CITY OF MANCHESTER NEW HAMPSHIRE

Gravel Wetland Cell at Nutt Pond

Stormwater Management Program Annual Report

May 1, 2017 to April 30, 2018

Manchester's Stormwater Management Program Summary

BMP Task Listing and Current Status for 2017

BMP#	Description		Develop	Implement	End Date	Priority	Completed
1-1	Assign SW Coordinator		8/1/2003	5/17/2003	7/30/2004	**Completed**	5/17/2003
1-2	Add SW Info to City's Website		10/1/2004	Ongoing	3/21/2004	**Completed**	10/7/2003
1-3	Outreach with Local watershed groups		10/1/2004	Ongoing	7/30/2004	**Completed**	Ongoing
1-4	Brochures available DPW & library		7/1/2004	Summer 2004	7/1/2006	**Completed**	Summer 2004/ Ongoing
1-5	Signage @ Urban Ponds (Reposted as Needed)		9/1/2003		3/21/2004	**Completed**	9/25/2003
1-6	Pet Waste Brochure & Signage		7/30/2004	Draft done 3/2004	7/1/2006	**Completed**	1/28/2005
2-1	Comply with State Public Notice		Complied with Ordinance and Regulations Notices				City Protocol
2-2	Annual Household Haz-waste Day		Yearly - Info provided by Recycling Coordinator			**Completed**	May 12 & Oct 13
2-3	Collect Used Oil, batteries & tires		Yearly - Info provided by Recycling Coordinator			**Completed**	12/31/2014
2-4	Urban Forestation "Green Street Program"	Mike Baer	Ongoing - 44 trees for year 2013			**Completed**	12/31/2014
2-5	Stormwater & Combined Sewer Hotline	**665-6899**	9/1/2003	7/30/2004		**Completed**	8/26/2003
3-1	Present Draft Storm Sewer Ordinance	Adpoted	12/1/2003	7/30/2005	7/30/2006	**Completed**	8/2/2006
3-2	Dry weather screening of outfalls 2X/5yrs		4/1/2004	Summer 2004	9/30/2005	**Completed**	Completed / Ongoing
3-3	Develop & Implement Illicit Discharge Protocol		1/1/2004	Ongoing	7/30/2008	**Completed**	8/1/2003
3-4	Map Outfalls & Receiving Waters		Ongoing updates of City's GIS			**Completed**	12/12/2005
4-1	Ordinance - Erosion, Sediment & Construction Material		12/1/2003	Adopted Ordinance & Regulations		**Completed**	8/2/2006 - 12/5/2006
4-2	Develop Procedure for Public Comment		9/1/2003	Outline City Protocol for SWMP		**Completed**	8/1/2003
4-3	Check Erosion & Construction Material Onsite		(Developed winter of 2003) List used at inspections			**Completed**	In Use
5-1	Ordinance for Runoff Controls for Developments		12/1/2003	Adopted Ordinance & Regulations		**Completed**	8/2/2006 - 12/5/2006
5-2	Recommend BMP Manual for Planners & Developers		8/1/2003	Outlined in Regulations - 6(A), 1-4		**Completed**	12/5/2006
6-1	Install Silt Fence Around Snow Dump		9/30/2003	11/1/2005	Annually	**Completed**	11/14/2006
6-2	Track CB Cleaning Program, Priority Basins Annually		8/1/2003	9/15/2003	Ongoing	**Completed**	12/31/2014
6-3	Sweep Streets 3X Annually		9/1/2003	Before Phase II	Ongoing	**Completed**	Min 3X/yr.
6-4	SOPs for Disposal of CB and Street Sweeping Residuals		8/1/2003	Visit 6/26/2003	In Practice	**Completed**	Ongoing
6-5	Minimize Salt Usage, Maintain Cover Over Salt Storage		12/1/2003 (1)	11/1/2005	Ongoing	**Completed**	Ongoing
6-6	Program to Clean Pond Inlets and Trash Racks		8/15/2003	Tank Inspections	Annually	**Completed**	Ongoing
6-7	Develop/Implement Employee Education Program		9/1/2003		Ongoing	**Completed**	Ongoing
6-8	Design & Construct Pond Specific P2 Projects		8/31/2003	Nutt Pond / Tannery Brook	Ongoing	**Completed**	Completed / Ongoing
6-9	BMPs for Derryfield Country Club		12/31/2003	Spring / Summer 2004	7/30/2006	**Completed**	8/1/2004

(1) Although the City covers salt piles, calibrates sander/salt spreaders and provides snow fence around snow dumping areas, there is no formal salt reduction program. Salt is applied as needed and completely weather dependant. The City has done a pilot study in the Nutt Pond sub watershed to determine sand and salt application rates and what can be done to reduce this impact. A pollutant-load watershed model was developed for this watershed. The Nutt Pond Watershed Sediment Loading Reduction brochure was developed and was sent to all the commercial property owners to try and reduce the loadings to Nutt Pond. A follow-up survey was conducted to determine the effectiveness of the program. A one page informational brochure was developed to provide residents with additional information on how they can protect the pond. This informational brochure is posted at the kiosk.

City of Manchester, New Hampshire
Stormwater Management Program Annual Report
May 1, 2017 through April 30, 2018

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Certification Statement

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Frederick J. McNeill Date: 4/30/18

Frederick J. McNeill, P.E.
Chief Engineer - EPD

BMP #1 Public Education and Outreach

 # 1-1, Assign Stormwater Coordinator – (BMP Completed)

Current Status: The City of Manchester hired the stormwater coordinator on May 17, 2003. The title for this position is Environmental Permits Coordinator.

BMP Effectiveness Evaluation: The Coordinator position allows the City to review, implement and enforce requirements of the stormwater program effectively. The responsibility of the position meets, but in many cases exceeds the level of expectations of the regulatory agencies. The hiring of the Coordinator helped to fulfill all the requirements of the five-year program one year ahead of schedule.

Future Goals: To continue to carry out the requirements of the stormwater program. To expand the program through implementation of stormwater practices that go beyond the five-year program requirements and to meet the requirements of the next permit.

The Coordinator will continue the inter-departmental efforts between the Planning, Parks & Recreation, Health and Highway Departments to enhance the existing stormwater program.

To utilize the City's engineering inspection staff to a greater degree when they do construction site inspections related to infrastructure. Each year they learn more about the stormwater program and implementation of BMPs for erosion and sediment control. For this reporting period, EPD did not perform any formal training, but spent time out in the field with representatives from the Highway Division to help them understand more about our system and requirements of our program.

 # 1-2, Add Stormwater Information to the City's Website – (BMP Completed)

Current Status: The City of Manchester uploaded the initial stormwater website on October 7, 2003 consisting of four pages. Since then the website has expanded considerably. The total number of pages accessible within the stormwater site is well over fifty, which includes outside pages, related to stormwater, and associated PDF files.

The Manchester Urban Pond Restoration Program website is a site linked and referenced throughout the stormwater website and vice versa. The information on the Urban Pond site demonstrates how stormwater controls can improve and enhance the quality of local ponds and lakes. The urban ponds web page was updated this reporting year.

BMP Effectiveness Evaluation: Although this BMP has been an effective means of providing stormwater information for public access in the past, many portions of the website are out of date. The EPD is currently working to update this web page.

Future Goals: The first goal will be to update the website for changes to the stormwater program based on the newest MS4 permit requirements. Also, the stormwater portion of

the EPD's website will be simplified to make it easier to locate information as well as to explain the importance of addressing stormwater issues for the layperson.

 # 1-3, Conduct Outreach with Local Watershed Organizations – (BMP Implemented & Ongoing)

Current Status: The City has provided funds for kiosk maintenance supplies for 10 kiosks, equipment, and water analyses for the two watershed organizations (Crystal Lake Preservation Association – CLPA and the Pine Island Pond Environmental Society – PIPES) and the part-time acting coordinator of the Manchester Urban Ponds Restoration Program (Jen Drociak). This commitment will continue through the Stormwater Program.

The formal, full-time City-funded Urban Pond Restoration Program Coordinator position was terminated in February of 2005 and was carried within the Planning Department through December 2005 when it was subsequently eliminated. There is no longer anyone assigned to coordinate these activities.

Without a formal full-time Urban Pond Restoration Program Coordinator, outreach has continued through the Environmental Permits Coordinator and also the acting coordinator (noted above), who works on a seasonal, part-time basis with funding through the Environmental Protection Division.

The acting coordinator performs website and outreach material updates, annual kiosk maintenance at 10 kiosks, coordinates pond cleanups once per year at multiple pond sites, and monitors water quality at four ponds three times during the summer. Please see the below link for the cleanup events this year.

http://www.manchesternh.gov/Departments/Environmental-Protection/SEPP/Pond-Restoration/Clean-Up-Events

Appendix A to this report contains summary graphs for the various cleanup events from the year 2000 through 2017.

Appendix B includes water quality data tables showing various parameters that have been tested between 2000 and 2017. Included in these data tables are measurements for average acid neutralizing capacity (ANC), average chlorophyll-a, average chloride, average conductivity, median pH, average water clarity/transparency, average total phosphorous, and average turbidity. The link to the tables is below.

http://www.manchesternh.gov/Portals/2/Departments/environ_protec/ponds_new/AllPondsWaterQualityTable.pdf

The City has budgeted for total phosphorus analysis, while all other sampling is performed in the field and/or analyzed at no cost at the NHDES Limnology Center under the umbrella of the NH Volunteer Lake Assessment Program (VLAP). The level of sampling and analysis that was done when the Urban Pond Coordinator was with the City has remained the same. This work is being completed by members of the watershed organizations along with the Environmental Permits Coordinator and the Urban Ponds Restoration Program acting coordinator.

The acting coordinator updates the Urban Pond Restoration Program website and posts the results of the sampling on the City's website for the public to view, as noted on the previous page.

The City of Manchester has worked with the New Hampshire Rivers Council in the past as a project partner along with other organizations on the McQuesten Brook Watershed Management Plan and implementation efforts.

In 2017, the City of Manchester participated in a NH PBS documentary titled, "Water Works", which highlighted the importance of managing this precious resource. The special was advertised by NH PBS as, "Water Works traces water from its source to faucets, and shows the challenges to our water supply like aging infrastructure, drought and pollution. It also examines what's being done to address these issues and how to keep clean water flowing in New Hampshire." The City distributes copies of the documentary to all school visitors to the WWTF.

The link for the documentary can be found at: http://video.nhptv.org/video/2366020875/

BMP Effectiveness Evaluation: The outreach has been effective. The City's Environmental Permits Coordinator and the acting coordinator of the Urban Ponds Program will continue various aspects of the Program in the absence of the Urban Pond Coordinator.

Future Goals: To continue the support for the watershed organizations and the acting coordinator, as well as support the sampling and analysis efforts. The website will be updated and simplified. The main goal in the future will be to become compliant with the newest MS4 permit.

 # 1-4, Make Brochures Available at the DPW and Public Libraries – (BMP Completed)

Current Status: The City has a limited number of previously developed brochures that are still available. These will be used for the continued education of the public. These brochures will be targeted toward individuals/groups that would best benefit from this information.

The City developed and printed brochures explaining the "Wastewater Treatment Process" (provided in the first stormwater report), when visiting classrooms to teach students. These will continue to be given during classroom educational sessions.

BMP Effectiveness Evaluation: There have been no surveys or feedback forms developed to gauge the effectiveness of this BMP. The department has received limited feedback from its citizens.

Future Goals: As the newest MS4 permit evolves, the outreach requirements will significantly change. The future goal is to comply with the requirements of this next permit.

As noted in the previous year's report, the EPD has partnered with the NH Institute of Art for a stormwater stenciling campaign around their campus. A select number of stormwater sites were stenciled in 2017. This effort will continue, with the sites expanded, in 2018.

 # 1-5, Develop, Install & Maintain Signage at Urban Ponds – (BMP Completed)

Current Status: The signage information that was presented in the first report is still applicable. There are issues with vandalism, but these signs are repaired in the spring when the Parks & Recreation Department begins to prepare the Urban Pond areas for public usage. During the 2008 spring and summer seasons the signs at the ponds were replaced and some new informational signs were added. The Plexiglas was replaced with some new Lexan which is more durable and will stand up to vandalism better. The kiosks are repainted on a regular basis as needed. Outdated information was replaced with current information in April of 2018. An inspection of each kiosk is done in the spring to see what repairs and repainting efforts are needed.

BMP Effectiveness Evaluation: It is difficult to gauge the effectiveness of this BMP. The signs are only effective if read. The kiosks are at the popular entrance areas of each pond and are easily accessible. The individuals who frequent the area most will probably retain more of the sign's information through subconscious familiarity. The kiosks are kept up to date and are more effective at getting the message across.

Future Goals: The goal is to maintain these signs in serviceable and readable condition. The kiosks will be updated, repaired, and painted as needed to help get information to the residents that are using the ponds. They are inspected in the spring to see what repairs and repainting efforts are needed. To help curb a growing vandalism problem, EPD investigated whether installing and maintaining surveillance cameras is viable in these areas. Due to logistical issues, this was determined not to be a feasible alternative during the last reporting period.

 # 1-6, Distribute Pet Waste Brochures with Dog Licenses & Increase Signage at Parks – (BMP Completed)

Current Status: There are signs for "No Fouling By Pet Waste" erected at the entrances of the urban ponds and also at City Parks. These signs reference the City ordinance that enforces this law.

In 2005, 10,500 brochures were mailed to registered dog owners within the City of Manchester. The City Clerk has additional brochures that are given to the owners of all newly registered dogs, although residents who are renewing their dog licenses do not receive the brochure.

There is also signage at some of the ponds that indicate it is improper to feed ducks. This will help prevent geese and birds from fouling the shores of the ponds that the residents frequent.

BMP Effectiveness Evaluation: It is difficult to gauge the effectiveness of this program. In the next permit cycle, the City will need to develop a more effective way of measuring the effectiveness of these messages, which have specific requirements with respect to the audience(s) and timing.

Manchester is hoping that the original brochures were effective enough to encourage the uninformed dog owners to clean up after their pets.

Future Goals: To keep residents informed in regards to their obligations handling their pet waste. Comply with the requirements of the newest MS4 permit.

The EPD is in the early stages of partnering with the Parks and Recreation Division as well as the Highway Division for procurement, installation, supplies, and disposal at pet waste kiosks, which include pet waste messaging, pet waste bags, and a trash can for pet waste disposal, at the City's parks.

Continue visual field observations for problem areas when higher amounts of pet waste are noted.

BMP #2 Public Participation

 # 2-1, Comply with State Public Notification Laws – (BMP Implemented & Ongoing)

Current Status: The City of Manchester continues to comply with all Public Notification Laws regarding the Stormwater Management Program process. The meetings that EPD scheduled in the early stages of ordinance development, with the Planning Board, and the Highway Commission, were announced on the weekly agenda for those perspective meetings, posted at City Hall, the Highway Department, and posted on the City's website.

Examples of public announcements announced in the local newspaper were included in previous year's reports.

Manchester went beyond the newspaper public notice and mailed agendas and draft documents to developers, contractors and engineering firms that usually do business within the City. The City incorporated many of the comments into the draft Ordinance and the Regulations.

In addition to the Public Notification Law, the City of Manchester has a guide that all departments, boards, committees and the Mayor and Aldermen must abide by. It references the rules on Meetings, the Formation of Committees, and Rules for Ordinances, Resolutions and Orders, Access to Public Records and Meetings, and Minutes and Records Available for Public Inspection. These Rules comply with the State of New Hampshire Public Notification Laws as outlined in RSA 47:6, and RSA 91-A:1 through RSA 91-A:6. This guidebook is available in all departments for reference should questions arise in regards to the implementation of Public Notice Law regulations.

Future Goals: To continue the public notification policy whenever any changes are made to the ordinance, or when substantial changes are made to the Regulations.

 # 2-2, Hold Annual Household Hazardous Waste Day – (BMP Implemented & Ongoing)

Current Status: The City of Manchester held two Household Hazardous Waste Days in Manchester during 2017. These dates have always fallen on the second Saturday of May and the second Saturday of October. The first collection was held on May 13, 2017 and the second was held on October 14, 2017. The date of collection is mentioned on the City's website, announced on flyers at the Highway Department, various other kiosks throughout the City, and also announced in the newspaper the week of the collection. Also, sewer customers in the City are provided with a residential waste brochure with their water and sewer bill that contains this information. On the City's website is an alternative household products list. This list was included in the 2009 Annual Report.

The following amounts of wastes were collected during 2017:

Waste Description	Quantity Collected
Universal Waste (TVs, CRTs, and computer peripherals)	184 Tons
Scrap Metal	441 Tons
Refrigerators	515 Units
Air Conditioning/De-Humidifier Units	777 Units

Spring HHW Collection: Hazardous materials consisting of the following components:

Waste Description	Quantity Collected (Pounds)
Waste Paint	11,000
Waste Aerosols	1,050
Waste Pesticides Liquid	1,350
Waste Oxidizing Liquid	15
Waste Pesticides Solid	2,000
Waste Corrosive Liquids	450
Waste Ammonia Solutions	20
Waste Mercury	10
Universal Waste (CFL)	100
Non DOT Regulated Material (Fluorescent Light Bulbs)	750
Waste Flammable Liquids	5,250
Asbestos	15
Batteries, dry, sealed	10
Waste Oxidizing Solid	50
Total	**22,070**

Fall HHW Collection: Hazardous materials consisting of the following components:

Waste Description	Quantity Collected (Pounds)
Waste Paint	9,000
Waste Aerosols	1,050
Waste Pesticides Liquid	1,050
Waste Pesticides Solid	2,000
Waste Corrosive Liquid	600
Waste Ammonia Solutions	150
Waste Mercury	30
Universal Waste (CFL)	40
Non DOT Regulated Material (Fluorescent Light Bulbs)	475
Waste Flammable Liquids	4,550
Batteries, dry, sealed	50
Waste Oxidizing Liquid	15
Total	**19,010**

BMP Effectiveness Evaluation: The household hazardous waste collection is possibly the most successful environmental program conducted semi-annually throughout Manchester. This program recovers a huge waste stream that could potentially be dumped in off road areas near brooks and ponds.

The City notifies all residents who receive a sewer bill regarding yard waste pick-up. It is also posted on the City's website. This notification helps in the prevention of yard waste being disposed of along roadsides and brooks, which help reduce nutrients that move into the Merrimack River from the tributary streams.

Future Goals: Manchester will hold two hazardous waste collection days during the 2018 calendar year. The first will be held on May 12th and the second on October 13th. For 2018, the City has extended the hours it will accept household hazardous waste by opening the event one (1) hour earlier on both days.

 # 2-3, Continue Regular Used Oil, Battery and Tire Collection – (BMP Ongoing)

Current Status: The City of Manchester continues to collect used oil, batteries, and tires. These are collected during normal business hours. These wastes are not reserved for the Household Hazardous Waste Days. The amount of wastes that were collected and shipped is listed in the next table.

The City collected the following amounts of wastes during 2017:

Waste Description	Quantity Collected
Tires	50 Tons
Used Motor Oil	1,875 Gallons
Lead Acid Batteries	7,140 Pounds

Future Goals: Continue the same level of accessibility and collection hours as currently established.

 # 2-4, Continue Urban Forestation through "Green Streets" Program – (BMP Ongoing)

Current Status: Similar to 2016, the "Green Streets" Program was not funded in 2017.

A Green Roof was installed in September of 2007 on the roof at City Hall using the GreenGrid system. The plants were sampled for heavy metals as a baseline to help determine uptake. The only metal that was detected was zinc. This is thought to be due to the zinc orthophosphate in the drinking water used for corrosion control. The plants were sampled on November 6, 2017 for heavy metals. There were eight metals that were detected during this sampling event, as shown on the following table. In 2016 there were four metals that were detected.

GREEN ROOF SAMPLING RESULTS

Parameter	2014 Results in ug/g	2015 Results in ug/g	2016 Results in ug/g	2017 Results in ug/g	4 Year Averages
Antimony	1.6	BDL	BDL	0.11	0.43
Arsenic	BDL	BDL	BDL	BDL	BDL
Beryllium	BDL	BDL	BDL	BDL	BDL
Cadmium	BDL	0.45	BDL	0.27	0.18
Chromium	BDL	0.96	BDL	0.49	0.36
Copper	BDL	12	6.91	6.18	6.27
Lead	13	58	1.33	20.5	23.21
Mercury	BDL	0.027	BDL	0.036	0.02
Nickel	BDL	1.3	7.36	2.09	2.69
Selenium	BDL	BDL	BDL	BDL	BDL
Silver	BDL	BDL	BDL	BDL	BDL
Thallium	BDL	BDL	BDL	BDL	BDL
Zinc	38	104	30.2	47.7	55.0

BDL = Below Detectable Limits (assumed 0 for averages)

Future Goals: To reinstate the "Green Streets" Program as previously established provided the funding is available. Assure the public is aware of the availability of this service through the City of Manchester.

The City will continue to sample the plants on the Green Roof for metal uptake on an annual basis.

Establish a "Green Initiative Program" under the City's Phase II CSO Program. These types of improvements will be investigated during future Phase II CSO separation designs.

 # 2-5, Publicize & Maintain Stormwater & Combined Sewer Hotline – (BMP Ongoing)

Current Status: The City established the Stormwater / CSO Hotline on August 26, 2003. The phone number is (603) 665-6899. The City previously sent envelope stuffers with the 24,000 bills (residential, commercial and industrial customers) informing these users of the storm water hotline and how it can be used to address environmental concerns. The hotline number is provided on the City's stormwater website and on the Environmental Permits Coordinator's business cards.

BMP Effectiveness Evaluation: It is difficult to gauge the effectiveness of this. The Environmental Permits Program Coordinator receives between five (5) and ten (10) calls annually related to stormwater related issues. When these calls come through, the residents typically state that they saw the number on the website. So in that respect, it is effective.

Future Goals: In the future, the goal will be to become compliant with the newest MS4 permit.

BMP #3 Illicit Discharge Detection and Elimination

3-1, Develop & Present Draft Storm Sewer Ordinance – (BMP Completed)

Current Status: The presentation of the Stormwater Ordinance was done October 4, 2005. Comments were received, reviewed and where appropriate, incorporated. The Ordinance was approved by the Board of Mayor and Aldermen on August 1, 2006.

BMP Effectiveness Evaluation: The adoption of the ordinance and regulations has given the City the ability to cite codified references for enforcement actions.

Future Goals: To review the current stormwater ordinance and revise as needed to become compliant with the newest MS4 permit.

3-2, Continue Dry Weather Screening of Outfalls – (BMP Completed)

Current Status: The requirement of two inspections during the five-year program was completed.

The ponds were sampled for phosphorous, alkalinity, conductivity, pH, turbidity, temperature, dissolved oxygen, and zooplankton/phytoplankton as part of the Volunteer Lake Assessment Program (VLAP).

The ponds and sections of the rivers are sampled each week during the summer months by the City of Manchester Health Department for recreational purposes. When the water results are greater than 88 E-Coli per 100 milliliters of water the area is usually posted and it may get closed for swimming depending on the location in accordance with NH RSA 485-A, Class B waters.

The Merrimack River was sampled for aluminum four times a month for a year. The sampling program was completed. A wet weather increase for the aluminum concentration has been observed. The EPA and NHDES determined that there were no water quality concerns in the Merrimack River upstream and downstream from the WWTP's outfall. Aluminum was removed from the previous permit.

The outfalls at the Wastewater Treatment Facility and at the Drop-Off Facility have been monitored per the Multi Sector General Permit (MSGP) for each.

BMP Effectiveness Evaluation: The City has catalogued observable outfalls along the Merrimack and Piscataquog River along with the ponds. The City has collected samples from outfalls that run in dry weather (usually the result of small streams), has tested them and has found that only background levels of bacteria are present. During the rare occasion of elevated bacteria counts follow-up sampling and investigations were conducted.

The urban ponds, being more environmentally sensitive, have several pollutants tested during the course of the summer. Please refer to the list of pollutants above.

Future Goals: The City will conduct dry weather screening per the requirements in the next permit. Continue sampling the urban ponds during the course of the summer for the pollutants listed above. Sample the outfalls at the Wastewater Treatment Facility and the Drop-Off Facility according to the MSGP.

 # 3-3, Develop and Implement System for Detection & Elimination of Illicit Discharges – (BMP Completed)

Current Status: This program was developed and submitted with the first year's report. The program has been a good baseline document for detecting illicit discharges. The New Hampshire Seacoast Coalition developed a document entitled "Guidelines and Standard Operating Procedures" for IDDE. Manchester did review this manual and included some of the procedures and suggestions into our developed Illicit Discharge Program.

BMP Effectiveness Evaluation: This BMP is effective in providing guidance when trying to determine the source of an illicit discharge that proves to be a difficult source to locate.

Future Goals: Our goal is to continue to aggressively respond to illicit discharges as they are found. The City will conduct illicit discharge investigation and monitor the outfalls per the requirements in the next permit.

 # 3-4, Map Outfalls and Receiving Waters – (BMP Completed)

Current Status: The City's engineer mapped the outfalls from earlier engineering studies in 2001. An extensive GIS mapping system was developed for the City to include both sewage and drainage systems. This mapping has been extended to include tax maps, City assessing information and the water department's infrastructure.

The City's engineering department inputs all the new growth and sewer extension updates into the GIS to assure it is a dynamic mapping system rather than a dated static system. The City's engineering department and our CMOM consultant both perform periodic updates of the GIS from work that has been completed by City crews, City projects, and our CMOM program.

Errors to the developed GIS system continue to be found in the field. The discrepancies are noted and brought to the City's engineering staff so the GIS information can be updated and corrected.

A new numbering system for the collection system features was instituted. The new numbering system links to the old numbering system.

In 2016, the EPD purchased a tablet that links to our GIS system. This has proven to facilitate changes to the GIS based on field observations and continues to be utilized.

BMP Effectiveness Evaluation: This tool has proven invaluable to our Stormwater Management Program. It is being used to track cleaning of lines, location of baffle tanks, sectioning off catch basin cleaning areas, and for review to determine potential locations for illicit discharges.

Future Goals: To further develop the GIS system to include information related to inspection and maintenance. Also, EPD has just entered into a contract to implement asset management as part of our CMOM program. Among other things, the new asset management system will facilitate scheduling and tracking of maintenance activities.

BMP #4 Construction Site Runoff Controls

 # 4-1, Develop & Present Ordinance to Require Erosion & Sediment Control Plan (to include construction material management plan and plan review for sites disturbing more than one acre) – (BMP Completed)

Current Status: The Ordinance was drafted, reviewed, modified and adopted on August 1, 2006. The Board of Mayor and Aldermen authorized the Director of Public Works to develop a set of Regulations to expand upon and detail the content of the Ordinance. These Regulations were adopted by the Director of Public Works with approval by the Highway Commission on December 5, 2006.

BMP Effectiveness Evaluation: Manchester was possibly the first City in New England, and certainly New Hampshire that adopted a specific Stormwater Ordinance and supporting Regulations. These documents promote compliance at construction sites with subsequent enforcement capability should the contractor neglect Stormwater Pollution Prevention Plan requirements.

Future Goals: The future goal is to review existing standards and edit as necessary to be compliant with the newest MS4 permit requirements.

 # 4-2, Develop Procedure for Receipt and Consideration of Public Comment – (BMP Completed)

Current Status: The attachments outlined in BMP # 2-1 illustrate how the City processes public comment. All comments are taken seriously, the citizens are contacted, the issues discussed and if the suggestion is sound, incorporated into the stormwater management program.

Manchester will continue to receive suggestions via the website, phoned comments, statements made at hearings, and by letter.

BMP Effectiveness Evaluation: The process used during the public hearing regarding the Stormwater Ordinance was well received and most of the comments were incorporated into the adopted Ordinance (August 1, 2006). This process is working well.

Future Goals: The goal is to continue following the City's protocol with any future changes to the adopted Stormwater Ordinance or the approved Regulations.

 # 4-3, Check Erosion Control Measures and Construction Material Management, Onsite Inspection – (BMP Implemented and Ongoing)

Current Status: The City developed an inspection checklist for site visits. This inspection sheet has proven to be a comprehensive document when referring back to conditions that existed at a particular time during project development.

The inspection sheet includes information regarding the site, weather conditions since the last inspection, and the conditions of BMPs.

The inspection of BMPs is gauged against the Erosion and Sediment Control Plan and SWPPP that was submitted by the developer during the site plan approval process. Any deviance from the plan is noted and a clean typed copy is made from the field inspection notes. The clean copy is signed by the inspector and delivered to the contractor for action. Pictures taken at the site are referenced by link on the sheet and can be easily retrieved in the computer to evaluate the current findings with those from previous reports. An example of a completed site inspection form was included in the 2011 Annual Report.

Since the adoption of the Ordinance, the City has developed a two-part "Notice of Violation" that can be used in the enforcement process. An example of this report was included in the 2007 Annual Report. The inspection report serves as the first notice to the contractor that they need to come in compliance with their Stormwater Pollution Prevention Plan or Best Management Practices for site disturbances. A time frame for correction is outlined in the inspection report.

If the non-compliance has not been corrected at the time of the second inspection, a "Notice of Violation" is prepared and sent via certified mail, return receipt requested. A copy of the notice is presented to the site superintendent. More stringent time limitations are included for compliance.

If upon reinspection, the site non-compliance has not been corrected, the enforcement actions proceed, with associated fines and penalties, as outlined in the Ordinance.

BMP Effectiveness Evaluation: The field inspection checklist, "Notice of Violation," Regulations and Ordinance provide the City with all the tools needed for compliance and enforcement regarding the Stormwater Program. The compliance at the construction sites has been well above average.

Contractors and developers have been quick to correct issues found. If they are present during the inspection, the violations are pointed out so that they can correct them in a timely manner.

Future Goals: The future goal is to make use of the tools available for inspection and enforcement. Also, to follow up on minor enforcement actions to assure that these issues are corrected. Without follow up, the process of escalating enforcement would not be possible. The sites will be inspected each month during the year. We are finding that with the climate changes that more sites are active year round. This requires inspection during the winter months that were traditionally non-active months.

BMP #5 Post-Construction Stormwater Management in New Development & Redevelopment

 # 5-1, Develop Ordinance to Require Runoff Controls for New & Re-Development for Projects Disturbing > One Acre – (BMP Completed)

Current Status: This requirement is incorporated in the approved Ordinance and adopted Regulations.

Post construction consists of maintaining BMPs and structures that have been installed within a development after the contractor has left. The City spent many hours reviewing documents that required long–term maintenance for installed BMPs.

The department developed a Long–Term Maintenance Agreement (LTMA) to be signed by any new developments that are completed within the City. This will assure that the structures that are installed are maintained. The maintenance of structures after the construction was completed has always been an issue. An example of a LTMA was included in the 2009 Annual Report.

BMP Effectiveness: It is difficult to gauge the effectiveness of this document. The Environmental Permits Program Coordinator has been working with the Highway Division as well as Planning and Community Development to ensure the LTMA is signed, registered, and carried by the Association. If the association performs the maintenance as outlined in the LTMA, it should prove to be an effective means of assuring maintenance of BMPs after the development is completed.

Future Goals: To assure that this agreement is signed by the owner and registered by the City before issuing the final certificate of occupancy for all future developments within the City of Manchester.

 # 5-2, Recommend BMP Manual for Use by Planners and Developers – (BMP Completed)

Current Status: The suggested manuals referenced are outlined in the approved Regulations. These manuals are:

- New Hampshire Department of Environmental Services Sediment and Erosion Control Manual, (Rockingham County "Stormwater Management and Erosion Control Handbook for Urban and Developing Areas");
- Manchester's "Standard Specifications for Road, Drain & Sewer Construction";
- Innovative Stormwater Treatment Technologies BMP Manual, NHDES, May 2003;
- New Hampshire DOT Guidelines for Temporary Erosion and Sediment Control and Stormwater Management – NHDOT Bureau of Construction.

Other reference manuals and materials are mentioned on the website. These have not been incorporated into the Regulations, but warrant a mention on the website. The listing of references mentioned on the website is listed below:

- EPA's BMPs for Stormwater Phase II
- State of New Hampshire BMPs
- International Stormwater BMP Database
- California Stormwater Quality Associations' Handbook for Construction Site BMPs
- U.S. DOT Guide to BMPs
- EPA Guide to Developing a SWPPP
- Overview of Minnesota's Construction Stormwater Permit
- National Resource Defense Council Stormwater Fact Sheet

BMP Effectiveness: These references are voluntary guidance. The manuals can be an effective approach as most New Hampshire contractors are familiar with the contents of these manuals and refer to these guidelines when developing their sediment and erosion control plans.

Future Goals: Continue to review other manuals to determine if these would be suitable for reference within the Stormwater Regulations. The City is in the process of determining what changes will be necessary to become compliant with the newest MS4 permit.

BMP #6 Pollution Prevention / Good Housekeeping for Municipal Operations

6-1, Install Silt Fence Around Snow Dump Area – (BMP Ongoing)

Current Status: Silt fences continue to be erected around the snow dumping areas in Manchester. The erection of these fences is verified during the month of November and early December.

In the spring after the snow has melted, any accumulated trash, debris and the silt fence is removed from the site until the next season.

During the previous years the City used a snow-melter to reduce the congestion caused by accumulating snow. This practice helped in reducing the spring peak runoff as the snow was melted during the colder days. This snow-melter has not been used in a couple of years.

BMP Effectiveness: The silt fence keeps the trash and sand that is collected with the plowed snow from entering the waterways.

Future Goals: Continue with the existing program and assure silt fence is erected in areas where first time snow dump areas are set up.

6-2, Catch Basin Cleaning Program, Including Priority Catch Basins – (BMP Ongoing)

Current Status: The City contracts annually to have catch basins cleaned by a private company. The amount of funding dedicated to catch basin cleaning during Fiscal Year 2018 (July 2017 – June 2018) was around $100,000, or sixty-nine percent (69%) more than the previous year. This allowed for cleaning approximately 3,000 catch basins, which is sixty-three percent (63%) more catch basins cleaned than the previous year. City crews cleaned approximately 400 additional catch basins, for a grand total of around 3,400 catch basins cleaned. At an estimated 0.4 cubic yards of material per basin, about 1,400 cubic yards of material was removed so far this past year. The listing of streets where catch basins were cleaned this past year is included as Attachment A.

There is a listing of priority catch basins adjacent to the Urban Ponds in the City that must be inspected annually or semi-annually if the condition warrants. City personnel inspect these in the spring and City forces clean these at least once during the reporting year. If additional cleaning is needed, a City crew is dispatched to clean these basins more frequently. These were all cleaned at least once during 2017 by City of Manchester personnel or by the CB cleaning contractor. The priority status for these basins assures that a significantly reduced pollutant load enters the ponds. The Urban Pond Priority CB Inspection and the Urban Pond Priority CB Cleaning List are included as Attachments B and C, respectively. The catch basins surrounding the urban ponds receive top priority.

Sewer calls are tracked to determine if roots, grease or other maintenance issues are the cause of the blockages.

As noted in last year's report, the catch basin cleaning program was expanded and formalized in 2017. The new program continues so that the City's approximately 14,000 catch basins will have been cleaned on a six-year cycle.

BMP Effectiveness: This process continues to work well. The current schedule of CB cleaning is helping to minimize the pollutants getting to the ponds. The ongoing development of the problem areas listing sheet allows the City to trend areas that need more attention and response.

The sewer problem areas are noted and inspected on a minimum of an annual basis and sometimes more frequently, depending on the type and/or frequency of the problem. Approximately 50 percent of the City's sewer system is still combined. Heavy rains will cause sewer problems beyond maintenance issues.

The City continues to inspect our sewer manholes in the combined areas through our CMOM program. We are also inspecting combined sewer lines using CCTV and zoom camera technologies. The City is still in negotiations with the EPA on our CSO Long Term Control Plan; this plan outlines our future separation efforts. The first portion of the of the Phase II program as proposed by Manchester will cost $165 million over 20 years and remove 70 percent of the CSO quantity from the system.

Future Goals: To continue designation of the urban pond catch basins as a priority for cleaning. To continue to implement the new catch basin cleaning program and focus the City vactor crews on priority CB areas annually. To review this program and make changes as necessary to comply with the newest MS4 permit.

 # 6-3, Sweep Streets Three Times Annually – (BMP Ongoing)

Current Status: Most of the sand found on City streets comes from winter sanding and some small amounts of sediment from erosion on residential lawns. Sand is applied to sidewalks and schoolyards during snowstorms. Salt is applied to the highways during snowstorms. A sand / salt mix is used during icing conditions or ice storms.

The City has two vacuum and three mechanical sweepers. These are employed continually during the spring to cleanup from the winter sanding operations.

Most of the sand is collected off the streets during the first few neighborhood runs immediately after the winter storm season.

BMP Effectiveness: This BMP continues to be quite effective as some sections of the inner City business district are swept three times per week and others are swept twice a week. Some other sections of the City are swept once a month. The current sweeping schedule is structured so that all City streets are swept a minimum of three times annually. A copy of the schedule was included in the 2009 Annual Report.

Future Goals: To continue the street sweeping program at its current rate.

 # 6-4, Continue to Follow SOPs for Disposal of Catch Basin Cleaning and Street Sweeping Residuals – (BMP Ongoing)

Current Status: The City continues to place street sweeping debris and catch basin debris up in the rear lot of the recycling facility. The street sweepings are placed on a concrete pad with three-sided cement block walls. These sweepings are dried out, mixed with the gravel / asphalt pile and eventually ground up to make road base for streets and sidewalks.

The catch basin waste is piled across from the street sweeping debris in a compacted depression. This catch basin waste is allowed to evaporate to a certain extent then it is also mixed with the gravel / asphalt pile and eventually ground up to also make road base for streets and sidewalks.

BMP Effectiveness: This BMP is effective as designed and provides a reuse for the material collected that would otherwise be sent to landfill.

Future Goals: Monitor the catch basin disposal area for evidence of pollution to the surrounding area. Take any BMP measures necessary to assure pollution is contained.

 # 6-5, Minimize Salt Usage and Maintain Cover over Salt Storage Area – (BMP Ongoing)

Current Status: The salt the City uses for highway treatment in the winter is kept under cover at the Department of Public Works in the salt shed.

All salting trucks are calibrated once annually before the winter sand / salt application season begins to assure the greatest efficiency and minimal salt use during spreading. The amount of salt added in any season is dependent to the number of snowstorms, the amount of freezing rain received and the nightly refreeze conditions of early spring.

The City of Manchester pretreats roads with brine. The brine is made at the Department of Public Works and is applied 8 hours before a storm. It will take a few seasons to determine the amount of salt we were able to reduce.

The State of New Hampshire in 2013 created the statutory authority, RSA 489-C Salt Applicator Certification Option. Env-Wq 2200 Voluntary Certified Applicator Program was developed under RSA 489-C:3. This rule provides road salt applicators with some BMPs to follow. It also reduces their liability if they become certified, follow the BMPs and they would have to track what is being applied. All of the DPW Highway Division staff who apply salt for the City have been trained under the Green SnowPro Program.

The postings for the trainings will be at: http://t2.unh.edu/green-snowpro-certification

In addition to the Green SnowPro training, in early 2018 the City was awarded an "Excellence in Snow and Ice Management" Award from the American Public Works Association (APWA). The purpose of this award is to promote the best practices in snow and ice removal while minimizing environmental impacts. This is a testament to the City's efforts to continually improve the snow and ice control program while minimizing salt usage.

Manchester undertook a sub–watershed review around the Nutt Pond area for salting and sanding reduction. This pilot study used a model to see what improvements can be made to reduce the sand and salt application in this area and quantify the success. A sand reduction program was developed and distributed to the commercial property owners in the watershed.

BMP Effectiveness: Salt usage is weather dependent and it is hard to gauge effectiveness. Manchester can compare the current chloride analyses taken at the urban ponds and compare those to past years to determine if there is a reduction. The unknown factor is the number of homes around any pond that have water-softening units, which contribute chlorides to the water table.

A survey was conducted to gauge the effectiveness of the sand reduction program around Nutt Pond. Of the 50 commercial property owners that received copies of the sand reduction program and were asked to complete an online survey, only 2.5 surveys were completed. One facility only completed half of the survey.

The Nutt Pond Watershed Restoration Plan and modeling was completed in January, 2010. A copy of the plan was included in the 2010 Annual Report.

Future Goals: Implement recommendations in the Nutt Pond Watershed Restoration Plan. See #6-6 below for update.

 # 6-6, Develop / Implement Program for Cleaning Pond Inlets & Trash Racks – (BMP Ongoing)

Current Status: As part of the first phase of watershed restoration, a project was completed at Nutts Pond in 2007. The new structures were added to the maintenance logs. The modification to the structure at the North Inlet allows the isolation of the structure from the pond by using the installed gates. This allows removal of sediment from the structure. During the retrofit 20 cubic yards were removed from this structure. A repair was made in 2010 in the wetlands at the East Inlet. One of the channels had some erosion. The channel was repaired and seeded. It has been inspected since and the repair has held.

The City of Manchester completed another project in the Nutt Pond watershed in 2010. The project was referred to as the Woodgate Court Drainage Project. It was named this because the project starts at the end of Woodgate Court. A section of Tannery Brook at

the end of Woodgate Court upstream of Nutt Pond was dredged and stabilized using natural vegetation, erosion control fabric, biologs, rock cross vanes, and natural seed mixes. Approximately 4,500 cubic yards of sediment were dredged from this channel. To protect this area from silting up again in the future a deep sump catch basin and a ten foot diameter deep sump drain manhole were installed. These two structures were added to the inspection list. They are inspected twice per year and cleaned at least once per year.

The dredging and stabilization of this channel helps to reduce the loadings to the Nutt Pond East Inlet Forebay. The majority of the sediment that has been dredged from this forebay in the past originated from this channel and not from winter sanding operations.

In 2016, the second phase of Nutt Pond watershed restoration was completed. This project included a sediment forebay and two gravel wetland cells at the west inlet to Nutt Pond. At Precourt Park on the north inlet side, two tree box filters, a stabilized precast concrete boat ramp, a rain garden, and porous pavement parking area were all installed. The intent of this project is to assist with treatment of TSS, phosphorous, nitrogen, and bacteria.

The three, three-chamber baffle tanks at Dorrs Pond, the one, three-chamber baffle tank at Crystal Lake, the Vortechnics swirl concentrator at Douglas street, and the Hooksett Plaza swirl concentrator are all inspected bi-annually and maintained as necessary.

The City continues to use the checklist for the spring and fall inspections of these units to assure they are cleaned when they begin to get filled with sediment.

There is a StormTreat™ System at Crystal Lake that the City is currently operating. It was restarted in May of 2005. The City cleaned the lines, retrofitted the baffle tank and has the unit on the semi-annual inspection checklist.

The work that was done at Crystal Lake was recognized by the EPA as a Nonpoint Source Program Success Story. Crystal Lake and Crystal Lake Beach are no longer listed as impaired for primary or secondary contact recreation for sedimentation / siltation. A copy of this article was included in the 2009 Annual Report.

To keep track of the sediment that is removed from the BMPs. A Structural BMPs Sediment Removals Log was developed. This log has all the sediment removal data since 2005 or when the BMP was constructed. A copy of the log is included as Attachment D.

BMP Effectiveness: The amounts of sediment that are removed from the various structures indicate that the program is effective.

Future Goals: To assure that the structures continue to be checked on a semi-annual basis and they are cleaned when they are partially full. Also, implement other measures as necessary to be compliant with the newest MS4 permit.

 # 6-7, Develop / Implement Employee Education Program – (BMP Ongoing)

Current Status: The City continues to provide training to the staff who are involved with any aspect of stormwater management. Similar to last year, this year the EPD focused on informal field O&M training for the crews that are responsible for maintenance of these systems.

The EPD continues to promote our industry by conducting tours of the WWTP and training with students on wastewater and stormwater. This program, which was started in 2007, continues to be an integral part of the City's Stormwater Program. During this reporting period, the City has provided tours to local public middle schools, both public and private high schools, as well as local colleges. The EPD will look at expanding our target audience to include elementary students.

EPD also regularly participates in Science Fair judging hosted by the Manchester Water Works.

The Manchester Area Stormwater Coalition have continued collaborative sessions with the Nashua Area Stormwater Coalition over the past year. This provides an opportunity for members of both coalitions to exchange ideas and collaborate. The latest meeting was held on April 19, 2018.

BMP Effectiveness: This BMP continues to grow, and with experience, is more effective with each passing year. The only area that will see a decrease in training is the work with the middle school students. The high school students are now receiving training. Employees who work in the field and inspect construction sites are more familiar with the requirements of the Manchester's Stormwater Program.

Future Goals: To continue the outreach to the students and provide training on wastewater and stormwater. Participate in the Science Fair judging with the Manchester Water Works.

Continue the training of City staff regarding the stormwater program. Continue hosting the Manchester Regional Stormwater Coalition meetings. Continue attending and taking part in stormwater workshops and meetings. Continue to have a representative serve as a Chairperson in the New England Stormwater Collaborative.

Revise this BMP as needed to comply with the newest MS4 permit.

 # 6-8, Design & Construct Pond Specific Pollution Prevention Projects – (BMP Completed)

Current Status: All pond specific pollution projects have been designed in accordance with the five-year program and the Supplemental Environmental Projects Programs requirements. This is a completed task.

BMP Effectiveness: Many of the benefits of these pond specific projects are outlined in BMP # 6-6. These structures have removed several hundred cubic yards of material from the river and ponds that would have otherwise entered these water bodies.

Future Goals: Continue the upkeep and inspections of these structures. Please refer to BMP # 6-6.

 # 6-9, Best Management Practices for Derryfield Country Club – (BMP Completed)

Current Status: This BMP was completed. The asphalt cart path has held up well and has almost eliminated erosion in a location that was previously heavily eroded.

BMP Effectiveness: This BMP reduces the amount of sediment contributed from the second hole at the Country Club. Each year approximately 10 to 15 cubic yards of fill was brought in to repair the erosion caused by the winter snowmelt in this area. Since the installation of the asphalt cart path this has not been necessary.

Future Goals: There are no future goals regarding this BMP.

Stormwater Catch Basin Cleaning Program

Program year May 2017 through April 2018

In accordance with the City of Manchester's Stormwater Management Program, the City is required, under BMP # 6-2, to track the catch basins that are cleaned. This is a listing of the streets where catch basins have been cleaned throughout the City. During this reporting year approximately 3,400 catch basins (1,400 cubic yards of material estimated) were cleaned in the below listed streets by the private contractor and by the City of Manchester personnel. Manchester is using .4 cubic yards as an estimate for each basin cleaned for material removed. Additional basins are being cleaned this spring and will be included in next year's report.

An outside contractor cleaned 3,000 of the 3,400 catch basins listed on the following page. City of Manchester personnel cleaned all the catch basins around the ponds and additional basins in certain areas in the City.

The streets that were cleaned during the reporting period are listed on Page 2 of this attachment.

Catch Basin Cleaned by Street

Apple Hill Court
Applegate Street
Appleton Street
Arah Street
Arthur Avenue
Ash Street
Ashland Street
Barrett Street
Bayberry Lane
Beech Street
Belmont Street
Bicentennial Drive
Birchwood Road
Blevens Drive
Blodget Street
Bridget Lane
Bruce Road
Burnsen Aveenue
Byledge Road
Cambell Street
Camelot Place
Campbell Street
Carnegie Street
Carpenter Street
Castle Drive
Chase Way
Chestnut Street
Clarke Street
Coral Avenue
Crestview Circle
Crestview Road
Crosbie Street
Currier Drive
Cutler Lane
Dallaire Street
Davis Street
Day Street
Edward Roy Jr Drive
Elgin Avenue
Elm Street
Eve Street
Everett Street
Exchange Avenue
Fairfield Street
Fleming Street
Fogg Court
Fox Hollow Way
Hall Street
Hamel Drive
Hanover Street
Harrison Street
Heather Street
Heathrow Avenue
High Ridge Road
Highview Circle
Highview Terrace
Holmes Drive
Hooksett Road
Irwin Drive
Jonathan Lane
Juniper Street
Kearney Circle
Kearney Street
Kennard Road
Knight Street
Lakeview Lane
Lancelot Avenue
Larchmont Road
Lavalle Lane
Ledgewood Avenue
Lexington Street
Lincoln Street
Lindahl Street
Madeline Road
Mammoth Road
Maple Street
Maqnolia Road
McCarthy Street
McIntyre Court
Mclane Lane
Mongolia Road
Monroe Street
Myrtle Street
North Adams Road
North Bay Street
North Bend Drive
North Gate Road
North Russell Street
North Street
Orange Street
Park Place
Patricia Lane
Paule Avenue
Pelham Street
Perley Street
Pickering Street
Pinecrest Road
Poplar Street
Prospect Street
Radburn Street
Ray Street
Readey Street
Red Coat Lane
Ridge Road
River Road
Riverview Place
Robie Street
Sagamore Street
Salmon Street
Shady Lane
Shepard Road
Smyth Lane
Smyth Road
Straw Hill Road
Thayer Street
Tory Road
Trenton Street
Union Street
Vassar Street
Victoria Street
W. Clarke Street
Walnut Avenue
Webster Street
Wellesley Street
Wellington Hill Road
Wellington Road
West River Road
Westchester Way
Whitford Hill
Whitford Street
Whitney Avenue
Whittington Street
Wind Song Avenue

The following is a listing of streets, the were determined to be priority streets in the Phase I Malcolm-Pirnie study, around the City of Manchester's Urban Ponds. City personnel inspect these in the spring and City equipment cleans these at least once during the reporting year. If additional cleaning is needed, a City crew is dispatched to clean these basins more frequently. These were all cleaned at least once during 2015 by City of Manchester personnel.

Stevens Pond

- Pennsylvania Avenue
- Delaware Avenue
- Beaver Street (to Bridge Street)
- Maplehurst Street (to Bridge Street)
- Ohio Avenue

Maxwell Pond (Black Brook)

- English Village Road
- Garden Road
- Greeley Street (CB 3950 to CB 3948)

Dorrs Pond

- Apple Court
- Hooksett Road (CB 1277 to 1272)
- Poplar Street
- Juniper Street
- Shady Lane
- Campbell Street (Shady Lane to Poplar Street)
- Bicentennial Drive (CB 1289 to CB 1284)
- Crosbie Street (Pickering Street to Hooksett Road)
- Day Street (Fairfield Street to Hooksett Road)
- Pickering Street (Barrett Street to Crosbie)
- Livingston Park / Pool lots

McQuestan Pond

- South Main Street (Intersection of Second Street to Oneida Street)
- South Main Street (Newgate Circle to Balch Ave.)
- Erie Street

Nutt Pond

- Driving Park Road
- Leclerc Circle
- March Avenue (from Gold Street to John E. Devine Drive)
- John E. Devine (From South Willow Street)
- McGrail Circle
- Bradley Street
- Beech Hill Ave. (Beech Hill Street to Bradley Street)

Nutt Pond (cont'd)

- Beech Hill Drive (To Bradley Street)
- Titus Ave. (east from South Beech Street)
- Mystic Street (From Ruggles Street to Fowler Street)
- Ruggles Street
- Fowler Street

Pine Island Pond

- Goffs Falls Road (Gosselin Road to Pond Drive)
- Pond Drive
- Kennedy Street

Crystal Lake

- Corning Road (CB 3053 to 3049)
- Corning Road (Intersection of Bryant Road up toward Bodwell Road)
- West Shore Avenue

Attachment B
Urban Pond Priority CB Inspection

Nutts Pond - Map 4G
March Avenue - 11 CBs
Driving Park Road - 8 CBs
John E. Devine - 8 CBs

April, 2017 Date Work Completed
Name of Crew: Inspected, clean in the fall.

Crystal Lake - Map 6H
Corning Road - 9 CBs

April, 2017 Date Work Completed
Name of Crew: Inspected, clean in the fall.

Dorrs Pond - Map - 4C
Juniper Street - 7 CBs
Poplar Street - 14 CBs
Arah Street - 20 CBs
Bicentential Drive - 6 CBs
Day Street - 8 CBs
Crosbie Street - 6 CBs
Hooksett Road - 6 CBs

April, 2017 Date Work Completed
Name of Crew: Inspected, clean in the fall.

Pine Island Pond - Map 4I
Goffs Falls Road - 11 CBs
Kennedy Street - 2 CBs
Pond Drive - 10 CBs

April, 2017 Date Work Completed
Name of Crew: Inspected, clean in the fall.

Maxwell Pond - Map 2D
(Black Brook)
Garden Drive - 9 CBs
English Village Road - 11 CBs
Greeley Street - 2 CBs

April, 2017 Date Work Completed
Name of Crew: Inspected, clean in the fall.

McQuesten Pond - Map 2G
Erie Street - 10 CBs
South Main Street - 18 CBs (Newgate to Ann Ave)
South Main Street - 10 CBs (Second to Oneida)

April, 2017 Date Work Completed
Name of Crew: Inspected, clean in the fall.

Stevens Pond - Map 5E & 6E
Maplehurst Avenue - 5 CBs
Beaver Street - 3 CBs
Bridge Street - 4 CBs
Pennsylvania Avenue - 5 CBs
Deleware Avenue - 5 CBs

April, 2017 Date Work Completed
Name of Crew: Inspected, clean in the fall.

Attachment C
Urban Pond Priority CB Cleaning List

Nutts Pond - Map 4G
March Avenue - 11 CBs
Driving Park Road - 8 CBs
John E. Devine - 8 CBs

November 2017 Date Work Completed

Name of Crew: V-701

Crystal Lake - Map 6H
Corning Road - 9 CBs

November, 2017 Date Work Completed

Name of Crew: V-701

Dorrs Pond - Map - 4C
Juniper Street - 7 CBs
Poplar Street - 14 CBs
Arah Street - 20 CBs
Bicentential Drive - 6 CBs
Day Street - 8 CBs
Crosbie Street - 6 CBs
Hooksett Road - 6 CBs

November, 2017 Date Work Completed

Name of Crew: V-701

Pine Island Pond - Map 4I
Goffs Falls Road - 11 CBs
Kennedy Street - 2 CBs
Pond Drive - 10 CBs

November, 2017 Date Work Completed

Name of Crew: V-701

Maxwell Pond - Map 2D
(Black Brook)
Garden Drive - 9 CBs
English Village Road - 11 CBs
Greeley Street - 2 CBs

November, 2017 Date Work Completed

Name of Crew: V-701

McQuesten Pond - Map 2G
Erie Street - 10 CBs
South Main Street - 18 CBs (Newgate to Ann Ave)
South Main Street - 10 CBs (Second to Oneida)

November, 2017 Date Work Completed

Name of Crew: V-701

Stevens Pond - Map 5E & 6E
Maplehurst Avenue - 5 CBs
Beaver Street - 3 CBs
Bridge Street - 4 CBs
Pennsylvania Avenue - 5 CBs
Deleware Avenue - 5 CBs

November, 2017 Date Work Completed

Name of Crew: V-701

ATTACHMENT D

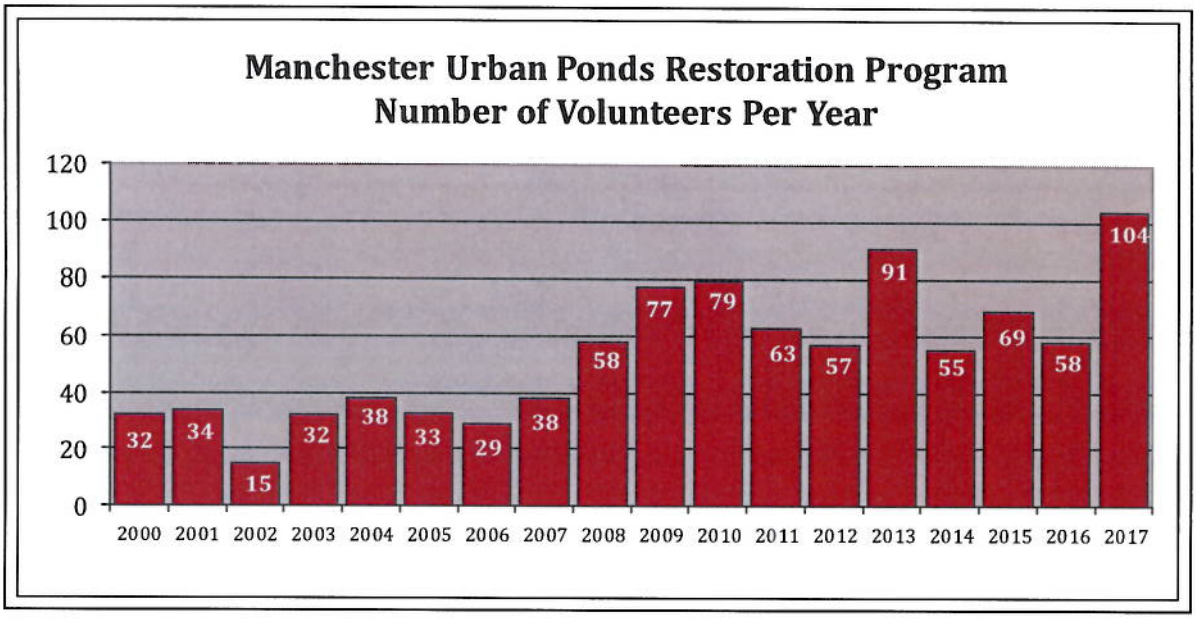
STRUCTURAL BEST MANAGEMENT PRACTICES SEDIMENT REMOVALS LOG

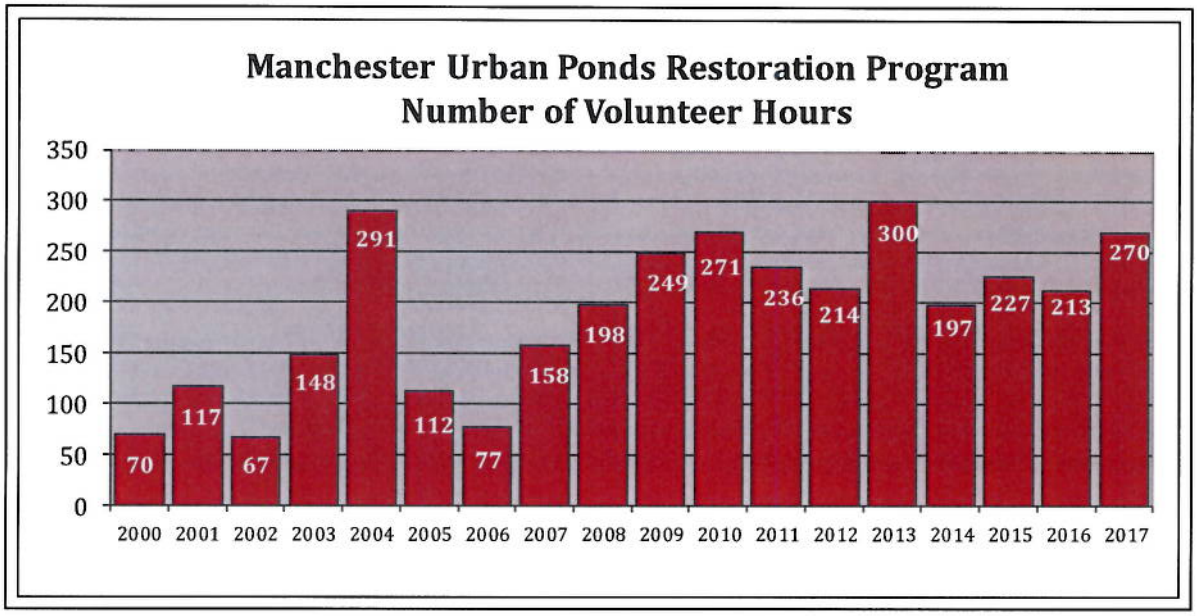
REV. 4/24/18

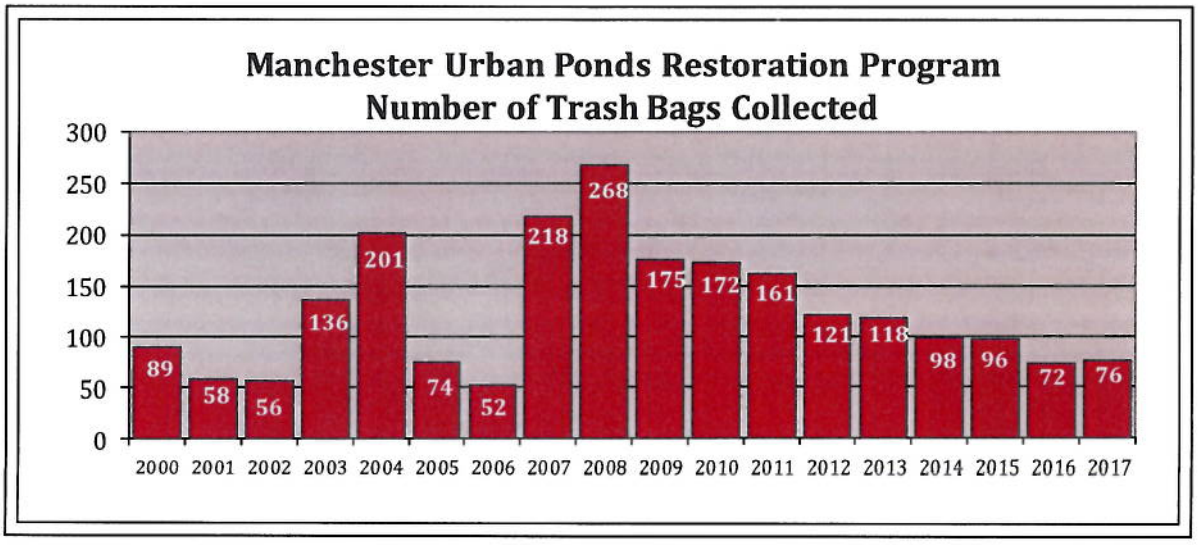
Removals in Cubic Yards														
	Crystal Lake		Dorrs Pond				Piscataquog River	Nutt Pond						
Year	STS Baffle Tank	Corning Road Baffle Tank	Hooksett Plaza	Site 4 Baffle Tank	Site 5 Baffle Tank	Site 6 Baffle Tank	Douglas St. Vortechnics	East Inlet Forebay	South Inlet Forebay	North Inlet Baffle Tank	South Inlet Baffle Tank	Woodgate Court Drain Manhole	Woodgate Court Catch Basin	Woodgate Court Project
2006	4.0	1.5	0.0	2.0	2.5	5.5	7.0	Project was constructed in 2006 and 2007.				Project was constructed in 2010.		
2007	1.3	1.0	0.1	0.2	0.2	0.1	0.5	8.0	0.0	20.0	0.0			
2008	3.5	2.0	2.0	2.0	2.0	4.0	2.0	55.0	0.0	0.0	0.0			
2009	1.0	0.5	0.0	3.0	3.0	6.0	1.0	50.0	0.0	0.0	0.0			
2010	3.0	1.0	0.0	1.0	0.0	3.0	0.0	20.0	0.0	0.0	0.0	4.0	0.0	4500.0
2011	0.5	0.3	0.0	1.0	4.0	3.0	3.0	60.0	144.0	0.0	0.0	1.0	0.5	0.0
2012	0.0	0.0	0.0	3.0	3.0	3.0	0.8	25.0	120.0	1.0	0.0	2.0	0.5	0.0
2013	0.0	0.0	0.0	1.0	3.0	3.0	1.5	90.0	200.0	0.0	0.0	2.5	0.5	0.0
2014	0.0	0.0	0.0	1.0	3.0	3.0	1.5	90.0	200.0	0.0	0.0	2.5	0.5	0.0
2015	3.0	1.5	0.0	1.0	3.0	3.0	1.0	50.0	0.0	0.0	0.0	2.0	0.5	0.0
2016	0.0	0.0	1.5	1.0	2.0	0.0	2.0	25.0	0.0	2.0	0.0	0.0	0.0	0.0
2017	1.0	0.5	0.0	1.0	0.5	1.0	0.5	5.0	1.5	1.0	0.0	1.0	0.5	0.0
Totals	17.3	8.3	3.6	17.2	26.2	34.6	20.8	478.0	665.5	24.0	0.0	15.0	3.0	4500.0

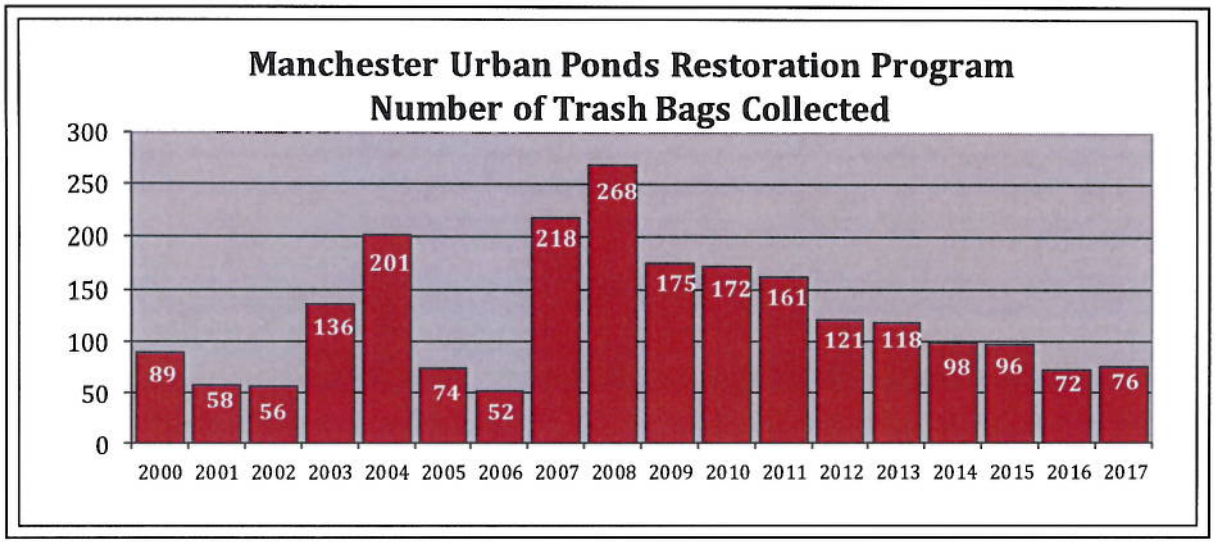
APPENDIX A

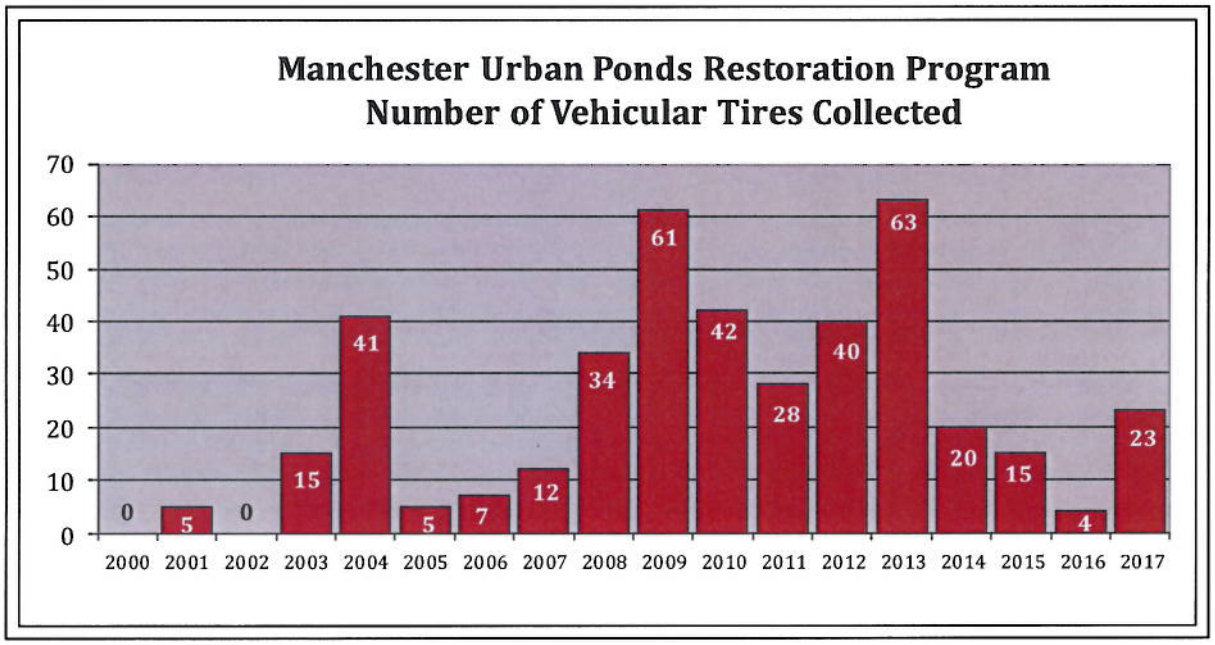
URBAN PONDS CLEANUP CHARTS 2000 TO 2017

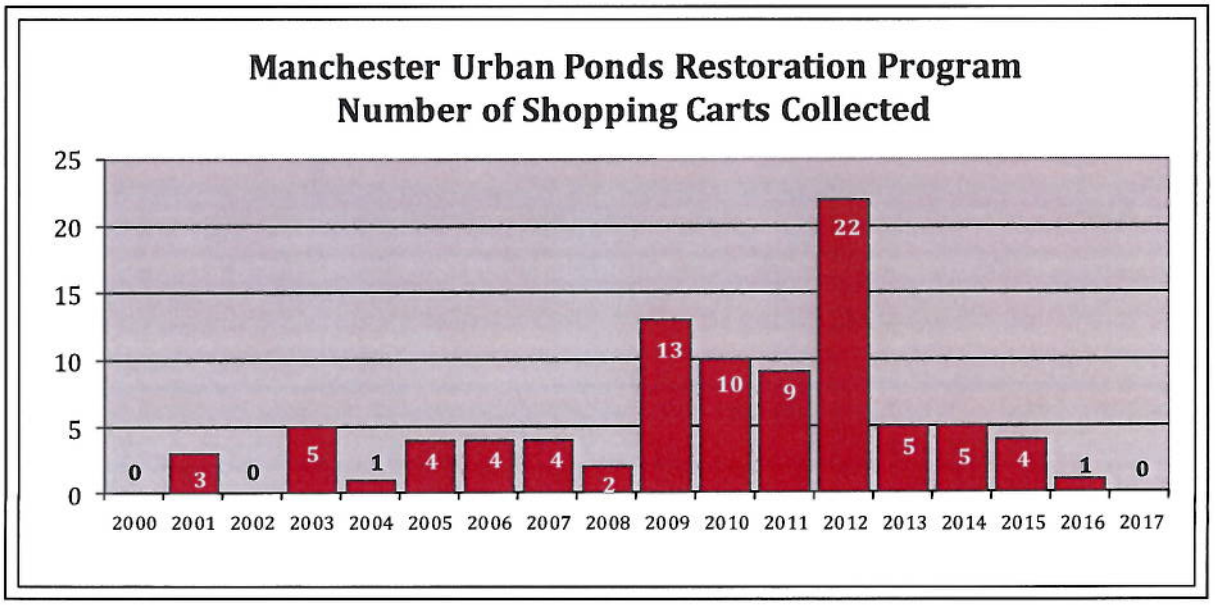

Manchester Urban Ponds Restoration Program
Number of Volunteers Per Year
120
100
80
60
40
20
0
32
34
15
32
38
33
29
38
58
77
79
63
57
91
55
69
58
104
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017


Manchester Urban Ponds Restoration Program
Number of Volunteer Hours
350
300
250
200
150
100
50
0
70
117
67
148
291
112
77
158
198
249
271
236
214
300
197
227
213
270
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017


Manchester Urban Ponds Restoration Program
Number of Trash Bags Collected
300
250
200
150
100
50
0
89
58
56
136
201
74
52
218
268
175
172
161
121
118
98
96
72
76
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017


Manchester Urban Ponds Restoration Program
Number of Trash Bags Collected
300
250
200
150
100
50
0
89
58
56
136
201
74
52
218
268
175
172
161
121
118
98
96
72
76
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017


Manchester Urban Ponds Restoration Program
Number of Vehicular Tires Collected
70
60
50
40
30
20
10
0
0
5
0
15
41
5
7
12
34
61
42
28
40
63
20
15
4
23
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017


Manchester Urban Ponds Restoration Program
Number of Shopping Carts Collected
25
20
15
10
5
0
0
3
0
5
1
4
4
4
2
13
10
9
22
5
5
4
1
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

APPENDIX B

URBAN PONDS WATER QUALITY TABLES

2000 TO 2017

Manchester Urban Ponds Restoration Program
Water Quality Parameter Data Tables 2000 – 2017

Disclaimer: Please note that the **Chemical and Biological Parameter Explanations** discussed within the context of this document are extracted from the NH Volunteer Lake Assessment Program (VLAP) document of the same name which can be found at: http://des.nh.gov/organization/divisions/water/wmb/vlap/documents/parameters.pdf. Please also note that the tables below are **NOT** intended to assert specific water quality standard violations, but rather, are intended to provide the interested citizen with general categorical information for each water quality parameter's annual and historic averages. Lastly, the tables below are not intended to replace the valuable information included within the annual water quality reports. To view the annual VLAP reports for each waterbody, as well as the new regional VLAP reports, visit www.manchesternh.gov/urbanponds and click on "Publications".

Average Acid Neutralizing Capacity (ANC) Measurements in Milligrams per Liter (mg/L)

ANC (mg/l as C_aCO_3)	Category
< 0	Acidified
0 - 2	Extremely Vulnerable
2.1 - 10	Moderately Vulnerable
10.1 - 25	Low Vulnerability
> 25	Not Vulnerable

Buffering capacity or Acid Neutralizing Capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. Historically, the waters of NH have had low ANC because of the prevalence of granite bedrock. The relatively low ANC values means that NH surface waters are vulnerable to the effects of acid precipitation. There is no numeric water quality standard for ANC, but values can typically be thought of in categories of vulnerability (to acid inputs).

Annual Average & Historical Average Epilimnion (Top Layer of Waterbody) ANC Measurements

Waterbody	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Historical Average
Crystal Lake	18.1	17.3	20.2	18.5	14.4	16.3	17.1	16.7	15.2	16.1	16.2	17.0	14.8	18.7	18.1	Not Monitored	20.1	26.0	**17.7**
Dorrs Pond	16.2	21.7	26.5	20.3	24.3	20.4	22.4	28.5	18.6	25.3	27.4	24.2	30.0	23.3	24.8	29.3	34.9	25.0	**24.6**
Maxwell Pond	6.8	9.8	6.7	6.4	5.5	5.6	6.1	9.7	5.9	Since the Maxwell Pond dam was removed (and Black Brook was restored) in 2009, ANC is no longer measured since the water is no longer impounded to create a "deep spot".									**6.9**
Nutts Pond	14.3	17.3	15.4	17.0	13.5	16.6	16.7	18.0	13.4	16.3	22.8	18.7	16.4	17.8	18.2	22.6	23.8	20.8	**17.8**
Pine Island Pond	17.1	20.1	21.2	14.6	11.5	16.6	13.8	17.6	20.2	12.2	21.6	18.0	16.9	17.8	18.5	30.0	34.4	27.0	**19.4**
Stevens Pond	34.2	31.0	30.8	29.2	29.1	28.7	30.3	35.2	25.0	27.9	38.1	33.4	28.1	30.7	30.9	33.3	37.0	31.2	**31.3**

Average Chlorophyll-a (Chl-a) Measurements in Milligrams per Meters Cubed (mg/m^3)

Chl-a (mg/m^3)	Category
0 - 5	Good
5.1 - 15	More than Desirable
> 15	Nuisance Amounts

Chlorophyll-a, a pigment found in plants, is used as an indicator of algal growth. Because algae is a plant and contains chlorophyll-a, the concentration of chlorophyll-a found in the water gives us an estimation of the concentration of algae. If the chlorophyll-a concentration increases, this typically indicates an increase in the algal population. There is no numeric surface water quality standard for chlorophyll-a, but values can typically be thought of in the categories of "good", "more than desirable", or "nuisance amounts".

Annual Average & Historical Average Metalimnion (Middle Layer of Waterbody) Chlorophyll-a Measurements

Waterbody	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Historical Average
Crystal Lake	3.39	4.75	2.64	3.14	4.62	1.79	5.95	2.43	4.23	6.57	3.31	3.32	3.85	3.77	3.01	Not Monitored	3.30	2.87	**3.70**
Dorrs Pond	30.84	14.75	8.40	18.03	15.09	8.34	12.13	8.83	16.52	8.50	10.69	11.67	5.10	10.15	9.21	9.07	13.74	5.69	**12.04**
Maxwell Pond	1.55	3.17	1.68	1.65	2.30	2.33	1.89	5.67	2.42	Since the Maxwell Pond dam was removed (and Black Brook was restored) in 2009, ANC is no longer measured since the water is no longer impounded to create a "deep spot".									**2.52**
Nutts Pond	27.42	14.01	10.81	17.13	19.31	13.49	19.53	4.67	6.96	4.51	3.63	8.86	5.73	8.13	12.14	10.05	17.40	8.02	**11.77**
Pine Island Pond	8.00	13.20	8.23	2.21	8.97	8.46	11.04	10.63	9.81	3.04	8.04	12.98	11.93	6.63	9.98	21.81	12.33	10.77	**9.89**
Stevens Pond	8.68	6.26	10.32	4.28	9.44	3.04	63.57	35.47	16.29	12.35	11.33	9.58	32.62	8.02	6.13	5.87	19.94	7.51	**15.04**

Average Chloride (Cl-) Measurements in Milligrams per Liter (mg/L)

The chloride ion is found naturally in some surface ground waters and in high concentrations in seawater. Research has shown that elevated chloride levels can be toxic to freshwater aquatic life. In order to protect freshwater aquatic life, New Hampshire has adopted an acute standard of 860 mg/L for a one-hour average and a chronic standard of 230 mg/L for a four-day average. The chloride content in New Hampshire lakes is naturally low, generally less than 2 mg/L in surface waters located in remote areas away from habitation. Higher values are generally associated with salted highways, and water-softening systems from residential and commercial use that discharge into septic systems. Annual average and historic average chloride measurements above 230 mg/L are highlighted in orange in the table below to indicate stations that may exceed the threshold for chloride on more than one occasion throughout the monitoring season.

Annual Average & Historical Average Chloride Measurements									
Waterbody	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Historical Average**
Crystal Lake									
Epilimnion	110	100		22	101	Not Monitored	137	135	**101**
Dorrs Pond									
Epilimnion	193	147	147	112	167	217	257	193	**179**
Inlet	545	317	232	240	230	413	277	304	**320**
East Inlet 2	140	167	149	160	240	277	143	241	**190**
Juniper Street Inlet		118	87	115	157	223	210	208	**160**
Outlet	230	100			183	227	240	200	**197**
Nutts Pond									
Epilimnion	195	180	190	155	360	370	390	305	**268**
Inlet	240	217	180	250	360	447	224	512	**304**
Outlet		160			350	373	387	299	**314**
Pine Island Pond									
Epilimnion	88			86	91	130	143	134	**112**
Inlet	130			93	93	147	163	175	**134**
Outlet	100				89	130	137	133	**118**
Stevens Pond									
Epilimnion	217	200	195	175	327	410	343	256	**265**
Outlet						403	353	287	**348**

Average Conductivity Measurements in Micromhos per Centimeter (uMhos/cm)

Conductivity (uMhos/cm)	Category
0 - 100	Normal
101 - 200	Low Impact
201 - 500	Moderate Impact
> 501	High Impact
> 835	Exceeding Chronic Chloride Standard

Conductivity is the numerical expression of the ability of water to carry an electrical current. It is determined by the number of ionic particles present. The soft waters of New Hampshire have traditionally had low conductivity values. High conductivity may indicate pollution from such sources as road salting, septic systems, or urban/agriculture runoff. **Note:** There is no numeric surface water quality standard for conductivity, and good and bad levels can not be constructed because variations in watershed geology can result in natural fluctuations in conductivity. However, values in NH lakes exceeding 100 uMhos/cm generally indicate external influences.

Annual Average & Historical Average Conductivity Measurements																			
Waterbody	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Historical Average**
Crystal Lake																			
Epilimnion	419	440	444	473	459	511	383	359	422	381	428	421	393	386	449	Not Monitored	575	546	**440**
Hypolimnion	417	481	433	526	454	525	385	351	435	392	404	425	396	393	449	Not Monitored	563	535	**445**
Dorrs Pond																			
Epilimnion	408	831	883	759	644	842	455	631	512	517	765	571	564	501	667	811	933	705	**667**
Hypolimnion	432	825	904	782	653	625	520				608								**676**
Inlet	414	876	1095	1015	850	1014	1030	1250	553	761	1752	1246	840	764	844	1513	1057	1240	**1006**
East Inlet 2	707	814	917	1162	807	843		799	560	722	663	657	581	692	926	1029	592	907	**787**
Juniper Street Inlet			1030			732	441	494	525	503	601	498	400	542	611	826	841	766	**629**
Outlet	430	793	925	666	651		574	633	504	510	784	573	570	496	1226	812	939	698	**693**
Maxwell Pond / Black Brook																			
Deep Spot/Former Impoundment	122	155	169	180	151	148	101	131	110	95	165	95	89	91	102	128	132	117	**127**
Inlet	120		672	180	151	148	101	137	109	93	162	93	88	91	102	127	137	117	**155**
Outlet	122	562	597	182	151	151	101	132	110	93	171	94	89	95	105	130	136	119	**174**
Nutts Pond																			
Epilimnion	485	714	580	786	599	877	469	545	620	610	765	610	652	723	927	1265	1355	989	**754**
Hypolimnion	1769	1960	1798	2018	2193	2615	2160	1124	1544	2447	2143	2407	1776	2187	2990	2797	2463	2570	**2164**
Inlet	826	1034	688			919	1011	900	678	996	922	850	746	992	1301	1577	862	1646	**997**
Outlet	509	708	614	807	599	970	465	573	612	609	763	631	653	723	1226	1258	1369	964	**781**
Pine Island Pond																			
Epilimnion	287	383	316	339	256	324	235	252	289	207	428	329	306	306	370	534	634	510	**350**
Hypolimnion	305	350	318	306	268	320	237	221	328	251	399	340	262	283	378	515	610	443	**341**
Inlet	269	451	354	335	289	394	241	268	283	206	500	395	411	383	388	613	757	557	**394**
Outlet	273	382	317	330	270	303	236	281	289	208	432	334	303	296	377	534	643	521	**352**
Stevens Pond																			
Epilimnion	769	1149	1140	1258	860	1099	578	785	716	688	840	705	636	787	1143	1387	1277	1006	**935**
Hypolimnion	792	1634	1248	1606	1041	1742	593	838	1451	1164	854	1553	843	1194	1764	1502	1348	1448	**1256**
Outlet		1097	1193	1316		1032	750	795	550	684	865	696	696	784	1134	1401	1273	1011	**955**

Median pH Measurements

pH (Units)	Category
6.50 - 8.00	Satisfactory
5.50 - 6.49	Endangered
5.00 - 4.49	Critical
< 5.00	Acidified

pH is measured on a logarithmic scale of 0 to 14. Lake pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. The Class B surface water quality standard for pH in New Hampshire is a range of 6.5 - 8.0 units. **It is important to note that sometimes readings that fall below the range of 6.5 - 8.0 are determined to be naturally occurring.** This is often a result of wetlands near the sample station. Wetlands can lower pH because the tannic and humic acids released by decaying plants can cause water to become more acidic. Annual median and historic median pH measurements below 6.5 are highlighted in red in the table below to indicate stations that may exceed the threshold for pH on more than one occasion throughout the monitoring season.

Annual Median pH Measurements																		
Waterbody	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Crystal Lake																		
Epilimnion	7.10	7.31	7.13	7.08	6.92	6.98	6.88	7.28	7.20	7.10	7.17	7.08	7.18	7.15	7.11	Not Monitored	7.17	7.28
Hypolimnion	6.84	6.88	6.94	6.59	7.00	6.76	6.89	6.84	6.97	6.57	6.58	6.87	6.87	6.84	6.98	Not Monitored	6.85	7.03
Dorrs Pond																		
Epilimnion	7.24	7.26	7.24	7.15	6.87	6.82	7.10	7.23	6.81	7.10	7.04	6.85	7.28	6.81	6.94	7.31	7.03	6.94
Hypolimnion	6.74	7.14	7.02	7.11	7.14	6.71	6.82				7.17							
Inlet	6.91	7.05	6.98	6.95	7.01	6.87	6.96	7.03	6.92	7.12	7.11	7.03	7.00	6.93	6.98	6.90	6.96	6.85
East Inlet 2	7.26	7.38	7.23	7.16	7.16	6.83		7.18	7.06	7.26	7.10	7.11	7.24	7.24	7.26	7.14	6.99	7.12
Juniper Street Inlet	6.38	6.84	6.89			6.45	6.58	6.63	6.35	6.33	6.74	6.33	6.65	6.36	6.50	6.45	6.63	6.48
Outlet	7.11	7.30	7.14	7.21	7.04		7.05	7.15	6.94	7.16	7.22	7.20	7.32	7.06	6.97	7.07	7.00	6.95
Maxwell Pond / Black Brook																		
Deep Spot/Former Impoundment	6.41	6.48	6.51	6.18	6.32	6.36	6.25	6.61	6.25	6.62	6.47	6.06	6.41	6.29	6.66	6.49	6.63	6.35
Inlet	6.58	6.75	6.56	6.30	6.60	6.54	6.34	6.55	6.34	6.51	6.72	5.80	6.32	6.26	6.73	6.40	6.69	6.32
Outlet	6.66	6.93	6.42	6.47	6.61	6.41	6.59	6.79	6.47	6.66	6.78	5.56	6.51	6.32	6.46	6.67	6.45	6.43
Nutts Pond																		
Epilimnion	7.01	7.16	7.09	7.00	7.00	6.90	7.18	6.98	6.72	7.08	7.13	7.14	7.04	6.94	7.20	6.97	6.82	7.20
Hypolimnion	6.48	6.47	6.39	6.33	6.33	6.41	6.49	6.36	6.22	6.47	6.29	6.37	6.33	6.38	6.37	6.46	6.49	6.43
Inlet	6.94	6.89	6.72			6.77	7.06	6.91	6.66	6.86	7.11	7.05	7.07	7.00	6.98	6.87	6.60	6.85
Outlet	6.95	6.90	6.94	6.92	6.79	6.91	7.02	6.83	6.96	6.93	6.89	7.12	6.96	7.03	7.32	6.99	7.20	7.21
Pine Island Pond																		
Epilimnion	7.18	7.18	6.93	6.69	6.82	7.00	7.09	6.74	6.63	6.69	7.28	7.15	6.94	6.96	7.05	6.74	7.18	7.41
Hypolimnion	6.79	6.74	6.79	6.51	6.52	6.74	6.69	6.43	6.35	6.47	6.59	6.57	6.59	6.64	6.61	6.75	6.74	6.69
Inlet	6.90	6.95	6.92	6.77	6.82	7.01	7.08	7.03	6.57	6.64	7.03	7.09	7.08	7.06	7.12	7.03	7.35	7.10
Outlet	7.17	7.17	7.10	6.92	6.98	7.07	7.18	6.98	6.85	6.84	7.16	7.24	7.13	7.25	7.32	7.19	7.31	7.23
Stevens Pond																		
Epilimnion	7.28	7.28	7.10	7.10	7.25	7.00	7.29	7.26	6.96	7.22	7.29	7.14	7.35	7.01	6.97	6.85	7.08	6.98
Hypolimnion	7.08	7.05	6.95	7.00	6.71	6.68	6.82	6.76	6.46	6.57	6.68	6.56	6.71	6.58	6.71	6.91	6.70	6.62
Outlet		6.95	6.92	6.78	6.77	6.96	6.94	6.86	6.72	6.82	6.69	6.79	6.78	6.76	6.80	6.68	8.88	6.78

Average Water Clarity/Transparency Measurements in meters (m)

Clarity (m)	Category
<2	Poor
2 - 4.5	Good
> 4.5	Exceptional

The Secchi-disk is a 20cm disk with alternating black and white quadrants used to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, is affected by the amount of algae, color, and particulate matter within a lake. **It is important to note that clarity values may vary depending on the maximum depth of the lake or pond.** For example, if the maximum depth of the pond is 3 meters, a good clarity reading would be 2-3 meters.

Annual Average & Historical Average Transparency Measurements (Without Viewscope)																			
Waterbody & Maximum Depth	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Avg**
Crystal Lake / 7.5 m	4.3	3.5	3.9	5.0	3.9	5.4	4.2	4.2	3.4	3.4	4.5	4.7	4.5	3.8	3.5	Not Monitored	4.3	3.7	**4.1**
Dorrs Pond / 2.5 m	1.1	1.3	2.0	1.7	1.7	2.0	2.0	1.9	1.6	1.8	1.5	1.8	1.9	1.4	1.5	Not Monitored	1.2	1.7	**1.6**
Maxwell Pond / 1.1 m	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	Since the Maxwell Pond Dam was removed (and Black Brook was restored) in 2009, Transparency is no longer measured since the water is no longer impounded to create a "deep spot".									
Nutts Pond / 9.0 m	3.1	2.4	2.9	2.3	1.8	2.5	2.5	3.5	2.8	3.4	3.9	2.4	4.1	3.1	2.2	2.9	2.9	3.0	**2.9**
Pine Island Pond / 5.0 m	1.9	1.9	1.9	1.9	1.8	1.9	1.8	1.8	2.1	2.0	2.1	1.5	2.1	2.0	2.1	1.6	1.4	1.7	**1.9**
Stevens Pond / 5.5 m	2.6	2.5	3.0	1.7	2.6	3.2	2.3	2.0	1.9	2.4	2.6	2.4	2.3	2.5	2.6	3.0	2.2	2.5	**2.5**

Average Total Phosphorus (TP) Measurements in Milligrams per Liter (mg/L)

TP (mg/L)	Category
0.001 - 0.010	Low (Good)
0.011 - 0.020	Average
0.021 - 0.040	High
> 0.040	Excessive

Phosphorus is the most important water quality parameter measured in our lakes. It is the nutrient that limits the algae's ability to grow and reproduce. Phosphorus sources around a lake typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands. There is no numeric standard for total phosphorus for Class B waters, however, narrative criteria for phosphorus states that "unless naturally occurring, shall contain no phosphorus in such concentrations that would impair any existing or designated uses". The hypolimnion layer is the lower most layer of ponds and lakes. This is an area that is highly subjective to natural pond turnover during the spring and fall and also low dissolved oxygen conditions due to depth and decomposition. It is generally expected that the total phosphorus measurements in this layer (due again to decomposition of plants and animals) would be higher than in the Metalimnion (middle layer) or Epilimnion (top layer).

Annual Average & Historical Average Total Phosphorus Measurements																			
Waterbody	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Historical Average**
Crystal Lake																			
Epilimnion	0.011	0.012	0.012	0.010	0.012	0.014	0.017	0.013	0.010	0.012	0.014	0.015	0.011	0.014	0.013	Not Monitored	0.012	0.011	**0.013**
Metalimnion	0.010	0.017			0.009			0.013	0.010	0.011	0.014	0.015	0.014	0.013	0.014	Not Monitored	0.012	0.014	**0.013**
Hypolimnion	0.025	0.017	0.014	0.018	0.018	0.013	0.017	0.018	0.017	0.021	0.026	0.020	0.017	0.016	0.013	Not Monitored	0.021	0.014	**0.018**
Dorrs Pond																			
Epilimnion	0.045	0.027	0.021	0.024	0.028	0.026	0.030	0.022	0.027	0.028	0.026	0.025	0.101	0.243	0.023	0.022	0.031	0.023	**0.043**
Hypolimnion	0.088	0.029	0.127	0.022	0.033	0.027	0.029				0.022								**0.047**
Inlet	0.171	0.035	0.025	0.077	0.026	0.026	0.026	0.027	0.024	0.026	0.032	0.031	0.113	0.033	0.029	0.025	0.036	0.028	**0.044**
East Inlet 2	0.039	0.024	0.021	0.014	0.038	0.032		0.025	0.023	0.025	0.035	0.026	0.092	0.111	0.016	0.023	0.502	0.016	**0.062**
Juniper Street Inlet		0.025	0.250			0.014	0.016	0.028	0.015	0.017	0.021	0.014	0.056	0.014	0.012	0.014	0.071	0.011	**0.039**
Outlet	0.042	0.030	0.031	0.025	0.028		0.024	0.027	0.024	0.025	0.025	0.023	0.024	0.029	0.021	0.031	0.030	0.022	**0.027**
Maxwell Pond/Black Brook																			
Deep Spot/Former Impoundment	0.014	0.018	0.015	0.017	0.022	0.020	0.018	0.022	0.023	0.025	0.019	0.021							**0.020**
Inlet	0.015	0.013	0.021	0.015	0.021	0.018	0.016	0.017	0.022	0.029	0.020	0.022							**0.019**
Outlet	0.017	0.016	0.014	0.015	0.021	0.019	0.019	0.019	0.023	0.027	0.016	0.029							**0.020**
Nutts Pond																			
Epilimnion	0.017	0.023	0.024	0.032	0.021	0.028	0.024	0.023	0.019	0.018	0.015	0.019	0.015	0.018	0.012	0.014	0.017	0.016	**0.020**
Metalimnion	0.054	0.030	0.028	0.032	0.025	0.032	0.028	0.028	0.024	0.020	0.017	0.026	0.067	0.025	0.017	0.022	0.080	0.017	**0.032**
Hypolimnion	0.089	0.097	0.179	0.109	0.082	0.064	0.088	0.045	0.039	0.051	0.101	0.076	0.372	0.083	0.061	0.072	0.078	0.054	**0.097**
Inlet	0.026	0.014	0.018				0.027	0.042	0.034	0.032	0.033	0.028	0.026	0.024	0.017	0.024	0.203	0.031	**0.039**
Outlet	0.021	0.038	0.021			0.036	0.021	0.022	0.018	0.018	0.034	0.018	0.058	0.018	0.012	0.014	0.018	0.018	**0.024**
Pine Island Pond																			
Epilimnion	0.024	0.016	0.029	0.029	0.024	0.021	0.026	0.022	0.029	0.021	0.020	0.028	0.027	0.022	0.024	0.026	0.020	0.024	**0.024**
Metalimnion	0.025	0.024		0.027	0.010	0.010	0.029	0.026	0.033	0.022	0.024	0.035	0.035	0.034	0.025	0.029	0.022	0.027	**0.026**
Hypolimnion	0.028	0.030	0.030	0.031	0.034	0.032	0.032	0.055	0.072	0.029	0.047	0.053	0.194	0.033	0.058	0.038	0.045	0.037	**0.049**
Inlet	0.024	0.050	0.022	0.032	0.021	0.018	0.018	0.018	0.025	0.021	0.016	0.024	0.017	0.020	0.016	0.015	0.012	0.019	**0.022**
Outlet	0.022	0.016	0.022		0.022	0.026	0.026	0.022	0.026	0.021	0.017	0.025	0.023	0.021	0.020	0.020	0.017	0.023	**0.022**
Stevens Pond																			
Epilimnion	0.019	0.025	0.018	0.017	0.022	0.017	0.031	0.030	0.042	0.024	0.026	0.025	0.025	0.026	0.018	0.019	0.028	0.022	**0.024**
Metalimnion	0.029	0.018	0.015	0.018	0.040	0.021	0.036	0.036	0.026	0.036	0.037	0.028	0.107	0.027	0.019	0.021	0.034	0.022	**0.032**
Hypolimnion	0.042	0.023	0.035	0.027	0.081	0.027	0.034	0.047	0.048	0.066	0.058	0.075	0.166	0.062	0.033	0.017	0.048	0.092	**0.055**
Outlet		0.026	0.017	0.013	0.021	0.018		0.036	0.029	0.019	0.035	0.024	0.071	0.021	0.028	0.019	0.021	0.016	**0.026**

Average Turbidity Measurements in Nephelometric Turbidity Units (NTUs)

Turbidity in the water is caused by suspended matter (such as clay, silt, and algae) that cause light to be scattered and absorbed, not transmitted in straight lines through the water. High turbidity readings are often found in water adjacent to construction sites. Also, improper sampling techniques (such as hitting the bottom sediments or sampling streams with little flow) may also cause high turbidity readings. The Class B water quality standard for turbidity 10 NTUs over the background level. Annual averages and historic averages for turbidity measurements above 10 NTU are highlighted in orange in the table below to indicate stations that may exceed the threshold for turbidity on more than one occasion throughout the monitoring season. **However, it is important to note that background levels have not been adequately determined at this time.**

Annual Average & Historical Average Turbidity Measurements																			
Waterbody	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Historical**
Crystal Lake																			
Epilimnion	0.49	0.89	2.21	0.79	1.64	0.82	1.41	1.79	1.04	1.25	0.92	1.68	1.11	1.18	1.22	Not Monitored	1.41	1.22	**1.24**
Metalimnion	0.51	1.05		0.84	1.78			1.05	1.20	1.72	0.88	1.46	1.00	1.01	1.60	Not Monitored	1.63	1.10	**1.20**
Hypolimnion	3.07	1.24	2.00	1.63	2.35	1.12	1.18	1.45	1.54	2.05	1.90	1.41	1.36	1.04	1.71	Not Monitored	1.44	1.45	**1.64**
Dorrs Pond																			
Epilimnion	3.75	3.70	3.22	3.42	4.61	2.45	3.13	2.51	3.49	2.47	3.99	3.20	3.32	3.43	5.04	5.05	7.08	2.82	**3.70**
Hypolimnion	8.10	4.13	3.54	4.87	5.44	2.69	3.16			4.55	3.08								**4.40**
Inlet	5.37	6.05	12.61	32.42	5.43	3.78	3.84	6.63	3.42	4.81	12.70	6.03	9.70	3.04	5.97	5.82	8.79	4.50	**7.83**
East Inlet 2	2.37	1.13	0.80	0.92	6.59	2.24		0.74	1.32	2.67	0.80	0.88	1.00	0.99	1.00	0.61	0.87	0.59	**1.50**
Juniper Street Inlet			69.37			0.68	8.24	12.60	2.52	4.55	13.57	9.73	35.10	4.61	5.60	5.21	5.73	3.72	**12.95**
Outlet	2.88	3.50	4.84	3.21	4.23		2.29	2.54	3.14	2.46	3.14	2.93	3.31	2.65	2.19	3.22	5.75	2.27	**3.21**
Maxwell Pond																			
Deep Spot/Former Impoundment	2.03	3.39	2.16	2.57	2.12	1.69	1.63	2.09	2.09	2.43	3.87	1.76	1.82	1.65	1.25	0.94	1.40	1.19	**2.00**
Inlet	1.10	0.72	3.12	2.00	2.77	1.38	1.37	1.38	2.14	2.24	4.38	1.60	1.84	1.65	1.33	1.29	1.87	0.98	**1.84**
Outlet	2.10	2.93	2.46	2.26	2.96	1.41	1.40	1.70	2.37	2.62	3.48	1.98	1.66	1.80	1.14	1.08	1.63	1.13	**2.01**
Nutts Pond																			
Epilimnion	0.93	1.76	3.83	2.80	5.32	2.64	1.71	1.43	1.54	1.15	1.08	1.70	1.20	1.44	2.38	1.86	1.82	1.61	**2.01**
Metalimnion	1.94	3.38	3.53	2.43	5.74	2.34	1.77	2.63	2.78	1.62	26.90	2.18	2.04	2.17	3.89	4.01	2.87	2.26	**4.14**
Hypolimnion	39.84	31.42	43.32	60.14	76.30	61.30	33.06	56.41	11.15	60.87	69.78	70.67	92.97	46.21	106.27	78.93	110.37	62.34	**61.74**
Inlet	0.24	3.39	0.96			3.14	1.36	1.50	1.73	1.04	2.20	0.79	0.67	0.69	1.63	0.97	1.24	1.38	**1.43**
Outlet	1.12	2.93	2.46	2.26	2.96	1.41	1.40	1.70	2.37	2.62	3.48	1.98	1.66	1.88	2.19	1.82	2.00	1.74	**2.17**
Pine Island Pond																			
Epilimnion	1.34	1.69	3.19	3.54	3.01	2.12	2.65	2.38	2.51	1.56	1.65	2.23	1.96	1.48	2.63	4.45	2.67	1.94	**2.39**
Metalimnion	1.30	3.15		3.27		2.23	2.75	2.63	3.10	1.69	2.45	2.97	2.82	2.46	2.83	5.81	3.06	2.71	**2.83**
Hypolimnion	1.86	6.37	6.02	7.91	9.21	6.05	5.68	15.14	24.00	4.98	11.19	11.13	12.37	7.30	10.56	7.03	14.63	7.06	**9.36**
Inlet	2.56	2.01	2.34	2.97	2.62	2.00	1.71	1.96	2.09	1.91	1.18	1.93	1.67	1.39	1.63	1.95	1.32	1.92	**1.95**
Outlet	1.09	1.31	2.28	3.08	2.77	1.74	2.21	2.12	2.09	1.53	0.73	1.57	1.14	1.01	1.44	2.10	1.12	1.54	**1.72**
Stevens Pond																			
Epilimnion	2.36	2.23	2.45	2.63	2.30	1.64	2.98	2.26	2.73	1.37	1.67	2.05	2.28	1.30	2.48	1.65	3.37	1.46	**2.18**
Metalimnion	2.34	1.75	2.88	2.07	3.84	2.20	3.20	2.76	3.67	3.20	2.91	1.99	3.25	2.00	2.33	1.63	3.86	1.95	**2.66**
Hypolimnion	9.80	2.65	15.24	3.68	22.87	2.59	10.17	4.92	9.68	14.48	12.50	12.63	16.64	11.69	9.50	1.55	12.92	2.51	**9.78**
Outlet		2.32	2.47	1.74		1.09	1.32	2.82	2.32	1.22	2.59	1.15	1.34	1.12	2.55	1.97	2.03	1.39	**1.84**