

**STATE OF VERMONT**  
**AGENCY OF NATURAL RESOURCES**  
**DEPARTMENT OF ENVIRONMENTAL CONSERVATION**

**1272 ORDER NO. 3-1207-A4**  
**COMBINED SEWER OVERFLOW ABATEMENT**  
**EFFECTIVENESS STUDY**

**SUBMITTED BY:**

**City of Montpelier**  
**Department of Public Works**  
**City Hall**  
**39 Main Street**  
**Montpelier, Vermont 05602**

**DATE:**

**December 31, 2013**

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CITY OF MONTPELIER CSO ABATEMENT EFFECTIVENESS STUDY

1272 ORDER NO. 3-1207-A4

DECEMBER 31, 2013

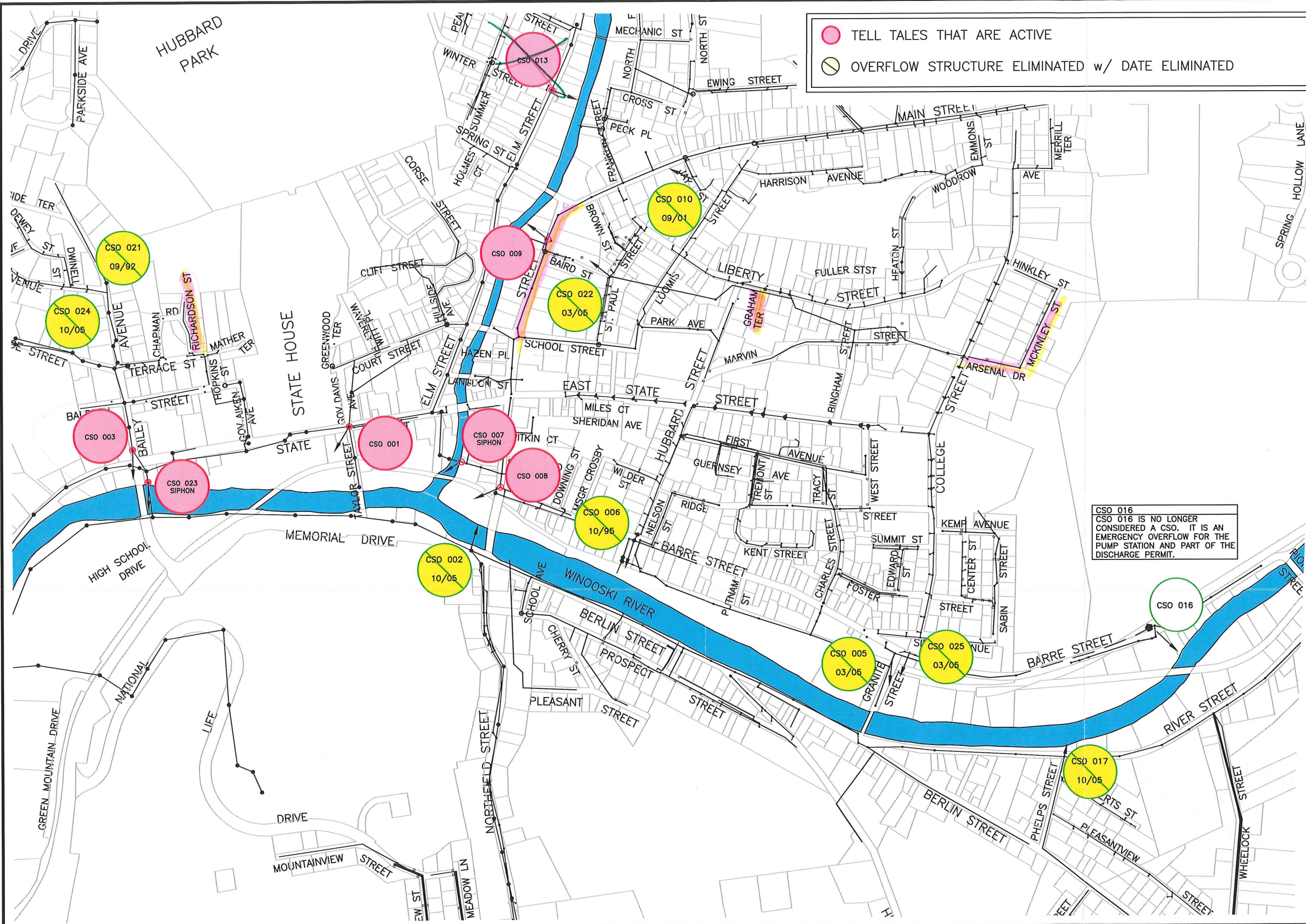
**I. Introduction:**

The City of Montpelier has been actively addressing the Combined Sewer Overflow (CSO) system since the first preliminary engineering report in 1992. Through a phased construction schedule spanning a period of 10 years, the total number of overflow structures has gone from twenty-five to eight and the number of catch basins connected to the sewer system has been reduced from 525 to what is currently estimated to be approximately 30. Consequently, the frequency and volume of overflow events has been significantly reduced.

The City of Montpelier established tell-tale devices in the remaining active overflow structures on April 5, 2013 and monitored for overflow events until October 22, 2013. The CSO structures that were monitored included CSO 001, 003, 007, 008, 009, and 023. The locations of these overflow structures can be found on Figure G1 prepared by Stantec Consulting Services dated February, 2007.

Overflow events are caused by a variety of factors including rainfall intensity, ground water levels, snow melt runoff, and level of base plant Influent flow during the storm event. It should be kept in mind that correlation of storm intensity to overflow events are only approximate due to these multiple variables which can be compounded to magnify effects on the results.

VA:\p000000\0119511\...3\Civil\...Assess...\_Tell Tale...ales-11...2007.24...nkatz, VL...VT-BRL...30



● TELL TALES THAT ARE ACTIVE  
○ OVERFLOW STRUCTURE ELIMINATED w/ DATE ELIMINATED

CSO 016  
 CSO 016 IS NO LONGER CONSIDERED A CSO. IT IS AN EMERGENCY OVERFLOW FOR THE PUMP STATION AND PART OF THE DISCHARGE PERMIT.



Rev.	Description	By	Date

VERMONT

CITY OF MONTPELIER  
 CSO ELIMINATION  
 PHASE 2 ASSESSMENT  
 CSO LOCATION MAP

MONTPELIER

Project No.	195110929
Proj. Manager	T.D. NESBITT
Proj. Designer	C.W. SLATER
Drawn By	C.W. SLATER
Checked By	T.D. NESBITT
Scale	1"=600'
Approved	
Date	FEBRUARY 2007

G1

Sheet 1 of 2  
B 6140009

## II. Monitoring Results:

Table 1 shows the results of the CSO monitoring for 2013. Tell-tales were used to document overflow events, which consisted of small blocks of wood tied to a ladder rung in the structure. The blocks were placed on top of the overflow weir and checked and reset on the next business day following each storm event. While this method is effective, there is the possibility for some false readings primarily caused by rats living in the system.

CSO 001, located at the intersection of State St. and Taylor St. is now the most frequently active overflow with a total of 13 overflows during the 2013 monitoring period. CSO 009 followed with 8, then CSO 003 with 6, CSO 007 and CSO 023 with 5, and CSO 008 with 3. Table 2.1 shows the difference in overflow events between the 2005, 2008 monitoring and 2013 monitoring periods.

TABLE 2.1

COMPARISON OF TELL-TALE INSPECTION RESULTS											Total Precipitation During Monitoring Period
Year	CSO 001	CSO 003	CSO 005	CSO 007	CSO 008	CSO 009	CSO 013	CSO 022	CSO 023	Total # Overflows	
2005	8R,15Y	1R,12Y	0	6Y	27Y	1R,8Y	4Y	2R,17Y	13Y	102	28.34"
2008	20R,2Y	7Y	X	9Y	3R,13Y	12Y	X	X	18Y	61	31.61"
2013	13Y	6Y	X	1R, 5Y	3Y	8Y	X	X	5Y	40	25.81"

As can be seen in the above table, all overflows were reduced with the exception of CSO 001. The results from CSO 001 from 2005 and 2008 may be misleading however because the outfall leaving this structure was collapsed during these monitoring period and it is likely that as the water in the sewer line receded, the tell-tale block was moved from an overflow position to a reversal position from the surcharged water leaving the overflow pipe. If this was the case, the number of actual overflows at CSO 001 would have been reduced from 22 to 13 between 2008 and 2013 monitoring periods. Overall, taking into account variations in annual rainfall amounts, this data shows that as a result of the abatement efforts performed by the City of Montpelier, the number of overflow events has been roughly reduced by 50% from 2005 to 2013. This indicates that CSO abatement projects are a very effective method in reducing the frequency of CSO overflow events.

CSO Abatement work completed between the 2008 and 2013 monitoring periods included repair of the outfall line from CSO 001, raising the weir elevations at CSO 001 and 008, separation of combined sewer / storm systems on Richardson St., Graham Terrace, Main Street, Lower State Street, Arsenal Drive and McKinley St. and separation of one catch basin and drainage associated with a development project at 15-17 Northfield Street.

TABLE 1- CSO MONITORING RESULTS

APRIL 2013																			
DATE	WEATHER	Plant PREC. (INCHS)	Airport PREC. (INCHS)	Storm Duration (Hrs)	Avg Intensity (In/Hr)	Max 1/2hr Intensity (In/Hr)	Max 1hr Intensity (In/Hr)	PLANT FLOW			TELL-TALE INSPECTION RESULTS								
								MAX. (MGD)	MIN. (MGD)	TOT. (MGD)	CSO 001	CSO 003	CSO 007	CSO 008	CSO 009	CSO 023			
1	OVERCAST	0.04	0.16					4.52	2.27	2.95									
2	CLEAR	0.00	TRACE					1.84	1.84	2.54									
3	CLEAR	0.00	TRACE					2.75	1.75	2.34									
4	CLEAR	0.00	0.00					2.67	1.74	2.27									
5	CLEAR	0.00	TRACE					2.64	1.65	2.38									
6	OVERCAST	0.00	TRACE					2.51	1.55	2.08	N	N	N	N	N	N			
7	CLEAR	0.00	TRACE					2.44	1.51	2.05									
8	CLEAR	0.00	TRACE					2.62	1.52	2.14									
9	RAIN	0.14	0.13					2.67	1.98	2.37	N	N	N	N	N	N			
10	OVERCAST	0.10	0.20					2.72	1.80	2.37									
11	OVERCAST	0.07	0.00					2.63	1.66	2.24									
12	RAIN	0.40	0.59	7.30	0.05	0.05	0.10	2.84	1.77	2.43									
13	RAIN	0.01	0.02					4.04	1.87	2.93									
14	RAIN	0.12	0.22					3.35	2.08	2.76									
15	CLEAR	0.00	0.00					2.91	1.92	2.49	N	N	N	N	N	N			
16	OVERCAST	0.00	0.09					2.78	1.79	2.44									
17	CLEAR	0.00	0.00					2.71	1.71	2.29									
18	CLEAR	0.00	0.01					2.65	1.64	2.23									
19	RAIN	0.59	0.47	1.75	0.34	0.31	0.51	4.30	1.64	2.50									
20	OVERCAST	0.00	0.04					2.94	1.87	2.45									
21	CLEAR	0.00	TRACE					2.49	1.64	2.15									
22	CLEAR	0.00	0.00					2.56	1.62	2.12	N	N	N	N	N	N			
23	CLEAR	0.00	0.00					2.43	1.50	2.09									
24	CLEAR	0.00	TRACE					2.33	1.49	1.96									
25	CLEAR	0.00	0.02					2.28	1.43	1.95									
26	CLEAR	0.00	TRACE					2.23	1.37	1.88									
27	CLEAR	0.00	0.00					2.08	1.32	1.77									
28	CLEAR	0.00	0.00					2.05	1.31	1.71									
29	CLEAR	0.00	0.00					2.27	1.29	1.75	N	N	N	N	N	N			
30	CLEAR	0.00	TRACE					2.14	1.27	1.74									
TOTAL		1.47	1.95					81.49	49.80	67.44									
AVG		0.05	0.10					2.72	1.66	2.25									
MAX		0.59	0.59					4.52	2.27	2.95									
TOTAL OVERFLOW EVENTS											0	0	0	0	0	0			
MIN. PRECIPITATION CAUSING OVERFLOW (INCHES)											-	-	-	-	-	-			
MIN. PRECIPITATION CAUSING REVERSAL (INCHES)											-	-	-	-	-	-			
LOWEST MAX PLANT FLOW FOR OVERFLOW (MGD)											-	-	-	-	-	-			
LOWEST MAX PLANT FLOW FOR REVERSAL (MGD)											-	-	-	-	-	-			

- N = Reversal
- Y = Overflow
- N = No Activity
- X = Weekend (no CSO's checked)
- \* = Storm Event over 0.25"

TABLE 1- CSO MONITORING RESULTS

MAY 2013																		
DATE	WEATHER	Plant PREC. (INCHS)	Airport PREC. (INCHS)	Storm Duration (Hrs)	Avg Intensity (In/Hr)	Max 1/2hr Intensity (In/Hr)	Max 1hr Intensity (In/Hr)	PLANT FLOW			TELL-TALE INSPECTION RESULTS							
								MAX (MGD)	MIN (MGD)	TOT. (MGD)	CSO 001	CSO 003	CSO 007	CSO 008	CSO 009	CSO 023		
1	CLEAR	0.00	0.00					2.22	1.25	1.68								
2	CLEAR	0.00	TRACE					1.97	1.20	1.63								
3	CLEAR	0.00	0.00					2.03	1.16	1.63								
4	CLEAR	0.00	0.00					1.75	1.15	1.52								
5	CLEAR	0.00	0.00					1.75	1.10	1.48								
6	CLEAR	0.00	0.00					1.94	1.10	1.55	N	N	N	N	N	N	N	N
7	CLEAR	0.00	0.00					1.90	1.08	1.51								
8	RAIN	0.11	0.06					1.82	1.08	1.52								
9	RAIN	0.02	TRACE					1.93	1.08	1.56								
10	RAIN	0.04	0.02					1.90	1.08	1.52								
11	RAIN	0.02	0.12					1.92	1.12	1.52								
12	OVERCAST	0.00	TRACE					1.78	1.02	1.47								
13	OVERCAST	0.02	0.01					1.86	1.04	1.51	N	N	N	N	N	N	N	N
14	CLEAR	0.00	0.01					1.95	1.04	1.52								
15	RAIN	0.04	0.05					1.88	1.02	1.51								
16	OVERCAST	0.00	0.00					1.89	1.01	1.47								
17	CLEAR	0.00	0.00					1.79	0.97	1.43								
18	CLEAR	0.00	0.00					1.63	0.97	1.31								
19	RAIN	0.30	0.27	7.50	0.04	0.05	0.09	2.18	0.99	1.49								
20	RAIN	0.17	0.03					2.25	0.97	1.48	N	N	N	N	N	N	N	N
21	RAIN	0.99	0.62	1.25	0.47	0.24	0.54	3.88	1.20	1.89								
22	RAIN	0.42	0.14	11.75	0.04	0.32	0.34	3.54	1.34	1.92	N	N	Y	R	Y	N	N	N
23	RAIN	0.62	0.62	12.25	0.05	0.23	0.28	3.84	1.30	2.12	N	N	N	N	N	N	N	N
24	RAIN	0.59	0.74	20.75	0.03	0.08	0.15	3.11	1.53	2.78								
25	RAIN	0.81	0.97	14.00	0.06	0.08	0.12	3.11	2.95	4.20								
26	RAIN	0.02	0.07					3.49	2.12	2.84								
27	CLEAR	0.00	0.00					2.59	1.71	2.22								
28	RAIN	0.03	0.00					2.57	1.56	2.11	N	N	N	N	N	N	N	N
29	RAIN	0.34	0.45	3.25	0.10	0.15	0.22	4.09	1.83	2.34								
30	CLEAR	0.00	0.01					2.58	1.55	2.14								
31	CLEAR	0.00	0.00					2.20	1.34	1.88								
TOTAL		4.14	4.19					75.54	40.22	56.95								
AVG		0.13	0.15					2.44	1.30	1.84								
MAX		0.81	0.97					5.11	2.95	4.20								
TOTAL OVERFLOW EVENTS											0	0	1Y	1R	1Y	0		
MIN. PRECIPITATION CAUSING OVERFLOW (INCHES)											-	-	0.59	-	0.59	-		
MIN. PRECIPITATION CAUSING REVERSAL (INCHES)											-	-	-	0.7	-	-		
LOWEST MAX PLANT FLOW FOR OVERFLOW (MGD)											-	-	3.88	-	3.88	-		
LOWEST MAX PLANT FLOW FOR REVERSAL (MGD)											-	-	-	3.88	-	-		

- R = Reversal
- Y = Overflow
- N = No Activity
- X = Weekend (no CSO's checked)
- = Storm Event over 0.25"

TABLE 1- CSO MONITORING RESULTS

JUNE 2013																	
DATE	WEATHER	Plant PREC. (INCHS)	Airport PREC. (INCHS)	Storm Duration (Hrs)	Avg Intensity (In/Hr)	Max 1/2hr Intensity (In/Hr)	Max 1hr Intensity (In/Hr)	PLANT FLOW			TELL-TALE INSPECTION RESULTS						
								MAX. (MGD)	MIN. (MGD)	TOT. (MGD)	CSO 001	CSO 003	CSO 007	CSO 008	CSO 009	CSO 023	
1	CLEAR	0.18	0.06					2.45	1.35	1.70							
2	RAIN	0.99	0.54	5.25	0.19	0.83	0.87	4.62	1.38	3.51							
3	CLEAR	0.00	0.00					2.72	1.67	2.28	N	N	Y	Y	Y	N	
4	CLEAR	0.00	0.00					2.54	1.58	2.12							
5	CLEAR	0.00	0.00					2.34	1.43	1.94							
6	RAIN	0.35	0.11	23.75	0.01	0.06	0.08	2.25	1.56	2.00	N	N	N	N	N	N	
7	RAIN	1.10	1.04	23.00	0.05	0.13	0.21	4.86	2.90	3.50							
8	RAIN	0.03	0.33					4.60	2.12	3.09							
9	OVERCAST	0.00	0.00					2.76	1.86	2.35							
10	RAIN	0.77	0.32	23.75	0.01	0.09	0.15	1.98	1.96	2.78	N	N	N	N	N	N	
11	RAIN	0.98	1.60	16.00	0.06	0.12	0.14	4.13	4.13	5.33							
12	RAIN	0.02	0.12					5.28	3.15	4.32	Y	Y	N	N	Y	Y	
13	OVERCAST	0.00	0.00					3.80	2.54	3.30	N	N	N	N	N	N	
14	CLEAR	0.00	Trace					3.30	2.20	2.77							
15	CLEAR	0.00	0.00					2.71	1.76	2.32							
16	RAIN	0.21	0.19					3.24	1.70	2.26							
17	RAIN	0.12	0.06					2.84	1.71	2.40	N	N	N	N	N	N	
18	CLEAR	0.00	0.03					2.88	1.52	2.23							
19	CLEAR	0.00	0.00					2.74	1.31	1.96							
20	CLEAR	0.00	0.00					2.87	1.26	1.93							
21	CLEAR	0.00	0.00					2.22	1.35	1.83							
22	RAIN	0.19	0.49					2.69	1.34	1.83							
23	RAIN	0.07	0.61					3.38	1.26	1.83							
24	RAIN	0.04	0.22					3.81	1.46	2.57	N	N	N	N	N	N	
25	RAIN	0.03	0.81					4.37	1.82	2.80							
26	RAIN	0.06	0.52					5.39	2.13	3.57	N	N	N	N	N	N	
27	OVERCAST	0.85	0.01					3.81	2.11	2.84							
28	OVERCAST	0.23	1.09	2.45	0.44	0.08	0.11	5.54	3.12	4.15							
29	CLEAR	0.04	0.06					3.43	2.24	2.91							
30	OVERCAST	0.11	0.14					2.69	1.84	2.35							
TOTAL		6.31	8.35					102.23	56.86	79.97							
AVG.		0.21	0.29					3.41	1.90	2.67							
MAX.		1.10	1.60					5.54	4.13	5.33							
MONTHLY TOTAL NUMBER OF EVENTS												1Y	1Y	1Y	1Y	2Y	1Y
MIN. PRECIPITATION CAUSING OVERFLOW (INCHES)												0.98	0.98	0.99	0.99	0.98	0.98
MIN. PRECIPITATION CAUSING REVERSAL (INCHES)												-	-	-	-	-	-
LOWEST MAX PLANT FLOW FOR OVERFLOW (MGD)												4.13	4.13	4.62	4.62	4.13	4.13
LOWEST MAX PLANT FLOW FOR REVERSAL (MGD)												-	-	-	-	-	-

- R - Reversal
- Y - Overflow
- N - No Activity
- X - Weekend (no CSO's checked)
- Storm Event over 0.25"
- Rain gage malfunction, data not available.



TABLE 1- CSO MONITORING RESULTS

JULY 2013											TELL-TALE INSPECTION RESULTS					
DATE	WEATHER	Plant PREC. (INCHS)	Airport PREC. (INCHS)	Storm Duration (Hrs)	Avg Intensity (In/Hr)	Max 1/2hr Intensity (In/Hr)	Max 1hr Intensity (In/Hr)	PLANT FLOW			CSO 001	CSO 003	CSO 007	CSO 008	CSO 009	CSO 023
								MAX. (MGD)	MIN (MGD)	TOT. (MGD)						
1	RAIN	0.52	0.43	20.90	0.03	0.14	0.22	4.75	1.86	3.07	Y	Y	N	N	Y	Y
2	RAIN	0.44	0.83	19.50	0.02	0.19	0.26	5.02	3.29	4.25	Y	N	N	N	N	N
3	OVERCAST	0.21	0.34					4.33	2.87	3.49						
4	RAIN	1.31	0.69	1.25	1.05	0.61	0.93	5.86	2.72	4.39	Y	Y	Y	Y	Y	Y
5	CLEAR	0.00	0.01					5.13	3.07	4.11						
6	CLEAR	0.04	Trace					3.63	2.43	3.05						
7	RAIN	0.72	0.11	5.50	0.13	0.35	0.40	5.17	2.34	3.14	Y	Y	Y	N	Y	Y
8	RAIN	0.04	0.91					5.39	3.25	4.40						
9	OVERCAST	0.00	0.00					4.02	2.87	3.50	N	N	N	N	N	N
10	RAIN	0.20	0.17					4.47	2.62	3.40						
11	RAIN	0.06	0.09					3.77	2.22	3.00						
12	CLEAR	0.00	0.00					3.03	1.94	2.56						
13	OVERCAST	0.00	Trace					2.66	1.85	2.24						
14	OVERCAST	0.00	0.00					2.47	1.63	2.12						
15	CLEAR	0.00	0.00					2.51	1.48	2.01						
16	CLEAR	0.00	0.00					2.09	1.32	1.81	N	N	N	N	N	N
17	RAIN	0.00	0.00					3.12	1.39	2.03						
18	RAIN	0.39	0.01					2.08	1.25	1.71						
19	CLEAR	0.09	0.16					2.02	1.26	1.71						
20	CLEAR	0.00	0.01					1.89	1.24	1.60						
21	CLEAR	0.00	0.00					1.80	1.19	1.52						
22	RAIN	0.75	0.01	20.75	0.04	0.37	0.48	4.31	1.15	1.92						
23	RAIN	0.52	1.23	21.75	0.06	0.16	0.22	4.51	1.39	2.43						
24	OVERCAST	0.01	0.09					2.58	1.38	2.03						
25	OVERCAST	0.00	0.00					2.50	1.31	1.86	Y	N	N	N	N	N
26	CLEAR	0.00	0.00					2.08	1.14	1.69						
27	CLEAR	0.00	0.01					1.75	1.14	1.49						
28	RAIN	0.35	0.23	16.75	0.01	0.08	0.13	2.32	1.14	1.64	N	N	N	N	N	N
29	CLEAR	0.00	0.11					2.74	1.16	1.73						
30	CLEAR	0.00	0.00					2.07	1.03	1.52						
31	CLEAR	0.00	0.00					1.68	0.95	1.40						
TOTAL		5.70	5.34					101.55	55.88	76.82						
AVG		0.18	0.18					3.28	1.80	2.48						
MAX		1.31	1.23					5.86	3.29	4.40						
TOTAL OVERFLOW EVENTS											5Y	3Y	2Y	1Y	3Y	3Y
MIN. PRECIPITATION CAUSING OVERFLOW (INCHES)											0.52	0.72	0.72	1.31	0.72	0.72
MIN. PRECIPITATION CAUSING REVERSAL (INCHES)											-	-	-	-	-	-
LOWEST MAX PLANT FLOW FOR OVERFLOW (MGD)											4.31	5.17	5.17	5.86	5.17	5.17
LOWEST MAX PLANT FLOW FOR REVERSAL (MGD)											-	-	-	-	-	-

- Reversal
- Overflow
- No Activity
- Weekend (no CSO's checked)
- Storm Event over 0.25"

TABLE 1- CSO MONITORING RESULTS

AUGUST 2013																
DATE	WEATHER	Plant PREC (INCHS)	Airport PREC (INCHS)	Storm Duration (Hrs)	Avg Intensity (In/Hr)	Max 1/2hr Intensity (In/Hr)	Max 1hr Intensity (In/Hr)	PLANT FLOW			TELL-TALE INSPECTION RESULTS					
								MAX (MGD)	MIN (MGD)	TOT. (MGD)	CSO 001	CSO 003	CSO 007	CSO 008	CSO 009	CSO 023
1	RAIN	0.10	0.06					2.30	1.19	1.68						
2	RAIN	0.14	0.16					2.14	1.11	1.57						
3	CLEAR	0.07	0.16					1.71	1.09	1.42						
4	RAIN	0.13	0.24					1.94	1.08	1.48						
5	CLEAR	0.00	0.01					1.79	1.09	1.53	N	N	N	N	N	N
6	CLEAR	0.00	0.00					1.79	1.02	1.47						
7	CLEAR	0.00	Trace					1.83	0.90	1.34						
8	RAIN	0.35	Trace	2.75	0.13	0.09	0.12	3.18	0.90	1.83						
9	RAIN	0.24	0.54					3.16	1.13	1.83						
10	CLEAR	0.00	0.00					1.74	1.00	1.42						
11	CLEAR	0.00	0.00					1.67	0.98	1.35						
12	CLEAR	0.01	0.00					2.05	0.86	1.44	Y	N	N	N	N	N
13	CLEAR	0.08	0.16					2.10	0.86	1.52						
14	RAIN	0.10	0.11					1.99	1.06	1.57						
15	CLEAR	0.01	0.00					1.82	0.94	1.46						
16	CLEAR	0.02	Trace					1.72	0.94	1.44						
17	CLEAR	0.01	0.01					1.65	0.91	1.27						
18	CLEAR	0.00	0.00					1.59	0.91	1.28						
19	CLEAR	0.00	0.00					1.86	0.93	1.35						
20	CLEAR	0.00	0.00					1.79	0.96	1.46						
21	CLEAR	0.00	0.00					1.87	0.93	1.44						
22	RAIN	0.44	0.48	0.50	0.88	0.42	0.42	3.43	0.95	1.60						
23	CLEAR	0.00	0.00					1.73	0.90	1.33						
24	CLEAR	0.01	0.00					1.66	0.90	1.27						
25	CLEAR	0.09	0.03					1.58	0.92	1.29						
26	OVERCAST	0.01	0.11					1.79	0.76	1.26						
27	CLEAR	0.00	0.00					1.87	0.77	1.41	Y	N	N	N	N	N
28	OVERCAST	0.00	0.00					1.61	0.87	1.34						
29	OVERCAST	0.00	0.07					1.68	0.89	1.33						
30	CLEAR	0.04	0.00					1.80	0.86	1.33						
31	OVERCAST	0.16	0.19					1.92	0.78	1.29						
TOTAL		2.01	2.33					60.76	29.39	44.42						
AVG		0.06	0.08					1.96	0.95	1.43						
MAX		0.44	0.54					3.43	1.19	1.83						
TOTAL OVERFLOW EVENTS											2Y	0	0	0	0	0
MIN. PRECIPITATION CAUSING OVERFLOW (INCHES)											0.35	-	-	-	-	-
MIN. PRECIPITATION CAUSING REVERSAL (INCHES)											-	-	-	-	-	-
LOWEST MAX PLANT FLOW FOR OVERFLOW (MGD)											3.18	-	-	-	-	-
LOWEST MAX PLANT FLOW FOR REVERSAL (MGD)											-	-	-	-	-	-

- R - Reversal
- Y - Overflow
- N - No Activity
- X - Weekend (no CSO's checked)
- Storm Event over 0.25"



TABLE 1- CSO MONITORING RESULTS

SEPTEMBER 2013																				
DATE	WEATHER	Plant PREC. (INCHS)	Airport PREC. (INCHS)	Storm Duration (Hrs)	Avg Intensity (In/Hr)	Max 1/2hr Intensity (In/Hr)	Max 1hr Intensity (In/Hr)	PLANT FLOW			TELL-TALE INSPECTION RESULTS									
								MAX. (MGD)	MIN (MGD)	TOT. (MGD)	CSO 001	CSO 003	CSO 007	CSO 008	CSO 009	CSO 023				
1	CLEAR	0.01	0.11					1.51	0.79	1.20										
2	RAIN	0.29	0.25	0.75	0.39	0.23	0.28	2.73	0.83	1.53										
3	CLEAR	0.09	0.04					1.87	0.91	1.44	N	N	N	N	N	N				
4	OVERCAST	0.22	0.15					2.22	0.89	1.48										
5	OVERCAST	0.00	0.05					1.64	0.87	1.33										
6	CLEAR	0.00	0.00					1.78	0.87	1.33										
7	CLEAR	0.10	0.01					1.52	0.94	1.26										
8	CLEAR	0.00	0.12					1.62	0.88	1.31										
9	OVERCAST	0.10	0.00					1.80	0.88	1.32	N	N	N	N	N	N				
10	RAIN	0.43	0.36	1.75	0.25	0.20	0.34	4.00	0.88	1.68										
11	CLEAR	0.48	0.28	5.00	0.10	0.24	0.19	3.30	0.91	1.70										
12	OVERCAST	0.91	0.99	15.25	0.06	0.33	0.40	4.56	1.09	2.28										
13	OVERCAST	0.15	0.89					3.50	1.30	2.10	Y	Y	N	N	N	N				
14	OVERCAST	0.00	0.01					1.95	1.12	1.55										
15	RAIN	0.06	0.01					1.75	1.04	1.44										
16	OVERCAST	0.02	0.14					1.95	1.08	1.57	N	N	N	N	N	N				
17	CLEAR	0.00	0.00					1.86	1.04	1.51										
18	CLEAR	0.00	0.01					1.88	0.99	1.47										
19	CLEAR	0.10	0.02					1.88	0.97	1.42										
20	CLEAR	0.00	0.00					1.79	0.94	1.38										
21	OVERCAST	0.66	0.04	3.50	0.19	0.40	0.55	4.33	0.95	1.72										
22	OVERCAST	0.00	0.64					1.94	1.00	1.51	Y	N	N	N	Y	N				
23	OVERCAST	0.00	0.00					1.99	0.98	1.47	N	N	N	N	N	N				
24	OVERCAST	0.00	0.00					1.89	0.95	1.45										
25	OVERCAST	0.00	0.00					1.83	0.95	1.45										
26	OVERCAST	0.00	0.00					1.79	0.97	1.44										
27	CLEAR	0.00	0.00					1.84	0.89	1.41										
28	CLEAR	0.00	0.00					1.69	0.90	1.30										
29	CLEAR	0.01	0.00					1.73	0.88	1.30										
30	CLEAR	0.00	0.00					1.76	0.88	1.37										
TOTAL		3.63	4.32					65.90	28.58	44.54										
AVG		0.12	0.14					2.20	0.95	1.48										
MAX		0.91	0.99					4.56	1.30	2.29										
TOTAL OVERFLOW EVENTS											2Y	1Y	0	0	1Y	0				
MIN. PRECIPITATION CAUSING OVERFLOW (INCHES)											0.66	0.91	-	-	0.66	-				
MIN. PRECIPITATION CAUSING REVERSAL (INCHES)											-	-	-	-	-	-				
LOWEST MAX PLANT FLOW FOR OVERFLOW (MGD)											4.33	4.56	-	-	4.33	-				
LOWEST MAX PLANT FLOW FOR REVERSAL (MGD)											-	-	-	-	-	-				

- R = Reversal
- Y = Overflow
- N = No Activity
- X = Weekend (no CSO's checked)
- = Storm Event over 0.25"

TABLE 1- CSO MONITORING RESULTS

OCTOBER 2013																			
DATE	WEATHER	Plant PREC (INCHS)	Airport PREC (INCHS)	Storm Duration (Hrs)	Avg Intensity (In/Hr)	Max 1/2hr Intensity (In/Hr)	Max 1hr Intensity (In/Hr)	PLANT FLOW			TELL-TALE INSPECTION RESULTS								
								MAX (MGD)	MIN (MGD)	TOT (MGD)	CSO 001	CSO 003	CSO 007	CSO 008	CSO 009	CSO 023			
1	CLEAR	0.01	0.00					1.85	0.91	1.38									
2	CLEAR	0.01	0.00					1.81	0.91	1.42									
3	CLEAR	0.01	0.00					1.77	0.92	1.40									
4	OVERCAST	0.00	0.02					1.84	0.88	1.39									
5	OVERCAST	0.00	0.02					1.76	0.82	1.27									
6	OVERCAST	0.31	0.31	1.50	0.21	0.12	0.18	2.96	0.84	1.47									
7	OVERCAST	0.70	0.73	10.75	0.07	0.52	0.58	4.72	0.86	1.90	Y	N	N	N	N	N	N		
8	CLEAR	0.00	0.00					1.99	1.01	1.51	Y	Y	Y	Y	Y	Y	Y		
9	CLEAR	0.00	0.00					1.90	0.98	1.46	N	N	N	N	N	N	N		
10	CLEAR	0.00	0.00					1.94	0.93	1.43									
11	CLEAR	0.00	0.00					1.93	0.93	1.38									
12	CLEAR	0.01	0.00					1.77	0.90	1.31									
13	CLEAR	0.00	0.00					1.73	0.89	1.30									
14	RAIN	0.14	0.12					1.98	0.91	1.44									
15	CLEAR	0.00	0.00					1.76	0.87	1.39	N	N	N	N	N	N	N		
16	OVERCAST	0.07	0.01					1.83	0.87	1.38									
17	OVERCAST	0.55	0.19	5.50	0.10	0.11	0.21	3.05	1.18	1.99									
18	OVERCAST	0.01	0.49					2.55	1.08	1.67									
19	CLEAR	0.05	0.05					1.82	1.06	1.46									
20	CLEAR	0.01	0.15					1.90	0.96	1.43									
21	CLEAR	0.00	0.00					1.79	1.00	1.46	Y	N	N	N	N	N	N		
22	CLEAR	0.02	0.02					1.81	0.98	1.47	N	N	N	N	N	N	N		
23	CLEAR	0.00	Trace					1.87	0.95	1.44									
24	RAIN	0.09	0.16					1.91	0.95	1.52									
25	OVERCAST	0.00	0.02					1.81	0.96	1.45									
26	OVERCAST	0.01	0.03					1.82	0.95	1.38									
27	OVERCAST	0.00	0.01					1.76	0.94	1.36									
28	OVERCAST	0.02	0.00					2.05	0.93	1.46									
29	OVERCAST	0.00	0.00					2.09	0.96	1.45									
30	OVERCAST	0.00	Trace					1.85	0.95	1.44									
31	RAIN	0.31	0.44	7.25	0.04	0.06	0.09	2.34	0.95	1.83									
TOTAL		2.33	2.77					64.86	29.21	45.57									
AVG		0.08	0.10					2.09	0.94	1.47									
MAX		0.70	0.73					4.72	1.16	1.90									
TOTAL OVERFLOW EVENTS											2Y	1Y	1Y	1Y	1Y	1Y			
MIN. PRECIPITATION CAUSING OVERFLOW (INCHES)											0.31	0.7	0.7	0.7	0.7	0.70			
MIN. PRECIPITATION CAUSING REVERSAL (INCHES)											-	-	-	-	-	-			
LOWEST MAX PLANT FLOW FOR OVERFLOW (MGD)											2.96	4.72	4.72	4.72	4.72	4.72			
LOWEST MAX PLANT FLOW FOR REVERSAL (MGD)											-	-	-	-	-	-			
SUM OF OVERFLOW EVENTS FOR 2008 MONITORING PERIOD											13Y	6Y	1R, 5Y	3Y	8Y	5Y			

X = Reversal  
 Y = Overflow  
 N = No Activity  
 = Weekend (no CSO's checked)  
 = Storm Event over 0.25"

### III. Correlation to WWTF Base Flow & Precipitation Events:

Although a significant amount of work has been completed to separate the stormwater from the sewer system, portions of Montpelier are still operating as a combined system. As a result, the capacity of the sewer mains can be exceeded if a sudden increase in flow from a high intensity storm is introduced to the system. A longer, lower intensity storm may not exceed the capacity of the system, even if the total rainfall amount from the storm is less than a shorter, higher intensity storm.

Data was taken from the Montpelier Wastewater Treatment Facility (WWTF) for daily rainfall amounts and plant influent flow. A rain gage, model Davis Vantage Pro 2, was installed at the WWTF prior to the 2013 monitoring season with the capability to measure rainfall intensity. This was compared with data from the Knapp State Airport located in Berlin, VT. There is variation in the two readings, possibly due to the elevation difference between the two stations. It is felt that the new rain gage at the WWTF yielded more accurate results due to the relative proximity to the drainage area affecting the overflows.

In examining the data, it appears that the threshold for overflows at each structure varies significantly not only between structures but also seasonally. Table 3.1 provides average values for precipitation events and wastewater influent flows causing overflows at each structure.

**TABLE 3.1  
AVERAGE VALUES FOR OVERFLOW EVENTS**

<b>CSO</b>	<b>Average Max Plant Influent Flow During Overflow Event (MGD) 2013</b>	<b>Average Precipitation Causing Overflow (Inches) 2013</b>	<b>Average Storm Rainfall Intensity Causing Overflow (In/Hr) 2013</b>
001	4.84	1.04	0.25
003	5.00	0.95	0.3
007	4.85	0.86	0.38
008	5.07	1.00	0.44
009	4.78	0.88	0.33
023	5.08	0.96	0.35

Average values for overflow events are generally a better representation for correlation to overflow events due to the multiple variables contributing to the sewer system capacity. For reference however, the minimum storm events resulting in an overflow at each CSO structure are shown in Table 3.2.

**TABLE 3.2  
MINIMUM VALUES FOR OVERFLOW EVENTS**

<b>CSO</b>	<b>Minimum Plant Influent Flow During Overflow Event (MGD) 2013</b>	<b>Minimum 24hr Precipitation Causing Overflow (Inches) 2013</b>	<b>Minimum Storm Rainfall Intensity Causing Overflow (In/Hr) 2013</b>
001	2.96	0.31	0.03
003	4.13	0.70	0.06
007	3.88	0.59	0.07
008	4.62	0.70	0.07
009	3.88	0.59	0.06
023	4.13	0.7	0.06

**V. Vermont Combined Sewer Overflow Control Policy, June 1990:**

The Vermont CSO Control Policy requires that Vermont communities eliminate the discharge of partially or untreated sewage for all storms less than the 24 hour, 2.5" rainfall event, which is approximately equivalent to the one year storm. As an alternative, if a CSO was permitted to remain active, treatment could be established for the overflow provided it was designed to meet the 24 hour 2.5 inch rainfall.

In 1992, following the report prepared by Dufresne-Henry Inc., the City of Montpelier decided that the best solution to the overflow problem was to implement a phased storm and sewer separation project. Over 10 years of construction took place in order to meet the goals outlined in the Vermont CSO Control Policy. Additionally, the City of Montpelier utilized ARRA funding to perform further storm / sewer separation work in 2010. Despite this work, the City has not yet been able to meet the requirements described in the policy. As evidenced from the monitoring results, there continue to be overflows during rainfall events below the policy threshold.

**VI. Recommendations:****A. CSO Separation**

In a continued effort to meet the requirements of the CSO Control Policy, the City of Montpelier has identified the next combined sewer overflow separation project. This project is located on **Towne Street**, where there is still currently a storm water system connected to the municipal sanitary sewer. This system runs cross-country to Main Street and contributes to CSO 001, 007,009 and 023. Additionally, **Sunset Ave.** will also be evaluated for a potential storm sewer separation project. The City anticipates a two phase approach to these separation projects with an anticipated completion date for work in the **Fall of 2015**.

**B. Modifications to CSO Monitoring System**

The current monitoring techniques only provide for limited information yielding yes or no results. The City of Montpelier proposes to install ultrasonic monitoring devices at each of the active CSO structures, which will allow for detailed information on overflow events including start and stop times, and discharge volume estimates. This information will allow the City to further assess the cause of overflows. It is the City's intent to have these devices in place prior to the next monitoring season starting in **April of 2014**.

**C. CSO Weir Elevation Assessment**

Some elevation adjustments have been made to a limited number of overflow weirs in the system. This work appears to have yielded positive results in reducing the number of overflow events. The City proposes to conduct a detailed survey of the weir elevations at all remaining overflow structures and correlate these elevations to the lowest upstream sewer service elevation at the building entrance. This information will then be used to raise the elevation of the weirs to the extent possible without causing sewer backups in the basements of residents and businesses. The estimated completion date for this work is **July, 2014**.

## TABLE 2 PUBLIC BUILDING ROOF DRAIN CONNECTION STATUS SUMMARY (1)

PAGE 1 OF 2

**A. ROOF DRAINS CONFIRMED CONNECTED**

ADDRESS	BUILDING	INFO (2) SOURCE	AREA (3) (SF)	INFLOW RATE @ 1"/HR RAIN	
				(GPM)	(MGD)
<i>crit. ed not connected</i> - BAILEY AVE -	HIGH SCHOOL - No Confirmed 2010 PHO				
135 BALDWIN ST	STATE OF VERMONT	O	52,100	542	0.780
18 BARRE ST	ST AUGUSTINE'S RECTORY	I	5,500	57	0.082
<i>noted 2012</i> - 52 BARRE ST	SENIOR CITIZEN CENTER	O	1,750	18	0.026
7 COURT ST	VT LEGAL AID, APTS	I	7,800	81	0.117
41 ELM ST	MATT'S MINI-MART	I	4,100	43	0.061
42 ELM ST	CAPITOL CITY LAUNDROMAT	I	4,300	45	0.064
GREENWOOD ST	CAPITOL APTS	I	1,800	19	0.027
<i>noted 2011</i> - 8 LANGDON ST	ONION RIVER SPORTS, OTHERS	I	8,000	83	0.120
11 LANGDON ST	YANKEE BOOKSTORE	I	8,800	92	0.132
9 MAIN ST	HAIRDRESSERS SALON	I	3,000	31	0.045
21 MAIN ST	LEGION HALL	I	4,000	42	0.060
<i>removed 2007</i> - MAIN ST	CITY HALL	I	2,600	27	0.039
<i>+ removed 2012</i> - 73 MAIN ST	STORES AND FIRE STATION	O	14,200	148	0.213
79 MAIN ST	HEANY REAL ESTATE BLDG	I	17,400	181	0.261
110 MAIN ST	RIVENDALL BOOKS, OTHERS	I	3,000	31	0.045
170 MAIN ST	MAIN ST MIDDLE SCHOOL	I	4,100	43	0.061
RIVER ST	WALKER FORD	O	24,700	257	0.370
RIVER ST	CODY CHEVROLET	I,O	7,600	79	0.114
<i>crit. ed not connected</i> SCHOOL ST	UNION ELEMENTARY SCHOOL	I,O	13,800	144	0.207
12-32 STATE ST	SEIVWRIGHT'S DRUGS, OTHERS	O	25,000	260	0.374
56 STATE ST	CHADWICK'S RESTAURANT	I	11,300	118	0.169
<i>noted 2004</i> - 64 STATE ST	CHRIST CHURCH PARISH HALL	I	3,200	33	0.048
<i>removed 2013</i> - 89 STATE ST	VERMONT MUTUAL (1954 BLDG)	I,O	3,200	33	0.048
91 STATE ST	CAPITOL MOVIE THEATRE	O	5,500	57	0.082
120 STATE ST	STATE - MOTOR VEHICLES	O	10,500	109	0.157
<i>noted 2013</i> - 122 STATE ST	STATE - BOILER PLANT	O	10,800	112	0.162
133 STATE ST	STATE - TRANSPORTATION	O	5,600	58	0.084
136 STATE ST	STATE - HISTORIC PRESERVATION	O	14,900	155	0.223
			2,300	24	0.034
			280,850	2,921	4.206

**B. ROOF DRAINS SUSPECTED CONNECTED**

BAIRD ST	APARTMENT BLDG	I	5,000	52	0.075
2-8 BARRE ST	CRUMPS, OTHERS	I	8,250	86	0.124
23 BARRE ST	BLUE SEAL FEEDS	I	6,900	72	0.103
34 BARRE ST	BLOUIN'S PAINTS	I	4,200	44	0.063
46 BARRE ST	ST AUGUSTINE'S SCHOOL	I	9,000	94	0.135
55 BARRE ST	RECREATION DEPT BLDG	I	6,600	69	0.099
204 BARRE ST	BAILEY BROS AUTO SUPPLY	I	3,500	36	0.052
21 E. STATE ST	VT CNTR FOR INDEPENDENT LIVING	I	5,000	52	0.075
HEATON ST	HEATON HOUSE	O	7,500	78	0.112
22-28 MAIN ST	DRAWING BOARD, OTHERS	I	5,400	56	0.081
32-42 MAIN ST	AUBUCHONS, OTHERS	I	8,300	86	0.124
44-64 MAIN ST	MCAULIFFES, OTHERS	I	10,500	109	0.157
<i>noted 2012</i> - 68 MAIN ST	PLAY IT AGAIN SAM	I	5,600	58	0.084
118-124 MAIN ST	VT BUSINESS MACHINES, OTHERS	I	3,500	36	0.052
137 MAIN ST	BARBER & LANIER FUNERAL HOME	I	4,800	50	0.072
13-17 STATE ST	VT NATIONAL BANK BLDG	I,O	5,000	52	0.075
43 STATE ST	CHITTENDEN BANK	I	3,500	36	0.052
89 STATE ST	VERMONT MUTUAL (1979 BLDG)	O	5,300	55	0.079
			107,850	1,122	1.615

## NOTES:

- (1) DATA SUMMARIZED FOR ROOF DRAIN SURVEY OF FLAT-ROOFED MAJOR COMMERCIAL, INDUSTRIAL AND PUBLIC BUILDINGS CONNECTED TO MONTPELIER SEWER SYSTEM
- (2) I = INSPECTED, O = OCCUPANT/OWNER PROVIDED INFORMATION
- (3) ROOF AREA DRAINED BY ROOF DRAINS; FROM 1" = 200' AIR PHOTO MAPPING