OLD COLONY PLANNING COUNCIL

Town of Halifax
Stormwater Mapping Assistance Project

September 2013

PREPARED BY OLD COLONY PLANNING COUNCIL
70 SCHOOL STREET, BROCKTON, MA 02301
UNDER MASSDOT CONTRACT #69649

Introduction

Weather events over the past year (October 2012 – September 2013) have been, as is typical for southeastern Massachusetts, variable and unpredictable. Hurricane Sandy, which struck New England in late October 2012, deposited 2.5 inches of rain on the Old Colony Region over the course of a four-day period.[1] While our region was spared a direct hit, the heavy rains, at a time when falling leaves tend to block up many storm drains, demonstrated the need for functional stormwater drainage systems.

While neither Hurricane Sandy nor 2011's Hurricane Irene were as severe for our region as the March 2010 storms which resulted in flooding throughout Massachusetts and Rhode Island, all of these events should serve as reminders of the importance of good stormwater management to our transportation network, our built environment, and the quality of our environmental resources. Inadequate or non-functioning drainage can lead to flooding, roadway damage, and pollution.

The geography of our region – generally flat terrain with many ponds and wetlands – combined with our relatively dense and growing population can lead to costly and damaging flood impacts in the event of severe weather. Additionally, scientific research on climate change indicates that the likelihood and severity of extreme weather events may increase in the future. These two factors place the burden of preventing stormwater-related damage directly on the condition, placement and efficiency of our stormwater infrastructure.

Towards this end, OCPC has been engaged in stormwater planning for our communities over the past four years. Possessing high-quality GIS data is a vital tool for proper stormwater management. In 2012, OCPC completed a study of the level of digitized geographic data that exists in the sixteen cities and towns in our region and found that while some towns are well prepared, others, particularly smaller towns, struggle with finding the resources, funding or expertise to complete these tasks. With our knowledge of stormwater management and our data collection abilities, OCPC is well suited to fill this role for our towns.

The NPDES Phase II Permit

Since 2010, Old Colony Planning Council has been engaged in efforts to identify areas where stormwater and roadway runoff problems exist and to offer solutions. In FFY 2012, Old Colony Planning Council examined our communities' preparedness for the issuance of the Environmental Protection Agency's (EPA) National Pollution Discharge Elimination System (NPDES) Phase II Permit program. This program regulates non-point source water pollution generated by urbanized area municipalities through their municipal separate storm sewer systems (MS4s). The initial permit was issued in 2003 and expired in 2008. The new permit, currently in draft form, has not yet been released in a final version.

Among the requirements to identify and mitigate non-stormwater discharges of pollutants, the permit calls for communities to identify and map outfalls and their contributing pipe networks, catch basins and catchment areas. The new permit will demand completion of this system mapping within two years of the permit's effective date[2].

Although there have been delays in the issuance of the permit, communities are wise to take steps immediately to begin mapping, especially if they have little or none of the mapping completed. OCPC recognizes that communities do not always have the most current technology available to them. The time commitments of learning a new technology, the cost of GIS software and hardware, and the realities of budgeting time and money for town workers are all reasons for the slow rate of adoption of GIS technology at the municipal level. OCPC, in contrast, benefits from the pooled resources of its communities and has many of the tools to simplify stormwater data collection work.

Recognizing this fact, the FFY 2013 phase of the Climate Change Roadway Drainage and Runoff Study is focused on stormwater mapping assistance for our communities.

Stormwater Mapping Assistance in Halifax

Upon completion of the report *The State of Stormwater Mapping in the OCPC Region* in October 2012, OCPC contacted member communities to share the GIS data created for the project. This data was contained within a geodatabase, showing hydrology features in each town – river networks and water bodies. This work is mostly complete, though still being refined by adding flow directions and river attributes. In addition to the data, OCPC offered mapping assistance for towns to comply with the NPDES Phase II permit. The Town of Halifax, specifically the Highway Department, responded in late October of 2012 and indicated interest in our assistance. The Halifax Highway Department is responsible for stormwater management in the town, and annual progress reports have been submitted to the EPA by Highway Surveyor Robert Badore.

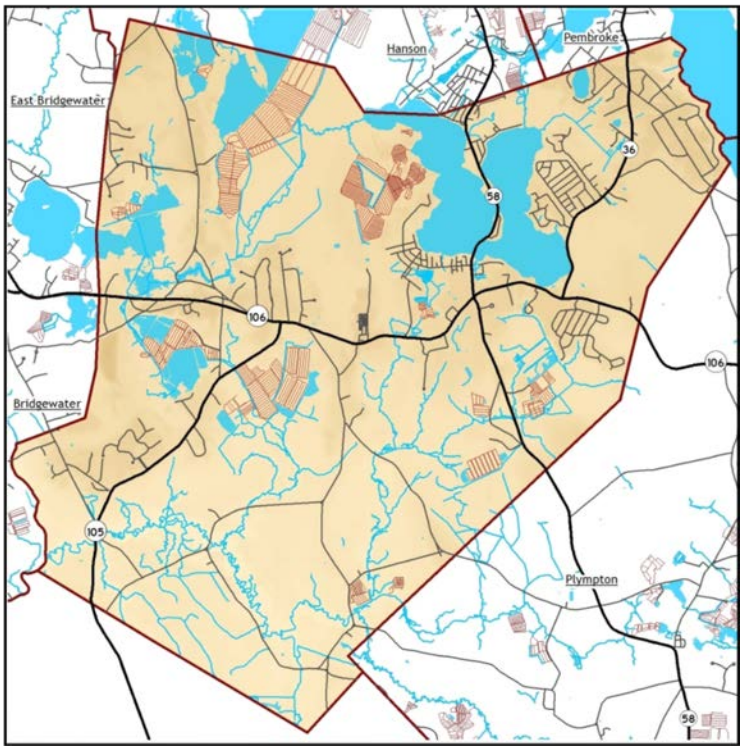

Figure 1. Map of Halifax

Like many small communities, resources for supplementary projects such as stormwater mapping are often scarce. Halifax's population, and therefore its tax base, is the fourth smallest in the region and the second least dense. The Highway Department employs five full-time workers, none of whom had prior experience with GIS technology. The Halifax Water Department, with which the Highway Department shares a facility, is using Toughbook Laptops in the field, but feels that they are not utilizing them to their full ability. The Highway Department possesses a Trimble GIS unit, but it is currently non-functioning. OCPC trained the former Highway Surveyor in its use in 2006, but she departed several years ago.

Since that time, Halifax hired an outside consultant to map the locations of catch basins, but they were dissatisfied with the work and it was left only partially complete. With no existing data of verifiable quality to work with, it was decided that OCPC should construct a new stormwater infrastructure database for Halifax. The finished geodatabase would contain feature classes for catch basins, outfalls, pipes, culverts and junctions, while also showing catchment areas for each outfall and flow direction. This geodatabase should also align with the OCPC Hydrologic Features geodatabase, created for the 2011 Roadway Drainage and Runoff Study, which includes streams and water bodies. Together these provide a spatial representation of the movement of water throughout the town of Halifax and the region.

The Halifax Highway Department suggested that one of their workers accompany us in the field to open each catch basin. This would allow the Highway Department staff to assess the condition of the basins for the purpose of regular maintenance, and would allow us to see the direction of pipes leading into and out of the basin. The pipe directions, as well as the institutional knowledge of Halifax Highway Department workers, would let us infer the connections among basins, junctions, trunk lines and outfalls.

On May 21st, we began mapping. We brought our Trimble GeoXT mobile GIS unit as well as 11x17 orthophoto printouts of the neighborhoods that we intended to map. Using ArcPad, a version of ArcGIS intended for use on small devices rather than desktop computers, we edited a shapefile of catch basins, adding in information on the number of pipes visible in the basin, the direction of these pipes, and whether or not the basin was flooded. On the paper maps, we wrote textual notes and drew sketches of the basins and pipes, showing connectivity and possible outfalls.

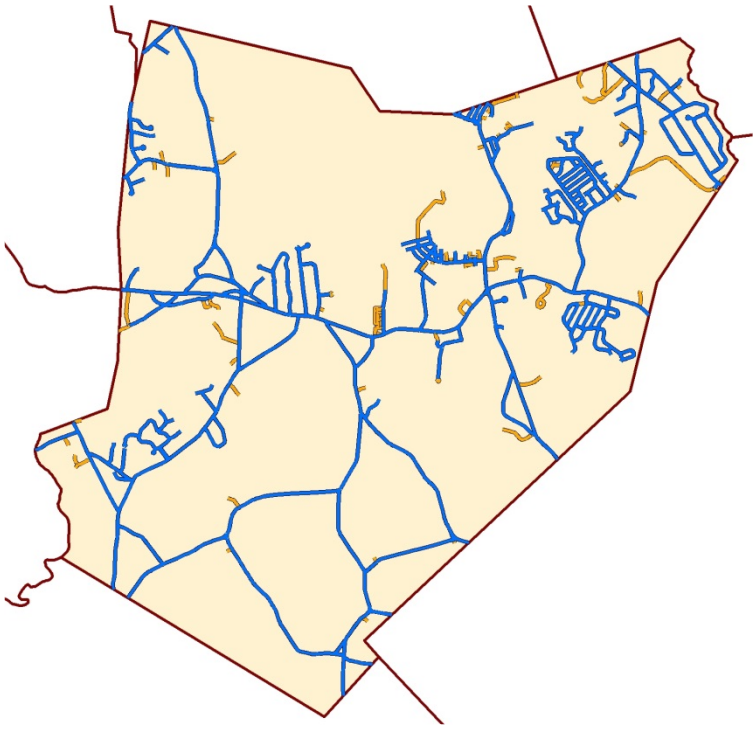

Figure 2. Roads surveyed in the 2013 Stormwater Mapping Assistance Project. Blue roads represent those surveyed. Roads known to have no drainage, dirt roads, and private ways were not considered.

A Highway Department employee assisted us at all times, opening the grated covers of the catch basins and providing information on where the catch basin would likely empty out as well as instructing us on the common methods used in designing stormwater drainage systems. From their local knowledge, we were able to identify many of the likely locations of the outfalls.

For the first four visits to Halifax, two OCPC staff members did the mapping in tandem. This was useful for instructing staff in the use of the Trimble unit, as only one team member had prior experience with it. In all, four OCPC staff participated in the mapping project. After each person had been trained on the Trimble, mapping could be accomplished efficiently by one person$_3$.

Mapping Halifax's Stormwater Network

The Town of Halifax has a flat topography, with the difference between the highest and lowest points in town being less than 50 feet. Extensive wetlands cover the north-central part of town, while cranberry bogs are scattered throughout. The majority of the town is located in the Taunton River Watershed; therefore the general flow of water is to the south and west. The major river in Halifax is the Winnetuxet, a slow-moving, broad tributary of the Taunton. The twin lakes of East and West Monponsett are a dominant feature, as is Silver Lake to the northeast. Given the flat terrain and numerous bodies of water, one might expect Halifax to be vulnerable to flooding; however, the soil is very sandy and percolates well. Even during events such as Hurricane Irene or the March 2010 floods, Halifax had little or no flooding.

Figure 3. An example of a typical catch basin, showing concrete and metal pipes.

Development in Halifax is clustered around the areas of relatively higher ground. The oldest neighborhoods, built generally before 1960, are tightly crowded near the ponds. A corridor of development extends along Route 106, the town's major east-west route, and between the ponds. Newer developments exist in the northeast corner of town and the southwest. Commercial development is located mainly on numbered routes passing through town: Route 106, Route 58, which is the major north-south route, and Route 36, a short numbered route which begins in east Halifax.

Drainage systems in the town are of varying ages and construction styles. Only a few newer developments such as the Highland Circle subdivision in south Halifax, deposit their stormwater in retention basins. Most of the town's stormwater drainage flows into streams, ponds, or wetlands.

Given the age of the stormwater network's construction, drains and outfalls are often hidden in dense plant cover. In many cases, we would have been unable to confirm the existence of outfalls without the knowledge of Halifax Highway Department workers. The database reflects this, labeling outfalls where we were able to visually confirm their location as Verified, or outfalls where the location was not confirmed as Inferred.

In sixteen sessions of mapping, OCPC staff members were able to locate 1,207 catch basins. Each was

opened and examined. From the direction of the pipes leading from the drain, 53 outfalls were verified, as well as 49 possible unverified outfalls. Some drains led only to leaching pits, particularly in the mobile home park on the town's eastern edge, while approximately 13 basins were too flooded to determine the pipe directions with any accuracy. When we were unable to determine if or where pipes led from the basin, we looked for clues in the roadway, such as the appearance of manhole covers, indicating a pipe junction, or patches or depressions in the road where the pipe was buried. All of the junctions were inferred from the presence of manhole covers, the direction of the pipes, and the terrain of the area.

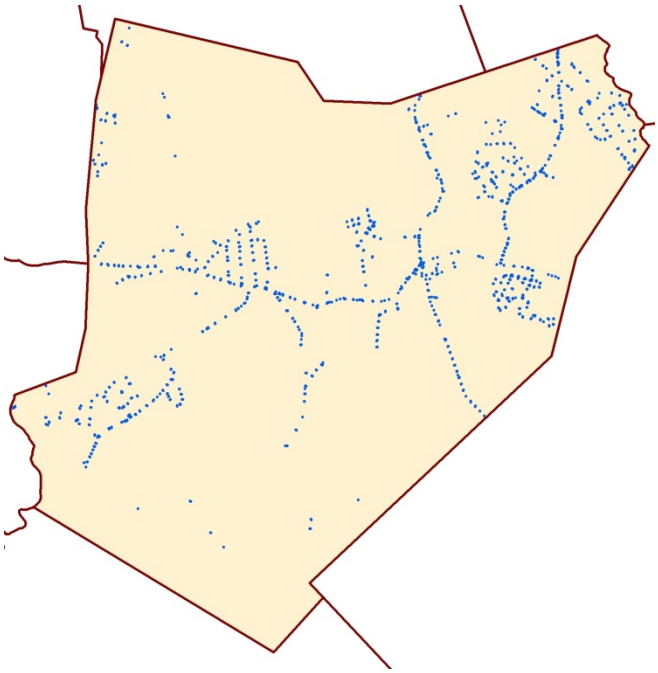

Figure 4. A map of the 1,207 catch basins located in this study.

No areas of flooding that were previously unknown were identified in this study. Even catch basins that lay under heavy vegetation, where drain clogging could be an issue, have only localized, minor pooling of water that has not affected property owners. There are two reasons why this is. As mentioned before, the sandy soils of Halifax absorb stormwater more quickly than other towns in our region. Therefore, barring an extended period of precipitation when the ground is already saturated or a very sudden, intense rainfall, most stormwater subsides into the ground. Also, where there has been flooding in the past, the Halifax Highway Department has responded and built the necessary drainage to keep the area dry.

The proper placing and carrying capacity of drainage is important, but just as important is regular maintenance and cleaning. The Town of Halifax hires an outside contractor to clean the basins annually. During our inspection of the catch basins, we noted that a large number of them are offset – the basin is several feet away from being directly under the storm drain grating. This presents a challenge for cleaning, as the contents of the basin cannot be reached from the surface. There is no easy solution to this problem until the roadway is reconstructed and the drainage modified.

When roadways are reconstructed and drainage is rebuilt, modern techniques can be used to ensure that the drains are accessible for cleaning and functioning to keep pollution minimized. The most recent stormwater improvements in Halifax, in particular the commercial areas on Route 106 west of the center, have oil and gas separators. Separators are little more than an elbow-jointed pipe facing down into the storm drain. Oil and gas pollutants in the stormwater float above the water surface, and thus the water conveyed through the pipe is mostly free of these. It is OCPC's recommendation that this kind of drainage be phased in gradually as drainage structures are repaired or rebuilt.

Next steps

Halifax's Highway Department has been provided with our draft maps of the stormwater network, and will be filling in gaps in our knowledge with their own institutional expertise. Should further review be necessary, the Highway Department keeps an archive of road construction plans. This will allow us to gain a complete picture of stormwater drainage in Halifax.

Figure 5. Detail of catch basins, pipes, junctions, and outfalls near Christmas Tree Lane in Halifax.

The next step toward providing Halifax with a comprehensive stormwater map is to map all the outfalls. Access to all the outfalls was not practical during the summer, when the data collection was undertaken. Halifax is a heavily forested town with abundant wetlands, and the summer of 2013 had more precipitation and higher temperatures than normal, providing excellent growing conditions. Many outfalls were simply inaccessible at that time of year. Outfall mapping will occur as part of a future element of the Roadway Drainage and Runoff Study, in the autumn or spring when plant cover is reduced.

Once the outfalls are mapped, OCPC will determine the catchment area boundaries for each outfall. By delineating the area from which an outfall collects its stormwater, pollution can be tracked to its source more easily. OCPC will use LIDAR elevation data made available by the Massachusetts Office of Geographic Information (MassGIS) in 2011 to find ridgelines and flow directions. This elevation data has a one-meter resolution, which should be sufficient even for the flat terrain of Halifax.

Continuing on into the future, OCPC will reach out to its other member communities who are in need of assistance on stormwater mapping, particularly those identified in the 2012 *State of Stormwater Mapping* report.

Endnotes

1. National Climate Data Center http://www.ncdc.noaa.gov
2. Section 2.4.4.6 of NPDES Phase II Permit
3. See Appendix 1

Appendix 1: Stormwater Mapping Sessions in Halifax

Staff	Date
Andrew Vidal, Kyle Mowatt	5/16
Andrew Vidal, Kyle Mowatt	5/21
Andrew Vidal, Josh Callahan	5/23
Andrew Vidal, Shawn Bailey	5/30
Andrew Vidal	6/4
Josh Callahan	6/6
Kyle Mowatt	6/11
Shawn Bailey	6/13
Andrew Vidal	6/18
Josh Callahan	6/20
Kyle Mowatt	6/25
Shawn Bailey	6/27
Andrew Vidal	7/9
Andrew Vidal, Shawn Bailey	8/1
Andrew Vidal, Shawn Bailey	8/6
Andrew Vidal, Shawn Bailey	8/8