SECTION 6.0
CAPITAL IMPROVEMENTS

The purpose of this section is to identify potential capital improvements that would help to establish long-term infrastructure redundancy and increase system supply and storage to meet the projected future demands of the system. These capital improvements are divided into two categories – functional improvements that are critical to the immediate and future reliability of the system, and operational improvements that are not critical, but provide beneficial system redundancy or make operating the system easier and more efficient.

6.1 FUNCTIONAL CAPITAL IMPROVEMENTS

This section describes capital improvements that are considered critical to the immediate and future reliability of the system. These capital improvements address certain system deficiencies that PARE identified during the course of our system evaluation. The deficiencies that PARE identified include:

1. There is currently a significant deficit in pump capacity in the Low Service Area. The current pump capacity in the Low Service Area is 0.79 MGD while the maximum day demand in the Low Service Area is approximately 1.3 MGD, a deficit of approximately 0.51 MGD.

2. After full town-wide build-out, there will be a substantial deficit in pump capacity in both the Low Service Area and the High Service Area. The future maximum day demand in the Low Service Area is estimated to be 1.8 MGD, approximately 1.0 MGD greater than the current pump capacity in the Low Service Area. The current pump capacity in the High Service Area is 1.58 MGD while the future maximum day demand is estimated to be 2.05 MGD, a deficit of approximately 0.47 MGD.

3. There is currently a deficit in system storage in both service areas. The High Service Area currently has 0.52 MG of useable storage, while it appears as though approximately 2.1 MG would be more appropriate, a deficit of 1.6 MG. The Low Service Area currently has 0.71

MG of useable storage. It appears as though 1.9 MG would be more appropriate for the Low Service Area, a deficit of approximately 1.2 MG.

4. After full town-wide build-out, the deficit in useable storage in the system will increase significantly. In the future, the system should have upwards of 5.0 MG, a deficit of 4.0 MG over what the system has currently.

5. Fire flow system-wide appears to be generally adequate; however, there are several facilities in Town that have significant fire flow demands that the current system cannot meet. Those facilities include the Trottier School, the Finn School, and the business district on Cordaville Road.

6. In section 3.1.4, PARE identified seven pipe segments that the Town should consider replacing or should consider installing redundant mains elsewhere in the system. Of those seven pipe segments, there are 4 that appear to be critical to the system. The pipe on Sears Road is the sole source of supply to a large portion of the High Service Area. The pipe on Main Street between I-495 and Sears Road is a critical path for fire flow to the same portion of the High Service Area. The pipe on Main Street beneath I-495 is the sole source of supply to a small neighborhood west of I-495. The pipe beneath the Hosmer Pump Station access road is the sole source of supply to the entire Low Service Area.

Table 6-1 below provides a summary of each of the deficiencies identified above and the corresponding capital improvement that PARE proposes to resolve these deficiencies.

TABLE 6-1: Critical System Deficiencies and the Corresponding Capital Improvement			
Deficiency	Corresponding Capital Improvement		
	Description	Report Section	Cost
1.Insufficient pump capacity in the Low Service Area	Upgrade Hosmer Station - include (3) 650 gpm pumps, new generator & Automatic Transfer Switch	6.1.1	$ 260,000.00
2.Insufficient pump capacity in the High Service Area	Upgrade Boland Station - include (3) 750 gpm pumps, new generator & Automatic Transfer Switch	6.1.1	$ 300,000.00
3.Insufficient storage in the Low Service Area	Add 2.0 MG of Storage, likely at the Oak Hill and Clear Hill Tank Sites	6.1.2	$ 4,400,000.00
4.Insufficient storage in the High Service Area	Add 2.2 MG of Storage	6.1.2	$ 4,100,000.00
5.Insufficient fire flow at the Trottier School	Upgrade 2,400 lf of existing 8" water main on Flagg Road to 12"	6.1.7	$ 460,000.00
6.Insufficient fire flow at the Finn School	Upgrade PRV on Parkerville Road (plus recent upgrades on Parkerville Road)	6.2.5	$ 63,000.00
7.Insufficient fire flow near the Business District at Cordaville Road	Re-evaluate fire flow requirements and identify if improvements could be made to reduce the needed fire flow	6.3	NA
8.No redundancy for the water main on Hosmer Station access road	Install 1,100 lf of parallel 12-inch water main	6.1.4	$ 200,000.00
9.Inadequate redundancy for the water main on Main Street and no redundancy on for Sears Road	Install new 12-inch water main between Presidential Drive and Fisher Road	6.1.3	$ 170,000.00
10.No redundancy for the water main on Main Street beneath I-495	Install 400 lf of parallel 12-inch water main	6.1.6	$ 78,000.00

A description of each critical capital improvement, the resulting system benefit, and PARE's opinion of probable construction cost for each improvement are provided in subsequent sections of this report.

6.1.1 *Pump Station Upgrades*

<u>*Boland Pump Station*</u>

The Boland Station, which serves the High Service Area, currently has adequate capacity to serve its existing customer base. However, in the future it is anticipated that the station will have a capacity shortage of approximately 0.5 MGD. To meet future maximum day demand, the station capacity should be increased from 1.6 MGD to 2.1 MGD. Currently, the station has two 550-gpm pumps and a 1,000-gpm gasoline-fired backup pump. Given that the backup pump needs to be started manually, the station is not completely emergency-ready. PARE recommends that backup pump be replaced with an electric pump rated for 750 gpm. In addition, PARE recommends that the two 550-gpm pump be replaced with 750-gpm pumps. This would provide a capacity of 1,500 gpm (2.16 MGD) through two pumps, with a third pump for system redundancy. Please note that the pump sizes recommended by PARE are approximate; two 750-gpm pumps running together may provide slightly less than 1,500 gpm. A specific evaluation of the Boland Station would need to be completed to provide an exact pump size.

PARE also recommends that the Town install an emergency backup generator at the Boland Station. A new generator would also require the installation of an automatic transfer switch and electrical upgrades to the station. In addition, PARE recommends that the buried gasoline storage tank behind the station be removed.

PARE's opinion or probable construction cost for this capital improvement is $310,000.00. A breakdown of the cost is provided below.

TABLE 6-2: Boland Pump Station Upgrades				
	Quantity	Unit Price	Unit	Total
1. Pumps	3	$ 20,000.00	/EACH	$ 60,000.00
2. Generator/ATS	1	$ 70,000.00	/LS	$ 70,000.00
3. Electrical Upgrades	1	$ 50,000.00	/LS	$ 50,000.00
4. UST Removal	1	$ 15,000.00	/LS	$ 15,000.00
5. Minor Structural Repairs	1	$ 20,000.00	/LS	$ 20,000.00
		Sub-Total		$ 215,000.00
6. Mobilization/Demobilization				$ 21,500.00
7. Engineering/Design/Permitting (10 %)				$ 22,000.00
8. Contingency (20%)				$ 52,000.00
		TOTAL		**$ 310,000.00**

Hosmer Pump Station

The Hosmer Station, which serves the Low Service Area, currently has a capacity shortage of 0.5 MG. In the future, the capacity shortage is anticipated to be 1.0 MG. To meet future maximum day demand, the station capacity should be increased from 0.8 MGD to 1.8 MGD. Currently, the station has one 650-gpm pump, one 550-gpm pump, and a propane-fired backup engine that can drive the 650-gpm pump. Given that the backup engine only provides partial redundancy to the station, PARE recommends that engine be replaced with an electric pump with a rated capacity of 650 gpm, and we recommend that the 550-gpm pump be replaced with a 650-gpm pump, so that the station would have a total of three 650-gpm pumps (including the existing 650-gpm pump, which would remain). This would provide a capacity of 1,300 gpm (1.87 MGD) through two pumps, with a third pump for system redundancy. As with Boland, the pump sizes recommended by PARE are approximate; two 650-gpm pumps running together may provide slightly less than 1,300 gpm. A specific evaluation of the Hosmer Station would need to be completed to provide an exact pump size.

PARE would also recommend that the Town install an emergency backup generator at the Hosmer Station. At this station it is unlikely that natural gas is available, and therefore a liquid propane or diesel generator would be required. There is currently a propane tank on-site (for the existing backup engine), which could make a propane-fired generator more economical than a diesel generator. A new generator would also require the installation of an automatic transfer switch and electrical upgrades to the station.

PARE's opinion or probable construction cost for this capital improvement is $270,000.00. A breakdown of the cost is provided below.

TABLE 6-3 Hosmer Pump Station Upgrades

	Quantity	Unit Price	Unit	Total
1. Pumps	2	$ 17,000.00	/EACH	$ 34,000.00
2. Generator/ATS	1	$ 65,000.00	/LS	$ 65,000.00
3. Electrical Upgrades	1	$ 50,000.00	/LS	$ 50,000.00
4. Minor Structural Repairs	1	$ 20,000.00	/LS	$ 20,000.00
		Sub-Total		$ 169,000.00
5. Mobilization/Demobilization				$ 16,900.00
6. Engineering/Design/Permitting (10 %)				$ 17,000.00
7. Contingency (20%)				$ 41,000.00
		TOTAL		**$ 240,000.00**

6.1.2 *System Storage Upgrades*

<u>High Service Area</u>

Currently, the High Service Area has a storage deficit of 1.6 MG. In the future, the High Service Area's storage deficit is anticipated to increase to 2.2 MG. The useable storage in the High Service Area is currently 0.52 MG, which is only a fraction of the total storage, 1.3 MG. In order to increase the useable storage, PARE recommends that the Town consider increasing the storage capacity in the High Service Area from 0.52 MG to 2.7 MG. In addition, PARE recommends that any new storage be constructed such that the bulk of the storage (at least 2.2 MG) is above an elevation of 450 ft MSL to make the storage useable.

If the Town elects to construct a standpipe style storage facility, the Town will be substantially limited in where they could locate such a tank and still provide the needed useable storage. The Town would need to locate the tank on a parcel with a ground surface elevation at or above 450 ft. If they were to locate the new standpipe on a parcel with a ground surface elevation of less than 450 ft, the standpipe's overall height would be greater and the portion below 450 ft would be unusable, and therefore less cost-effective.

If the Town elects to construct an elevated spheroid or ellipse style tank, the Town would have more flexibility in where they place the storage facility. If, for practical purposes, we assume a maximum overall height of 100 feet, then the Town could pursue parcels with a ground surface elevation of 415 ft or above, which may open up parcels that would not be practical for a standpipe. However, elevated tanks are limited in their storage volumes and are generally 2-4 times more expensive than standpipes. If the Town opted for an elevated tank, they may need to construct multiple tanks at a much higher cost than a standpipe. Therefore, PARE recommends that the Town construct a standpipe style tank and at a location close to or higher than 450 ft.

PARE's opinion of probable construction cost to upgrade system storage in the High Service Area is $4.1M. A breakdown of the cost is provided below.

TABLE 6-4 New Storage Tank in the High Service Area

	Quantity	Unit Price	Unit	Total
1. Tank	1	$ 2,200,000.00	/LS	$ 2,200,000.00
2. Property Acquisition	1	-	/LS	-
3. Site Work	1	$ 250,000.00	/LS	$ 250,000.00
		Sub-Total		$ 2,450,000.00
4. Mobilization/Demobilization				$ 245,000.00
5. Engineering/Design/Permitting (7%)				$ 172,000.00
6. Contingency (20%)				$ 573,000.00
		TOTAL		**$ 3,400,000.00**

Low Service Area

Currently, the Low Service Area has a storage deficit of 1.5 MG. In the future, the Low Service Area's storage deficit is anticipated to increase to 2.0 MG. The useable storage in the Low Service Area is currently 0.48 MG. In order to increase the useable storage, PARE recommends that the Town consider increasing the storage capacity in the Low Service Area from 0.48 MG to 2.5 MG. In addition, PARE recommends that any new storage be constructed such that the bulk of the storage (at least 2.0 MG) is above an elevation of 415 ft MSL, to make the storage completely useable.

As described in our evaluation of the High Service Area, it would likely be more cost effective to pursue the construction of a standpipe on a parcel with a ground surface elevation of 415 ft or higher than to construct multiple elevated style tanks on parcels with lower ground surface elevations. Therefore, PARE recommends that the Town pursue a standpipe on a parcel at elevation 415 ft.

In addition, it may be most cost-effective to replace one or both of the existing storage facilities with new tanks, rather than add a separate third tank to the system. The benefit would be that the Town already owns both parcels on which the existing tanks are located, which would save the cost of the purchasing a new parcel. Also, the two tanks in the Low Service Area are relatively old (almost 80 years) and relatively small. Therefore, PARE recommends that the Town consider replacing both of the existing storage tanks in the Low Service Area with new 1.25 MG storage facilities.

PARE's opinion of probable construction cost to upgrade storage in the Low Service Area is $4.4M. A breakdown of the cost is provided below.

TABLE 6-5: New Storage Tank in the Low Service Area				
	Quantity	Unit Price	Unit	Total
1. Tank	2	$ 1,250,000.00	/LS	$ 2,500,000.00
2. Property Acquisition (NA)	2	$ -	/LS	$ -
3. Site Work	2	$ 300,000.00	/LS	$ 600,000.00
		Sub-Total		$ 3,100,000.00
4. Mobilization/Demobilization				$ 310,000.00
5. Engineering/Design/Permitting (7%)				$ 217,000.00
6. Contingency (20%)				$ 725,000.00
		TOTAL		**$ 4,400,000.00**

It is important to note that, unlike the High Service Area, increasing the storage capacity in the Low Service Area may not be critical in the short-term if the Town increases the storage in the High Service Area and upgrades the system's four existing PRVs. If the Town increases storage in the High Service Area by 2.2 MG, which would serve the future needs of the High Service Area, the total useable storage in the system will increase from 1.0 MG to 3.2 MG, which is relatively close to 3.4 MG, which is an appropriate amount of storage for the entire system if it were operated as one service area. However, the Town would need to be able to shift that water from the High Service Area to the Low Service Area in order for it to be an effective solution for the Low Service Area's storage deficit. Therefore, the PRVs would need to be upgraded in order to allow water to flow from the High to the Low during peak water demand, which is when the water is needed the most. This would allow the Town to defer construction of a new storage facility(s) in the Low Service Area and focus their resources on other capital improvements.

If the Town opts to defer construction of new storage facilities in the Low Service Area, the Town could consider combining the two service areas into one service area and eliminate the need for the PRVs entirely. If the Town were able to eliminate the need for two service areas, the water system would be easier to operate and would have more inherent redundancy in piping and pumping. This would also reduce the overall storage requirements in the system because the Town would no longer need to provide separate fire flow reserves in each area. The downside to combining the service areas is the increase in pressure it would create in areas of the Low Service Area that already have high pressure. Although the static head difference between the two service areas is only about 22 ft, or 9.5 psi, and therefore, the increase in pressure may not be that significant (refer to Appendix N for a combined system pressure plan). Those customers with excessively high pressure could have PRVs installed at their homes or businesses.

6.1.3 *Water Main between Presidential Drive and Fisher Road*

This capital improvement consists of installing approximately 1,000 linear feet (lf) of new 12-inch DI water main between the end of Fisher Road and Presidential Drive in the High Service Area. This capital improvement would provide significant system redundancy for two critical system water mains, the 12-inch main on Main Street and the 12-inch main on Sears Road. If the water main on Sears Road were taken off-line, customers north of Main Street in the High Service Area would be entirely without water, making Sears Road a critical water main. If the water main on Main Street were taken off-line, customers in the High Service Area north of Main Street would still have water, but would have substantially reduced fire flow. Currently, the available fire flow in the High Service Area north of Main Street ranges from 625 to 1,600 gpm. Without the water main on Main Street, the available fire flow would be less than 300 gpm. However, with the addition of this capital improvement, the available fire flow would range from 800 to 1,375 gpm without the water main on Main Street; 1,000 to 2,225 gpm with the water main on Main Street. Therefore, this capital improvement would provide a substantial benefit to the water system.

There are three primary challenges to this capital improvement – 1) the Town would need to secure an easement between Fisher Road and Presidential Drive as there is currently no public right-of-way, 2) the Town would need to cross an existing railroad track, which would require coordination with the rail owner, and 3) the anticipated future alignment is densely wooded, which would add cost to the installation.

PARE’s opinion or probable construction cost for this capital improvement is $370,000.00, not including the cost to secure an easement across the railroad tracks. A breakdown of the cost is provided below.

TABLE 6-6: 12" Water Main between Presidential Drive and Fisher Road					
	Quantity	Unit Price	Unit		Total
1. Water Main Installation (Roadway)	900	$ 150.00	/LF	$	135,000.00
2. Clearing and Grubbing	0.41	$ 5,000.00	/ACRE	$	2,050.00
3. Rock Removal	100	$ 185.00	/SY	$	18,500.00
4. Railroad Crossing	85	$ 1,000.00	/LF	$	85,000.00
5. License Agreement with Rail Company	1	$ 15,000.00	/LS	$	15,000.00
		Sub-Total		$	255,550.00
6. Mobilization/Demobilization				$	25,600.00
7. Engineering/Design/Permitting (10 %)				$	26,000.00
8. Contingency (20%)				$	61,000.00
		TOTAL		**$**	**370,000.00**

6.1.4 *Water Main on Hosmer Pump Station Access Road*

This capital improvement consists of installing approximately 1,100 lf of 12-inch DI water main along the access road to the Hosmer Station, from the station to the access road south of the golf course. Currently, the existing 12-inch main provides the sole source of supply from the Hosmer Station to the Low Service Area. If this main were off-line, there would be a serious disruption in service to the entire Low Service Area. Therefore, this water is a critical system component. An additional 12-inch water main would provide significant system redundancy.

PARE's opinion or probable construction cost for this capital improvement is $320,000.00. A breakdown of the cost is provided below.

TABLE 6-7: 12" Water Main beneath Hosmer Station Access Road				
	Quantity	Unit Price	Unit	Total
1. Water Main Installation	1,100	$ 150.00	/LF	$ 165,000.00
2. Rock Removal	122	$ 185.00	/CY	$ 22,570.00
3. Pavement	611	$ 56.00	/SY	$ 34,216.00
		Sub-Total		$ 221,786.00
5. Mobilization/Demobilization				$ 22,200.00
6. Engineering/Design/Permitting (10%)				$ 22,000.00
7. Contingency (20%)				$ 53,000.00
		TOTAL		**$ 320,000.00**

6.1.5 *Water Main on Main Street under I-495*

This capital improvement consists of installing approximately 400 lf of new 12-inch DI water main on Main Street beneath the I-495 overpass. This water main is the sole source of supply to a small neighborhood on the west side of I-495. The primary benefit of this water main would be the redundancy it would provide in the event that the existing water main along Main Street were off-line.

PARE's opinion or probable construction cost for this capital improvement is $119,000.00. A breakdown of the cost is provided below.

TABLE 6-8: 12" Water Main on Main Street at I-495 Crossing				
	Quantity	Unit Price	Unit	Total
1. Water Main Installation	400	$ 150.00	/LF	$ 60,000.00
2. Rock Removal	44	$ 185.00	/CY	$ 8,140.00
3. Pavement	222	$ 56.00	/SY	$ 12,432.00
4. Traffic Protection	6	$ 400.00	/DAY	$ 2,400.00
		Sub-Total		$ 82,972.00
5. Mobilization/Demobilization				$ 8,300.00
6. Engineering/Design/Permitting (10%)				$ 8,000.00
7. Contingency (20%)				$ 20,000.00
		TOTAL		**$ 119,000.00**

6.1.6 *Water Main on Flagg Road between Lovers Lane and the Trottier School*

This capital improvement consists of replacing approximately 4,300 lf of 8-inch main on Flagg Road between Lovers Lane and Strawberry Hill Road with 12-inch DI pipe. The primary purpose of this capital improvement is to increase fire flow to the Trottier School. Currently, the available fire flow at the School is approximately 2,500 gpm, approximately 500 gpm less than what ISO recommends. Upgrading this pipe to 12-inch diameter pipe will increase the available fire flow at the School to 3,000 gpm.

PARE’s opinion or probable construction cost for this capital improvement is $1,280,000.00. A breakdown of the cost is provided below.

TABLE 6-9 12" Water Main on Flagg Road				
	Quantity	Unit Price	Unit	Total
1. Water Main Installation	4,300	$ 150.00	/LF	$ 645,000.00
2. Rock Removal	478	$ 185.00	/CY	$ 88,430.00
3. Pavement	2,389	$ 56.00	/SY	$ 133,784.00
4. Traffic Protection	58	$ 400.00	/DAY	$ 23,200.00
		Sub-Total		$ 890,414.00
5. Mobilization/Demobilization				$ 89,000.00
6. Engineering/Design/Permitting (10 %)				$ 89,000.00
7. Contingency (20%)				$ 214,000.00
		TOTAL		**$ 1,280,000.00**

6.2 OPERATIONAL CAPITAL IMPROVEMENTS

This section describes capital improvements that are considered non-critical to the immediate and future reliability of the system, but would provide a benefit to the system through additional redundancy, increased efficiency, or ease of maintenance.

6.2.1 *SCADA System Installation*

The installation of a Supervisory Control and Data Acquisition (SCADA) System would promote more efficient operation of the distribution system. A SCADA system provides real-time data collection and monitoring of critical system components, such as tanks and pumps. Currently, the Town has no means of collecting real-time data at their pump stations or tanks, other than alarms installed at the pump stations. The Town relies on system operators visiting the pump stations and reading pen-type chart recorders on a daily basis. Then and only then do the system operators have the information necessary to make decisions about system operations, such as manually adding another pump to fill system storage tanks, taking a pump off-line if it appears to be malfunctioning, overriding pump cycles to promote balanced pump use, or manually drawing down a tank to promote water circulation. The current system is labor intensive and is not well suited for making real-time adjustments to meet changes in system demand. A SCADA system would allow the Town to monitoring their facilities from one centralized location and could facilitate certain system operations remotely, such as the operation of the system's PRVs. A typical SCADA system would allow the Town to manually turn on and off pumps, monitor storage tank levels, open or close the system PRVs, etc. A SCADA system could also be expanded to monitor water quality in the tank, pump stations, or even in the distribution system.

Typical SCADA components can be grouped into essentially three categories, monitoring equipment, communication equipment, and operational equipment. The monitoring equipment typically includes the components used to measure system parameters such as flow, pressure, temperature, run status, etc. Communication equipment typically includes the instrumentation necessary to log field parameters and send that information back to a centralized location. The communication equipment also receives information from a central location and disseminates that information to the process equipment. The operational equipment typically includes the HMI, or Human Machine Interface, which is the apparatus that displays system data to the system operator and allows the operator to remotely control system components.

For the Southborough system, the minimum amount of monitoring equipment that would be required is anticipated to include level transmitters at the three system storage tanks, flow and pressure transmitters at the two pump station, electrical monitoring equipment at the pump stations to determine such parameters as pump run status, and pressure transducers at the PRV vaults. Alarm equipment would also be required, such as fire alarms, intrusion alarms, and various "trouble" alarms that indicate equipment failure. Southborough currently owns much of this equipment, so upgrading to SCADA would require retrofitting this equipment to make it SCADA ready.

The communication equipment that would be required would include five remote telemetry units (RTUs), one at each tank and both pump stations. The RTUs are the SCADA components that send and receive process control signals back and forth between the system components and the operators' control station. The RTUs can communicate through radio, telephone, or Ethernet, depending on which system is most cost-effective for a particular system. All five RTUs would relay information back and forth to a master telemetry unit (MTU), which would be located at central location, such as the DPW Garage. In addition, programmable logic controls (PLCs) would be required at both pump stations to compile the various data signals from the process equipment and disseminate basic logic commands to the process equipment.

The operational equipment required would be an operator workstation at a centralized location, likely the DPW Garage. The workstation would include apparatus to monitor system components and send out process commands. This equipment is usually limited to a computer workstation, with perhaps extra displays to monitor various components at once.

PARE's opinion of probable construction costs to install a SCADA system is $400,000.00. A breakdown of the cost is provided below.

TABLE 6-10: SCADA Installation

	Quantity	Unit Price	Unit		Total
1. SCADA System, complete and installed	1	$ 300,000.00	/LS	$	300,000.00
		Sub-Total		$	300,000.00
2. Engineering/Design/Permitting (10%)				$	30,000.00
3. Contingency (20%)				$	66,000.00
		TOTAL		**$**	**400,000.00**

6.2.2 *Water Main on Woodland Road at the I-90 Crossing*

The existing water main on Woodland Road at the I-90 crossing is an 8-inch DI pipe. This main connects to two 8-inch mains on either side of I-90, and therefore appears to be a bottleneck. However, when PARE evaluated the contribution this pipe provides to the Low Service Area, it appears to be fairly small. There are currently three other pipes that cross I-90 and bring water to the southern half of the Low Service Area, although one is a connection to the High Service Area and therefore does not contribute on a regular basis. During normal conditions, the Woodland Road pipe contributes approximately 15 percent of the total flow to the southern half of the Low Service Area. If upgraded to a 12-inch pipe, its relative contribution would remain around 15 percent. This is due in large part to the fact that the closest system storage tank, the Oak Hill Tank, is connected directly to a 12-inch main on Walnut Drive in close proximity to I-90. As a result, a disproportionate amount (i.e., 75 percent) of flow travels through the pipe on Walnut Drive and into the southern half of the Low Service Area.

If the pipe on Walnut Drive were off-line, the relative contribution of the Woodland Road pipe would increase to 68 percent, 70 percent if it were upgraded to 12-inches.

It does not appear as though upgrading the Woodland Road water main will significantly increase the available fire flow to the southern half of the Low Service Area. However, if the 12-inch main on Walnut Drive were off-line, this main would provide important redundancy to the southern half of the Low Service Area.

PARE's opinion of probable construction cost for this capital improvement is $78,000.00. A breakdown of the cost is provided below.

TABLE 6-11: 8" Water Main on Woodland Road at I-90 Crossing

	Quantity	Unit Price	Unit	Total
1. Water Main Installation	300	$ 125.00	/LF	$ 37,500.00
2. Rock Removal	33	$ 185.00	/CY	$ 6,105.00
3. Pavement	167	$ 56.00	/SY	$ 9,352.00
4. Traffic Protection	4	$ 400.00	/DAY	$ 1,600.00
	Sub-Total			$ 54,557.00
5. Mobilization/Demobilization				$ 5,500.00
6. Engineering/Design/Permitting (10%)				$ 5,000.00
7. Contingency (20%)				$ 13,000.00
	TOTAL			**$ 78,000.00**

6.2.3 *Water Main on Rt. 9 between Crystal Pond and Deerfoot Roads*

This capital improvement consists of installing approximately 1,800 lf of new 12-inch DI water main on the south side of Rt. 9 between Crystal Pond and Deerfoot Roads. This capital improvement would provide redundancy to the existing 12-inch water main on the north side of Rt. 9. If the main on the north side of Rt. 9 were off-line, customers south of Rt. 9 would still get water; however, their available fire flow would be significantly reduced. Currently, the available fire flow south of Rt. 9 ranges from 700 to 1,000 gpm. If the existing water main on the northern side of Rt. 9 were off-line, the available fire flow south of Rt. 9 would be less than 300 gpm. However, it doesn't appear as though the addition of this water main will substantially increase the available fire flow south of Rt. 9 above what it is currently.

The primary challenge of this capital improvement is that the work would need to be done in a State roadway (i.e., Rt. 9). As such, the State would likely require a thicker pavement profile than in a Town roadway and would require controlled density fill (CDF) in lieu of traditional backfill, both of which would add cost to the project. In addition, given the busy nature of Rt. 9, there may be restrictions on the hours during the day that construction can occur, and added traffic protection may be required.

PARE's opinion or probable construction cost for this capital improvement is $760,000.00. A breakdown of the cost is provided below.

TABLE 6-12: 12" Water Main on Rt. 9 between Crystal Pond and Deerfoot Roads

	Quantity	Unit Price	Unit	Total
1. Water Main Installation	1,800	$ 150.00	/LF	$ 270,000.00
2. Control Density Fill	1,000	$ 150.00	/SY	$ 150,000.00
3. Rock Removal	200	$ 185.00	/CY	$ 37,000.00
4. Pavement	1,000	$ 56.00	/SY	$ 56,000.00
5. Traffic Protection	36	$ 400.00	/DAY	$ 14,400.00
		Sub-Total		$ 527,400.00
6. Mobilization/Demobilization				$ 52,700.00
7. Engineering/Design/Permitting (10%)				$ 53,000.00
8. Contingency (20%)				$ 127,000.00
		TOTAL		**$ 760,000.00**

6.2.4 *PRV Upgrades*

All four PRVs, when working properly, would provide a substantial benefit to the system. Fully functioning PRVs would allow the system to act more like one system and less like two separate pressure zones. The PRVs would allow water to be shared between the two service areas, which would reduce the pump capacity and storage deficit that currently exists in the Low Service Area, and would reduce the system-wide pumping and storage deficit that is anticipated at full build-out.

PARE evaluated two PRVs individually because they are anticipated to contribute significantly to a localized fire flow requirement at two locations. The Parkerville Road PRV is adjacent to the Finn School, and the Mt. Vickery Road PRV is located adjacent to the Cordaville Road business district, both of which have the highest fire flow requirements in town.

Parkerville Road PRV

The Parkerville Road PRV is an 8-inch PRV located just south of I-90 on Parkerville Road, adjacent to the Finn School. The primary benefit of this PRV is its proximity to the Finn School, which has a high fire flow requirement. Currently, the Finn School requires approximately 2,250 gpm for fire flow, but based on our evaluation only has approximately 2,150 gpm available. It is our understanding that Southborough recently upgraded the water main on Parkerville from an 8-inch to a 12-inch pipe from Rt. 9 to Middle Road. It appears as though this pipe upgrade, along with a working PRV, would contribute enough flow to the Low Service Area during a fire event to supply adequate fire flow to the Finn School. The combination of these two capital improvements would increase the available fire flow at the Finn School to approximately 2,500 gpm.

Mount Vickery Road PRV

The Mount Vickery PRV is located in a grassed area to the northwest of the intersection of Cordaville Road (Rt. 85) and Mt. Vickery Road. The primary benefit of this PRV is its proximity to the Cordaville Road business district, including the Public Works garage and the transfer station. Currently, this area requires approximately 3,500 gpm for fire flow, but based on our evaluation only has approximately 1,650 gpm available. A properly functioning PRV could contribute up to 750 gpm to the Cordaville area in a fire event, with the existing piping. While this does not completely make up the difference between what is needed and what is available, this PRV could contribute significantly to the fire flow in that area.

TABLE 6-13: PRV Upgrades				
	Quantity	Unit Price	Unit	Total
1. Ledge Hill Road	1	$ 50,000.00	/LS	$ 50,000.00
2. Parkerville Road	1	$ 50,000.00	/LS	$ 50,000.00
3. Town Square	1	$ 50,000.00	/LS	$ 50,000.00
4. Mount Vickery Road	1	$ 50,000.00	/LS	$ 50,000.00
		Sub-Total		$ 200,000.00
5. Mobilization/Demobilization				$ 20,000.00
6. Engineering/Design/Permitting (10%)				$ 20,000.00
7. Contingency (20%)				$ 48,000.00
		TOTAL		**$ 290,000.00**

6.2.5 *Water Main on Rt. 9 between Willow Street and Winter Street*

This capital improvement consists of installing approximately 2,400 lf of new 8-inch DI water main on the north side of Rt. 9 between Willow Street and Winter Street. It also consists of upgrading approximately 2,500 lf of existing 6-inch and 8-inch water main on the south side of Rt. 9 to 12-inch pipe. The existing 6-inch water main on the south side of Rt. 9 is from Willow Street to Oak Hill Road and the existing 8-inch water main is from Oak Hill Road to Winter Street. A new 12-inch water main on the north side of Rt. 9 would provide redundancy in the system. This capital improvement will also upgrade the existing water main on the south side of Rt. 9, which would provide an increased flow through this section of water main. However, it does not appear as though the existing water main on the south side of Rt. 9 is a critical system main as there is already some redundancy in the system in that area.

PARE evaluated the available fire flow south of Rt. 9 in the Low Service Area, which ranges from 850 to 5,000 gpm. With the upgrades to the existing water main on the south side of Rt. 9 and the installation of new water main on the north side of Rt. 9, there is little to no increase in the available fire flow. Therefore, it doesn't appear as though this capital improvement will substantially increase the available fire flow south of Rt. 9 above what it is currently.