2013 Water Quality Summary from UNH

Attached file or read the 2011 report here:
https://drive.google.com/file/d/0B3ZgrJ7Tv9sZaUdLVndYeEtZWHc/view?resourcekey=0-8T7E8X9VmKZygClJ6sODiw

From the Report:

The 2013 Newfound Lake Watershed Assessment monitoring effort expands upon Newfound Lake base-line data that provides insight into the identification of potential problem areas within the Newfound Lake watershed. This effort is designed to generate data that will provide local decision makers and the public with a better understanding of the potential impacts of development, population growth, and land use change on the Newfound Lake and its drainage basin (watershed).

Deep Sampling Site Water Quality Assessment

The overall condition of Newfound Lake remained excellent and was characteristic of a relatively young, oligotrophic lake, although there was a clear difference between the Mayhew sampling station and the remaining Newfound Lake sampling sites. The Mayhew site, the only site located south of Mayhew Island, was characterized by the lowest dissolved oxygen concentrations among the seven sampling locations (Appendix F). The lack of dissolved oxygen in the deeper, cold waters, of the Mayhew site likely restricted the cold water fishery to other areas of Newfound Lake during the summer and fall months. Likewise, the water clarity was shallower (Figure 7), the amount of algal (microscopic plant) growth was higher (Figure 6) and the total phosphorus (nutrient) concentrations were higher (Appendix B) at the Mayhew Site. The Mayhew site is located in the most developed segment of Newfound Lake and might be reflecting localized nutrient inputs associated with a more intense level of residential development (Craycraft and Schloss, 2009). As indicated above, the overall Newfound Lake water quality is excellent but the Mayhew sampling site is exhibiting the early symptoms of nutrient enrichment that are not evident at the other Newfound Lake sampling sites.

Headwater Stream Assessment

The overall Newfound headwater tributary water quality was excellent although sampling during higher flow periods and following heavy periods of rainfall reaffirms the threat of phosphorus and sediment loading from upland sources (Craycraft and Schloss, 2012). Turbidity measurements were slightly elevated in Brock Brook on June 13, 2013, relative to other sampling locations within the Fowler River subwatershed. Historical water quality sampling conducted on August 30, 2011 and October 3, 2011 also documented elevated turbidity measurements in Brock Brook and suggest this stream may be more susceptible to increased sediment loading during periods of elevated streamflow (Craycraft and Schloss, 2012).

Long-Term Water Quality Trends

A review of twenty eight years of water quality sampling in Pasquaney Bay indicates a long-term trend of decreasing water clarity since 1986 (Figure 16). The amount of algal (microscopic plant) growth exhibits a trend of increasing concentrations in both Pasquaney Bay and south of Mayhew Island since 1986 (Figures 17 and 18). Thus, while the overall water quality remained excellent in Newfound Lake, there are signs that the water quality has been degraded over time (even at the deep centrally located reference station) and may be influenced by land use changes within the Newfound Lake watershed.

Lake Loading Response Model Report UNH 2013

Attached

- The Lake Loading Response Model is used throughout New Hampshire to estimate water quality conditions in lakes based on the land use in the watershed. It is a relatively simple model but is used widely in watershed management. Using the LLRM, we can estimate pre-development water quality, as well as water quality conditions under different development and forestry conditions.
- The model makes a conservative estimate of 6% of phosphorus loading comes from septic systems
- The septic portion of the report is relatively readable and starts on page 20. Language is included below.

Septic System Loading Estimates (From UNH LLRM Report 2013)

While not originally in the scope of the work, local discussions with watershed stakeholders indicated an interest in the impact of shoreline septic systems on the lake nutrient loading. To be done accurately, a shoreline resident survey should be undertaken. The information required for an optimum estimation would include a survey undertaken for each shoreline residence and business that specified: type of system, age of system, location of leach field in relation to shoreline, most recent time of inspection/pump out of septic tank or holding tank, whether a clothes washer and/or dish washer is in use, whether a sink garbage disposal is installed and used, if a water softener is presently used, the number of persons in the household and the schedule of occupancy (i.e. if the residence is occupied seasonally, multiple seasons or year-round). Best case for localized modeling to subwatershed scale would be a Global Positioning System recorded location or a digitized tax map location. At a minimum, some locational information with the shoreline section of the lake matched to the survey entry would be useful. We encourage the Watershed Project Team to facilitate such a survey in the future (see also: Recommendations Section) to allow for a more informed estimate.

However, by examining the results of surveys done for other New Hampshire lakes (Schloss and Squam Lakes Association unpublished, Schloss et al 2006, Jesperson and Diemer 2011) and by utilizing the analysis of buildings within the shoreland zone along with the septic system suitability within that zone from this project's extensive GIS Watershed Ecological Resources Inventory we can make some assumptions and come up with a reasonable estimate to then compare to other sources of phosphorus loading in the watershed.

In all 577 building were located within the 250 foot shoreland zone. An argument may be made that a modern septic system should process a majority of the nutrients given a distance of 75 to 125 feet depending on soils and slope. However, the suitability analysis (Appendix B) shows that over 62 percent of the shoreland zone has poorly suited soils for septic system function and most of the area is highly sloped. In addition, many shoreline areas have developments that were completed well before the state regulated septic system standards. A previous study at Lake Chocorua (Schloss 2000) confirmed that a 250 foot setback of all leach fields results in no discernible septic influence even in shallow groundwater inflows (confirmed by shallow well monitoring) thus buildings greater than 250 feet from shore were not included in the analysis.

For simplicity sake, it was assumed that about a third of the households were year-round (365 days of use), a third multi-seasonal (100 days of use) and a third seasonal (60 days of use). This was based on previous survey results from the Squam Lake (discussed in Schloss et al. 2006) and more recently for

Lake Wentworth (Jesperson and Diemer 2011). A second assumption was, on average, there were 2.6 persons per household, again based on recent studies. Three generalized situations were used given the fact that almost 68 percent of the buildings in the shoreland zone were located on soils with severe constraints:

- 60 percent of the residences had typical mid-age functioning septic systems.
- 20 percent of the residences had new, upgraded and/or raised bed septic systems.
- 20 percent of the septic systems were under-designed, not up to current code/standards, not properly maintained, and/or were marginal in their function.

The above most likely represents a conservative estimate (i.e. most likely underestimating actual loading) based on previous NH studies that used type of system, age of system, distance to lake, and site constraints to infer system functionality and the phosphorus assimilation capacity of the system (see Connor and Bowser 1997 and Schloss et al 2009).

The calculated results are displayed in the table below:

Septic system calculations in Newfound (Major Watersheds) model								
Category	# of Dwellings	People/ Dwelling	# of Days	TP Trans. Factor	Mean TP Conc (mg/L)	P Load (kg/yr)	Water (m3/day)	Water Load (m3/yr)
New or upgraded septic system	115	2.6	175	0.1	8	10.5	0.25	13081
Marginal/Old septic systems	116	2.6	175	0.4	8	42.2	0.25	13195
Typical mid-age septic systems	346	2.6	175	0.25	8	78.7	0.25	39358
Total Septic System Loading						**131.4**		**65634**

The result of 131.4 kg phosphorus per year surpasses 16 of the 19 tributaries monitored and modeled. It represents about 7 percent (comparably with other inputs that include atmospheric deposition, tributary input, and near shore runoff) of the annual phosphorus load and is comparable to the near shore (ungauged watershed) lands runoff which comes in at about 8 percent of the total load. While the original water nutrient budget (Craycraft and Schloss 2008) did not directly measure shallow groundwater wells to estimate septic and groundwater loading, best professional judgment and solving the mass balance of total phosphorus for Newfound Lake estimated the groundwater influx at 110.3 kg phosphorus per year. This estimated the septic loading at about 6 percent of the total phosphorus load so the modeled result is very close to the previous estimate from the empirical study.

As the septic system loading is not evenly distributed throughout the year and the majority of the loading actually occurs during the growing season (late spring and summer), when home occupancy is at its peak, the impact of septic systems can have an even greater role in influencing lake productivity in the summer. This would especially be true during a dry growing season. Also, as discussed earlier, these calculations represent a conservative estimate which is why a more detailed calculation should be done after surveying shoreland residents.