Pawtuckaway Lake Evaluation- Spring 2016 Update

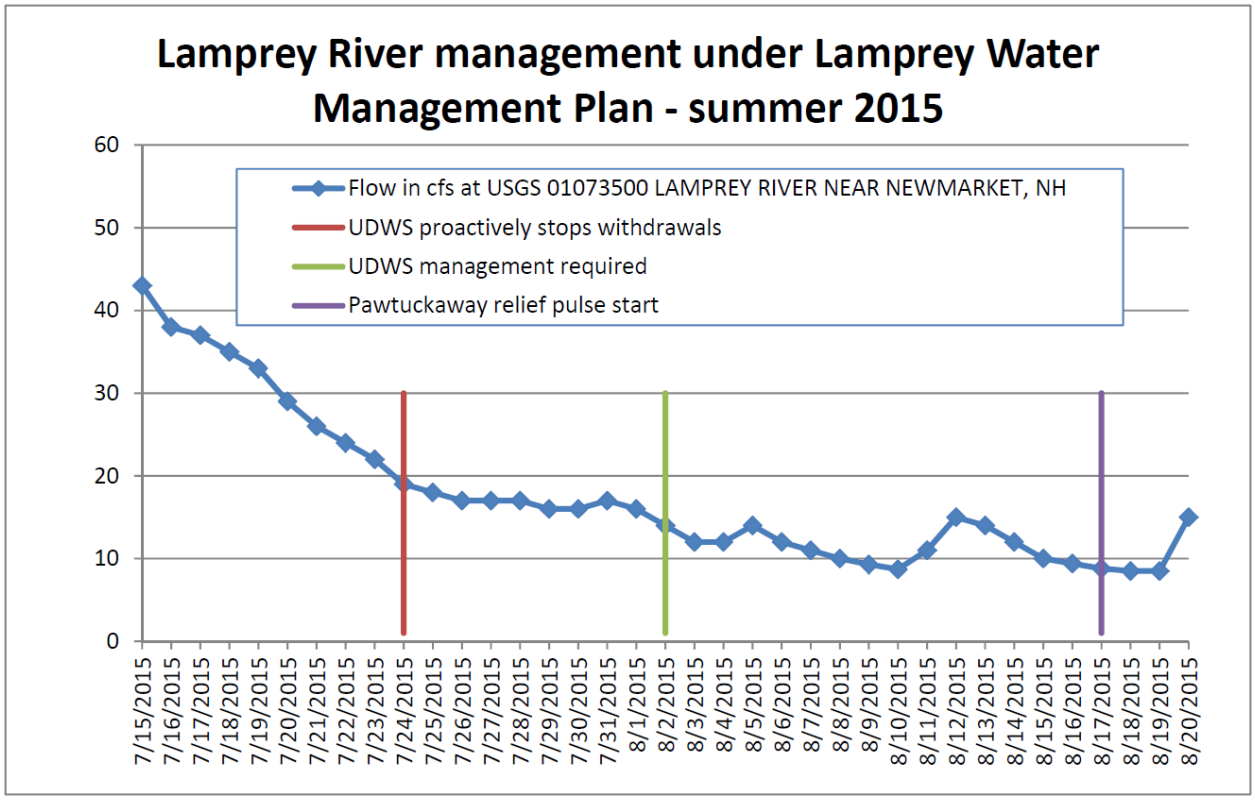
Prepared by the NH Department of Environmental Services (NHDES)

Over the last year, NHDES continued its multi-year evaluation of Pawtuckaway Lake's phosphorus and aquatic lake conditions. NHDES staff completed another round of aquatic plant surveys and measured Pawtuckaway Lake outflow volumes and phosphorus concentrations. Semi-annual meetings were held each spring and fall. A meeting was held September 17, 2015 in Nottingham where the summer relief pulses and the public hearings about the draft 2015 Report of the Instream Flow Pilot Program were discussed.

Lake Drawdown – On October 13, 2015 the NHDES Dam Bureau started the fall drawdown by opening the Drowns gate and removing a stoplog from Dolloff dam, which was subsequently replaced. Most of the flow from Pawtuckaway during the last two years' drawdown had gone through Drowns. Initially, the target release ratio was 70:30 (Drowns: Dolloff), however the ratio has drifted to a 90:10 split in trying to maximize phosphorus export. However, this has resulted in long periods when the Pawtuckaway River received no flow other than leakage. This is much less than is needed to support that river's ecosystem. In future drawdowns, NHDES will apply a more balanced release to match the target ratio while still preferentially releasing higher phosphorus concentrations at Drowns. In a related issue, over the weekend beginning October 30, NHDES reroute all outflow through Dolloff Dam when Fish & Game Department noted that alewives were not using the new gate open at Drowns Dam. The fish would not out-migrate from the lake using the gate and were schooling in front of Drowns Dam with nowhere to go. By shifting all flow out by way of Dolloff Dam for the weekend, it appeared that the alewives identified and found egress from the lake over the stoplogs at Dolloff Dam. On Monday, November 1st, Dam Bureau reestablished the previous flow conditions at each dam. NHDES and NHF&G are coordinating on how to operate the drawdown to support the alewives' migration out of the lake.

2015 Phosphorus values – Phosphorus export during the fall of 2015 was significantly less than in 2014. From October 10 to December 3, 2015, 211 pounds of phosphorus were released from Pawtuckaway Lake during the early stages of the lake drawdown, compared to 1066 pounds in 2014 as a result of lower phosphorus concentrations and less water entering and leaving the lake. The volume released from the lake in 2015 was 37 percent of 2014's volume, and the peak phosphorus concentration at Drowns Dam outlet in 2015 was 40.2 ug/L compared to 2014's concentration of ___ ug/L. NHDES is looking into the reasons for lower phosphorus concentrations in the lake.

Wiswall Dam water use – Under the UNH/Durham Water System's Instream Flow Program water management plan, UDWS must stop withdrawing water from the Lamprey River whenever flows at the USGS gage fall below 16 cfs. In practice during the July and August 2015 period of low flows, UDWS stopped withdrawing from the Lamprey River nine days before flows fell below 16 cfs. (Note that UDWS may withdraw water from the Wiswall Reservoir on the Lamprey River so long as they maintain outflow equal to inflow—this would result in a lowering of the Wiswall Reservoir water level.) UNH has developed a website at http://energy.sr.unh.edu/water/ which shows UDWS's water withdrawals from Wiswall Reservoir and the reservoir levels.



http://nwis.waterdata.usgs.gov/nh/nwis/uv?cb_00060=on&cb_00065=on&format=gif_default&site_no=01073500&period=&begin_date=2015-07-01&end_date=2015-08-31

October 10, 2015 - UDWS withdrawal is now online - Start of the Wiswall online data showing UDWS withdrawal rate as gpm and height in feet of the water level relative to the 15-min data for last 30 days and daily averages for 365 days at http://energy.sr.unh.edu/water/

Throughout this past year, NHDES continued its efforts under the Partnership

Agreement with PLIA to evaluate Pawtuckaway Lake conditions. A public meeting was held August 28, 2014 in Nottingham which had a focus on winter dock protection. Darlene Forst from the DES Wetlands Bureau answered questions and offered to meet with dock owners. Through the fall and winter, NHDES staff continued to assess conditions in the lake to answer key questions about water resource management effects concerning phosphorus concentrations in the lake during the fall drawdown, and the location, abundance, and types of plants growing in the lake.

Lake Drawdown - On October 15th, NHDES began to draw the lake down to reach the 6-foot drawdown target for the 2014/15 winter. The lake was held near 4.8 feet below full pool elevation from November 27 to December 3, 2014 to again demonstrate the future drawdown level. The bulk of the water released this year was directed through Drowns Dam to improve phosphorus export. The lake level was drawn down over 5.8 feet from February 17 through March 14. Next year's drawdown target will be 5.5 feet and in 2017, 4.8 feet, which is the final drawdown level called for in the Lamprey River Water Management Plan.

Aquatic plant survey - Another aquatic plant survey was conducted using sonar and collections by hand sampling. The lake drawdown levels last winter were similar to historical conditions, so this survey can be considered another baseline condition. The surveys from the last two years detected small changes in plant density that are within the normal variability in plant growth. These results will be compared to the surveys that will be conducted in future years.

2014 Phosphorus values - NHDES measured stream height and phosphorus concentrations at the outlet dams during the fall drawdown from October 10 through December 4. From these measurements, NHDES calculated the amount of phosphorus exported from each dam. As a comparison with past operations, NHDES also estimated the phosphorus export if this year's release followed historic operations. Recent operations direct most of the flow out of the lake via Drowns Dam instead of Dolloff Dam. This produced a much greater export of phosphorus as a result of discharging water with a higher concentration of phosphorous. NHDES estimates that the historical drawdown practices would have released 350 pounds of phosphorus. The new drawdown operations released 1066 pounds of phosphorus (716 pounds more than would have been historically released).

Phosphorus Export from Pawtuckaway Lake Dams during 2014 Drawdown (Oct 10-Dec 4, 2014) and comparison to historical drawdown practices

NHDES continued its efforts under the Partnership Agreement with PLIA to evaluate Pawtuckaway Lake conditions. A meeting in Nottingham town offices was held August 28. Wetlands Bureau's Darlene Forst offered to meet with dock owners. Through the fall and winter after the meeting NHDES staff continue to assess conditions on the lake to answer some key questions about water resource management effects.

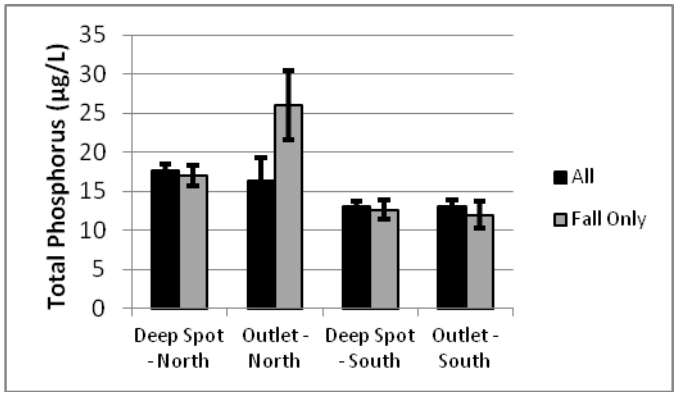
The key questions that are being addressed by DES are:

- *How do phosphorus concentrations at the south and north inlake deep spot sampling points and the outlets compare during the study period?*
- *Is more or less phosphorus being released from the lake by changing drawdown levels and outlets?*
- *How will changes in winter drawdown levels affect the location, abundance, and types of plants growing in the lake?*

NHDES had a target 6 foot drawdown for Pawtuckaway Lake for the 2014/15 winter. NHDES began the fall drawdown October 15. Again this year, the bulk of the water released was directed through Drowns Dam to improve phosphorus export. [DMattaini estimate of percent distribution? or TSWenson from logger data?] The lake was held near 4.8 feet of drawdown from November 27 to December 3. Next year's drawdown target will be 5.5 feet and finally 4.8 feet, which is the level called for in the Lamprey River Water Management Plan, in 2016/17.

NHDES estimated the outflow from each dam and linked this with the concentrations measured for phosphorus leaving the lake. The mass of phosphorus leaving from each dam was determined. [switch the flows to generate what would have usually come out.]

2014 P values



Estimated P export – spreadsheet in
\\Des\data\WD-Watershed\Rivers_Lakes\ISF\Lamprey\Lamprey_WMP_operations\Pawtuckaway_Lake\Phosphorus\2014-15 P
Flow data are in
S:\WD-Watershed\Rivers_Lakes\ISF\Lamprey\Admin\Reference_Data\Staff_gages

Measurements of water level collected at 15 minute intervals were converted to flow. A conversion formula was developed based on the relationship between discrete NHDES measurements of water level and flow. Monthly phosphorus sampling results were interpolated between measurement dates and applied to the 15 minute flows to generate a mass per 15 minute increment.

IMG_4364.JPG - 04-PAR with water level logger deployed. Protective PVC casing is bolted onto cinder block and cb is wired to tree.

IMG_4373.JPG - 10-NOR staff gage with water level logger deployed just upstream under edge of bridge. Protective PVC casing is bolted onto cinder block and cb wire is ziptied to rebar

Graphs of P export from Dolloff versus from Drowns

- outflow estimates
- P concentration
- Cumulative P export in pounds

2015 program review schedule

draft report
public hearing
final report
legislative response