

## **Report Tables**

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Table 1 - Summary of Board of Health and Building Department Information

	Number	Street	Owner	MAP RTE LO	DWCP <sup>(1)</sup> Year	DWCP <sup>(1)</sup> Number	Type of Leaching System <sup>(5)</sup>	REI <sup>(2)</sup> Date	COC <sup>(3)</sup> Date	100' from Marsh?	Variance Granted from Marsh Setback?	Plan Date	Comments
1	105	Chatham Crest	Marylou L Leussler	5D -13I -C12	1980	80-105	T+2		7/20/1981	Y		1981	
2	83	Chatham Crest	Gary T Seasholtz	5D -13C -C17	1981	81-128	T+T	95-81	8/23/1982	Y			
3	93	Chatham Crest	Brenda L Madden	5D -13H -C13	2002	02-345; 81-114	T+2	03-02	1/2/03; 9/18/81	Y		1981	
4	123	Chatham Crest	Ronald C & Marcia A Trahan Tru	5D -13J -C26	1985	85-53	T+1	01-14	7/5/1985	Y		1977	
5	67	Cockle	Charles L Chesnut	5D -12 -MIS6	1990	90-158; 88-41	T+1		3/27/1991	Y		1990	
6	85	Cockle	George E Foote	5D -1 -SM115	1990	90-51	T+G		4/23/1990	Y		1989	
7	0	Cockle Cove	Roger F Naill	5C -7B -L3						-			
8	271	Cockle Cove	Peter C Kolb	5C -6 -K2	1995	95-87	T+2		3/6/1995	N	No	1995	
9	227	Cockle Cove	Roger F Naill	5C -5 -K1	1994	94-30	T+2		2/11/1994	Y		1994	
10	249	Cockle Cove	John H Kolb	5C -5A -K1A	1977	77-19	T+2		8/3/1977	Y		1976	
11	75	Cranberry	Patricia Slattery & Judith Fish Tru	5D -33 -G8	1962		CP			Unknown			BD <sup>(4)</sup>
12	76	Cranberry	James K Warnick	5D -34 -G9	1994	70-122; 94-190	T+1		8/28/1994	Y		1994	
13	11	Crest	John F Mancini	5D -13F -C15	2002	02-157; 96-183; 81-	T+G	96-73	8/9/1996	Y		2002	
14	12	Crest	Michael E Geezil	5D -13E -C16	1982	82-32	T+2		6/18/1982	Y		1981	
15	3	Crest	David A Connolly	5D -13G -C14			T+P			Unknown			BD <sup>(4)</sup>
16	98	Deering	Keith S Sherin	5C -52 -B4	1994	94-97; 74-79	T+1		5/9/1994	Y			
17	100	Deering	Michael L Mahoney	5C -51 -B3	1981	81-54; 80-80	T+2		4/8/1980	Y		1980	
18	96	Diane	Robert L Kemp	6C -71 -G108	1979	79-3	T+2		4/12/1979	Y		1978	
19	0	Diane	Chatham Conservation Fndn Inc	6C -79 -G115						-			
20	58	Diane	Janet M Labelle	6C -77 -G113	1988	88-159	T+T		8/31/1988	N	Yes	1988	Leaching trench 74' from wetland
21	74	Diane	Judith A Emerson	6C -74 -G110	1998	98-208	T+T		9/28/1999	Y		1992	
22	34	Diane	Philip B Reed	6C -59 -G116	1992	92-11	T+T		9/1/1992	Y		1990	
23	82	Diane	Clifford E Moebius	6C -73 -G109	1962	62-71	6x6 pit		12/10/1962	Unknown			Variance-5' from street line
24	26	Evergreen	Cathleen Creedon	5E -1 -4B	1997	97-63	T+T		9/29/1997	Y		1996	
25	76	Island View	Russell H Tessier	5D -55 -F17	1982	82-112	T+Disposal Field		10/19/1982	Y		1982	
26	68	Island View	Sheldon Strauss	5D -56 -F18	1996	96-214; 72-141	T+FD		9/16/1996	Y		1996	
27	120	Island View	John B Bendas	5E -13 -F13	1978	78-33	T+3	98-139	8/15/1978	Y			
28	96	Island View	George H Hillman	5D -53 -F15	1974	74-144	T+2		3/14/1975	Unknown			
29	108	Island View	Mary E Cummings Trustee	5D -51 -F14	2003	03-171; 73-143	T+C; T+3	03-26	10/20/2003	Y		2003	40 mil polyvinyl barrier @ 100' from wetland
30	124	Island View	Peter M Barry	5E -12 -F12	2000	00-295	T+G		4/9/2001	Y		2000	
31	84	Island View	Frederick M Burke	5D -54 -F16	2001	01-253; 73-71	T+G	01-145	11/30/2001	Y		2001	
32	70	Lantern	Stuart Fx Smith	5D -22 -D23A	2002	02-263	T+C; T+3		2/27/2004	Y		2002	
33	71	Lantern	John M Pierce	5D -21 -D20	1986	86-113	T+1		9/17/1986	Y		1986	
34	2175	Main	James Herbert Bremser Trustee	5E -4 -F23	1998	98-60; 89-57; 71-18	T+7		4/10/98; 6/6/89	Y		1989	
35	2177	Main	James Herbert Bremser Trustee	5E -4A -3	1989	89-98	T+1		4/21/1989	Y		1989	
36	99	Nantucket	David/Dorothy Farrell	6B -14 -G101	1994	94-83	T+C; T+3		5/3/1994	Y		1993	
37	120	Nantucket	Christopher J Lacroix	6C -72 -G107	1995	95-85	T+2		3/8/1995	Y		1994	
38	59	Nantucket	Thomas D Robinson	6B -9 -G96	1997	97-195	T+T		3/18/1998	N	Yes	1995	33' variance approved
39	47	Nantucket	John J Heavey	6B -8 -G95	2004	04-131	T+C			Y (>100' from water)		2004	New Construction
40	139	Nantucket	M A Jacqueline Callahan Trustee	5C -17 -106A	1963	63-33	T+T			Unknown			
41	0	Nantucket	M A Jacqueline Callahan Trustee	6B -18 -105B						-			
42	119	Nantucket	Carolyn H Scott	6B -17 -G103	1971	71-148	6x8		8/16/1971	Unknown			
43	87	Nantucket	John J & Theresa Heavey	6B -12 -G99A	1966	66-162	T+F		DWCP Expired	Unknown			
44	0	Nantucket	John J Heavey	6B -10 -G97A						-			
45	77	Patuxet	Jean L Seligman	5D -71 -M10	1987	87-243	T+1	00-142	2/21/1989	Y		1987	
46	75	Patuxet	Christopher B Smith	5D -80 -M11	1988	88-95	T+1	02-250; 02-260	6/1/1988	Y		1988	
47	0	Pine	Chatham Conservation Fndn Inc	6C -47 -J7						-			
48	101	Pine Knoll	Robert A & Bernice H Sullivan Tr	6C -100 -S64	1993	93-84	T+1		6/21/1993	Y		1993	
49	135	Pine Knoll	Patricia Goldmann	5C -48 -S60						Unknown			
50	121	Pine Knoll	Robert P & Carole A Malatesta T	5C -49 -S61	1993	93-132; 68-214	T+1; 6x8		9/24/1993	Y		1993	
51	117	Pine Knoll	Robert & Carole Malatesta Trust	5C -50 -S63	2000	00-311	T+G		10/5/2000	Y		2000	
52	75	Pine Knoll	Francis J Gorman Jr	6C -97 -S67	1993	93-292	T+1		3/11/1994	N	Yes	1993	Leaching pit 56' from wetland
53	67	Pine Knoll	Walter J Dutcher	6C -96 -S68	2005	05-41	FAST		4/28/2005	Y		2004	
54	139	Pine Knoll	John W Jannell Jr	5C -47 -S59	2002	02-125	T+G		10/31/2002	Y		2002	
55	0	Pine Knoll	Robert P & Carole A Malatesta T	5C -15A -10A						-			
56	93	Pine Knoll	Ellen W Ridley	6C -99 -S65	1959		CP			Unknown			BD <sup>(4)</sup>
57	145	Pine Knoll	Lesley & J Aaron Gordon Trustee	5C -15B -W1	1982	82-116	T+G	95-50; 00-214; 03-46	Feb-83	Y		1982	
58	434	Ridgevale	Bary F & Elaine G Cunningham	6B -5 -G92	1990	90-187; 70-88	T+1		2/7/1991	N	Yes	1990	Leaching pit 96' from wetland

Table 1 - Summary of Board of Health and Building Department Information

	Number	Street	Owner	MAP RTE LO	DWCP <sup>(1)</sup> Year	DWCP <sup>(1)</sup> Number	Type of Leaching System <sup>(5)</sup>	REI <sup>(2)</sup> Date	COC <sup>(3)</sup> Date	100' from Marsh?	Variance Granted from Marsh Setback?	Plan Date	Comments
59	300	Ridgevale	Paul Jenkins	6C -86 -00P1	1983	83-200	T+4G		12/29/1983	Y		1982	
60	306	Ridgevale	Paul & Ruth A Jenkins Trustees	6C -86A -P2	1983	83-13	T+1		5/6/1983	Y		1982	
61	29	Shannon	John G Boas	5D -52E -H20	1989	89-138	T+1		9/22/1989	Y		1989	
62	59	Shannon	Nicholas J Boas	5D -52H -H23	2005	05-36	T+2			Y		2005	New Construction
63	77	Shannon	Michael Schnipper T/E	5D -52J -H25	1991	91-38	T+1	00-146	6/19/1991	Y		1991	
64	25	Shannon	Marcia M Gorgone	5D -52D -H19	1989	89-226	T+1		5/21/1990	Y		1989	
65	17	Shannon	John C Andres	5D -52C -H18	1991	91-23	T+1		6/19/1991	Y		1989	
66	45	Shannon	Robert D Wachob	5D -52F -H21	1989	89-245	T+1		5/21/1990	Y			
67	138	Soundview	Patrick M DiBello	5C -15C -W2	1983	83-17	T+2	00-213; 01-193; 03-20	4/7/1983	Y		2002	
68	130	Soundview	Paul Kourafas	5C -38 -S18	1998	98-99	T+T		6/29/1998	Y		1998	
69	20	Stoughton	Harold R Jenkins	6C -83 -J23	1994	94-114; 74-137	T+FD; T+2		10/31/1994	<100' from wetland		1994	
70	0	Stoughton	Chatham Conservation Frndn Inc	6C -80 -J20						-			
71	56	Whitman	Lillian M Dunn	6C -92 -S54	1990	90-129	T+1		5/31/1991	N	Yes	1990	Leaching pit 90' from wetland
72	49	Whitman	Chet J Grocki	6C -90 -S52	1989	89-193	T+1		11/9/1989	Y		1989	
73	50	Whitman	Jerome H Casey	6C -93 -S55	2000	00-271; 96-160	FAST; T+G		6/19/1996	N	Yes	2000	Leaching pit 93' from wetland
74	57	Whitman	Albert & Philomena Dicesare	6C -91 -S53						Unknown			
75	38	Whitman	Peter A Norcross	6C -94 -S57	1988	88-157	T+1		9/7/1988	N	Yes	1987	Leaching pit 70' from wetland
76	45	Whitman	Gary F Mackenzie	6C -89 -S51	1975	75-58	T+3	97-46	8/12/1975	Unknown			
77	20	Clark Metters	Carole Genova McCarty Trustee	5B -19 -13	1995	95-253	T+P		4/22/1996	Y		1995	
78	18	Clark Metters	Deborah J Carberry	5B -19B -13B	1995	95-250	T+4G		9/12/1995	Y		1995	
79	12	Clark Metters	William J & Brenda A Sweeney	5B -19C -13C	1995	95-309	T+T	99-185	9/12/1995	Y		1995	
80	424	Cockle Cove	Gloria T & Frances G Ouellette	5B -17 -16	2001	01-134	T+T	00-200	7/23/2001	Y		2001	
81	358	Cockle Cove	Nathanial B Wordell	5B -10 -8	1984	84-28	T+1			Y		1983	
82	370	Cockle Cove	Joy Wordell	5B -21 -9	1997	97-123	T+T	05-38	12/15/1997	Y		1997	
83	70	Diane	Louisa Caswell	6C -75 -G111	1957		CP			Unknown			BD <sup>(4)</sup>
84	68	Diane	Robert S Fitzpatrick	6C -76 -G112	2003	03-219; 93-207	T+F		10/27/2003	N	Yes	2002	Leaching pit 80' from wetland
85	37	Volunteer	Jon E Wordell	5C -21 -4						Unknown			
86	67	Volunteer	Jon E Wordell	5C -19 -6						Unknown			
87	83	Volunteer	Jon E Wordell	5C -18 -7						Unknown			
88	85	Pine Knoll		6C 98 S66	1972	72-33	6x8 pits (2)		5/1/1972	Unknown			

- 1 DWCP=Disposal Works Construction Permit
- 2 REI=Real Estate Inspection
- 3 Certificate of Compliance
- 4 BD=Information obtained from Building Department
- 5 T+T=Tank and Trench
- T+#=Tank and Number of Pits
- T+G=Tank and Galley
- T+FD=Tank and Flow Diffusor
- T+F=Tank and Field
- T+C=Believed to be Tank and Cesspool

Vacant Land  
No Info

Cockle Cove Creek Enterococci Source Assessment Study  
Chatham, MA

Table 3 - Possible Enterococci-Contributing Properties

	Civic	Street	Owner	MAP RTE LO	DWCP Year	DWCP Number	Type of System	SYS	REI Date	Cert. Comp. Date	100' from Marsh	Variance Granted?	Plan Date	Comments
11	75	Cranberry	Patricia Slattery & Judith Fish Trustees	5D -33 -G8	1962		CP	CP			Unknown			BD
23	82	Diane	Clifford E Moebius	6C -73 -G109	1962	62-71	6x6 pit	CP		12/10/1962	Unknown			Variance-5' from street line
42	119	Nantucket	Carolyn H Scott	6B -17 -G103	1971	71-148	6x8	CP		8/16/1971	Unknown			
49	135	Pine Knoll	Patricia Goldmann	5C -48 -S60				CP			Unknown			
56	93	Pine Knoll	Ellen W Ridley	6C -99 -S65	1959		CP	CP			Unknown			BD
74	57	Whitman	Albert & Philomena Dicesare	6C -91 -S53				CP			Unknown			
83	70	Diane	Louisa Caswell	6C -75 -G111	1957		CP	CP			Unknown			BD
85	37	Volunteer	Jon E Wordell	5C -21 -4				CP			Unknown			
86	67	Volunteer	Jon E Wordell	5C -19 -6				CP			Unknown			
87	83	Volunteer	Jon E Wordell	5C -18 -7				CP			Unknown			
88	85	Pine Knoll		6C 98 S66	1972	72-33	6x8 pits (2)	CP		5/1/1972	Unknown			
8	271	Cockle Cove	Peter C Kolb	5C -6 -K2	1995	95-87	T+2	SS		3/6/1995	N	No	1995	
20	58	Diane	Janet M Labelle	6C -77 -G113	1988	88-159	T+T	SS		8/31/1988	N	Yes	1988	
38	59	Nantucket	Thomas D Robinson	6B -9 -G96	1997	97-195	T+T	SS		3/18/1998	N	Yes	1995	
39	47	Nantucket	John J Heavey	6B -8 -G95	2004	04-131	T+C	SS			Y (>100' from water)		2004	New Construction
52	75	Pine Knoll	Francis J Gorman Jr	6C -97 -S67	1993	93-292	T+1	SS		3/11/1994	N	Yes	1993	
58	434	Ridgevale	Barry F & Elaine G Cunningham Trustees	6B -5 -G92	1990	90-187; 70-88	T+1	SS		2/7/1991	N	Yes	1990	
69	20	Stoughton	Harold R Jenkins	6C -83 -J23	1994	94-114; 74-137	T+FD; T+2	SS		10/31/1994	<100' from wetland		1994	
71	56	Whitman	Lillian M Dunn	6C -92 -S54	1990	90-129	T+1	SS		5/31/1991	N	Yes	1990	
73	50	Whitman	Jerome H Casey	6C -93 -S55	2000	00-271; 96-160	FAST; T+G	I/A		6/19/1996	N	Yes	2000	
75	38	Whitman	Peter A Norcross	6C -94 -S57	1988	88-157	T+1	SS		9/7/1988	N	Yes	1987	
84	68	Diane	Robert S Fitzpatrick	6C -76 -G112	2003	03-219; 93-207	T+F	SS		10/27/2003	N	Yes	2002	

Cockle Cove Creek Enterococci Source Assessment Study  
Chatham, MA

Table 5 - July, August, and September 2005 Sampling Results

Date	Precipitation <sup>(1)</sup>	CM-G		CM-J		CM-F		CM-K		B4b		CM-12		CM-L	
		CFU/100 mL	Salinity												
7/1/2005	1.01														
7/2/2005	0.02														
7/3/2005	0														
7/4/2005	0														
7/5/2005	0														
7/6/2005	0.31														
7/7/2005	0.01	40		91		323		574		456		379		14	
7/8/2005	1.72														
7/9/2005	0														
7/10/2005	0														
7/11/2005	0														
7/12/2005	0														
7/13/2005	0	41	0	114	0	375	0	68	4	15	5	4	12	1	29
7/14/2005	0														
7/15/2005	0														
7/16/2005	0.01														
7/17/2005	0														
7/18/2005	0.1														
7/19/2005	0	26	0	98	0	678	0	155	6	16	6	9	14	19	20
7/20/2005	0														
7/21/2005	0														
7/22/2005	0.21														
7/23/2005	0														
7/24/2005	0														
7/25/2005	0	60	0	371	0	1417	10	432	18	343	21	54	23	1	30
7/26/2005	0														
7/27/2005	0														
7/28/2005	0														
7/29/2005	0														
7/30/2005	0														
7/31/2005	0.01														
8/1/2005	0														
8/2/2005	0.12														
8/3/2005	0														
8/4/2005	0														
8/5/2005	0														
8/6/2005	0														
8/7/2005	0														
8/8/2005	0														
8/9/2005	0.01	191	0	243	0	1748	0	272	5	916	5	220	14	1	28
8/10/2005	0														
8/11/2005	0	118	0	262	0	930	0	17	4	43	5	13	14	1	28
8/12/2005	0														
8/13/2005	0														
8/14/2005	0.38														
8/15/2005	0.05	427	0	593	0	3065	2	67	8	210	9	55	15	9	30
8/16/2005	0	367	0	292	0	2020	2	40	8	43	9	12	16	1	30
8/17/2005	0.01														

Cockle Cove Creek Enterococci Source Assessment Study  
Chatham, MA

Table 5 - July, August, and September 2005 Sampling Results

Date	Precipitation <sup>(1)</sup>	CM-G	CM-J	CM-F	CM-K	B4b	CM-12	CM-L
		CFU/100 mL						
		Salinity						
8/18/2005	0							
8/19/2005	0							
8/20/2005	0							
8/21/2005	0							
8/22/2005	0							
8/23/2005	0							
8/24/2005	0.01							
8/25/2005	0	96	128	733	58	45	26	1
8/26/2005	0.01							
8/27/2005	0							
8/28/2005	0							
8/29/2005	0.01	107	175	1380	35	40	8	1
8/30/2005	0.74	6105	6749	7933	1407	1210	653	15
8/31/2005	0	157	370	1787	130	356	50	8
9/1/2005	0.07	342	1087	2453	990	1013	619	22
9/2/2005	0	158	322	1007	443	752	508	17
9/3/2005	0							
9/4/2005	0							
9/5/2005	0.01							
9/6/2005	0.01							
9/7/2005	0							
9/8/2005	0.01	126	315	800	63	22	6	1
9/9/2005	0							
9/10/2005	0							
9/11/2005	0.01							
9/12/2005	0	131	713	283	73	30	7	15
9/13/2005	0							
9/14/2005	0	178	423	640	70	31	10	1
9/15/2005	1.85							
9/16/2005	0.74							
9/17/2005	1.01							
9/18/2005	0							
9/19/2005	0.01							
9/20/2005	0.02							
9/21/2005	0							
9/22/2005	0.01	106	415	277	169	92	8	1
9/23/2005	0							
9/24/2005	0							
9/25/2005	0.01							
9/26/2005	0.01	96	427	332	47	20	6	1
9/27/2005	0.31							
9/28/2005	0	48	180	273	30	15	8	1
9/29/2005	0.19							
9/30/2005	0							

Table 6 - July 2005 12-hour Tidal Cycle Sampling Results

Time	CM-G		CM-J		CM-F		CM-K		B4b		CM-12		CM-L	
	cfu/100 ml	Salinity												
700	63	0	1544	0	1282	25	1700	25	1053	24	723	28	34	29
800	83	0	1472	0	1270	23	2140	24	1126	25	777	27	35	30
900	78	0	825	0	1618	18	1820	22	918	23	627	25	15	30
1000	53	0	2020	0	2040	15	1273	21	665	20	313	24	254	24
1100	47	0	1478	0	2306	9	603	20	433	19	12	30	7	30
1200	38	0	320	0	1067	7	418	9	9	28	6	30	See Note	See Note
1300	47	0	208	0	57	19	59	20	4	30	8	30	See Note	See Note
1400	45	0	143	0	20	26	12	28	2	30	8	30	See Note	See Note
1500	45	0	113	0	83	25	21	26	2	29	1	30	See Note	See Note
1600	42	0	153	0	123	20	138	18	7	28	3	29	See Note	See Note
1700	33	0	141	0	745	10	365	15	27	25	17	28	2	30
1800	127	0	189	0	832	5	617	14	108	18	28	24	1	30
1900	80	0	247	0	1286	2	673	15	308	12	67	20	2	30

Table 7 - August 2005 12-hour Tidal Cycle Sampling Results

Time	CM-G		CM-J		CM-F		CM-K		B4b		CM-12		CM-L	
	cfu/100 ml	Salinity												
700	101	0	350	0	2197	20	423	22	260	25	110	28	3	30
800	116	0	330	0	1853	15	540	20	727	24	217	26	6	30
900	129	0	282	0	1543	11	480	18	977	20	507	24	4	30
1000	124	0	197	0	1765	6	347	16	757	18	278	22	1	30
1100	121	0	225	0	1476	5	108	16	420	15	58	20	27	24
1200	110	0	443	0	1421	4	113	15	67	12	5	30	6	30
1300	129	0	373	0	185	8	111	8	12	30	12	30	See Note	See Note
1400	107	0	273	0	18	30	7	30	6	30	1	30	See Note	See Note
1500	182	0	268	0	9	30	8	30	1	30	5	30	See Note	See Note
1600	139	0	533	0	7	30	8	30	4	30	3	30	See Note	See Note
1700	120	0	793	0	35	30	22	28	7	30	8	30	See Note	See Note
1800	137	0	300	0	238	28	83	28	11	30	2	30	See Note	See Note
1900	117	0	255	0	2320	25	172	22	70	28	32	30	See Note	See Note

Note: This station was not sampled every hour. The depth of the water made the sampling point inaccessible.

## **Report Figures**

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0 500 1,000 2,000 Feet  
 SCALE: 1" = 2000'

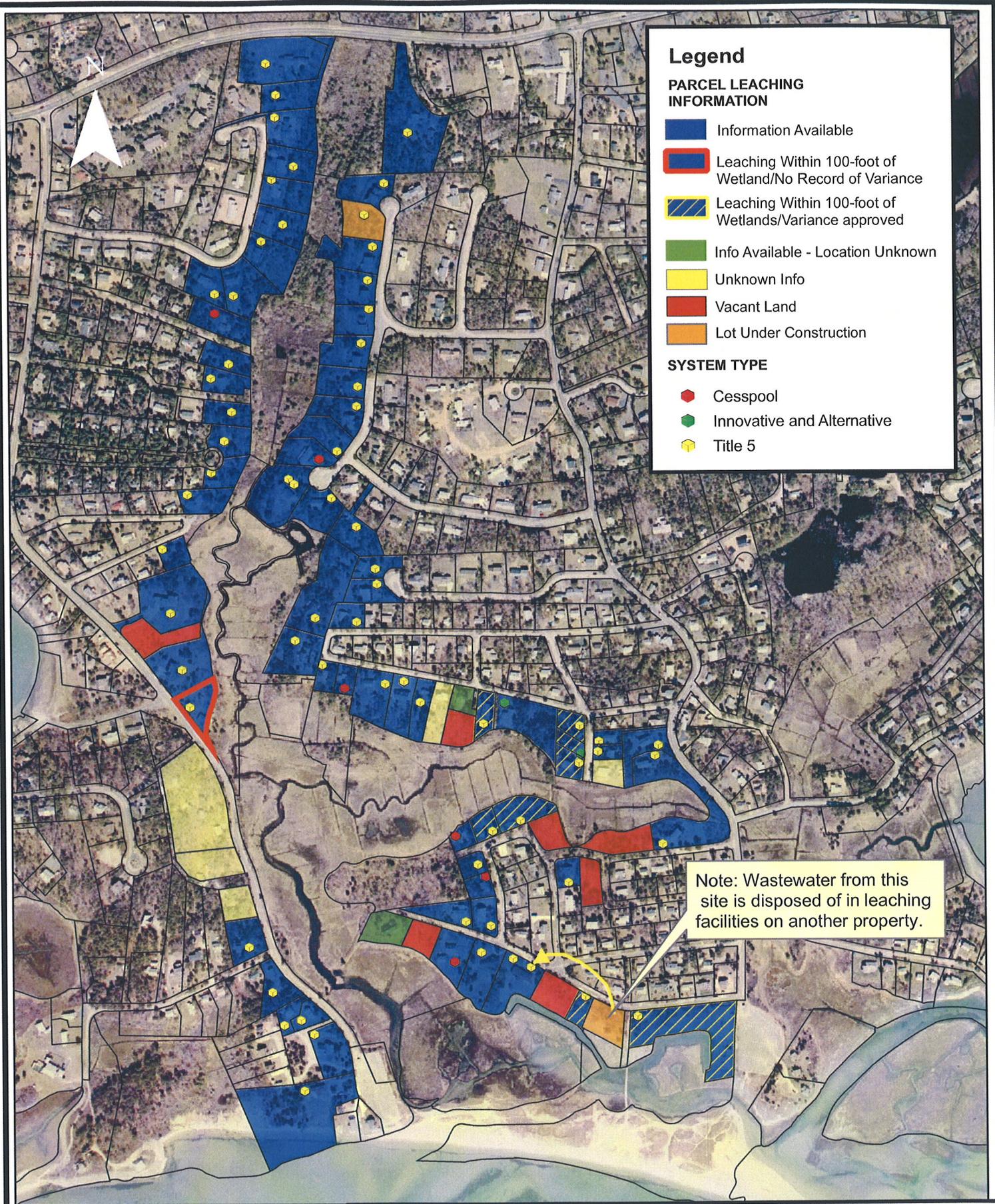
 **Stearns & Wheler, LLC**  
 Environmental Engineers and Scientists  
 HYANNIS, MASSACHUSETTS

phone: (508) 790-1707  
 web: www.stearnswheler.com

Town of Chatham, Massachusetts

Cockle Cove Creek Enterococci  
 Source Assessment Study Area

**FIGURE 1 - LOCUS MAP**



0 125 250 500 Feet  
 SCALE: 1" = 500'

**Stearns & Wheler, LLC**  
 Environmental Engineers and Scientists

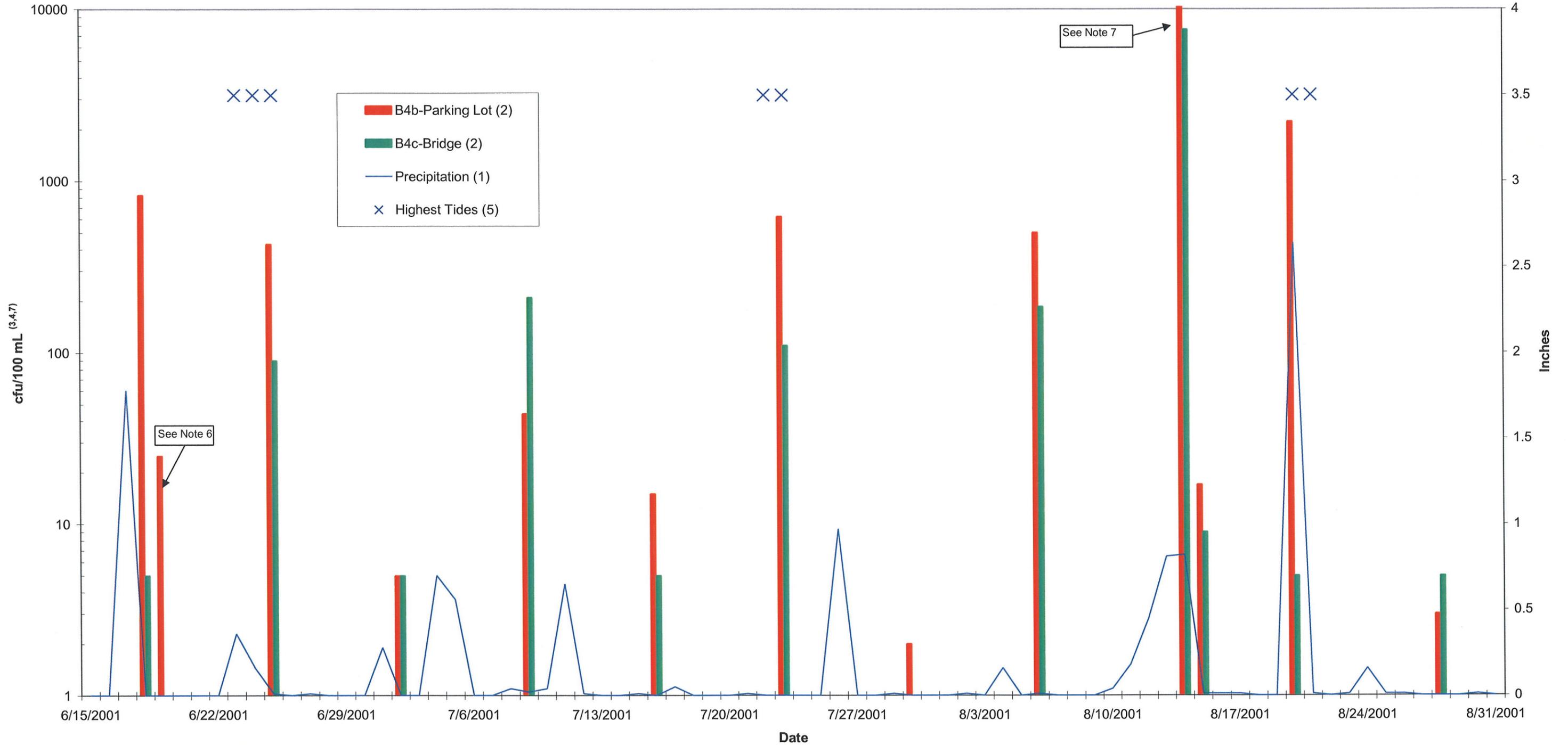
HYANNIS, MASSACHUSETTS  
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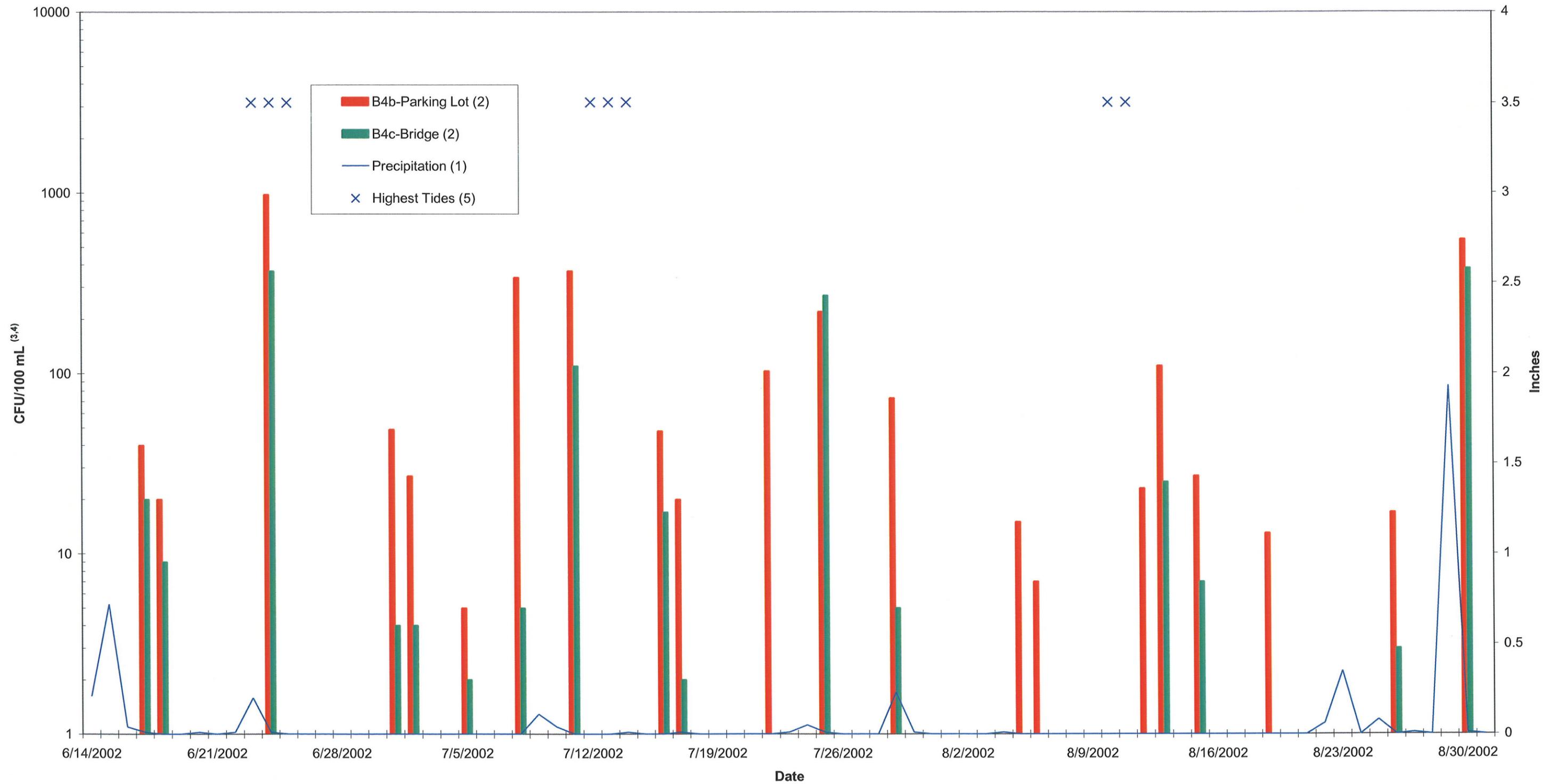
**FIGURE 2 - SEPTIC  
 SYSTEM INFORMATION**

Figure 3 - 2001 Enterococci Values



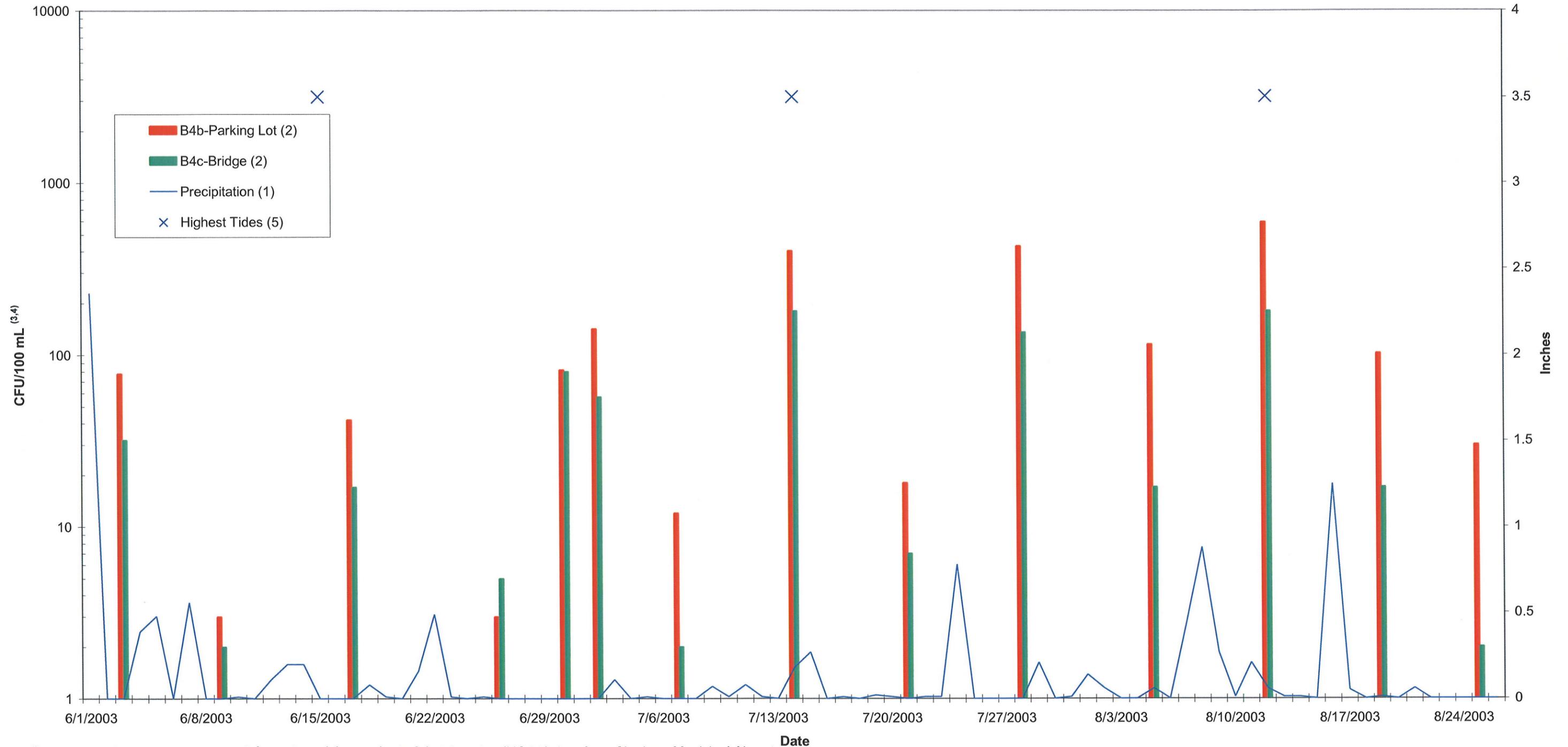
1. Precipitation data based on National Oceanic and Atmospheric Administration (NOAA) data from Chatham Municipal Airport.
2. Enterococci sampling data based on Chatham Board of Health sampling results.
3. Bacteria counts recorded as Colony Forming Units per 100 milliliters (cfu/100 mL).
4. Enterococci readings of reported as less than (<\*\* cfu/100 mL) are recorded as half the reported number.
5. Tide information based on Nautical Software data for Stage Harbor.
6. B4c was not sampled on 6/19/2001. Other dates where B4c results do not appear are because the result was 1 cfu/100 ml.
7. B4b results were 13, 590 cfu/100 ml, which is beyond the scale of this graph.

Figure 4 - 2002 Enterococci Values



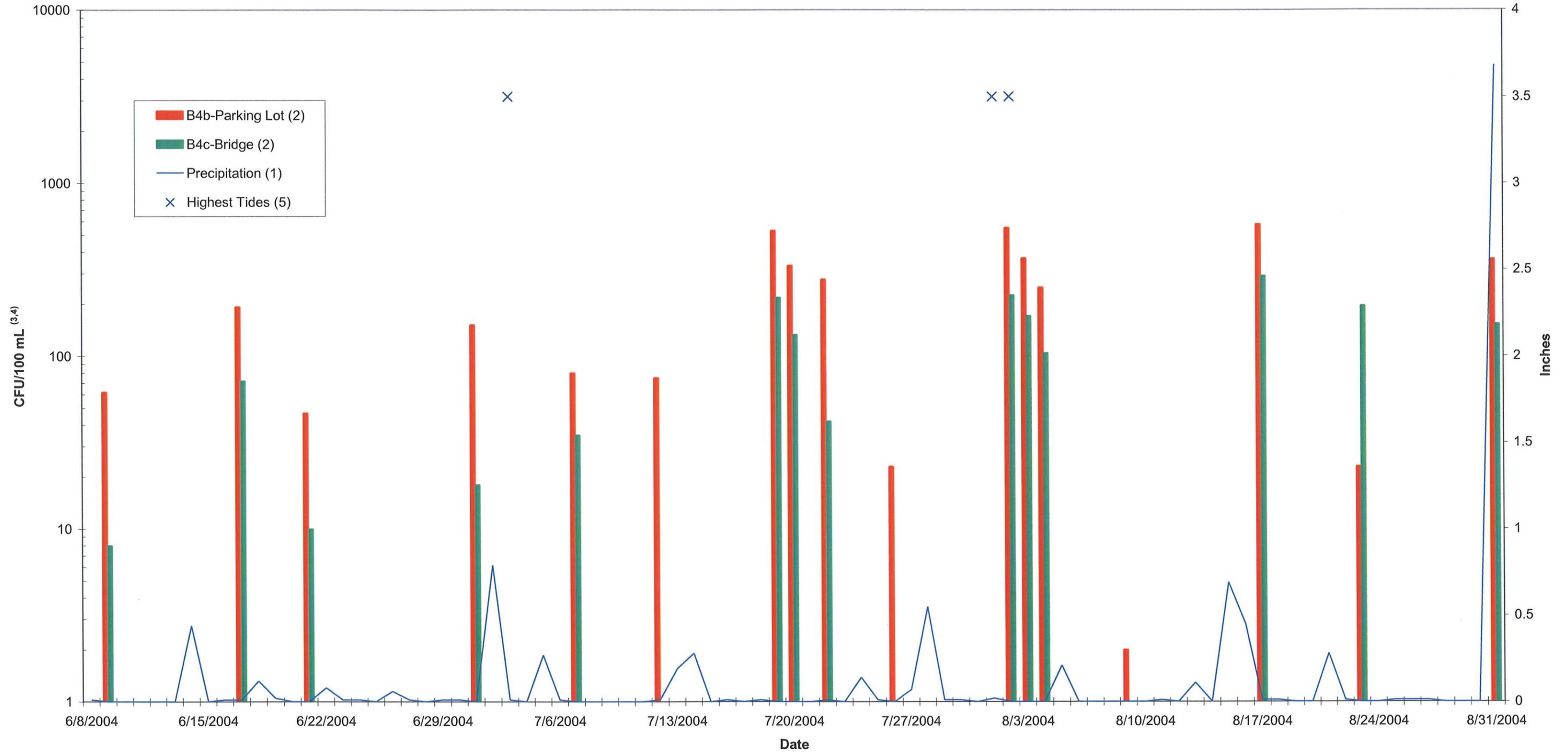
1. Precipitation data based on National Oceanic and Atmospheric Administration (NOAA) data from Chatham Municipal Airport.
2. Enterococci sampling data based on Chatham Board of Health sampling results.
3. Bacteria counts recorded as Colony Forming Units per 100 milliliters (cfu/100 mL).
4. Enterococci readings of reported as less than (<\*\* cfu/100 mL) are recorded as half the reported number.
5. Tide information based on Nautical Software data for Stage Harbor.
6. Dates with no visible results for B4c are because the result was 1 cfu/100 ml.

Figure 5 - 2003 Enterococci Values

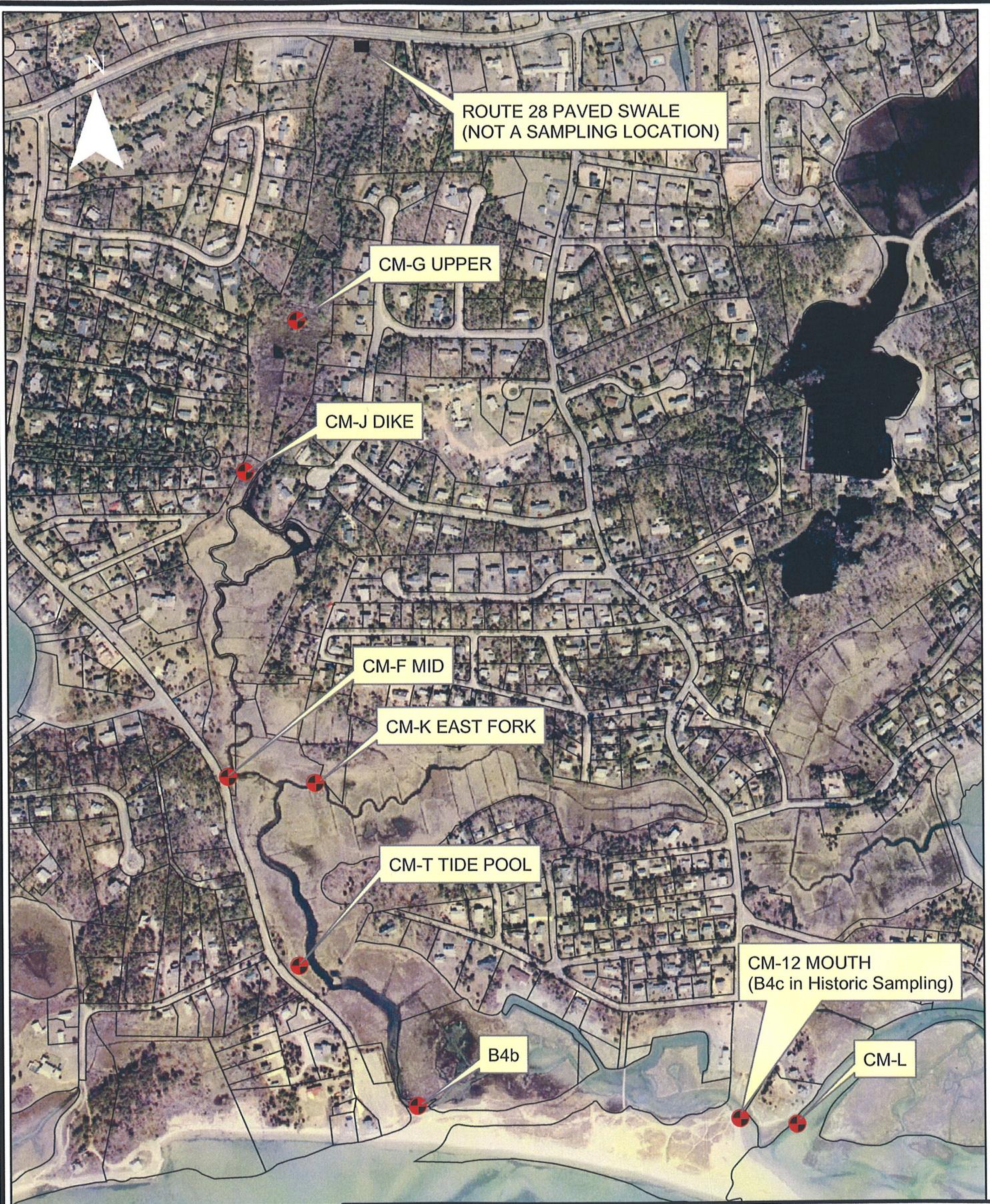


1. Precipitation data based on National Oceanic and Atmospheric Administration (NOAA) data from Chatham Municipal Airport.
2. Enterococci sampling data based on Chatham Board of Health sampling results.
3. Bacteria counts recorded as Colony Forming Units per 100 milliliters (cfu/100 mL).
4. Enterococci readings of reported as less than (<\*\* cfu/100 mL) are recorded as half the reported number.
5. Tide information based on Nautical Software data for Stage Harbor.
6. Dates with no visible results for B4c are because the result was 1 cfu/100 ml.

Figure 6 - 2004 Enterococci Values



1. Precipitation data based on National Oceanic and Atmospheric Administration (NOAA) data from Chatham Municipal Airport.
2. Enterococci sampling data based on Chatham Board of Health sampling results.
3. Bacteria counts recorded as Colony Forming Units per 100 milliliters (cfu/100 mL).
4. Enterococci readings of reported as less than (<\*\* cfu/100 mL) are recorded as half the reported number.
5. Tide information based on Nautical Software data for Stage Harbor.
6. Dates with no visible results for B4c are because the result was 1 cfu/100 ml.



0 125 250 500 Feet

SCALE: 1" = 500'



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Job No.: 70098

Date: 11/08/05

**Town of Chatham, Massachusetts**

Cockle Cove Creek Enterococci  
Source Assessment Study Area

**FIGURE 7 - SAMPLING LOCATIONS**

Figure 8 - Enterococci Sampling Events and Rain Events

Figure 8a - July 2005

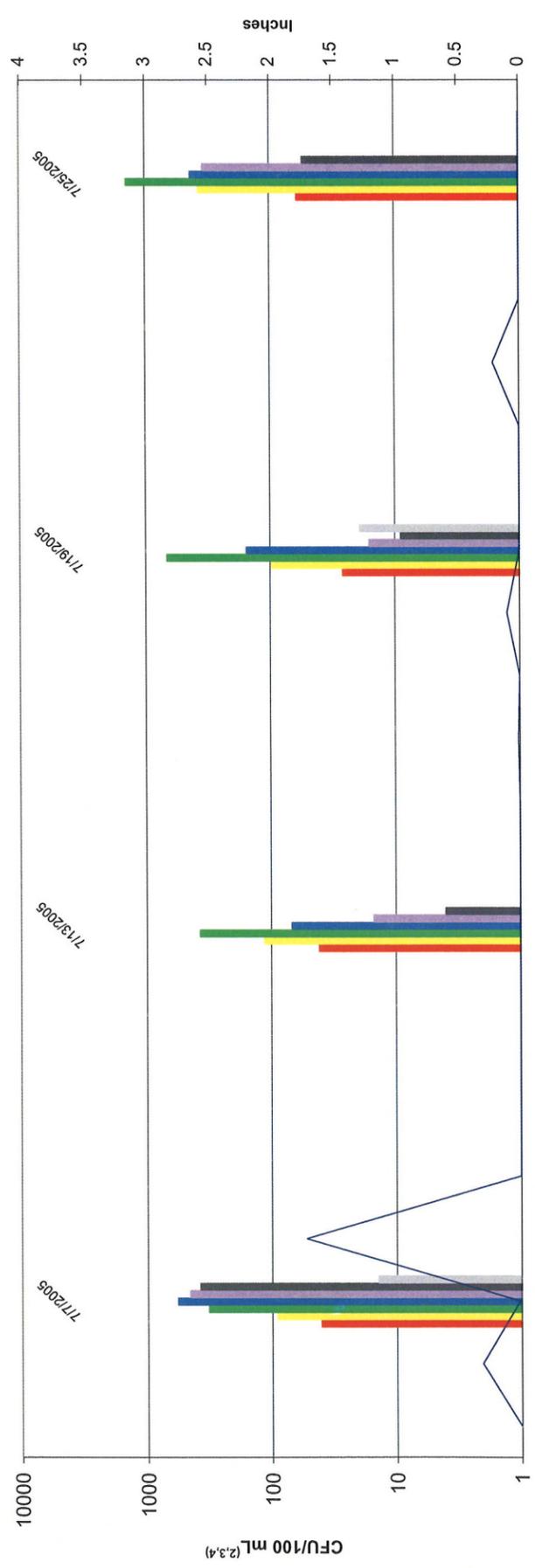


Figure 8b - August 2005

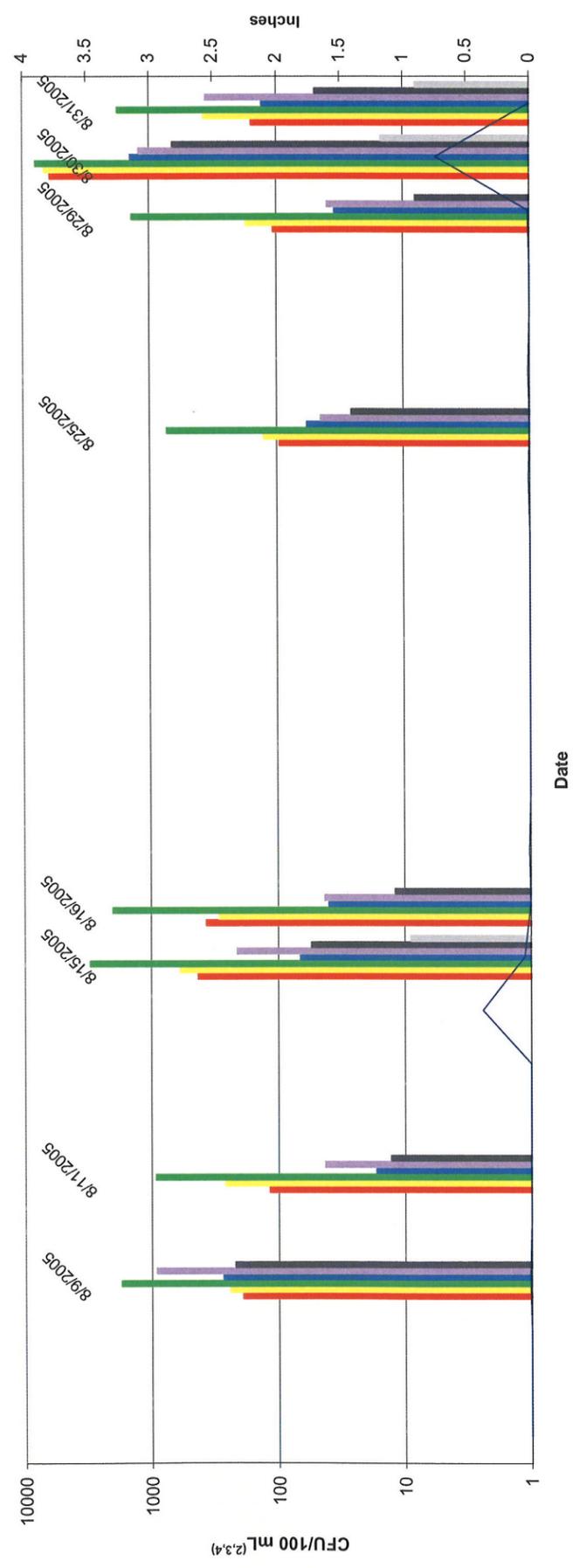
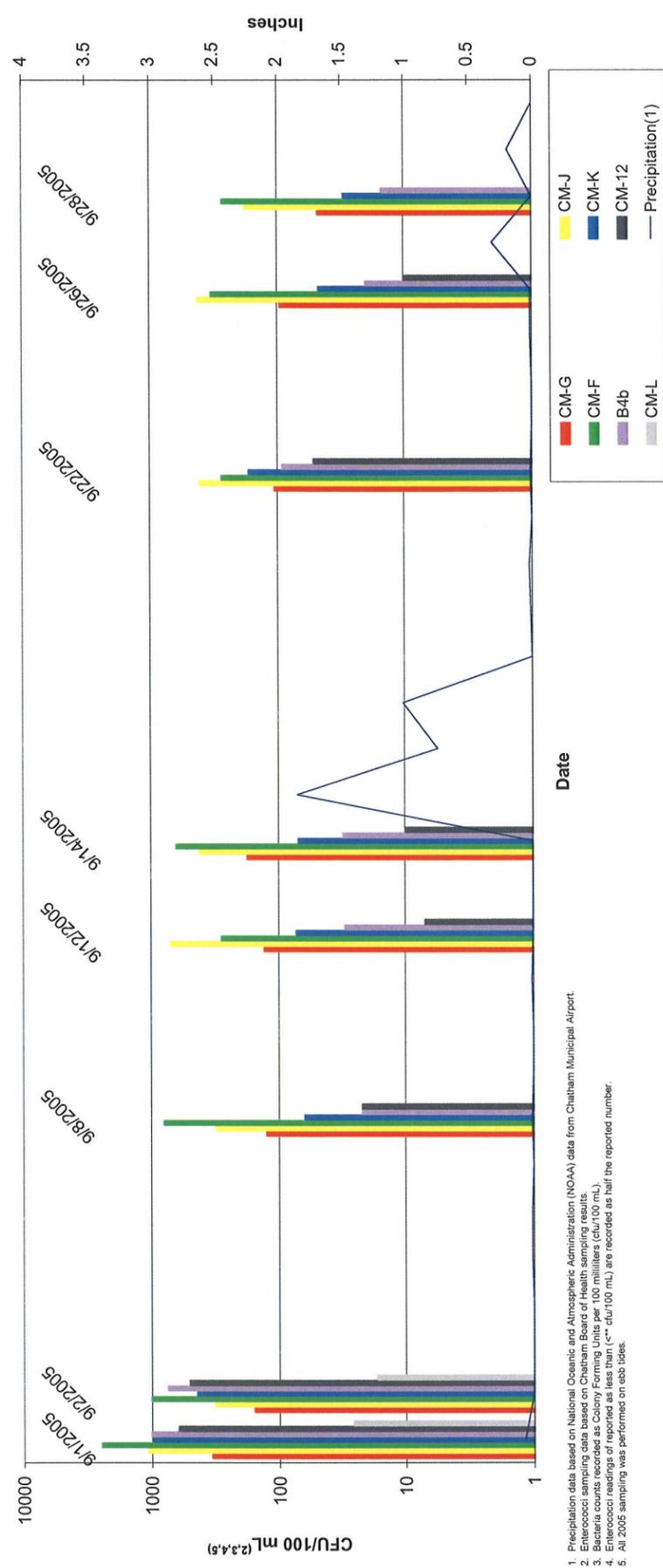
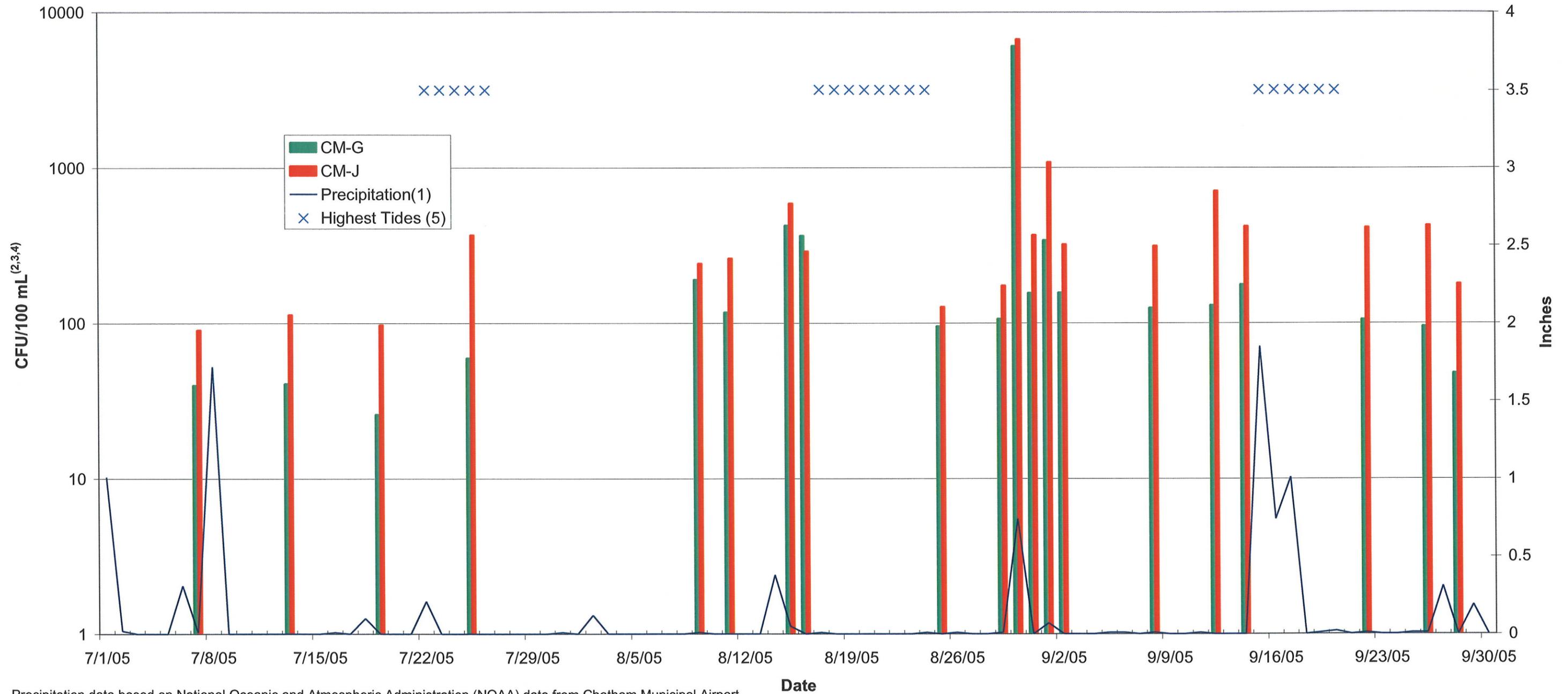


Figure 8c - September 2005



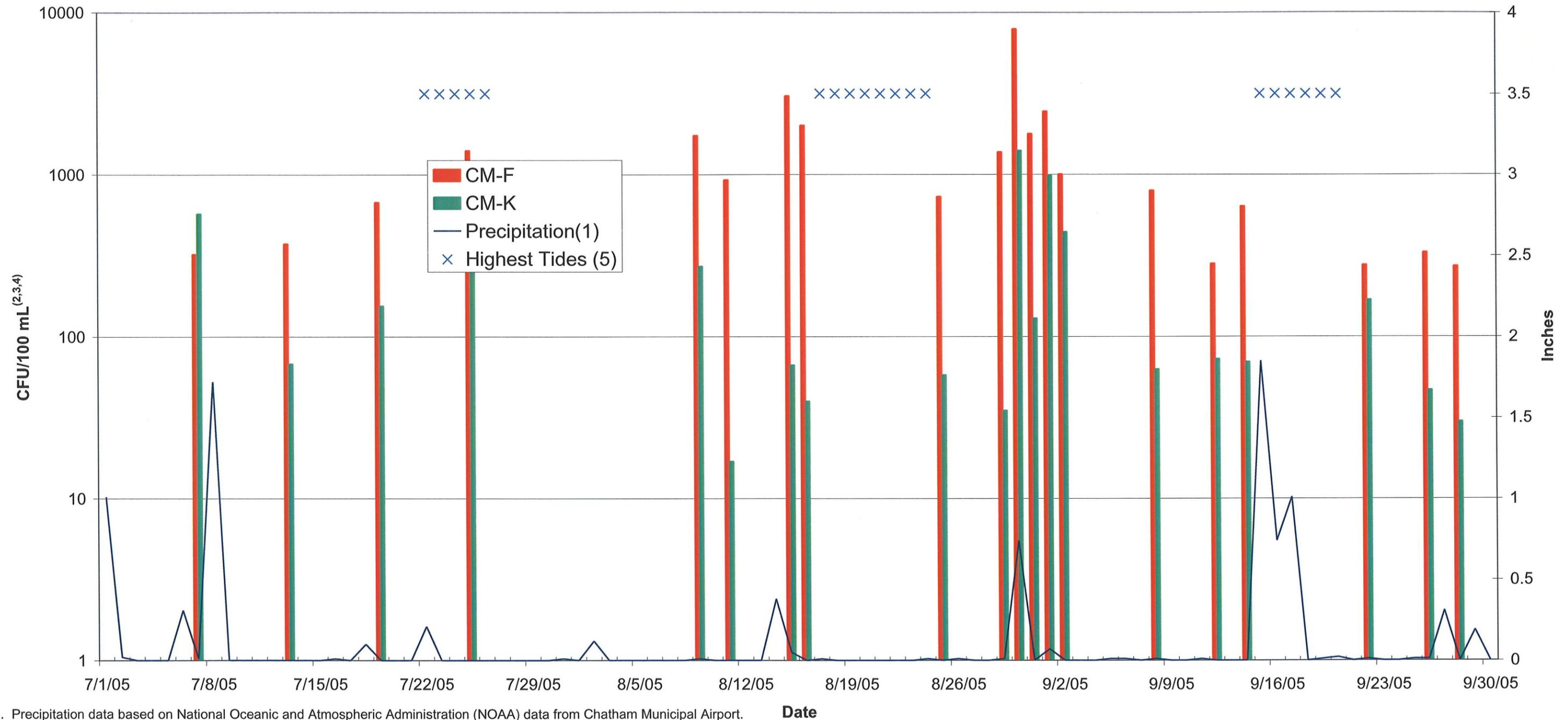
1. Precipitation data based on National Oceanic and Atmospheric Administration (NOAA) data from Chatham Municipal Airport.  
 2. Enterococci sampling data based on Chatham Board of Health sampling results.  
 3. Bacteria counts recorded as Colony Forming Units per 100 milliliters (cfu/100 mL).  
 4. Enterococci readings of reported as less than (<) cfu/100 mL are recorded as half the reported number.  
 5. All 2005 sampling was performed on odd tides.

Figure 9 - 2005 Upper Creek



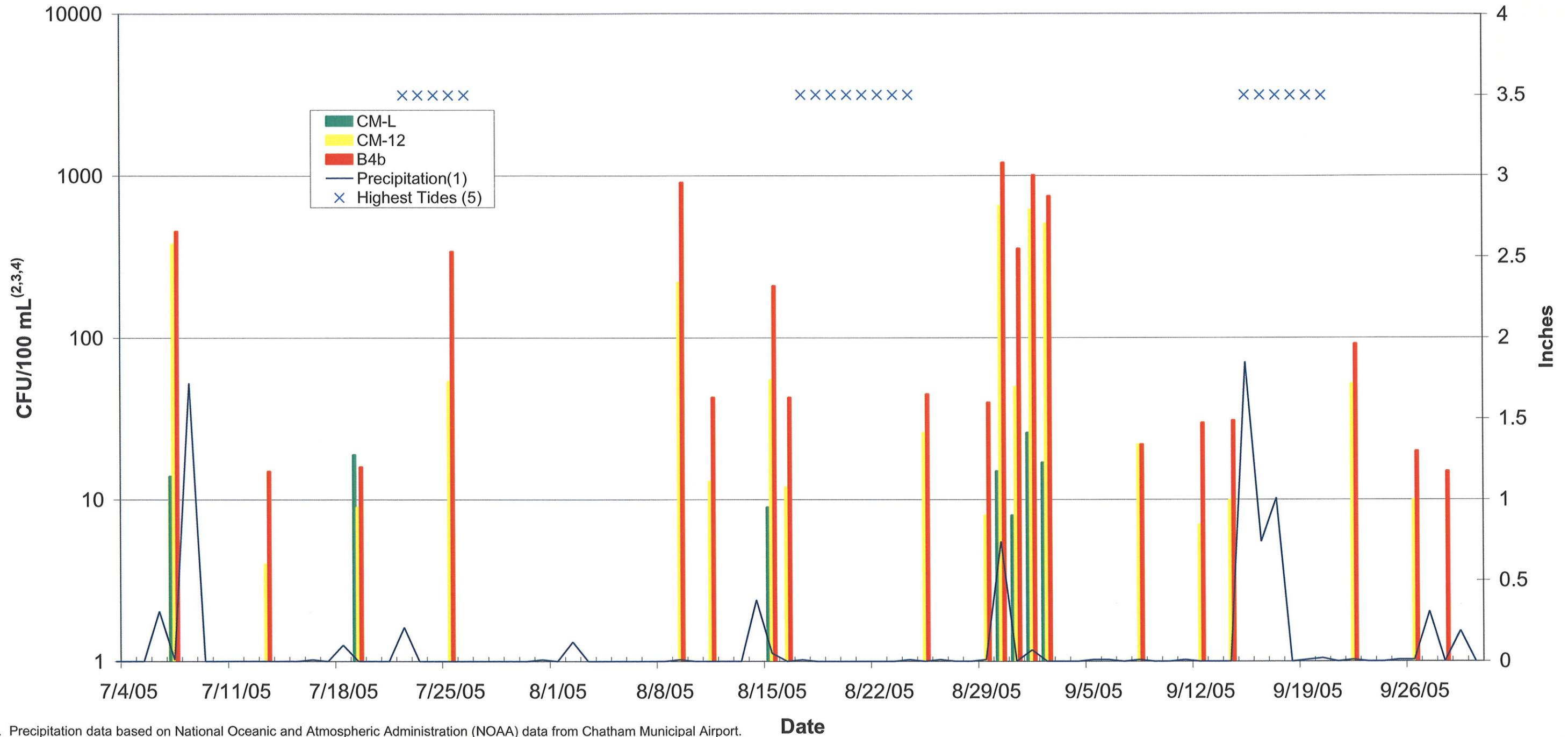
1. Precipitation data based on National Oceanic and Atmospheric Administration (NOAA) data from Chatham Municipal Airport.
2. Enterococci sampling data based on Chatham Board of Health sampling results.
3. Bacteria counts recorded as Colony Forming Units per 100 milliliters (cfu/100 mL).
4. Enterococci readings of reported as less than (<\*\* cfu/100 mL) are recorded as half the reported number.
5. Tide information based on Nautical Software data for Stage Harbor.
6. All 2005 sampling was performed on ebb tides.

Figure 10 - 2005 Mid Creek



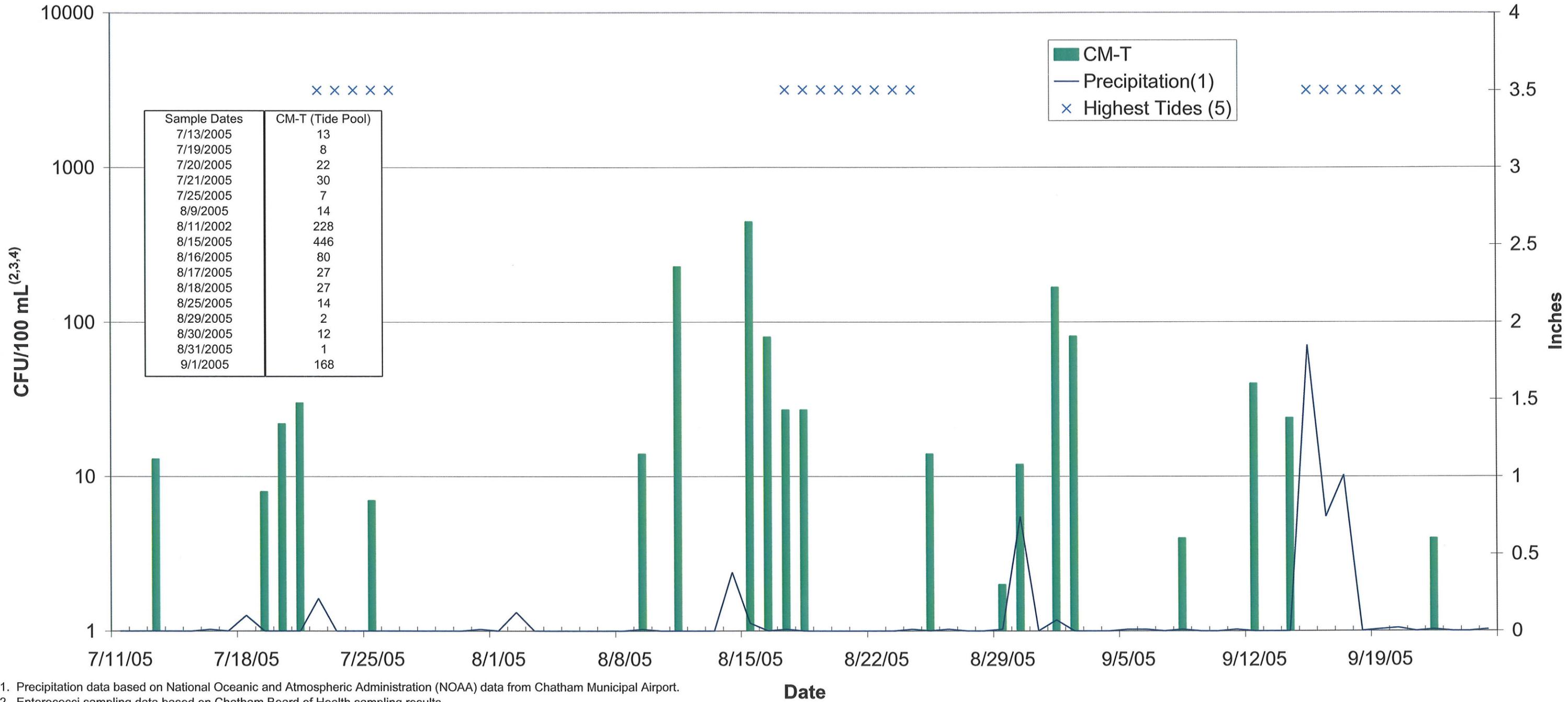
1. Precipitation data based on National Oceanic and Atmospheric Administration (NOAA) data from Chatham Municipal Airport.
2. Enterococci sampling data based on Chatham Board of Health sampling results.
3. Bacteria counts recorded as Colony Forming Units per 100 milliliters (cfu/100 mL).
4. Enterococci readings of reported as less than (<\*\* cfu/100 mL) are recorded as half the reported number.
5. Tide information based on Nautical Software data for Stage Harbor.
6. All 2005 sampling was performed on ebb tides.

Figure 11 - 2005 Lower Creek

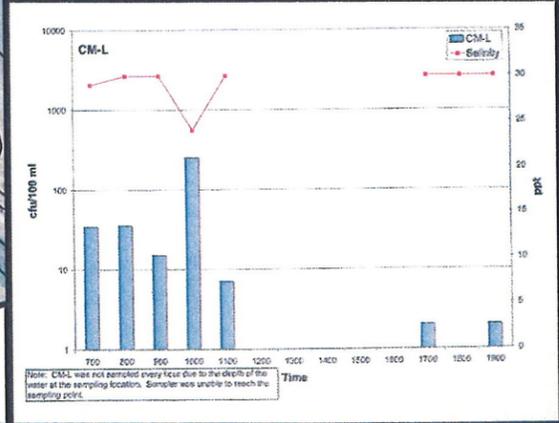
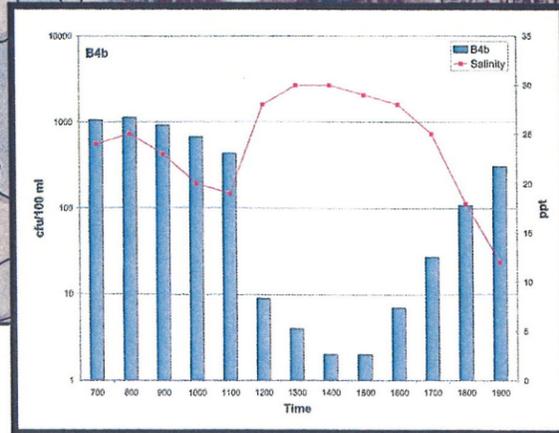
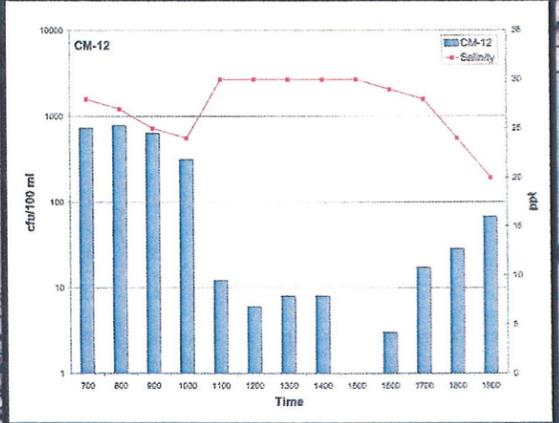
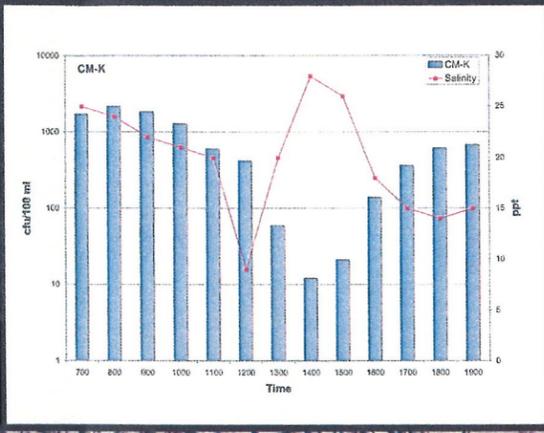
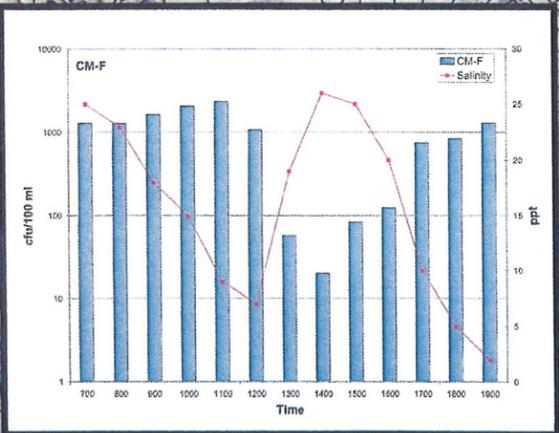
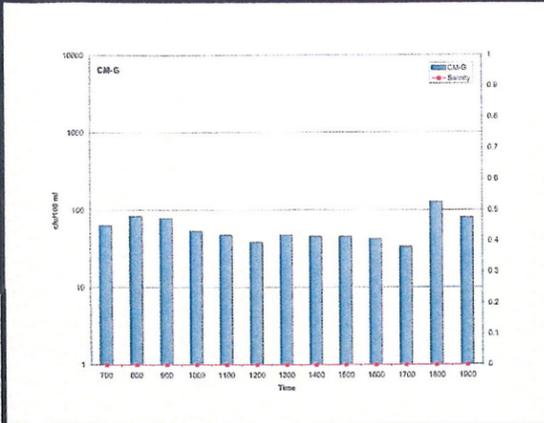
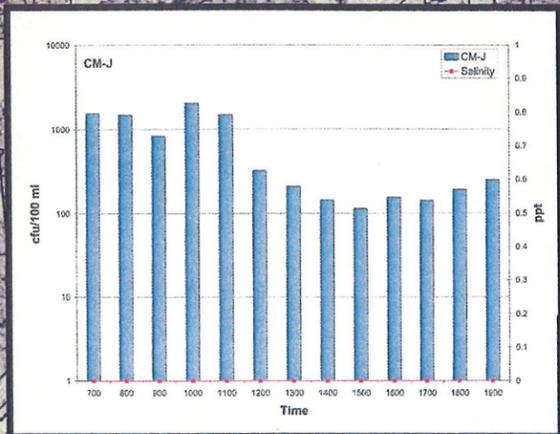


1. Precipitation data based on National Oceanic and Atmospheric Administration (NOAA) data from Chatham Municipal Airport.
2. Enterococci sampling data based on Chatham Board of Health sampling results.
3. Bacteria counts recorded as Colony Forming Units per 100 milliliters (cfu/100 mL).
4. Enterococci readings of reported as less than (<\*\* cfu/100 mL) are recorded as half the reported number.
5. Tide information based on Nautical Software data for Stage Harbor.
6. All 2005 sampling was performed on ebb tides.

Figure 12 - 2005 Tide Pool



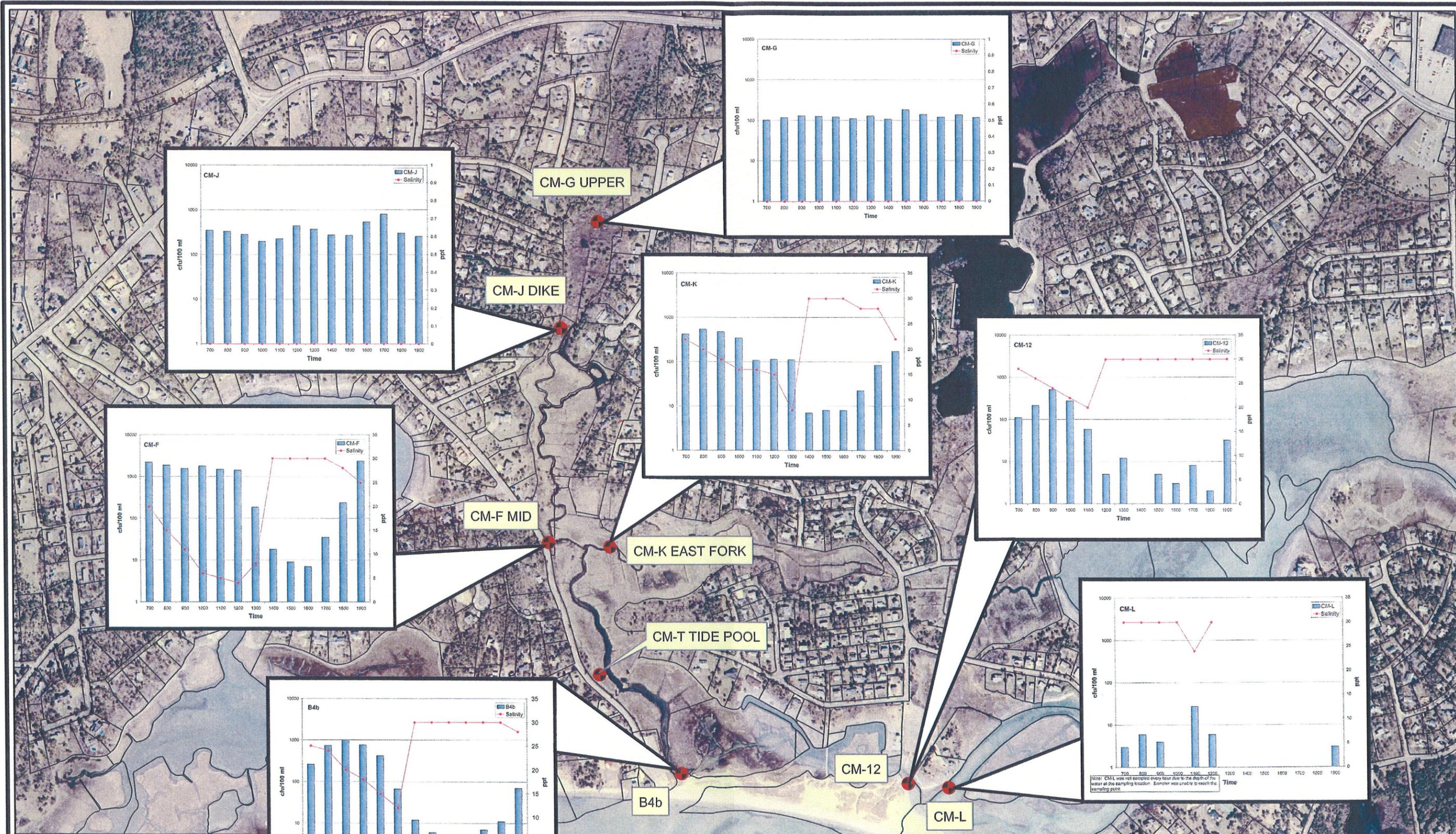
1. Precipitation data based on National Oceanic and Atmospheric Administration (NOAA) data from Chatham Municipal Airport.
2. Enterococci sampling data based on Chatham Board of Health sampling results.
3. Bacteria counts recorded as Colony Forming Units per 100 milliliters (cfu/100 mL).
4. Enterococci readings of reported as less than (<\*\* cfu/100 mL) are recorded as half the reported number.
5. Tide information based on Nautical Software data for Stage Harbor. Cockle Cove Creek's tides are approximately 2 hours behind Stage Harbor tides.
6. All 2005 sampling was performed on ebb tides.
7. Tide pool data is shown separate from other sampling data for clarity and because the tide pool was not sampled on exactly the same schedule.



0 125 250 500 Feet  
SCALE: 1" = 500'

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Town of Chatham, Massachusetts  
Cockle Cove Creek Enterococci  
Source Assessment Study Area  
**FIGURE 13 - JULY TIDAL CYCLE SAMPLING**



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Town of Chatham, Massachusetts

Cockle Cove Creek Enterococci  
Source Assessment Study Area

**FIGURE 14 - AUGUST TIDAL CYCLE SAMPLING**

**Appendix A**

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**Meeting Minutes from the  
November 1, 2005 Stakeholders' Meeting**

Stakeholders Meeting  
COCKLE COVE CREEK ENTEROCOCCI SOURCE ASSESSMENT STUDY  
TOWN OF CHATHAM, MASSACHUSETTS

November 1, 2005  
10:00 am  
Chatham Annex Bldg

---

*Attendees:*

Bob Duncanson – Town of Chatham  
Shannon Cook – Town of Chatham  
Dan Tobin – Town of Chatham  
Paul Kelly – Chatham Board of Health  
Nate Weeks – S&W  
Jeff Gregg – S&W  
Darlene Zelinski – S&W  
Steve McKenna – CZM

*Copies to:*

All Attendees  
File

Agendas were distributed and the reason for the meeting was summarized.

**Project Status** – The status of the project was discussed. The sampling of the creek is complete, although sampling will continue by the Chatham Health Department indefinitely. The groundwater sampling will be performed one more time, possibly a second time.

**Sampling** – The process and results of the sampling were discussed. Draft report figures were reviewed and the following suggestions were received:

- The location of the tidal pool on the sampling location figure needs to be revised.
- The text should discuss that sampling was performed two times per week on the low tide. A complete sampling cycle took 45 minutes.
- The tidal sampling was performed on July 22 and August 22. Two people were needed for the tidal sampling due to the length of time necessary to collect a set of samples.
- Tidal sampling was done on the highest lunar tides of the month.

**Conclusions** – The conclusions about the possible enterococci sources (septic systems, the treatment plant, stormwater, and natural sources) were discussed. Precipitation was initially thought to be a large factor in enterococci levels. However, in reviewing the figures, the lack of a direct correlation was discussed. Very large rain events tended to have the expected effect on enterococci levels, but smaller events did not follow a regular pattern.

The possible effect of temperature on enterococci levels was discussed. Town personnel will continue to sample through the winter to further determine any correlation.



The likelihood of enterococci levels resulting from natural sources was discussed. The bacterial counts in Cockle Cove Creek are not huge compared to other similar marsh systems in Chatham. In addition, marshes are natural sources of bacteria.

Discussion ensued regarding utilizing bacterial source tracking (BST) to determine what species was the primary source of the enterococci levels. CZM does not fully fund BST because the results are still inconclusive. There is not complete agreement among scientists as to the reliability of BST. There is still far too much variability in the sample results. Paul Kelly requested that CZM provide copies of any current information on BST studies that are being funded by CZM.

The consistently high bacteria levels seen at sampling station CM-F were discussed. Though stormwater runoff was initially regarded as a minor contributor, it was noted that CM-F is the sampling point closest to a roadway. The location would be revisited by S&W personnel after the meeting to re-evaluate the effect of stormwater runoff. Several properties in the vicinity of CM-F were also noted to have no septic system information. This was discussed as a possible source. After reviewing maps, it was determined that the suspect properties were located too far away to have an effect on the Creek. These properties would also be looked at after the meeting.

The tentative schedule is to have the Final Assessment Report ready for submission to CZM by mid December 2005 and the reimbursement request no later than December 31, 2005.

ACTION ITEM	RESPONSIBLE PARTY
Complete sampling	Town of Chatham
Revise figures and graphs	S&W
Provide draft report for review by Bob Duncanson	S&W
Complete stormwater calculations	S&W

**Appendix B**

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**Stormwater Calculations**

TOWN OF CHATHAM, MA  
 COCKLE COVE CREEK ENTEROCOCCI  
 SOURCE ASSESSMENT STUDY - 2005

Time of Concentration ( $T_c$ ) Worksheet

3.5

**Sub-Drainage Area** **To swale**

**Sheet Flow**

*Segment 1*

Surface description	Table 3-1	Grasses
Manning's roughness, n	Table 3-1	0.24
Flow length, L (ft)		306
Land slope, s (ft/ft)		0.082
$T_t$ (hours)		0.316

*Segment 2*

Surface description	Table 3-1
Manning's roughness, n	Table 3-1
Flow length, L (ft)	
Land slope, s (ft/ft)	
$T_t$ (hours)	

*Segment 3*

Surface description	Table 3-1
Manning's roughness, n	Table 3-1
Flow length, L (ft)	
Land slope, s (ft/ft)	
$T_t$ (hours)	

*Sheet Flow Sub-Total (hrs)* 0.32

**Shallow Concentrated Flow**

*Segment 1*

Surface Type		Paved
Flow length, L (ft)		250
Watercourse slope, s (ft/ft)		0.044
Average velocity, V (ft/s)	Figure 3-1	4.2
$T_t$ (hours)		0.017

*Segment 2*

Surface Type	
Flow length, L (ft)	
Watercourse slope, s (ft/ft)	
Average velocity, V (ft/s)	Figure 3-1
$T_t$ (hours)	

*Shallow Concentrated Sub-Total (hrs)* 0.02

**Channel Flow**

*Segment 1*

Flow area, a (ft <sup>2</sup> )	r=a/p <sub>w</sub>
Wetted perimeter, p <sub>w</sub> (ft)	
Hydraulic radius (ft)	
Channel slope, s (ft/ft)	
Manning's roughness, n	
V (ft/s)	
Flow length, L (ft)	
$T_t$ (hours)	

*Channel Flow Sub-Total (hrs)* 0.00

**Sub-Drainage Area  $T_c$  (hrs)** **0.33**

Notes:

1. Calculations based on procedures contained in United States Department of Agriculture Soil Conservation Service (a.k.a. Natural Resource Conservation Service) Technical Report 55.
2. Calculations based on a two-year rainfall depth of 3.5 inches.

TOWN OF CHATHAM, MA  
 COCKLE COVE CREEK ENTEROCOCCI  
 SOURCE ASSESSMENT STUDY - 2005

<b>Sub-Drainage Area</b>		<b>To swale</b>
<b>Area Parameters</b>		
Drainage area, $A_m$ (mi <sup>2</sup> )	B soils	0.00950
Pervious (ft <sup>2</sup> , CN=61)		168,231
Dirt Parking (ft <sup>2</sup> , CN=72)		
Impervious (ft <sup>2</sup> , CN=98)		96,063
Composite Curve No., CN		74
Max. Retention, S (in)	$S=(1000/CN)-10$	3.43
Initial abstraction, $I_a$ (in)	USE CN WITH TABLE 4-1	0.70
Time of Concentration (hr)		0.33
<b>Two-Year Storm Analysis</b>		
24-Hour Rainfall, P (in)	3.5	3.5
$I_a/P$		0.20
$q_u$ (csm/in)	USE $I_c$ AND $I_a/P$ WITH EXHIBIT 4 III	440
$F_p$	Table 4-2	1.0
Runoff, Q (in)	$= (P-0.2*S)^2 / (P+0.8*S)$	1.27
Peak discharge, $q_p$ (cfs)		5.3
<b>Five-Year Storm Analysis</b>		
24-Hour Rainfall Depth (in)	4.3	4.3
$I_a/P$		0.16
$q_u$ (csm/in)	USE $I_c$ AND $I_a/P$ WITH EXHIBIT 4 III	450
$F_p$		1.0
Runoff, Q (in)	$= (P-0.2*S)^2 / (P+0.8*S)$	1.85
Peak discharge, $q_p$ (cfs)		7.9
<b>Ten-Year Storm Analysis</b>		
24-Hour Rainfall Depth (in)	4.8	4.8
$I_a/P$		0.15
$q_u$ (csm/in)	USE $I_c$ AND $I_a/P$ WITH EXHIBIT 4 III	460
$F_p$		1.0
Runoff, Q (in)	$= (P-0.2*S)^2 / (P+0.8*S)$	2.24
Peak discharge, $q_p$ (cfs)		9.8
<b>Twenty-Five-Year Storm Analysis</b>		
24-Hour Rainfall Depth (in)	5.8	5.8
$I_a/P$		0.12
$q_u$ (csm/in)	USE $I_c$ AND $I_a/P$ WITH EXHIBIT 4 III	465
$F_p$		1.0
Runoff, Q (in)	$= (P-0.2*S)^2 / (P+0.8*S)$	3.06
Peak discharge, $q_p$ (cfs)		13.5
<b>Water Quality Volumes</b>		
One-half inch of Runoff (cf)		4,000
One inch of Runoff (cf)		8,000

Notes:

1. Return frequency storm analyses based on procedures contained in United States Department of Agriculture Natural Resource Conservation Service (f.k.a. Soil Conservation Service) Technical Report 55.
2. Water Quality Volumes are based on a procedure set forth in the Massachusetts Stormwater Policy where runoff depth is applied to the impervious area.

**Appendix C**

---

**Bacterial Assessment Newsletter**



Paved Stormwater Swale on Route 28

## Recommendations

Based on these findings, several specific recommendations were made and are being considered by the Town to mitigate the presence of enterococci.

### Stormwater:

- Improved stormwater facilities should be implemented to reduce the existing discharges from road runoff. Route 28 is the primary source of road runoff to the Cockle Cove Creek watershed. The Massachusetts Highway Department should be encouraged to replace an existing paved swale with catchbasins and leaching facilities capable of containing the first flush of stormwater runoff.
- Construction of a fresh water pond in the upper portion of Cockle Cove Creek may be considered. The pond would improve water quality by preventing the stormwater from flowing directly into Cockle Cove Creek, allowing infiltration of the stormwater.

### Septic Systems:

- While septic systems around Cockle Cove Creek were not found to be a significant source of enterococci, the Town should continue with its program of septic system design reviews and inspections to ensure the proper design, location, and operation of these facilities.



Waterfowl in Cockle Cove Creek

- The assessment identified a handful of properties for which information was unavailable. The Town should require inspection of the septic systems on these properties to ensure that they are functioning properly and not contributing to enterococci contamination in Cockle Cove Creek.
- The groundwater monitoring wells sampled during the project should be maintained and monitored periodically to identify long-term groundwater quality trends.

### Other:

- Further analyses should be performed to better understand the Cockle Cove Creek ecosystem. A better understanding will help to verify the conclusion that natural sources are responsible for enterococci levels. The analyses that are recommended are:
  - Analysis of the link between water temperature and enterococci levels.
  - Analysis of sediment from Cockle Cove Creek.

**For more information, please call  
Robert Duncanson, Ph. D., Director, Department of  
Health and Environment, at (508) 945-5165.**



Stearns & Wheler, LLC

# Cockle Cove Creek Enterococci Source Assessment Study: Findings & Recommendations



During the summer and fall of 2005, the Town of Chatham performed an evaluation of the Cockle Cove Creek watershed. The goal of this assessment project was to investigate the source of the bacteria, to provide greater understanding of the problem, and to aid in identifying possible management strategies to mitigate the bacteria problem.





Accumulated Algal Wrack

For the past several years, bacterial testing in a portion of Cackle Cove Creek has indicated elevated levels of enterococci bacteria. Bacterial counts are typically at acceptable levels during incoming tides, but the consistently high levels on outgoing tides have prompted the Town to issue a swimming ban for the southern end of Cackle Cove Creek, which is adjacent to two popular Nantucket Sound beaches. Cackle Cove Creek is not a designated bathing beach, but it does attract bathers from the adjacent bathing beaches because the water is warm and shallow.

### What is enterococci?

Enterococci is an “indicator” bacteria, and its presence in a water body indicates the possible presence of waterborne pathogens (bacteria or viruses that can cause disease), which are a risk to human health.

### Where is it coming from?

The preliminary evaluation phase of the study identified several potential sources:

- Stormwater runoff from the roadways and other impervious surfaces around Cackle Cove Creek.
- Failed septic systems, causing a surface flow of effluent to Cackle Cove Creek.
- Properly operating septic systems that potentially contribute enterococci to the groundwater, which subsequently recharges to Cackle Cove Creek.



Fiddler Crab Holes

- Septic systems that could be connected to a stormwater outfall or other direct outlet to Cackle Cove Creek.
- Treated effluent from the Wastewater Treatment Facility (WWTF), which is discharged into sand infiltration beds.
- Flow from Buck’s Creek flowing into Cackle Cove Creek, which could possibly carry bacteria.
- Vegetation and algae accumulated in the wrack line, which can harbor enterococci for later release, or can incubate bacteria of non-fecal origin, resulting in false high enterococci values.
- Animals living in or visiting the watershed including: waterfowl, seagulls, and wild and domesticated animals.
- Sediments accumulated in various parts of Cackle Cove Creek, which can potentially store fecal material from the sources listed above, that can be resuspended into the water column.

### What was found?

A detailed evaluation was conducted by the Chatham Department of Health and Environment and Stearns & Wheeler, the environmental engineering firm retained by the Town. The evaluation included multiple site inspections, septic system records review, and a comprehensive sampling program, including existing monitoring wells, WWTF effluent, and multiple locations in Cackle Cove Creek. Town of Chatham personnel carefully sampled marine water and potential groundwater pollution sources. These samples were then analyzed by the Chatham Department of Health and Environment. The results of this evaluation told us that:

1. Stormwater runoff from impervious surfaces may play a small role in contributing to enterococci contamination. However, it is believed that stormwater runoff is not one of the major contributors to the enterococci levels.
2. No significant septic system impacts were identified after detailed investigations.
3. Based on several sampling events, it was concluded that the WWTF does not significantly contribute to the elevated enterococci levels.
4. Buck’s Creek flow was observed during a tidal cycle. When Buck’s Creek stops flowing out into Nantucket Sound and the tide begins coming in, Cackle Cove Creek continues to flow out for a period of time. Therefore, no water from Buck’s Creek was observed flowing into Cackle Cove Creek, thus reducing the likelihood that Buck’s Creek is a potential enterococci source.
5. Natural sources, such as wildlife activity and accumulation of wrack material, were considered to be the primary source of the elevated enterococci levels.



Accumulated Wrack



Fox Den



Wildlife Fecal Material