Calculation of Great Bay Estuary Total Nitrogen (TN) Concentrations at Actual (2010 and 2011) TN Loading Rates and at Reduced TN Loading Rates that Achieve the Proposed 100 kg TN/ha/year Loading Target

- Point source (PS) and nonpoint (NPS) TN loads to the Great Bay Estuary System (GBES) were estimated for the year 2010 (Table 1) and normalized by the surface area (5,455 ha) of the GBES to yield an annual aerial TN loading rate (kg TN/ha/yr). The total 2010 TN loading rate was 252 kg/ha/yr with 90 and 162 kg TN/ha/yr coming from PS and NPS, respectively.

- Table 1 also contains a combination of reduced PS and NPS TN loads that achieve the proposed 100 kg TN/ha/yr loading target. The PS effluent TN concentration was assigned at 6.0 mg/l and the river TN concentration was reduced from approximately 0.5 mg/l to 0.22 mg/l yielding a total (PS + NPS) annual aerial TN loading rate of 100 kg/ha/yr.

- The computed 2010 daily average TN concentrations at 3 sites (12, 14 and 15) in Great Bay (Figure 3) were computed with the hydrodynamic model for both the actual TN loading rate (252 kg/ha/yr) and reduced TN loading rate (100 kg/ha/yr) and are presented in Figure 4. In this calculation, TN is treated as a conservative constituent. The three components (background or ocean water, PS, and NPS) comprising the calculated TN levels in Great Bay are indicated in Figure 4 by the color shading. For example, at location 12 with the actual TN loading rate (252 kg/ha/yr), the high March river flows produce NPS TN loads that are responsible for most of the TN in Great Bay as indicated by the pink shaded area. Conversely, during low August river flow conditions, the Great Bay TN concentrations are mostly due to oceanic water (blue shading) and PS loads (green shading).

- The same analysis is presented for the 100 kg/ha/yr TN loading condition in the four panels on the right side of Figure 4. The computed Great Bay TN concentrations are dominated by the oceanic boundary condition (0.17 mg/l) and the reduced NPS loading (0.22 mg/l) thereby producing a relatively constant Great Bay TN concentration of approximately 0.2 mg/l.

- This same analysis is repeated for the year 2011 (Table 2 and Figure 5) and shows similar results.

- The general conclusion is that various combinations of future PS and NPS TN reductions that are consistent with a TN loading rate of 100 kg/ha/yr will result in an average Great Bay TN concentration of approximately 0.2 mg/l.

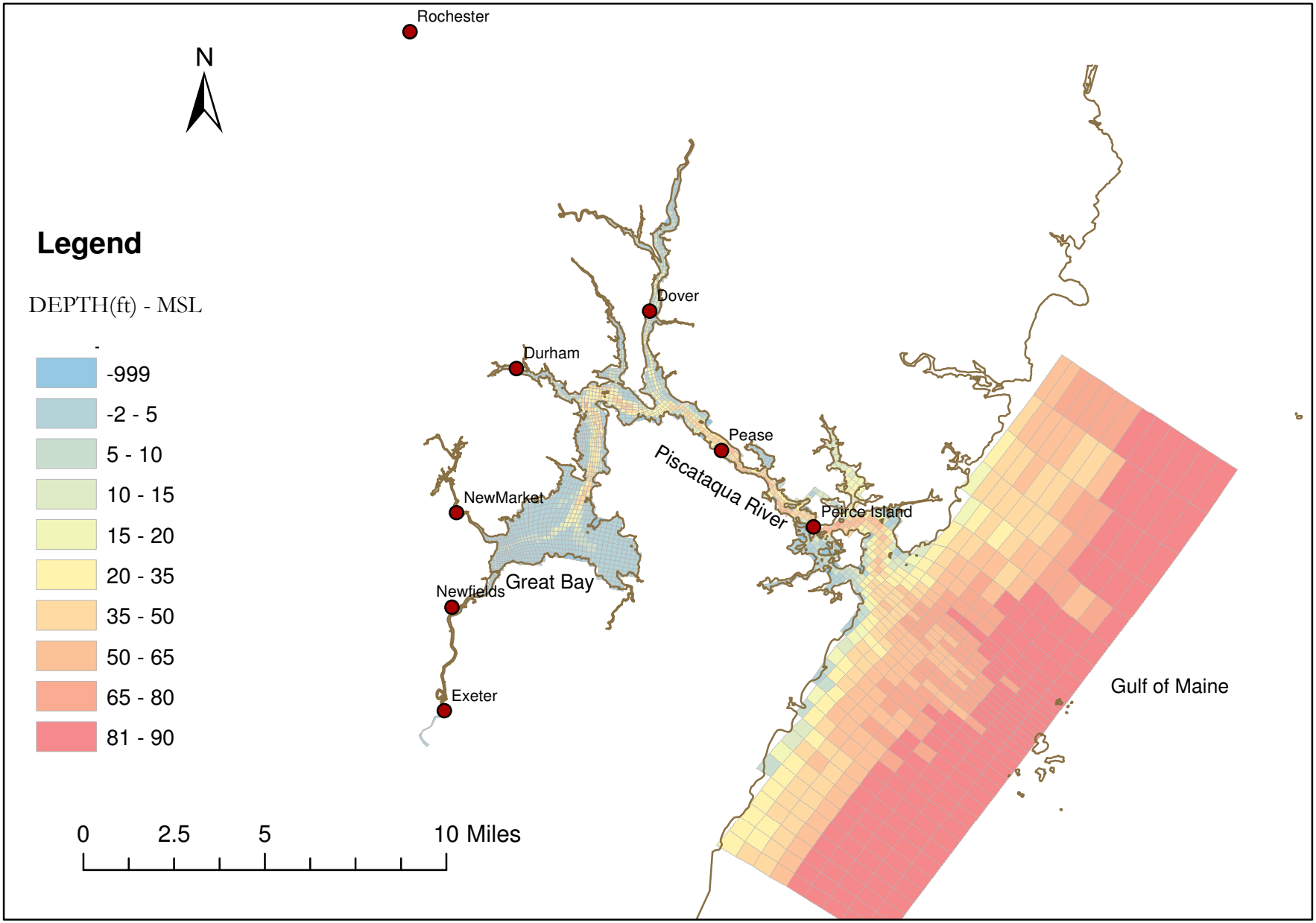

Figure 1. Great Bay Estuary System: Location of Sewage Treatment Plants (STP).

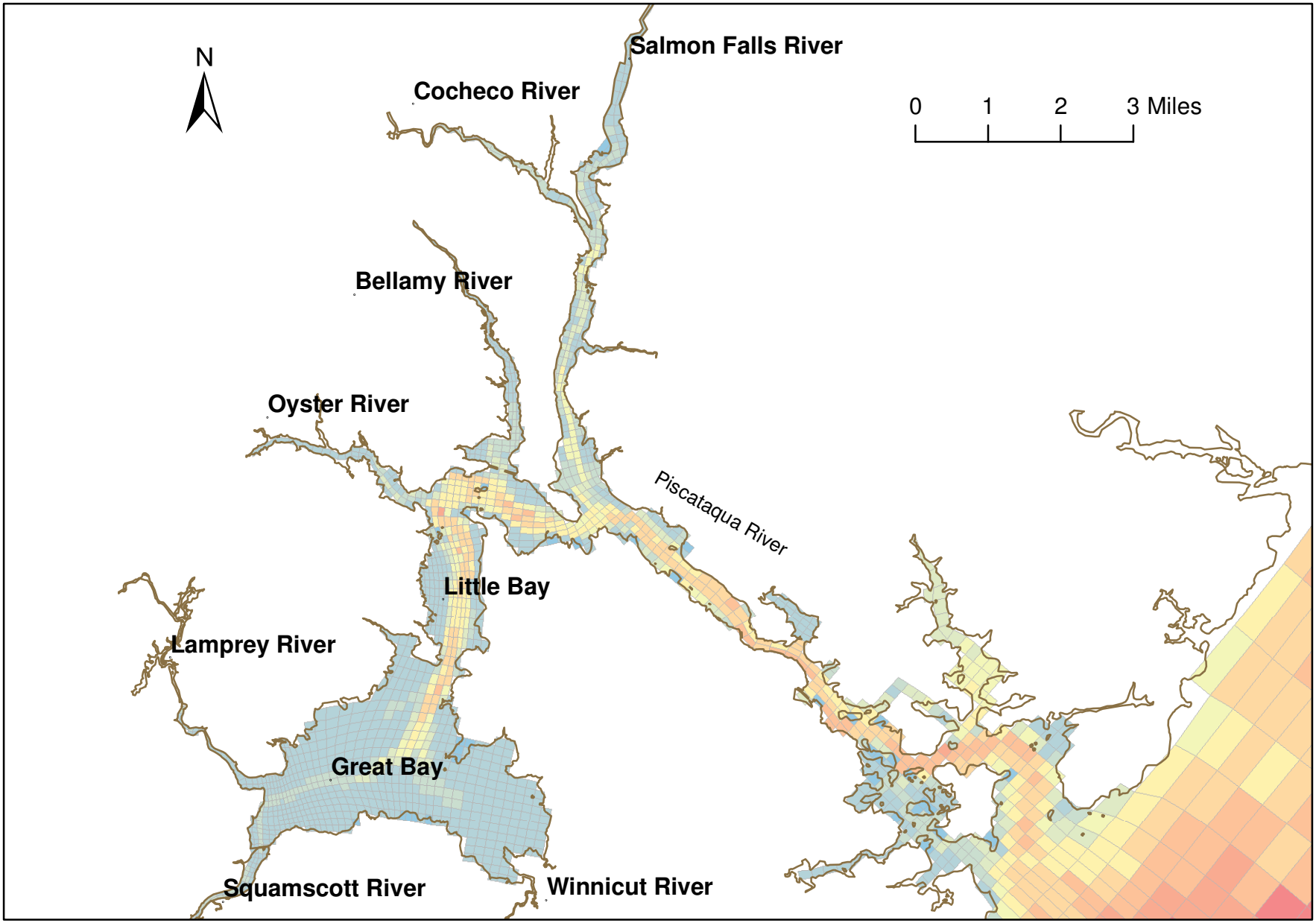

Figure 2. Great Bay Estuary Tributaries.

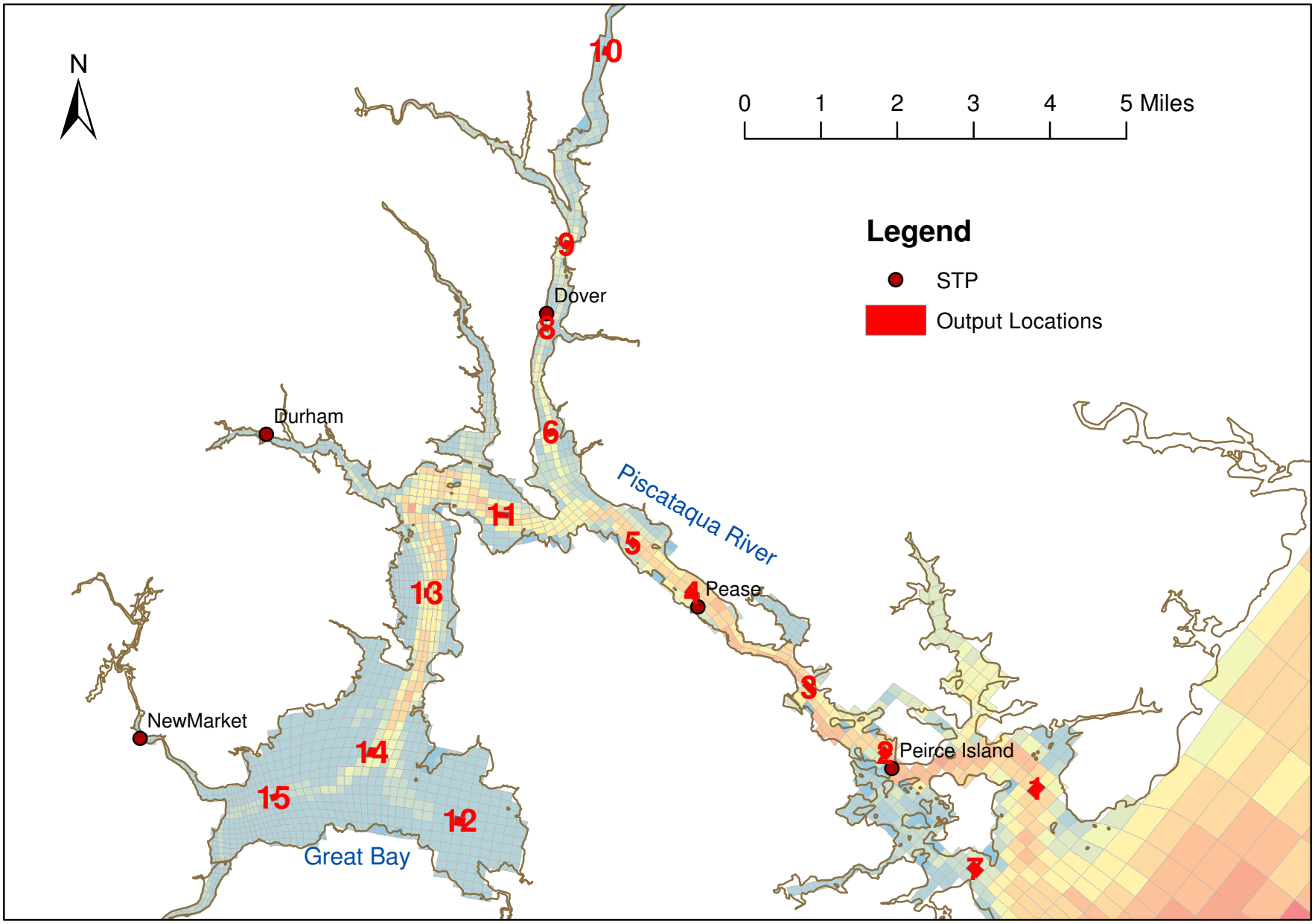

Figure 3. GBES Hydrodynamic Model Locations for Computed TN Concentrations.

Point Sources	Actual 2010 TN Loads		Reduced 2010 TN Loads	
	TN, kg/year	TN, kg/ha/year	TN at 6 mg/L, kg/year	TN, kg/ha/year
Durham	12,333	2	9,263	2
Exeter	43,750	8	18,750	3
Newfields	1,700	0	566	0
Newmarket	29,292	5	5,863	1
Dover	101,250	19	27,625	5
Pierce IS	105,833	19	49,000	9
Rochester	189,583	35	32,500	6
Pease	6,500	1	4,350	1
Point Sources	**490,242**	**90**	**147,916**	**27**
Non-Point Sources	**Actual 2010 TN Loads**		**Reduced 2010 TN Loads**	
	TN, kg/year	TN, kg/ha/year	TN at 0.22 mg/L, kg/year	TN, kg/ha/year
Lamprey	205,000	38	87,500	16
Squamscott	105,000	19	57,500	11
Oyster	33,200	6	14,400	3
Cocheco	178,000	33	72,600	13
Salmon	332,000	61	152,000	28
Winnicut	24,700	5	9,850	2
Bellamy	5,460	1	3,870	1
Non-Point Sources	**883,360**	**162**	**397,720**	**73**
Total PS+NPS	**1,373,602**	**252**	**545,636**	**100**

Table 1. Actual and Reduced TN Loads for Point and Non-Point Sources, Year 2010

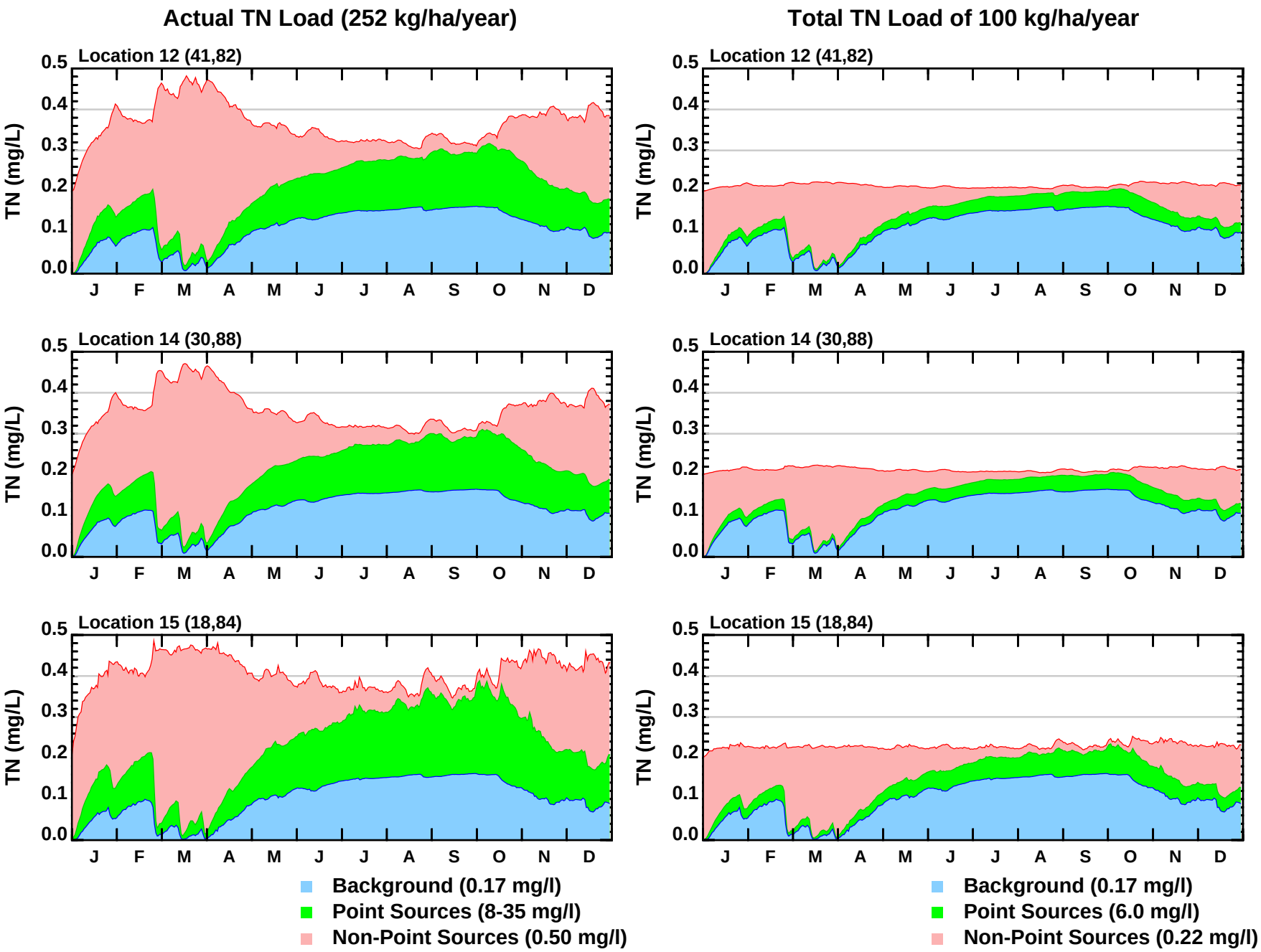

Figure 4. Effect of TN Loads from Ocean Boundary Condition, Point Sources and Non-Point Sources GREAT BAY, YEAR 2010

Point Sources	Actual 2011 TN Loads		Reduced 2011 TN Loads	
	TN, kg/year	TN, kg/ha/year	TN at 6 mg/L, kg/year	TN, kg/ha/year
Durham	12,333	2	9,263	2
Exeter	43,750	8	18,750	3
Newfields	1,700	0	566	0
Newmarket	29,292	5	5,863	1
Dover	101,250	19	27,625	5
Pierce IS	105,833	19	49,000	9
Rochester	189,583	35	32,500	6
Pease	6,500	1	4,350	1
Point Sources	**490,242**	**90**	**147,916**	**27**
Non-Point Sources	**Actual 2011 TN Loads**		**Reduced 2011 TN Loads**	
	TN, kg/year	**TN, kg/ha/year**	**TN at 0.21 mg/L, kg/year**	**TN, kg/ha/year**
Lamprey	205,000	38	83,300	15
Squamscott	108,000	20	56,500	10
Oyster	30,300	6	12,600	2
Cocheco	207,000	38	80,200	15
Salmon	354,000	65	154,000	28
Winnicut	20,800	4	7,940	1
Bellamy	4,990	1	3,370	1
Non-Point Sources	**930,090**	**170**	**397,910**	**73**
Total PS+NPS	**1,420,332**	**260**	**545,826**	**100**

Table 2. Actual and Reduced TN Loads for Point and Non-Point Sources, Year 2011

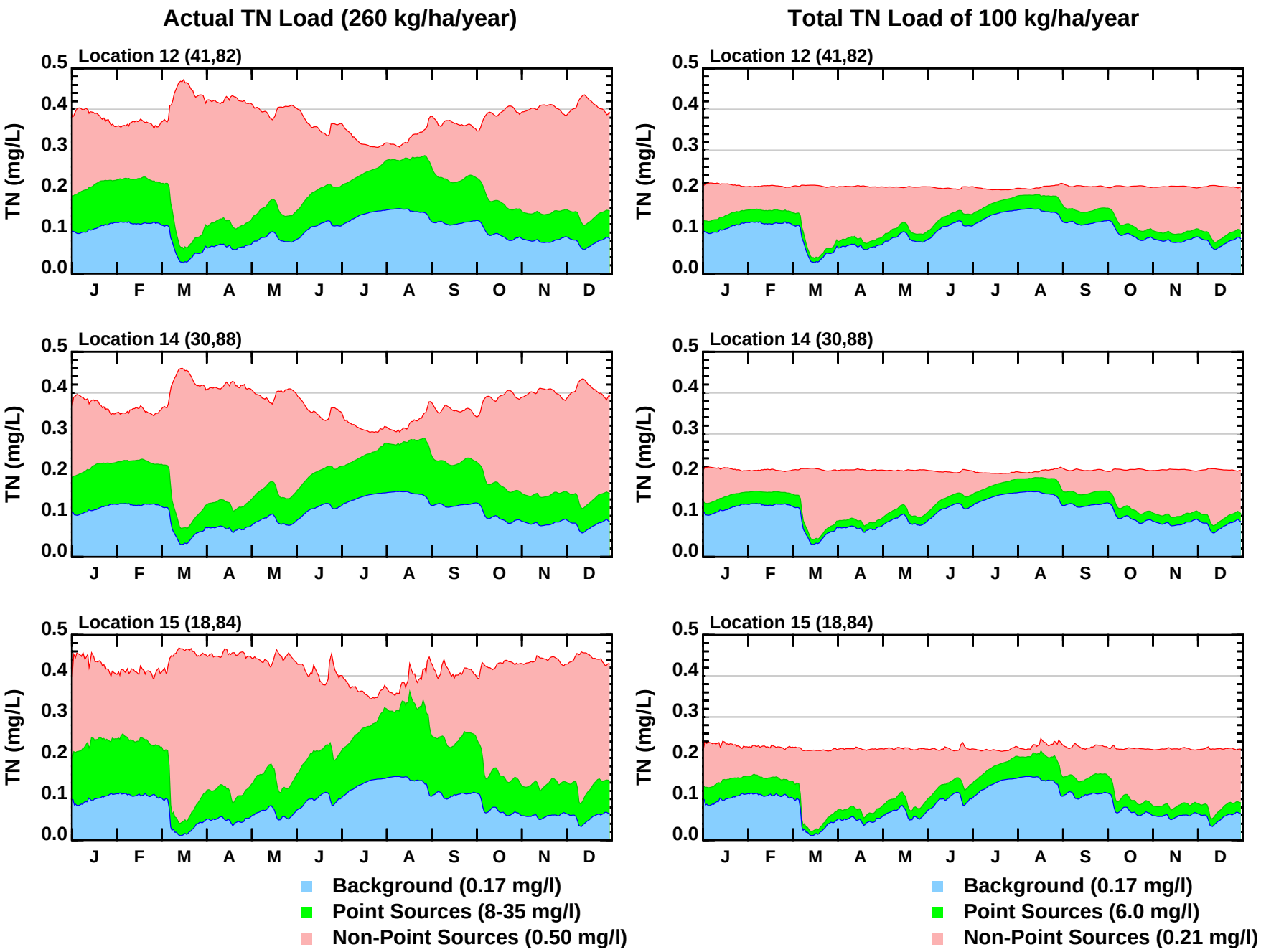

Figure 5. Effect of TN Loads from Ocean Boundary Condition, Point Sources and Non-Point Sources GREAT BAY, YEAR 2011