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MEMORANDUM

TO: **John Hall**

FROM: **Ben Kirby, Bill Hall**

DATE: **November 1, 2016**

RE: **2016 Great Bay System Analysis**

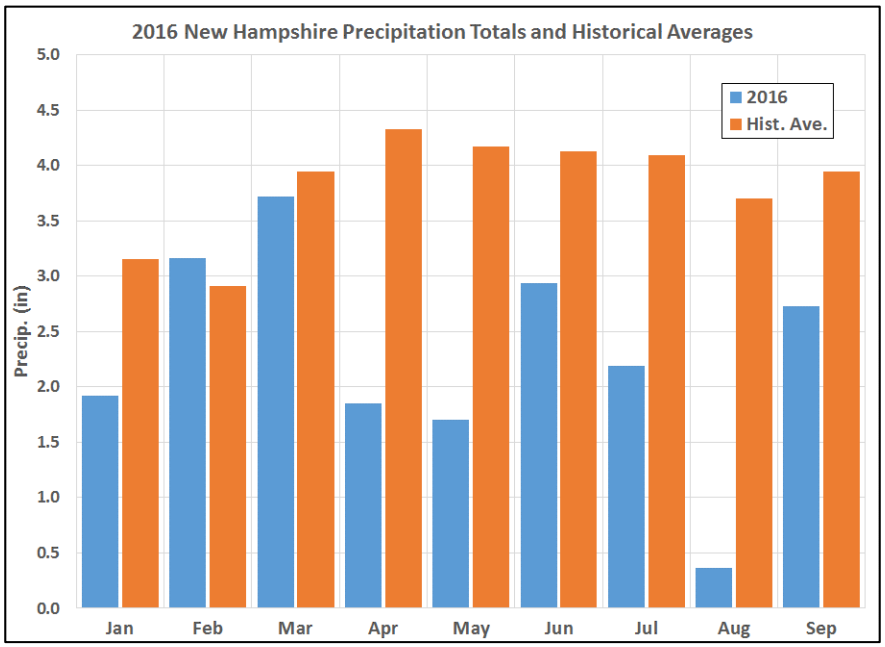
For an extended period of time, the Great Bay Municipal Coalition (GBMC) has been at odds with EPA and DES over the efficacy of total nitrogen load reductions on eelgrass in the Great Bay Estuary. In 2015, total nitrogen load reductions voluntarily implemented by Rochester and Dover served as an objective basis for assessment of the impact of those load reductions on relevant water quality conditions (e.g., dissolved oxygen, transparency, phytoplankton) in the Piscataqua River. As we know, the significantly reduced TN levels had no material impact on these parameters. Atmospheric conditions combined with voluntary reduced loading during the 2016 calendar year have provided the GBMC with an opportunity for a more comprehensive assessment of the efficacy of nutrient reduction from both wastewater and MS4 contributions on a multitude of water quality conditions in Great Bay Estuary.

Specifically, precipitation and the corresponding tributary flows to the estuary have been greatly reduced during the 2016 calendar year. As a result, runoff induced loads of nutrients, color dissolved organic matter (CDOM), and non-algal particulates (NAP) should have been greatly reduced. On the nutrient side, the conditions prevalent during 2016 should represent a very significant overall reduction in TN loads – beyond what EPA has sought for MS4 loads. The estuary response to these reductions can be directly assessed to see whether such load reductions have resulted in a rebound in eelgrass cover or substantial improvement in other factors (e.g., reduction in phytoplankton growth). In addition, with the reduced load of CDOM and NAP, water transparency in the estuary should be greatly improved, yielding optimal conditions for promoting eelgrass growth.

Consequently, we recommend that the water quality data collected by PREP for the 2016 growing season be assessed promptly to demonstrate whether even drastic nutrient load reductions have any material impact on eelgrass in the estuary. The recommended assessment will need to consider the effect of the 2016 ambient conditions (total nitrogen, dissolved inorganic nitrogen, water clarity, CDOM, NAP, salinity, temperature) on DO, transparency, eelgrass cover, and macroalgae in the estuary.

- Precipitation

In 2016, New Hampshire experienced drought conditions, particularly from April to September (see Figure below). Coupled with the already reduced WWTP loads from Rochester and Dover, this should have produced the best water quality since the 1960's when the last extended drought occurred. The total measured precipitation at Rochester from January-September 2016 totaled 20.6 in. vs. 34.4 in., the average over the last three decades (1981-2010). Total precipitation from April-August measured 11.8 in. vs. 24.4 in., the historical average over the same timeframe.

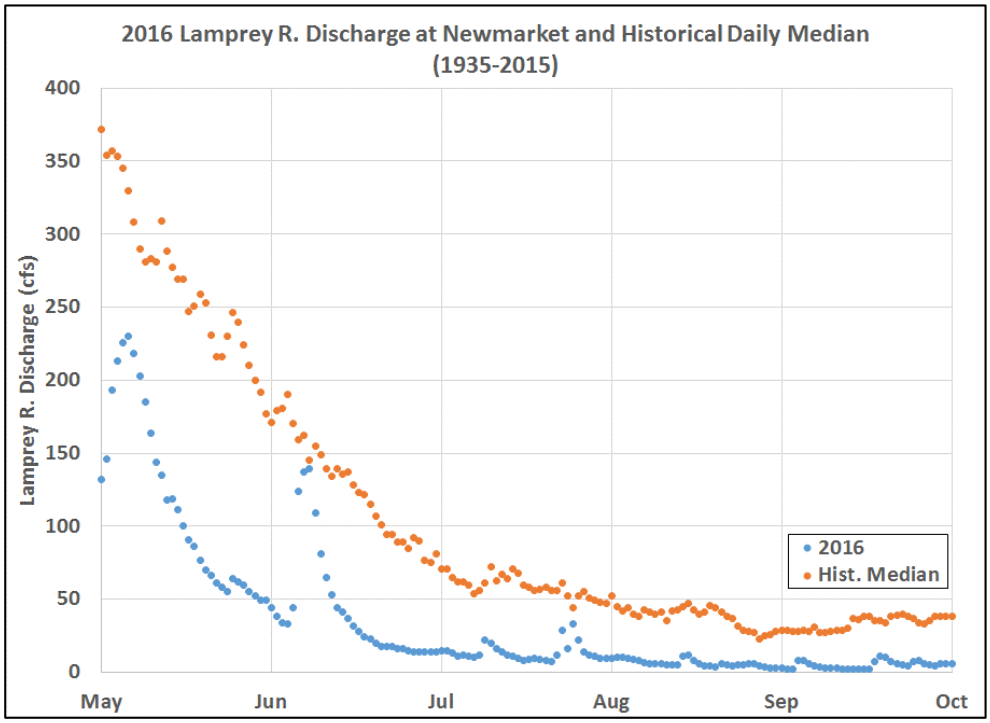


Rochester, NH Precipitation - Hist. Ave. and 2016 Totals									
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Hist Ave	3.2	2.9	3.9	4.3	4.2	4.1	4.1	3.7	3.9
2016	1.9	3.2	3.7	1.9	1.7	2.9	2.2	0.4	2.7

Given this significant reduction in rainfall, the overall nonpoint source loads to the estuary should be greatly reduced in 2016.

- Tributary Flow

The drought is also evident from Great Bay's tributary flows compared with the historical daily median flows. The 2016 flows for the Lamprey River (near Newmarket; USGS 01073500) are plotted below:



Lamprey R. Discharge (cfs)						
	Apr	May	Jun	Jul	Aug	Sep
Hist. Median	560	269	131	60	41	34
2016 Median	304	100	33	12	5.8	4.3

From May to September – the "prime" growing season – tributary runoff was reduced by approximately 70%. With such low precipitation and low tributary flows, especially during the growing season, this presents a natural opportunity to investigate the effects of the following conditions on eelgrass health:

- Decreased point source discharges of TN;
- Low nonpoint source inputs of TN;
- Low CDOM; and
- Increased water clarity.

However, competing with the lower TN loadings is the anticipated increased ambient water clarity and increased residence time which would be conducive to higher phytoplankton growth. It will be interesting to see if phytoplankton levels, once again, remained relatively constant.

Additionally, the drought conditions and expected low nonpoint source inputs act as a simulation of, and test the efficacy of, future nonpoint source TN reductions via MS4 permit limits. If no significant changes due to the major nonpoint source TN decrease can be detected, that would further support the MS4 group initiative and show that EPA's assertion that specific MS4 reductions must be targeted at TN removal is misplaced.

A comprehensive review of the 2016 Great Bay data, including hydrodynamic and water quality model simulations, will reveal the actual system response to these conditions associated with the drought and provide information regarding the efficacy of proposed regulatory actions involving nutrient reductions.