Manchester’s CSO Abatement Program: Past, Present, and Future

By Frederick J. McNeill, P.E., City of Manchester, NH
Joseph L. Laliberte, P.E., CDM

Background
The City of Manchester, like many older communities in the Northeast, originally constructed a combined sewer system, using a single pipe to convey both wastewater and stormwater. The City’s collection system dates back to the early 1870s, and includes 10 pump stations, 375 miles of sewers (~100 miles over 100 years old), and a 34 mgd WWTP. When the combined sewer system exceeds its hydraulic capacity during a rainstorm or snowmelt, the result is a series of combined sewer overflows (CSO) that discharge to the Merrimack and Piscataquog Rivers. Manchester is committed to solving its CSO issues and has been working to abate these problems for over 20 years.

“Manchester’s Past” - LTCP and Phase I CSO Program (early 1990s-2009)
Based on a study dating back to the early 1990s, the City submitted a Long-Term CSO Control Plan (LTCP) to the EPA and NHDES in 1995 and entered into a Compliance Order in March, 1999. This Compliance Order adopted a phased approach to abate CSOs, in which Phase I included the implementation of the following projects over a 10-year period:

- Separate fourteen CSO basins;
- Upgrade wet weather capacity at WWTP;
- Raise two CSO weirs; and
- Implement a Supplemental Environmental Projects Program (SEPP).

In 2009, Manchester completed all required construction projects, which were primarily on the City’s west side. Due to the success of the program, the City was able to fully separate an additional basin. All total more than 53 miles of new or rehabilitated piping (sewer, water, gas and drain) was installed. The end result was a full infrastructure reconstruction consisting of roads, curbing and sidewalks, while the majority of the underground pipelines were replaced. Table 1 provides a summary of the infrastructure renewal.

Table 1: Phase 1 Infrastructure Renewal

<table>
<thead>
<tr>
<th>Sewers</th>
<th>Total</th>
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<tbody>
<tr>
<td>New Sewer</td>
<td>8 Miles</td>
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<tr>
<td>Rehabilitated Sewer</td>
<td>3 Miles</td>
</tr>
<tr>
<td>CSO Outfalls Eliminated</td>
<td>13</td>
</tr>
<tr>
<td>CSO Discharge Reduction</td>
<td>53 MG</td>
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<tr>
<td>Private Inflow Sources Removed</td>
<td>121</td>
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<table>
<thead>
<tr>
<th>Drains</th>
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</thead>
<tbody>
<tr>
<td>New Drain</td>
<td>19 Miles</td>
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<tr>
<td>New Outfalls</td>
<td>6</td>
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<table>
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<th>Other Utilities</th>
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</thead>
<tbody>
<tr>
<td>New Gas</td>
<td>15 Miles</td>
</tr>
<tr>
<td>New Water</td>
<td>4 Miles</td>
</tr>
<tr>
<td>Rehabilitated Water</td>
<td>4 Miles</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Surface Construction</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Road Reconstructed</td>
<td>26 Miles</td>
</tr>
<tr>
<td>New or Reset Curbing</td>
<td>9 Miles</td>
</tr>
<tr>
<td>New Sidewalks</td>
<td>6 Miles</td>
</tr>
</tbody>
</table>

(Continued on page 1)
NEWSLETTER COMMITTEE

Steve Clifton, Mary Jane Meier, Chris Hipkiss, Stephanie Rochefort, Todd Gianotti, Dave Michelsen, and Joseph Laliberte. We welcome additional members. We are looking for meaningful articles for the Wastewater Operator in a timely fashion. Send submission articles for THE COLLECTOR to Steve Clifton via email at wsclifton@underwoodengineers.com

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THE PO BOX IN CONCORD NH IS NO LONGER BEING USED BY THE NEWSLETTER. THANK YOU.

SPECIAL THANKS TO THIS ISSUES ARTICLE WRITERS

Steve Goodwin, Tom Burack, Charlie Tyler, Ben Dreyer, Wes Ripple

Fall Wastewater Training
Class Schedule

The Fall 2011 wastewater operator training program of classes is now posed to the NH DES web site. Please copy and paste this link into your browser to find the Application for Certification exam, the License Renewal form and the Dec., 2011 exam announcement:


The Fall 2011 Training Announcement and Course Descriptions and Course Enrollment Form can be found at:


UP COMING EVENTS

September 23 - NHWPCA Fall Meeting at the Allenstown, NH WWTF with lunch at the Red Blazer in Concord, NH.

December 8 - NHWPCA Winter Meeting at the Hooksett, NH WWTF with lunch at the Puritan Back Room in Manchester, NH.
Phase I reduced the volume of CSO discharges from the area west of the Merrimack River by more than 99% and now controls up to the 2-year storm event, which exceeded the goal of the program (3-month level of control). The program also addressed numerous private property sewer backups and street flooding. All CSOs to the Piscataquog River upstream of Bass Island have been eliminated, which led to the re-establishment of a frequently used park system (fields, walking trails and swimming areas) along both banks. In addition, Phase I provided numerous and lasting benefits through the SEPP, such as preservation of a rare Atlantic Cedar Swamp at Hackett Hill, development of environmental school curricula, and construction of stormwater and erosion controls.

Completion of this 10-year, $58 million dollar CSO program accomplished many significant milestones, beyond the construction of new infrastructure, which have improved the environment while also improving the quality of life for the citizens. The Phase I CSO program was a success by every quantitative measure; it was completed under budget, ahead of schedule, included more system improvements than originally planned, and achieved a higher CSO level of control than required.

“Manchester’s Present” – Development and Submittal of Revised LTCP (2009-2011)

The Compliance Order required the City to submit a revised LTCP after the completion of Phase I for control of the remaining CSOs, which are primarily on the City’s east side. The revised LTCP was submitted in March 2010 and is currently being evaluated by the EPA and NHDES.

To develop a holistic plan that continues to addresses the public’s needs and water quality concerns, the City engaged its sewer users via a questionnaire to identify the deficiencies within the collection system. More than 12,500 questionnaires were returned with nearly 30% of the customers reporting experience with either sewer backups or street flooding. The data was integrated into GIS and a hydraulic model to identify high priority areas that require attention.

Development of the plan also included meeting with other City departments to achieve the ultimate vision of redevelopment and urban revitalization (i.e., pavement, gateway roads, curbing, sidewalks, green infrastructure, plantings, and extension of trail network). An important goal in developing the LTCP was to ensure that the CSO abatement program is performed in concert with other City initiatives to reduce the financial burden on the rate payers.

The recommended plan comprises various CSO abatement components, including WWTP upgrades, system optimization, removal of brooks, separation, and CSO storage, which ensures that multiple goals are being achieved simultaneously by providing the greatest long-term overall benefit. The development of plan did not focus solely on any single objective, but rather programs that effectively blended each of the elements.

“Manchester’s Future” - Phase II CSO Programs (2012-2032)

Building on its Phase I success, the City is now looking to the future. In Phase II, Manchester proposes to install infrastructure upgrades that will reduce CSO discharges by 70% while providing relief for more than 500 sewer backup and street flooding locations. In keeping with the City’s vision, this plan will maximize the expenditure of money on local benefits and achieve multiple goals. The major components of the proposed 20-year Phase II program are:

- $20 million for WWTP improvements;
- $3 million for system optimization;
- $65 million for removal of Cemetery Brook; and
- $73 million in sewer separation.
ARRA in the Rear View Mirror

By Paul L Heirtzler P. E. Esq., NHDES

The other day I was thinking that there is something weird about those car mirrors that say objects are closer than they appear. For one thing, how does a mirror know how objects appear to us? Would it know if I have some kind of hyperopia and, if it did, would that make the objects that are closer look fuzzy? What would the mirror say if I was traveling at the speed of light? Could the object appear both closer and farther than it really was at the same time? I was about to rip the mirrors off of my car when it occurred to me that perhaps relativity was the answer. For most people, ARRA is far in the distance no matter which mirror they are looking at; but for DES, a significant amount of ARRA work is happening right now with more to come in the future. Relativity speaking, ARRA is behind, alongside and up ahead all at the same time - another example of space-time continuum in state government.

By now we all know that the American Recovery and Reinvestment Act of 2009 was passed to stimulate the economy, create jobs and upgrade aging infrastructure. From a wastewater perspective, ARRA has been a major success in New Hampshire. The NH Clean Water State Revolving Fund program received $39,163,900 from EPA of which 96% or $37,597,344 was available for wastewater projects. DES opted to use this entire amount as subsidy in the form of loan principal forgiveness, which does not have to be repaid.

DES received 324 loan applications for ARRA projects totaling more than $625 million. To make the largest number of affordable projects possible, each of the projects selected was funded with 50% ARRA and 50% conventional SRF funds. This mixture of funds allowed for the financing of 51 projects worth $75 million. To date, 9 of the projects have been completed, 2 are just beginning and 40 are in various stages of construction. All ARRA projects are expected to be completed by the end of 2012. As of June 30, 2011, 90 full time construction related jobs have been created as the primary result of ARRA wastewater projects. This number does not include the secondary jobs created in the manufacturing industry and other related sectors.

In addition to pumping money into the local economy and creating jobs, ARRA provided for needed new or upgraded infrastructure and water quality projects. ARRA projects ranged from the traditional wastewater treatment facility upgrade to the non-traditional non-point source low impact development project. Another important feature of ARRA is that 20% of the funds must be spent on “green” projects. This has opened the door to new thinking in the design of wastewater facilities that will ultimately lower a community’s operation and maintenance costs. High efficiency aeration systems, variable frequency drives and green buildings are becoming the norm. We expect to see greater use of solar and geothermal energy at our treatment facilities. The green requirement started under ARRA has continued for the 2010 and 2011 EPA grants to the SRF programs and will likely continue indefinitely.

For DES, ARRA has three distinct phases. Phase I included the preparation of project loan agreements, completion of project designs, projects put out to bid and award of construction contracts. Phase I was successfully completed before the ARRA deadline of February 17, 2010. That work represents the work behind us. Phase II includes construction of the projects which is ongoing and represents the majority of the work alongside us. Phase III includes long term servicing of the ARRA project loan and continued enhanced reporting to multiple federal agencies which is mainly the work that lies ahead.
How to Save a Buck or Two, Buckaroo
By Steve Goodwin, Durham WWTF

With all the belt tightening and downsizing we are expected to do, here’s a great money saving tip from Steve Goodwin, Grade 2 Wastewater Operator from Durham WWTF. Steve shared his recent win that saved the Town of Durham nearly $500. Here’s the scoop:

It was time to replace Fluorescent light bulbs at the plant, so I called our nearby suppliers Northeast Electrical and Rockingham Electric. The price quoted by Northeast was $6.67 each. The price from Rockingham was $8.23 each for the bulbs (Fluorescent F48T12/CW/HO/ALTO).

I also needed Leviton replacement sockets to complete the job and the only dealer is Consolidated Electrical Distributors Inc., (CED).

When I went to CED to buy sockets I was told they had the “State Contract with NH” and so their pricing was good.

I asked about the price for the fluorescent bulbs I had ordered with Northeast. He checked the price and said yes, we have them for $3.13 each.

I talked to Mike at CED's Dover, NH store. His number is 603-516-1500 please call him if you need more information.

Nice savings for our little town of Durham. All state and town departments should check with them for their next purchase, you may save a buck or two as well.

You can find out more about what items are covered by various Current State Contracts by following the link to the web page at http://admin.state.nh.us/purchasing/index2.asp

The Bureau of Purchase and Property's prime responsibility is to purchase goods and services for all state agencies and institutions unless they are specifically exempted by law. Doing Business with the State is an opportunity to participate in providing economic, high quality and efficient services to state agencies, political sub-divisions and non-profit organizations.

The Bureau of Purchase & Property maintains a list of existing, new, extended and amended contracts that are available to all State Agencies, Municipalities, Political sub-divisions, State Colleges and Universities. The Bureau is dedicated to providing fair and equitable opportunities for both state agencies and the vending public in accordance with the laws of the State of New Hampshire.
Unless you’ve just crawled out from under a rock, you’ve probably heard something about total nitrogen limits on the horizon. So, grab a cup of coffee and I’ll share what I’ve learned as it relates to my world in the wastewater lab. Better make it a good cup of coffee, not that sludge that’s been sitting in the communal pot. Don’t get me wrong, I’m usually all for caffeine any way that I can get it. However, sometimes you just need to indulge in a caramel latte – order it with skim milk and Splenda® and you can even pretend it’s healthy!

Let’s get the bad news right out of the way – at the time this article is going to press (I’ve always wanted to write that!) there is no 40 CFR 136 approved method for total nitrogen. So, what the heck is total nitrogen and why is it so difficult?

In wastewater, there are several forms of nitrogen. These forms are: nitrate, nitrite, ammonia and organic nitrogen. All of these forms, along with nitrogen gas, are bio-chemically inter-convertible and are all components of the nitrogen cycle. Since this is a lab article, I’m going to write about how to test for the first four forms and the arithmetic sum of the results is the total nitrogen result.

**Nitrate:** When researching a method, the first place that I always look is in the list of EPA compliant Hach methods. Nitrate is not on that list. Next I check 40 CFR 136 and find only one method on the list – EPA 352.1. There’s some other methods listed in the “other” column, but after digging through the foot-notes it’s just the same method with different names. EPA 352.1 looks like a fun method – you use a spectrophotometer and a lot of glass sample tubes and wire racks and two water baths.

**Nitrite:** After my disappointment with the nitrate methods, I skipped the step of looking for the easy Hach method and went right to 40 CFR 136. Yet again, I find one method on the list, but there’s a little note in the “other” column. The little note actually lists Hach method 8507. It might not be a lot of fun, but it’s a very easy colorimetric method.

**Nitrate and Nitrite:** The winner in my research is EPA method 353.3. This method can also be found in Standard Methods. The nitrate is reduced to nitrite in the presence of cadmium and then nitrite is determined colorimetrically. You can reduce the samples one at a time or spend some money on an auto-analyzer (method 353.2) to hurry things along.

**Ammonia and Organic Nitrogen:** I’ve been distilling samples and analyzing for ammonia for quite some time now. I figured that I would just need to add this organic nitrogen portion into the mix. Well, organic nitrogen is defined as organically bound nitrogen in the tri-negative oxidation state. You don’t analyze for it directly. You analyze for kjeldahl nitrogen and then subtract the ammonia portion. Since I want both portions, I would only need to analyze for kjeldahl nitrogen. This involves purchasing a kjeldahl apparatus. We can all thank Johan Kjeldahl for this. He developed a method of determining nitrogen content in 1883 that was faster and more accurate than any other method available while studying proteins produced during beer-making.

To sum everything up, it looks like it would be easiest to run the nitrate-nitrite test and the kjeldahl nitrogen test and to add these two together for a total nitrogen result. Of course, it would really be easiest if a cheaper, easier method for total nitrogen was developed and approved. In the mean-time, I think I’ll research some pricing on the new laboratory equipment that I’ll need to run total nitrogen samples. I think I’ll do this research from home, so that I can enjoy an appropriate beverage in honor of Mr. Kjeldahl while I’m at it – you think?
Henry David Thoreau once wrote, “A lake is a landscape’s most beautiful expressive feature. It is earth’s eye, on looking into which the beholder measures the depth of his own nature.”

The DES family recently lost an iconic colleague, Jody Conner, who looked deeply into every lake in this state and in many ways was our own Thoreau. At the time of his death, and some 30 years prior, Jody worked as the Director of DES’s Limnology Center, which he helped to establish for the purpose of protecting and ensuring the long-term quality of New Hampshire’s lakes and other water bodies.

It is in no small measure because of Jody’s efforts that New Hampshire’s lakes are the envy of the country, and the world for that matter. Jody had a way of making complex scientific issues so simple that everyone could understand how their actions play a role and why they need to get involved. One day many years ago, a state legislator asked Jody to explain to him how watersheds worked and why they are important. Jody told him to imagine a watershed as a funnel that we all live in, and because all rainfall that hits the sides of the funnel eventually ends up at the bottom of the funnel, practically everything we do in our daily lives has a collective impact on water quality in that watershed, no matter how far it may seem that we are from a water body. Shortly thereafter, the legislator appeared at a legislative hearing brandishing a large plastic funnel labeled watershed, and explained to his fellow legislators that because we all live in watersheds, sources of contamination like construction activities, road runoff, fertilizers and septic systems all have an impact on water quality, so they need to be properly managed. This ability to teach using simple imagery, to help the public look into the water and see their own and other’s impacts in the reflection, made Jody a powerful and persuasive force in helping to protect New Hampshire’s lakes for the future.

Because he grew up on New Hampshire’s lakes and appreciated them for all of their values, when he saw the impacts of human activities on these natural wonders, he took action, often with legislative support, to create many of the programs and approaches that are in place today to protect and restore water quality in the state’s water bodies. The list is long and includes monitoring for the effects of acid rain, beach inspections, biomonitoring, boat inspections (to prevent sewage discharges), sampling for mercury and toxic cyanobacteria, as well as the Clean Lakes Program, the Exotic Species Program, the Lakes Management and Protection Program and the Volunteer Lakes Assessment Program.

At a recent presentation in the Lakes Region, Jody concluded his talk with the following plea to the audience: “Get involved! Yes, YOU can make a difference! There are a variety of ways to help keep New Hampshire’s water quality great, including: participating in a local volunteer monitoring program on a lake, pond or river near you; becoming active in a local lake association, conservation commission or planning board; being a good land steward on your own property; staying informed on current issues and evolving solutions; reporting problems to appropriate officials so that they do not persist or grow.” These words are good counsel for all of us.

Jody will not soon be forgotten here at DES, and his positive impact on our state will be felt for generations to come. The depth of his nature was as deep as the deepest of New Hampshire’s lakes, and every bit as pure. Jody was an extremely humble person, never seeking public accolades, although he was certainly deserving. Those of us who had the privilege of being his students, colleagues and friends will carry on Jody’s work knowing that it’s what he would have expected of us. And New Hampshire’s lakes, those eyes of the earth into which Jody gazed so intently, will remain our landscape’s most expressive features thanks to what he did to love and care for them.

Editor’s Note: This article is reprinted from the July-August 2011 NHDES Newsletter ENVIRONMENTAL NEWS.

TO HONOR JODY CONNER’S LEGACY

DES is seeking ideas for one or more living memorials to Jody Connor and his work. If you have such an idea or would like to support such an effort, please send me your thoughts by Labor Day 2011 at: Thomas.burack@des.nh.gov.
2011 NHWPCA SUMMER OUTING HIGHLIGHTS
PHOTOS BY CHARLIE TYLER MWRA DEER ISLAND TREATMENT PLANT
THE OTHER TYPE OF WASTEWATER: LOW IMPACT DEVELOPMENT AND SUSTAINABLE DESIGNS FOR STORMWATER TREATMENT

By Ben Dreyer, Underwood Engineers

Wastewater is not the only water that we discharge to our streams and rivers that is requiring treatment these days. State regulatory agencies and local municipal boards are taking a closer look at pollutants carried in stormwater runoff and are adapting new standards for treatment measures to ensure the health and preservation of our natural waterways. NHDES set the precedent for local government bodies by adapting new rules that require implementing Low Impact Development (LID) techniques to treat and manage stormwater runoff impacted by site development. Many of the treatment principles that make LID effective are based on established wastewater treatment applications such as anaerobic nutrient removal provided by the gravel wetland, filtering pollutants with sand or other media and using gravity based pretreatment measures to settle large particles prior to targeting nutrient based pollutants.

Numerous LID practices have surfaced throughout the construction and development industry as a sustainable means to control and improve the quality of stormwater runoff. The essence of LID is to mimic natural stormwater hydrology by treating runoff “in situ” using natural features (e.g. vegetation), disconnecting impervious areas and encouraging groundwater recharge. Like wastewater treatment, LID elements are typically designed using a treatment train approach combining several treatment elements in series. The typical stages of a treatment train are summarized in the line diagram below:

![Treatment Train Diagram]

Some common LID design elements you may notice in your area or even at your treatment plant include Gravel Wetlands, Sand Filters, Rain Gardens, Tree Filters and Porous Pavements. Pretreatment systems for LID design elements include Sediment Forebays (gravity settling), Hydrodynamic Separators (enhanced settling tank), Water Quality Units (like a septic tank for stormwater) and Modified Catch Basins (outlet covers and deep sumps to catch solids). Because LID elements are now required for large site developments and expansions you may see some of these designs in future plant upgrades. Certain LID elements are also counted toward design points for LEED certified buildings which are becoming more common for WWTF’s in New Hampshire.

As with any effective treatment system, proper maintenance is the key. Standard wastewater treatment skills will be easily applied to implementing the maintenance steps required for stormwater discharges that preserve water quality.

Rain Garden – Keene NH

Porous Concrete Sidewalk – Keene NH
Can You Guess What This Is?

(Answer on inside back cover)
“Hey Frank, I think I got enough change for us to get lunch today!”

Answer to “Can You Guess What These Are” on page
A Turbine Sewer Machine Company - Drag Type Sewer Cleaner
Conclusion

The true success of a completed program is often measured by the multiple benefits achieved through its implementation. The future CSO abatement program will likely be one of the largest capital projects that the City has ever implemented. A project of this magnitude will need to be coordinated at many levels to ensure the visions for redevelopment and revitalization are met, making Manchester a better place to work and live. With a clear direction laid out, the City can expect to achieve further improvements to its overall environmental health and urban renewal visions through the implementation of future CSO abatement projects.