Ratio	Total Mitigation Proposed	Total Enhancement per Area
Shoreline Buffer	0.002 ac. (108 sq. ft.)	Permanent Impacts (Area 1)	Restore & Enhance	2:1	0.050 ac. (216 sq. ft.)	Area 1 0.172 ac. (7,487 sq. ft.)
	0.217 ac. (9,444 sq. ft.)	Temporary Impacts (Area 2)	Restore & Enhance	1:1	0.217 ac. (9,444 sq. ft.)	Area 2 0.050 ac. (2,173 sq. ft.)
	3 Black Cottonwood Trees	Permanent Vegetation Impacts (Area 1)	Stem Replacement & Enhance	4.67:1 Stem Replacement	0.032 ac. (1,400 sq. ft.)	Area 3 0.032 ac. (1,400 sq. ft.)
Shorelines Jurisdiction (outside of buffer)	0.014 ac. 629 sq. ft.	Temporary Impacts	Restore & Enhance	1:1	0.014ac. (629 sq. ft.)	Shoreline Jurisdiction 0.014 ac. (629 sq. ft.)
Total Onsite Mitigation and Restoration:						0.268 ac. (11,689 sq. ft.)

SHORELINE BUFFER MITIGATION (AREA 1)

Permanent impacts to the shoreline buffer of the Cowlitz River due to the installation of a gabion wall for the stormwater outfall conveyance system are proposed to be mitigated at a 2:1 ratio and temporary impacts to the shoreline buffer of the Cowlitz River due to grading within Area 1 are proposed to be mitigated at a 1:1 ratio. Mitigation will include removal of all non-native, invasive species, excluding reed canarygrass, installation of biodegradable erosion control jute matting, placement of large woody material as habitat structures, installation of shrubs, seeding with a native upland seed mix, and mulching Area 1 with certified weed-free straw. Permanent and temporary shoreline buffer impacts due to the installation of the gabion wall will occur where vegetation almost completely consists of non-native, invasive species. Existing functions in Area 1 are reduced because of the presence of scotch broom and Himalayan blackberry. For this reason, mitigation will create a native vegetated area resulting in a lift of ecological functions in the shoreline buffer. Mitigation plantings will promote infiltration to remove pollutants in surface runoff, and protective signage will deter human access to critical shoreline habitat. Habitat

features including at least two logs and five rootwads will be installed in Area 1 to provide valuable wildlife habitat for birds and small mammals for nesting and roosting. Dense shoreline plantings in Area 1 will result in a functional lift of ecological functions through slowing surface runoff and promoting infiltration and establishing a native seed source that can spread throughout shoreline and riparian habitat areas.

Prior to installation of mitigation plantings, all non-native, invasive species, excluding reed canarygrass will be removed and compacted soils in Area 1 will be ripped or tilled to allow plants to better establish root systems, and biodegradable jute erosion control matting and habitat features including downed logs and rootwads will be placed within Area 1. Table 5 details mitigation ratios and Table 6 details shrub and seed specifications for Area 1.

Table 6.Planting Specifications and Native Upland Seed Mixture (Area 1)

Shoreline Buffer Planting Area 1-Mitigation of 0.172-acres/7,487 square feet			
Species	Spacing (on-center)	Stock	Quantity
Shrubs			
Scouler's willow (<i>Salix scouleriana</i> , FAC)	4-feet	Cutting Stock	200
Dune willow (<i>Salix hookeriana</i> , FACW)			135
Sitka willow (<i>Salix sitchensis</i> , FACW)			135
Total			470
Shoreline Buffer Planting Area 1-Mitigation of 0.172-acres/7,487 square feet			
Upland Disturbance Areas – Sunmark Seeds Stream Bank Plus			
Species	Composition	Rate	Quantity
Native red fescue (<i>Festuca rubra</i> , FAC)	50%	1lb/1,000 sq. ft.	Approximately 7.5 lbs
California brome (<i>Bromus carinatus</i> , NI)	20%		
Blue wildrye (<i>Elymus glaucus</i> , FACU)	20%		
Large leaf lupine (<i>Lupinus polyphyllus</i> , FAC)	10%		
Total	100%		

HABITAT FEATURES (AREA 1)

Prior to installing plants, habitat features including downed logs and rootwads will be placed within Area 1 (Figure 7). These features will be a maximum of 20 feet apart, and a minimum of two logs with attached rootwads and five rootwads will be placed within Area 1. Actual locations will be determined in the field with consideration to the listed spacing and density to produce the most natural appearance possible. All rootwads will be a minimum of 6 feet in diameter and will be placed on its side so lateral roots can provide habitat and roosting opportunities for birds. Downed logs with rootwads will be a minimum of 20 feet long and will have a minimum diameter of 20-inches at the small end with branches retained as much as possible. Downed logs will be placed so they do not roll downhill towards the public or the Cowlitz River. Specifications for habitat features within Area 1 are detailed in Table 7.

Table 7.Habitat Feature Specifications (Area 1)

Habitat Feature Type	Specifications	Location	Quantity to be Installed
Rootwads	>6' in diameter Clean roots of soils prior to transportation Retain lateral roots as much as possible Place on its side so roots can provide perching	Along the waterward side of the proposed gabion wall (Area 1)	Minimum of 5
Downed Logs with Rootwads	20" in diameter on the small end >20 feet in length Retain branches as much as possible Place logs so they do not roll downhill towards the river		Minimum of 2

SHORELINE BUFFER RESTORATION (AREA 2)

Area 2 as shown on Figure 7 is also within the shoreline buffer of the Cowlitz River. Only temporary impacts to herbaceous vegetation are proposed within Area 2 to accommodate grading and the installation of stormwater outfall piping. Restoration within Area 2 will be restored at a 1:1 ratio by removing non-native, invasive species, excluding reed canarygrass prior to construction. Post construction mitigation will include seeding with a native upland seed mix and mulching with a certified weed-free straw. Existing functions in Area 2 are reduced because of the presence of scotch broom and Himalayan blackberry. For this reason, restoration will create a native vegetated area that will result in a lift of ecological functions in the shoreline buffer. All restoration specifications for Area 2 are detailed in Table 5 and specifications for native upland seed mix are detailed in Table 8.

Table 8.Native Upland Seed Mixture (Area 2)

Shoreline Buffer Planting Area 2- Mitigation of 0.050-acres/2,173 square feet			
Upland Disturbance Areas – Sunmark Seeds Stream Bank Plus			
Species	Composition	Rate	Quantity
Native red fescue (<i>Festuca rubra</i> , FAC)	50%	1lb/1,000 sq. ft.	Approximately 2.2 lbs
California brome (<i>Bromus carinatus</i> , NI)	20%		
Blue wildrye (<i>Elymus glaucus</i> , FACU)	20%		
Large leaf lupine (<i>Lupinus polyphyllus</i> , FAC)	10%		
Total	100%		

SHORELINE BUFFER MITIGATION (AREA 3)

Permanent impacts due to tree removal within the shoreline buffer of the Cowlitz River will be mitigated within Area 3 (Figure 7). Mitigation in Area 3 includes removing non-native, invasive vegetation, excluding reed canarygrass, planting native trees at a 4.67:1 stem replacement ratio, seeding with a native upland seed mix and mulching Area 3 with certified weed-free straw. Mitigation within Area 3 will compensate for the removal of three native black cottonwood (*Populus trichocarpa*) trees in Area 1, which is necessary for grading and installation of the proposed stormwater outfall conveyance system. Removing invasive species and establishing native vegetation will improve ecological functions, including pollutant removal, reducing human disturbance, slowing surface runoff, promoting infiltration, and providing a native seed source that can spread throughout the shoreline buffer.

Prior to installation of mitigation plantings, all non-native, invasive vegetation, excluding reed canarygrass will be removed and compacted soils in Area 3 will be ripped or tilled to allow plants to better establish root systems. All mitigation specifications for Area 3 are detailed in Table 5 and Table 9 details native tree installation and native upland seed mix specifications for Area 3.

Table 9. Planting Specifications and Native Upland Seed Mixture (Area 3)

Shoreline Buffer Planting Area 3-Mitigation of 0.032-acres/1,400 square feet			
Species	Spacing (on-center)	Stock	Quantity
Trees			
Lodgepole Pine (<i>Pinus contorta</i>)	10-feet	1-gallon potted	14
Shoreline Buffer Planting Area 1-Mitigation of 0.172-acres/7,487 square feet			
Upland Disturbance Areas – Sunmark Seeds Stream Bank Plus			
Species	Composition	Rate	Quantity
Native red fescue (<i>Festuca rubra</i> , FAC)	50%	1lb/1,000 sq. ft.	Approximately 1.4 lbs
California brome (<i>Bromus carinatus</i> , NI)	20%		
Blue wildrye (<i>Elymus glaucus</i> , FACU)	20%		
Large leaf lupine (<i>Lupinus polyphyllus</i> , FAC)	10%		
Total	100%		

SHORELINE JURISDICTION OF THE COWLITZ RIVER MITIGATION

All temporary impacts to shoreline jurisdiction of the Cowlitz River are proposed to be mitigated at a 1:1 ratio by removing all removing non-native, invasive vegetation, excluding reed canarygrass prior to construction. Post construction mitigation will include seeding with a native upland seed mix and mulching with a certified weed-free straw over 1,747 square feet of the temporarily impacted shoreline jurisdiction. Existing functions of the impacted area within shoreline jurisdiction of the Cowlitz River outside of the shoreline buffer are minimal due to scotch broom and Himalayan blackberry. The restoration of this area will provide an overall ecological functional lift by eliminating non-native, invasive vegetation, excluding reed canarygrass and restoring the impacted areas with native vegetation providing habitat, and foraging opportunities. All mitigation specifications for shoreline jurisdiction of the Cowlitz River are detailed in Table 5 and Table 10 details native upland seed mix specifications.

Table 10. Native Upland Seed Mixture (Shoreline Jurisdiction of the Cowlitz River)

Shoreline Jurisdiction of the Cowlitz River-Restoration of 0.014-acres/629 square feet			
Upland Disturbance Areas – Sunmark Seeds Stream Bank Plus			
Species	Composition	Rate	Quantity
Native red fescue (<i>Festuca rubra</i> , FAC)	50%	1lb/1,000 sq. ft.	Approximately 0.63 lbs
California brome (<i>Bromus carinatus</i> , NI)	20%		
Blue wildrye (<i>Elymus glaucus</i> , FACU)	20%		
Large leaf lupine (<i>Lupinus polyphyllus</i> , FAC)	10%		
Total	100%		

SPECIFICATIONS FOR PHASE 1A PREPARATION, PLANTING, AND MAINTENANCE

The following specifications will be used to protect existing critical areas, set boundaries for mitigation, provide direction for installing vegetation and habitat features, and provide maintenance requirements for the 5-year monitoring and maintenance period.

Prepare Mitigation Areas

1. Install appropriate BMPs along the mitigation area boundaries.
2. Stake or flag the mitigation area waterward of shorelines jurisdiction.
3. Install temporary construction fencing along the boundary of the mitigation areas onsite to prevent equipment access.
4. Rip or till soils in planting locations as needed to loosen compact soils in mitigation areas.
5. Remove all non-native, invasive vegetation, excluding reed canarygrass within the proposed mitigation areas.
6. Install riparian bank stabilizing biodegradable jute matting within Area 1.

Install Habitat Features within Area 1

1. Install a minimum of seven pieces of habitat features including downed logs or rootwads according to the specifications in Table 7.
2. Habitat features will be located within Area 1 west of the proposed gabion wall within the shoreline buffer of the Cowlitz River, landward of the OHWM.
3. Place habitat features a maximum of 20 feet apart.
4. Place rootwads on their side.
5. Place downed logs so they will not roll downhill.

Install Cutting Stock in Area 1, Bare root Stock in Area 3, and Native Upland Seed Mixture in all Mitigation Areas

1. Plant native 1-gallon potted trees and cuttings during the late fall to early spring (October-March) at spacing identified in Table 6 and Table 9, respectively.
2. 1-gallon potted trees will be purchased from a native plant nursery.
3. Cuttings will be collected within the Phase 1a boundary, where possible. Any remaining cuttings will be salvaged from local offsite sources or purchased from a native plant nursery. Onsite or local offsite cutting material will be used as much as possible because these plants are best adapted to the local microclimate.
4. Cuttings will be a minimum of 3 feet long and between ¼ to ½ inches in diameter.
5. One-gallon potted trees and cuttings will be protected until installation by being refrigerated, covered in damp burlap, placed in moist sand or peat, or other method of keeping cool and moist.
6. Cuttings will be installed within 1 to 2 days of harvesting.
7. Unused cuttings must be properly stored at the end of each planting day to prevent drying out.
8. Spread appropriate amount of native upland seed mix within all mitigation areas.

9. Install a minimum of 3-inch depth mulch layer within all mitigation areas. The mulch will be comprised of certified weed-free straw. Avoid placing mulch directly against plant stems.
10. Irrigate all newly installed 1-gallon potted trees, cuttings, and seeded areas as the Phase 1a boundary and weather conditions warrant.

Install Habitat Signs

Install durable, enamel coated metal critical area signs at a minimum of 100-foot intervals on metal or wood posts bordering mitigation Area 1 and Area 3.

Maintain Enhancement and Restoration Areas

The planted 1-gallon potted trees and shrub cuttings will be maintained as often as necessary to ensure that the specified performance standards are met. The maintenance includes the following:

1. Inspect the plantings at least once annually, or more often as appropriate, and maintain to achieve the performance standards specified in the subsection titled “Goals, Objectives, & Performance Standards.”
2. Irrigate planted 1-gallon potted trees and shrubs during the dry season for the first 2 to 3 years after planting. Water should be delivered at a minimum rate of 1 gallon every 4 weeks. Adjust as necessary based on site and weather conditions.
3. Remove competing vegetation from around the base of plant species during first 2 to 3 years after planting and as needed thereafter.
4. Replace mulch as needed to suppress competing vegetation.
5. Replace dead or failed 1-gallon potted trees or cuttings to meet the minimum annual performance standards (Table 11). Replaced plants will be installed as described for the original installation.

Minor corrective actions will be undertaken as necessary as a part of routine maintenance and will be documented in the subsequent monitoring report. Corrective actions include, but are not limited to, the following:

1. Replant 1-gallon potted trees.
2. Replant shrub cuttings.
3. Implement a fertilizing schedule.
4. Repair damaged limbs or prune dead branches.
5. Substitute the anti-herbivore device, such as painting lower stems with sanded latex paint, or spraying herbivore deterrent.

GOALS, OBJECTIVES, AND PERFORMANCE STANDARDS

The goal of this mitigation plan is to establish a multi strata riparian habitat buffer and shoreline vegetation screening to compensate for impacts to the shoreline buffer and to shoreline jurisdiction of the Cowlitz River from grading and installation of a stormwater outfall conveyance system. The proposed mitigation will enhance and restore vegetative structure, habitat, and water quality functions. To accomplish this goal, the following goals, objectives, and performance standards have been established.

NON-NATIVE, INVASIVE SPECIES REMOVAL

Objective 1: Remove all non-native, invasive plants, excluding reed canarygrass within enhancement and restoration areas to improve habitat and ecological function within the shoreline buffer and shoreline jurisdiction of the Cowlitz River.

Performance Standard 1a: Manually or mechanically remove all non-native, invasive plants, excluding reed canarygrass within the enhancement and restoration areas prior to installation of habitat features, plantings, seeding, and mulching. This performance standard is complete when all non-native, invasive plants, excluding reed canarygrass are removed and documented in the as-built report.

Performance Standard 1b: Inspect all mitigation areas and remove all non-native, invasive plants, excluding reed canarygrass. Non-native, invasive plants, excluding reed canarygrass will not exceed 10 percent cover in all mitigation areas for the duration of monitoring. This performance standard is completed when documented in all annual monitoring reports.

HABITAT STRUCTURE

Objective 2: Install habitat features to favor small mammals and birds to improve riparian habitat functions. Habitat features will also deter public presence near active operations.

Performance Standard 2a: A minimum of seven habitat features including rootwads or downed logs will be placed within Area 1. The performance standard is completed when the habitat features are installed and documented in the as-built report.

VEGETATIVE STRUCTURE

Objective 3: Establish a multi strata riparian habitat buffer and shoreline jurisdiction herbaceous vegetation screening to compensate for impacts to the shoreline buffer and to shoreline jurisdiction of the Cowlitz River, and to enhance vegetative structure, habitat, and water quality functions.

Performance Standard 1a: Install all native 1-gallon potted trees, native shrub cuttings, and mulch and seed mitigation areas as described in Tables 6, and 8-10. The performance standard is completed when plants are installed and documented in the as-built report.

Performance Standard 1b: By Year 1, native trees and shrubs will achieve at least 90 percent survival. Dead plants will be replaced if this performance standard is not met.

Performance Standard 1c: By Year 2, native trees and shrubs will achieve at least 80 percent survival. Dead plants will be replaced if this performance standard is not met.

Performance Standard 1d: By Year 3, native trees and shrubs will achieve at least 75 percent survival. Dead plants will be replaced if this performance standard is not met.

Performance Standard 1e: By Year 5, native trees and native shrubs will have a minimum 25 percent cover. Dead plants will be replaced if this performance standard is not met.

Table 11. Performance Standards for Vegetation by Monitoring Year

	Percent Survival and Cover			
	Year 1	Year 2	Year 3	Year 5
Tree & Shrub Strata				
Survival	≥90%	≥80%	≥75%	--
Cover	--	--	--	≥25%
Non-native, invasive vegetation, excluding reed canarygrass				
Cover of non-native, invasive species	<10%	<10%	<10%	<10%

LONG-TERM SITE PROTECTION

Objective 4: Establish long term protection mechanism for Area 1 and Area 3.

Performance Standard 4a: Record a conservation covenant with the City of Castle Rock protecting Area 1 and Area 3 in perpetuity. This performance standard will be met when a conversation covenant is recorded at the city and a copy is included in the as-built report.

Performance Standard 4b: Critical areas signage with verbiage approved by the responsible official made of enamel coated metal attached to a durable metal or wood posts shall be installed at a maximum of 100 feet apart along the perimeter Area 1 and Area 3. Signage shall be maintained in perpetuity. This performance standard will be met when all installed signs are documented in the final monitoring report. Additional signage may be required during additional development phases.

MONITORING, MAINTENANCE, AND CONTINGENCY METHODS

The shoreline buffer and shoreline jurisdiction mitigation areas will be monitored for a five-year period following project construction in Year 0 (as-built), 1, 2, 3, and 5. Monitoring reports will

be submitted to the City of Castle Rock by December 31st of each monitoring year. The goal of monitoring is to determine if previously stated performance standards are being met. All mitigation areas will be monitored once during the growing season, preferably during the same two-week period each year to better compare data.

Monitoring of the mitigation areas will follow the requirements of established performance standards. Monitoring plots will be established within the shoreline buffer and shoreline jurisdiction of the Cowlitz River. A minimum of four monitoring plots will be established to document if the Phase 1a boundary is meeting performance standards. At least one photostation will be established per monitoring plot to document changes over time. Additional photostations may be established outside of monitoring plots as needed. Photostations and monitoring plot locations will be established in the as-built report.

MONITORING PLOTS

During the first annual monitoring event, a minimum of four monitoring plots will be established, with at least two monitoring plots in Area 1 and two monitoring plots within Area 3. The monitoring plots will be staked with metal t-posts and identification tags. Their locations will be identified by GPS and placed on an as-built Phase 1a boundary map that will accompany the monitoring reports. Permanent photo points will be established at each monitoring plot and directions documented on Phase 1a boundary map.

Vegetation

To assess the status of the vegetation within the mitigation areas, the vegetation monitoring will measure the following:

- Total stem count of trees and shrubs (to determine survival rate) within Area 1 and Area 3.
- Percent aerial cover of planted and naturally recruiting native trees and shrubs within a 15-foot radius from the metal t-post.
- Percent aerial cover of naturally occurring herbaceous plants within a 5-foot radius from the metal t-post.
- Percent aerial cover of non-native, invasive species, excluding reed canarygrass within a 15-foot radius from the metal t-post.
- Change in the plant community over time (documented at each designated photo point).

Fauna

To assess the development of wildlife habitat within shoreline jurisdiction, wildlife monitoring will document the following regarding use of the downed logs or rootwads, and overall plant condition:

- Insect use
- Amphibian/reptile use
- Bird use
- Mammal use

- Level of herbivory

Soils and Hydrology

If the planted species show poor or failed growth, soil moisture and soil nutrients may also be monitored during the growing season. If necessary, soil moisture will be monitored monthly during the growing season and soil nutrients will be assessed annually during the growing season. Corrective actions will be taken as appropriate based on the soil moisture and soil nutrient data. These actions include, but are not limited to, a revised irrigation schedule and a fertilization schedule.

At minimum the following items will be included in annual monitoring reports:

- Location, map, and as-built drawing including any changes.
- Historic description of the project, including dates of plant installation, current year of monitoring, and remedial actions taken (if necessary).
- Description of monitoring methods.
- Documentation of vegetative performance standards and overall development.
- Assessment of non-native, invasive species, excluding reed canarygrass and recommendations for continued management.
- Photographs from established photostations.
- Observations of wildlife including amphibians, invertebrates, reptiles, birds, and mammals. If photographs are taken, they will be included.
- Summary of maintenance and contingency measures completed for the past year and proposed for the next year.

MAINTENANCE

Maintenance will occur during the growing season and will include the following:

- Irrigating mitigation areas as needed during the dry season for the first three years. Taper watering in Years 2-3.
- Remove competing non-native, invasive species excluding reed canarygrass as needed within a 3-foot radius of planted species, re-apply mulch as needed.
- Replace dead or failed plants as described for the original installation to meet the minimum performance standards.

CONTINGENCY MEASURES

If performance standards are not met by Year 5, steps will be taken to correct the situation in a timely manner. The following steps will be implemented when an area is identified as failing or potentially failing:

- Identify the cause(s) of failure or potential failure.
- Identify the extent of failure of potential failure.
- Implement corrective actions such as irrigating, fertilizing, or replanting.
- Document activities and include this data in annual monitoring reports.

- If routine corrective action will not correct the problem, immediately consult with the appropriate agencies.
- Evaluate recommendations from resource agency staff and implement recommendations in a timely manner.

Funding for corrective actions will be the responsibility of the applicant.

LIMITATIONS

ELS bases this report's determinations on standard scientific methodology and best professional judgment. In our opinion, local, state, and federal regulatory agencies should agree with our determinations; however, the information contained in this report should be considered preliminary and used at your own risk until it has been approved in writing by the appropriate regulatory agencies. ELS is not responsible for the impacts of any changes in environmental standards, practices, or regulations after the date of this report.

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FIGURES

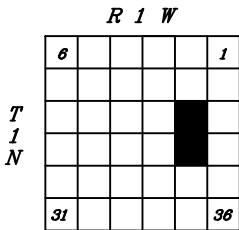
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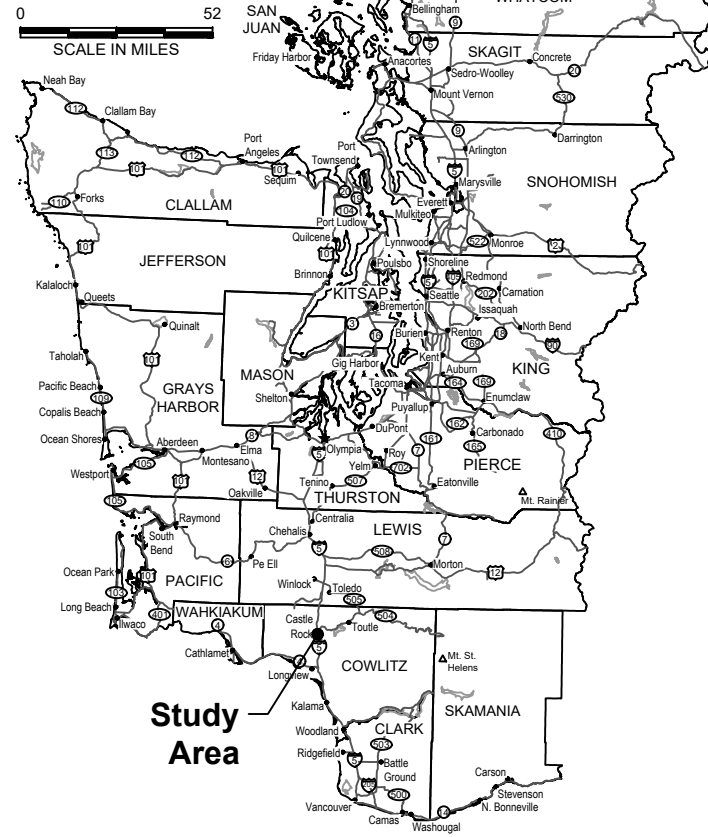
LOCATION MAP



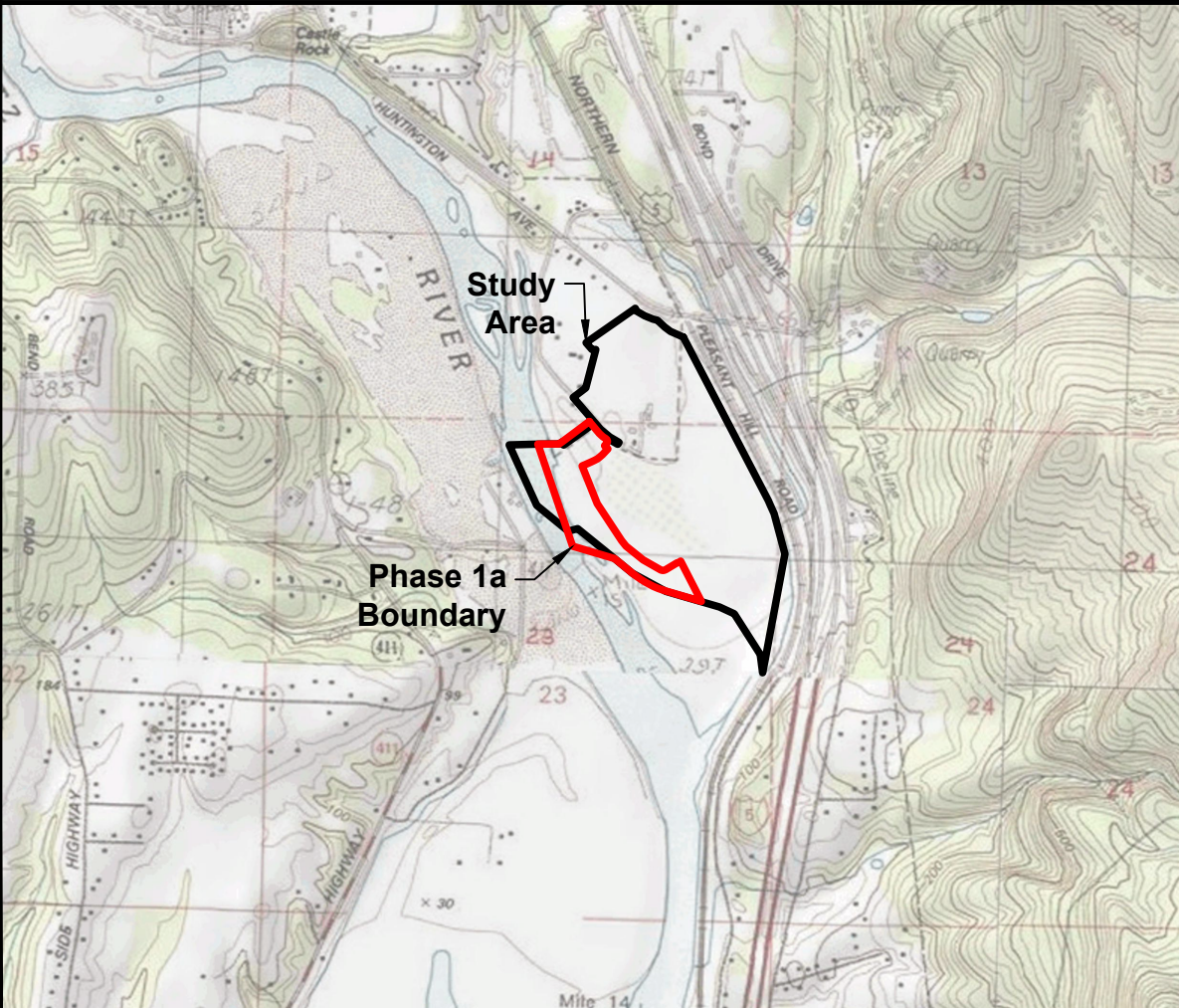
NOTE:

Quadrangle topographic map from USGS.

PROJECT VICINITY MAP



Study Area



Study Area

Phase 1a
Boundary

Figure 1

VICINITY MAP

Castle Rock Business Park Permitting Outfall
CT6, LLC
Castle Rock, Cowitz County, WA
Section 14,23, Township 9N, Range 2W, W.M.

DATE: 2/19/25

DWN: EF

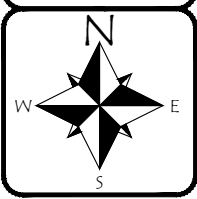
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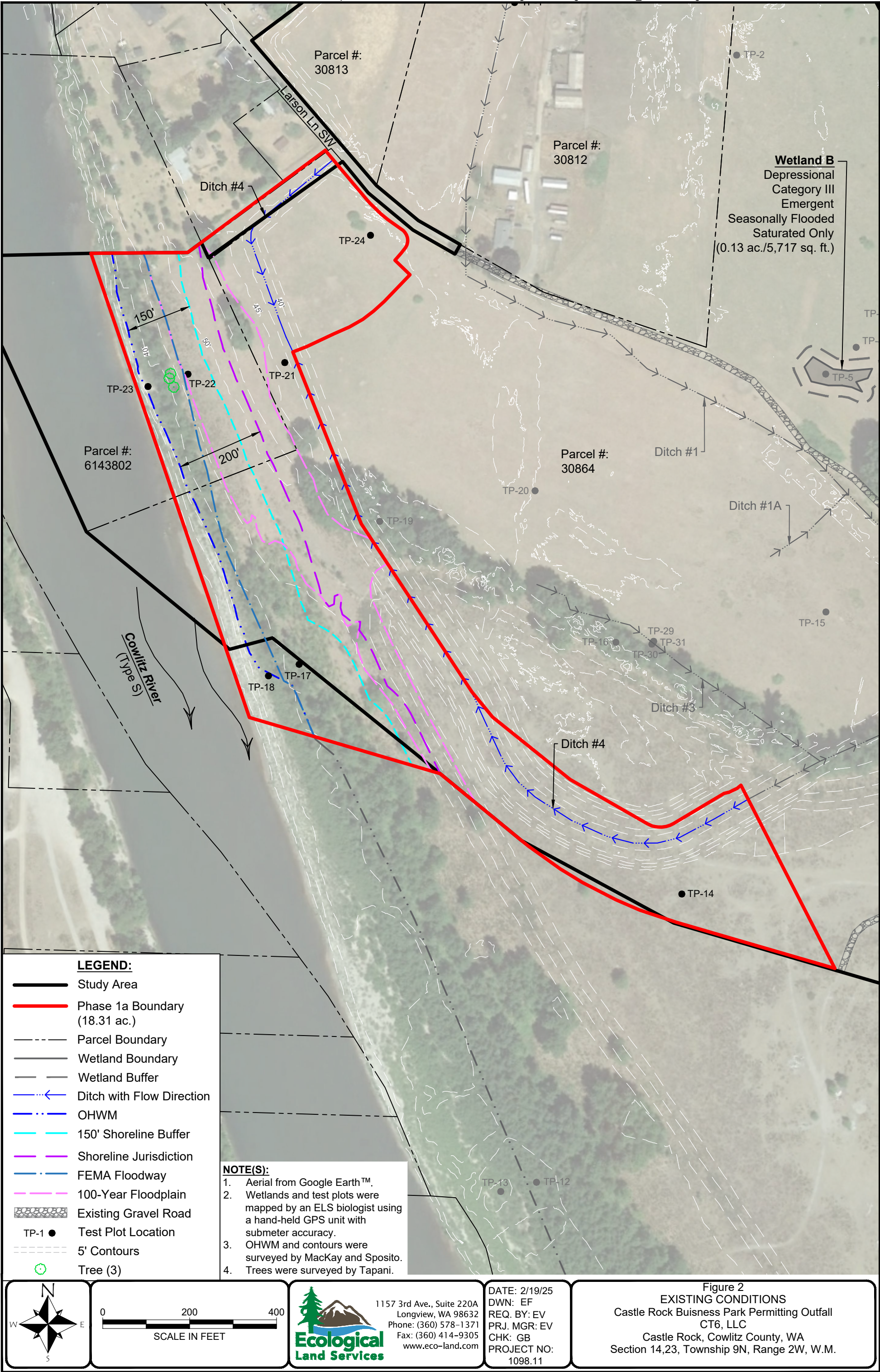
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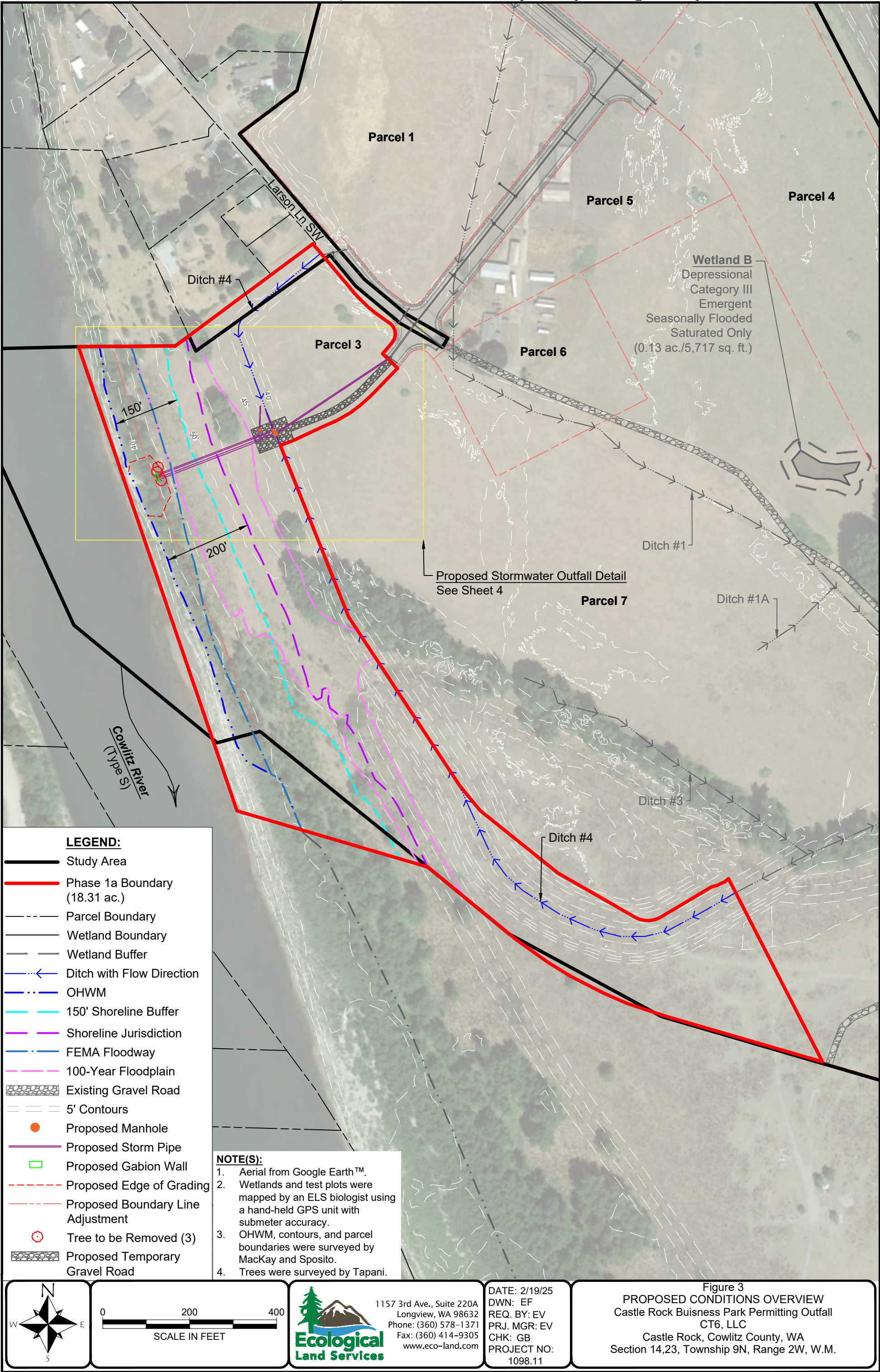
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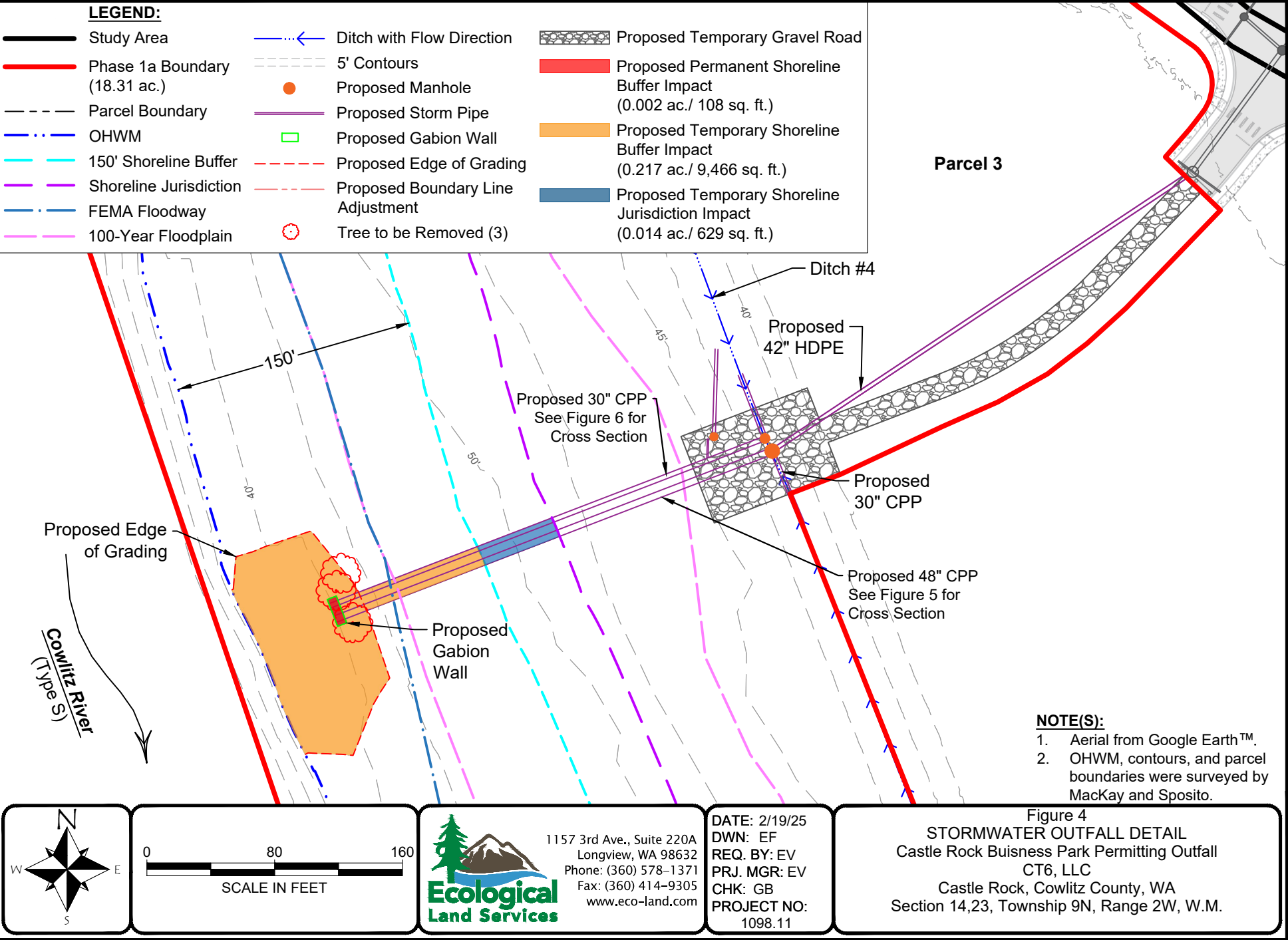
PROJECT NO:
1098.11

1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371
Fax: (360) 414-9305
www.eco-land.com

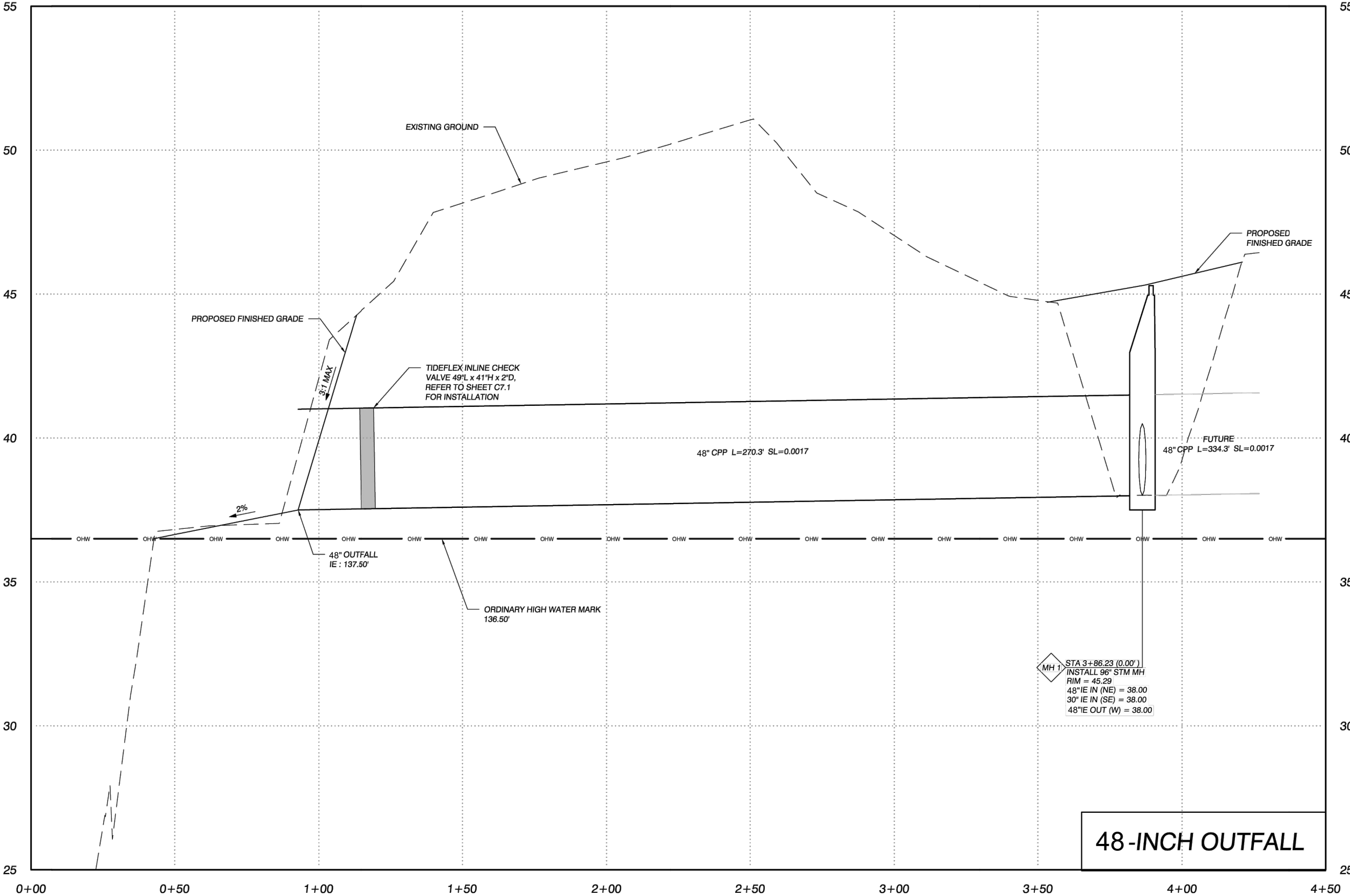




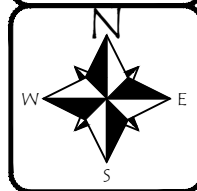




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48-INCH STORMWATER OUTFALL PROFILE



NOT TO SCALE

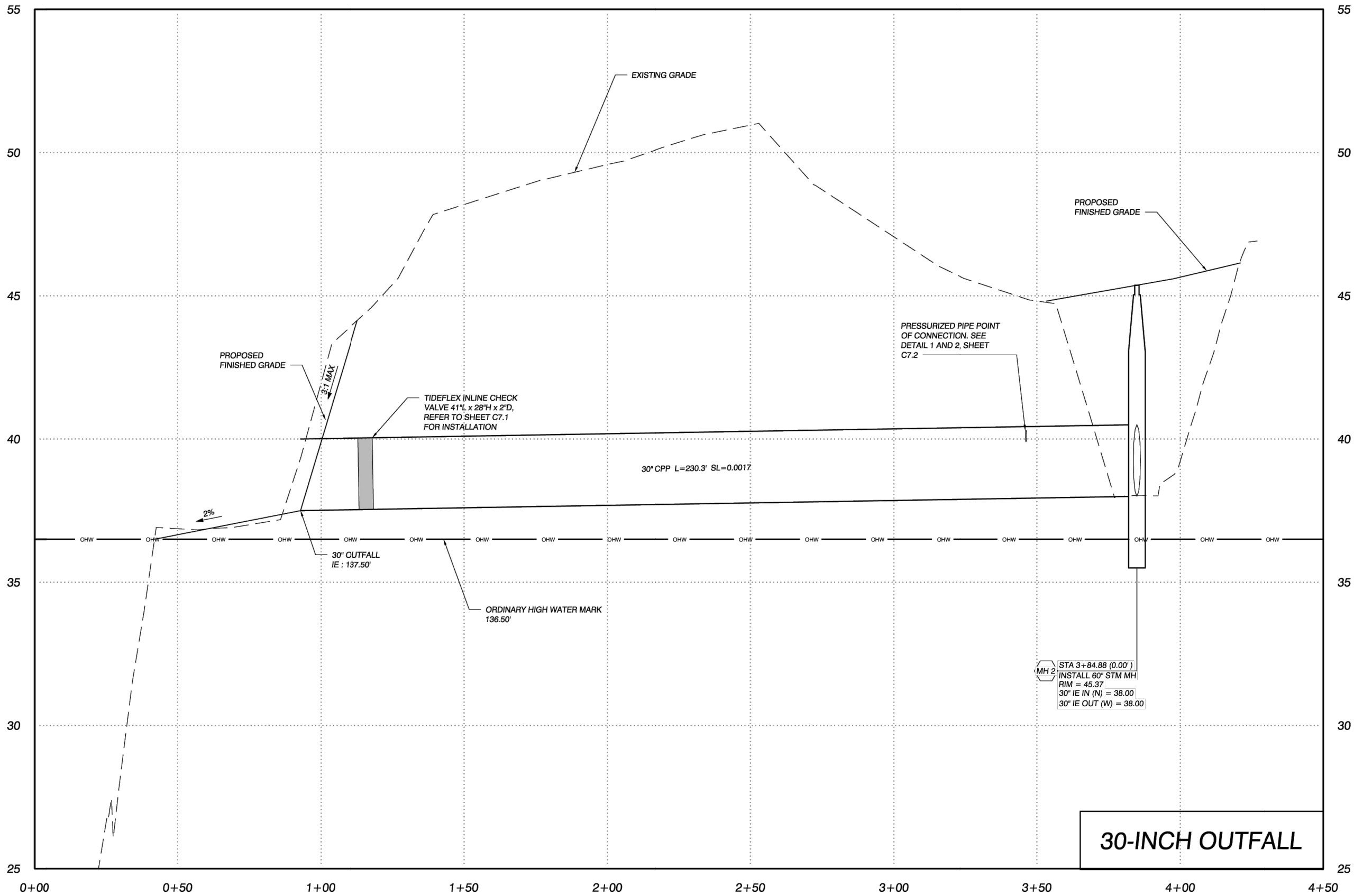


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PROJECT NO: 1098.11

Figure 5
48 INCH STORMWATER OUTFALL - CROSS SECTION
Castle Rock Business Park Permitting Outfall
CT6, LLC
Castle Rock, Cowitz County, WA
Section 14.23, Township 9N, Range 2W, W.M.

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30-INCH STORMWATER OUTFALL PROFILE



NOT TO SCALE

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Fax: (360) 414-9305
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Ecological Land Services

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PROJECT NO: 1098.11

Figure 6
30 INCH STORMWATER OUTFALL - CROSS SECTION
Castle Rock Business Park Permitting Outfall
CT6, LLC
Castle Rock, Cowitz County, WA
Section 14.23, Township 9N, Range 2W, W.M.

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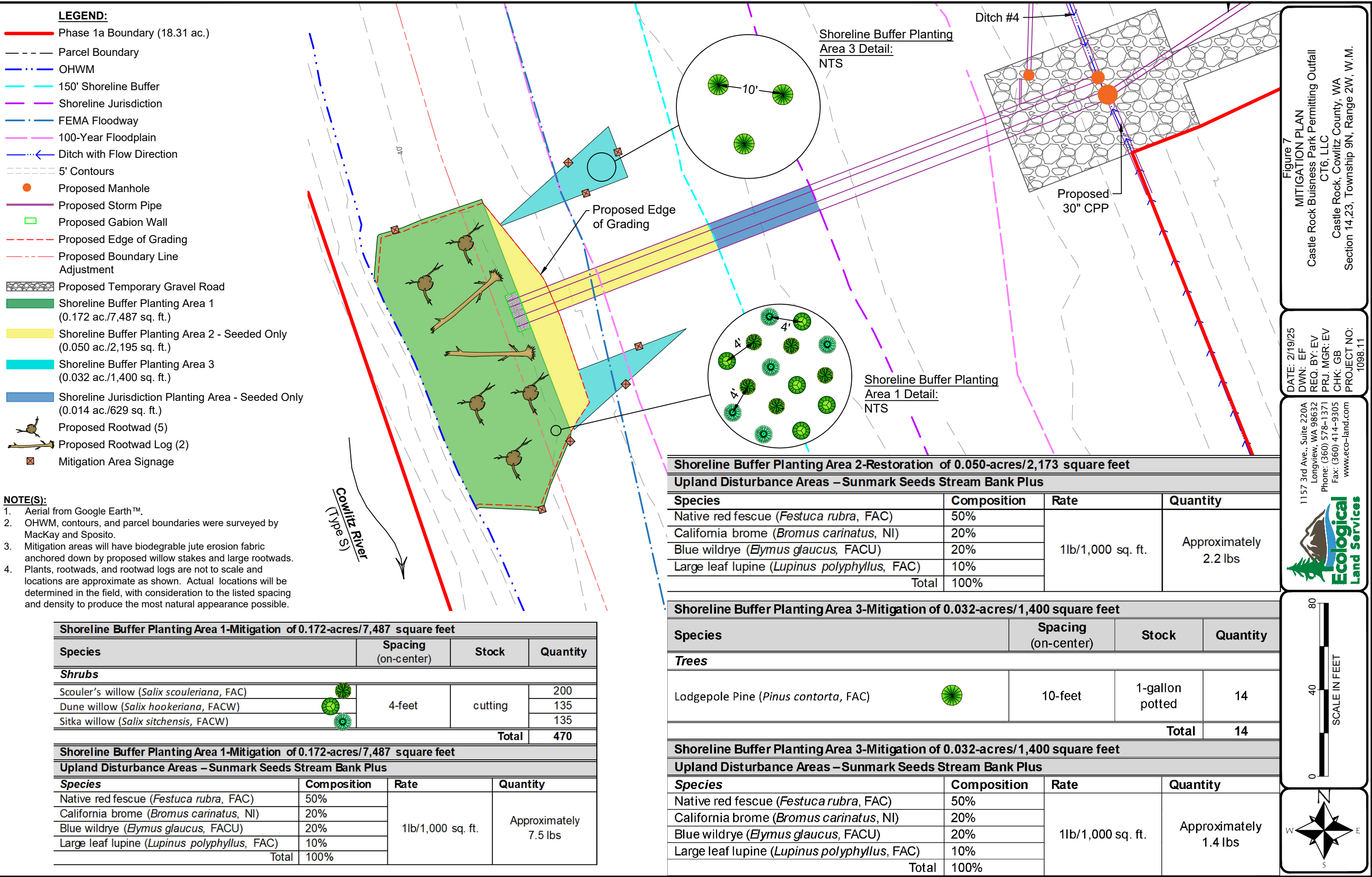


Figure 7

MITIGATION PLAN

Castle Rock Business Park Permitting Outfall

CT6, LLC

Castle Rock, Cowlitz County, WA

Section 14.23, Township 9N, Range 2W, W.M.

DATE: 2/19/25

DWN: EF

REQ. BY: EV

PRJ. MGR: EV

CHK: GB

PROJECT NO: 1098.11

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Ecological Land Services

0 40 80

SCALE IN FEET



December 4, 2024

CT6, LLC
Attn: Mr. Shane Tapani
PO Box 1419
Battle Ground, Washington 98604

Subject: Castle Rock Business Park Memorandum | Update to the Ordinary High Water Mark of the
Cowlitz River | Castle Rock, Cowlitz County, Washington

Mr. Tapani,

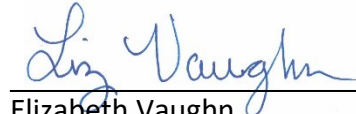
Ecological Land Services, Inc. (ELS) assessed Cowlitz County Parcel Numbers 6143802, 30864, 308640200, 30813, 30812, and a portion of Department of Natural Resources (DNR) property, for critical areas on August 23, 2021 and March 23, 2022 in preparation for future development of the study area. The study area is located in Castle Rock, Washington within Section 23, Township 9 north, and Range 2 west of the Willamette Meridian (Figure 1). ELS has completed further field work regarding the ordinary high water mark (OHWM) of the Cowlitz River. This letter contains details regarding updates to the location of the OHWM in Phase 1a and 1b boundary.

An amended report summarizing methodology and critical areas, *Castle Rock Business Park Amended Critical Areas Report* (ELS 2022), was prepared by ELS and submitted to Mr. James Carsner of the U.S. Army Corps of Engineers (Corps) and to the appropriate Washington Department of Ecology (Ecology) staff for the purpose of a formal wetland boundary verification and verification of the OHWM flagging on the Cowlitz River and Salmon Creek in 2022. Wetland and stream boundaries and the OHWM of the Cowlitz River were verified by Ecology via email on August 25, 2022 and by Corps on September 16, 2022 (Corps Reference Number NWS-2022-557).

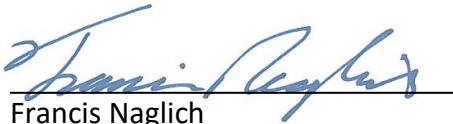
An additional study area visit was conducted to revise the OHWM boundary with Ecology on August 29, 2024 and verified via email the same day. Additionally, the boundary of future proposed development of a stormwater outfall conveyance system has been added (Phase 1a) and the boundary of future proposed development of a recreational RV park (Phase 1b). The Phase 1a and 1b boundary and verified changes to the OHWM of the Cowlitz River are shown on Figure 2.

If you have any questions please contact Elizabeth Vaughn at elizabeth@eco-land.com, or Francis Naglich at francis@eco-land.com, or by phone at (360) 578-1371.

Sincerely,

A handwritten signature in blue ink, reading "Liz Vaughn", written over a horizontal line.

Elizabeth Vaughn
Wetlands Biologist I

A handwritten signature in blue ink, reading "Francis Naglich", written over a horizontal line.

Francis Naglich
Principal/Sr. Wetland Biologist

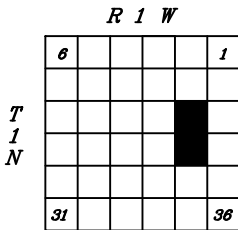
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WASHINGTON



Latitude: 46.2552°
Longitude: -122.8900°

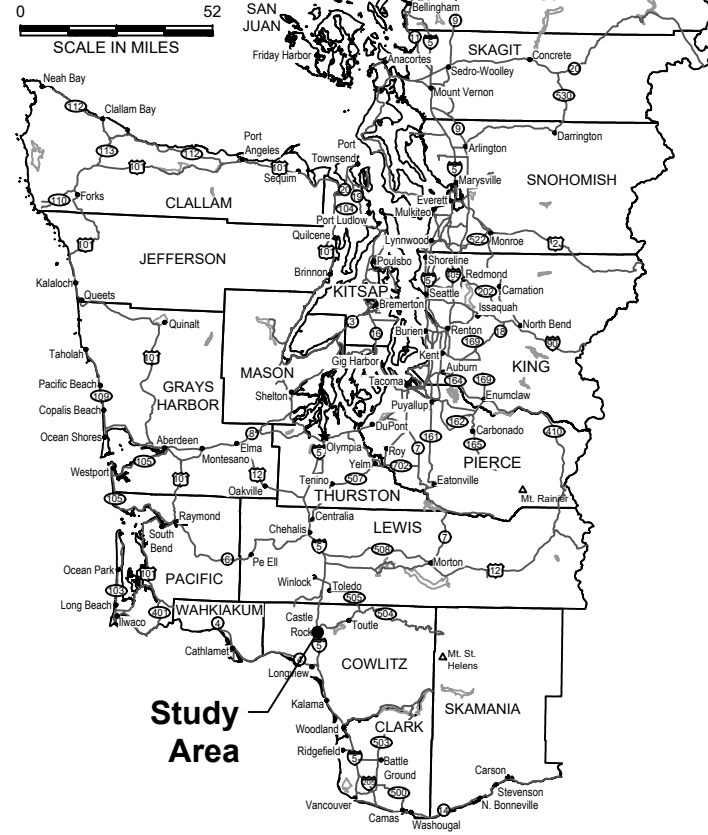
LOCATION MAP



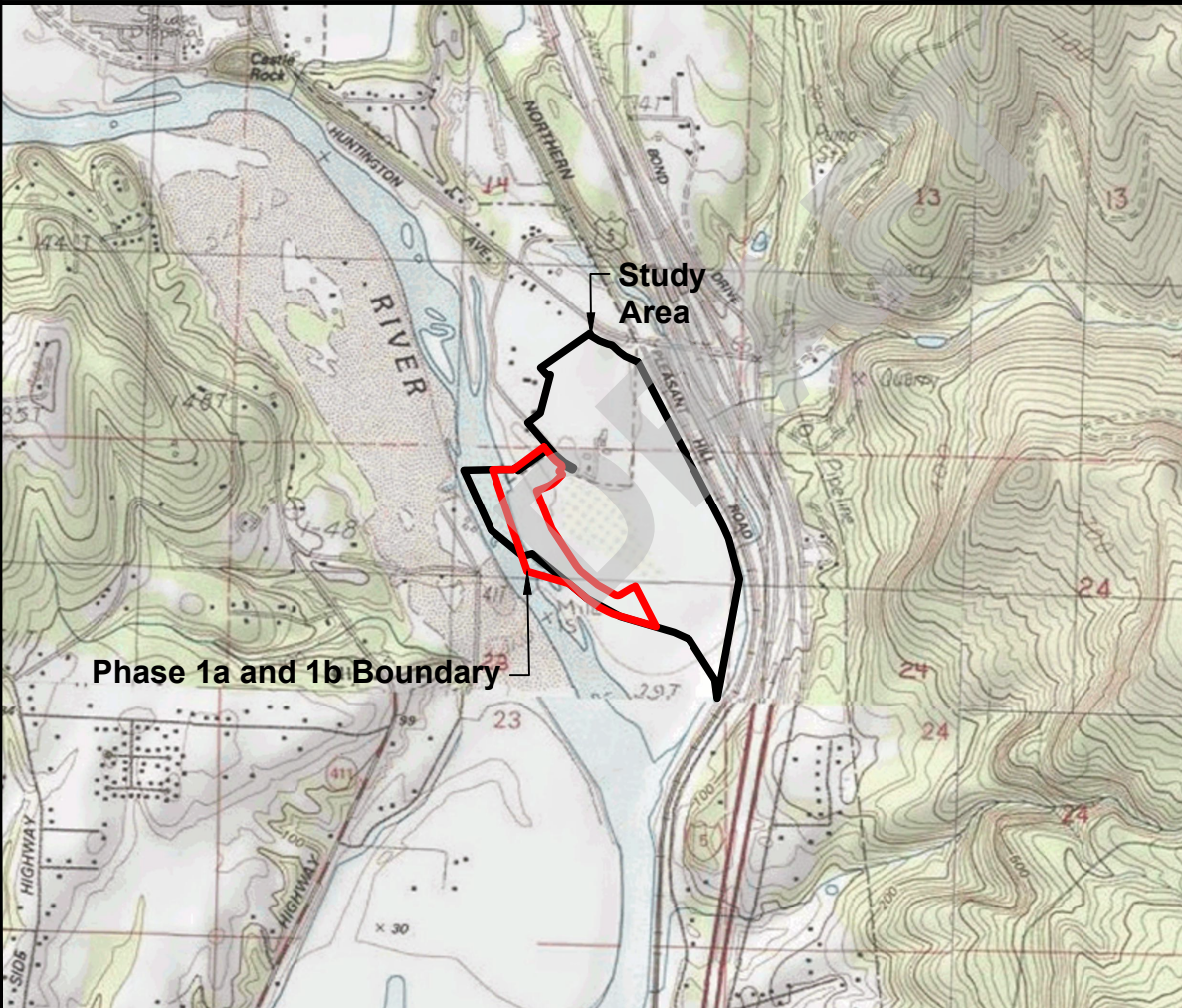
NOTE:

Quadrangle topographic map from USGS.

PROJECT VICINITY MAP



Study Area



Phase 1a and 1b Boundary

Figure 1

VICINITY MAP

Castle Rock Business Park Permitting Memo

CT6, LLC

Castle Rock, Cowlitz County, WA

Section 14,23, Township 9N, Range 2W, W.M.

DATE: 12/4/24

DWN: EF

REQ. BY: EV

PRJ. MGR: EV

CHK: GB

PROJECT NO: 1098.11

1157 3rd Ave., Suite 220A

Longview, WA 98632

Phone: (360) 578-1371

Fax: (360) 414-9305

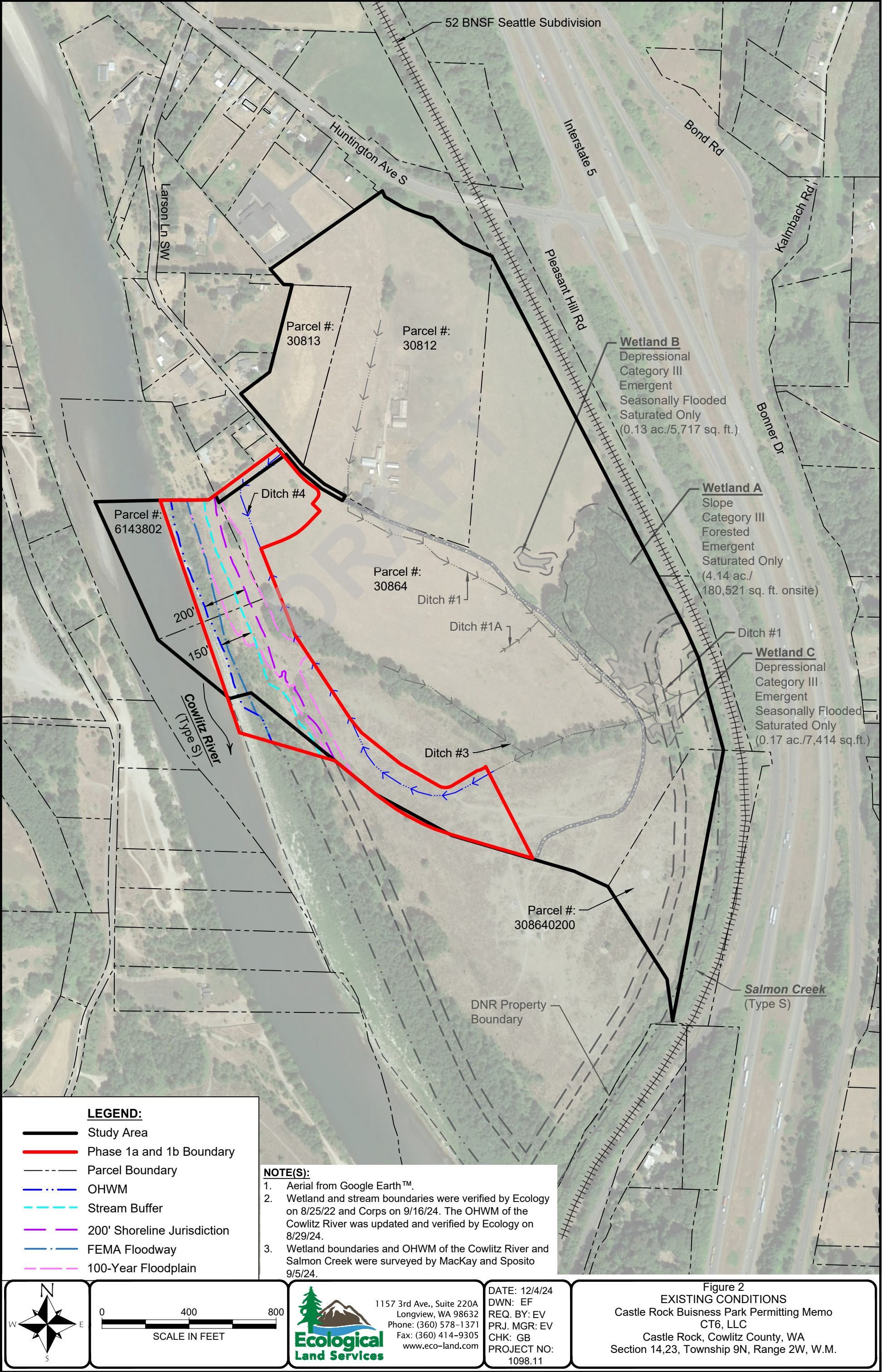
www.eco-land.com



0 2000 4000

SCALE IN FEET







Excavation and Grading

Supplemental Addendum

Page 1 of 4

141 A St SW / PO Box 370

Castle Rock, WA 98611

Phone: (360) 274-8181

finance@ci.castle-rock.wa.us

kakesson@ci.castlerock.wa.us

Permits Required

Except as specified below, no person shall do any grading without first having obtained a grading permit from the building official.

Exempted Work

A grading permit is not required for the following:

1. When approved by the building official, grading in an isolated, self-contained area if there is no danger to private or public property.
2. An excavation below finished grade for basements and footings of a building, retaining wall or other structure authorized by a valid building permit. This shall not exempt any fill made with the material from such excavation or exempt any excavation having an unsupported height greater than 5 feet (1524 mm) after the completion of such structure.
3. Cemetery graves.
4. Refuse disposal sites controlled by other regulations.
5. Excavations for wells, tunnels or utilities.
6. Mining, quarrying, excavating, processing or stockpiling of rock, sand, gravel, aggregate or clay where established and provided for by law, provided such operations do not affect the lateral support or increase the stresses in or pressure upon any adjacent or contiguous property.
7. Exploratory excavations under the direction of soil engineers or engineering geologists.
8. An excavation that (1) is less than 2 feet (610 mm) in depth or (2) does not create a cut slope greater than 5 feet (1524 mm) in height and steeper than 1 unit vertical in 1 ½ units horizontal (66.7% slope).
9. A fill less than 1 foot (305 mm) in depth and placed on natural terrain with a slope flatter than 1 unit vertical in 5 units horizontal (20% slope), or less than 3 feet (914 mm) in depth, not intended to support structures, that does not exceed 50 cubic yards (38.3 M3) on any one lot and does not obstruct a drainage course. Exemption from a permit shall not be deemed to grant authorization for any work to be done in any manner in violation of the provisions of the International Building Code or any other laws or ordinances of this jurisdiction.

If you feel your project is exempt from permit; please circle the appropriate items above. Even if you feel your project is exempt from permits, please provide the drawings required on page two (2) and the following information:

How much total volume of material is involved in the excavation and grading activity? Be sure to include cuts, Fills and/or road building. (27 cubic feet = 1 cubic yard) 1,098 CY

Indicate the type of excavation and/or grading activity (CIRCLE ALL THAT APPLY):

☒ Cut ☐ Fill ☒ Grading Foundation Excavation Road building
☒ Placing Culverts/Utilities* Retaining Wall ☒ Landscaping



Excavation and Grading Supplemental Addendum

Page 2 of 4

Provide the following information for CUTS:

No. Cubic Yards: 121 CY
Finished Slope of Cut: 0% - 33%
Slope Prior to Cutting: 0% - 50%

Provide the following information for FILLS:

No. Cubic Yards: 977 CY
Slope Prior to Filling: 0% - 50%
Maximum Depth of Fill: 7.5'
Finished Slope of Fill: 0% - 33%
Material Used for Fill: On-Site Borrow

What type of material is involved in the excavation and grading activity (Including Cuts and Fills)?

	Amount in Cubic Yards	Percentage of Total Amount
Dirt/Soil	<u>1,098 CY</u>	<u>100%</u>
Large Rock 12"+	<u></u>	<u></u>
Pit Run 4"-12"	<u></u>	<u></u>
Fines Less Than 4"	<u></u>	<u></u>
Concrete over 12"	<u></u>	<u></u>
Concrete Less Than 12"	<u></u>	<u></u>
Other (State Type)	<u></u>	<u></u>

Will the proposed excavation and/or grading cause one of the following (Circle YES or NO).

- YES ☒ NO ☐ Create runoff
YES ☒ NO ☐ Will runoff impact neighboring property
☒ YES ☐ NO Will finish grading retain runoff on property
☒ YES ☐ NO Will the effects of the runoff be negligible
☒ YES ☐ NO Will runoff be contained within an approved drainage system

Describe impacts of runoff after filling and/or finish grading (If you answered YES to any of the above items, please explain):

Runoff from the proposed grading will be controlled to contain sedimentation and prevent runoff onto properties adjacent to the project site. The effects of the runoff will be negligible, as BMPs will be put in place to mitigate any impacts from runoff. Flow paths and runoffs will utilize the existing drainage channels and outfall after sedimentation removal.

What measures will be implanted for erosion control?

BMPs from the 2019 Stormwater Management Manual for Western Washington will be implemented including the following: BMP C105, C120, C130, C201, C233

If your excavation/grading activity meets one or more of the following criteria, you may be deemed exempt From SEPA review. (CHECK applicable spaces below):

- ☐ Activity involves less than 100 cubic yards
☐ Is for septic system installation
☐ Is for foundation excavation or associated backfill
☐ Is for Landscaping

A SEPA Review was previously completed for this area with the mass grading permit

***NOTE:** Some projects may require additional information, plans or permits upon our review.

Signature: _____ Date: _____



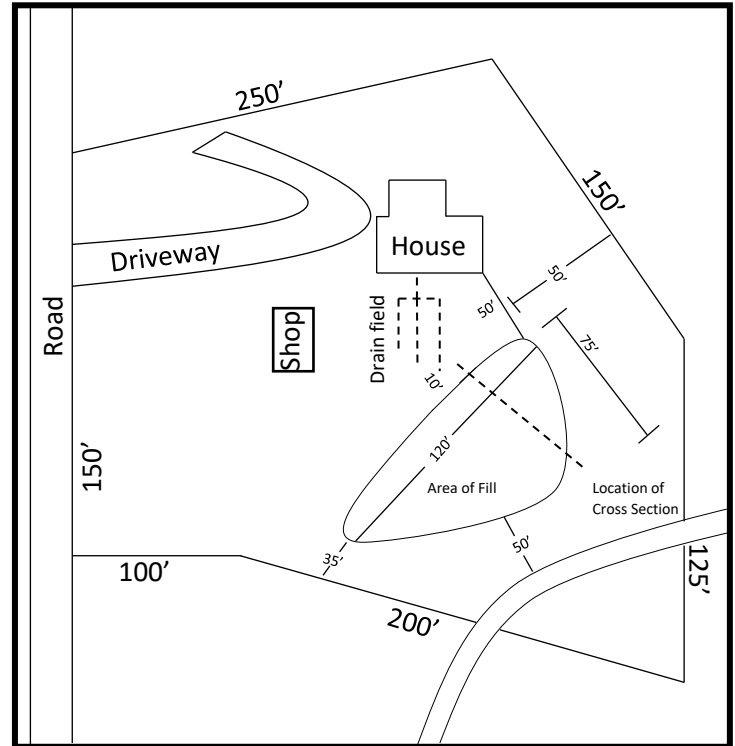
Excavation and Grading Supplemental Addendum

Page 3 of 4

SITE PLAN MUST SHOW:

1. Lot dimensions and property lines.
2. Directional arrow indicating north.
3. Any existing or proposed roads or driveways.
4. Any existing structures and their distances to each other, to property lines, to the centerline of the road and to ascending and descending slopes.
5. Location of drain fields, slope of land, wells, and their distances o proposed or existing structures or projects.
6. Location and dimensions of any excavation or grading.
7. Bodies of water, natural and manmade (streams, creeks, rivers, ditches, etc.), and distance to proposed structures or developments.
8. All easements (utility, access, etc.)
9. Adjacent property addresses and uses.
10. Location of retaining walls.

EXAMPLE SITE PLAN:



APPLICANT'S SITE PLAN:

see attached



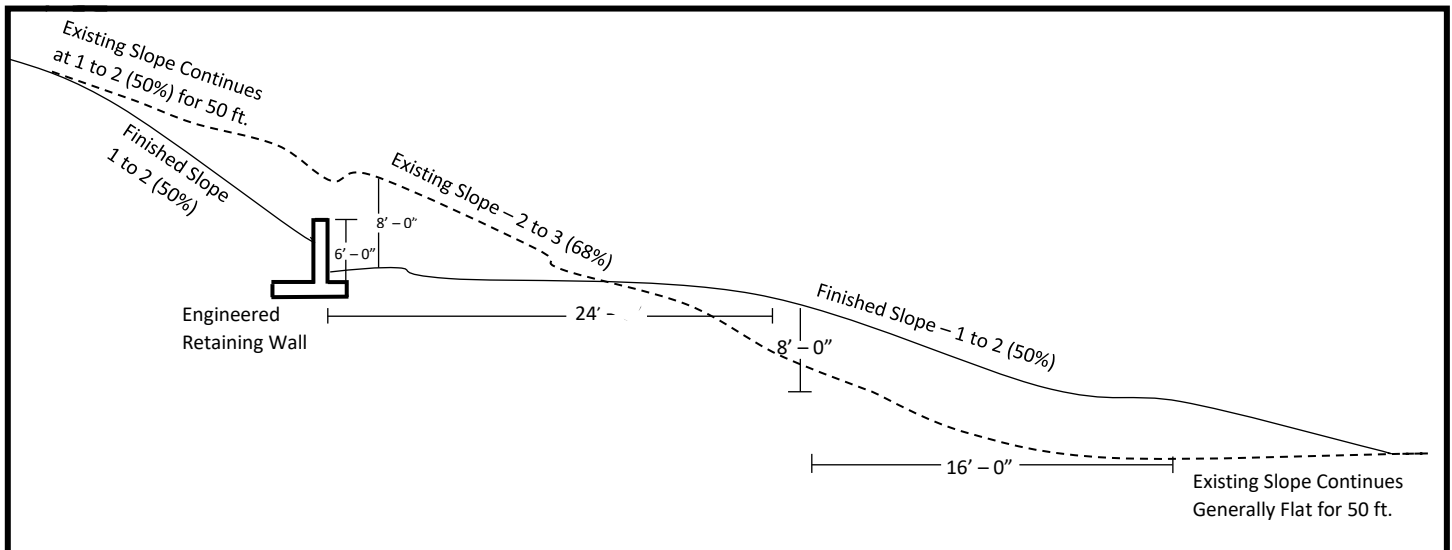
Excavation and Grading Supplemental Addendum

Page 4 of 4

CROSS SECTION MUST SHOW:

1. Maximum depth of fill and maximum height of cut.
2. Buildings and their setbacks to ascending and descending slopes.
3. Existing grade (before any work is done) to extend a minimum 20' beyond scope of work.
4. Finished grade of cuts and fills to extend a minimum of 20' beyond scope of work.
5. Retaining walls.
6. Grade of all existing cut and fill areas (ex. 2 units horizontal to 1 unit vertical).

EXAMPLE CROSS SECTIONS:



APPLICANT'S CROSS SECTION:

see attached

City of Castle Rock

PO Box 370
Castle Rock, WA 98611
(360) 274-7478



Letter of Completeness

CT6, LLC
Ingrid Friedberg,
Special Projects Manager
PO Box 1419, Battle Ground, WA 98604

RE: Landing on the Cowlitz Stormwater Outfall: Substantial Shoreline Development Permit (SSDP)
and SEPA Checklist

Ms. Friedberg,

Thank you for submitting a Substantial Shoreline Development Permit (SSDP) and SEPA Checklist to the City of Castle Rock to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOTIC) Master Plan. The site is located within the Recreation designated portion of the approved LOTIC Master Plan and recently approved Boundary Line Adjustment (CR-BLA-24-01) Parcel 3 and Parcel #308110100.

The city has received the following application materials:

1. Application Submittal Overview
2. Signed Master Application Form
3. Narrative
4. SEPA Checklist
5. Habitat Management, Mitigation and Monitoring Plan dated February 19, 2025, by Ecological Land Services
6. Ordinary High-Water Mark Memo dated December 4, 2024, by Ecological Land Services
7. Check in the amount of \$1,500.00 and a check in the amount of \$300 made payable to the City of Castle Rock

This letter acts as a letter of completeness for materials received related to the Substantial Shoreline Development Permit (SSDP) and SEPA Checklist. Please keep in mind that during the technical review the city can request clarification, revisions or additional information.

The Shoreline Substantial Development Permit and SEPA will be integrated into the current engineering review for Phase 1 Access & Utilities and the Stormwater Outfall, and all public meetings will be consolidated to streamline the permitting process.

Please reach out if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read 'Ran', with a stylized, flowing script.

Rachel Granrath, Contract Planner

Cc: Karlene Akesson, Deputy Clerk

Exhibit B: Noticing Materials

AFFIDAVIT OF PUBLICATION

Longview Daily News
770 11th Ave
(360) 577-2525

State of Florida, County of Broward, ss:

Rachel Cozart, being first duly sworn, deposes and says: That (s)he is a duly authorized signatory of Column Software, PBC, duly authorized agent of Longview Daily News, published in Cowlitz county, has been approved as a Legal newspaper by order of the Superior court of the State of Washington of Cowlitz County, and that the Annexed printed copy is a true copy of the notice in the above entitled matter as it was printed in the regular entire issue of said paper and online at www.tdn.com , for publication dates as listed below, and that said newspaper was regularly distributed to its subscribers during all of said period, and that said notice was published in said paper and not in a supplement form. That the full amount of the fee charged for said forgoing publication is as listed below, and is \$3.50 per line for the first insertion and \$3.00 per line for each subsequent insertion. There is also an additional charge of \$10.00 for every additional affidavit copy over two copies.

PUBLICATION DATES: May. 27 2025

NOTICE ID: cOHx7zvUzI18HHJGIFFH

PUBLISHER ID: COL-WA-100925

NOTICE NAME: CR-25-007/008 - SSDP/SEPA - LOTC Stormwater

Publication Fee: \$363.10

Rachel Cozart

(Signed) _____

VERIFICATION

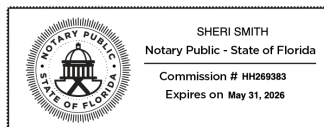
State of Florida
County of Broward

Subscribed in my presence and sworn to before me on this: 06/02/2025

S. Smith

Notary Public

Notarized remotely online using communication technology via Proof.

**PUBLIC NOTICE**

Notice of SEPA Mitigated Determination of NonSignificance (MDNS), Substantial Shoreline Development Permit, and Public Hearing

Phase 1: Stormwater Outfall Landing on the Cowlitz Master Planned Development

Lead Agency: City of Castle Rock, WA

Proponent: CT6, LLC

Location: Landing on the Cowlitz (LOT) Master Plan, formally Parcel 3 (#6143802), adjusted per Boundary Line Adjustment (CR-BLA-24-01 - AFN#3762029)

Description of proposal:

The applicant has submitted a Substantial Shoreline Development Permit (SSDP) and SEPA Checklist to the City of Castle Rock to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOT) Master Plan.

Mitigated Determination of Non-Significance (MDNS):

The City of Castle Rock has determined that this proposal will not have a probable significant adverse impact on the environment. Pursuant to WAC 197-11-350(3), the proposal has been clarified, changed, and conditioned to include necessary mitigation measures to avoid, minimize or compensate for probable significant impacts. Materials are available at the City's website www.ci.castle-rock.wa.us or available to the public on request at: 141 "A" Street SW, Castle Rock, WA 98611.

Notice of Public Hearing of the Planning Commission:

Date: June 17, 2025

Time : 6:00 pm

Location : Castle Rock Senior Center 222 2nd Ave SW, Castle Rock, WA 98611

Purpose: To review the proposed Substantial Shoreline Development permit and SEPA MDNS to construct a stormwater outfall with the first phase of development.

This MDNS is issued under WAC 197-11-350 and the comment period will end on June 10, 2025.

Agency Contact: City Contract Planner Rachel Granrath, Submit written comments to: Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611 or to kakesson@ci.castle-rock.wa.us

Signature: Rachel Granrath, May 20, 2025

Appeal: Castle Rock Municipal Code (CRMC) 18.04.210 and 18.04.220 (E)
5/27 COL-WA-100925

Notice of SEPA MDNS, Substantial Shoreline Development Permit, and Public Hearing

1 message

Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Tue, May 27, 2025 at 8:15 AM

To: Carie Cuttonaro <ccuttonaro@ci.castle-rock.wa.us>, Jason Lugo <jason.lugo@wsdot.wa.gov>, "Mendoza, Jennifer" <mendozaj@cowlitzwa.gov>, sepaunit@ecy.wa.gov, Chris Fritsch <cfritsch@crschools.org>, Taylor Aalvik <taylor.a@cowlitz.org>, SEPA@dahp.wa.gov, "McCoy, Catherine (COM)" <catherine.mccoy@commerce.wa.gov>, Mike Moss <mossm@co.cowlitz.wa.us>, Kessina Lee <TeamRidgefield@dfw.wa.gov>, David Vorse <crpvd@ci.castle-rock.wa.us>, TDN Front Door <frontdoor@tdn.com>, Bill Fashing <bfashing@cwccog.org>, Laurie Lebowsky <laurie.lebowsky@wsdot.wa.gov>, pacific-cascade.region@dnr.wa.gov, Andrea Yoho <yohoa@cowlitzwa.gov>, NRD-Cowlitz Indian Tribe <NRDpermit@cowlitz.org>, Christina Hallock <Tina@swcleanair.org>, sepacenter@dnr.wa.gov, Christian Cordova <Christian.Cordova@wsdot.wa.gov>, Bill LeMonds <chief@cowlitz6fire.org>, Rudy Salakory <Rsalakory@cowlitz.org>, Lorie Clark <lclark@lcfwb.gen.wa.us>, Rachel Granrath <Rachel.Granrath@kimley-horn.com>, Charles Worley <cworley@crpolice.org>, Department of Fish and Wildlife Southwest - Region 5 <R5.planning@dfw.wa.gov>, Duane Johnson <Duane@swcleanair.org>, Jeff Barsness <jeff.barsness@wsdot.wa.gov>
Cc: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Good morning,

Please see the attached NOTICE of SEPA Mitigated Determination of Nonsignificance (MDNS), Substantial Shoreline Development Permit (SSDP), and Public Hearing for the proposed construction of the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOT) Master Plan.

Materials are available to be viewed online at:
<https://ci.castle-rock.wa.us/notices.htm>

Sincerely,
Karlene Akesson
Deputy Clerk
City of Castle Rock
PO Box 370
Castle Rock, WA 98611
Phone: 360-274-8181

City Hall Hours Effective January 2, 2024:

Monday through Thursday, 7:30 AM – 5:00 PM

CLOSED Friday and legal holidays



Public Notice SEPA MDNS SSDP Stormwater Outfall with Map.pdf
303K

City of Castle Rock

PO Box 370
Castle Rock, WA 98611
(360) 274-7478



PUBLIC NOTICE

Notice of SEPA Mitigated Determination of NonSignificance (MDNS), Substantial Shoreline Development Permit, and Public Hearing Phase 1: Stormwater Outfall Landing on the Cowlitz Master Planned Development

Lead Agency: City of Castle Rock, WA

Proponent: CT6, LLC

Location: Landing on the Cowlitz (LOTIC) Master Plan, formally Parcel 3 (#6143802), adjusted per Boundary Line Adjustment (CR-BLA-24-01 – AFN#3762029)

Description of proposal: The applicant has submitted a Substantial Shoreline Development Permit (SSDP) and SEPA Checklist to the City of Castle Rock to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOTIC) Master Plan.

Mitigated Determination of Non-Significance (MDNS): The City of Castle Rock has determined that this proposal will not have a probable significant adverse impact on the environment. Pursuant to WAC 197-11-350(3), the proposal has been clarified, changed, and conditioned to include necessary mitigation measures to avoid, minimize or compensate for probable significant impacts. Materials are available at the City's website www.ci.castle-rock.wa.us or available to the public on request at: 141 "A" Street SW, Castle Rock, WA 98611.

Notice of Public Hearing of the Planning Commission:

Date: June 17, 2025

Time: 6:00 pm

Location: Castle Rock Senior Center 222 2nd Ave SW, Castle Rock, WA 98611

Purpose: To review the proposed Substantial Shoreline Development permit and SEPA MDNS to construct a stormwater outfall with the first phase of development.

This MDNS is issued under WAC 197-11-350 and the comment period will end on June 10, 2025.

Agency Contact: City Contract Planner Rachel Granrath,
Submit written comments to: Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611 or to kakesson@ci.castle-rock.wa.us

Signature: Rachel Granrath, May 20, 2025

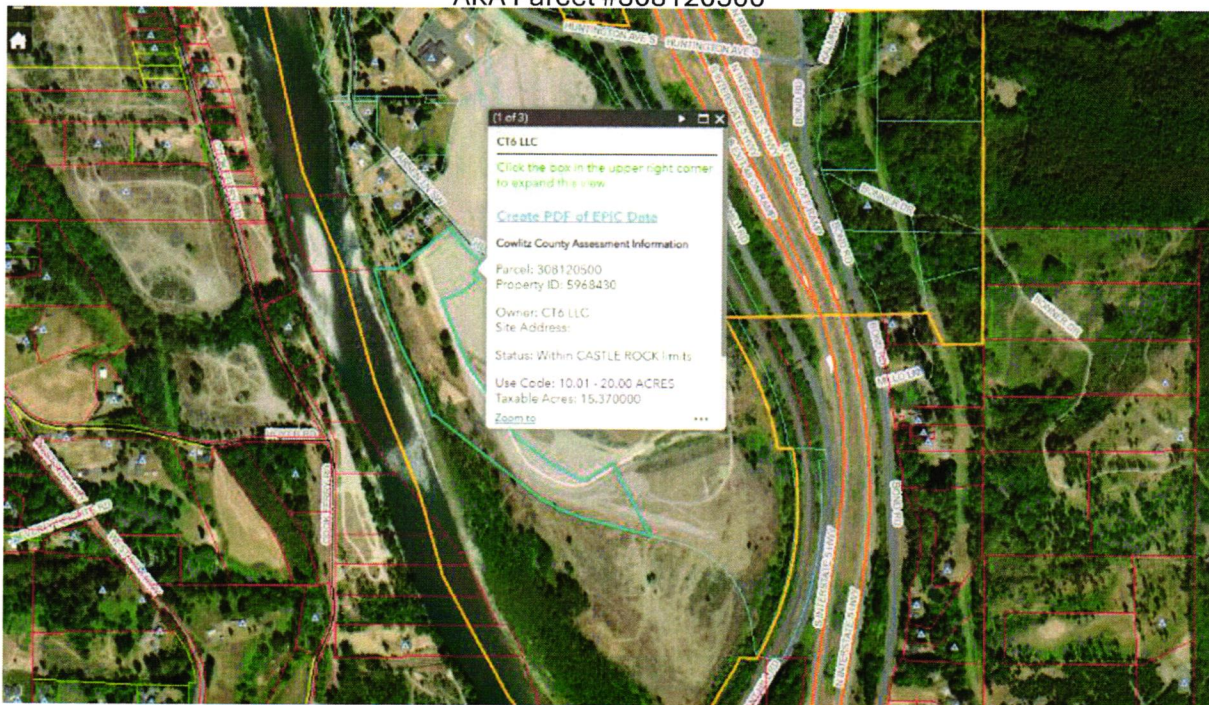
Appeal: Castle Rock Municipal Code (CRMC) 18.04.210 and 18.04.220 (E)

Parcel #6143802

#CR- BLA-24-01, Parcel 3



AKA Parcel #308120500



Posted at: City Hall, CR Post Office, CR Library on 05/27/2025
mailed on: 05/27/2025
Notice + Materials Posted on Website: 05/27/2025



Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Larson lane

2 messages

Brice Anshutz <banshutz@ci.castle-rock.wa.us>
To: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Tue, May 27, 2025 at 8:05 AM

Brice Anshutz <banshutz@ci.castle-rock.wa.us>
To: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Tue, May 27, 2025 at 8:10 AM



On Tue, May 27, 2025, 8:05 AM Brice Anshutz <banshutz@ci.castle-rock.wa.us> wrote:
Posted on site: 05/27/2025



Posted on site: 05/27/2025

Exhibit C: SEPA MDNS

City of Castle Rock

PO Box 370
Castle Rock, WA 98611
(360) 274-7478



STATE ENVIRONMENTAL POLICY ACT Mitigated Determination of NonSignificance

May 20, 2025

Lead Agency: City of Castle Rock, Washington

Agency Contact: City Contract Planner Rachel Granrath,

Comments submitted to Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611
or to kakesson@ci.castle-rock.wa.us

Project Description: The applicant has submitted a Substantial Shoreline Development Permit (SSDP) and SEPA Checklist to the City of Castle Rock to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOT) Master Plan.

Project Location: The site is located within the Recreation designated portion of the approved LOT Master Plan, formally Parcel 3 (#6143802), adjusted per Boundary Line Adjustment (CR-BLA-24-01 – AFN#3762029). The Castle Rock Landing on the Cowlitz Master Planned Mixed Use Development site is accessed from I-5 from Exit #48 and is located on the south side of Huntington Avenue S, approximately 4 mile west of the exit. The site is located within the Recreation designated portion of the approved Landing on the Cowlitz Master Plan.

Proponent: CT6, LLC

Project Representative: Ingrid Friedberg, Special Projects Manager

Mailing Address: PO Box 1419, Battle Ground, WA 98604

Telephone: (360) 553-9144

Email: ingridf@tapani.com

The City of Castle Rock has determined that this proposal will not have a probable significant adverse impact on the environment. Pursuant to WAC 197-11-350(3), the proposal has been clarified, changed, and conditioned to include necessary mitigation measures to avoid, minimize or compensate for probable significant impacts. An environmental impact statement (EIS) is not required under RCW 43.21C.030. The necessary mitigation measures are listed below, the Environmental Checklist is attached and associated materials are available at the City's website www.ci.castle-rock.wa.us

This determination is based on the following mitigation measures, findings and conclusions:

- **Dedication of Improvements:** Upon completion of construction, all site improvements and associated rights-of-way shall be dedicated to the City.
- **Storm Event Mitigation:** Due to the location of the improvements, the applicant shall implement mitigation measures to address impacts during peak storm events and periods of high water as required by stormwater regulations, standards, codes and subject to approval by the City.
- **General Construction Stormwater Permit Compliance:** The applicant shall either amend the existing General Construction Stormwater Permit (GCSP) for the mass grading project or obtain a new permit to cover construction activities related to site access, utilities, and the stormwater outfall. Compliance with this requirement may be included as a condition of the Mitigated Determination of Nonsignificance (MDNS).
- In the event of inadvertent discovery of archaeological resources during site disturbance, all work shall cease in the vicinity of the find and the City shall be notified immediately for further direction.
- The applicant will remain compliant with the Master Planned Development Agreement and conditions associated.
- The applicant will obtain a substantial shoreline development permit and processed as a Type VIII Permit in CRMC 17.77.040 (8).

This MDNS is issued under WAC 197-11-350 and the comment period will end on June 10, 2025.

Responsible Official:

Agency Contact: City Contract Planner Rachel Granrath,

Submit written comments to: Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611 or to kakesson@ci.castle-rock.wa.us

Telephone: (360) 274-7478.



Signature

May 20, 2025

Appeal process: Castle Rock Municipal Code (CRMC) 18.04.210 and 18.04.220 (E)

Exhibit D: Comments Received



Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Larsen lane -CT6, LLC Tapani, 6 brothers!, hidden 6.

2 messages

sheryl adams <sheryladams2012@yahoo.com>

Sun, Jun 1, 2025 at 9:02 PM

To: kakesson@ci.castle-rock.wa.us

Well , sounds like I was right about Larsen lane 3 years ago ! No one wants to be sold out to tapani and there lies about our road. We were promised no outlet or public access to river , we were promised from the city of castle rock, not to be used!!! City said and tapani said Larsen lane we not be allowed for traffic and be opened for access to development! Also we want our eagles to nest and our beavers not to be bothered also we have geese out with there babies. The wildlife will be impacted on this despicable act done by you the city of castle rock! I was told that our road wasn't going to be touched! See if you keep your word or you sold us out for a pile of cement. And the tax payers are paying for the new water project! . Has the city checked the levels of lead in town at school's pipes! I think that's more important than a development . Don't sell Larsen lane out for tapani and there pile of concrete! It's not right!!! Also the road sign says comments by 10 of June ! Letters are different than what you send . You need to post all letters on road!!!

sheryl adams <sheryladams2012@yahoo.com>

Sun, Jun 1, 2025 at 9:24 PM

To: kakesson@ci.castle-rock.wa.us

Sent from my

> On Jun 1, 2025, at 9:02 PM, sheryl adams <sheryladams2012@yahoo.com> wrote:

>

> Well , sounds like I was right about Larsen lane 3 years ago ! No one wants to be sold out to tapani and there lies about our road. We were promised no outlet or public access to river , we were promised from the city of castle rock, not to be used!!! City said and tapani said Larsen lane we not be allowed for traffic and be opened for access to development! Also we want our eagles to nest and our beavers not to be bothered also we have geese out with there babies. The wildlife will be impacted on this despicable act done by you the city of castle rock! I was told that our road wasn't going to be touched! See if you keep your word or you sold us out for a pile of cement. And the tax payers are paying for the new water project! . Has the city checked the levels of lead in town at school's pipes! I think that's more important than a development . Don't sell Larsen lane out for tapani and there pile of concrete! It's not right!!! Also the road sign says comments by 10 of June ! Letters are different than what you send . You need to post all letters on road!!!

>

>

5 attachments

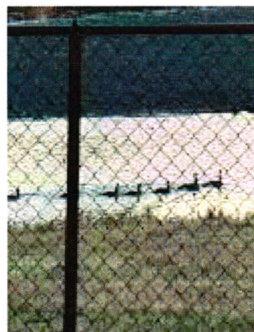


image0.jpeg
2925K

SEPA Record# 202502192
CR-24-051 - CRP-25-007/008

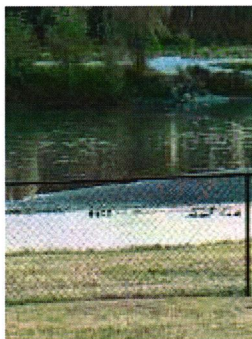


image1.jpeg
3748K



image2.jpeg
2512K



image3.jpeg
2567K



image4.jpeg
3047K



Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Castle rock , tapani construction are back yard to Cowlitz. Babies geese

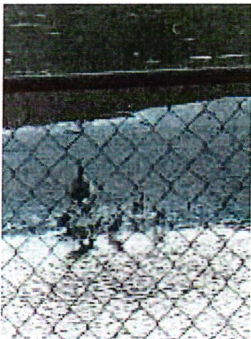
1 message

sheryl adams <sheryladams2012@yahoo.com>
To: kakesson@ci.castle-rock.wa.us

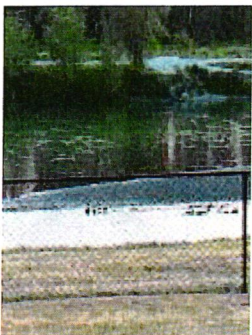
Mon, Jun 2, 2025 at 7:04 PM

Sent from my iPhone

5 attachments



IMG_0534.jpg
2512K



IMG_0533.jpg
3748K

SEPA Record # 20250292
OR-24-051-CRP -25-007/008



IMG_0530.jpg
2925K



IMG_0529.jpg
2458K



IMG_0527.jpg
2992K

This proposed outflow is the harbinger of issues to come and so must bear this present scrutiny not only in design but in its overall purpose. The construction of this outfall raises questions that must begin to be answered at this point in development since an outfall is pointless unless it is attached to some body of water.

1) WOTUS and Setbacks

There is a lack of consensus among the courts as to whether drainage ditches can be considered WOTUS. Please see included documentation from Somach Simmons & Dunn, attorneys at law.

Courts Apply New WOTUS Rule to Ditches and Canal

In the face of this uncertainty it is incumbent upon the applicant to provide for any neighboring property the maximum EPA/governmental agencies setbacks required now or in a future caused by this development. The applicant has created “new drainage features” with the creation of their drainage ditch and should be required to insure that said ditch will NEVER encroach on neighboring property’s ability to build or develop, ie setbacks from waterways or other environmental requirements. To fail to do so would constitute the unlawful use of eminent domain by a corporation.

2) Using the “new drainage ditch” to drain stormwater from Timberlake Church and the properties surrounding them, opens the issue of a previously closed infiltration system (that was totally contained on those properties and did not overflow onto the Hornstra, now Tappani property) to the uncertainties of a WOTUS declaration by the EPA or other agencies and potential loss of development use to the properties it drains. (Please see historical data and brief explanation included.)

It is incumbent upon the developers to a) create a closed infiltration system for these properties similar to the closed system in use before the applicant’s destruction of that system so they could hookup to their “new ditch” or b) insure in perpetuity that their mitigations include all properties that drain stormwater into the “new drainage ditch” and are free from future stormwater related encumbrances to development.

The above stated concerns are relevant at this stage of planning because the applicant is proposing an outflow that directly discharges in a WOTUS River, the Cowlitz, thus forcing a discussion and decision by EPA and other agencies as to whether “the new ditch” including all waters discharged by this outfall and the ditch supplying the outfall will be declared WOTUS and subject to setback and environmental requirements of WOTUS.

Additionally: at present there are no apparent wetlands or environmentally sensitive areas that “the new ditch” drains, but as the ditch ages, wetlands grasses ie wire grass, cattails, and other determinate plants will grow as well as it providing homes for wetland birds and animals. This will create the potential for future EPA and other agencies designation of “the new ditch” (which is drained by this proposed outflow) as an environmentally sensitive area, requiring setbacks and mitigation to development on adjacent properties.

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CR-24-051 - CRP-25-007/008

Finally, I am adamantly opposed to transferring responsibility for maintenance of the infiltration/overflow system to the church. It must remain Tappani's or the city's responsibility to avoid the same scenario as is presently the case where the city approved, privately engineered design, fails to eliminate the stormwater successfully and leaves the landowners holding the bag for remediation. At minimum a 20 year performance bond must guarantee the proper functioning of this system.

This outflow consequently becomes the harbinger of issues to come and so must bear this present scrutiny as part of this decision making process.

Roy Henson
2278 LARSEN LN SW
1933 HUNTINGTON AVE S
2335 LARSEN LN SW

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October 15, 2024 | Written by Ellen M. Moskal

Lack of Consensus Emerges as Courts Apply New WOTUS Rule to Ditches and Canals

The limits to federal jurisdiction over “waters of the United States” (WOTUS) have continued to develop following the Supreme Court’s landmark decision in *Sackett v. Environmental Protection Agency*, as federal district courts begin to vary in determining federal Clean Water Act jurisdiction over manmade ditches and canals.

A critical question, subject to extensive rulemaking and litigation over past decades, involves the extent to which manmade ditches and canals qualify as waters of the United States subject to federal regulation. In 2001, in *Headwaters Inc. v. Talent Irrigation District*, the Ninth Circuit Court of Appeal recognized manmade irrigation canals as WOTUS if water flowed, at least occasionally, through such features into natural streams. The United States Environmental Protection Agency (EPA) took a consistent view, defining WOTUS to include drainage ditches, even with only intermittent flow, provided that they were tributary to a water of the United States and had perceptible ordinary high water marks.

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The landscape changed with the Supreme Court's 2006 decision in *Rapanos v. United States* and *Carabell v. United States* (collectively referred to as *Rapanos*), in which the plurality opinion instituted the "relatively permanent" test ("relatively permanent, standing or continuously flowing bodies of water" that are connected to traditional navigable waters, plus wetlands with a "continuous surface connection" to such relatively permanent water bodies, are WOTUS) while a concurrence relied on the "significant nexus" test (WOTUS include wetlands that possess a "significant nexus" to waters that are or were navigable in fact or that could reasonably be so made). The EPA and Army Corps of Engineers issued guidance in 2008, advising that waters that satisfied either test qualified as WOTUS. The Trump and Biden Administrations subsequently adopted competing definitions of WOTUS within the confines of the *Rapanos* decision.

Then, in May 2023, the Supreme Court decided *Sackett*. The court upheld the "relatively permanent" test to the exclusion of the "significant nexus" test, finding that WOTUS include "only those relatively permanent, standing or continuously flowing bodies of water 'forming geographic[al] features' that are described in ordinary parlance as 'streams, oceans, rivers, and lakes.'" Some interpreted this holding as supporting the position that canals and ditches would not qualify as WOTUS because they are not ordinarily described as streams, oceans, rivers, or lakes. The EPA subsequently adopted a revised definition of WOTUS to comport with the *Sackett* decision, expressly excluding, in relevant part, "Ditches (including roadside ditches) excavated wholly in and draining only dry land and that do not carry a relatively permanent flow of water." The revised definition became effective in September 2023. Notably, this definition does not clearly align with *Sackett*, as it does not address the Supreme Court's expression of the limitation to relatively permanent bodies of water that are ordinarily described as streams, oceans, rivers, and lakes.

Over the last year, United States district courts have begun to apply *Sackett* to determine whether canals and ditches qualify as WOTUS. While a consensus has begun to emerge, it has not been consistently interpreted. In the first case decided after *Sackett*, *San Francisco Baykeeper v. City of Sunnyvale (Baykeeper)*, the District Court for the Northern District of California reconsidered and upheld its pre-*Sackett* holding that a manmade channel qualified as WOTUS. The channel at issue conveys stormwater, irrigation water runoff, and groundwater to traditional WOTUS. The court held that it qualified under *Sackett* because, though it flowed seasonally, "it flows continuously during certain times of the year" and "more than in direct response to precipitation." The court also rejected the "argument that *Sackett* calls into question whether manmade channels with continuous seasonal flows such as this can be [WOTUS] merely because they are manmade." It did not, however, explain why its holding is consistent with *Sackett*'s language limiting WOTUS to those "described in ordinary parlance as 'streams, oceans, rivers, and lakes.'" Similarly, the District Court for the Western District of Washington indicated, in *Waste Action Project v. Girard Res. and Recycling, LLC*, that a ditch flowing into a creek could be grounds for qualification as WOTUS, but did not decide the issue.

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In contrast, other district courts have recognized or applied stricter limitations on manmade ditches. Following *Sackett*, the plaintiff in *Ragsdale v. JLM Construction Services, Inc.* (*Ragsdale*), which was decided in the District Court for the Western District of Texas, abandoned his claims that the defendant violated the Clean Water Act by discharging into manmade features, conceding “that the stock pond, drainage ditches, culverts, and trenches are not covered under the [Clean Water Act].” Similarly, in *United States v. Sharfi* (*Sharfi*), the District Court for the Southern District of Florida in 2024 held that seasonal drainage ditches with varying flow throughout the year were not WOTUS under *Sackett*, focusing on the fact that ditches are not ordinarily described as streams, oceans, rivers, or lakes, and that flow was intermittent. Notably, the *Ragsdale* and *Sharfi* courts both cited *Baykeeper* for the general history of the WOTUS rule leading up to *Sackett*, but did not explain or otherwise acknowledge the inconsistencies between their respective analyses.

The developing split among district courts warrants caution in determining whether manmade canals and ditches qualify as WOTUS under the current regulatory regime, particularly within the Northern District of California, which covers Alameda, Contra Costa, Del Norte, Humboldt, Lake, Marin, Mendocino, Monterey, Napa and San Benito, San Francisco, San Mateo, Sunnyvale, and Santa Cruz counties. Moreover, there is a potential for litigation challenging the regulatory exemption for ditches given its inconsistency with the *Sackett* decision. Pursuant to the Supreme Court’s recent decision in *Loper Bright Enterprises, et al. v. Raimondo, Secretary of Commerce, et al.*, courts must review the definition of WOTUS using their independent judgment, rather than deferring to the EPA’s interpretation of its statutory authority, increasing the chances for successful challenges to the regulation in light of *Sackett*’s definition of WOTUS.

For inquiries or additional information, please contact:

- Ellen M. Moskal, emoskal@somachlaw.com
- Kelley M. Taber, ktaber@somachlaw.com

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Historical Recap:

The permit for me to short plat and sell the property in 1995 to Cowlitz Valley Christian Center now Timberlake Church, was conditioned by city attorney, city engineer, and city council on the fact that no water would flow across the property line of the Sam Hornstra property per a letter from Odine Husemoen, Sam's attorney. The as built stormwater retention system used 3 French drain/ drywells on my property (1933 and 1955 Huntington, 1955 was subsequently sold for this development) The drywell system functioned successfully as designed. With the construction of the church, the city approved a new stormwater system that included the 3 drywells, berm, and the current bioswale system on the former Timberlake property, now belonging to Tappani. ALL water was contained and perked on site and no stormwater crossed into the Hornstra, now Tappani property. It was a closed system with NO WOTUS potential. Although the berm prevented water from flowing onto the Hornstra property, the churches newly engineered bioswale system backed water onto my property because of what I believe was insufficient sizing for the church runoff.

Currently Tappani destroyed and filled in the third drywell and French drain on my former property and connected the stormwater from Lowe's, now Partridge property, and other northern properties that flows across my property (1933 Huntington) to their drainage system that crosses over the old Hornstra property line. This direct connection of stormwater to their ditch creates a potential WOTUS situation and requires an answer to the original WOTUS question.

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CR-24-051 -CRP-25-007/008
CRP-25-009

**Walstead, Mertsching
Husemoen, Donaldson & Barlow P.S.**

Attorneys at Law

FOUNDING PARTNERS
Howard J. Atwell 1880-1962
Ronald Moore 1897-1968
Jerome Walstead 1913-1981

Michael J. Baldwin
John A. Barlow
Mark S. Brumbaugh
Barry J. Dahl
Norman C. Dick
D.L. Donaldson
Timothy J. Hayes
Odine H. Husemoen
Scott M. Kilpatrick
Charles T. Mertsching
Stephen L. Wanderer
Craig W. Weston

January 13, 1995

City Engineer
City of Castle Rock
141 A Street, SW
Castle Rock, WA 98611

RE: South Castle Rock Drainage

Dear Sir or Madam:

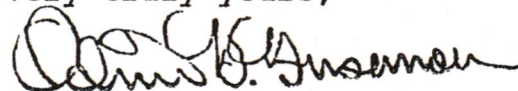
Some time ago I wrote you on behalf of Sam Hornstra and his wife about a concern he had over potential drainage problems near his property in south Castle Rock. The purpose of this letter is again to alert you to that concern.

Mr. and Mrs. Hornstra want you to be assured that they have no particular problem with any development or growth in Castle Rock. Their concern centers around a potential problem which seems obvious to him. The area around his home has surface water drainage problems now, and any new construction will add to that particular problem. Therefore, it is suggested that your attention to be addressed to storm and surface water drainage.

If there is to be construction in the area of the Hornstra property, we believe that all those problems could be resolved if sufficient drainage is installed at the time of any new construction. If you are already alerted to this problem, then you may disregard this letter, but if not, please take into consideration this problem as any development could have an adverse affect on the Hornstra property.

Thank you in advance for your courtesy and attention to this letter.

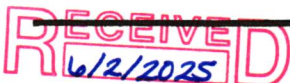
Very truly yours,



Odine H. Husemoen

OHH:clm

cc: Mr. and Mrs. Hornstra



June 9, 1995

Mayor Gene Frymire
City of Castle Rock
P.O. Box 370
Castle Rock, WA 98611

Dear Mayor Frymire:

I wish to inform you that Mr. Roy Henson has agreed to put a berm around his improved property, adequate enough to retain any water runoff from coming onto my property. This is in addition to the drainage system he has already proposed to the council.

If these two measures are done, and the systems are maintained in working order, my concerns regarding the runoff problem from this property will be satisfied.

It is my hope that any further development in the Larsen lane area will be approved with similar conditions to keep any water runoff from draining onto my property.

Sincerely,



Sam Hornstra, Owner
Larsen Lane SW

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Description of Project: A portion of the subject property is an old river channel of centuries past. During the eruption of Mt. St. Helens in 1980, this channel was filled by the mud flow. This mud flow hardened forming a less permeable surface which now stands water until it slowly percolates and evaporates. (See cross section)

Scope of Project: The plan is two fold. (1) Drain the existing standing water estimated at 4000 cubic feet. (2) Provide a permanent solution in the form of access from the mud flow to the original sandy loam soil. This is accomplished by a series of trenches and dry-wells. (See plan) Since all property in this area drains in a Southerly direction, this property owner was required to provide drainage for all neighboring property lying to the North of the subject property. This is the purpose of dry-well #1. Dry-wells #2 and #3 provide drainage for the subject property.

Details and Specifications: Dry-wells; 3 @ 800 cubic feet each
capable of draining 50 cu.ft\ hr each
total capability is 1200 cu.ft\ day

Trenches; 2 ft. width, tapered depth to 2ft.

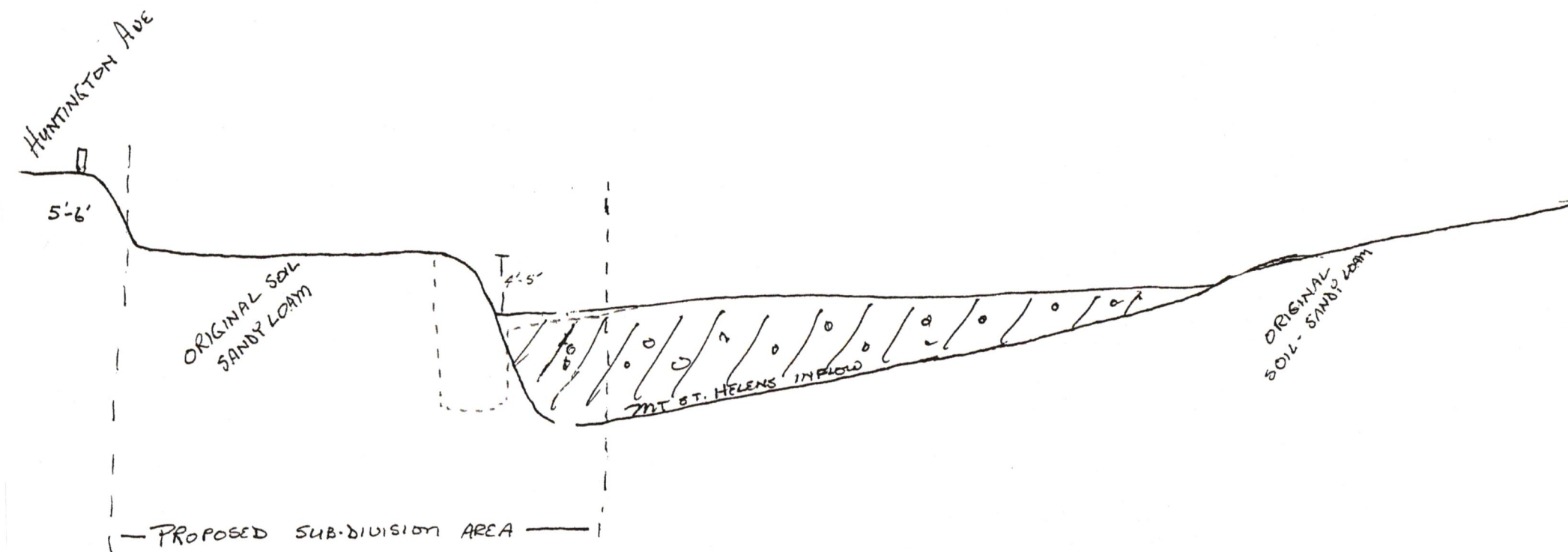
Natural Vegetation; trees planted every 4 ft. along perimeter of property. Young trees will respire 12 gal. water per day. Mature trees 100 gals \day

Rainfall; 1 inch of rain on subject area equals 200 cu.ft

Conclusion: Even in the severest of weather the system has worked. No surface water is flowing onto neighboring properties. Water no longer stands on mud flow area. It is immediately drained away to appropriate dry-well . Video tape of before and after is available as evidence.

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CROSS SECTION LOOKING SOUTH

NOT TO SCALE

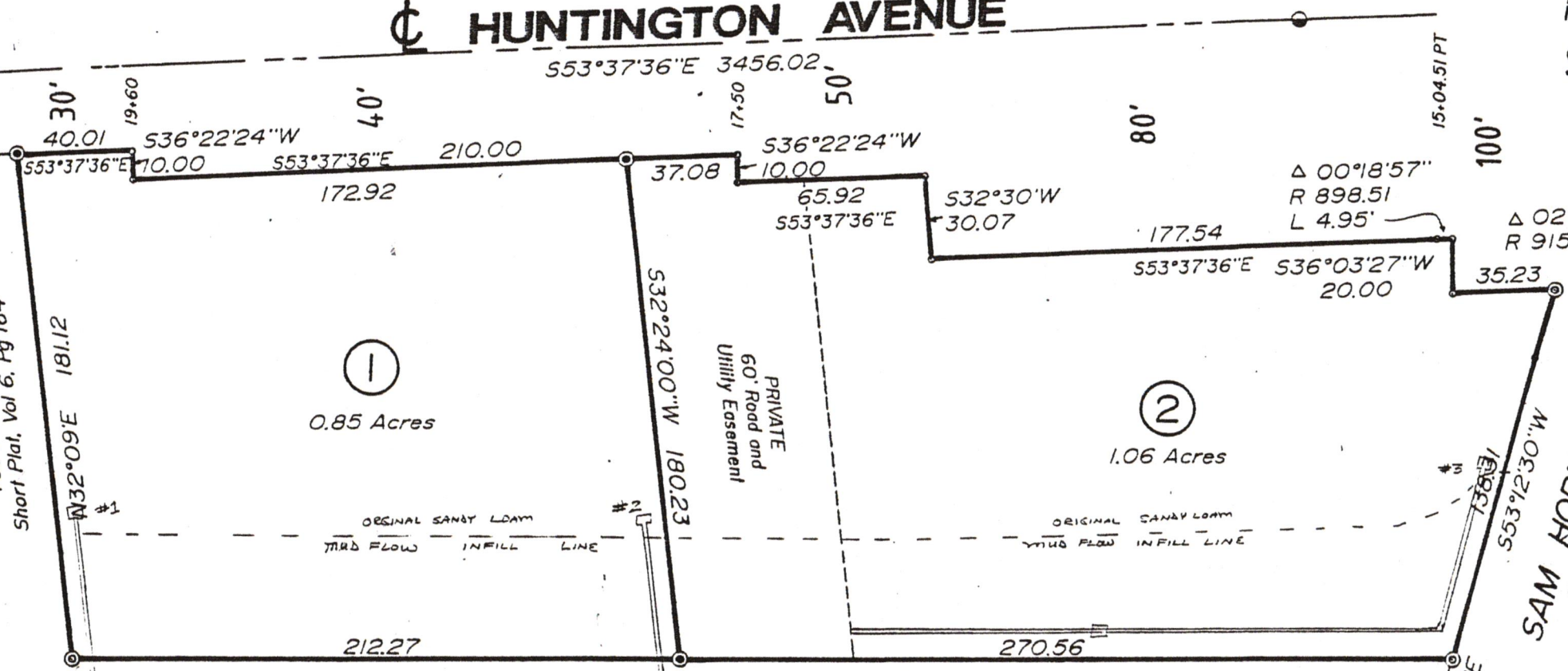
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HUNTINGTON AVENUE

Short Plat, Vol 6, Pg 164



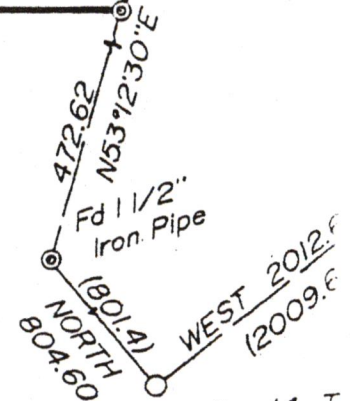
SAM HORNSTRA
Fee No. 825832

Tax Lot O L 298

ROY HENSEN PROPERTY

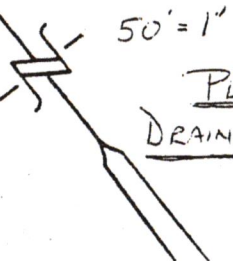
(COWLITZ VALLEY CHRISTIAN CENTER)

Fee No. 941230003



DESCRIPTION

Beginning at the Southeast corner of Section 14, T. W.M., in Cowlitz County, Washington and running thence NORTH 804.60 (801.4) feet to an iron pipe, thence N53°12'30'E 472.62 feet along the Northwesternly Hornstra under Auditor's fee number 825832 to the association thence N51°09'00'W 482.83 feet.



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RE: Notice of Preliminary Plat, SEPA MDNS and Public Hearing (DAHP 2025-06-03886)

Stone, Jessica (DAHP) <jessica.stone@dahp.wa.gov>

Mon, Jun 16, 2025 at 9:35 AM

To: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Cc: "permitreview@cowlitz.org" <permitreview@cowlitz.org>, James Gordon <jgordon@cowlitz.org>, Shana Lombard <slombard@cowlitz.org>, "sdinubilo@squaxin.us" <sdinubilo@squaxin.us>, "106review@ctwsbnr.org" <106review@ctwsbnr.org>, "THPO@grandronde.org (THPO@grandronde.org)" <thpo@grandronde.org>, Casey Barney <casey_barney@yakama.com>, "Jerry Meninick (Yakama)" <jerry_meninick@yakama.com>

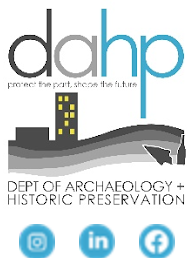
Dear Karlene,

Thank you for contacting the DAHP regarding the above-referenced project. Although a negative cultural resources survey was completed in the project location, it is still within an area marked "Very High Risk" for encountering archaeology by our Archaeological Risk Assessment Model. Therefore, we recommend that an Inadvertent Discovery Plan (IDP) be created and kept on site.

Please also note that I have assigned DAHP Project Tracking Number 2025-06-03886 to this project. Please include this number with any future related correspondence.

Thanks, and please let me know if you have any questions,

Jessica



Jessica Stone, Ph.D (she/her)

Assistant State Archaeologist

Email: jessica.stone@dahp.wa.gov | www.dahp.wa.gov

Cell: (360) 890-2633 | Main Office: (360) 586-3065

Hours: 7:30-4:00 PST Monday-Friday

Physical Address: [1110 S. Capitol Way, Suite 30](#), Olympia, WA 98501

Mailing Address: PO Box 48343, Olympia, WA 98504-8343

From: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Sent: Tuesday, June 3, 2025 3:17 PM

To: Carrie Cuttonaro <ccuttonaro@ci.castle-rock.wa.us>; Lugo, Jason <jason.lugo@wsdot.wa.gov>; Mendoza, Jennifer <mendozaj@cowlitzwa.gov>; ECY RE SEPA REGISTER <separegister@ecy.wa.gov>; Chris Fritsch <cfritsch@crschools.org>; Taylor Aalvik <taylor.a@cowlitz.org>; DAHP SEPA <sepa@dahp.wa.gov>; Mike Moss <mossm@co.cowlitz.wa.us>; Team Ridgefield (DFW) <TeamRidgefield@dfw.wa.gov>; David Vorse <crpwd@ci.castle-rock.wa.us>; TDN Front Door <frontdoor@tdn.com>; Bill Fashing <bfashing@cwecog.org>; Lebowsky, Laurie <laurie.lebowsky@wsdot.wa.gov>; DNR RE PACIFIC CASCADE REGION <pacific-cascade.region@dnr.wa.gov>; Andrea Yoho <yohoa@cowlitzwa.gov>; NRD-Cowlitz Indian Tribe <NRDpermit@cowlitz.org>; Christina Hallock <Tina@swcleanair.org>; DNR RE SEPACENTER <SEPACENTER@dnr.wa.gov>; Cordova, Christian <christian.cordova@wsdot.wa.gov>; Bill LeMonds <chief@cowlitz6fire.org>; Rudy Salakory <Rsalakory@cowlitz.org>; Lorie Clark <lclark@lcfwb.gen.wa.us>; Rachel Granrath <Rachel.Granrath@kimley-horn.com>; Charles Worley <cworley@crpolice.org>; R5 Planning (DFW) <R5.Planning@dfw.wa.gov>; Duane Johnson <Duane@swcleanair.org>; Barsness, Jeff <jeff.barsness@wsdot.wa.gov>; newservice <newservice@cowlitzpud.org>; ECY RE SEPA REGISTER <separegister@ecy.wa.gov>

Cc: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Subject: Notice of Preliminary Plat, SEPA MDNS and Public Hearing

External Email

Good afternoon,

Please see the attached Notice of Preliminary Plat, SEPA MDNS and Public Hearing for the proposed River's Edge at the Landing Subdivision located on approximately 8.93 acres of the residential designated portion of the approved Landing on the Cowlitz (LOT) Master Plan. (SEPA Record No. 202502295)

Materials will be available for viewing online at:

<https://ci.castle-rock.wa.us/notices.htm>

--

Karlene Akesson

Deputy Clerk

City of Castle Rock

PO Box 370

Castle Rock, WA 98611

Phone: 360-274-8181

City Hall Hours Effective January 2, 2024:

Monday through Thursday, 7:30 AM – 5:00 PM

CLOSED Friday and legal holidays



**STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY**

Southwest Region Office
PO Box 47775, Olympia, WA 98504-7775 • 360-407-6300

June 16, 2025

Karlene Akesson, Deputy Clerk
City of Castle Rock
PO BOX 370
Castle Rock, WA 98611

Dear Karlene Akesson:

Thank you for the opportunity to comment on the mitigated determination of non-significance for the River's Edge at the Landing Subdivision Project as proposed by CT6, LLC. The Department of Ecology (Ecology) reviewed the environmental checklist and has the following comment(s):

HAZARDOUS WASTE & TOXICS REDUCTION: Garret Peck (564) 669-0836

The applicant proposes to demolish an existing structure(s). In addition to any required asbestos abatement procedures, the applicant should ensure that any other potentially dangerous or hazardous materials present, such as PCB-containing lamp ballasts, fluorescent lamps, and wall thermostats containing mercury, are removed prior to demolition. It is important that these materials and wastes are removed and appropriately managed prior to demolition. It is equally important that demolition debris is also safely managed, especially if it contains painted wood or concrete, treated wood, or other possibly dangerous materials.

Please review the "Dangerous Waste Rules for Demolition, Construction, and Renovation Wastes," posted at Ecology's website, <https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Dangerous-waste-guidance/Common-dangerous-waste/Construction-and-demolition>. The applicant may also contact Katy Harvey of Ecology's Hazardous Waste and Toxics Reduction Program at katy.harvey@ecy.wa.gov for more information about safely handling dangerous wastes and demolition debris.

SHORELANDS & ENVIRONMENTAL ASSISTANCE: Matt Gerlach, (360) 584-2804

Thank you for the opportunity to review this proposal. Ecology notes that filling a parcel so that the new grade is at or above the base flood elevation doesn't remove the parcel from the special flood hazard area. The only way to remove a parcel from the special flood hazard area is to go through the Letter of Map Change process with FEMA. Any future development will require a floodplain development permit and be subject to applicable conditions (including elevating and/or floodproofing any structures) following the flood damage prevention regulations found in Ch. 15.24 Castle Rock Municipal Code.

Karlene Akesson

June 16, 2025

Page 2

SOLID WASTE MANAGEMENT: Derek Rockett (360) 995-3176

All grading and filling of land must utilize only clean fill. All other materials may be considered solid waste and permit approval may be required from your local jurisdictional health department prior to filling. All removed debris resulting from this project must be disposed of at an approved site. Contact the local jurisdictional health department or Department of Ecology for proper management of these materials.

Ecology's comments are based upon information provided by the lead agency. As such, they may not constitute an exhaustive list of the various authorizations that must be obtained or legal requirements that must be fulfilled in order to carry out the proposed action.

If you have any questions or would like to respond to these comments, please contact the appropriate reviewing staff listed above.

Department of Ecology
Southwest Regional Office

(JKT:202502295)

cc: Garret Peck, HWTR
Matt Gerlach, SEA
Derek Rockett, SWM

STORMWATER PUMP AGREEMENT

1. **Effective Date:** _____, 2025

2. **Parties:** CT6, LLC, a Washington limited liability company
(Developer);

and

The City of Castle Rock, a Washington
municipal corporation (City)

3. **Recitals:**

3.1 Developer, Raymond Pieren, and MLC Ventures, LLC are the owners of certain real property within the City legally described in **Exhibit A** attached to this Agreement and incorporated fully by this reference (Property).

3.2 Developer is developing property within the master planned community on the Property in accordance with the Landing on the Cowlitz Master Plan (Master Plan) approved by the City of Castle Rock on November 8, 2021, in Ordinance 2021-10 (LOTIC or the Project).

3.3 Ordinance 2021-10 contains the conditions of approval, including that "Prior to the initiation of any clearing and grading activities the Project Sponsor shall submit for City review and approval a Master Clearing, Fill, and Grading Plan that is integrated with a Stormwater Management Plan that includes an analysis of the impacts of the proposed development to adjacent properties and measures to ensure that stormwater or flood waters will not adversely affect neighboring properties."

3.4 Developer submitted to the City a Stormwater Master Plan Technical Information Report (TIR) on November 13, 2024, which was revised January 30, 2025, February 14, 2025, and March 10, 2025 (the TIR). Additional information specific to the onsite development is available in the LOTIC - Phase 1 Access and Utilities Technical Information Report.

3.5 In a letter dated April 7, 2025, the City informed Developer that a permanent stormwater pumping station would be required for the Project and that the parties would need to agree upon ownership and maintenance of ditches and pipelines related to stormwater management for the Project.

3.6 In a meeting with the City on May 1, 2025, the City and Developer agreed that Developer can provide a temporary pumping station and formalize a stormwater pump plan pursuant to this Agreement.

NOW, THEREFORE, the parties agree as follows:

4. **Purpose.** The general purpose of this Agreement is to identify which party is responsible for monitoring river levels and operating and maintaining the stormwater pump in conformance with the Landing on the Cowlitz – Offsite Stormwater Pumping Plan attached as **Exhibit B** (Pumping Plan), which includes clear, identifiable conditions for when stormwater pumping would be needed to handle stormwater runoff from a drainage system outside the boundaries of the Property.

5. **Stormwater Master TIR and LOTC Stormwater Outfall Drawings.** The City hereby affirms the approval of the Landing on the Cowlitz Stormwater Outfall (City ref. CR-24-51) and Landing on the Cowlitz Stormwater Master Plan Technical Information Report (City ref. CR-24-52), and has determined this documentation satisfies the Project's conditions of approval, City code, and all applicable regulations.

6. **Stormwater Pump.** Developer is responsible for placement of an existing Godwin Dri-Prime CD150M stormwater pump (the Pump) for pumping and draining stormwater consistent with the requirements of this Agreement and the Pumping Plan. Developer shall ensure that the Pump is ready for operation once the City has issued a letter of acceptance for the constructed Phase 1 Access & Utility Infrastructure (City refs. CR-24-51 and CR-24-52) (Commencement Date). The specifications for the Pump and pumping plan are further outlined in the Pumping Plan.

7. **Operation and Maintenance.**

7.1 Developer will place the Pump in the location shown on **Exhibit C** labelled "Approximately storage location of pump and other associated materials" and will be responsible to operate and maintain the Pump starting on the Commencement Date according to the Pumping Plan. Developer is responsible for monitoring river levels to determine when pumping is needed pursuant to the Pumping Plan. Developer will be further responsible for maintaining the ditch draining to the Pump from Larsen Lane SW as shown on **Exhibit C** labelled "Ex. Ditch/Pond to Remain for Offsite Drainage System."

7.2 Developer will maintain the Pump in good, working order and will promptly repair the Pump so that it is consistently operational in conformance with the specifications included in the Pumping Plan as attached in **Exhibit B**.

7.3 Developer's obligation to operate and maintain the Pump will terminate once property taxes are assessed against any portion(s) of the property within the Master Plan

in the amount of \$25,000 or more, at which point and upon written notice by the Developer, the City agrees to assume complete responsibility for the operation and maintenance of the Pump and Developer will convey the Pump to the City according to a Bill of Sale at no cost and without warranty (City Commencement Date). Prior to acceptance of the Bill of Sale, the City has a right to inspect and approve the condition of the Pump. If the Pump is in good working order, the City must accept ownership of the Pump.

8. **Continuing Obligations.** The City agrees to operate and maintain stormwater pumping for the Property and the Pump starting on the City Commencement Date. The City agrees that Developer may assign any Developer obligations to a property owners association with jurisdiction over any portion of the Property, and in the case of an assignment, the Developer will have no further obligations under this Agreement, including those contained in **Exhibit B**.

9. **Termination and Amendment.** This Agreement may be amended or terminated only upon mutual written agreement by both parties.

Dated this ____ day of _____, 2025

CITY OF CASTLE ROCK,
a Washington municipal corporation

By: _____

By: _____

Name: _____

Title: _____

CT6, LLC
a Washington limited liability company

By: _____

Name: _____

Title: _____

STATE OF WASHINGTON)
 : ss.
County of Clark)

I certify that _____ appeared personally before me and that I know or have satisfactory evidence that he signed this instrument, on oath stated that he was authorized to execute this instrument and acknowledged it as the Manager of CT6, LLC, to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

DATED: _____

Notary Public
My Appointment Expires: _____

STATE OF WASHINGTON)
 : ss.
County of Cowlitz)

I certify that _____ appeared personally before me and that I know or have satisfactory evidence that he signed this instrument, on oath stated that he was authorized to execute this instrument and acknowledged it as the City Manager of Castle Rock, Washington, to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

DATED: _____

Notary Public
My Appointment Expires: _____

EXHIBIT A

PARCEL 1:

A PARCEL OF PROPERTY LOCATED IN A PORTION OF THE BENJAMIN HUNTINGTON D.L.C. AND THE SOUTH HALF OF SECTION 14, AND THE NORTH HALF OF SECTION 23, TOWNSHIP 9 NORTH, RANGE 2 WEST OF THE WILLAMETTE MERIDIAN IN THE CITY OF CASTLE ROCK, COWLITZ COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE CORNER COMMON TO SECTION 13, 14, 23 AND 24, TOWNSHIP 9 NORTH, RANGE 2 WEST, AS SHOWN ON RECORD-OF-SURVEY RECORDED IN VOLUME 43, PAGES 120-121 OF THE WILLAMETTE MERIDIAN, COWLITZ COUNTY, WASHINGTON;

THENCE NORTH 01°42'22" EAST, ALONG THE EAST LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 14, A DISTANCE OF 742.50 FEET TO THE NORTH LINE OF THE SOUTH HALF OF THE BENJAMIN HUNTINGTON DONATION LAND CLAIM ;

THENCE NORTH 88°18'14" WEST, ALONG SAID NORTH LINE, 1915.35 FEET;

THENCE SOUTH 01°33'06" WEST 26.70 FEET TO THE NORTHWEST CORNER OF "PARCEL I" AS CONVEYED TO CT6, LLC BY DEED RECORDED UNDER AUDITOR'S FILE NUMBER 3682681, COWLITZ COUNTY RECORDS AND THE TRUE POINT OF BEGINNING;

THENCE SOUTH 88°09'15" EAST ALONG THE NORTH LINE OF SAID PARCEL I, A DISTANCE OF 88.61 FEET;

THENCE NORTH 68°26'31" EAST ALONG THE NORTH LINE OF SAID PARCEL I, A DISTANCE OF 93.90 FEET TO A NON-TANGENT 530.00 FOOT RADIUS CURVE TO THE LEFT, FROM WHICH THE RADIUS POINT BEARS NORTH 67°48'33" EAST;

THENCE ALONG SAID 530.00 FOOT NON-TANGENT CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 22°53'04" (LONG CHORD BEARS SOUTH 38°40'15" WEST 210.28 FEET) AN ARC DISTANCE OF 211.69 FEET;

THENCE SOUTH 50°06'47" EAST 328.61 FEET TO A 35.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 35.00 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 88°23'02" AN ARC DISTANCE OF 53.99 FEET;

THENCE SOUTH 38°16'16" WEST 604.48 FEET TO A 30.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 30.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 82°46'20" AN ARC DISTANCE OF 43.34 FEET TO A POINT 30.00 FEET NORTHERLY OF, WHEN MEASURED RADially TO, THE CENTERLINE OF LARSEN LANE AS SHOWN ON SAID RECORD OF SURVEY, VOLUME 43, PAGES 120-121 AND A 313.53 FOOT RADIUS COMPOUND CURVE TO THE RIGHT:

THENCE PARALLEL WITH SAID LARSEN LANE CENTERLINE AND ALONG SAID 313.53 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 19°31'25", AN ARC DISTANCE OF 106.84 FEET;

THENCE NORTH 39°25'59" WEST, PARALLEL WITH SAID CENTERLINE 82.70 FEET;
THENCE NORTH 41°01'19" WEST, PARALLEL WITH SAID CENTERLINE 22.20 FEET;
THENCE SOUTH 48°56'17" WEST 17.50 FEET TO THE NORTH RIGHT-OF-WAY LINE OF SAID LARSEN LANE, SAID
NORTH RIGHT OF WAY LINE BEING 12.50 FEET NORTHERLY OF, WHEN MEASURED PERPENDICULAR TO, SAID
CENTERLINE;

THENCE NORTH 41°01'19" WEST, ALONG SAID NORTHERLY RIGHT-OF-WAY LINE 337.54 FEET TO THE WEST LINE OF
"PARCEL I" AS CONVEYED TO CT6, LLC BY DEED RECORDED UNDER AUDITOR'S FILE NUMBER 3682681, COWLITZ
COUNTY RECORDS

THENCE NORTH 53°08'46" EAST, LEAVING SAID NORTHERLY RIGHT-OF-WAY LINE AND ALONG THE WEST LINE OF
SAID "PARCEL I" A DISTANCE OF 165.33 FEET;

THENCE NORTH 14°33'38" EAST, ALONG SAID WEST LINE 393.71 FEET TO THE TRUE POINT OF BEGINNING.

SAID PARCEL CONTAINS 8.92 ACRES MORE OR LESS.

PARCEL 2:

A PARCEL OF PROPERTY LOCATED IN A PORTION OF THE BENJAMIN HUNTINGTON D.L.C. AND THE SOUTH HALF OF SECTION 14, TOWNSHIP 9 NORTH, RANGE 2 WEST OF THE WILLAMETTE MERIDIAN IN THE CITY OF CASTLE ROCK, COWLITZ COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE CORNER COMMON TO SECTION 13, 14, 23 AND 24, TOWNSHIP 9 NORTH, RANGE 2 WEST, AS SHOWN ON RECORD-OF-SURVEY RECORDED IN VOLUME 43, PAGES 120-121 OF THE WILLAMETTE MERIDIAN, COWLITZ COUNTY, WASHINGTON;

THENCE NORTH 01°42'22" EAST, ALONG THE EAST LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 14, A DISTANCE OF 742.50 FEET TO THE NORTH LINE OF THE SOUTH HALF OF THE BENJAMIN HUNTINGTON DONATION LAND CLAIM;

THENCE NORTH 88°18'14" WEST, ALONG SAID NORTH LINE 943.41 FEET TO THE WESTERLY RIGHT OF WAY LINE OF THE BURLINGTON NORTHERN SANTA FE RAILROAD RIGHT OF WAY AS SHOWN ON SAID SURVEY AND THE TRUE POINT OF BEGINNING;

THENCE SOUTH 27°15'58" EAST ALONG SAID WESTERLY RIGHT OF WAY LINE 86.12 FEET;

THENCE SOUTH 62°44'02" WEST 234.58 FEET;

THENCE SOUTH 38°16'16" WEST 196.98 FEET;

THENCE NORTH 50°06'47" WEST 420.40 FEET TO A 450.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 450.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 27°55'29" AN ARC DISTANCE OF 219.32 FEET TO A NON-TANGENT 450.00 FOOT RADIUS COMPOUND CURVE TO THE RIGHT FROM WHICH THE RADIUS POINT BEARS NORTH 68°05'35" EAST;

THENCE ALONG SAID NON-TANGENT 450.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 15°02'44" (LONG CHORD BEARS NORTH 14°20'03" WEST, 117.83 FEET) AN ARC DISTANCE OF 118.17 FEET;

THENCE NORTH 06°48'41" WEST 43.09 FEET TO A 480.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 480.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 06°48'01" AN ARC DISTANCE OF 56.97 FEET TO A 31.00 FOOT RADIUS COMPOUND CURVE TO THE RIGHT;

THENCE ALONG SAID 31.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 33°50'03" AN ARC DISTANCE OF 18.31 FEET;

THENCE NORTH 33°49'24" EAST 46.00 FEET TO A 31.00 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 31.00 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 24°20'38" AN ARC DISTANCE OF 13.17 FEET TO A 480.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 480.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 15°47'09" AN ARC DISTANCE OF 132.25 FEET TO A 45.00 FOOT RADIUS COMPOUND CURVE TO THE RIGHT;
THENCE ALONG SAID 45.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 74°17'19" AN ARC DISTANCE OF 58.35 FEET TO THE SOUTHERLY RIGHT OF WAY LINE OF HUNTINGTON AVENUE SOUTH;

THENCE ALONG SAID SOUTHERLY RIGHT OF WAY LINE THE FOLLOWING SIX (6) COURSES:

THENCE SOUTH 51°50'03" EAST 93.69 FEET;
THENCE SOUTH 37°34'48" WEST 20.00 FEET;
THENCE SOUTH 53°13'49" EAST 34.86 FEET;
THENCE NORTH 55°00'09" EAST 16.07 FEET;
THENCE SOUTH 60°12'51" EAST 318.00 FEET;

THENCE SOUTH 52°26'51" EAST 262.13 FEET TO A POINT ON WESTERLY RIGHT OF WAY LINE OF THE BURLINGTON NORTHERN- SANTA FE RAILROAD RIGHT OF WAY AS SHOWN ON SAID SURVEY;

THENCE SOUTH 27°15'58" EAST, LEAVING SAID SOUTHERLY LINE AND ALONG SAID WESTERLY LINE 152.49 FEET TO THE TRUE POINT OF BEGINNING.

SAID PARCEL CONTAINS 8.63 ACRES MORE OR LESS.

PARCEL 3:

A PARCEL OF PROPERTY LOCATED IN A PORTION OF THE BENJAMIN HUNTINGTON D.L.C. AND THE NORTH HALF OF SECTION 23, TOWNSHIP 9 NORTH, RANGE 2 WEST OF THE WILLAMETTE MERIDIAN IN THE CITY OF CASTLE ROCK, COWLITZ COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE CORNER COMMON TO SECTION 13, 14, 23 AND 24, TOWNSHIP 9 NORTH, RANGE 2 WEST, AS SHOWN ON RECORD-OF-SURVEY RECORDED IN VOLUME 43, PAGES 120-121 OF THE WILLAMETTE MERIDIAN, COWLITZ COUNTY, WASHINGTON;

THENCE NORTH 88°18'41" WEST ALONG THE NORTH LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23, A DISTANCE OF 1956.09 FEET;

THENCE SOUTH 01°41'19" WEST 24.09 FEET TO THE INTERSECTION OF THE NORTH LINE OF "PARCEL II" AS CONVEYED TO CT6, LLC BY DEED RECORDED UNDER AUDITOR'S FILE NUMBER 3682681, COWLITZ COUNTY RECORDS AND A POINT 30.00 FEET SOUTHWESTERLY OF, WHEN MEASURED PERPENDICULAR TO, THE CENTERLINE OF LARSEN LANE AND TO THE TRUE POINT OF BEGINNING;

THENCE SOUTH 53°23'25" WEST, ALONG SAID NORTH LINE 394.16 FEET;
THENCE SOUTH 89°35'00" WEST, ALONG SAID NORTH LINE 145.25 FEET TO THAT BOUNDARY AGREEMENT LINE AS DESCRIBED IN EXHIBIT A OF THAT BOUNDARY LINE AGREEMENT DOCUMENT RECORDED UNDER AUDITOR'S FILE NUMBER 3597924, COWLITZ COUNTY RECORDS:

THENCE ALONG SAID BOUNDARY AGREEMENT LINE AND THE ORDINARY HIGH WATER LINE ON THE LEFT BANK OF THE COWLITZ RIVER LINE APPROXIMATED BY THE FOLLOWING FOUR (4) COURSES:

THENCE SOUTH 16°25'08" EAST 239.13 FEET;
THENCE SOUTH 20°06'11" EAST 262.43 FEET;
THENCE SOUTH 25°28'57" EAST 218.98 FEET;
THENCE SOUTH 20°33'29" EAST 229.50 FEET;

THENCE LEAVING SAID ORDINARY HIGH WATER LINE AND CONTINUING ALONG SAID BOUNDARY AGREEMENT LINE THE FOLLOWING FOUR (4) COURSES;

THENCE NORTH 74°55'34" EAST 13.28 FEET

THENCE SOUTH 50°34'51" EAST 735.65 FEET TO A 1000.00 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 1000.00 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 23°12'02" AN ARC DISTANCE OF 404.92 FEET:

THENCE SOUTH 73°46'53" EAST 380.03 FEET TO A POINT WHICH BEARS NORTH 88°25'11" WEST 732.00 FEET FROM A POINT ON THE EAST LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23 THAT IS SOUTH 01°34'49" WEST, 1869.34 FEET FROM THE NORTHEAST CORNER OF SAID NORTHEAST QUARTER ;

THENCE NORTH 27°09'34" WEST LEAVING SAID BOUNDARY AGREEMENT LINE 473.65 FEET TO A NON-TANGENT 68.00 FOOT RADIUS CURVE TO THE RIGHT, FROM WHICH THE RADIUS POINT BEARS NORTH 44°16'29" WEST;

THENCE ALONG SAID 68.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 36°57'42" (LONG CHORD BEARS SOUTH 64°12'22" WEST, 43.11 FEET) AN ARC DISTANCE OF 43.87 FEET;

THENCE SOUTH 59°11'47" WEST 135.17 FEET TO A 60.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 60.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 60°25'22" AN ARC DISTANCE OF 63.27 FEET;

THENCE NORTH 60°22'52" WEST 196.18 FEET;

THENCE NORTH 55°33'49" WEST 8.40 FEET;

THENCE NORTH 51°13'48" WEST 229.26 FEET;

THENCE NORTH 39°20'53" WEST 74.85 FEET;

THENCE NORTH 33°21'26" WEST 463.09 FEET;

THENCE NORTH 21°40'07" WEST 430.63 FEET;

THENCE NORTH 68°57'08" EAST 110.83 FEET TO A 302.00 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 302.00 FOOT RADIUS CURVE TO THE LEFT, THROUGH A CENTRAL ANGLE OF 24°57'49", AN ARC DISTANCE OF 131.58 FEET;

THENCE NORTH 43°59'19" EAST 84.68 FEET;

THENCE NORTH 46°00'41" WEST 48.00 FEET TO A NON-TANGENT 226.00 FOOT CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 5°43'03" (LONG CHORD BEARS NORTH 41°07'47" EAST, 22.54 FEET) AN ARC DISTANCE OF 22.55 FEET;

THENCE NORTH 38°16'16" EAST 12.91 FEET TO A 30.00 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 30.00 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 95°55'39" AN ARC DISTANCE OF 50.23 FEET TO A POINT 30.00 FEET SOUTHWESTERLY OF, WHEN MEASURED PERPENDICULAR TO, THE CENTERLINE OF LARSON LANE AND A 373.53 FOOT RADIUS COMPOUND CURVE TO THE RIGHT;

THENCE PARALLEL WITH SAID CENTERLINE AND ALONG SAID 373.53 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 18°13'24" AN ARC DISTANCE OF 118.80 FEET;

THENCE NORTH 39°25'59" WEST PARALLEL WITH SAID CENTERLINE 81.86 FEET;

THENCE NORTH 41°01'19" WEST PARALLEL WITH SAID CENTERLINE 53.39 FEET TO THE TRUE POINT OF BEGINNING.

SAID PARCEL CONTAINS 15.37 ACRES MORE OR LESS.

PARCEL 4:

A PARCEL OF PROPERTY LOCATED IN A PORTION OF THE BENJAMIN HUNTINGTON D.L.C. AND THE SOUTH HALF OF SECTION 14, AND THE NORTH HALF OF SECTION 23, TOWNSHIP 9 NORTH, RANGE 2 WEST OF THE WILLAMETTE MERIDIAN IN THE CITY OF CASTLE ROCK, COWLITZ COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE CORNER COMMON TO SECTION 13, 14, 23 AND 24, TOWNSHIP 9 NORTH, RANGE 2 WEST, AS SHOWN ON RECORD-OF-SURVEY RECORDED IN VOLUME 43, PAGES 120-121 OF THE WILLAMETTE MERIDIAN, COWLITZ COUNTY, WASHINGTON;

THENCE NORTH 88°18'41" WEST ALONG THE NORTH LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23 A DISTANCE OF 1336.06 FEET;

THENCE SOUTH 01°41'19" WEST 70.08 FEET;

THENCE NORTH 62°49'48" EAST 389.96 FEET TO A NON-TANGENT 500.00 FOOT RADIUS CURVE TO THE LEFT FROM WHICH THE RADIUS POINT BEARS SOUTH 61°46'53" WEST AND THE TRUE POINT OF BEGINNING;

THENCE ALONG SAID 500.00 FOOT RADIUS CURVE TO THE LEFT, THROUGH A CENTRAL ANGLE OF 21°53'40" (LONG CHORD BEARS NORTH 39°09'57" WEST 189.90 FEET), AN ARC DISTANCE OF 191.07 FEET;

THENCE NORTH 50°06'47" WEST 86.41 FEET;

THENCE NORTH 39°53'13" EAST 40.00 FEET;

THENCE NORTH 50°06'47" WEST 79.06 FEET;

THENCE NORTH 38°16'16" EAST 196.98 FEET TO A POINT WHICH BEARS SOUTH 62°44'02" WEST, 234.58 FEET FROM A POINT ON THE WEST RIGHT OF WAY LINE OF THE BURLINGTON NORTHERN-SANTE FE RAILROAD RIGHT OF WAY LINE WHICH IS 86.12 FEET SOUTHEASTERLY OF, AS MEASURED ALONG SAID WEST RIGHT OF WAY LINE, THE NORTH LINE OF THE SOUTH HALF OF THE BENJAMIN HUNTINGTON DONATION LAND CLAIM AS SHOWN ON SAID SURVEY;

THENCE NORTH 62°44'02" EAST 234.58 FEET TO SAID WESTERLY RIGHT OF WAY LINE;

THENCE SOUTH 27°15'58" EAST ALONG SAID WESTERLY RIGHT OF WAY LINE 1072.10 FEET;

THENCE SOUTH 61°34'57" WEST 277.33 FEET;

THENCE SOUTH 62°44'02" WEST 69.99 FEET;

THENCE NORTH 27°15'58" WEST 633.94 FEET TO A 500.00 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 500.00 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 00°57'09" AN ARC DISTANCE OF 8.31 FEET TO THE TRUE POINT OF BEGINNING.

SAID PARCEL CONTAINS 8.80 ACRES MORE OR LESS.

PARCEL 5:

A PARCEL OF PROPERTY LOCATED IN A PORTION OF THE BENJAMIN HUNTINGTON D.L.C. AND THE SOUTH HALF OF SECTION 14, AND THE NORTH HALF OF SECTION 23, TOWNSHIP 9 NORTH, RANGE 2 WEST OF THE WILLAMETTE MERIDIAN IN THE CITY OF CASTLE ROCK, COWLITZ COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE CORNER COMMON TO SECTION 13, 14, 23 AND 24, TOWNSHIP 9 NORTH, RANGE 2 WEST, AS SHOWN ON RECORD-OF-SURVEY RECORDED IN VOLUME 43, PAGES 120-121 OF THE WILLAMETTE MERIDIAN, COWLITZ COUNTY, WASHINGTON;

THENCE NORTH 88°18'41" WEST ALONG THE NORTH LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23 A DISTANCE OF 1336.06 FEET;

THENCE SOUTH 01°41'19" WEST 70.08 FEET TO THE TRUE POINT OF BEGINNING:

THENCE NORTH 62°49'48" EAST 389.96 FEET TO A NON-TANGENT 500.00 FOOT RADIUS CURVE TO THE LEFT FROM WHICH THE RADIUS POINT BEARS SOUTH 61°46'53" WEST;

THENCE ALONG SAID 500.00 FOOT RADIUS CURVE TO THE LEFT, THROUGH A CENTRAL ANGLE OF 21°53'40" (LONG CHORD BEARS NORTH 39°09'57" WEST 189.90 FEET), AN ARC DISTANCE OF 191.07 FEET;

THENCE NORTH 50°06'47" WEST 86.41 FEET;

THENCE SOUTH 39°53'13" WEST 28.00 FEET;

THENCE NORTH 50°06'47" WEST 41.14 FEET TO A 35.00 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 35.00 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 91°36'58" AN ARC DISTANCE OF 55.97 FEET;

THENCE SOUTH 38°16'16" WEST 607.28 FEET TO A 35.00 FOOT RADIUS CURVE THE LEFT;

THENCE ALONG SAID 35.00 FOOT RADIUS CURVE THE LEFT, THROUGH A CENTRAL ANGLE OF 81°37'14" AN ARC DISTANCE OF 49.86 FEET TO A 336.77 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 336.77 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 04°50'31" AN ARC DISTANCE OF 28.46 FEET TO A POINT WHICH BEARS SOUTH 01°41'19" WEST 242.22 FEET FROM A POINT ON THE NORTH LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23 AND 1625.44 FEET WEST OF, AS MEASURED ALONG SAID NORTH LINE, OF THE NORTHEAST CORNER OF SAID SECTION 23;

THENCE NORTH 51°29'32" EAST 56.61 FEET TO A POINT WHICH BEARS SOUTH 62°49'48" WEST FROM THE TRUE POINT OF BEGINNING;

THENCE NORTH 62°49'48" EAST 280.94 FEET TO THE TRUE POINT OF BEGINNING.

SAID PARCEL CONTAINS 3.24 ACRES MORE OR LESS.

PARCEL 6:

A PARCEL OF PROPERTY LOCATED IN A PORTION OF THE BENJAMIN HUNTINGTON D.L.C. AND THE NORTH HALF OF SECTION 23, TOWNSHIP 9 NORTH, RANGE 2 WEST OF THE WILLAMETTE MERIDIAN IN THE CITY OF CASTLE ROCK, COWLITZ COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE CORNER COMMON TO SECTION 13, 14, 23 AND 24, TOWNSHIP 9 NORTH, RANGE 2 WEST, AS SHOWN ON RECORD-OF-SURVEY RECORDED IN VOLUME 43, PAGES 120-121 OF THE WILLAMETTE MERIDIAN, COWLITZ COUNTY, WASHINGTON;

THENCE NORTH 88°18'41" WEST ALONG THE NORTH LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23 A DISTANCE OF 1336.06 FEET;

THENCE SOUTH 01°41'19" WEST 70.08 FEET;

THENCE SOUTH 62°49'48" WEST 280.94 FEET TO THE TRUE POINT OF BEGINNING;

THENCE NORTH 62°49'48" EAST 280.94 FEET;

THENCE SOUTH 27°20'27" EAST 329.48 FEET;

THENCE SOUTH 62°44'02" WEST 390.43 FEET;

THENCE NORTH 27°15'58" WEST 253.26 FEET TO A 276.77 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 276.77 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 11°14'29" AN ARC DISTANCE OF 54.30 FEET TO A POINT THAT BEARS SOUTH 01°41'19" WEST 280.94 FEET FROM A POINT ON THE NORTH LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23 AND 1671.18 FEET WEST OF, AS MEASURED ALONG SAID NORTH LINE, THE NORTHEAST CORNER OF SAID SECTION 23;

THENCE NORTH 51°29'32" EAST 116.61 FEET TO THE TRUE POINT OF BEGINNING.

SAID PARCEL CONTAINS 2.93 ACRES MORE OR LESS.

PARCEL 7:

A PARCEL OF PROPERTY LOCATED IN A PORTION OF THE BENJAMIN HUNTINGTON D.L.C. AND THE SOUTH HALF OF SECTION 14, AND THE NORTH HALF OF SECTION 23, TOWNSHIP 9 NORTH, RANGE 2 WEST OF THE WILLAMETTE MERIDIAN IN THE CITY OF CASTLE ROCK, COWLITZ COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE CORNER COMMON TO SECTION 13, 14, 23 AND 24, TOWNSHIP 9 NORTH, RANGE 2 WEST, AS SHOWN ON RECORD-OF-SURVEY RECORDED IN VOLUME 43, PAGES 120-121 OF THE WILLAMETTE MERIDIAN, COWLITZ COUNTY, WASHINGTON;

THENCE NORTH 01°42'22" EAST, ALONG THE EAST LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 14, A DISTANCE OF 742.50 FEET TO THE NORTH LINE OF THE SOUTH HALF OF THE BENJAMIN HUNTINGTON DONATION LAND CLAIM;

THENCE NORTH 88°18'14" WEST, ALONG SAID NORTH LINE 943.41 FEET TO THE WESTERLY RIGHT OF WAY LINE OF THE BURLINGTON NORTHERN-SANTA FE RAILROAD RIGHT OF WAY AS SHOWN ON SAID SURVEY;

THENCE SOUTH 27°15'58" EAST ALONG SAID WESTERLY RIGHT OF WAY LINE 1158.22 FEET TO THE TRUE POINT OF BEGINNING;

THENCE ALONG SAID WESTERLY RIGHT OF WAY LINE THE FOLLOWING FOUR (4) COURSES:

THENCE SOUTH 27°15'58" EAST 434.13 FEET TO A SPIRAL CURVE TO THE RIGHT;

THENCE ALONG SAID SPIRAL CURVE TO THE RIGHT (CHORD BEARS SOUTH 25°09'13" EAST 416.74 FEET) TO A NON-TANGENT 1810.08 FOOT RADIUS CURVE TO THE RIGHT FROM WHICH THE RADIUS POINT BEARS SOUTH 69°09'31" WEST;

THENCE ALONG SAID 1810.08 FOOT RADIUS CURVE TO THE RIGHT FEET THROUGH A CENTRAL ANGLE OF 49°19'01" AN ARC DISTANCE OF 1558.02 FEET;

THENCE SOUTH 29°10'46" WEST 45.34 FEET TO THAT BOUNDARY AGREEMENT LINE AS DESCRIBED IN EXHIBIT A OF THAT BOUNDARY LINE AGREEMENT DOCUMENT RECORDED UNDER AUDITOR'S FILE NUMBER 3597924, COWLITZ COUNTY RECORDS;

THENCE NORTH 07°43'13" WEST LEAVING SAID WESTERLY RIGHT OF WAY LINE AND ALONG SAID BOUNDARY AGREEMENT LINE THE FOLLOWING FOUR (4) COURSES:

NORTH 07°43'13" WEST 169.53 FEET TO A 600.00 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 600.00 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 48°27'45" AN ARC DISTANCE OF 507.50 FEET TO A 600.00 FOOT RADIUS COMPOUND CURVE TO THE LEFT:

THENCE ALONG SAID 600.00 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 17°35'55" AN ARC DISTANCE OF 184.29 FEET;

THENCE NORTH 73°46'53" WEST 204.75 FEET TO A POINT WHICH BEARS NORTH 88°25'11" WEST 732.00 FEET FROM A POINT ON THE EAST LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23 THAT IS SOUTH 01°34'49" WEST, 1869.34 FEET FROM THE NORTHEAST CORNER OF SAID NORTHEAST QUARTER;

THENCE NORTH 27°09'34" WEST LEAVING SAID BOUNDARY AGREEMENT LINE 473.65 FEET TO A NON-TANGENT 68.00 FOOT RADIUS CURVE TO THE RIGHT, FROM WHICH THE RADIUS POINT BEARS NORTH 44°16'29" WEST;

THENCE ALONG SAID 68.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 36°57'42" (LONG CHORD BEARS SOUTH 64°12'22" WEST, 43.11 FEET) AN ARC DISTANCE OF 43.87 FEET;

THENCE SOUTH 59°11'47" WEST 135.17 FEET TO A 60.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 60.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 60°25'22" AN ARC DISTANCE OF 63.27 FEET;

THENCE NORTH 60°22'52" WEST 196.18 FEET;

THENCE NORTH 55°33'49" WEST 8.40 FEET;

THENCE NORTH 51°13'48" WEST 229.26 FEET;

THENCE NORTH 39°20'53" WEST 74.85 FEET;

THENCE NORTH 33°21'26" WEST 463.09 FEET;

THENCE NORTH 21°40'07" WEST 430.63 FEET;

THENCE NORTH 68°57'08" EAST 110.83 FEET TO A 302.00 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 302.00 FOOT RADIUS CURVE TO THE LEFT, THROUGH A CENTRAL ANGLE OF 24°57'49", AN ARC DISTANCE OF 131.58 FEET;

THENCE NORTH 43°59'19" EAST 84.68 FEET TO A 274.00 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 274.00 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 05°43'03", AN ARC DISTANCE OF 27.34 FEET;

THENCE NORTH 38°16'16" EAST 13.70 FEET TO A 30.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 30.00 FOOT RADIUS CURVE TO THE RIGHT FOR THROUGH A CENTRAL ANGLE OF 100°04'37", AN ARC DISTANCE 52.40 FEET TO A 276.77 FOOT RADIUS COMPOUND CURVE TO THE RIGHT;

THENCE ALONG SAID 276.77 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 03°08'40", AN ARC DISTANCE OF 15.19 FEET TO A POINT THAT BEARS SOUTH 01°41'19" WEST 280.94 FEET FROM A POINT ON THE NORTH LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23 AND 1671.18 FEET WEST OF, AS MEASURED ALONG SAID NORTH LINE, THE NORTHEAST CORNER OF SAID SECTION 23 AND A NON-TANGENT 276.77 FOOT RADIUS CURVE TO THE RIGHT FROM WHICH THE RADIUS POINT BEARS SOUTH 51°29'32" WEST;

THENCE ALONG SAID 276.77 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 11°14'29", AN ARC DISTANCE OF 54.30 FEET;

THENCE SOUTH 27°15'58" EAST 253.26 FEET;
THENCE NORTH 62°44'02" EAST 390.43 FEET;

THENCE NORTH 27°20'27" WEST 329.48 FEET TO A POINT THAT BEARS SOUTH 01°41'19" WEST 70.08 FEET FROM A POINT ON THE NORTH LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23 AND 1336.06 FEET WEST OF, AS MEASURED ALONG SAID NORTH LINE, THE NORTHEAST CORNER OF SAID SECTION 23;

THENCE NORTH 62°49'48" EAST 389.96 FEET TO A NON-TANGENT 500.00 FOOT RADIUS CURVE TO THE RIGHT FROM WHICH THE RADIUS POINT BEARS SOUTH 61°46'53" WEST:

THENCE ALONG SAID 500.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 0057'09" (LONG CHORD BEARS SOUTH 27°44'33" EAST, 8.31 FEET) AN ARC DISTANCE OF 8.31 FEET;

THENCE SOUTH 27°15'58" EAST 633.94 FEET;

THENCE NORTH 62°44'02" EAST 69.99 FEET TO A POINT WHICH BEARS SOUTH 61°34'57" WEST FROM THE TRUE POINT OF BEGINNING;

THENCE NORTH 61°34'57" EAST 277.33 FEET TO THE TRUE POINT OF BEGINNING.

SAID PARCEL CONTAINS 60.81 ACRES MORE OR LESS.

EXHIBIT B

MEMORANDUM

TO: City of Castle Rock, Public Works Department

FROM: MacKay Sposito (on behalf of CT6, Inc.)

RE: Landing on the Cowlitz – Offsite Stormwater Pumping Plan

DATE: June 9, 2025

As part of the first phase of development on the Landing on the Cowlitz (LOTIC), MacKay Sposito and CT6, LLC have proposed a new stormwater outfall to the Cowlitz River. The proposed system includes two isolated systems that keep the stormwater runoff from the onsite development and the existing offsite basin completely separated. While the onsite system will be fully gravity-fed under all conditions, the offsite system may occasionally require assistance from a pump when the Cowlitz River rises to flood stage. For more information on the scenarios and frequency in which pumping may be needed, please refer to the Stormwater Master Plan Technical Information Report (TIR) that has been prepared for the project.

MacKay Sposito and CT6 received a letter dated April 7, 2025 (received April 9, 2025) from the City of Castle Rock concerning the proposed Stormwater Master Plan TIR and Stormwater Outfall Design. In the letter (and the associated plan review comments), the City stated its concerns with the proposed portable stormwater pumping system and formally requested that a permanent stormwater pump station be provided instead. At CT6's request, a follow-up meeting was held at Castle Rock City Hall on May 1, 2025. After a thorough discussion, it was ultimately decided that a modified version of the previously proposed system would be sufficient as long as CT6 took responsibility for an interim period and provided a detailed plan for monitoring, operation, and maintenance. This memorandum has been written to outline the details of the proposed stormwater pumping system. For information more about duration of responsibility for the stormwater pumping system, see the Stormwater Pump Agreement.

Materials and Equipment:

Below is a summary of the materials, equipment, and/or associated specifications proposed to be used as part of this pumping plan. Tapani, Inc. (the project sponsor) owns this equipment, and it is currently stored at their construction yard in Battle Ground, WA. Upon completion of the new outfall system to

the Cowlitz River, the pump will be permanently relocated to the project site. This equipment was acquired as part of the previous temporary pumping plan and is already reserved for use at the Landing on the Cowlitz. The pump will be held in reserve at the site for the duration of Tapani's responsibility for monitoring and operating the offsite stormwater system. A summary of the pump capacity, features and associated parts are as follows:

- 6" Godwin Dri-Prime Pump (CD150M) – Max Capacity 2,290 GPM (A full cut sheet for the proposed pump is attached)
 - Diesel engine (74 HP @ 2200 rpm)
 - 60-gallon fuel tank
 - Self-priming
 - Trailer mounted
- 20 LF of 6" hose for the suction line
- 20 LF of 6" hose for the outlet to the outfall connection point
- Crew truck with 50-gallon diesel fuel transfer/tank for re-filling the pump

Monitoring Site Conditions:

As outlined in the Stormwater Master Plan TIR, pumping assistance is not anticipated to be needed for the offsite drainage system unless the water surface elevation (WSEL) of the Cowlitz River reaches flood stages (as defined by the USGS and described in the TIR) and a local 25-year or greater storm event occurs at the site. While the scenario described above has a low probability of occurring, it is important that the responsible party continually monitor the river elevation, weather conditions and the WSEL of the detention pond for the offsite basin. Pumping should only be required when there is a buildup of runoff within the detention pond for the offsite basin.

Flood stages are reached when the river reaches a WSEL of 41 feet at the project site (using the onsite datum). However, the nearest USGS river elevation gage is located a few miles upstream of the project site at a bridge crossing in town and the equivalent elevation at that location is 48 feet (6.3 feet in elevation change between the site and the gage, plus a 0.7 foot datum difference). To monitor river gage elevations, the USGS offers a free notification service called WaterAlert. The responsible party shall register with this service and sign up for notifications at the Action Stage and each flood stage above that. The Action Stage is intended to serve as an advance warning that river levels are rising towards flood stages so that mitigating measures can be prepared. For this gaging station, the Action Stage is set at 46 feet (2 feet below the minor flood stage).

The responsible party will also need to monitor the WSEL within the detention pond reserved for the offsite drainage basin. The portion of the basin dedicated to the offsite system has a bottom elevation of 38 feet and an approximate overflow/spillover elevation of 42 feet. As specified in the Stormwater Master Plan TIR, the pump should be operated any time that the WSEL reaches an elevation of 40 feet. To track the WSEL of the pond, an auto dialer will be installed onsite with float switch sensors. Floats will be set at a minimum of 38.5, 39.0, 39.5, 40.0, 41.0 and 41.5 feet. As the water level in the pond rises, the float switches will send notifications to the responsible party. A crew should be ready to

initiate pumping once the 39.5-foot float is activated, but pump operation is mandatory once the 40-foot notification is received.

There are many reliable weather forecasting services available that can be used to track weather patterns, but the NOAA website shall be the primary source for forecasts. The operator shall track weather patterns in the Castle Rock area and place a crew on standby if a large weather event is predicted to occur while the Cowlitz River is in an elevated condition.

For more information on the layout of the proposed monitoring system, please refer to the Stormwater Outfall Plans.

Implementation of Pumping:

Once the float switches have activated and a crew has been mobilized to the site, the pump shall be moved to the pumping manhole and connected to both the inflow and outflow ports. Prior to pumping, the manual slide gate valve on the outfall line shall be closed. When the pump is connected and valve closed, the pump should be started and standing water pumped down even if an elevation of 40 feet has not been reached. Since the probability of needing the pump is low, any operation of the pump is a benefit for long term maintenance. When there is no longer any threat of a buildup of water within the detention area, the pump can be disconnected and the valve opened. Once the valve has been opened, the crew shall ensure that no water is backflowing into the detention area from the river. If any backflow occurs, the valve shall be maintained in the shut position until the river drops to a safe level.

Ownership, Operation, and Maintenance Agreement:

Once the stormwater pumping system is constructed and operational, CT6/Tapani shall assume responsibility for operation and maintenance as described in this memo. The pump shall be operated and maintained on a regular basis to ensure that it is ready when needed (semi-annually at a minimum). The pump shall be tested and in working order prior to the start of the wet season (October 1st). In addition, it shall be the responsibility of CT6/Tapani to monitor site conditions and weather forecasts as outlined in this memo.

CT6/Tapani personnel should make a conscious effort to educate the neighbors and other onsite personnel about how the system works and the response plan that is in place. CT6/Tapani should also consider installing signage for water levels rising past a designated mark in the offsite detention pond with contact information for the responsible party, should any of the monitoring systems in place fail. This will also give the community more involvement and a sense of assuredness.

While the offsite drainage system will be constructed in conjunction with the Phase 1 Development of the site, the offsite drainage system is fully isolated and is not a part of the LOTC onsite stormwater system. The proposed pumping system is being constructed for the benefit of the existing residents of the offsite property north of the proposed development. Therefore, CT6/Tapani intends for the City of Castle Rock to assume responsibility for operation and maintenance of the offsite stormwater system

once the system is established and tax revenue from the development can support the additional maintenance responsibilities from City personnel. CT6 proposes that the City take responsibility for the system once \$25,000 in tax revenue has been generated by onsite development within the LOTC Master Plan. At that time, CT6/Tapani shall no longer be held responsible for the operation of the pumping system outlined in this memo. CT6/Tapani will also donate the aforementioned pump to the City for continued operation of the system. For more information, see the associated Stormwater Pump Agreement.

Sincerely,
MacKay Sposito

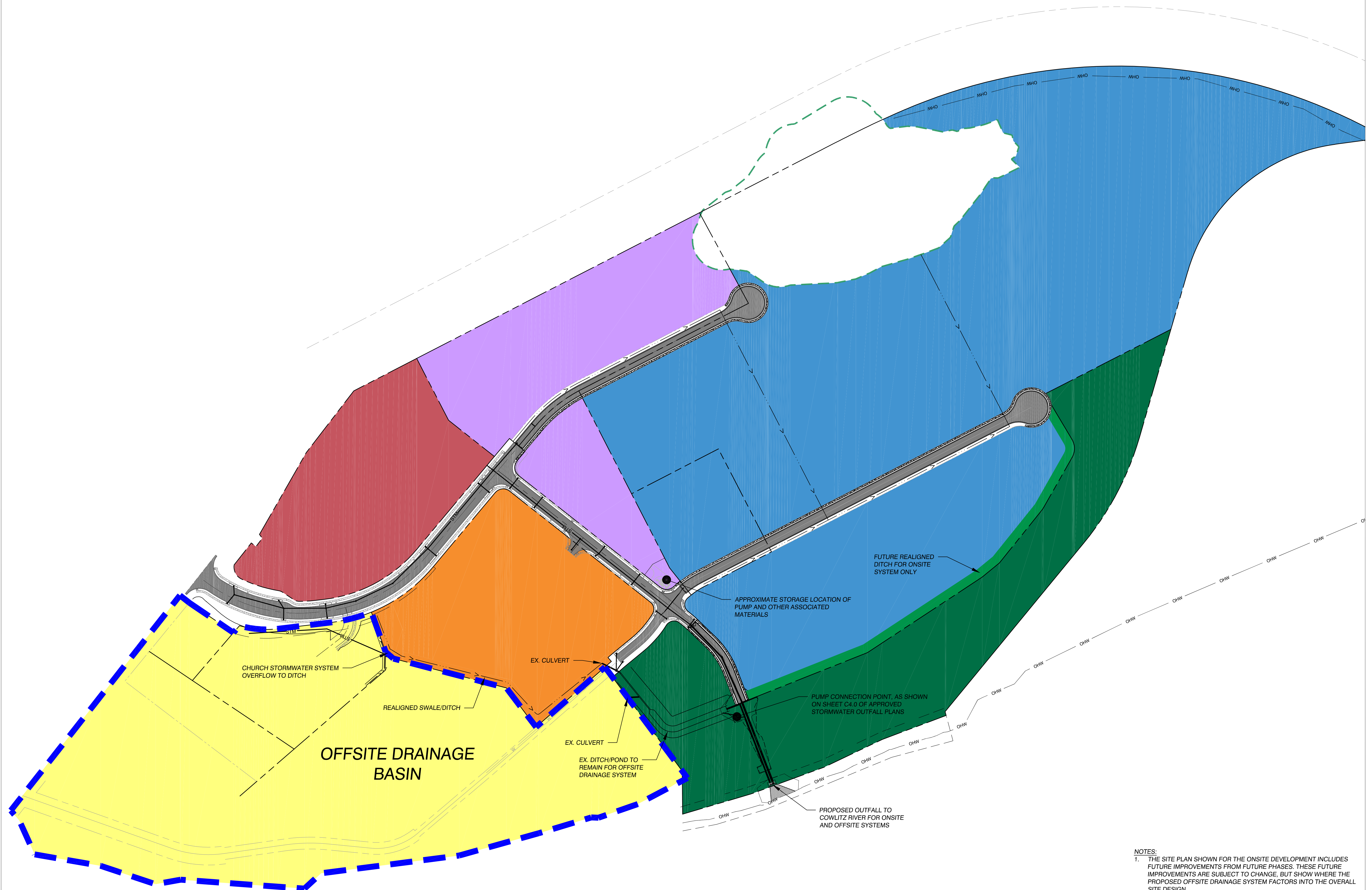
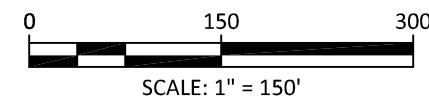


Taylor Wilson, PE
Project Manager



06/09/2025

EXHIBIT C



- NOTES:**
1. THE SITE PLAN SHOWN FOR THE ONSITE DEVELOPMENT INCLUDES FUTURE IMPROVEMENTS FROM FUTURE PHASES. THESE FUTURE IMPROVEMENTS ARE SUBJECT TO CHANGE, BUT SHOW WHERE THE PROPOSED OFFSITE DRAINAGE SYSTEM FACTORS INTO THE OVERALL SITE DESIGN.
 2. THIS EXHIBIT IS NOT TO BE USED FOR CONSTRUCTION. IT IS SOLELY FOR THE PURPOSE OF IDENTIFYING LOCATIONS DISCUSSED IN THE LANDING ON THE COWLITZ - STORMWATER PUMP AGREEMENT.



Review / Authorization

Primary Responsible Department: Finance

Permit No. 2025-0007

Castle Rock Fair Parade

Barbara Rider 360.274.4136 berider@cni.net

Reviewed by: (mark "X" & date upon review)

Comments and Conditions

☒ Finance Carie Cuttonaro, Clerk-Treasurer Date: 6/4/2025	no issues
☒ Fire (Cowlitz County Fire District 6) Bill LeMonds, Fire Chief Date: 6/4/2025	per email - no issues
☐ Police Charlie Worley, Chief Date:	
☒ Public Works / Engineering Dave Vorse, Public Works Director Date: 6/4/2025	
☐ Parks	
☒ Streets	street closures - ok
☒ Traffic	set up detours - ok
☒ Other	provide additional garbage cans - ok
☐ Building/Planning, if needed	n/a
Additional Comments: Waiting for comment/approval from Police Dept. Their insurance policy renews at the end of June, so Barbara has already talked to her insurance agent and he is going to email a copy of the Certificate of Liability over once it renews. Per Barabara she has already got the ok from WSDOT as well.	
☐ Approved ☐ Denied	Primary responsible department signature _____ Date _____



Special Event Permit

Permit No. **2025-0007**

City of Castle Rock | Phone: 360.274.8181 | www.ci.castle-rock.wa.us

Application must be made a minimum of **60 days** prior to event (30 if a prior annual event)

Contact Information

Organization/Sponsor Castle Rock Fair	Address/City/State/Zip PO Box 655 Castle Rock, WA 98611	
Contact Person Barbara Rider	Phone 360-274-4136	Email berider@cnl.net
As contact person, are you authorized by the Organization/Sponsor to act on its behalf? ☒ YES ☐ NO	Address/City/State/Zip (if different from above) 325 Ogden Rd. Castle Rock, WA 98611	
Are there other individuals authorized to act on behalf of the Organization/Sponsor? Brian Platt ☒ YES ☐ NO If yes, please provide their name and contact information: 360-572-0809		

Event Information

Event Name Castle Rock Fair Parade		Date(s) of event July 17, 2025	Estimated # of participants for event 800
Start Time 6 AM	End Time 7:30 AM	Setup Time 5 AM	Takedown Time 7:30 AM
Is this an annual event? ☒ YES ☐ NO*		Applicant may be required to collect approval signatures from neighboring or affected residents and/or business owners.	
Have you previously requested a permit for such activity? Yes		If yes, approximate date? July 18, 2024	
Are participants required to pay a fee? NO		Are participants to make a donation? NO	
Will this event impede traffic? ☒ YES ☐ NO		Follow traffic, pedestrian and bike laws? ☒ YES ☐ NO	
		Utilize sidewalks only? ☐ YES ☒ NO	
Details of event (Please include a detailed map showing location of event and copies of any proposed brochures, posters, flyers, or mailings you desire to use to advertise this event. Additionally, please identify on the map where volunteers will be placed to assist with this event. Include additional pages if needed to fully explain details.)			

Type of Use

Type of use requested ☒ Parade ☐ Street Closure ☐ Street Sale ☐ Athletic Run/Walk ☐ Block Party ☐ Other	Where is use requested? ☐ Park area*/where? ☐ Park building*/which one? ☐ Private property/where? ☐ Other
*Note: If planning to use a park area or building, please contact the Public Works Department at 360.274.7478 for any additional forms required for the use of a park area or building.	
Please check all that apply to this event: ☒ Requesting closure/impediment of a street or public right-of-way. (Please attach a map and mark location.) ☐ Requesting to erect structure(s)/tent(s). Number and location ☐ Planning to serve food/drink. If yes, including alcohol beverages? ☐ YES ☐ NO ☐ This event involves political or religious activity intended primarily for the communication or expression of ideas. ☐ Participants will be required to pay a fee. ☐ Participants will be asked to make a donation.	
Permit holders are responsible for cleanup of debris in connection with their activities.	

RECEIVED

JUN 28 2025

BY:

City Assistance Requested

Public Works Division (example: street closure, signage, signal adjustment, facility availability, additional sanitation/garbage, restrooms) - Explain	Police Department (example: traffic, patrol, security) - Explain
	Other - Explain

Insurance Information

The City does not maintain insurance that will respond to claims against the applicant arising out of the use of facilities by the applicant, its members, or those attending the event. Depending on the type of event you are planning, and the activity and risk level of your group, you may be required to obtain bodily injury and property damages liability insurance in accordance with City policy, name the City as an additional insured on the policy, and be responsible for obtaining said insurance. After reviewing this application, the City will determine whether you must obtain liability insurance.

Agreement

Depending on the type of event planned, you may be required to defend, indemnify and hold harmless the City, its agents, employees and officials, while acting within the scope of their duties, from all causes of action, demands and claims, including the cost of their defense, arising in favor of the organization, the organization's employees or third parties on account of personal injuries, bodily injuries, death, or damage to property arising out of the acts or omissions of the organization, its employees or representatives, concessionaires of the event or any other person or entity, except for liability caused due to the sole negligence of the City. After reviewing this application, the City will determine whether you must indemnify the City and its agents.

By my signature I state that I am authorized to obligate the above-titled Organization/Sponsor, including financially, for any statements or requests made herein.

Applicant Name (please print) Barbara Rider	Applicant Signature Barbara Rider
Organization/Title Castle Rock Fair Treasurer	Date 5-28-25

Add additional information on separate sheets as needed.

City Use Only

Other permits required in conjunction with this permit:

☐ Electrical
 ☐ Fire, Life & Safety
 ☐ Parks
 ☐ Other: _____

Fees/Payments/Refunds

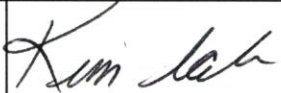
	Fee(s)	Initial(s)	Date(s)
Deposit(s)			
Permit(s)			
Facility Use/Rental(s)			
Admission Tax(es)			
Additional Costs			
TOTAL PAID			
TOTAL REFUND / DUE			

Proof of insurance required? ☐ Yes ☐ No	Bond Required? ☐ Yes ☐ No
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Special Event Signature Collection Sheet

Event: C.R. Fair Parade Date: July 17th 2025 Time: 6:00 PM to 7:30 PM

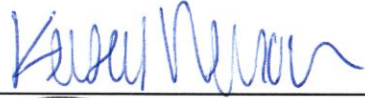
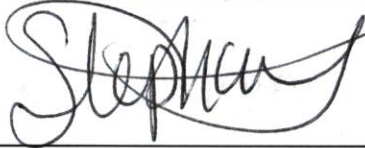
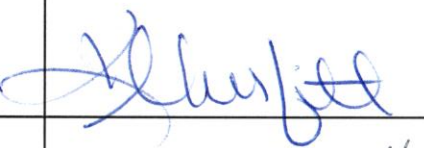
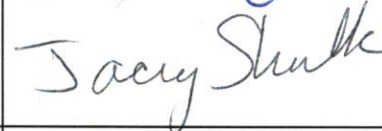
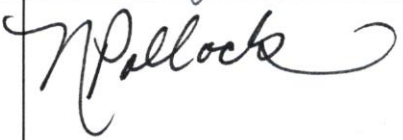
By signing this paper, I am stating that I am either in favor or against the above listed event. Please write clearly.

Name	Signature	Business	Address	In Favor	Not in Favor
Kim Lake		Bredfields	102 Cowlitz St	✓	
Kim Lake		Kim's unique boutique	#23 Cowlitz St	✓	
Jana Gann		Knotty Stitches	105 Cowlitz St. W	✓	
Jill Roehrbach		Pharmacy	117-1st Ave	✓	
David M		PT Northwest	51 Cowlitz street	✓	
Nguyen nguyen		Shayla nails & spa	413 Cowlitz St W	✓	
Karl Germanson	by phone		33 Cowlitz	✓	

Special Event Signature Collection Sheet

Event: CR Fair Parade Date: July 17 Time: 6:00 to 7:00

By signing this paper, I am stating that I am either in favor or against the above listed event. Please write clearly.

Name	Signature	Business	Address	In Favor	Not in Favor
River Ridge Real Estate		Kelsie Weisow	101 FRONT AVE SW	YN	
NAPA auto parts		Stephanie Moore	105 Hunnington Ave	SV	
Castle Rock auto lic		Tammy Brossad	2 Cowlitz W.	AB	
GFE + Betherlight		Kari Morfitt	10 Cowlitz St W	SD	
Vanlet Books & Brew		Jacey Shulke	20 Cowlitz St.	OS	
Blueberry Hill		Nancy Pollock	28 Cowlitz St	WP	
Parwell Farms		Matisyn Chapman	32 Cowlitz St W	MC	