FACILITIES PLAN

FOR

WATER AND SEWER SYSTEMS

HALIFAX COUNTY, VIRGINIA

Prepared For:

Halifax County Service Authority
2529 Houghton Road
South Boston, Virginia 24592

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1.0 INTRODUCTION

1.1 General Information

Halifax County is located in south central Virginia, adjacent to the State of North Carolina border. The local governments have established an "Urban Planning Area" (UPA), which surrounds the Towns of Halifax and South Boston and provides zoning and land use guidance for the development of lands within the designated area. Utility development and directed growth for Halifax County in the foreseeable future is expected to occur largely within the UPA. Municipal utility infrastructure, consisting of water and sewer systems, is concentrated in and near the two Towns.

The water and sewer systems in the UPA are operated by the Halifax County Service Authority (HCSA). HCSA was originally formed on July 1, 2007. Water and sewer assets were transferred to HCSA from the Town of South Boston, Town of Halifax and Halifax County on January 1, 2008. Most of the infrastructure transferred in 2008 remains in service today, however, many capital projects have been undertaken to replace and/or add infrastructure to the water and sewer systems.

A map of Halifax County, showing the extent of the UPA, is included as Figure 1.

1.2 Purpose Of This Report

HCSA has been in full operation for six years. Until now, the Authority has been guided in part by a Water and Sewer Master Plan (2005), which was developed for the purpose of documenting infrastructure of Halifax County and the Towns of Halifax and South Boston, as they considered forming the HCSA. Conclusions and recommendations in that document have served as the basis for several of the capital improvements accomplished to date. Other improvements have been introduced into HCSA's plans and completed as needs were recognized. Considerable progress has been made in the improvement of above-ground facilities, primarily including water and sewage treatment plants and lift stations. In addition, some underground work has been completed to replace piping infrastructure and extend service system limits.

At this time, HCSA is in need of a new guidance document to outline and prioritize future capital improvements. It is desired, in preparation of this document, to analyze functionality, age, condition and criticality of each component of the physical assets of the existing water and sewer systems. Through this evaluation, the facilities in the system which are most in need of replacement or upgrade, will be revealed and can be scheduled for attention within a structured Capital Improvement Program.

A secondary purpose of this report is to create a database into which new or revised information can be imported over time to facilitate the updating of the Facilities Plan in the future. As system improvements are completed and other records are maintained, this data will be introduced into the database and the prioritization of potential projects will be easily revisited. The vehicles for collection and import of data will be the existing water and sewer system hydraulic models and the Authority's current record keeping system for operation and maintenance.

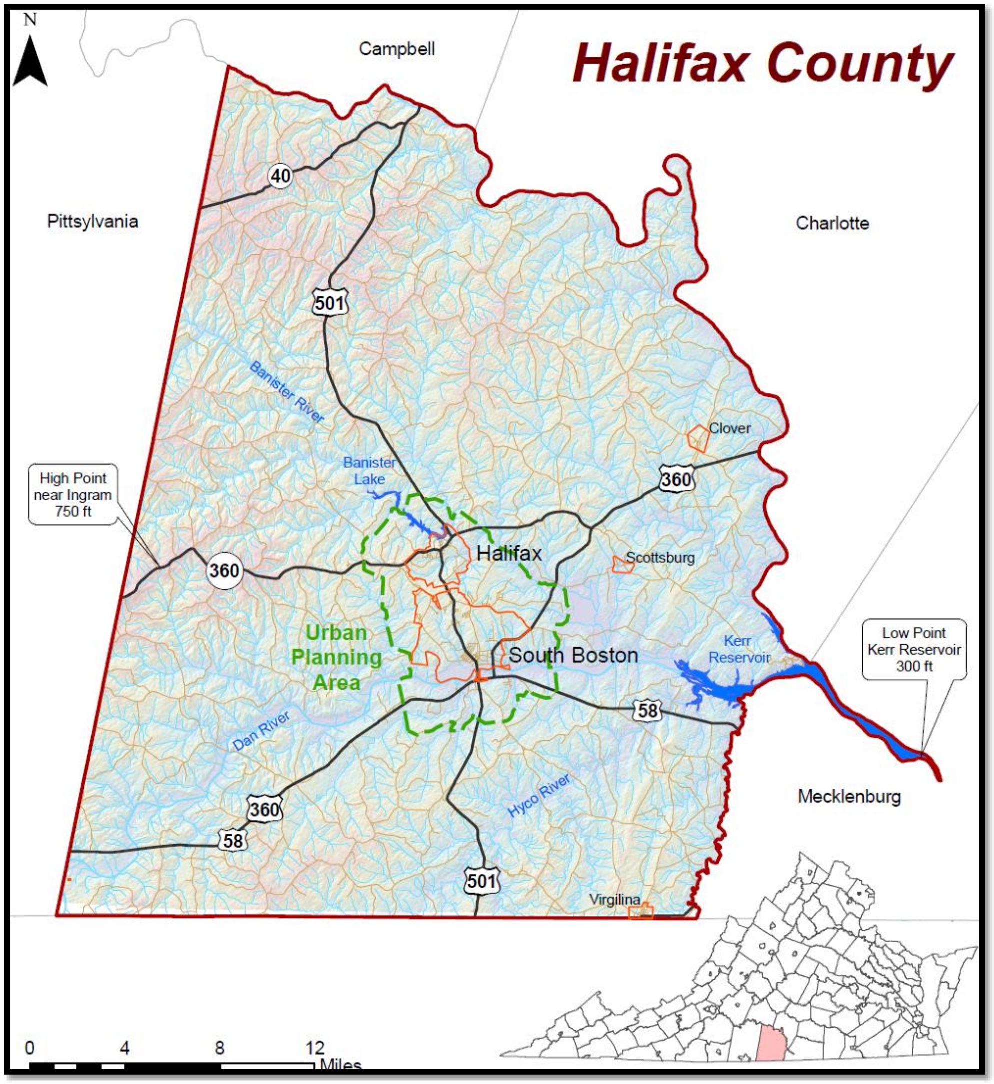
1.3 Background Information

In order to complete this Facilities Plan, existing system resources were reviewed. The following documents, among others, were utilized in this effort:

1. Halifax County Water and Sewer Master Plan, December 31, 2005.
2. HCSA Water Model, constructed and operated by Draper Aden Associates.
3. HCSA Sewer Model, constructed and by Olver & Associates and operated by HCSA (lacking Town of Halifax sewer system).
4. Halifax County GIS information.
5. VGIN Aerial Photography.
6. Miscellaneous Design Plans documenting existing infrastructure.
7. HCSA Operations and Maintenance records.

Along with the resources noted above, it is appropriate to credit the organizations and persons who have had input to this report via meetings, telephone conversations and review comments. In particular, we acknowledge the assistance of Halifax County Service Authority Board Members, Executive Director and Staff.

Figure 1: Halifax County UPA



2.0 EXISTING WATER SYSTEM

2.1 Introduction

This project considers the existing water system assets of the Halifax County Service Authority (HCSA) serving the Urban Planning Area (UPA) of Halifax County. The effectiveness of existing facilities in the system is examined in some detail and recommendations are made for improvements to better meet the present and future needs of the systems. The basic infrastructure of the HCSA water system is shown on Figure 2.

2.2 HCSA's Urban Planning Area Water System

HCSA draws its water from the Dan River. HCSA operates a 3.0 MGD capacity water treatment plant in the southern portion of the Town of South Boston. The system's Raw Water Pumping Station is rated at 3.0 MGD capacity and uses vertical turbine pumps to elevate the flow from the river to the treatment facility. The Water Treatment Plant uses conventional chemical addition, coagulation, flocculation, sedimentation, filtration and disinfection to produce potable water. The plant was constructed in 1953. Finished Water Pumps, two rated at 1.01 MGD, one at 1.70 MGD and one at 1.28 MGD, deliver the potable water into the distribution system. Three of the pumps usually operate concurrently throughout the operating day with periodic adjustments as system tanks empty and fill. With a current customer base of 10,000 persons, the plant has an average production of about 1.40 MGD in recent years, with maximum day flows reaching 2.00 MGD on very rare occasions.

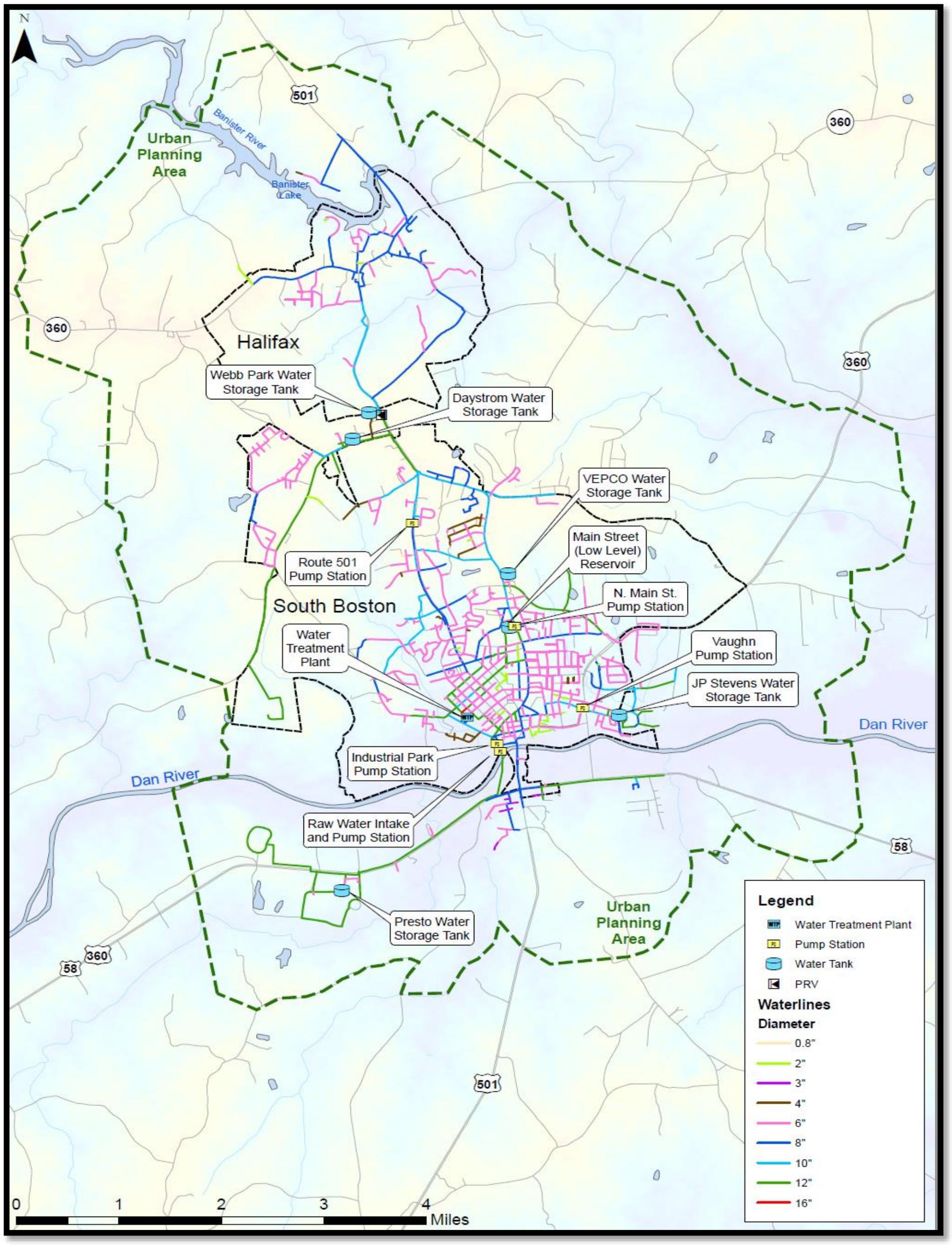
Finished water is pumped from the plant into the distribution system where HCSA operates six pressure zones. The lowest pressure zone (SB Zone 1) serves the downtown area of South Boston and areas along the Dan River. It operates at a gradient controlled by the level in the Main Street (or Low Level) Reservoir (USGS elev. 489.0 ft). A small zone (SB Zone 1A) in the eastern portion of South Boston, known as "Vaughan," operates on the level of the JP Stevens Tank (USGS elev. 502.1 ft). The Vaughan Pump Station delivers water to the zone and typically operates at about 620 gpm. The industrial zone (SB Zone 1B), on the south side of the Dan River, operates on the level of the Presto Tank (USGS elev. 549.0 ft). The Industrial Pump Station delivers water to the zone and operates at about 740 gpm. The intermediate pressure zone (SB Zone 2), in South Boston, is fed from the lower zone and is controlled by elevation of storage in the VEPCO Tank

(USGS elev. 595.8 ft). The North Main Street Pump Station delivers water to the zone and operates at about 1,400 gpm. The highest pressure zone (SB Zone 3) is fed by pumping from the intermediate zone and serves areas in the northern portion of the Town of South Boston and around the southern perimeter of the Town of Halifax. This zone is controlled by the Daystrom Tank (USGS elev. 629.0 ft). The Route 501 Pump Station delivers about 800 gpm to this zone. The old Town of Halifax zone (H Zone) is the final zone, which is controlled by the level of the Webb Park tank (USGS elev. 585.85 ft). A Backpressure Sustaining Valve releases flow from the Daystrom zone to feed the Webb Park tank. A summary of the basic parameters for the existing water storage tanks is presented below in Table 1:

Table 1: Existing Water Storage Tanks

Storage Name and Zone of Operation for HCSA Tanks	Full Capacity (gallons)	Approximate Effective Volume (gallons)	Tank Overflow Elevation (ft above sea level)	Storage Tank Type
Main Street – South Boston 1 (Finished Water)	1,000,000	600,000	489.00	Ground Level Welded Steel
JP Stevens – South Boston 1A (Vaughan)	500,000	465,000	502.10	Elevated Welded Steel
Presto – South Boston 1B (Industrial)	500,000	500,000	549.00	Elevated Welded Steel
VEPCO – South Boston 2 (North Main St)	850,000	425,000	595.80	Ground Level Welded Steel
Daystrom – South Boston 3 (Route 501)	100,000	100,000	629.00	Elevated Welded Steel
Webb Park – Halifax (Backpressure Valve)	200,000	200,000	585.85	Elevated Welded Steel
Totals for HCSA Tanks	**3,150,000**	**2,290,000**		

Figure 2: HCSA Basic Water System Infrastructure



3.0 ASSESSMENT OF ABOVE GROUND WATER SYSTEM FEATURES

3.1 Raw Water Pump Station

The Raw Water Pump Station draws water from the Dan River at rates up to 3.0 MGD. The pump station has been reliable and will remain in service to feed the Water Treatment Plant. No significant capital improvements are needed at the Raw Water Pump Station.

3.2 Water Treatment Plant

The Water Treatment Plant is rated for a capacity of 3.0 MGD. It is located at the end of Leigh Street, in the southwest corner of the Town of South Boston. It is an award winning plant, made possible by its committed operators. The plant has been reliable and will remain in service to provide safe potable drinking water to the Authority customers. No significant capital improvements are needed at the Water Treatment Plant.

3.3 Main Street (Low Level) Reservoir

The Main Street Reservoir is a 1.0 MG ground level water storage tank constructed of welded steel. It is located in the central area of the Town of South Boston near the intersection of Main Street and Mason Street. Its floor elevation is 467.00 and overflow elevation is 489.00. It is approximately 88 feet in diameter. It receives water from the Finished Water Pumps at the Water Treatment Plant. Effective volume is estimated to be 0.6 MG for service to customers in the South Boston Low Service Zone (SB Zone 1). A primary concern at this tank is the low pressure resulting on the outlet line, to the North Main Street Pump Station, when the pump station is operated. In the future, when water demands increase it is expected that this situation will become more pronounced. It has been proposed that this tank be replaced on site with a taller and narrower ground level water storage tank with overflow elevation at about elevation 515.00 and diameter of 62 feet. This improvement would be completed within a future project called “Tank Consolidation Project.”

3.4 North Main Street Pump Station

The North Main Street Pump Station is located on the west side of Main Street immediately adjacent to the Main Street Reservoir. The original pump station structure and equipment from the 1950’s remains on site, although it has been deactivated. New pumps and controls were installed in 2008. There are two Baker Pitless Booster Pumps on site, each with capacity of 1,400 gpm to deliver flow to the VEPCO Water Storage Tank. The pumps have performed well overall. However, an internal check valve in one of the units has been troublesome, causing excessive repair bills for the HCSA. To remedy the check valve problem it is proposed to construct an external check valve vault, where the operation of the valves can be monitored and repairs will be simpler and less costly.

3.5 VEPCO Water Storage Tank

The VEPCO Water Storage Tank is a 0.85 MG ground level water storage tank constructed of welded steel. It is located on North Main Street north of Hamilton Boulevard. Its floor elevation is 506 and overflow elevation is 595.80. It is approximately 40 feet in diameter. It receives water from the North Main Street Pumps. Effective volume is estimated to be 0.425 MG for service to customers in South Boston Service Zone 2 (SB Zone 2). A primary concern on this site is the condition of the tank. It is in desperate need of maintenance for corrosion protection and coating. It has been proposed that this tank be removed from the site and its capacity be replaced using a 1.0 MG elevated tank at Centerville. The Centerville tank would be equipped with overflow elevation at about elevation 629.00 and would be 33 feet deep with diameter of 72 feet. This improvement would be completed within the "Tank Consolidation Project." The Centerville site will include space for a second equally sized tank.

3.6 Vaughan Pump Station

The Vaughan Pump Station is located on the east side of the Town of South Boston near the intersection of Vaughan Street and Riley Avenue. It draws water from SB Zone 1. It delivers flow to the JP Stevens Water Storage Tank in South Boston Service Zone 1A (SB Zone 1A) at an estimated rate of 620 gpm. These pumps have served well over the years. When the Main Street Water Storage Tank is replaced with a larger tank at a higher operating grade, it is thought that these pumps will be able to be removed from service. This removal would take place under the "Tank Consolidation Project."

3.7 JP Stevens Water Storage Tank

The JP Stevens Water Storage Tank is a 0.5 MG elevated water storage tank constructed of welded steel. It is located at the east end of Vaughan Steet near the intersection of Willow

Street. It is 50 feet in diameter, with water depth of 34 feet and overflow elevation at 502.10. It receives water from the Vaughan Pumps. Effective volume is estimated to be 0.465 MG for service to customers in SB Zone 1A. A primary concern on this site is the condition of the tank. It is in need of maintenance for corrosion protection and coating. It has been proposed that this tank be considered for removal from the site and its capacity be included in the replacement Main Street Reservoir. This optional change in storage could be completed within the "Tank Consolidation Project."

3.8 Industrial Pump Station

The Industrial Pump Station is located on the south side of the Town of South Boston at the south end of Ferry Street near the intersection of Seymour Drive. It draws water from SB Zone 1. It delivers flow to the Presto Water Storage Tank in South Boston Service Zone 1B (SB Zone 1B) at an estimated rate of 740 gpm. These pumps have served well over the years. These pumps will remain in service in their current role in the system. No significant capital improvements are needed at the Industrial Pump Station.

3.9 Presto Water Storage Tank

The Presto Water Storage Tank is a 0.5 MG elevated water storage tank constructed of welded steel. It is located in the industrial park at the south end of the Town of South Boston, along Industrial Park Road. It is 50 feet in diameter, with water depth of 34 feet and overflow elevation at 549.00. It receives water from the Industrial Pumps. Effective volume is equal to the total volume of 0.5 MG for service to customers in (SB Zone 1B). This tank is in good condition and will remain in service to satisfy water demands and fire protection needs in the Industrial Park. No significant capital improvements are needed at the Presto Water Storage Tank.

3.10 Route 501 Pump Station

The Route 501 Pump Station is located on the northwest side of the Town of South Boston along Route 501, near White Oak Drive. It draws water from SB Zone 2. It delivers flow to the Daystrom Water Storage Tank in South Boston Service Zone 3 (SB Zone 3) at an estimated rate of 800 gpm. These pumps have served well over the years. With the removal of the VEPCO Tank and the Daystrom Tank in the future, these pumps will be able to be removed from service. This removal would take place under the "Tank Consolidation Project."

3.11 Daystrom Water Storage Tank

The Daystrom Water Storage Tank is a 0.10 MG elevated water storage tank constructed of welded steel. It is located on Greens Folly Road near Holland Drive. It is 30 feet in diameter and 19 feet in water depth with overflow elevation at 629.00. It receives water from the Route 501 Pumps. Effective volume equals the total volume 0.1 MG for service to customers in SB Zone 3. A primary concern on this site is the condition of the tank. It is in desperate need of maintenance for corrosion protection and coating. It has been proposed that this tank be removed from the site and its capacity be replaced using a 1.0 MG elevated tank at Centerville. The Centerville tank would be equipped with overflow elevation at about elevation 629.00 and would be 33 feet deep with diameter of 72 feet. This improvement would be completed within the "Tank Consolidation Project." The Centerville site will include space for a second equally sized tank.

3.12 Webb Park Water Storage Tank

The Webb Park Water Storage Tank is a 0.20 MG elevated water storage tank constructed of welded steel. It is located off Route 501 on Moore Avenue on the southside of Halifax. It is 36 feet in diameter and 26 feet in water depth with overflow elevation at 585.85. It receives water from the Daystrom Water Storage Tank through a backpressure sustaining control valve. Effective volume equals the total volume 0.2 MG for service to customers in the Halifax Zone (H Zone). A primary concern on this site is the condition of the tank. It is in desperate need of maintenance for corrosion protection and coating. It has been proposed that this tank be removed from the site and its capacity be replaced using a 1.0 MG elevated tank at Centerville. The Centerville tank would be equipped with overflow elevation at about elevation 629.00 and would be 33 feet deep with diameter of 72 feet. This improvement would be completed within the "Tank Consolidation Project." The Centerville site will include space for a second equally sized tank.

3.13 Previously Abandoned Water System Facilities

It is noted that certain facilities remain in place, despite having been abandoned in years past. One of those facilities is the Halifax Water Treatment Plant, on Banister Lake. When the County of Halifax and the Towns of South Boston and Halifax formed the Halifax County Service Authority, the County and Town systems were merged, and the old Halifax Water Treatment Plant was no longer needed. Another abandoned facility is the 60,000 gallon elevated water storage tank in the downtown area of the Town of Halifax. That tank was removed from the system long prior to the formation of the Service Authority. No changes are needed at either of these sites.

4.0 ASSESSMENT OF BURIED WATER SYSTEM FEATURES

4.1 Water System Map

A water system map (and map book) is included along with this report for reference (Appendix A). The map identifies many of the above ground facilities in the water system by name. Underground facilities are referenced by the alpha numeric name given them in the HCSA water model. This mapping has been reviewed multiple times, and it is expected that any errors shown thereon are minor in nature. It is important to have the map updated when errors are located, to maintain the highest integrity of HCSA records and the model calibration.

4.2 Database Development – Fixed Data

In order to organize system data and coordinate it with the existing Bentley WaterCAD water model data, a database has been established. The database is titled "Facilities Plan – Asset Inventory and Status Chart – Water." The database is maintained to work with the WaterCAD software associated with the model. When a water system operating condition is run on the model, the output data can be transferred to the database. In general, two primary operating conditions will reflect the operation of the system over 95% of the time. The first condition is a tank-emptying situation, which simulates the system after water treatment plant shutdown. Virtually all the tanks are full under this condition as they drain to the system to meet water demands. The second condition is a tank-filling situation, where the system pumps are in operation and are recharging the tanks. These two conditions are relatively simple to run in the model with some reliability. Other common system conditions might include fire flows required at certain localized hydrants or water breaks, again at localized areas. Because fire flows and breaks do not consistently occur at the same place, it is difficult to provide a single representative model run to replicate fire conditions or breaks. The database focuses only on normal water supply conditions, in the absence of fire flows and breaks. The database is included for reference (Appendix B).

The database has over 900 lines of data included, each line relating to a single pipeline section in the water system. The pipe ID is the name of the pipe as shown on the water map. The upstream and downstream junctions are the ends of each pipeline section. The name of each junction is also taken from the water map. Since the naming and numbering of the pipes and junctions is not intuitive, a column is provided that indicates the physical location of the pipe, generally by street name and address. For crosslot pipes, a common local name for the area in which the pipe is located has been chosen as the address. As a rule, this information is imported directly from the water model into the database spreadsheet.

The next columns of the database provide some physical description of each pipe. Included in the physical description are the diameter, material and length of the pipe section. These bits of information are also imported directly from the water model. Inherent in the material of the pipeline is the overall life expectancy in the water system service. Ductile iron has been assigned a life of 75 years, PVC 50 years, Cast Iron 40 years and Asbestos Cement 40 years.

In addition, information relating to the construction date, its current age and remaining life expectancy are provided. The construction date is input manually. The pipe's current age will calculate automatically and the remaining life expectancy will be automatically entered based upon the materials of construction.

The zone in which the pipe segment resides is provided in the table and is another export feature of the model. Each of the five South Boston zones and one Halifax zone are included.

All of the data provided to this point in the database is 'fixed' data, which will be the same independent of which model condition is under observation.

4.3 Database Development – Dynamic Data

Dynamic data will change depending upon the operating condition of the model. The data appearing in the table for a tank-emptying scenario will differ from the data for the tank-filling scenario. Generally, the range between the data values will represent the total variation of a system parameter under normal operating conditions.

The upstream and downstream HGL values represent the hydraulic grade level of the water in the pipeline at the ends of the pipe. The HGL is expressed in elevation, in feet, above sea level. The HGL varies linearly to pressure in the system. A higher HGL is indicative of a higher pressure, if measured at the same location. The upstream and downstream pressures are determined by subtracting the pipe elevation from the HGL and converting the head in feet, to pressure in psi. A pressure gauge reading at the system location would ideally read this pressure. These values are exported from the model into the database.

The flow (gpm) in the pipeline and the flow velocity (fps) are provided based upon the operating condition and are also exported from the model.

The headloss is a measure of the loss of pressure as the flow is conveyed through the pipe. Since the overall headloss depends greatly on the length of pipe, a value for the headloss per 1,000 feet is also given. This headloss number can be compared between pipes in the system and allows us to evaluate which pipes are too restrictive for flow in the system. A high headloss per 1,000 feet warrants a pipe review to determine if the pipe should be increased in size or the system needs to be looped. This information is exported from the model.

These dynamic data have been compared under average day flow conditions and peak flow conditions. The average day flow represents a normal flow condition and is the annual average rate. The peak flow condition is basically two times the average flow and is representative of a summertime flow during a higher demand period of the day (say daybreak when people use the most water to prepare for their day).

4.4 Database Development – Trending Data

Trending data is data that is manually tracked and automatically scored to provide evidence of a need for replacement of piping. These data are observed by the operators of the water system, and not analyzed in a model.

Condition is a judgment determination of the integrity of the pipeline. Condition data may be gathered by 1) determination of pipe age against life expectancy, or 2) inspection of a main that has been uncovered for inspection or repair. A water main that is in excellent condition would receive a grade "1" in this column (indicating high integrity). A water main that shows evidence of erosion of wall thickness, deterioration of material, or other deformities would receive higher number grades based upon observations or age. In the initial database we have assigned the pipes with the least remaining life expectancy a grade of "5." This is for pipes with less than 5 years of remaining life. Grade "4" is for pipes with 5-10 years remaining, grade "3" is for pipes with 10-15 years remaining, grade "2" is for 15-20 years remaining and grade "1" is for pipes with over 20 years remaining life expectancy. As HCSA observes the physical condition of various lines in the future, these grade values can be adjusted to account for accelerated wear, or exceptional maintenance (abnormal aging).

Criticality is also a judgment determination of the importance of the pipeline. Criticality is determined by considering 1) how much water is delivered through the pipe, 2) who is receiving the water from this pipe, or 3) how much damage might occur from a water break at this location.

A pipe that carries water from a pump station to a storage tank (feeding an entire pressure zone), or one that feeds a hospital, school, government or military complex, or one that operates at high pressure and could washout a bridge or other important infrastructure, would rise to the top of the criticality scale, and receive a grade “5”. A neighborhood water main within a larger piping grid would likely receive a very low score for criticality. For the initial database, we have used a grade “5” all lines that are critical to keep storage tanks full. A “4” has been used for lines feeding critical facilities such as hospitals, schools and commercial/industrial areas. A “3” has been used for the highest flow lines (many of these may already be assigned higher numbers). The grade “2” is used for moderate flow lines and “1” is used for the lowest flowing lines in the system.

Break History is a partial judgment determination, but is based on history of the main relative to water breaks. A main that has had to be repaired several times in a short period of time shows evidence that something is wrong. It may be poor materials, high pressure, poor bedding conditions in the trench or just poor installation by a contractor. If the break history is frequent, it will pay to have the pipe replaced. An active break history will receive a grade 5. For the initial database, we have assigned a number equaling the number of breaks that have been recorded on the HCSA maintenance record over the past three years. The overall scale is 1 to 5.

Dirty Water History is also a partial judgment determination, and is based on history of the main to deliver good quality water. Dirty water can originate in a number of ways. In the HCSA system, it is often a consequence of old cast iron pipe, which has corroded significantly. Under various water supply conditions, where the rates of flow are subject to change, the flow velocity will pick up sediments or corroded elements in the pipe and deliver them into the local water services, resulting in dirty water complaints from customers. For the initial database, we have assigned a number equaling one half the number of water quality complaints over the past three years. The overall scale is 1 to 5.

Water Leakage is a judgment determination, but one made when there is some evidence of water leaks. HCSA makes a habit of correcting leakage once it is found. If the leakage event has been documented in the repair records of the Authority then the operator of the system can assign a value to each pipe based upon the leakage history. A pipe that has had an active leakage history will receive a higher grade than one that has had no leakage concern. The overall scale is 1 to 5.

Total Score is the sum of the trending data values for a pipeline. The total score is a direct indicator of how many problems are inherent in a segment of pipe, or the importance of the pipe in the system, and therefore relates to priority for repair or replacement. It is worth noting that the trending data parameters can be weighted if, in HCSA experience, one of the parameters is more directly associated with the need to replace a pipeline. The initial database has been set up with equal weight on each of the parameters.

4.5 Using the Database

The database includes over 900 lines of data. Manual searching of a pipe ID, junctions or block addresses would be cumbersome. It is envisioned that the database will be consulted on occasions when the overall system maps have been reviewed or field visits to a certain locale in the water system have been made. Operators may have questions about the infrastructure that exists at the local point of interest in the system. In such a case, the user should take note of the pipe ID number(s), junction number(s) or block address as determined from examination of the map or from the field visit. In the database, the columns of the spreadsheet are searchable. By using the dropdown menu in the appropriate column, the database will direct the user to the appropriate section of water main.

All columns are sortable, that is, data can be organized so the lines appear in alphabetical or numerical order according to the data provided in any single column. For example, pipelines could be organized from largest to smallest or they could be sorted from longest to shortest. Pressure data could be sorted from highest to lowest. If sorting of data in a column helps the operator visualize a system condition, or helps the operator determine operating parameters that are borderline or outside the desired limits, then sorting will serve its purpose.

The dynamic data is generated from the water model for the system. When a model run is completed the model run results can be transferred to the database and exported from the model as an excel spreadsheet. The spreadsheet can be manipulated with the search and sort features described above. To capture the basic range of operating conditions, except for fire flow scenarios, it will be important for the operators to have the system information for the tank full-pump off scenario and the tank empty-pump on scenario previously discussed. Once the data is "locked" into the exported spreadsheet, it will be searchable and sortable.

The trending data at the far right side of the spreadsheet is also sortable, for the purpose of ranking the pipes for replacement or repair. Since the trending data is essentially a scoring system, a sort from high to low would give a good indication of which pipes need the most attention.

4.6 Visual Indication of Concerns

With the model and database, it is relatively simple to run a water supply scenario, have it entered into the database and have areas of the system with questionable design or operational conditions earmarked on a system drawing. Four examples of such drawings have been included as examples in Appendix C.

The first map shows pipelines which have flow velocities greater than 4 fps under the represented condition. In general, pipelines should be designed for lower velocities, say 1.0 to 3.0 fps. When velocities exceed these levels it is more likely that the water system could experience pressure surges (water hammer) or sediments or corrosive deposits could be stirred up. A map showing where the high velocities occur could be useful in helping to design water system parallel mains or loops, which ultimately could reduce the velocities in the subject sections.

The second map shows pipelines and model junctions where pressures exceed 100 psi. In many localities pressures this high are typical. In the HCSA system, occurrence of these pressures are relatively uncommon. If there is leakage in a water system, operation at a higher pressure is sure to increase the amount of leakage being experienced. In addition, residential plumbing fixtures can be damaged by higher pressures. A map like this would give the HCSA staff a good idea where to consider having residential pressure reducing valves installed in the system. Or, there may be opportunities for certain pipelines to be ‘moved’ from one pressure zone to a lower pressure zone, by reconfiguring the pressure zone boundaries. This could significantly reduce the pressure on some lines and possibly limit exposure to residential complaints and excessive water system leakage.

The third map shows lower pressures in the system, under 25 psi. The Virginia Department of Health (VDH) requires systems to maintain at least 20 psi at all points in a system to prevent the potential for backflow conditions and contamination of the system. When pressures are as low as 25 psi under a normal water system condition, it is highly likely that there will be pressures lower than 20 psi when there is a spiked water demand, such as a fire would create. Knowledge of where these low pressures occur helps the HCSA identify ways to correct the issues. Similar to the high pressure scenario, it might be possible to have low pressure pipes ‘moved’ to a higher pressure zone.

The final map shows high headloss characteristics. Pipes with this feature may be the same or similar to those that have high velocity. High headloss is a condition which robs pressure from the water as it passes through a pipe. Resolution of high headloss may be replacement with a larger pipe, paralleling of existing pipe or looping of system pipe thereby allowing more water to get to the destination point in the system.

The maps that have been compiled are examples only. Other conditions can be run and other maps generated to highlight concerns on the system. For this report, these parameters have been selected as the primary parameters to be considered as indicators of system problems and therefore, recommendations for system correction.

5.0 WATER PROJECT IDENTIFICATION/PRIORITIZATION

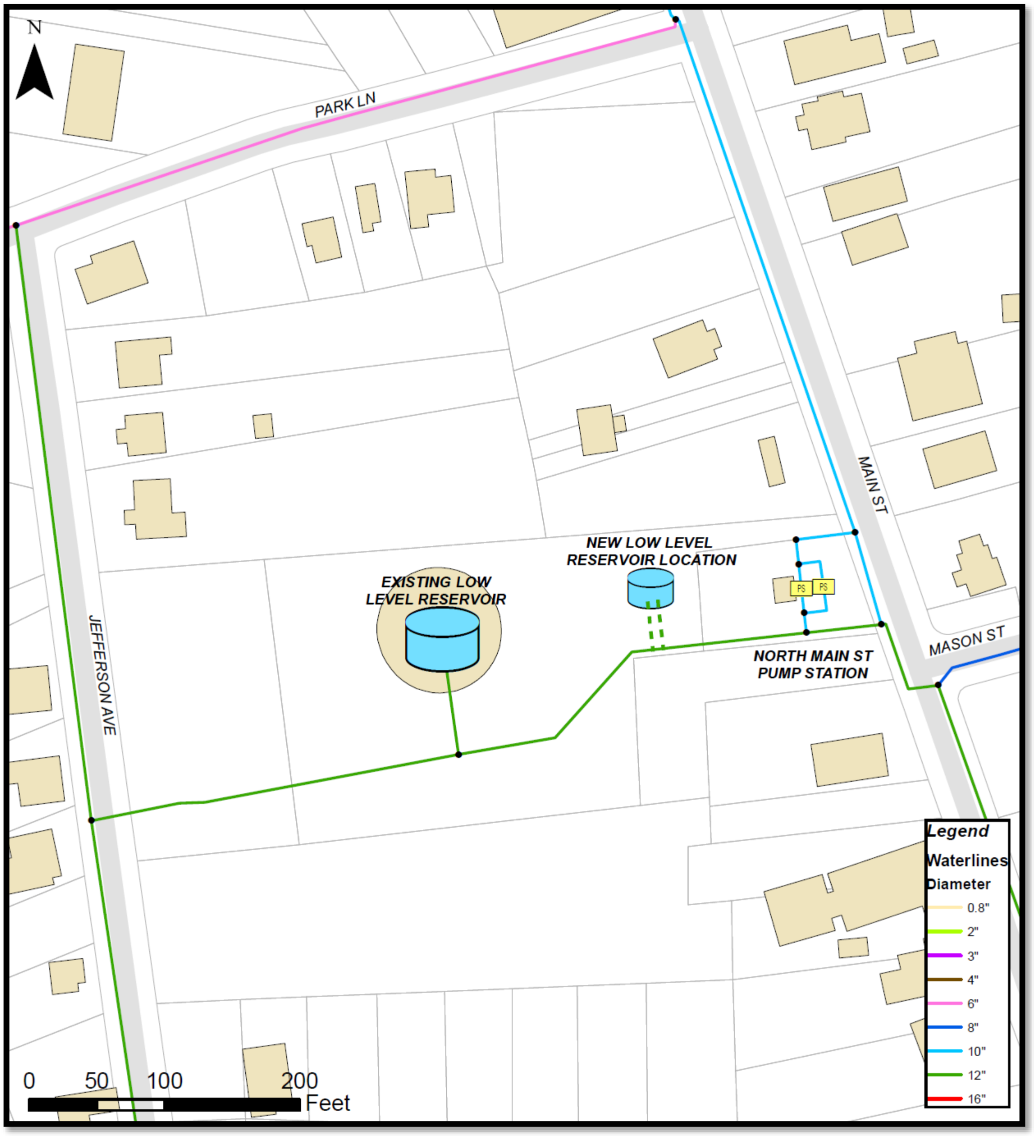
5.1 Water Storage Tank Consolidation Project

In the assessment of the above ground water system features (Chapter 3.0) it was evident that the future tank consolidation project would impact much of the above ground infrastructure in the water system. In itself, the project is planned to require 1) replacement of the Low Level Reservoir, 2) removal of the VEPCO, Daystrom and Webb Park Water Storage Tanks, 3) removal of Vaughan and Route 501 Pump Stations and 4) optional removal of the JP Stevens Water Storage Tank. These facilities would be replaced by a single Centerville Water Storage Tank (site will accommodate a second tank) and extensive pipe infrastructure to move water properly to and from the new storage. It is important to coordinate the plans in this project with other repairs, replacements or additions to the system, which may be impacted by the project design. The next several sections address the Tank Consolidation project elements

5.2 Low Level Reservoir Replacement

The Low Level Reservoir site is large enough to provide for the construction of a 62 foot diameter water storage tank, adjacent to the existing tank. The tank will have a maximum water depth of 45 feet, for a total capacity of 1 MG, and effective volume of 800,000 gallons. The tank floor would be set at approximately USGS elevation 467.00; overflow will be at elevation 512.00. To connect the new tank to the water system, it will be necessary to run 120 feet of 12-inch water main to the tank inlet and 120 feet of 12-inch water main from the tank outlet to the North Main Street Pump Station. A site schematic sketch is included as Figure 3, showing the general concept for the addition of the tank to the water system. The original North Main Street Pump Station (1950's construction) can be kept in place as a standby for the primary pumps (2009 construction).

Figure 3: New Low Level Reservoir Location



A project cost estimate for the work at the Low Level Reservoir site is provided below in Table 2.

Table 2: Project Cost Estimate - Low Level Reservoir

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$30,000	$30,000
12-inch Water Main	LF	240	$75.00	$18,000
12-inch Valves	EA	6	$1,200	$7,200
1 MG Storage Tank	GAL	1,000,000	$0.65	$650,000
Site Grading	SF	20,000	$1.50	$30,000
Demolish Exist Tank	LS	1	$40,000	$40,000
Access Drive	SF	2,400	$9.00	$21,600
Overflow Channel	SF	500	$15.00	$7,500
Fencing	LF	500	$25.00	$12,500
Electrical Work	LS	1	$30,000	$30,000
SCADA	LS	1	$10,000	$10,000
System Connections	EA	2	$3,000	$6,000
Hydrants	EA	2	$3,000	$6,000
Sub total				$868,800
Bonds, Insurance Etc.	%	5		$43,400
Sub-Total				$912,200
Contingency & Engineering	%	15		$136,800
Estimated Project Cost				$1,049,000

5.3 VEPCO Water Storage Tank Demolition

The elevation of the new Centerville Water Storage Tank will be adequate to allow the removal of the VEPCO Water Storage Tank. Customers in the VEPCO service area (SB Zone 2) will be served from Centerville.

Table 3: Project Cost Estimate – VEPCO Tank Demo

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$10,000	$10,000
Tank Removal	LS	1	$25,000	$25,000
Scrap Value	LS	1	($45,000)	($45,000)
Sub total				$0
Bonds, Insurance Etc.	%	5		$10,000
Sub-Total				$0
Contingency & Engineering	%	15		$0
Estimated Project Cost				$0

5.4 Daystrom Water Storage Tank Demolition

The elevation of the new Centerville Water Storage Tank will be adequate to allow the removal of the Daystrom Water Storage Tank. Customers in the Daystrom service area (SB Zone 3) will be served from Centerville.

Table 4: Project Cost Estimate – Daystrom Tank Demo

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$10,000	$10,000
Tank Removal	LS	1	$15,000	$15,000
Scrap Value	LS	1	($30,000)	($30,000)
Sub total				$0
Bonds, Insurance Etc.	%	5		$5,000
Sub-Total				$0
Contingency & Engineering	%	15		$0
Estimated Project Cost				$0

5.5 Webb Park Water Storage Tank Demolition

The elevation of the new Centerville Water Storage Tank will be adequate to allow the removal of the Webb Park Water Storage Tank. Customers in the Webb Park service area (Halifax Zone) will be served from Centerville.

Table 5: Project Cost Estimate – Webb Park Tank Demo

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$10,000	$10,000
Tank Removal	LS	1	$25,000	$25,000
Scrap Value	LS	1	($45,000)	($45,000)
Sub total				$0
Bonds, Insurance Etc.	%	5		$10,000
Sub-Total				$0
Contingency & Engineering	%	15		$0
Estimated Project Cost				$0

5.6 JP Stevens Water Storage Tank Demolition (Optional)

The elevation of the new Low Level Reservoir will be adequate to allow the removal of the JP Stevens Water Storage Tank. Customers in the JP Stevens service area (SB Zone 1A) will be served from the Reservoir.

Table 6: Project Cost Estimate – JP Stevens Tank Demo

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$10,000	$10,000
Tank Removal	LS	1	$25,000	$25,000
Scrap Value	LS	1	($45,000)	($45,000)
Sub total				$0
Bonds, Insurance Etc.	%	5		$10,000
Sub-Total				$0
Contingency & Engineering	%	15		$0
Estimated Project Cost				$0

5.7 Vaughan Pump Station Demolition

With the removal of SB Zone 1A from the water distribution system, there will be no need for the Vaughan Pump Station. The station can be disconnected from the system.

Table 7: Project Cost Estimate – Vaughan Pump Station Demo

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$10,000	$10,000
Disconnection	LS	1	$20,000	$20,000
Sub total				$30,000
Bonds, Insurance Etc.	%	5		$ 5,000
Sub-Total				$35,000
Contingency & Engineering	%	15		$ 5,000
Estimated Project Cost				$40,000

5.8 Route 501 Pump Station Demolition

With the removal of SB Zone 3 from the water distribution system, there will be no need for the Route 501 Pump Station. The station can be disconnected from the system.

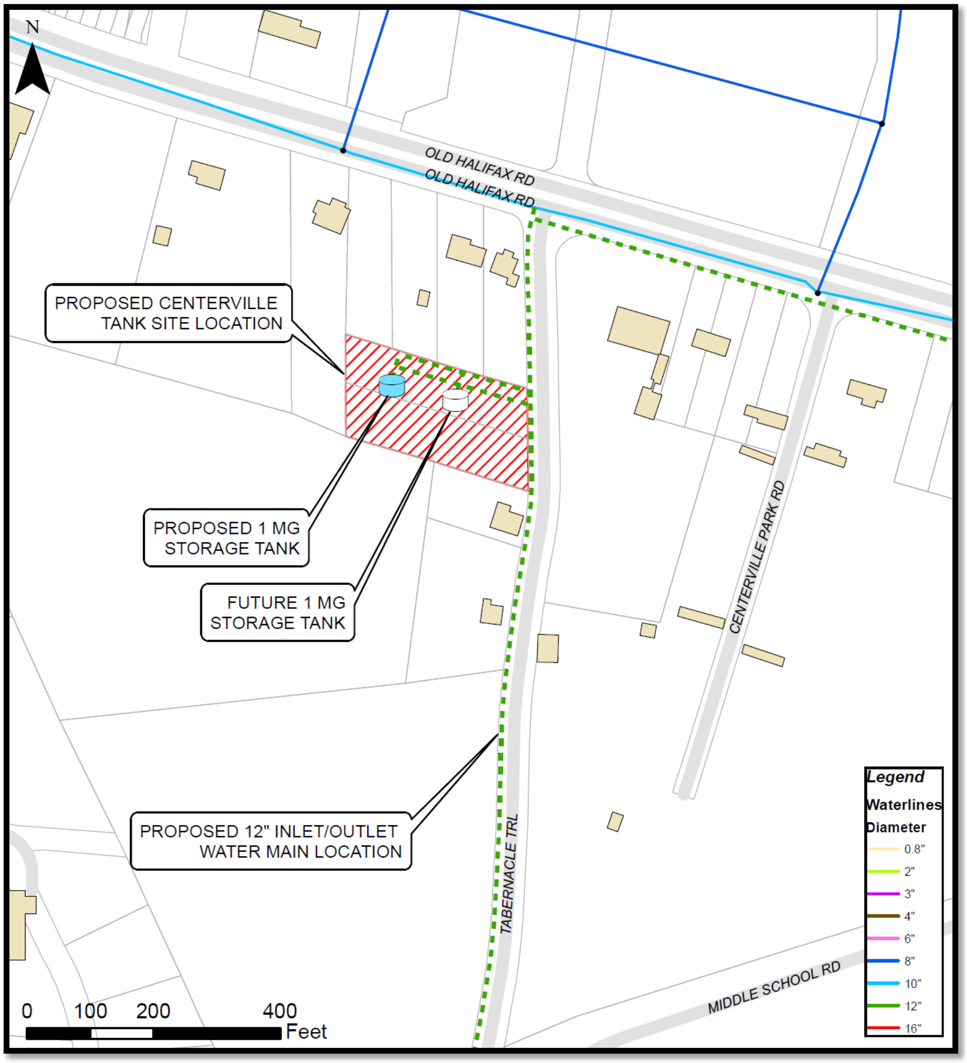
Table 8: Project Cost Estimate – Route 501 Pump Station Demo

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$10,000	$10,000
Disconnection	LS	1	$20,000	$20,000
Sub total				$30,000
Bonds, Insurance Etc.	%	5		$ 5,000
Sub-Total				$35,000
Contingency & Engineering	%	15		$ 5,000
Estimated Project Cost				$40,000

5.9 Centerville Elevated Tank Construction

A preliminary location has been identified for the Centerville Tank. The site, along Tabernacle Trail, will be adequate to provide for installation of two elevated tanks, with overflow levels at elevation 629, a 33 ft water depth and 80 ft support column. The total capacity of each tank would be 1 MG, all volume will be effective. To connect the new tank to the water system, it will be necessary to run 250 feet of 16-inch water main to the tank inlet and 250 feet of 16-inch water main from the tank outlet back into the system. A site schematic sketch is included as Figure 4, showing the general concept for the addition of the tank to the water system.

Figure 4: New Centerville Tank Location



A project cost estimate for work at the Centerville Tank site is provided in Table 9:

Table 9: Project Cost Estimate - Centerville Elevated Tank

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$50,000	$50,000
16-inch Water Main	LF	500	$90.00	$45,000
16-inch Valves	EA	6	$1,800	$10,800
1 MG Storage Tank	GAL	1,000,000	$1.50	$1,500,000
Site Grading	SF	20,000	$1.50	$30,000
Access Drive	SF	1,000	$9.00	$9,000
Overflow Channel	SF	500	$15.00	$7,500
Fencing	LF	500	$25.00	$12,500
Electrical Work	LS	1	$30,000	$30,000
SCADA	LS	1	$10,000	$10,000
System Connections	EA	2	$5,000	$10,000
Hydrants	EA	1	$3,000	$3,000
Sub total				$1,717,800
Land Acquisition	Acres	2	$15,000	$30,000
Bonds, Insurance Etc.	%	5		$85,900
Sub-Total				$1,833,700
Contingency and Engineering	%	15		$275,300
Estimated Project Total				$2,109,000

5.10 North Main Street Pump Station Check Valve Vault

Since the installation of the new North Main Street pumps in 2009, HCSA has experienced failure of the internal check valve on one of the units. Because the failure is internal to the pump, and it has recurred frequently, maintenance for this station has become expensive. One remedy to the issue is to provide a separate external check valve vault, with one check valve devoted to each of the pumps.

A construction cost estimate for work at the North Main Street Pump Station is provided in Table 10**:**

Table 10: Project Cost Estimate – N Main St Check Valve Vault

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$5,000	$5,000
Precast Vault	LS	1	$4,000	$4,000
Check Valves	EA	2	$2,000	$4,000
Piping and Valves	LS	1	$5,000	$5,000
Sub total				$18,000
Bonds, Insurance Etc.	%	5		$1,000
Sub-Total				$19,000
Contingency and Engineering	%	15		$3,000
Estimated Project Total				$22,000

5.11 Other Above-Ground Water Infrastructure Improvements

Many of the existing above-ground water system facilities are affected by the Tank Consolidation project. Those facilities that have not been mentioned above are in good condition for continued service in the water system.

5.12 Buried Water System Improvements – Design/Operations Basis

Using the parameter maps for the water system, we can identify certain improvements that should take place in the buried infrastructure to allow the system to operate under relatively standard conditions. A summary of the potential projects needed to satisfy these conditions is presented below:

HIGH VELOCITY:

In general, water mains serving as suction and discharge mains for water pump stations will exhibit the highest velocities in a water system. It is common to see velocities of 4 to 6 fps just upstream and downstream of pump stations. Water transmission mains, the long arteries of the system between pump stations and tanks, are sized for service at flow velocities of 2 to 4 fps under daily average and peak flows. In neighborhood areas, away from the influence of transmission mains**,** the velocities run much lower, but are highly variable depending upon where water demands are being satisfied. These lower velocities are usually a result of design for fire flows in the system. In the neighborhood areas, the piping is therefore sized for fire flow and oversized for typical water demands.

The HCSA water system is no exception. Several of the water mains with the highest velocities are located adjacent to pump stations.

Water Treatment Plant Finished Water Pumps – SBP-0361, SBP-0365, SBP-0367, SBP-0369, SBP-0371, SBP-0373, SBP-0375 & SBP-0377 – These are the suction and discharge pipes from the pump station. The highest velocity shown on the database, for one of these pipes is 6.70 fps in an 8-inch main. For this application, this velocity is not unduly high, and these mains should remain in service.

North Main Street Pump Station and Low Level Reservoir –

Route 501 Pump Station - P-59, P-60, P-62, P-63 – These are the suction and discharge lines to the Route 501 Pumps. It is not uncommon to have higher velocities local to pump stations (4-5 fps). These velocities are borderline high and don't warrant immediate action. These mains will be removed from the system, at little cost, with the construction of the Centerville Water Storage Tank. It is recommended that action on these mains be deferred until the Tank Consolidation Project is undertaken.

SBP-0214 – This 10-inch main is on the discharge side of the North Main Street Pump Station and delivers water north toward the VEPCO Water Storage Tank. The velocity in the main is nearly 5 fps. This velocity is borderline high and doesn't warrant immediate action on the main. As water demand increases over time, this main may become more restrictive to allowing the required flow to reach the Centerville Tank. Should restrictive flow symptoms begin to arise, then a project for paralleling or replacing the 10-inch line should be considered. It is recommended that action on these mains be deferred at least to the time when the Tank Consolidation project is undertaken.

SBP-0256 & SBP-0258 – These lines are shown as 10-inch mains feeding the VEPCO Water Storage Tank along North Main Street. The velocity in the mains is in the range of 5-6 fps. The velocity is borderline high for a 10-inch main and doesn't warrant immediate action on the main. As water demand increases over time, this main may become more restrictive to allowing the required flow to reach the Centerville Tank. Should restrictive flow symptoms begin to arise, then a project for paralleling or replacing the 10-inch line should be considered. It is recommended that action on these mains be deferred at least to the time when the Tank Consolidation project is undertaken.

SBP-0570 – This line is shown as a 6-inch main, at Fenton Street and Ellyson Avenue, feeding the eastern sector of SB Zone 1. This is one of only two water mains feeding this area. The two 6-inch mains are too small to carry the water demands at normal velocities. This main regularly has velocities of flow in the range of 5-6 fps, which is high for a 6-inch main. We recommend a replacement of this pipeline with main of increased size sufficient to accommodate flows to this area, and allow the second water main connection (SBP-0746) to remain in place. For estimating purposes, we have considered a 10-inch water main 145 ft long. For budgeting, we have assigned a budget of $8,700 ($60/ft).

SBP-0700 – This line is the 10-inch main from North Main Pump Station to the distribution line on Main Street (SBP-0214). The velocity in this main is in the range of 8 fps. The velocity is high and should be reduced through replacement of the main with a larger main. For budgeting, we have assigned a budget of $2,000 ($100/ft)

SBP-1274 – This line is the 8-inch main on US Route 501 leading north to the Route 501 Pump Station. It is common to find higher velocity mains in the area of pump stations. The velocity in the main is in the range of 4-5 fps. The velocity is borderline high and doesn't warrant immediate action on the main. The velocity of flow in this main will decrease when the Centerville Tank and Transmission Main are put into service. It is recommended that no action be taken on this water main.

SBP-1492 – This line is the 8-inch main on US Route 501 leading north out of the Route 501 Pump Station. Like pipe segment SBP-1274, it is common to find higher velocity mains in the area of pump stations. The velocity in the main is in the range of 4-5 fps. The velocity is borderline high and doesn't warrant immediate action on the main. The velocity of flow in this main will decrease when the Centerville Tank and Transmission Main are put into service. It is recommended that no action be taken on this water main.

SBP-1506 - This 12-inch main is the inlet and outlet line from the Low Level Reservoir. The velocity in the main is greater than 7 fps. This main will be removed from the system with the replacement of the Low Level Reservoir. It is recommended that any action on this main be deferred until the Tank Consolidation Project is undertaken.

SBP-1508, 1510 & 1512 – These lines, like segment SBP-1506, are also located on the suction side of the North Main Street Pump Station. Velocities are approximately 5.5 fps in SBP-1508 and 8 fps in the others. Mains SBP-1510 and SBP-1512 should be increased in size to reduce velocity. For budgeting, we have assigned a budget of $8,000 ($100/ft). Any changes to main SBP-1508 would be considered with the Tank Consolidation project.

HIGH PRESSURE:

SBP-0040 – 6-inch water main on Irish St. between Spears Ave. and Eastwood Ct.

SBP-0096 – 6-inch water main at Wilingham Ave and Westmoreland St.

SBP-0160 – 6-inch water main on Wilkerson St. east of Orleans Ave.

SBP-0162 – 6-inch water main on Orleans Ave. from Rivoli St. to Wilkerson St.

SBP-0220 – 10-inch crosslots water main connecting Porter Lane with Jewell St.

SBP-0454 – __-inch water main on Penck Ave. west of Jefferson Ave.

SBP-0478 – 6-inch water main on Elizabeth St. north of Haskins St.

SBP-0598 – 6-inch water main on Westmoreland St. from Bayonne Ave. to Orleans Ave.

SBP-0606 – 6-inch water main on Orleans Ave. and Stanley Ct. between Wilkerson St. and Haskins St.

SBP-0610 – 6-inch water main on Bayonne Ave. between Westmoreland St. and Wilkerson St.

SBP-0632 – 6-inch water main on Friend Ave and McRae Dr.

SBP-0638 – 6-inch water main on Willingham Ave. north of Westmoreland St.

SBP-0640 – 6-inch water main on Willingham Ave. between Westmoreland St. and Wilkerson St.

SBP-0646 – 6-inch water main on Eastwood Ct. north of Irish St.

SBP-0744 – 6-inch water main on Second St. crossing Broad St.

SBP-0848 – 6-inch water main on Tanglewylde Dr. south of Beechmont Rd.

SBP-0872 – 6-inch water main on Woodbrook Ave. north of Poplar Creek St.

SBP-1026 – 6-inch water main on Sutphin Rd. south of Porter Lane.

SBP-1148 – 10-inch water main on College Street between Burtis Ave and Grace Ave.

SBP-1344 – 6-inch water main on Tanglewylde Dr. south of Beechmont Rd.

SBP-1346 – 6-inch water main on Ridge Street just west of Farragut Ave.

SBP-1444 & SBP-1446 – 6-inch water main on Wilkerson St west of Orleans Ave.

SBP-1538 – 6-inch water main crossing James D. Hagood Highway east of Hamilton Blvd.

SBP-1539 – 6-inch water main paralleling James D. Hagood Highway (north side) east of Cage Trail.

SBP-1540 & SBP-1541 – 6-inch paralleling James D. Hagood Highway (south side) east of Hamilton Blvd.

SBP-1542 – 6-inch water main on Belt Blvd. south of James D. Hagood Highway.

The highest pressures in the existing system are under 120 psi. Normally, there wouldn't be a concern with pipelines operating at these pressures. However, if any of these pipelines require excessive operation and maintenance attention, the higher pressure of these mains should be taken into account in any planned action. Potential solutions include moving pressure zone boundaries to subject the high pressure pipe to lower pressure conditions. At this time, for higher pressure pipelines without problems, a course of "no action" is recommended.

LOW PRESSURE:

SBP-0332 – 12-inch water main on Jefferson Ave. north of College St. This is the delivery line for water from the Water Treatment Plant to the Low Level Reservoir. The increased elevation of the Low Level Reservoir in the Tank Consolidation project will correct this situation, adding about 10 psi to the pressures along this pipeline. No action is recommended.

SBP-0361, SBP-0367, SBP-0371 & SBP-0375 – These 12-inch lines are on the suction side of the main water treatment plant pumps. It is normal to have these low pressures prior to pumping. No action is recommended.

SBP-0706 – 6-inch water main on College St between Llewellyn Ave. and Jefferson Ave. This main reflects pressure from the mainline piping between the Water Treatment Plant and the Low Level Reservoir. The increased elevation of the Low Level Reservoir in the Tank Consolidation project will correct this situation, adding about 10 psi to the pressures in this area. No action is recommended.

SBP-1504 – 12-inch water main crosslots from Jefferson Ave. to the Low Level Reservoir. This is the delivery line for water from the Water Treatment Plant to the Low Level Reservoir. The increased elevation of the Low Level Reservoir in the Tank Consolidation project will correct this situation, adding about 10 psi to the pressures in this area. No action is recommended.

SBP-1506 - This 12-inch main is the inlet and outlet line from the Low Level Reservoir. As noted in the section addressing velocity concerns this main will be removed from the system with the replacement of the Low Level Reservoir. It is recommended that any action on this main be deferred until the Tank Consolidation Project is undertaken.

SBP-1508 – This line is located on the suction side of the North Main Street Pump Station. Velocities are approximately ___fps. Any changes to this piping would be considered with the Tank Consolidation project. Depending on velocity make recommendation.12-inch water main crosslots from the Low Level Reservoir to the North Main Street Pump Station. As noted in a prior section, water mainThe increased elevation of the Low Level Reservoir in the Tank Consolidation project will correct this situation.

Commented [g1]: Need to have sizes, velocities and recommendations.

HIGH HEADLOSS:

P-59 & P-60 – These mains are the suction lines to the Route 501 Pumps. As noted in the section addressing velocity concerns, these mains will be removed from the system with the installation of the Centerville Tank. No action is recommended at this time.

P-62 & P 63 – These mains are the discharge lines from the Route 501 Pumps. As noted in the section addressing velocity concerns, these mains will be removed from the system with the installation of the Centerville Tank. No action is recommended at this time.

SBP-0570 – This line is shown as a 6-inch main feeding the eastern sector of SB Zone 1. See the section addressing velocity concerns. The recommended replacement of this water main with 10-inch pipe will address both the velocity and headloss concerns.

SBP-0700 – This line is the 10-inch main from North Main Pump Station to the distribution line on Main Street (SBP-0214). Changes to this line would be considered at the same time as any changes to SBP-0214.

Commented [g2]: Need specifics

SBP-0746 – This line is a 6-inch water main on Seymour Dr. from Edmundson Ave. to Ellyson Ave. This line, similar to SBP-0570, feeds the eastern sector of SB Zone 1, but experiences high headloss due to slightly high velocity. See the section addressing velocity concerns. The recommended replacement of SBP-0570 should allow this main to remain in place and have a lower flow level than currently. No action on SBP-0746 is recommended at this time.

SBP-1274 – This line is the 10-inch main on US Route 501 leading north to the Route 501 Pump Station. See the section addressing velocity concerns. No action is recommended at this time.

SBP-1492 – This line is the 10-inch main on US Route 501 leading north out of the Route 501 Pump Station. See the section addressing velocity concerns. No action is recommended at this time.

SBP-1508 – This line is located on the suction line to the North Main Street Pump Station at the pumps. See the sections addressing velocity and low pressure concerns. No action is recommended at this time.

5.13 Buried Water System Improvements – Tank Consolidation Project

For water service to HCSA customers under current water demands, the installation of the new Low Level Reservoir and the Centerville Tank, can improve service pressure conditions and potentially provide improved quality of water to most of the customers, by reducing the concern for Disinfection Byproduct formation in the distribution system. When the water system was modeled, under conditions including the new tanks, for 2010 service conditions, the following was discovered at average day flow rates of 1.32 MGD and maximum day flow rates of 2.64 MGD.

1. General Observations – Zone 1 will see increased pressures of about 10 psi on average as a result of the increased level of storage at the Low Level Reservoir site. Pressures in Zone 2 are predicted to increase unacceptably in some areas. The highest pressure will go from 117 psi to nearly 175 psi, with the current infrastructure unchanged. Restrictions in piping network between the North Main Street Pump Station and Centerville Tank location, result in these high pressures when the pump station is in operation. By providing mainline distribution piping improvements, to allow easier conveyance of water from North Main Street Pump Station to the Centerville Tank, the impact on Zone 2 can be reduced to allow pressures to remain under 132 psi. Pressures in Zone 3 will be slightly lower than they are currently, working from a tank at the same level as Daystrom, but one which is more distant from the zone. Pressures in Halifax Zone will increase about 10 psi, under the influence of the tank at Centerville which is higher than the Webb Park Tank.

As a result of the high pressure concerns, modeling of the system was completed considering the installation of a 12-inch water main on Hamilton Boulevard, to fill a pipeline gap in the system. In addition, a 12-inch transmission main has been added to parallel existing infrastructure between North Main Street Pump Station and the Centerville Tank. As a result of these model additions, the following results were obtained.

1. Average Day Production (Typical Pressure Conditions – 720) – All areas of the system maintained water pressures and could receive adequate flows. The lowest pressure in the system was 36.0 psi at College Street and Llewellyn Avenue (SB-J-413), not including junctions at the base of any reservoirs. The highest pressure under this condition is 132.0 psi at the creek near the intersection of Wilkerson Street and Bayonne Avenue (SB-J-418). This high pressure location has been reduced by over 40 psi, with the addition of the transmission main. There were also 8 pipeline sections identified with flow velocities of greater than 4.5 fps. No main had velocities of over 6.5 fps.
2. Maximum Hour Production (Minimum Pressure Conditions – 710) – The lowest pressure in the system was 33.6 psi at College Street and Llewellyn Avenue (SB-J-413, not including junctions at

the base of any reservoirs. The highest pressure under this condition is 119.7 psi near the creek at the intersection of Wilkerson Street and Bayonne Avenue (SB-J-418). There were no pipeline sections identified with flow velocities of greater than 4.5 fps.

3. Maximum Hour Plus Fire Flow (Conditions 760A, B, C) – Production of 500 gpm fire flows at 49 points in the model caused depressions of system pressures below 20 psi in the system (down from 117 points in the existing storage plan). Most of the problem areas are served by 4-inch piping, which is not generally equipped with hydrants, and cannot carry fire flows even short distances. In most cases, replacement of the 4-inch mains with 6-inch or larger mains would restore fire flows in those sections.

5.14 Hamilton Boulevard Connector

As noted in the prior paragraphs, a critical distribution link needed in Zone 2 is a 12-inch water main along Hamilton Boulevard to connect the primary discharge main from the North Main Street Pump Station to water mains along Route 501, which can assist in carrying water to the Centerville Tank and keeping high pressures in check within Zone 2. This connector is identified as SB-P-1603, SB-P-1604, and SB-P-1605 in the 700 and 800 series modeling runs. The length of the connector is roughly 2200 ft.

Figure 5: Hamilton Boulevard Connector

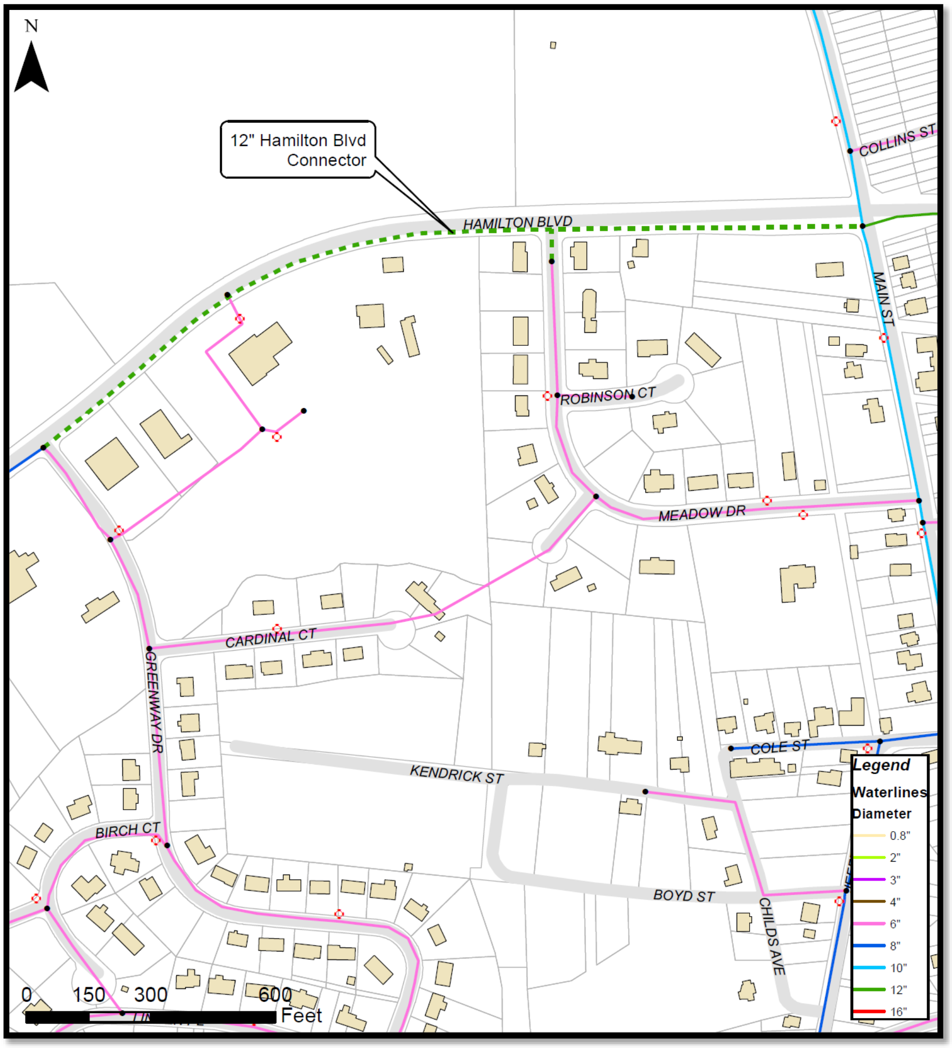

N
12" Hamilton Blvd Connector
HAMILTON BLVD
COLLINS ST
MAIN ST
ROBINSON CT
MEADOW DR
CARDINAL CT
GREENWAY DR
COLE ST
KENDRICK ST
BIRCH CT
BOYD ST
CHILDS AVE
Legend
Waterlines
Diameter
0.8"
2"
3"
4"
6"
8"
10"
12"
16"
0 150 300 600
Feet

Table 11: Construction Cost Estimate - Hamilton Boulevard Connector

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$30,000	$30,000
12-inch Water Main	LF	2,200	$75.00	$165,000
12-inch Valves	EA	4	$1,500	$6,000
12-inch Road Crossing	LF	100	$250	$25,000
Fire Hydrant Assembly	EA	2	$4,000	$8,000
Water Service Connects	EA	5	$1,000	$5,000
Air Release Valves	EA	2	$3,000	$6,000
Blowoff Valves	EA	1	$3,000	$3,000
12-inch Driveway Bores	LF	120	$80	$9,600
Pavement Replacement	SF	2,000	$25.00	$50,000
Sub total				$307,600
Bonds, Insurance Etc.	%	5		$15,400
Sub-Total				$323,000
Contingency and Engineering	%	15		$48,500
Estimated Project Total				$371,500

Centerville Tank Transmission Main-

Another highly critical infrastructure improvement that will be needed with the installation of the Centerville Tank will be a 12-inch water main between the proposed Tank site and the North Main Street Pump Station. The transmission main could be routed north along Main Street and Old Halifax Road to the Centerville Tank site on Tabernacle Trail (Figure 6). Alternately, a routing could be considered which takes the main at the west end of the Hamilton Boulevard connector and runs north through open lands, connecting several of the deadend water mains between US Route 501 and Old Halifax Road. This route would be of lesser length than the highway route, but could require significant easement acquisition efforts. We recommend the second route, provided easements can be obtained. Total length of this pipeline would be approximately 6,700 feet.

Figure 6: Centerville Tank Transmission Main

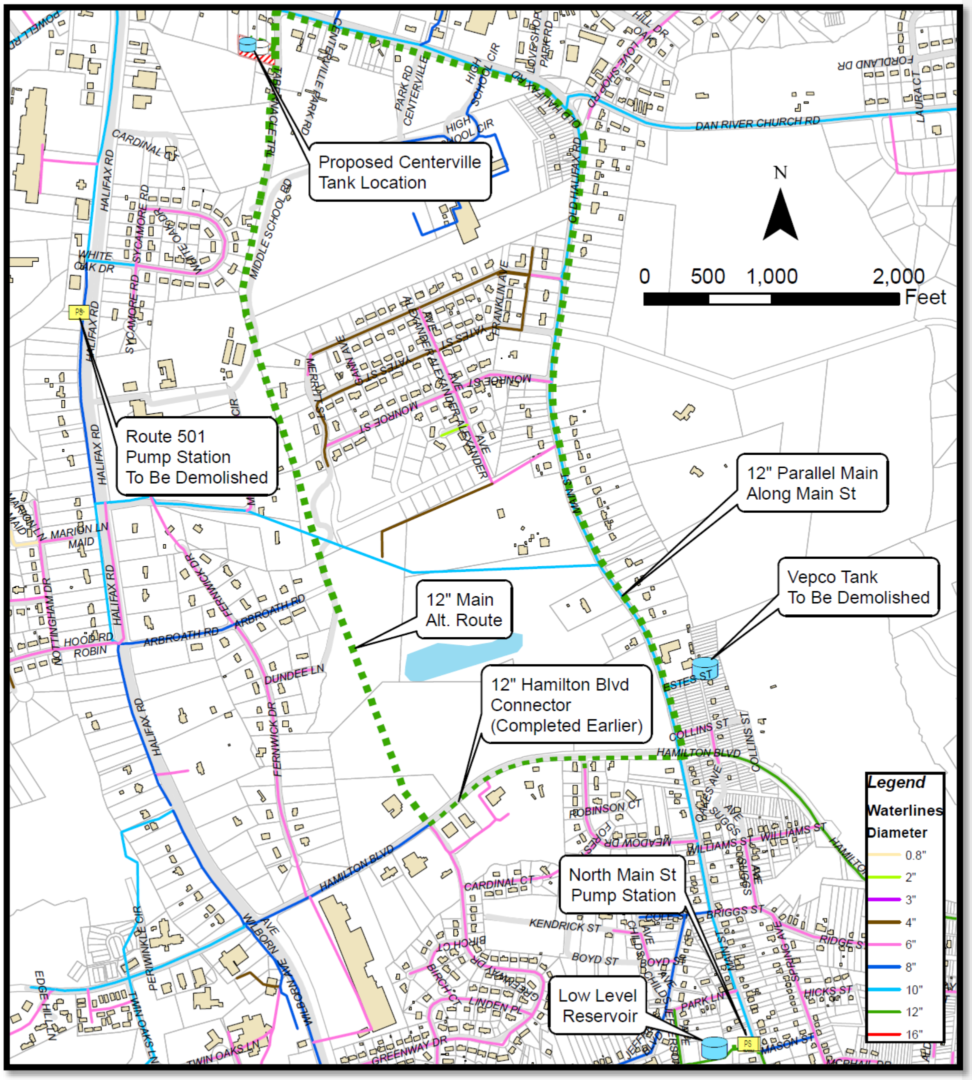


Table 12: Project Cost Estimate - Centerville Tank Transmission Main

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$100,000	$100,000
12-inch Water Main	LF	6,700	$75.00	$502,500
12-inch Valves	EA	6	$1,500	$9,000
12-inch Road Crossing	LF	100	$250	$25,000
Fire Hydrant Assembly	EA	13	$4,000	$52,000
Water Service Connects	EA	5	$1,000	$5,000
Air Release Valves	EA	4	$3,000	$12,000
Blowoff Valves	EA	2	$3,000	$6,000
12-inch Driveway Bores	LF	20	$80	$1,600
Pavement Replacement	SF	1,000	$25.00	$25,000
Sub total				$738,100
Bonds, Insurance Etc.	%	5		$36,900
Sub-Total				$775,000
Contingency and Engineering	%	15		$117,000
Estimated Project Total				$902,000

5.14 Buried Water System Improvements – Minor Projects-

Fire Protection - Most fire flows are adequate throughout the system, with the exception of some locations at dead end water mains and along 2-inch to 4-inch lines. Some dead ends could be eliminated to increase fire flows to acceptable levels by performing the following system upgrades. These upgrades are designed to improve water circulation in the water system by "looping" dead end water lines.

- Connect Summit Drive to Wickham Street (6-inch, approximately 630 LF)

Figure 7: Summit Drive to Wickham Street Connection

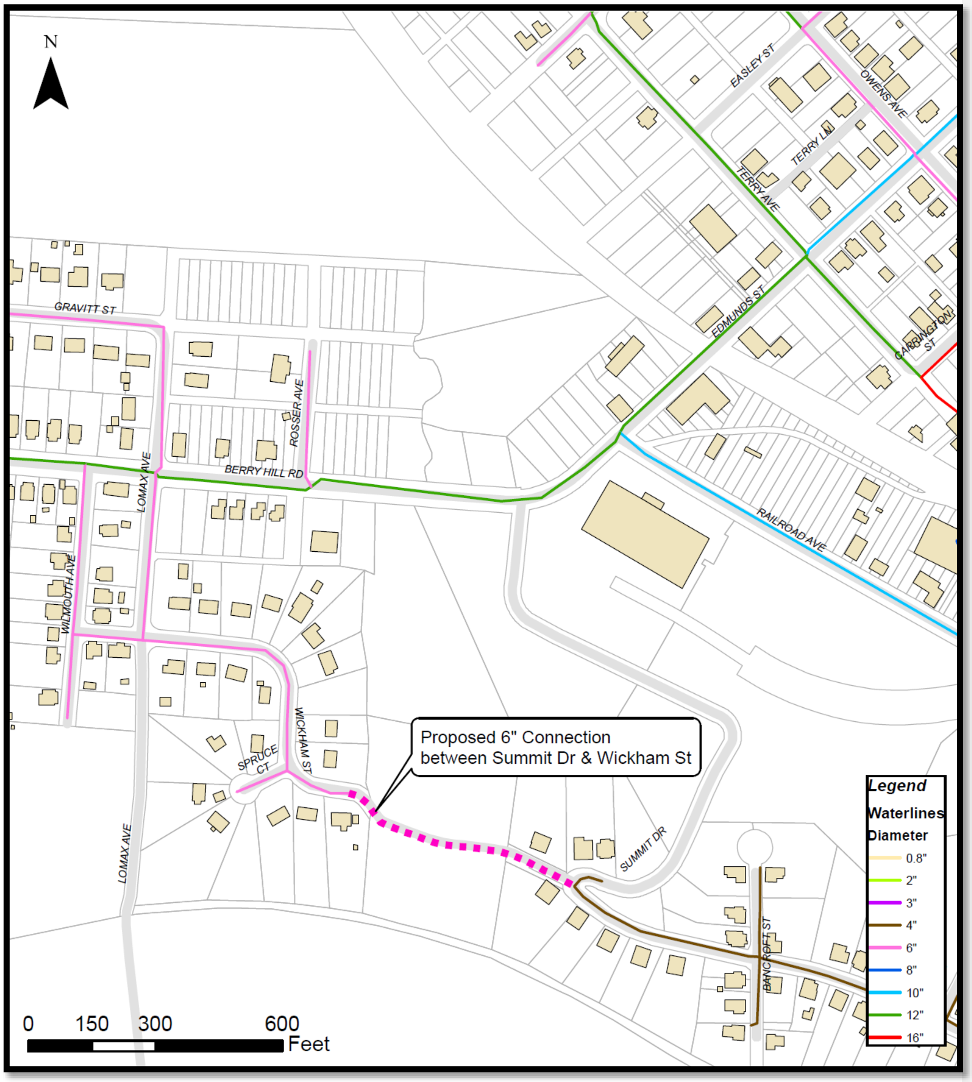


Table 13: Project Cost Estimate - Summit Dr to Wickham St Connect

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$10,000	$10,000
6-inch Water Main	LF	640	$40.00	$25,600
Fire Hydrant Assembly	EA	1	$4,000	$4,000
Air Release Valves	EA	1	$3,000	$3,000
Blowoff Valves	EA	1	$3,000	$3,000
Pavement Replacement	SF	100	$25.00	$2,500
Sub total				$48,100
Bonds, Insurance Etc.	%	5		$2,400
Sub-Total				$50,500
Contingency and Engineering	%	15		$7,500
Estimated Project Total				$58,000

- Connect Sinai Road between Westside Drive and Bane Street (6-inch, approximately 1500 LF)

Figure 8: Sinai Road Connection

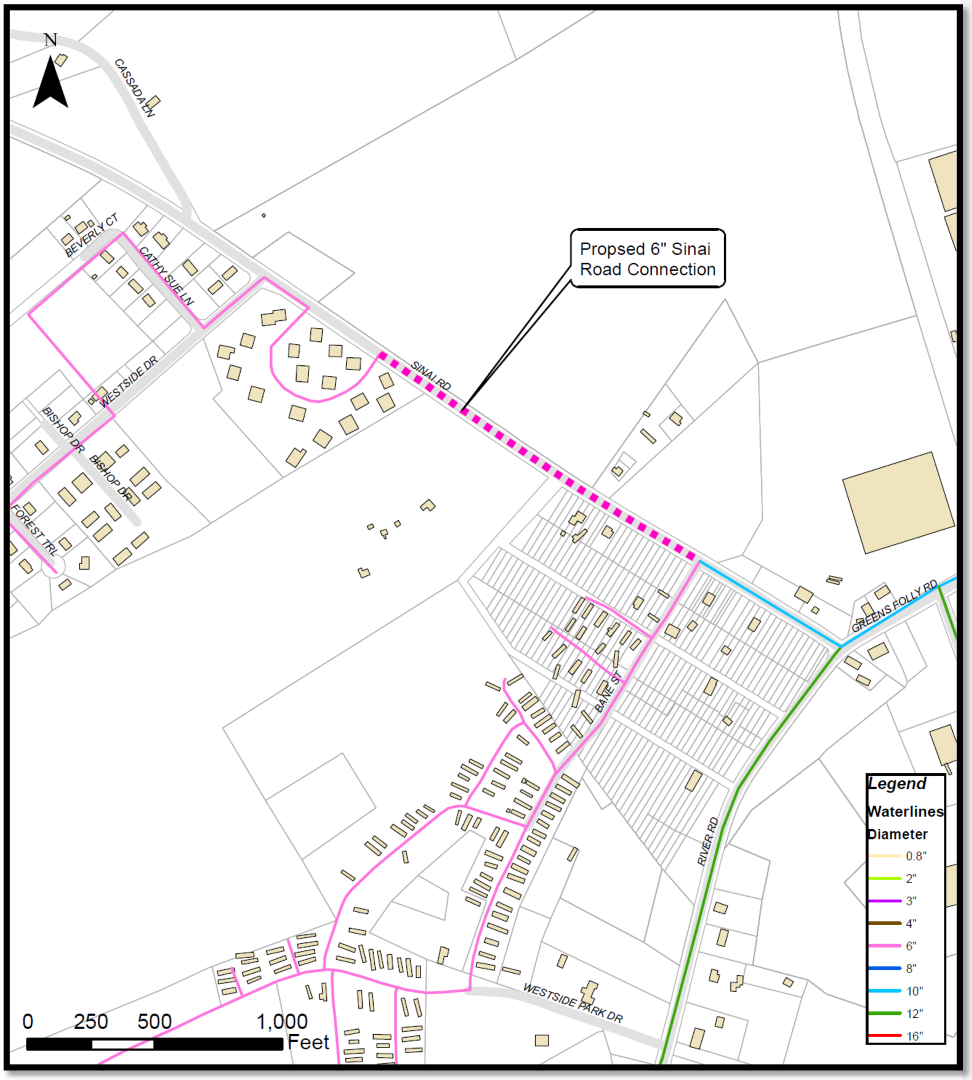


Table 14: Project Cost Estimate - Sinai Road Connect

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$10,000	$10,000
6-inch Water Main	LF	1,500	$40.00	$60,000
Fire Hydrant Assembly	EA	2	$4,000	$8,000
Air Release Valves	EA	1	$3,000	$3,000
Blowoff Valves	EA	1	$3,000	$3,000
Pavement Replacement	SF	300	$25.00	$7,500
Sub total				$91,500
Bonds, Insurance Etc.	%	5		$4,600
Sub-Total				$96,100
Contingency and Engineering	%	15		$14,400
Estimated Project Total				$110,500

- Connect Brentwood Drive to Eastover Drive (6-inch, approximately 400 LF)

Figure 9: Brentwood Drive to Eastover Drive Connector

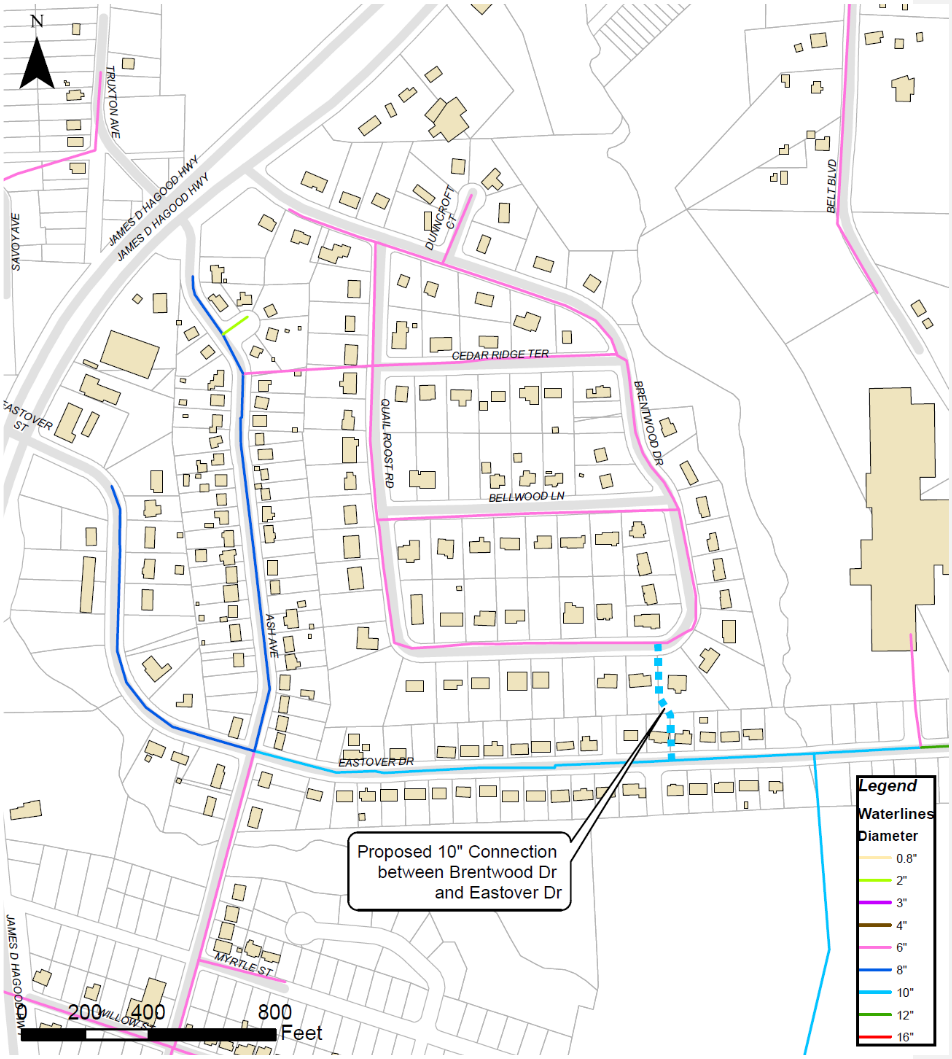


Table 15: Project Cost Estimate - Brentwood Eastover Connect

Work Item	Units	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$10,000	$10,000
10-inch Water Main	LF	400	$60.00	$24,000
Pavement Replacement	SF	160	$25.00	$4,000
Sub total				$38,000
Bonds, Insurance Etc.	%	5		$1,900
Sub-Total				$39,900
Contingency and Engineering	%	15		$6,100
Estimated Project Total				$46,000

5.15 Buried Water System Improvements – Operational Concerns

In the database, with the trending data section, there are pipelines that have 'scored' higher values than most. This is on very limited data, and data collection needs to continue to make this section a useful analysis. Based on the data provided to date, there are three water mains which have scored a total value of 9. HCSA will need to consider the value of repair or replacement of these mains.

SBP-1126 – 8-inch on Traver Ave, 636 ft, between Vaughan St and Fenton St. For capital planning purposes we have assigned a budget of $31,800 ($50/ft) for this project.

SBP-1516 – 10-inch on Vaughan St, 570 ft, on the discharge of the Vaughan Pump Station. For capital planning purposes we have assigned a budget of $34,200 ($60/ft) for this project.

SBP-1525 – 10-inch on Old Halifax Road, 787 ft, mostly between Centerville Park Road and Tabernacle Trail. For capital planning purposes we have assigned a budget of $47,220 ($60/ft) for this project.

Water System Audit – The cost of lost water can be very significant in an Authority operated water system. Location of leakage and identification of lost water uses are beneficial to the responsible operation of the system. It is recommended that a system-wide water system audit be conducted at intervals of about five years to locate and correct any system leakage. The cost of such an audit is estimated at about $30,000 on each occasion.

6.0 CONCLUSIONS AND RECOMMENDATIONS FOR WATER

6.1 General Conclusions

There are numerous capital improvement projects identified in the previous discussions. Several of them should be completed in concurrent efforts while others can be done as stand-alone projects. Notably, the projects identified with the Tank Consolidation Project should be completed together, since they are all targeted at the same goal. At the same time, the Tank Consolidation Project can be completed in two phases. The first phase could be devoted to the replacement of the Low Level Reservoir and the removal of the Vaughan Pump Station and JP Stevens Tank (optional). The second phase, which would be the more expensive elements of the project, would include the construction of the first Centerville Tank, Centerville Transmission Main and the removal of the VEPCO, Daystrom and Webb Park Tanks. In a capital improvement program, it is suggested that the Tank Consolidation Project components be distinguished in two phases, while the independent project work can be fit in around this project. The categories of work to be included in the Capital Improvement Program are illustrated in the tables below.

Table 16: Tank Consolidation Project – Phase I

Project	Type	Opinion of Probable Cost
Tank Consolidation – Phase I		
Low Level Reservoir	1.0 MG Tank	$1,049,000
Vaughan Pump Station Demo		$40,000
JP Stevens Tank Demo	0.5 MG Tank	$0
SBP-1506 Line Removal	High Vel & Low Press	$0
SBP-1508 Line Replacement	High Vel & Low Press	$0
SBP-1510 Line Replacement	High Velocity	$0
SBP-1512 Line Replacement	High Velocity	$0
SBP-0332 Line	Low Pressure	$0
SBP-0706 Line	Low Pressure	$0
SBP-1504 Line	Low Pressure	$0
Total Phase I Tank Consolidation Projects		**$1,089,000**

Table 17: Tank Consolidation Project – Phase II

Project	Type	Opinion of Probable Cost
Tank Consolidation – Phase II		
VEPCO Tank Demo	0.85 MG Tank	$0
Daystrom Tank Demo	0.1 MG Tank	$0
Webb Park Tank Demo	0.2 MG Tank	$0
Rte 501 Pump Station Demo		$40,000
Centerville Tank Construction	1 MG	$2,109,000
SBP-59 Line Removal	High Vel & HL	$0
SBP-60 Line Removal	High Vel & HL	$0
SBP-62 Line Removal	High Vel & HL	$0
SBP-63 Line Removal	High Vel & HL	$0
SBP-0214 Line	High Velocity	$0
SBP-0256 Line	High Velocity	$0
SBP-0258 Line	High Velocity	$0
SBP-0700 Line Parallel (Def)	High Vel & HL	$0
SBP-1274 Line Replacement	High Vel & HL	$0
SBP-1492 Line Replacement	High Vel & HL	$0
Centerville Transmission Main	12-inch	$902,000
Total Phase II Tank Consolidation Projects		**$3,051,000**

Table 18: Independent Capital Projects

Project	Type	Opinion of Probable Cost
Independent Capital Projects		
N Main St Check Valve Vault	Maintenance	$22,000
SBP-0570 Line Replacement	High Vel & HL	$8,700
SBP-0746 Line	High Headloss	$0
Hamilton Blvd Connector	12-inch	$371,500
Summit Dr/Wickham St	6-inch	$58,000
Sinai Rd – Westside to Bane	6-inch	$110,500
Brentwood/Eastover	10-inch	$46,000
Traver Repair	8-inch	$31,800
Vaughan Repair	10-inch	$34,200
Old Halifax Road Repair	10-inch	$47,220
Water System Audit	2014	$30,000
Water System Audit	2019	$30,000
Water System Audit	2024	$30,000
Water System Audit	2029	$30,000
Total Independent Capital Projects		**$819,920**

6.2 Recommendations

It is recommended that HCSA prioritize its capital program keeping the following issues in mind:

- The second phase of the Tank Consolidation Project is where much of the system benefit will be derived. It is also the most expensive component of the project work identified herein. Phase II of the program should be initiated when other debt of HCSA is retired sufficiently.
- The first phase of the Tank Consolidation Project has several overall system benefits. If possible, HCSA should attempt to get this phase of the work underway early in the Capital Improvement Program.
- The independent projects all have varying benefits to the water system. The Hamilton Blvd connector, repair projects and first water system audit are among the more beneficial project actions. It is recommended that these higher priority projects be undertaken prior to the Tank Consolidation Project while others wait until the Tank Consolidation Project has been completed.
- There is always a possibility that other projects not identified herein will become priorities due to pipe failure, inadequate capacity or other reasons. The capital improvement program needs to be flexible enough to allow for reorganization of projects in the priority schedule.

A schedule of projects has been provided in the table below, based on the discussion above.

Table 19: Recommended Capital Improvement Program HCSA

Project Title	Fiscal Year									
	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	Totals
N Main St Check Valve Vault	$22,000										$22,000
Traver	$31,800										$31,800
Vaughan	$34,200										$34,200
Old Halifax Road	$47,220										$47,220
Water System Audit	$30,000					$30,000					$60,000
Hamilton Boulevard		$190,000	$181,500								$371,500
Phase 1 Tank Consolidation				$500,000	$589,000						$1,089,000
Phase 2 Tank Consolidation						$1,100,000	$1,200,000	$751,000			$3,051,000
SBP-0570 Line Replacement									$8,700		$8,700
Summit/Wickham Street									$58,000		$58,000
Sinai Road – Westside to Bane									$110,500		$110,500
Brentwood										$46,000	$46,000
Totals	$165,220	$190,000	$181,500	$500,000	$589,000	$1,130,000	$1,200,000	$751,000	$177,200	$46,000	$4,929,920

7.0 EXISTING WASTEWATER SYSTEM

7.1 Introduction

This project considers the existing sewer system assets of the Halifax County Service Authority (HCSA) serving the Urban Planning Area (UPA) of Halifax County. The effectiveness of existing facilities in the system is examined in some detail and recommendations are made for improvements to better meet the present and future needs of the systems. The basic infrastructure of the HCSA sewer system is shown on Figure 10.

Figure 10: HCSA Basic Wastewater System Infrastructure

7.2 Sewer System Serving the Town of Halifax Area

The portion of the system serving the Town of Halifax collects wastewater throughout the Town area and directs it to the HCSA Wastewater Treatment Plant on the Banister River, a couple of miles downstream of Banister Lake. The Treatment Plant is rated for a capacity of 300,000 gpd and is designed for secondary treatment using the extended aeration process. The plant, in its current location, was constructed in 1987 and improvements were made in 1989, and again in 2000. The sewer system consists of approximately 15 miles of gravity sewer and four (4) wastewater pumping stations. There are plans in the works to decommission this treatment facility and convert it to a pumping station suited for delivering the wastewater flows into the portion of the system serving the Town of South Boston.

In most reporting months, the wastewater treatment plant is compliant with its discharge permit. Typically, the most significant concern at the plant is the flow rate which, due to the presence of infiltration and inflow in the sewer system, often exceeds 0.3 MGD for short wet weather periods. On occasion, longer wet weather periods have caused the average flow for an entire month to exceed the rated plant capacity. The high flow periods can also coincide with flooding events at the headworks to the plant. The headworks is located in a low area along the river, and is protected by an earthen dike. In very wet weather, limitations for removing water from the plant grounds, and saturation of the soils in the area, cause ponding of water within the plant site.

7.3 Sewer System Serving the Town of South Boston Area

HCSA operates a 2.0 MGD Wastewater Treatment Plant on the Dan River. The plant is designed for secondary treatment to meet discharge limits to the Dan. The plant was constructed in 1960 and upgraded in 1976. More recent improvements in 1995 and 2001 resulted in higher capacity in some of the treatment process (headworks) and better control of disinfection. Construction of a major plant upgrade is currently in process and, when done, the resulting capacity of the plant will be increased to 4.0 MGD. The sewer system serving the South Boston area consists of approximately 70 miles of gravity sewer and ten (10) wastewater pumping stations.

Historically, the wastewater treatment plant has generally been compliant when average flows are less than 2.0 MGD. The portion of the system serving the Town of South Boston has been prone to high levels of infiltration and inflow. At one time, temporary flow spikes to 10

MGD were noted on monthly reports. With efforts at correction of infiltration and inflow, flow spikes have been reduced significantly. The 4.0 MGD expanded plant is expected to eliminate an significant problems with flow surcharges.

8.0 ASSESSMENT OF ABOVE GROUND WASTEWATER SYSTEM FEATURES

8.1 Lift Stations Serving Town of Halifax

The Sinai Lift Station is outside the western boundary of the Town, along Grubby Road. It serves the Grubby Road Sewer District including about 32 connections and one school. The facility was constructed in 1999 for sewer service along Grubby Road and discharges to gravity sewer along Sinai Road. The station consists of two 10 HP suction lift pump units, rated for 80 gpm at 55 feet of TDH. The pumps were supplied by Smith & Loveless. The station can be powered by a portable emergency generator. Other than corrosion of metallic parts, the station is in good condition for continued operation.

Commented [g3]: Looks like a pump out in the photos. Is there alarm light or SCADA connection.

The Post 99 Lift Station is in the western portion of the Town, at the end of Mallard Lane. It serves the Grubby Road Sewer District and Sinai Road connections. The facility was constructed in 1999 and discharges to gravity sewer along Crawford Road. The station has two 15 HP suction lift pump units, rated for 185 gpm at 76 feet of TDH. This location is also equipped with a flow meter to track the wastewater flows coming out of this area of the system. The pumps were supplied by Smith & Loveless. The station can be powered by a portable emergency generator. This station is in good condition for continued operation.

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The Canterbury Lift Station is located near Banister Lake on Canterbury Drive. This station serves Canterbury Estates and discharges flow to a gravity sewer near the intersection of Canterbury Drive and Mountain Road. It is believed this station was constructed in the early 1970's. The station has two 7.5 HP submersible pump units, rated for __ gpm at __ feet of TDH. The pumps were supplied by Myers Pump Co. The station has emergency power connected and is activated by an Automatic Transfer Switch (ATS). Other than age of the facility, this station is in reasonable condition for continued operation. When Canterbury Lift Station reaches the end of its useful life, serious consideration should be given to combining the Canterbury and Lakeside drainage areas into a single area.

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Commented [g6]: Is there alarm light or SCADA connection.

The Lakeside Lift Station is located near Banister Lake on Park Lane. This station serves the Lakeside development and discharges flow to a gravity sewer in the intersection of Church Street and Maple Avenue. It is believed this station was constructed in the early 1970's, about the same time as the Canterbury Lift Station. The station has two 7.5 HP submersible pump units, rated for ___gpm at __ feet of TDH. The pumps were supplied by Myers Pump Co. The station can be powered by a portable emergency generator and is equipped with alarm light to indicate trouble. Other than age of facility, this station is in reasonable condition for continued operation. When Lakeside Lift Station reaches the end of its useful life, serious consideration should be given to combining the Lakeside and Canterbury drainage areas into a single area.

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Commented [g8]: Is there a SCADA connection

8.2 Cowford Road Wastewater Treatment Plant

The Cowford Road Wastewater Treatment Plant is located at the eastern boundary of the Town adjacent to the Banister River. The plant is a 300,000 gpd facility designed for secondary treatment using the extended aeration process. The plant was constructed in 1987 and improvements were made in 1989 and again in 2000. The plant is generally compliant with its discharge permit. Reaching required treatment levels becomes difficult when there is significant infiltration and inflow into the sewer system. The plant serves a sewer system approximately 15 miles in length with the four lift stations identified in the prior paragraphs. Plans are being drawn to convert this treatment facility into a major pumping station. Preliminarily, the sizing for the pump station is 750 gpm. The discharge for the pump station will follow existing gravity sewer easement to a location near US Route 501 and Green's Folly Road. This project will pick up the wastewater generated in the Town of Halifax and deliver it to the sewer system serving the Town of South Boston for treatment at the Maple Avenue Wastewater Treatment Plant at the southeastern corner of South Boston.

Certain portions of this plant will be preserved for continued operation as the plant is converted to use as a pump station. Most notably, the existing aeration basins are being considered to serve as equalization basins. This facility will undergo a significant upgrade, considered separately from this report, since design is in process.

8.3 Lift Stations Serving Town of South Boston

The Webb Park Lift Station is located along the southern border of Town of Halifax and collects wastewater flows from the Webb Park area between the Towns of Halifax and South Boston and west of US Route 501. This station discharges flow to a gravity sewer along Green's Folly Road near Sinai Road (old Daystrom Industrial Site). It is believed this station was constructed in 1991. The station has two 15 HP suction lift pump units, rated for 228 gpm at __ feet of TDH. The pumps were supplied by Enpo Cornell Pump Company. The station can be

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powered by portable emergency generator. A site visit revealed that the existing wetwell for this station is leaking in multiple locations. The regulatory agency has noted that this condition will need attention and could be completed under a maintenance budget. Otherwise, this station is in good condition for continued operation.

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The Westside Lift Station is located in the northwest corner of the Town near the intersection of Lincoln Drive and Westside Park Drive. The station discharges flow to a gravity sewer along Westside Park Drive. It is believed this station was constructed in ___, but it was upgraded in 2001. The station has one 15 HP and one 20 HP suction lift pump units, rated for 252 gpm at 102 feet of TDH. The pumps were supplied by Peabody Barnes. The station is connected to an onsite emergency generator. There is an alarm bell for audible local alert to trouble in the system. The Authority files also show evidence of field testing of the units, indicating wide differences in the flow rates from the station when compared to the design conditions. The pumps show their age and pump casings are excessively corroded. It is also reported that the air release valves have operational problems, causing the pumps to operate excessive hours when the valves fail to operate. It is recommended that this station be reviewed in a Preliminary Engineering Report (PER) to identify current conditions and problems, then determine actions to allow a better operation. The PER cost ($10,000) should be included in the capital program along with $150,000 budgeted for future repairs or replacements that are largely undefined at this time.

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Commented [g12]: Which pump is it? Is the other pump a different condition?

Commented [g13]: Is there a SCADA hookup?

The Dairy Delight Grinder Pump Station is located near the corner of US Route 501 and Green's Folly Road in the northwest area of the Town. The station discharges flow to a gravity sewer adjacent to the site. This station was constructed in 2006. The station has two 2 HP submersible grinder pumps, rated for 25 gpm at ___ feet of TDH. The pumps were supplied by Ebara. The station has no means for provision of emergency power or pump out. The flow is so low in this station that the operators can call on a septic hauler to pump out the station during a sustained power outage. The station has an alarm light to alert of trouble in the station operation. The Authority has given thought to connecting the sewers that feed this station to the Webb Park drainage basin by gravity. It is recommended that this option be studied in a Preliminary Engineering Report (PER). Elimination of the lift station could reduce Authority operating costs significantly over a period of time. A budget of $5,000 should be included in the capital program for the PER along with $50,000 for sewer to Webb Park drainage area.

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Commented [g15]: SCADA

The Fordland Lift Station is located behind the Fordland development just outside of the northeast boundary of the Town. The station discharges to a gravity sewer along Dan River Church Road. This station has two __ HP suction lift pump units, rated for 125 gpm at ___ feet of TDH. The pumps were supplied by Gorman Rupp. The station has a pump out connection for service by portable pump unit. The station pumps were recently replaced. This station is in good condition for continued operation.

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Commented [g17]: Need head
Commented [g18]: Alarm light or SCADA?

The Highland Hills Lift Station is located in the Highland Hills subdivision outside of the northeast boundary of the Town. The station discharges to a gravity sewer on Bellevue __. This station has two ___ HP suction lift pump units, rated for 180 gpm at ___ feet of TDH. The pumps were supplied by Gorman Rupp. The station has a pump out connection for service by a portable pump unit. The station has been largely trouble free and is in good condition for continued operation.

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Commented [g20]: Need HP
Commented [g21]: Need TDH
Commented [g22]: Alarm light or SCADA?

The Highway 129 Lift Station is located along Local Route 129 in the northern portion of the Town near the intersection of Monroe Street. The station serves housing that is lower than the highway elevation via a backlot sewer. The station discharges to gravity sewer on Route 129. This station has two 7.5 HP suction lift pump units, rated for 200 gpm at ___ feet of TDH. The pumps were supplied by Hydromatic. The station has a hookup for portable emergency generator. There is an external alarm light to alert neighbors or operators to problems at the station. The working area in the fiberglass building is very tight. Operation of the station is adequate currently. If operation becomes unduly difficult, then replacement of the station, rather than repair, should be considered.

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Commented [g24]: SCADA

The Hamilton Boulevard Grinder Pump Station (Cavalier & Younger) is located along Hamilton Boulevard near Oakes Avenue in the center of the Town. The station serves only a few building units, at the local solid waste convenience center, which cannot flow directly to the gravity sewer in the area. The station has two 2 HP submersible grinder pumps, rated for 25 gpm at ___ feet of TDH. The pumps were supplied by Liberty. The station has no means for provision of emergency power or pump out. In addition, access to the wetwell is very tight, nearly impossible. The flow is so low in this station that the operators can call on a septic hauler to pump out the station during a sustained power outage. The station has an alarm light to alert of trouble in the station operation. It is recommended that the Authority consider converting this station to a self-

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Commented [g26]: SCADA

contained household style grinder pump. This option could be evaluated in a Preliminary Engineering Letter Report (PER). Elimination of the lift station could reduce Authority operating costs significantly over a period of time. A budget of $1,500 should be included in the capital program for the PER and $20,000 for a replacement grinder pump installation..

The Shepherds Gate Lift Station is located along James D Hagood Highway (US Route 360) at Shepherds Gate Road near the Town's eastern boundary. The station serves the Shepherds Gate community. The station has two 5 HP suction lift pump units, rated for 36 gpm at 34 feet TDH. The station was constructed in 2005 and the pumps were supplied by Liberty. The station has a hookup for a portable emergency generator. There is an alarm light to alert of operating problems. At one time, the Authority had some trouble with pumps that would burn out when the discharge check valves would not properly close. This station is in good condition for continued service.

The Highway 501 Lift Station is located adjacent to the Dan River, along Huell Matthews Highway (US Route 501). It serves areas south of the Dan River, in both the Town and County. The station discharges flow from south of the river into gravity sewer north of the river on Main Street. The station has three 10 HP submersible pumps, rated for 525 gpm at 35 feet TDH. The station was constructed in ___ and the pumps were supplied by Flygt. The station has an onsite emergency generator. There is an alarm light to alert neighbors or operators of operation trouble. There are two structures onsite that serve no purpose. One appears to be an old wetwell and the other is a building on the river side of the lift station lot. There is a carbon canister on the site which effectively reduces odors. The primary problem at this station is the wearing of pump seals, resulting in maintenance costs. Otherwise, this station is in reasonable condition for continued service.

The Lasco Lift Station is located in the Industrial Park area south of US Route 58 to the southeast of the Town. The station serves the entire park and discharges to a gravity sewer in the park along Industrial Park Road. The flow from Lasco Lift Station is ultimately received and pumped again at the Highway 501 Lift Station. The station has two 10 HP submersible pumps, rated for 200 gpm at 76 feet TDH. The station was constructed in ___ and the pumps were supplied by Myers. The station has an onsite emergency generator. There is an alarm light to alert local businesses of operation trouble. Upgrades to this station and/or its force main are currently being

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Commented [g28]: Need date.

Commented [g29]: SCADA

Commented [g30]: One source shows each pump only capable of 100 gpm.

Commented [g31]: Need date

Commented [g32]: Alarm light or SCADA designed. Therefore, upgrade costs are not being considered in this capital program.

The Seven Oaks (Parren) Lift Station is located near the corner of Seven Oaks Drive and US Route 58 southeast of the Town. The station serves the Seven Oaks development and discharges to a gravity sewer to the west of this development. The flow from this station is ultimately received and pumped again at the Highway 501 Lift Station. The station has two 10 HP submersible pumps, rated for ___ gpm at __ feet TDH. The station was constructed in ___ and the pumps were supplied by Clow Yeomans. The station has a pump out connection for use with a portable pump. The station has an alarm light for alerting neighbors or operators of operations trouble. The station has had some problems with pump control in that operation of two pumps sometimes will not occur, although wetwell levels are requesting this operation. It is noted that the pump rails for servicing the pumps are corroded and difficult to use. Other than these maintenance issues, this station is in reasonable condition for continued service.

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Commented [g34]: Need date

Commented [g35]: SCADA?

The lift stations serving the HCSA sewer system in the Town of South Boston are generally in good operation to serve for years to come. The work needed in the system is as stated above at the Westside Lift Station, Dairy Delight Lift Station and Hamilton Lift Station. In addition, only one of the lift stations has flow metering associated with it (Post 99). It is suggested that flow metering at the other stations can be vital in identifying infiltration and inflow problems before they get out of hand. The Authority should budget for up to eight flow meters, at a cost of $200,000.

8.4 Maple Avenue Wastewater Treatment Plant

The Maple Avenue Wastewater Treatment Plant is located at the southeastern corner of the Town adjacent to the Dan River. The plant is a 2.0 MGD facility designed for secondary treatment. The plant was constructed in 1960 and improvements were made in 1976, 1995 and 2001. The plant is generally compliant with its discharge permit. Reaching required treatment levels becomes difficult when there is significant infiltration and inflow into the sewer system. The plant serves a sewer system approximately 70 miles in length with eleven lift stations. Construction is in progress on a project to increase the plant capacity to 4.0 MGD and to provide better means to equalize flows and prevent overflows. With this upgrade no other treatment improvements should be required for years to come.

9.0 ASSESSMENT OF BURIED WASTEWATER SYSTEM FEATURES

9.1 Sewer System Map

A sewer system map is included in this report for reference (Appendix D). The map identifies many of the above ground facilities in the sewer system by name. Underground facilities are referenced by the alpha numeric name given them in the HCSA sewer model. This mapping has been reviewed before, and it is expected that any errors shown thereon are minor in nature. It is important to have the map updated when errors are located, to maintain the highest integrity of HCSA records and the model calibration.

9.2 Database Development – Fixed Data

In order to organize system data and coordinate it with the existing Bentley SewerCAD sewer model data, a database has been established. The database is titled "Facilities Plan – Asset Inventory and Status Chart – Sewer." The database is maintained to work with the SewerCAD software associated with the model. When a sewer system operating condition is run on the model, the output data can be transferred to the database and the database can be extracted from the model software. In general, two primary operating conditions will reflect the operation of the system nearly 100% of the time. The first condition is an average flow situation (dry weather), which simulates the system operating under a very usual condition. The second condition is a peak flow situation, which usually coincides with an extreme wet weather event. These two conditions are relatively simple to run in the model with some reliability. This database is included for reference (Appendix E).

Commented [g36]: Is this correct?

The database has over ___ lines of data included, each line relating to a single pipeline section in the sewer system. The pipe ID is the name of the pipe as shown on the sewer map. The upstream and downstream junctions are the ends of each pipeline section, typically at manholes. The name of each junction is also taken from the sewer map. Since the naming and numbering of the pipes and junctions is not intuitive, a column is provided that indicates the physical location of the pipe, generally by street name and address. For crosslot pipes, a common local name for the area in which the pipe is located has been chosen as the address. As a rule, this information is imported directly from the sewer model into the database spreadsheet.

The next columns of the database provide some physical description of each pipe. Included in the physical description are the diameter, material and length of the pipe section. These bits of information are also imported directly from the sewer model. Inherent in the material of the pipeline is the overall life expectancy in the sewer system service. Ductile iron has been assigned a life of 75 years, PVC 50 years, cast iron 40 years, AC 40 years and VC 30 years.

In addition, information relating to the construction date, its current age and remaining life expectancy are provided. The construction date is input manually. The pipe's current age will calculate automatically and the remaining life expectancy will be automatically entered based upon the materials of construction.

The sewer shed (drainage area) in which the pipe segment resides is provided in the table and is another export feature of the model.

The upstream and downstream invert represent the elevation of the pipeline at the ends of the pipe. The invert is expressed in elevation, in feet, above sea level. The HGL varies linearly to pressure in the system. The slope of the pipe is given in %, based on the total drop in feet divided by the overall pipe length.

The flow capacity of the sewer is determined based upon the size and slope of the sewer.

All of the data provided to this point in the database is 'fixed' data, which will be the same independent of which model condition is under observation.

9.3 Database Development – Dynamic Data

Dynamic data will change depending upon the operating condition of the model. The data appearing in the table for an average flow scenario should differ from the data for the peak flow scenario. Generally, the range between the data values will represent the total variation of a system parameter under normal operating conditions.

The flow (gpm) in the pipeline is provided based upon the operating condition and is directly exported from the model. A flow problem (?) column is provided, which compares the flow capacity of the sewer to the calculated flow and will indicate if the flow is likely to result in surcharging of a manhole in that section.

These dynamic data have been compared under average day flow conditions and peak flow conditions. The average day flow represents a normal flow condition and is the annual average rate. The peak flow condition is a wet weather flow.

9.4 Database Development – Trending Data

Trending data is data that is manually tracked and automatically scored to provide evidence of a need for replacement of piping. These data are observed by the operators of the water system, and not analyzed in a model.

Condition is a judgment determination of the integrity of the pipeline. Condition data may be gathered by 1) determination of pipe age against life expectancy, or 2) inspection of a sewer that has been uncovered for inspection or repair. A sewer that is in excellent condition would receive a grade "5" in this column. A sewer that shows evidence of erosion of wall thickness, deterioration of material, or other deformities would receive lower grades based upon observations or age.

Criticality is also a judgment determination of the importance of the sewer. Criticality is determined by considering 1) how much wastewater is delivered through the pipe, 2) who depends upon this sewer, or 3) how much damage might occur from a sewer break at this location. A pipe that carries wastewater from a lift station to an adjacent sewershed, or one that serves a hospital, school, government or military complex, or one that runs across a waterway, would rise to the top of the criticality scale, and receive a grade 5. A neighborhood sewer serving few homes would likely receive a very low score for criticality.

Infiltration History is a partial judgment determination, but is based on history of the sewer relative to infiltration and inflow. A sewer that repeatedly contributes to infiltration and inflow shows evidence that something is wrong. It may be poor materials, high groundwater, poor bedding conditions in the trench or just poor installation by a contractor. If the infiltration history is evident, it will pay to have the pipe replaced or lined. An active infiltration history will receive a grade 5.

Blockage/O&M History is also a partial judgment determination, and is based on history of the sewer relative to service calls. Blockages can occur due to 1) reduced pipeline flow section, 2) changes in wastewater velocity or slopes in the sewers or 3) inappropriate materials within the wastewater flow. A section of sewer with frequent service calls will receive a grade of "5." Sewers that are free of past service calls will receive a grade of "1."

Surcharge History is a judgment determination, but one made when there is some evidence of sewer surcharging. Some sewer systems have known manholes that surcharge nearly every time it rains. Of course, those that are worst result in overflows and deserve a grade of "5." Where surcharges are not frequent, lower scores would be noted.

Total Score is the sum of the trending data values for a pipeline. The total score is a direct indicator of how many problems are inherent in a segment of pipe, and therefore relates to priority for repair or replacement. It is worth noting that the trending data parameters can be weighted if, in HCSA experience, one of the parameters is more directly associated with the need to replace a pipeline. The initial database has been set up with equal weight on each of the parameters.

9.5 Using the Database

The database includes over 900 lines of data. Manual searching of a pipe ID, junctions or block addresses could be cumbersome. It is envisioned that the database will be consulted on occasions when the overall system maps have been reviewed or field visits to a certain locale in the water system have been made. Operators may have questions about the infrastructure that exists at the local point of interest in the system. In such a case, the user should take note of the pipe ID number(s), manhole number(s) or block address as determined from examination of the map or from the field visit. In the database, the first four columns of the spreadsheet are searchable. By using the dropdown menu in the appropriate column, the database will direct the user to the appropriate section of sewer.

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All columns are sortable, that is, data can be organized so the lines appear in alphabetical or numerical order according to the data provided in any single column. For example, pipelines could be organized from largest to smallest or they could be sorted from longest to shortest. Flow data could be sorted from highest to lowest. If sorting of data in a column helps the operator visualize a system condition, or helps the operator determine operating parameters that are borderline or outside the desired limits, then sorting will serve its purpose.

The dynamic data is generated from the sewer model for the system. When a model run is completed the model run results can be transferred to the database. The spreadsheet can be manipulated with the search and sort features described above. To capture the basic range of operating conditions it will be important for the operators to have the system information for the average flow scenario and the peak flow scenario previously discussed. Once the data is "locked" into the exported spreadsheet, it will be searchable and sortable.

The trending data at the far right side of the spreadsheet is also sortable, for the purpose of ranking the pipes for replacement or repair. Since the trending data is essentially a scoring system, a sort from high to low would give a good indication of which pipes need the most attention.

9.6 Other Database Key Parameters

In addition to the scoring system provided in the database, there are other parameters that can be key indicators of a well operating system. The following paragraphs describe some of the parameters that should be reviewed periodically.

System pressures should be reviewed. Pressures that are either too high or too low can be problematic. Some system pressures currently run above 100 psi, which is a comfortable level for maximum system pressures in a system such as this. On the other hand, systems need to maintain at least 20 psi at all water services in the system under fire flow conditions. The HCSA system nearly achieves this objective, according to past hydraulic analyses. To provide some operational margin to allow fire flows in the system, average and peak flow pressures generally should be kept above 30 psi. With the sortable database it is simple to organize the pressure data to determine areas where average and peak flow pressures exceed 100 psi or are less than 30 psi. Ideal pressures for water systems are 50 to 70 psi. There may be opportunities in some cases to move pipelines from one pressure zone to another, to allow them to work under better operating conditions.

Water velocity should be reviewed. Velocities of 1 to 3 fps are ideal for most delivery situations. Higher velocities are an indication that water mains may be undersized or pumps feeding those lines are oversized. High velocity relates to higher headloss and possible loss of pressures in the water system. If high velocities occur, it is suggested that pipeline upsizing, pipeline paralleling, or system looping be considered to determine how water velocity might be reduced in a high velocity main. Velocity of flow of less than 1 fps (even 0 fps) is of less importance. In most cases the low velocity is simply an indication of a water main in a neighborhood area, where low residential water use is the rule. A water main that has a long term low velocity could be a candidate for long water age and potentially a concern for high disinfection byproducts. Another parameter, which goes along with high velocity is HL/1000 ft. A high number (>0.5 ft/1000 ft) also suggests that the water velocity in a section of pipe is too high.

9.7 Future Project Planning

One of the risks in facilities planning is taking on a project that will later be impacted by another project. In this situation, it is critical to reduce the impact on one project by another. Take for example the "Tank Consolidation Project" mentioned in prior sections. This project will be able to proceed once sufficient debt on past projects has been paid down by HCSA. In the meantime, recommendations are being made for infrastructure replacement, upsizing, demolition or other actions. Some of these facilities projects may recommend replacement of water mains in an area where future water main addition or replacement will be required. In such a case it is important to highlight those water mains in the database that might be considered for action as a part of the Tank Consolidation Project, rather than as part of a more immediate project tending to the maintenance of the system, per the database. We have provided a location in the database where conflicts with a previously planned, yet unconstructed, project can be identified.