



**TECHNICAL MEMORANDUM**

TO: PATHOGEN WORK GROUP DATE: JULY 8, 2009  
 USEPA REGION II RE: TMDL DEVELOPMENT  
 FROM: CHARLES DUJARDIN FILE: RTIN.003.002.001.4C

**OVERVIEW**

Combined Sewer Overflow and Stormwater discharge reductions are estimated in Appendices A and B in order to achieve various water quality objectives. These estimates are calculated for return intervals of 2, 3, 4, 5, and 10 years. In each major waterbody, a critical model segment was selected for the calculations. A table of results is developed for each of these waterbody segments. These calculations are based on the Pathogen Allocation Tool (PAT) and results of a long-term simulation (13 years). The long-term simulation was used basically to convert PAT results to the various return intervals. The information on the tables is as follows:

<b>CSO</b>	Concentration due to CSO discharges
<b>Storm</b>	Concentration due to stormwater discharges
<b>Background</b>	Concentration due to background (i.e. boundary conditions)
<b>Total</b>	Total maximum 30-day geometric mean concentration
<b>Total - .03 Storm</b>	Concentration assuming MS4 level of stormwater control (3%)
<b>Total - 0.1 Storm</b>	Concentration assuming moderate level of stormwater control (10%)
<b>% CSO Reduction</b>	Percent CSO reduction required to meet target
<b>% CSO Red (.03)</b>	Percent CSO reduction required assuming MS4 control
<b>% CSO Red (.10)</b>	Percent CSO reduction required assuming 10% stormwater control

<b>Conc. @ 0.5 CSO Red SW Reduction</b>	Estimated Concentration assuming 50% CSO control Estimated additional stormwater reductions that would be required to meet target
<b>Conc. @ 0.75 CSO Red SW Reduction</b>	Estimated Concentration assuming 75% CSO control Estimated additional stormwater reductions that would be required to meet target
<b>Conc. @ 0.85 CSO Red SW Reduction</b>	Estimated Concentration assuming 85% CSO control Estimated additional stormwater reductions that would be required to meet target
<b>Conc. @ 0.95 CSO Red SW Reduction</b>	Estimated Concentration assuming 95% CSO control Estimated additional stormwater reductions that would be required to meet target

It is noted that any calculated CSO reduction that is greater than 1.0 is obviously not attainable and are highlighted. It is also noted that any stormwater reductions that are greater than 10% is probably not achievable due to practical engineering implementation and cost.

Appendix A shows the estimates to achieve a maximum 30-day geometric mean enterococci standard of 35 No./100mL. On review of the results, it seems apparent that the enterococci standard of 35 is not practically achievable in the Passaic and Hackensack rivers. Therefore, additional analysis was performed in New Jersey waters for fecal coliform bacteria and computing reductions based on the SE2 secondary contact standard of 770 NO./100mL. These results are shown in Appendix B.

All results in this memo are considered estimates but it does give a good approximation of what may be achievable. Final results will be determined through long-term simulations which will be developed through discussions with the PWG and Oversight Group.

## **Appendix A**

### **Primary Contact CSO/SW Reductions**

**Enterococci Target - 35 mL/100mL**

#### **Tables**

- 1A East River – Management Zones 1 & 2**
- 2A Hudson River – Management Zones 3 & 4**
- 3A Upper Bay – Management Zones 6 & 7**
- 4A Kill Van Kull – Management Zones 8 & 9**
- 5A Upper Arthur Kill – Management Zones 8 & 9**
- 6A Arthur Kill – Management Zones 10 & 11**
- 7A Passaic River – Management Zone 16**
- 8A Hackensack River – Management Zone 15**

**Table 1A****Waterbody - East River****Management Zones 1& 2 - Enterococci**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	28.2	35.8	40.1	41.9	68.3
<b>Storm</b>	4.5	5.8	6.5	6.7	11.0
<b>Background</b>	1.0	1.0	1.0	1.0	1.0
<b>Total</b>	33.7	42.6	47.6	49.6	80.3
<b>Total - .03 Storm</b>	33.6	42.4	47.4	49.4	80.0
<b>Total - 0.1 Storm</b>	33.3	42.0	47.0	48.9	79.2
<b>% CSO Reduction</b>	0.00	0.21	0.31	0.35	0.66
<b>% CSO Reduction (.03)</b>	0.00	0.21	0.31	0.34	0.66
<b>% CSO Reduction (.10)</b>	0.00	0.20	0.30	0.33	0.65
<b>Conc. @0.5 CSO Red</b>	20	25	28	29	46
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	1.01
<b>Conc. @0.75 CSO Red</b>	13	16	18	18	29
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.85 CSO Red</b>	10	12	14	14	22
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.95 CSO Red</b>	7	9	10	10	15
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00

**Table 2A****Waterbody - Hudson River****Management Zones 3 & 4 - Enterococci**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	17.2	18.1	23.2	27.6	36.1
<b>Storm</b>	2.8	2.9	3.7	4.4	5.8
<b>Background</b>	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	20.0	21.0	26.9	32.0	41.9
<b>Total - .03 Storm</b>	19.9	20.9	26.8	31.9	41.7
<b>Total - 0.1 Storm</b>	19.7	20.7	26.5	31.6	41.3
<b>% CSO Reduction</b>	0.00	0.00	0.00	0.00	0.19
<b>% CSO Reduction (.03)</b>	0.00	0.00	0.00	0.00	0.19
<b>% CSO Reduction (.10)</b>	0.00	0.00	0.00	0.00	0.18
<b>Conc. @0.5 CSO Red</b>	11	12	15	18	24
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.75 CSO Red</b>	7	7	10	11	15
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.85 CSO Red</b>	5	6	7	9	11
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.95 CSO Red</b>	4	4	5	6	8
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00

**Table 3A****Waterbody - Upper Bay****Management Zones 6 & 7 - Enterococci**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	20.7	22.3	26.5	30.5	42.2
<b>Storm</b>	4.3	4.7	5.5	6.4	8.8
<b>Background</b>	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	25.0	27.0	32.0	36.9	51.0
<b>Total - .03 Storm</b>	24.9	26.9	31.8	36.7	50.7
<b>Total - 0.1 Storm</b>	24.6	26.5	31.5	36.3	50.1
<b>% CSO Reduction</b>	0.00	0.00	0.00	0.06	0.38
<b>% CSO Reduction (.03)</b>	0.00	0.00	0.00	0.06	0.37
<b>% CSO Reduction (.10)</b>	0.00	0.00	0.00	0.04	0.36
<b>Conc. @0.5 CSO Red</b>	15	16	19	22	30
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.75 CSO Red</b>	9	10	12	14	19
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.85 CSO Red</b>	7	8	9	11	15
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.95 CSO Red</b>	5	6	7	8	11
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00

**Table 4A****Waterbody - Kill Van Kull****Management Zones 8 & 9 - Enterococci**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	36.0	38.5	46.7	55.7	87.4
<b>Storm</b>	8.3	8.8	10.7	12.8	20.0
<b>Background</b>	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	44.3	47.3	57.4	68.5	107.4
<b>Total - .03 Storm</b>	44.1	47.0	57.1	68.1	106.8
<b>Total - 0.1 Storm</b>	43.5	46.4	56.3	67.2	105.4
<b>% CSO Reduction</b>	0.26	0.32	0.48	0.60	0.83
<b>% CSO Reduction (.03)</b>	0.25	0.31	0.47	0.59	0.82
<b>% CSO Reduction (.10)</b>	0.24	0.30	0.46	0.58	0.81
<b>Conc. @0.5 CSO Red SW Reduction</b>	26 0.00	28 0.00	34 0.00	41 0.44	64 1.44
<b>Conc. @0.75 CSO Red SW Reduction</b>	17 0.00	18 0.00	22 0.00	27 0.00	42 0.34
<b>Conc. @0.85 CSO Red SW Reduction</b>	14 0.00	15 0.00	18 0.00	21 0.00	33 0.00
<b>Conc. @0.95 CSO Red SW Reduction</b>	10 0.00	11 0.00	13 0.00	16 0.00	24 0.00

**Table 5A**

**Waterbody - Upper Arthur Kill**

**Management Zones 8 & 9 - Enterococci**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	70.0	83.0	88.2	100.8	179.1
<b>Storm</b>	25.9	30.8	32.7	32.7	66.4
<b>Background</b>	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	95.9	113.8	120.9	133.5	245.5
<b>Total - .03 Storm</b>	95.1	112.9	119.9	132.5	243.5
<b>Total - 0.1 Storm</b>	93.3	110.7	117.6	130.2	238.9
<b>% CSO Reduction</b>	0.87	0.95	0.97	0.98	1.18
<b>% CSO Reduction (.03)</b>	0.86	0.94	0.96	0.97	1.16
<b>% CSO Reduction (.10)</b>	0.83	0.91	0.94	0.94	1.14
<b>Conc. @0.5 CSO Red SW Reduction</b>	61 1.00	72 1.21	77 1.28	83 1.47	156 1.82
<b>Conc. @0.75 CSO Red SW Reduction</b>	43 0.32	52 0.54	55 0.60	58 0.70	111 1.15
<b>Conc. @0.85 CSO Red SW Reduction</b>	36 0.05	43 0.27	46 0.33	48 0.39	93 0.88
<b>Conc. @0.95 CSO Red SW Reduction</b>	29 0.00	35 0.00	37 0.06	38 0.08	75 0.61



**Table 6A****Waterbody - Arthur Kill****Management Zones 10 & 11 - Enterococci**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	45.1	53.5	56.9	65.0	115.4
<b>Storm</b>	48.2	57.2	60.8	69.5	123.4
<b>Background</b>	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	93.3	110.7	117.7	134.5	238.8
<b>Total - .03 Storm</b>	91.9	109.0	115.9	132.4	235.1
<b>Total - 0.1 Storm</b>	88.5	105.0	111.6	127.6	226.5
<b>% CSO Reduction</b>	1.29	1.41	1.45	1.53	1.77
<b>% CSO Reduction (.03)</b>	1.26	1.38	1.42	1.50	1.73
<b>% CSO Reduction (.10)</b>	1.19	1.31	1.35	1.42	1.66
<b>Conc. @0.5 CSO Red</b>	71	84	89	102	181
<b>SW Reduction</b>	0.74	0.86	0.89	0.96	1.18
<b>Conc. @0.75 CSO Red</b>	59	71	75	86	152
<b>SW Reduction</b>	0.51	0.62	0.66	0.73	0.95
<b>Conc. @0.85 CSO Red</b>	55	65	69	79	141
<b>SW Reduction</b>	0.41	0.53	0.56	0.64	0.86
<b>Conc. @0.95 CSO Red</b>	50	60	64	73	129
<b>SW Reduction</b>	0.32	0.43	0.47	0.54	0.76

**Table 7A****Waterbody - Passaic River****Management Zone 16 - Enterococci**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	201	215	259	288	293
<b>Storm</b>	161	173	208	231	235
<b>Background</b>	10	10	10	10	10
<b>Total</b>	372.0	398.0	476.6	529.4	537.9
<b>Total - .03 Storm</b>	367.2	392.8	470.4	522.5	530.9
<b>Total - 0.1 Storm</b>	355.9	380.7	455.8	506.3	514.4
<b>% CSO Reduction</b>	1.68	1.69	1.71	1.72	1.72
<b>% CSO Reduction (.03)</b>	1.65	1.66	1.68	1.69	1.69
<b>% CSO Reduction (.10)</b>	1.99	1.61	1.63	1.64	1.64
<b>Conc. @0.5 CSO Red SW Reduction</b>	272 1.47	290 1.48	347 1.50	385 1.52	391 1.52
<b>Conc. @0.75 CSO Red SW Reduction</b>	221 1.16	237 1.17	282 1.19	313 1.20	318 1.21
<b>Conc. @0.85 CSO Red SW Reduction</b>	201 1.03	215 1.04	257 1.07	284 1.08	289 1.08
<b>Conc. @0.95 CSO Red SW Reduction</b>	181 0.91	193 0.92	231 0.94	256 0.95	260 0.96

**Table 8A****Waterbody - Hackensack River****Management Zone 15 - Enterococci**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	114.5	126.4	143.3	160.5	212.7
<b>Storm</b>	136.8	150.9	171.1	191.6	254.0
<b>Background</b>	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	251.3	277.3	314.4	352.1	466.7
<b>Total - .03 Storm</b>	247.2	272.8	309.3	346.4	459.1
<b>Total - 0.1 Storm</b>	237.6	262.2	297.3	332.9	441.3
<b>% CSO Reduction</b>	1.89	1.92	1.95	1.98	2.03
<b>% CSO Reduction (.03)</b>	1.85	1.88	1.91	1.94	1.99
<b>% CSO Reduction (.10)</b>	1.77	1.80	1.83	1.86	1.91
<b>Conc. @0.5 CSO Red SW Reduction</b>	194 1.16	214 1.19	243 1.21	272 1.24	360 1.28
<b>Conc. @0.75 CSO Red SW Reduction</b>	165 0.95	183 0.98	207 1.00	232 1.03	307 1.07
<b>Conc. @0.85 CSO Red SW Reduction</b>	154 0.87	170 0.89	193 0.92	216 0.94	286 0.99
<b>Conc. @0.95 CSO Red SW Reduction</b>	143 0.79	157 0.81	178 0.84	200 0.86	265 0.90

## **Appendix B**

### **Secondary Contact CSO/SW Reductions**

**Fecal Coliform Target - 700 mL/100mL**

#### **Tables**

- 1B Passaic River – Management Zone 16**
- 2B Hackensack River – Management Zone 15**
- 3B Newark Bay – Management Zones 15 & 16 & 9**
- 4B Upper Arthur Kill – Management Zones 8 & 9**

**Table 1B****Waterbody - Passaic River****Management Zones 3 & 4 - Fecal Coliform Secondary Contact**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	648	695	836	930	945
<b>Storm</b>	308	330	397	442	449
<b>Background</b>	50	50	50	50	50
<b>Total</b>	1006.0	1075.0	1283.0	1422.0	1444.0
<b>Total - .03 Storm</b>	996.8	1065.1	1271.1	1408.7	1430.5
<b>Total - 0.1 Storm</b>	975.2	1042.0	1243.3	1377.8	1399.1
<b>% CSO Reduction</b>	0.36	0.44	0.61	0.70	0.71
<b>% CSO Reduction (.03)</b>	0.35	0.42	0.60	0.69	0.70
<b>% CSO Reduction (.10)</b>	0.32	0.39	0.57	0.65	0.67
<b>Conc. @0.5 CSO Red</b>	682	728	865	957	972
<b>SW Reduction</b>	0.00	0.00	0.24	0.42	0.45
<b>Conc. @0.75 CSO Red</b>	520	554	656	725	735
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.85 CSO Red</b>	455	484	572	632	641
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.95 CSO Red</b>	390	415	489	539	546
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00

**Table 2B****Waterbody - Hackensack River****Management Zone 15 - Fecal Coliform Secondary Contact**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	359	396	449	503	667
<b>Storm</b>	188	208	235	263	349
<b>Background</b>	3	3	3	3	3
<b>Total</b>	550.0	607.0	687.0	769.0	1019.0
<b>Total - .03 Storm</b>	544.4	600.8	680.0	761.1	1008.5
<b>Total - 0.1 Storm</b>	531.2	586.2	663.5	742.7	984.1
<b>% CSO Reduction</b>	0.00	0.00	0.00	0.00	0.37
<b>% CSO Reduction (.03)</b>	0.00	0.00	0.00	0.00	0.36
<b>% CSO Reduction (.10)</b>	0.00	0.00	0.00	0.00	0.32
<b>Conc. @0.5 CSO Red</b>	371	409	463	518	686
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.75 CSO Red</b>	281	310	350	392	519
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.85 CSO Red</b>	245	270	305	341	452
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.95 CSO Red</b>	209	231	260	291	385
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00

**Table 3B****Waterbody - Newark Bay****Management Zone 15 & 16 & 9 - Fecal Coliform Secondary Contact**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	412	449	521	582	685
<b>Storm</b>	82	89	103	116	136
<b>Background</b>	8	8	8	8	8
<b>Total</b>	502.0	546.0	632.0	706.0	829.0
<b>Total - .03 Storm</b>	499.5	543.3	628.9	702.5	824.9
<b>Total - 0.1 Storm</b>	493.8	537.1	621.7	694.4	815.4
<b>% CSO Reduction</b>	0.00	0.00	0.00	0.00	0.09
<b>% CSO Reduction (.03)</b>	0.00	0.00	0.00	0.00	0.08
<b>% CSO Reduction (.10)</b>	0.00	0.00	0.00	0.00	0.07
<b>Conc. @0.5 CSO Red</b>	296	322	372	415	487
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.75 CSO Red</b>	193	209	241	270	315
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.85 CSO Red</b>	152	164	189	211	247
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.95 CSO Red</b>	111	119	137	153	178
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00

**Table 4B****Waterbody - Upper Arthur Kill****Management Zone 8 & 9 - Fecal Coliform Secondary Contact**

	<b>2 YR</b>	<b>3 YR</b>	<b>4 YR</b>	<b>5 YR</b>	<b>10 YR</b>
<b>CSO</b>	211	251	267	305	541
<b>Storm</b>	41	49	52	59	105
<b>Background</b>	1	1	1	1	1
<b>Total</b>	253.0	301.0	320.0	365.0	647.0
<b>Total - .03 Storm</b>	251.8	299.5	318.4	363.2	643.9
<b>Total - 0.1 Storm</b>	248.9	296.1	314.8	359.1	636.5
<b>% CSO Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>% CSO Reduction (.03)</b>	0.00	0.00	0.00	0.00	0.00
<b>% CSO Reduction (.10)</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.5 CSO Red</b>	148	176	187	213	377
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.75 CSO Red</b>	95	113	120	136	241
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.85 CSO Red</b>	74	88	93	106	187
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00
<b>Conc. @0.95 CSO Red</b>	53	63	66	75	133
<b>SW Reduction</b>	0.00	0.00	0.00	0.00	0.00