

## IX. ALTERNATIVES TO IMPROVE WATER QUALITY

### IX.1 PRESENT LOADING WITH SEWERING OF EEL POND, INNER BACK RIVER, OUTER BACK RIVER, AND THE POND WATERSHEDS

The size of Phinney's Harbor relative to the other embayments within the system limits the effectiveness of sewerage the Eel Pond and Back River watersheds to reduce the overall nitrogen load. To demonstrate this, an alternative was developed to assess impact of removing 100-percent of the septic load from the Eel Pond and Back River watersheds while using the present loading conditions in Phinney's Harbor. Table IX-1 and Table IX-2 illustrate the overall change to septic and watershed loads resulting from this alternative. Septic removal from the Eel Pond and Back River watersheds results in significant reductions in the watershed loads in those sub-embayments. Based on the assumptions developed for this alternative, Table IX-3 presents the various components of nitrogen loading for the Phinney's Harbor system.

Table IX-1. Comparison of sub-embayment watershed **septic loads** (attenuated) used for modeling of present conditions in Phinney's Harbor with septic loads removed from Eel Pond, Inner back River, Outer Back River, and the Pond Watersheds. These loads do not include direct atmospheric deposition (onto the sub-embayment surface), benthic flux, runoff, or fertilizer loading terms.

sub-embayment	present septic load (kg/day)	scenario septic load (kg/day)	threshold septic load % change
Back River Inner	3.805	0.000	-100.0%
Back River Outer	1.381	0.000	-100.0%
Eel Pond	4.244	0.000	-100.0%
Phinney's Harbor	12.608	12.608	+0.0%

Table IX-2. Comparison of sub-embayment **total attenuated watershed loads** (including septic, runoff, and fertilizer) used for modeling of present conditions in Phinney's Harbor with septic loads removed from Eel Pond, Inner back River, Outer Back River, and the Pond Watersheds. These loads do not include direct atmospheric deposition (onto the sub-embayment surface) or benthic flux loading terms.

sub-embayment	present load (kg/day)	scenario load (kg/day)	threshold % change
Back River Inner	7.699	3.893	-49.4%
Back River Outer	1.964	0.584	-70.3%
Eel Pond	4.888	0.644	-86.8%
Phinney's Harbor	14.781	14.781	+0.0%

Table IX -3. Sub-embayment loads used for total nitrogen modeling of the Phinney's Harbor system for present loading scenario with septic loads removed from Eel Pond, Inner back River, Outer Back River, and the Pond Watersheds, with total watershed N loads, atmospheric N loads, and benthic flux.

sub-embayment	watershed load (kg/day)	direct atmospheric deposition (kg/day)	benthic flux net (kg/day)
Back River Inner	3.893	0.589	1.863
Back River Outer	0.584	0.340	0.148
Eel Pond	0.644	0.246	-0.451
Phinney's Harbor	14.781	5.186	14.525

Total nitrogen modeling results for existing conditions without the septic loads for Eel Pond and Back River watersheds indicate that the Phinneys Harbor would not meet the nitrogen threshold target at Station PH4 (Table IX-4 and Figure IX-1). It results in reductions in nitrogen concentration in the embayments, but no significant reductions within Phinney's Harbor. Nitrogen concentration reductions range from approximately 2% in outer Phinney's Harbor to under 19% in Eel Pond. Overall, this scenario indicates that to reduce the overall nitrogen load effectively, removing septic loads from the Phinney's Harbor watershed is the most practical and effective approach.

Table IX-4. Comparison of model average total N concentrations from present loading scenarios (with and without the septic loads removed from Eel Pond, Inner back River, Outer Back River, and the Pond Watersheds), with percent change, for the Phinney's Harbor system. The threshold station is shown in bold print.

Sub-Embayment	monitoring station	present (mg/L)	scenario (mg/L)	% change
Phinney's Harbor	PH2	0.347	0.340	-1.9%
Phinney's Harbor	PH3	0.351	0.344	-2.2%
<b>Phinney's Harbor</b>	<b>PH4</b>	<b>0.369</b>	<b>0.357</b>	<b>-3.3%</b>
Phinney's Harbor	PH5	0.390	0.365	-6.6%
Phinney's Harbor	PH6	0.343	0.336	-2.0%
Eel Pond - Inner	EP1	0.470	0.381	-18.9%
Eel Pond - Middle	EP2	0.437	0.376	-14.1%
Eel Pond - Back River	EP3	0.423	0.383	-9.4%

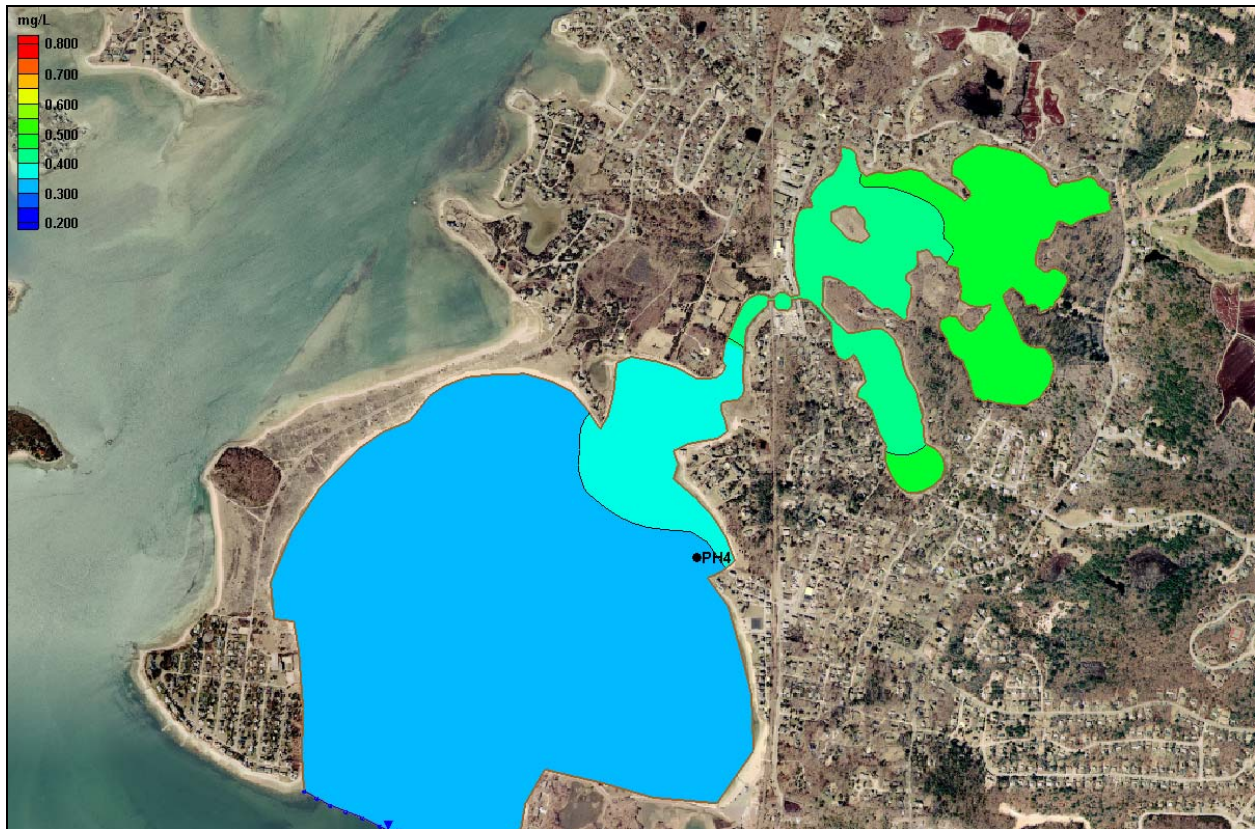


Figure IX-1. Contour plot of modeled total nitrogen concentrations (mg/L) in the Phinney's Harbor system, for present loading conditions with a 100-percent of the septic load removed from the Eel Pond and Back River watersheds.

## IX.2 DEEPING THE INLET CHANNEL TO EEL POND WITH PRESENT LOADING CONDITIONS.

Water quality improvements may be possible in Eel Pond by improving tidal exchange between the pond and Back River. The inlet to Eel Pond is relatively shallow, therefore by dredging the inlet and increasing the cross sectional area of the inlet, may resulting in increased tidal flushing of the nutrients from Eel Pond, improving the water quality within the pond. To quantitatively assess the impacts of dredging, model simulations were executed to simulate Eel Pond hydrodynamics and water quality with the inlet dredged to a uniform depth of -3.5 ft NGVD, which is approximately a half to two feet deeper than the existing inlet.

The model results for existing and dredged inlet conditions were compared and the dredged inlet does not result in improved water quality within Eel Pond. Results from the existing loading conditions with the dredged inlet are presented in Table IX-5. The TN concentrations are basically unchanged. There is a slight increase in the average Nitrogen concentrations in Eel Pond. The increase is due to a slight decrease in residence time within the Pond as a result of the inlet dredging. The reduction in residence time results in a small decrease in the amount of Nitrogen that can be taken up by benthic flux over a tidal cycle, thus resulting in a small increase in average Nitrogen concentration.

Table IX-5. Comparison of model average total N concentrations from present loading scenarios (with and without the dredged inlet to Eel Pond), with percent change, for the Phinney's Harbor system. The threshold station is shown in bold print.

Sub-Embayment	monitoring station	present (mg/L)	scenario (mg/L)	% change
Phinney's Harbor	PH2	0.347	0.347	-0.0%
Phinney's Harbor	PH3	0.351	0.351	-0.0%
<b>Phinney's Harbor</b>	<b>PH4</b>	<b>0.369</b>	<b>0.369</b>	<b>+0.0%</b>
Phinney's Harbor	PH5	0.390	0.390	-0.1%
Phinney's Harbor	PH6	0.343	0.343	-0.0%
Eel Pond - Inner	EP1	0.470	0.473	+0.6%
Eel Pond - Middle	EP2	0.437	0.440	+0.6%
Eel Pond - Back River	EP3	0.423	0.421	-0.4%