the Village of Shorewood

AT THE EDGE OF THE CITY AND THE HEART OF EVERYTHING

Report

Master Meter Pit Analysis

Village of Shorewood

February 2013

City Water

February 7, 2013

Leeann Butschlick
Director of Public Works
Village of Shorewood
3801 N. Morris Boulevard
Shorewood, WI 53211

Re: Master Meter Pit Analysis
Client Project No.:
City Water File No.:

Dear Leeann:

We are pleased to present you with the Meter Pit Analysis Report for the Downer Avenue Meter Pit. The Downer Avenue meter pit is the main water supply point from the City of Milwaukee for the Village of Shorewood's water distribution system. Maintaining operation of this meter pit is critical to ensuring adequate water supply for customer usage and fire flow capabilities will be achieved.

This report outlines the alternatives available and costs associated with upgrading the equipment and operation of the meter pit. Included in the report is an Emergency Plan for the Village to use as a guideline in case the operation of the meter pit fails before the planned improvements can be made.

Please contact me if you have any questions regarding this report.

Sincerely,

City Water, LLC

Thomas Nennig

Thomas Nennig, P.E.
Project Manager

Background

WATER DISTRIBUTION SYSTEM

The Village of Shorewood Water Utility is comprised of approximately 3,500 customers. The majority of water users are residential customers, with key commercial users located along Capitol Drive, and along Oakland Avenue, and a limited amount of public use accounts. The Village purchases supply water from the City of Milwaukee via two meter pits located along the Village border of Edgewood Drive. .

The average daily water usage for the Utility is approximately 1.25 million gallons per day (mgd), with a average maximum day water use is approximately 2.15 mgd, and a peak hour water use of 2,375 gallons per minute. The hydraulic grade line of the distribution system is set at each meter pit by pressure reducing valves. The hydraulic grade line at the Downer Ave meter pit is set at 778 ft. while the hydraulic grade line at the Oakland Ave meter pit is a little lower at 768 ft.

In fall of 2012, Village experienced a rash of water main breaks due to excessive water hammer that developed in the water distribution system. The cause of the water hammer was traced back to a faulty pressure reducing valve (PRV) located in the Downer Ave. Meter Pit. It was determined the PRV needs to be rebuilt, however, the isolation valves on either side of the PRV will not close far enough to allow for work to be done on the PRV. In order to replace the isolation valves, the Downer Ave. meter pit will need to be taken off line for a period of time that will comprise water service to the customers of the Utility.

In 2011 and 2012, the Village also investigated changing their water supplier from the City of Milwaukee to North Shore Water Commission. No decision has been made yet in this issue. However, it does complicate the meter pit issue because these pits could be abandoned if a supplier changer was made.

In January of 2013, City Water was hired to investigate alternatives available to the Utility to isolate the existing meter pit so improvements to the equipment can be made. As part of the improvement project, the City of Milwaukee would also like to upgrade the master meters in the meter pit by replace the old 12-inch turbo meters with new magnetic meters. The alternatives presented will include replacement of the master meters.

Meter Pits

DESIGN/OPERATION

The meter pits are used to meter the volume of water purchased by the Village from the City of Milwaukee. The Village is responsible for the maintenance and operation of the equipment inside each the meter pits with the exceptions of the master meters, and the meter test port piping. The hydraulic grade line of the supply water from Milwaukee is approximately 841 feet. The PRV's located in the meter pits are designed to reduce the hydraulic grade line approximately 65 feet. Reducing the hydraulic grade line 65 feet (28 psi) allows the Village to operate the distribution system between 40-60 psi of pressure for their customers.

The Downer Avenue meter pit is designed to supply the majority of water for the Village, while the Oakland Avenue meter pit is designed to supply water during peak periods of use, and during emergency situations, such as a fire.

Oakland Ave. Meter Pit – Water is supplied to the meter pit from an 8-inch diameter main in Oakland Drive. After the control valve for the meter pit, the main enters the meter pit where there are isolations valves, a master meter, test port, and a pressure reducing valve. Since the Oakland Ave. meter pit is designed to only operate during peak demand times or emergencies, the pressure reducing valve is set to operate at a hydraulic grade line of approximately 768 feet or 56 psi. This is approximately 10 feet or 4 psi lower than the set points for the Downer Ave. meter pit; therefore, the Oakland Ave meter pit will only operate with the system pressure at Downer Ave. meter pit is below 56 psi.

For a number of years, the water flow through the Oakland Ave. master meter was very minimal, indicating a problem with the set points and/or operation of PRV. In 2009, the Village serviced the PRV, replacing the interior parts of the valve and the pilot controls. The meter pit is now operating as designed, supplying water for peak demands times and emergencies. The maximum amount of water that can be supplied though the Oakland Ave meter pit is limited by the water flow through the PRV. The maximum water flow through an 8-inch PRV is 3,100 gpm or 4.5 mgd.

Downer Ave. Meter Pit – Water is supplied to the meter pit is from a 12-inch diameter main in Edgewood Drive. After the control valve for the meter pit, the main splits into two separate feeds (east and west) that enter into the meter pit. Inside the meter pit, on each feed line there are isolation valves for maintenance, a 12-inch master meter, meter test port, and a PRV to reduce the water pressure supplied by Milwaukee. After the feed lines exit the meter pit, both lines are connected to a 16-inch diameter main that is the main transmission line for the Village. The pressure reducing valve is set to operate at a hydraulic grade line of approximately 778 feet which translates to a system pressure of approximately 51psi.

The meter pit was designed to allow an equal amount of water to flow though each feed line while supplying the Village with enough water to meet their daily demand. The design also included the ability to meet the supply demands of the Village through only one feed line if the second feed line needed to be

taken out of service for maintenance or repairs. The meter pit was installed in the 1950's. Layout of the meter pit is illustrated in Figure 1.

In recent years, the meter pit has experienced the following issues:

- The meter pit could only be operated through the east feed line due to a problem with the west PRV.
- The isolation valves inside the meter pit would not close far enough for the City of Milwaukee to accurately test the master meters.
- A service clamp was installed on the west feed line to repair a leak that was caused by a small crack on the pipe
- The original entry ladder into the meter pit was failing and was replaced making entry into the pit difficult.
- The pit partially fills with groundwater which needs to be pumped out for entry to the pit. This wet environment is not good for people working in the pit or for equipment in the pit.
- The meter pit is classified as a confined space. Due to the existing configuration of the meter pit the worker entering the pit is required to unhook from a rescue line in order to enter the pit. This makes rescuing a worker very difficult.

The original construction of the meter pit included leaded joints. While the joints are fine, any future work with the piping in the pit could damage the joint and require repair. In 2012, when the Village experienced problems with the operation of the east PRV, the Village quickly repaired the west PRV by replacing the pilot controls on the outside of the PRV. The west PRV is now in operation while the east PRV is out of service.

The following section outlines alternatives available to the Utility for improving the operation of the meter pits.

Alternatives

Four alternatives were alternatives were examined for the Downer Avenue meter Pit. The first alternative is the Do Nothing approach, the second is an Emergency Connection Plan, the third is Equipment Replacement inside of the meter pit, and the fourth alternative is a complete replacement of the meter pit. The Emergency Plan will address the minimum amount of repairs necessary to make the east prv operational as soon as possible. Alternatives 3 and 4 were developed with the following key considerations:

- Meeting the peak available water demand of 4,993 gpm with the largest water supply line out of service. (4,993gpm is the peak hour water demand of the Village combined with a 3,500 gpm fire flow)
- Installation of magnetic flow meters from Milwaukee
- Minimize the amount of down time of the Downer Avenue meter pit
- Provide operational flexibility
- Address safety concerns of the existing meter pit (structural integrity, flooding, access issues)
- Maximize the service life of the improvements

DO NOTHING

Continuing to operate with only one of the feed lines in working condition in the Downer Ave meter pit will have the following impacts on the water service to Utility customers:

- Compromised fire flow volume for the distribution system with the east feed line out of service. The Utility will not be able to meet the required peak hour demand and a fire flow demand if a problem occurred with the west supply line of the Downer Ave meter pit.
- No back up water supply from the Downer Ave meters if the west feed line is in need of service or the Utility experiences problems with the operation of the west line PRV.
- Master meters cannot be tested to verify the accuracy of the meters – Village could be over billed for water supplied to the Village.
- The existing pit does not have SCADA (Supervisory Control and Data Acquisition) equipment to better regulate water supply and provide for better water accounting (water loss control).
- The existing pit does not meet DNR codes or City of Milwaukee standards for master meter pits. The DNR could order a rebuild. Milwaukee could also order a rebuild but would not be as likely to do this as DNR.

EMERGENCY PLAN

The emergency plan outlines the steps necessary to fix the current operational issues regarding the Downer Avenue meter pit if the west PRV fails in the near future. If the west PRV fails, water supply and system pressure will be provided by the 8-inch meter at the Oakland Ave meter pit. The 8-inch connection with Milwaukee will be enough to handle average day demand conditions but will struggle to meet peak hour demand and will not be able to supply enough flow to cover a fire flow demand. Therefore, an emergency connection with Milwaukee or Whitefish Bay will need to the completed before the meter pit is isolated from the system.

There are currently three (3) emergency connections with the City of Milwaukee along Edgewood Ave. at the intersections of Sherman, Hackett and Summit. However the interconnections have not been operated in recent history, and the age of the main in the Milwaukee system is early 1900's. Before relying on these interconnections to help in an emergency, the Village should contact the City and work with them to operate and flush the interconnections. There is also an old 6-inch meter pit just to the west of the Downer Ave meter pit that has been abandoned for years. The old 6-inch line could be revived to service as the temporary feed line.

The second option for an emergency interconnection would be a hydrant to hydrant connection. A hydrant from the Milwaukee system could be connected to a hydrant to the Shorewood system above ground to help in an emergency. There is a hydrant at the intersection of Edgewood Ave. and Hackett Ave. that is connected to the 12-inch diameter transmission main in Milwaukee, and a hydrant located on Hackett Ave. approximately 350' north of Edgewood Ave. These hydrants could be inner-connected through a temporary above ground main that could be installed in the curb line of Hackett Ave. The hydraulic losses through the two hydrants in addition to the losses inside the smaller diameter main (4-inch) will help reduce the pressure differences between the Milwaukee system and the Shorewood system. Low elevation areas of the Village should be monitored during the emergency connection. There will be driveway and sidewalk crossings that will need to be modified with temporary asphalt ramps to allow traffic to cross the temporary water main. The temporary main would be similar to the temporary mains that are set up for pipe cleaning projects.

A third option would be to establish an emergency interconnection with the Village of Whitefish Bay. This would most likely be a hydrant to hydrant connection. These interconnections have not been used in over 50 years so would need to be investigated more.

Once the temporary main is in place the Downer Avenue meter pit can be isolated from the Milwaukee and Shorewood distribution systems. It is not known at this time if the west isolation valves in the meter pit will operate correctly and provide a complete shutdown to work on the west side PRV. Since the west side isolation valves were installed at the same time as the east side we will assume the valves will not hold. The four isolation valves would need to be replaced and at least one of the PRV valves rebuilt before the meter pit would be able to be returned to service. With one PRV operational, the second PRV could be rebuilt. By replacing all four of the isolation valves, the master meters could also be replaced.

The estimated cost for an above ground emergency connection, replacement of all four isolation valves, and rebuild of the PRV's is $65,000 which includes a 30% contingency fee.

A draft Emergency Connection Plan is in Appendix A.

EQUIPMENT REPLACEMENT

This alternative consists of reusing the existing Downer Ave meter pit structure and replacing all of the equipment inside of the pit. In Table 1 are the suggested maximum flow rates from the equipment that will be installed in the meter pit.

Table 1 - Flow Rates

Equipment	Maximum Flow Rate (gpm)
12" Mag Meter	13,444
12" PRV	7,000
8" Mag Meter	5,975
8" PRV	3,100

6” Mag Meter	3,361
6” PRV	1,800

The PRV’s are the limiting flow factor in the configuration of the equipment inside the meter pit. Based on the DNR’s design requirements for water supply; average hour of the maximum day water demand plus fire flow has to be met when the largest water supply line is out of service. The design flow for the Village would be 4,993 gpm. Table 2 compares the design of two 12-inch supply lines vs. two 8-inch supply lines installed in the Downer Ave meter pit.

Table 2- Water Supply Configuration

Equipment	Oakland Ave Pit 8-inch line	East Supply Line		West Supply Line		Total Flow Rate (gpm)
		12”	8”	12”	8”	
Max. Flow (gpm)	3,100	7,000		Out of service		10,100
Max. Flow (gpm)	3,100		3,100		Out of service	6,200

Both the 8-inch and 12-inch supply lines will meet the design flow demand of the Village.

The first step in any replacement or rebuild alternative is to develop a successful shut down procedure for the Downer Ave meter pit. The shutdown procedure will include:

- Identify the proper control valves upstream and downstream of the meter pit that will close water supply to the meter pit.
- Exercise the control valves to verify the valves can close properly and shut off water supply to the meter pit. The Village of Shorewood would be responsible for the valves downstream of the meter pit while Milwaukee with be responsible for the valve(s) upstream of the meter pit. Coordinate operation of the valves between distribution crews in Milwaukee and the Village of Shorewood.
- Establish a temporary feed line into the Village from the City of Milwaukee or the Village of Whitefish Bay to help with peak water supply demands of the system while the meter pit is being closed. Temporary feed lines could be constructed above ground to supply the Village with enough water to meet peak demands while the meter pit is out of service. There is also an old 6-inch meter pit just to the west of the Downer Ave meter pit that has been abandoned for years. The old 6-inch line could be revived to service as the temporary feed line.
- Once the meter pit has been shut-down, the equipment on the east line could be removed and the new isolation valves installed. After the isolation valves have been installed the west line could be placed back into service while the east line is completed.
- After the east line has been replaced with new equipment, the meter pit will have to shut-down again so the west line can be replaced, starting with installing new isolation valves. Once the isolation valves have been installed, the east line could be placed back into service and the west line completed.
- The peak demand flow of 4,933gpm could be met by downsizing the existing 12-inch supply lines to 8-inch supply lines. Downsizing to 8-inch diameter lines will increase the accuracy of the flow meters, increase the work space around the supply lines, and help reduce the cost of the project.
- Other equipment upgrades in the meter pit would include a new sump pump, heating element, dehumidifier, SCADA controls, and entry door into the meter pit.

The estimate for probable construction costs for the replace equipment alternative is $220,000 (includes 15% engineering, and 15% contingency fees)

REBUILD METER PIT

The rebuild alternative consists of installing a new supply line to the City of Milwaukee and constructing a new meter pit. The new meter pit could be placed to the east of the existing pit in the sidewalk and terrace area. The new location would move the meter out from underneath the roadway and drastically improve the safety of the worker entering and working in the pit. The footprint of the new meter pit cold also be smaller by incorporating 8-inch diameter equipment and master meters instead of the 12-inch equipment and master meters. The new meter pit would be supplied by a 12-inch diameter main that is connected to Milwaukee's supply main on Edgewood and splits into two 8-inch diameter feed lines inside the meter pit. The supply lines would then connected into the existing 16-inch diameter transmission main located on Shorewood's distribution system. Key elements of the rebuild alternative include:

- Identify and exercising the proper control valves upstream and downstream of the meter pit in order to shut down the meter pit.
- Establish a temporary feed line into the Village from the City of Milwaukee or the Village of Whitefish Bay to help with peak water supply demands of the system while the meter pit is shut down. It is anticipated the shut-down would only be for one day to allow a connection to the existing 16-inch transmission main upstream of the proposed meter pit and installation of an isolation valve on the 16-inch line.
- Construction of the proposed meter pit could occur at any time during the process. The existing west supply line would remain in service providing water to the Village while the new supply connection and meter pit is under construction.
- Installing two 8-inch diameter feed lines will help reduce the overall footprint of the meter pit allowing the entry door to be installed outside of the pavement in Downer Ave.
- Upon completion of the new meter pit, the equipment in the existing meter pit could be removed and the old pit filled with granular backfill or slurry and abandoned.

Probable construction cost for the rebuild meter pit option is $445,000 (includes 15% engineering, and 15% contingency fees).

Recommendation

Regardless of the Alternative selected there are a couple of items the Village can do to prepare for the repairs to the meter pit.

1. The Village should work in conjunction with the City of Milwaukee and establish a protocol for isolating the Downer Ave. meter pit. The Village can operate the distribution valves downstream of the meter pit to ensure the valves will close and the City of Milwaukee can operate the valves upstream of the meter pit to ensure the meter pit can be isolated from the system if necessary.

2. An above ground connection location can be determined and piping and valve material purchased so if an emergency connection is need, the material will be ready to be installed.

3. The PRV settings at the Oakland Ave. meter pit should be increased to just below the hydraulic grade line of the Downer Ave. meter pit. Is will allow for an easier transition of supply water from the Oakland Ave. meter pit in case of an emergency.

4. The Emergency Plan or the Equipment Replacement option will restore both supply lines to full operation however it will not solve the structural or safety issues that exist with the current meter pit. Brand new piping and SCADA equipment will still be susceptible to the flooding problems of the existing pit and could accelerate the deterioration of the equipment. Installing new or rebuilding the equipment and piping will also not solve the safety issues that exist. Also, the DNR or the City of Milwaukee could still order a meter pit replacement because the existing pit does not meet current codes and standards. A new meter pit could be installed between the right-of-way and the existing meter pit. The new meter pit could be installed without taking the existing meter pit off line for an extend period of time. A new meter pit will also solve all of the structural and safety problems of the existing pit, therefore we are recommending a full replacement of the Downer Ave. meter pit.

Appendix A – Emergency Connection Plan

If an emergency connection with the City of Milwaukee is required, the following process are should be followed:

1. Contact Village fire and police personal to alert them a potential for low water pressure complaints and low fire flow availability.
2. Contact City of Milwaukee distribution to dispatch a crew to establish an emergency connection (see contact list)
    a. Below ground connection
        i. Open interconnection valve(s) on Edgewood at Sherman, Hackett and Summit intersections. Valves should be opened slowly to allow the pressure differential to slowly dissipate.
        ii. Flush closest hydrant to the interconnection
        iii. Monitor pressure in distribution system at low elevation locations (Milwaukee's hydraulic grade line is approximately 28 psi higher than Shorewood)
        iv. Throttle interconnection valves if necessary to help dampen the pressure spike from Milwaukee
    b. Above ground connection
        i. Install a hydrant inner-connect from the hydrant on Edgewood and Hackett (Milwaukee) to the Village of Shorewood's hydrant located approximately 150' form Edgewood Ave.
        ii. Construct inner-connect with hose connections to the 4 ½ inch hydrant nozzle and a connection to a 4-inch diameter plastic main located in the curb and gutter along the east side of Hackett. Connections from the hose to the plastic main can be made with Victaulic couplings.
        iii. Swab out hose and pipe with chlorine solution to disinfected emergency line
        iv. Flush nearest hydrant to help bleed air out of the system.
        v. Monitor system pressure in lower elevations of the Village.
        vi. Install asphalt ramps over the top of the water pipe that cross driveways and sidewalk.
    c. Isolate Downer Ave. meter pit.

DRAFT

3. Contact List

NAME	ORGANIZATION	PHONE NO.
Carrie Lewis	MWU - Superintendent	414.286.2801
Laura Daniels	MWU –Projects Manager	414.286.2802 (office) 414.708.3084 (mobile)
Jeff Novak	MWU – Meter Services Mgr.	414.286.2035 (office) 414.708.9014 (mobile)
Dave Goldapp	MWU – Distribution Supvr	414.286.6303 (office) 414.708.2695 (mobile)