MILL POND RESTORATION PROJECT

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Prepared by the

NASHUA REGIONAL PLANNING COMMISSION

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Project Summary and Goals

The goal of the *Mill Pond Restoration Project* is to assess and improve water quality in the Mill Pond and Nashua River Canal. Steps taken toward accomplishing this goal involved:

- Documenting flows from the gatehouse into Mill Pond and into the canal system
- Investigating why 10 cfs levels were not maintained by the hydro facility in accordance with their Federal Energy Regulatory Commission (FERC) license.
- Water quality monitoring at six fixed stations on a bi-weekly basis from June through September
- Sampling wet weather discharges during two rain events at 8 stormwater outfalls discharging to Mill Pond
- Assessing existing stormwater measures and determining the amount of impervious cover draining into the Mill Pond
- Developing public information materials, organizing monthly clean-up days, and storm drain stenciling

Introduction

The *Mill Pond Restoration Project* assessed the water quality of Mill Pond as well as the nonpoint sources of pollution (NPS) impacting the water quality of the pond and the Nashua River Canal. Both Mill Pond and the Canal have seen increased growth of aquatic vegetation in the past few years. In 1998, the NH Department of Environmental Services (DES) surveyed Mill Pond as part of the Lake Monitoring for Trophic Classification program. The survey, conducted on July 21, 1998, documented extremely dense growths of coontail and milfoil, and indicated that algal mats covered 40 percent of the pond. Water quality analysis indicated total phosphorous levels of .046 and .098 mg/l, at 2.5 and 5 meters respectively, clearly above the recommended level of concern of 0.05 mg/l. The survey also noted that Mill Pond receives large volumes of urban runoff from the parking lots and other impervious areas in the watershed.

Using a Geographic Information System (GIS), the drainage area of Mill Pond was determined to be approximately 515 acres with an estimated impervious surface coverage of 41percent. Eight outfalls drain directly into Mill Pond from the Nashua High School parking lots and athletic fields, all of Riverside Drive, and the approximately 20 businesses between Riverside Drive and West Hollis Street (Route 111).

Project Tasks

Task 1. Document Flow: Flow was measured on June 27, July 11, July 25, and August 8 at the outfall pipe from the Nashua River. On each of these days the level of water in the pipe, dissolved oxygen, and velocity was measured. The velocity in the pipe was zero on each occasion. There was an average of 1.30 cfs seeping from the rock bank to the left of the pipe. Dissolved oxygen averaged 6.7 mg/L. See Task One in the appendix for the Flow Monitoring Report.

The new owners of the hydrostation, Algonquin Power Systems, Inc., have been notified that a flow of 10 cfs is not being maintained into the Mill Pond and canal in accordance with their Federal Energy Regulatory Commission (FERC) license. In response, Algonquin sent a diver into the pipe to investigate the problem. The pipe is intact but the pipe is partially boarded up in the middle. A structural assessment is expected in early 2001 and corrective measures completed by July 2001.

Task 2. Research all Outfalls: A site walk was conducted to identify all of the outfalls in the drainage area. Initially 9 pipes were identified for wet weather sampling. Individual site plans were obtained from the City of Nashua Planning office and used to verify all stormwater drainage into

Mill Pond. Site #9 drains directly from the City of Nashua Department of Public Works Maintenance Garage into the western side of the Mill Pond. The Director of Public Works also serves on Mine Falls Advisory Committee. Upon learning of the situation, the sewer line was extended to the catch basin in the parking lot and the runoff was re-routed to the sewer. There is not an appendix for this task.

Task 3. GIS Database and Measure of Impervious Cover: The predominant land use in the Mill Pond drainage area is the High School (buildings, parking lots, and athletic fields), commuter parking lot and businesses with commercial landscaping. The drainage area for the Canal is light industrial and residential. NRPC staff converted AutoCad base plans to ArcView shapefiles and selected out features consistent with impervious surfaces. Features considered impervious included all buildings (including sheds/porches), pools, driveways, roads, sidewalks, and parking lots. Using these features it is estimated that 41% or 211 acres of the watershed is considered impervious. NRPC staff estimate that if the park and recreation layer is considered which includes athletic fields and tennis/basketball courts, the figure would be higher. The approximately 40 acres of sports facilities are located predominately at the Nashua High School and the Nashua Boys and Girls Club. There are also some parking lots missing near a large apartment complex. When these areas were included, the estimate for impervious surface coverage is closer to 45-46%.

Task 4. NPS Inputs to Stormwater Runoff and Existing Stormwater Management: The commuter parking lot, approximately 300 feet from Mill Pond, used to be a landfill in the late 1960's. The parking lot drains directly into the Mill Pond (Site 1&2) and it is possible that NPS pollution is leaching from the old dump toward Mill Pond. Research revealed that monitoring equipment was not used after the old dump closed. In addition, snow has been stockpiled in this area for many years and allowed to drain directly to Mill Pond.

A visual inspection of catch basins was performed and revealed no obvious structural problems. All clogged drains were reported to the DPW. There is a lack of swales and infiltration areas throughout the watershed. Although there were only two wet weather events sampled, the excessive amounts of phosphorus at Sites 1 and 2 indicate that there is a problem and may warrant construction of additional treatment measures.

Expansion of the Nashua High School is expected in the future. The level of NPS pollution entering the surface water via stormwater runoff warrants additional treatment. The system should be installed during construction to minimize cost and traffic/parking disruption. All additional stormwater measures should be addressed in compliance with EPA Phase II stormwater requirements.

Task 5. Develop Quality Assurance Protection Plan (QAPP): The QAPP was completed for the fixed site monitoring of Dissolved oxygen (DO), pH, E.coli, Total Suspended Solids (TSS), Total Phosphorus (TP), Turbidity, Chlorophyll A, and Alkalinity. Wet weather monitoring consisted of the same tests with the exception of Chlorophyll A and Alkalinity. The QAPP is on file at EPA and DES.

Task 6. Volunteer Monitor Training: The training by NHDES VLAP was completed on May 13 for shoreline and in pond sampling at 2.0 and 4.0 meters. A refresher in pond sampling was done on the first sampling date. In addition, the Project QA Officer assisted with the in pond sampling on September 5. There were two samplers per site so the entire season was completed successfully. The Volunteer Coordinator trained the DO monitor separately. It was easier to have one person do all of the sites instead of trying to coordinate 1 meter between 6 sites.

Task 7. Water Quality Sample Analysis: Data sheets are located in Task Seven of the appendix. The project used three different labs for sample analysis:

City of Nashua Wastewater Treatment Plant – E. coli, and TSS
DES Limnology Lab – pH, Conductivity, Turbidity, Chlorophyll A, and Alkalinity
DES State Lab – TP

Task 8. Education: See Task Eight in the appendix for additional materials not submitted in the July billing.

Task 9. Review and Recommendations: In general the E.coli and pH levels do not threaten the ecological health of the Mill Pond or the canal system and will not be discussed in the charts below. Turbidity is close to the state median and is not considered a problem. It is discussed below because of a few erratic numbers and what may have attributed to the high numbers. The parameters are discussed on a site by site basis.

Fixed Sampling Sites

Site 1. (Nashua River above the gatehouse) – Total Phosphorus (TP) levels were extremely high throughout the season with a range of 0.047 – 0.093 mg/L. The level of concern established by NHDES is 0.02 mg/L. The season average was 0.068 mg/L, which is considered Values >0.04 mg/L is considered excessive and represents the second highest sampling site tested. These results bring up an important issue of whether there is more TP in the Nashua River than the Mill Pond or the if monitoring site is not getting sufficient flow to provide an accurate TP reading.

This site has the lowest conductivity value with an average of 238 uS/cm. Conductivity over 100 is indicative of impacts from man-made sources such as road salt and runoff from urban areas. The riparian buffer and infiltration capacity in this location has kept this value low compared with the rest of the sites.

Site 1	Total P Mg/L	Conductivity uS/cm	Turbidity NTU	DO Mg/L	Temp Deg C
Site Range	.047 - .093	164 - 289	.63 - 1.81	6.14 - 10.35	17.1 - 24.0
Site Average	0.068	238	1.19	7.94	20.85
State Median	0.011	56.8	1.0	4 - 7	NA
Concern Level	> 0.02	> 100	> 10.0	< 4	> 21*

*Based on cold water fisheries.

Site 2. (In the Mill Pond at 2.0 meters- Epilimnion layer) – Secchi Disk readings indicate the waters transparency. The mean transparency for New Hampshire lakes is 3.7 meters. The Mill Pond ranged from 2.36 to 3.4 meters all season. The Volunteer Lakes Assessment Program (VLAP) ranks 2-4.5 meters as "Good". This ranking surprised many people because of the amount of algae present in the Mill Pond. Chlorophyll A levels were the highest in July with Dinoflagelletes dominating at approximately 98% of the population. Diatoms became the dominant species in the month of August.

Total Phosphorus (TP) levels were considered extremely high with the greatest epilimnetic values occurring at the beginning of July and at the end of August, which corresponds with the chlorophyll-a trends. Values reached a peak in August with the release of the nutrients from the sediment. Conductivity jumped from 456 to 775 in two weeks in June, which could likely be attributed to be an erosion problem during this time of the year. The average conductivity has doubled at this level in the Mill Pond since the monitoring began in May. Turbidity was the highest June 27 with a reading of 26 NTU, however this reading most likely does not accurately represent the turbidity levels at this site. The high turbidity levels on June 27 are probably the result of a contaminated Kemmerer bottle, non-representative debris suspended in the sample, or perhaps a bottom disturbance by an aquatic animal.

Site 2	Total P Mg/L	Conductivity uS/cm	Turbidity NTU	Alkalinity Mg/L CaCo3	DO Mg/L	Temp Deg C
Site Range	.02 - .054	310 - 775	0.9 – 26	27.8-59.3	4.62– 11.67	19.1–23.0
Site Average	0.031	420	1.37	35.6	6.1	18.55
State Median	0.011	56.8	1.0	4.9	4 - 7	NA
Concern Level	> 0.02	> 100	> 10.0		< 4	> 21*

* Based on cold water fisheries.

Site 3. (In the Mill Pond at 4.0 meters-hypolimnion layer) – At the 4 meter level the conductivity levels are very high and erratic. The average reading is 6 times the state level of concern. This may be the result of years of salt and metals washing into the Mill Pond from the DPW maintenance yard and general runoff from Route 111, Riverside Drive, and parking lots. Total Phosphorus is also 6 times the level of concern. The Mill Pond is essentially anoxic at this level because of the decomposition of organic matter (algae). This results in the release of phosphorus from the bottom sediments, also known as internal phosphorus loading.

Turbidity (transparency) was fairly stable throughout the summer and was overly affected by the drastic fluctuations in chlorophyll-a. The lowest reading took place in August in conjunction with the high chlorophyll-a value. The highest reading occurred in September, at the time of the lowest chlorophyll-a concentration. The turbidity average is rather high because of a 12.6 NTU reading on July 25 and 32 NTU on August 8. This is probably attributed to some sort of general bottom disturbance or non-representative debris suspended in the sample.

Site 3	Total P Mg/L	Conductivity uS/cm	Turbidity NTU	Chl A Composite	DO Mg/L	Temp Degree C
Site Range	.022 - .163	360 – 789	1.15 – 12.6	4.91 - 28.71	0.23 – 1.02	14.0 – 18.4
Site Average	0.080	628	5.04	12.08	0.46	14.9
State Median	0.011	56.8	1.0	4.9	4 - 7	NA
Concern Level	> 0.02	> 100	>10.0	> 15	< 4	> 21*

* Based on cold water fisheries.

Site 4. (Entrance to the Canal) – Water quality is improving at the Mill Pond outlet. The levels of phosphorus and conductivity are still of concern. This site had an unusually high E.coli on July 11 of 280. An inch of rain fell in Nashua the day before which could have contributed to the high colony count. The E. coli counts had been excellent with less than 20 all season. The sample may have been contaminated or there might have been a concentration of waterfowl on this particular day.

Site 4	Total P Mg/L	Conductivity uS/cm	Turbidity NTU	DO Mg/L	Temp Deg C
Site Range	.012 - .042	331 – 489	0.75 – 5.0 (1.76?)	5.75 – 9.9	18.1 – 25.3
Site Average	0.023	398	1.59 (1.09?)	8.11	22.03
State Median	0.011	56.8	1.0	4 - 7	NA
Concern Level	> 0.02	> 100	>10.0	< 4	> 21*

* Based on cold water fisheries.

Site 5. (Canal at Whipple Street) – Conductivity is the main problem at this site with an average of 398. The site has a good riparian buffer on both sides of the canal in this section. However, there is a stormwater outfall in close proximity downstream of the sampling site, which may be the source of the high conductivity readings. Overall this site was the healthiest tested.

Site 5	Total P Mg/L	Conductivity uS/cm	Turbidity NTU	DO Mg/L	Temp Deg C
Site Range	.013 - .017	316 – 508	0.44 – 1.98	6.75 – 8.32	17.5 – 24.4
Site Average	0.016	398	1.09	7.84	21.1
State Median	0.011	56.8	1.0	4 - 7	NA
Concern Level	> 0.02	> 100	>10.0	< 4	> 21*

* Based on cold water fisheries.

Site 6. (Canal at Pine Street-Millyard) – Phosphorus and conductivity remained above the level of concern throughout the sampling period. This is a very urbanized and open site in the middle of the Millyard. There is insufficient canopy cover due to the fact that trees have been removed. Tree roots make the canal banks unstable and were removed throughout the years.

The summer was very cloudy and cool and the figures for temperature do not represent a typical summer. Flushing the canal is the only way to maintain moderate temperatures from Whipple Street (site 5) to this site.

Site 6	Total P Mg/L	Conductivity uS/cm	Turbidity NTU	DO Mg/L	Temp Deg C
Site Range	.015 - .087	316 – 470	0.3 – 9.2	3.55 – 7.1	17.8 – 25.5
Site Average	0.036	389	1.66	5.46	21.9
State Median	0.011	56.8	1.0	4 - 7	NA
Concern Level	> 0.02	> 100	>10.0	< 4	> 21*

* Based on cold water fisheries.

Wet Weather Sampling

August 9, 2000

Mother Nature was not kind in the timing of rainfall this sampling season. It always rained at odd hours to catch the first flush or after the labs in the afternoon. August 9 was a brief rain event with light showers and moderately heavy rain. The first flush occurred between 10:00-10:30 am depending on the outfall. There is a water quality violation at sites 1 & 2 because the E.coli were too numerous to count. Total Phosphorus is a serious problem at all outfalls. According to Steve Couture of DES, low pH readings may be attributed to grass clippings collecting in catch basins this time of year. Grass clipping were noted in swales and catch basins. This could be attributed to infrequent mowing which would prevent effective mulching and nutrient uptake by vegetation.

Site	Location of Outfall	E.coli Col/100ml	TSS Mg/L	TP Mg/L	PH
WW1	Metal pipe under bush at boat ramp	TNC*	10	0.073	7.46
WW2	Second metal pipe at boat ramp	TNC*	11	0.276	7.09
WW3	Cement pipe #1	0 Flow	0 Flow	0 Flow	0 Flow
WW4	Cement pipe #2	0 Flow	0 Flow	0 Flow	0 Flow
WW5	Drainage swale from cement pipe	40	1	0.196	6.43
WW6	Beginning of school parking lot	120	2	0.01	4.66
WW7	End of parking lot near maintenance yard	0 Flow	0 Flow	0 Flow	0 Flow
WW8	Practice field drain	0 Flow	0 Flow	0 Flow	0 Flow

* Too Numerous to Count.

October 16, 2000

This rainstorm was steady and heavy at times. Samples were collected between 2:00-3:00pm. The samples may not have been collected during the "first flush" but were collected within the first hour of the rain event. Outputs at WW and WW7 had very heavy flows. At first pass, sites WW4 and WW6 showed no flow. A second pass revealed a heavy flow at WW4 and a sample was collected. There is a lag time, which varies at each outfall, before water flows from the pipe. This site is probably the most representative of "first flush". Site WW6 never flowed during the hour that we were collecting. It may have a longer lag time than the others but time was a problem.

When the sample was collected at site WW2, the water coming out of the outfall as well as the Mill Pond had foam. The surface water was covered in pure white foam a foot thick for approximately 10 square meters. Samples were difficult to collect because of the "head" of foam in the bottles. Although there were only two wet weather samples collected, there is a serious problem at sites 1, 2, 3, 4, 5, and 7.

Site	Location of Outfall	E.coli Col/100ml	TSS Mg/L	TP Mg/L	PH
WW1	Metal pipe under bush at boat ramp	N/A	79	0.526	6.45
WW2	Second metal pipe at boat ramp	N/A	34	0.364	6.02
WW3	Cement pipe #1	N/A	27	0.196	5.94
WW4	Cement pipe #2	N/A	3	0.074	6.1
WW5	Drainage swale from cement pipe	N/A	14	0.085	4.7
WW6	Beginning of school parking lot	N/A	0 Flow	0 Flow	0 Flow
WW7	End of parking lot near maintenance yard	N/A	13	0.077	4.32
WW8	Practice field drain	N/A	0 Flow	0 Flow	0 Flow

General Recommendations

- Determine runoff and flow calculations for each outfall for secondary stormwater treatment systems. This will enable the City of Nashua to determine the type, size, number of units, and the cost associated to pre-treat water entering Mill Pond and ultimately the Nashua River in the Mill Yard.
- Obtain Total Phosphorus data from NHDES and Nashua River Watershed Association for the Nashua River to determine if levels have generally been historically high at Site 1 in the Nashua River above the gatehouse.
- Sample from a boat or determine a site with more flow for future sampling at Site 1 in the Nashua River.
- Continue wet weather sampling and measure flow at sites 1-7 to establish a priority ranking system for secondary stormwater treatment.
- Pursue additional treatment systems at the boat ramp outfalls (WW1 & WW2) to remove excess phosphorus and metals.
- During the expansion of Nashua High School, reroute the stormwater drains to flow through a secondary treatment system before entering the Mill Pond and canal system.
- Stormwater management practices on new development sites within the drainage area should provide for the capture and treatment of all stormwater created by ten year, twenty-four hour storm event.
- The disposal of stored stormwater from the stormwater management system should be infiltration.
- Establish an annual maintenance plan for all catch basins and future secondary treatment systems.
- Move the City's "snow dump" to an area where the snowmelt will not drain into surface waters.
- Establish a maintenance plan to provide for the removal of snow to an infiltration area that will not harm groundwater.
- Consider a limited salting policy in the entire drainage area.
- Pursue LCHIP or other funding to fix the gatehouse if Algonquin Power System, Inc. fails to maintain flow as required by the FERC license.
- Distribute BMPs information for salt, snow and sand management to the businesses in the drainage area.
- Perform Phosphorus loading analysis above the gatehouse to determine what can be expected to enter the Mill Pond and Canal when proper flow is established.
- Continue to pursue the WRDA funding to establish how much "Flushing" is structurally safe for the banks.

APPENDICES NOT INCLUDED IN DIGITAL VERSION