FINAL

Gladstone Water System Master Plan

Prepared for

City of Gladstone, Oregon

November 2014

Brown AND Caldwell

6500 SW Macadam Avenue, Suite 200
Portland, OR 97239
Phone: 503.244.7005
Fax: 503.244.9095

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List of Abbreviations

AC	asbestos cement pipe
ADD	average day demand
AWWA	American Waterworks Association
BC	Brown and Caldwell
BPS	booster pump station
CMU	concrete masonry unit
EPS	extended period simulation
FCV	flow control valve
gpd	gallons per day
gpm	gallons per minute
GIS	geographic information system
HGL	hydraulic grade line
IFC	International Fire Code
LIDAR	Light Detection and Ranging
MDD	maximum day demand
MG	million gallons
MGD	million gallons per day
MMD	minimum month demand
NAD	North American Datum
NAVD	North American Vertical Datum
NCCWC	North Clackamas County Water Commission
OLWD	Oak Lodge Water District
PHD	peak hour demand
PRV	pressure reducing valve
PVC	polyvinyl chloride
psi	pounds per square inch

Executive Summary

Background/Introduction

This Water System Master Plan (WSMP) documents the methods and evaluation of the City of Gladstone's (City's) water system according to the master planning requirements established under Oregon Administrative Rules, Chapter 333, Division 61 for Public Water Systems.

The City's former water system master plan was developed in 1980. Since 1980, the City has transitioned water supply sources, experienced population growth and constructed water system improvements. There have also been substantial changes to available software for system mapping, modeling, asset management, and billing. This WSMP documents the current state of the City's water system by identifying current and future system deficiencies, identifying capital projects to address system deficiencies, prioritizing proposed capital improvement projects (CIPs) for implementation, and providing information necessary to perform a financial evaluation of the City's water utility rate in order to fund needed improvements.

Study Area Characteristics

The City owns and operates their water distribution system, which serves residential, commercial, and industrial customers within the Gladstone city limits. The current water system was inventoried and mapped by Sisul Engineering as the first phase of this project.

The City's primary source of water supply is the North Clackamas County Water Commission (NCCWC). Water is purchased from NCCWC to meet current water demand. As needed, and to provide emergency supply water, the City supplements their primary water source with additional water purchased from Oak Lodge Water District (OLWD). Gladstone's distribution system consists of three storage tanks, two pump stations, and a network of transmission mains and distribution piping that serve the City's three pressure zones.

The City's primary source of water is provided by a 27-inch main from NCCWC that enters the City's distribution system on Cason Road. Three interties with OLWD are in place to supplement the water from NCCWC. The high-pressure zone intertie is located at the intersection of Valley View Drive and Valley View Road. The intermediate-pressure zone intertie is located at the intersection of Oatfield Road and Caldwell Road. The low-pressure zone intertie is located in Rinearson Road, approximately 500 feet west of River Road. The low-pressure zone intertie in Rinearson Road is not currently used, but is in place for emergencies. The City does not own any water rights at this time, but is entitled to a minimum allocation of 2.5 million gallons per day (mgd) of treated water from the NCCWC per intergovernmental agreement and as a condition of signing over their water rights on the Clackamas River.

Regulatory Requirements

Regulation of drinking water quality by the U.S. Environmental Protection Agency (USEPA) is authorized by the Safe Drinking Water Act of 1974 and its amendments. Regulations were established to protect public health by setting national health-based standards to protect drinking water quality. The USEPA oversees the federal, state, and local water suppliers who implement the national standards.

Oregon implements drinking water protection through a partnership of the Oregon Department of Environmental Quality (DEQ) and the Oregon Health Authority (OHA). The Oregon Drinking Water Protection Program regulates drinking water quality on a statewide level by adopting the federal standards for water quality monitoring and also implementing standards for construction, cross-connection control, and system operations and maintenance (O&M).

Water supplied to the City is sourced from the Clackamas River and treated at the NCCWC treatment plant. As the City's source water provider, NCCWC provides sampling and monitoring to comply with drinking water regulations. The City is responsible for monitoring water quality parameters within its distribution system.

Study Methods

A hydraulic computer model of the City's water distribution system was developed and used as a tool for evaluating the existing water distribution system and proposed improvements to the system under estimated future water demands. The model was created using Innovyze's InfoWater v11.0 and ArcGIS v10.1.

Several water demand scenarios were created to simulate system performance (existing water use demands, future water use demands, fire flow demands) and operational settings. Evaluation criteria were then used to evaluate the water system's response to the water demands and operational settings in order to develop recommended improvements for the City. The evaluation criteria were related to system pressure for transmission and fire flow, system condition, and system capacity. The evaluation criteria were defined to provide the desired level of service to customers and to maximize the efficiency of the system.

Study Results

Results of the water system modeling effort were used to identify areas in the water system that did not meet the evaluation criteria. Such areas were identified as deficiencies to be addressed through improvements. Additionally, some deficiencies were identified by City staff during field work and based on ongoing maintenance needs. These issues included the upgrades at the Webster Pump Station and replacement of specific PRVs due to their need for repair or due to lack of access.

Collectively, the following problems/issues for correction were identified to be addressed through capital improvement projects:

- Decommissioning of the Ranney intake system.
- Fire flow deficiencies estimated at 49 locations (due to undersized pipes and lack of system looping).
- Pipe age and condition of 17 miles of asbestos concrete (AC) pipe.
- Operating pressures that exceed allowable pressures in pipes located at Meldrum Bar Park Road and at the end of Hardway Court.
- Locations and configurations of PRVs that limit the City's ability to test and maintain them.
- Unreliability of the backup propane pump at the Webster Pump Station.
- Data collection upgrades at the Webster Pump Station.
- Leaky service connections (specifically one identified between the high- and intermediate-pressure zones at Collins Crest).
- Additional storage capacity of 2.0 MG to meet selected emergency storage criteria.

These identified problems/issues resulted in the selection of 19 CIPs for implementation. Table ES-1 summarizes the selected CIPs and estimated costs. Figure ES-1 provides the general location of each of these CIPs. The last line in Table ES-1 should be included in the CIP as an annual line item with costs distributed over 30 years. An annual cost of $820,000 is recommended for AC pipe replacement in order to complete the $24.6 million worth of replacement over a 30-year implementation period.

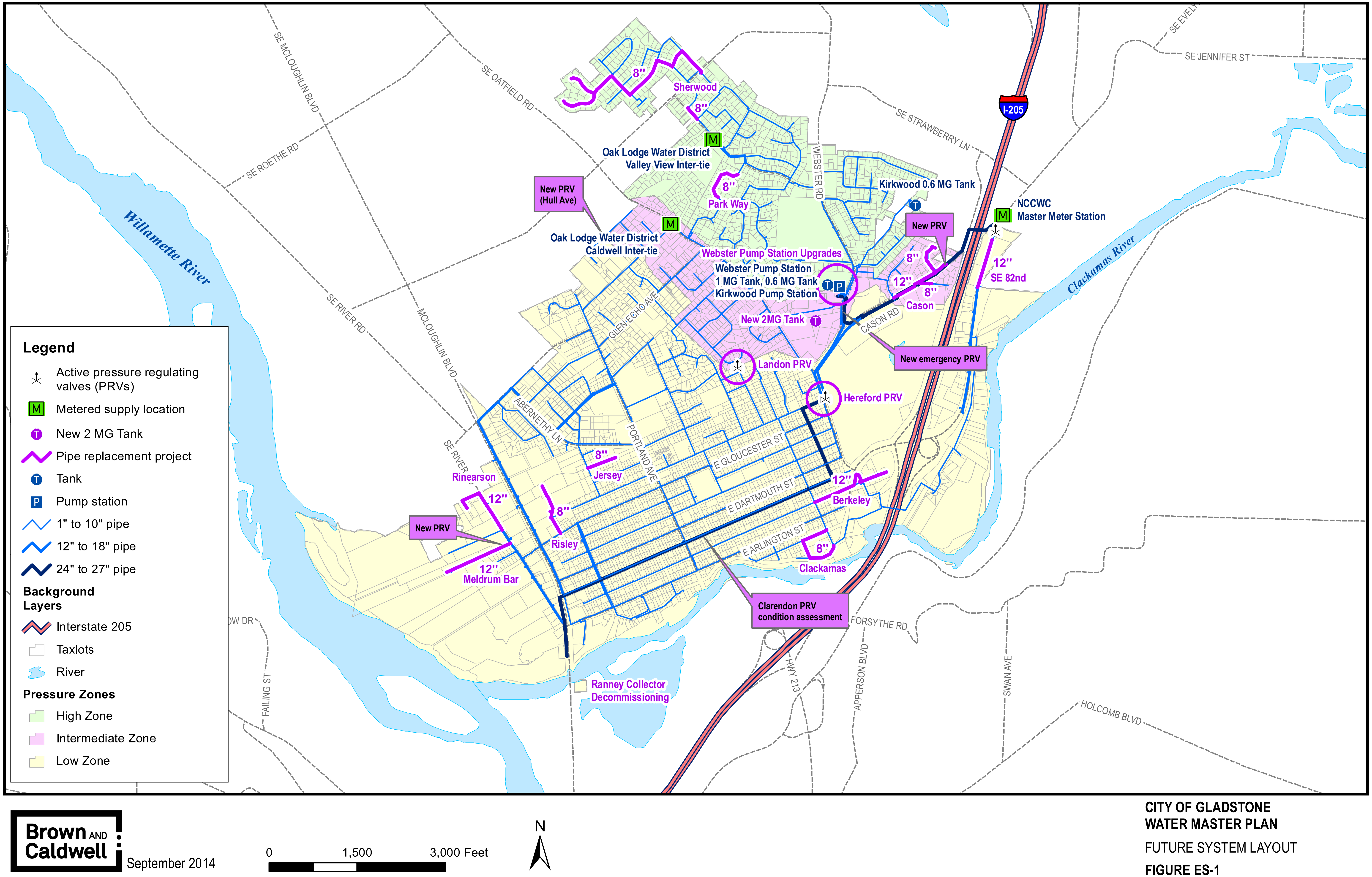
Table ES-1. CIP Estimated Cost Summary

CIP name	Total cost ($)
Supply	
Ranney Intake System Decommissioning	50,000
Piping	
Berkeley Street Pipe Replacement	960,000
Cason Road PRV and Pipe Replacement	1,260,000
Clackamas Boulevard Pipe Replacement	840,000
Clarendon PRV Condition Assessment	10,000
Hereford PRV	110,000
Hull Avenue PRV	110,000
Jersey Street Pipe Replacement	330,000
Landon PRV	110,000
Meldrum Bar Park Road PRV and Pipe Replacement	680,000
Park Way Pipe Replacement	510,000
Sherwood Neighborhood Pipe Replacement	2,170,000
Rinearson Road Pipe Replacement	590,000
Risley Avenue Pipe Replacement	460,000
SE 82nd Drive Pipe Replacement	470,000
AC Pipe Replacement[a]	$24,600,000
Pump Station	
Webster Pump Station Upgrades (Generator Set)	150,000
Webster Pump Station SCADA System	20,000
Storage	
New 2 MG Storage Tank	4,500,000
Total	$37,930,000

[a] *Recommended as an annual line item of $820,000 in the CIP. A leak detection survey is recommended prior to pipe replacement to prioritize the location of replacements.*

In addition to recommended CIPs, recommendations related to system operation and maintenance are also provided and include the following:

- **Leak Detection Survey**: While AC pipe replacement is highly recommended, prior to initiating replacement efforts, a leak detection survey is recommended to assist in prioritizing replacement. A lump sum of $75,000 has been estimated to conduct a leak detection survey prior to AC pipe replacement efforts.
- **SCADA System Maintenance**: An additional capital maintenance item includes annual maintenance of the SCADA system proposed as a CIP above. This is estimated to be approximately $2,500 per year.
- **Preventative Maintenance Program**: Preventative maintenance is essential to optimizing functionality and performance of a water system. The City currently does not have a documented O&M program, or current staffing to conduct preventative maintenance efforts at the recommended frequency. Implementation of the WSMP and CIPs is dependent upon the addition of staff to conduct/oversee preventative maintenance efforts. The addition of two full time staff is recommended in support of a preventative water system maintenance program.


Sherwood
8"
Oak Lodge Water District Valley View Inter-tie
Park Way
Kirkwood 0.6 MG Tank
NCCWC Master Meter Station
New PRV (Hull Ave)
Oak Lodge Water District Caldwell Inter-tie
Webster Pump Station Upgrades
Webster Pump Station 1 MG Tank, 0.6 MG Tank Kirkwood Pump Station
New PRV
12"
Cason
SE 82nd
New 2MG Tank
New emergency PRV
Landon PRV
Hereford PRV
Jersey
Rinearson
Risley
New PRV
Meldrum Bar
Berkeley
Clackamas
Clarendon PRV condition assessment
Ranney Collector Decommissioning
Willamette River
Clackamas River
I-205
SE MCLOUGHLIN BLVD
SE OATFIELD RD
SE ROETHE RD
SE RIVER RD
MCLOUGHLIN BLVD
WEBSTER RD
SE STRAWBERRY LN
SE JENNIFER ST
GLENEECHO AVE
ABERNETHY LN
PORTLAND AVE
E GLOUCESTER ST
E DARTMOUTH ST
E ARLINGTON ST
CASON RD
FORSYTHE RD
HWY 213
APPERSON BLVD
SWAN AVE
HOLCOMB BLVD
FAILING ST
Legend
Active pressure regulating valves (PRVs)
Metered supply location
New 2 MG Tank
Pipe replacement project
Tank
Pump station
1" to 10" pipe
12" to 18" pipe
24" to 27" pipe
Background Layers
Interstate 205
Taxlots
River
Pressure Zones
High Zone
Intermediate Zone
Low Zone
Brown AND Caldwell
September 2014
0 1,500 3,000 Feet
N
CITY OF GLADSTONE
WATER MASTER PLAN
FUTURE SYSTEM LAYOUT
FIGURE ES-1

Section 1

Introduction

This report documents the Water System Master Plan (WSMP) for the City of Gladstone, Oregon. This project was conducted in parallel with the development of a stormwater master plan and associated system-wide survey and mapping. The stormwater master plan is documented separately from this effort.

1.1 Statement of Purpose

The purpose of this WSMP is to comprehensively document and evaluate the City's water system according to the master planning requirements established under Oregon Administrative Rules, Chapter 333, Division 61 for Public Water Systems.

The City's former water system master plan was developed in 1980 by Robert C. Bitten Consulting Engineers. Since 1980, the City has transitioned water supply sources, experienced population growth and constructed water system improvements. Also, there have been substantial changes to available software for system mapping, modeling, asset management, and billing. This WSMP aims to document the current state of the City's water system by providing a comprehensive water system map, identifying current and future system deficiencies using the latest water system modeling software, identifying capital projects to address system deficiencies, prioritizing proposed capital improvement projects (CIPs) for implementation, and providing information necessary to perform a financial evaluation to assess the City's rate structure for funding needed improvements.

1.2 Study Activities

This project included creation of a system-wide map, development of a computer model of the City's water system, evaluation of the existing water system for deficiencies, development of projects for upgrading the water system, and preparation of cost estimates for improvements. City staff were consulted to gain a comprehensive understanding of the water system, ensure the accuracy of the information being analyzed, and determine practical and effective improvement alternatives. More detail regarding each of the project tasks is provided in the paragraphs below.

Data Development. Water system data were collected by Brown and Caldwell (BC) from the City to support the model and master plan development. These included historical water supply data from the North Clackamas County Water Commission (NCCWC), historical water supply data from the Oak Lodge Water District (OLWD), 2013 City billing records, and input from the fire department on required fire flows.

Facility/System Inventory. Sisul Engineering completed an electronic system-wide map in AutoCAD and geographic information system (GIS) of the City's water distribution system, which was previously recorded only on hard-copy maps. Sisul Engineering staff conducted all project surveying work and system mapping in AutoCAD, and worked with the City to horizontally locate water system valves, blow-offs, fire hydrants, water meters, master meters, tanks, pumps, and piping.

System Evaluation. BC developed a hydraulic model, calibrated the model, and evaluated the water system under existing conditions and those expected in the future.

BC prepared a technical memorandum (TM) detailing the methods and assumptions used in the development of the model (Appendix A). The TM provides a reference and background information for the City's future use of the model. The model was created in Innovyze's® InfoWater® software using the data collected earlier. The existing water demands were allocated in the model based on the billing system reference ID of each existing customer. The reference ID is unique to each customer's service address. The model was developed to include scenarios for two demand conditions: average day demand (ADD) and maximum day demand (MDD). A steady state simulation was used for modeling.

The water distribution system model was calibrated by adjusting model settings so that model results matched observed field data. BC wrote a TM outlining the calibration testing plan (Appendix B). Calibration testing of the distribution system included four hydrant tests. A BC representative assisted City staff during the testing.

An existing and future condition was evaluated in the distribution system model to identify current and future improvements that are required to meet the City's level of service goals. The future system condition represents the anticipated water demands in the year 2035, which satisfies the 20-year planning requirement for master plans. Gladstone is currently close to full buildout and future water demands are expected to be associated with infill.

CIP Development and Cost Estimation. The water distribution system model and interviews with City staff were used to develop a recommended capital improvement program. Costs were estimated for the recommended capital improvements based on the Association for the Advancement of Cost Engineering International criteria (described further in Appendix F). Proposed project improvements were developed to address the City's aging infrastructure, critical infrastructure deficiencies, and regulatory needs.

CIP Prioritization. CIPs from this WSMP were reviewed by City staff and prioritized according to predetermined criteria. A resulting CIP implementation schedule was prepared highlighting the top priority CIPs for construction in a 30-year implementation period.

Rate Evaluation and Assessment. FCS Group developed a water system financial plan with supporting rates based on the CIPs developed and prioritized for implementation. The rate evaluation is documented separately from this WSMP.

Section 2

Existing System

The City owns and operates the water distribution system, which services the residential, commercial, and industrial customers within the Gladstone city limits. The existing system described in this section was inventoried and mapped by Sisul Engineering in 2013 and 2014 as the first phase of the project. The results of the system inventory were documented on a system-wide map in AutoCAD, which was developed using multiple data collection techniques, including site survey, as-built drawing review, and interviews with City staff.

Figure 2-1 shows the water distribution system layout. A detailed system-wide map is included in Appendix C. Figure 2-2 shows a hydraulic schematic of the existing system, which illustrates the relationship between the three system delivery points, the tanks, and the pump stations.

The City's primary source of supply is purchased from NCCWC. On-demand and emergency supply water is purchased on an as-needed basis from OLWD. The distribution system consists of three storage tanks, two pump stations, and a network of transmission mains and distribution piping that serves the three pressure zones shown in Figure 2-1. This section summarizes the existing facilities that were included in the computer model and system evaluation.

2.1 Water Supply

When the 1980 master plan was developed, the City's primary water supply source was the Ranney Collector System, which included an infiltration gallery under the Clackamas River bed near the Highway 99E bridge. The City has since abandoned this source of supply due to regulatory requirements and currently purchases water wholesale from NCCWC and OLWD.

The City's primary source of water is provided by a 27-inch main from NCCWC that enters the City's system on Cason Road. The City was added to the NCCWC on July 18, 2005, with Addendum 1 to the second amended intergovernmental agreement (IGA) for the NCCWC. Other water users supplied by the NCCWC include the Sunrise Water Authority and OLWD. Under this agreement, the City is allocated a minimum of 2.5 million gallons per day (mgd) upon completion of the expansion of the NCCWC treatment plant.

Three interties with OLWD are in place to supplement the water from NCCWC. The high-pressure zone intertie is located at the intersection of Valley View Drive and Valley View Road. The intermediate-pressure zone intertie is located at the intersection of Oatfield Road and Caldwell Road. The low-pressure zone intertie is located in Rinearson Road, approximately 500 feet west of River Road. The IGA that provides the terms of this water supply agreement was last updated in 2007 and states that the purpose of the agreement is to provide emergency water between OLWD and the City and an on-demand supplemental source of water to the City. The low-pressure zone intertie in Rinearson Road is not used currently as an on-demand source of water, but is in place for emergencies.

The IGAs referred to in this section are located in Appendix D.

2.2 Water Rights

Prior to 2005, the City held water rights for 8.9 mgd of Clackamas River water. These rights were transferred to NCCWC as described in Section 3(b) of Addendum 1 to the second amended IGA for the NCCWC.

The City does not own any water rights at this time, but is entitled to a minimum allocation of 2.5 mgd of treated water from the NCCWC.

2.3 Water Quality

Regulation of drinking water quality by the U.S. Environmental Protection Agency (USEPA) is authorized by the Safe Drinking Water Act of 1974 and its amendments that were implemented to protect public health by setting national health-based standards to protect drinking water quality. The USEPA oversees the federal, state, and local water suppliers who implement the national standards.

Oregon implements drinking water protection through a partnership of the Oregon Department of Environmental Quality (DEQ) and the Oregon Health Authority (OHA). The Oregon Drinking Water Protection Program regulates drinking water quality on a statewide level by adopting the federal standards for water quality monitoring and also implementing standards for construction, cross-connection control, and system operations and maintenance (O&M). The rules were most recently adopted on May 8, 2014, and are documented in the OAR, Oregon Heath Authority Public Health Division, Chapter 333, Division 61.

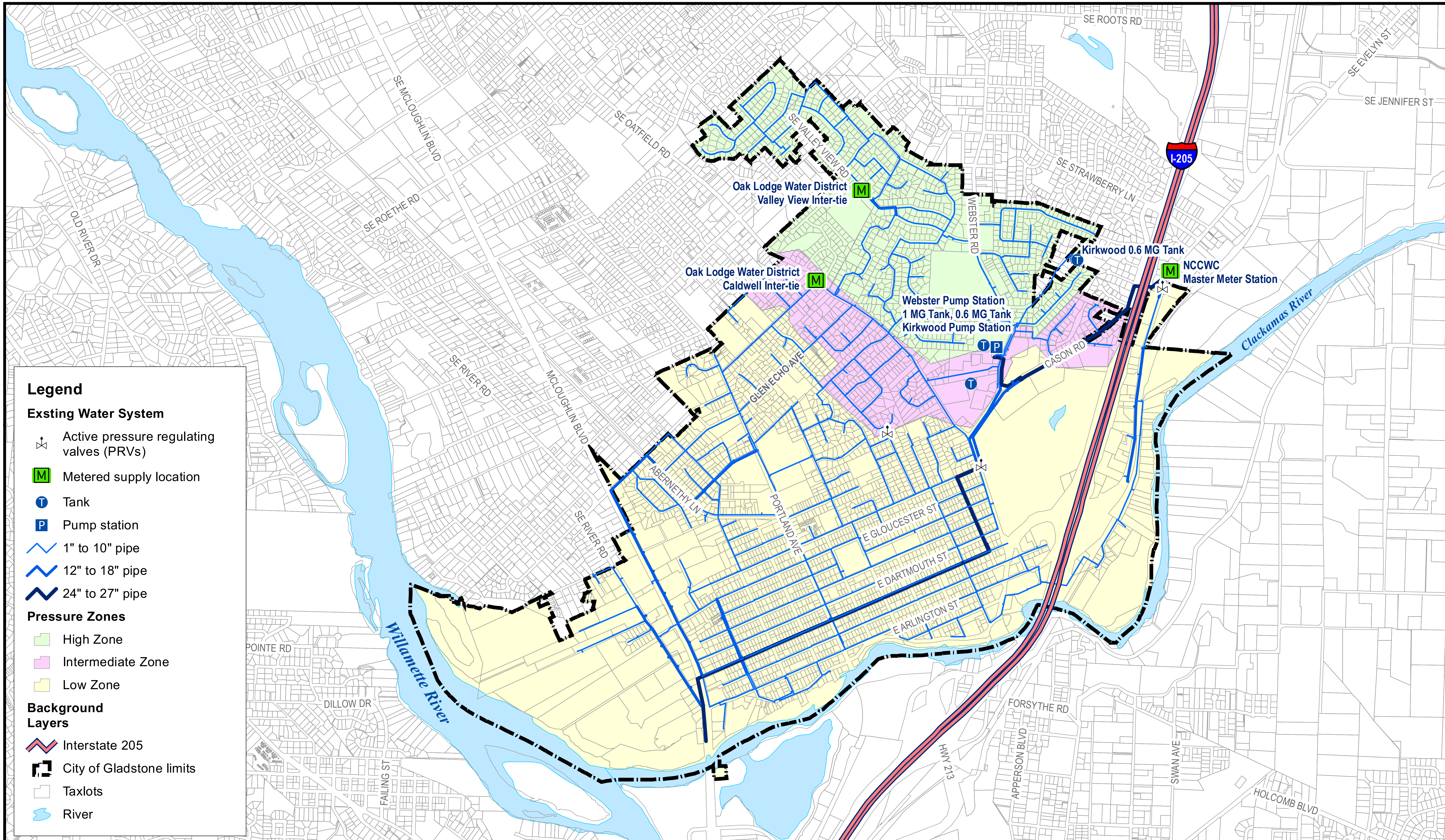
Water supplied to the City is sourced from the Clackamas River and treated at the NCCWC treatment plant. As the City's source water provider, NCCWC provides sampling and monitoring to comply with drinking water regulations. The City is responsible for monitoring water quality parameters within its distribution system that include total coliform, disinfection byproducts, copper, and lead. City staff complete weekly coliform testing and the City contracts with Backflow Management Inc. to complete the remaining testing and document results in annual consumer confidence reports.

2.4 Pressure Zones

The City's water distribution system serves a range in elevations from 35 to 330 feet and is divided into low-, intermediate- and high-pressure zones, as shown in Figure 2-2.

The low-pressure zone hydraulic grade line (HGL) is set by the pressure-reducing valve (PRV) at Oatfield Road and Hereford Road, the PRV at Southeast 82nd Drive and Hanson Court, and by the Webster Tank level. The intermediate zone HGL is set by the Kirkwood tank level and supplemented by the OLWD intertie at Oatfield Road and Caldwell Road when pressures in this zone drop below 40 pounds per square inch (psi). The high-pressure zone HGL is set by the Webster Pump Station and supplemented by the OLWD intertie at Valley View Road when pressures in this zone drop below 45 psi.

The distribution system layout shown in Figure 2-1 shows the three pressure zones described in this section.



Brown AND Caldwell

August, 2014

CITY OF GLADSTONE
WATER MASTER PLAN
EXISTING WATER SYSTEM

FIGURE 2-1

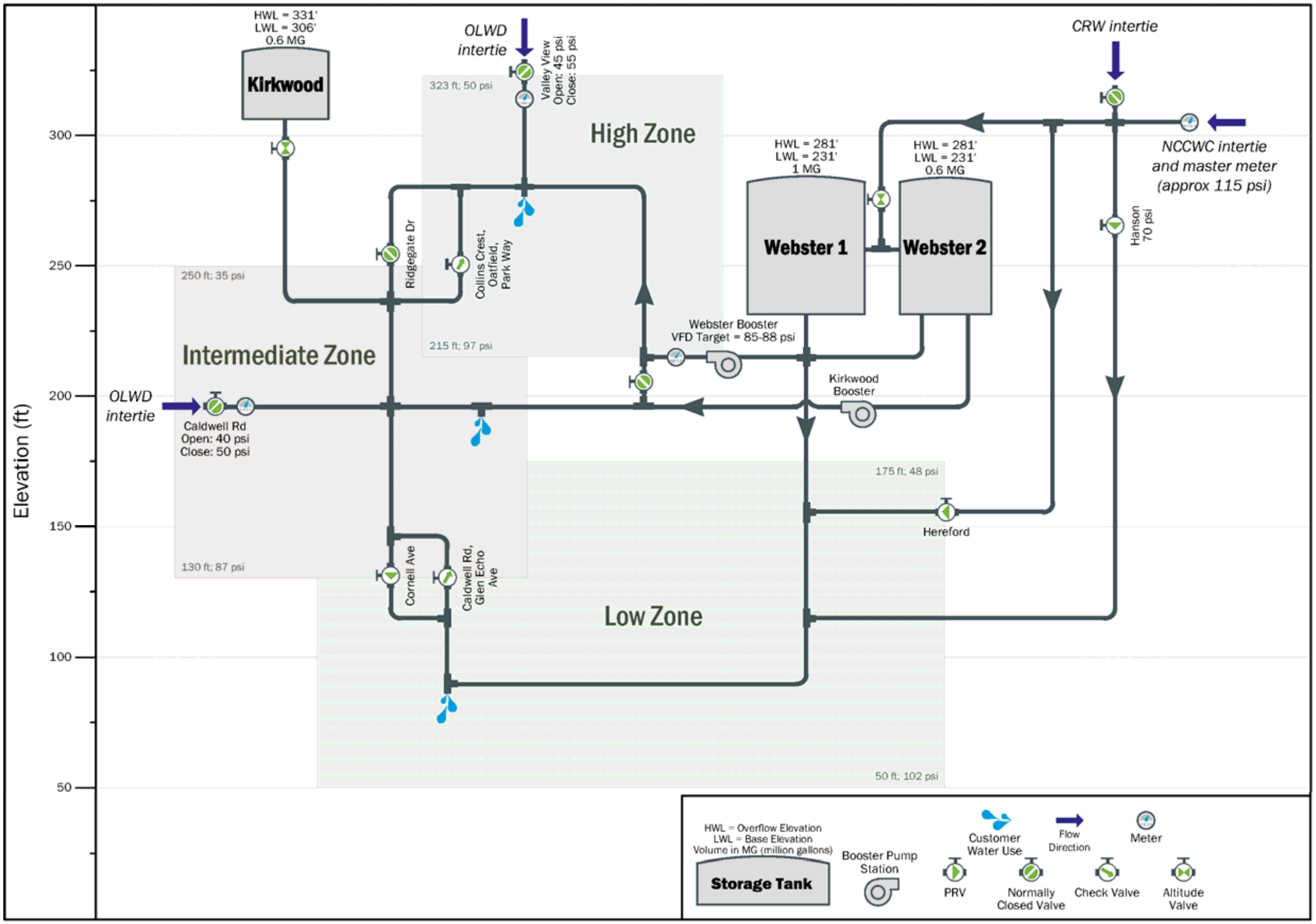


Figure 2-2. Existing system hydraulic schematic

2.5 Storage Tanks

The City owns and operates three water storage tanks, which have a total volume of 2.2 million gallons (MG). The Kirkwood tank is a 60-foot-diameter steel cylinder that was rebuilt in 2001 and is located at the end of Kirkwood Street. The Kirkwood tank has a volume of 0.6 MG and supplies the intermediate-pressure zone with water at maximum elevation of 332 feet. There are also two steel cylinder tanks located at the Webster site on Webster Road south of Ridgewood Drive. The 0.6 MG Webster tank was constructed in 1928 and the 1-MG tank was constructed in the 1960s. The tanks at the Webster site serve the low-pressure zone and act as a reservoir for the Webster Pump Station, which serves the high-pressure zone. The tanks are both 50 feet high and are equalized to supply water at the same maximum HGL of 284.5 feet. A summary of the existing water storage is provided in Table 2-1.

Table 2-1. Existing Storage Tank Summary

Tank	Type	Installation date	Base elevation, feet	Overflow height, feet	Diameter, feet	Capacity, gallons
Kirkwood	Welded steel	2001	308	332	60	600,000
Webster 1 MG	Welded steel	1960	234.5	284.5	60	1,000,000
Webster 0.6 MG	Welded steel	1928	234.5	284.5	45	600,000

2.6 Pump Stations

There are two pump stations in the City's distribution system that are located at the Webster site. The Kirkwood pumps were installed in 2003 and are positioned under a small stainless steel cover, which houses the two pumps. The pumps are identical, type C, end suction close-coupled general purpose pumps (Peerless Model C1025A). The two pumps are constant-speed and follow a lead/lag operation that is alternated on a weekly basis.

The Webster Pump Station was originally constructed in the 1960s. It is of concrete masonry unit construction and houses the two Webster pumps, a backup propane pump, the flow meter interface for the meter downstream of the pumps, and circle charts that provide data regarding the Kirkwood tank level, Webster pump discharge pressure, Webster pump flow, and Webster Tank level. The pump motors were rebuilt in 2007 and variable frequency drives (VFDs) were added to the pumps. Following work on the pump motors, one was damaged by falling equipment and is now considerably louder during operation than the other. The pumps follow a lead/lag operation with the first pump matching demand until the downstream system pressure drops below 75 psi, at which time the second pump is turned on.

The City owns a backup generator that is located at the Webster Pump Station, but according to City maintenance staff, the generator is unreliable and in need of replacement.

Existing pump stations are summarized in Table 2-2.

Table 2-2. Existing Pump Station Summary

Pump station	Service level	Installation date	Number of pumps	Manufacturer/ model	Single pump operating point, flow/head	Horsepower	VFD or constant speed
Kirkwood	Intermediate	2003	2 (identical)	Peerless/C1025A	350 gallons per minute (gpm)/65 feet	10	Constant speed
Webster	High	1960s	2 (identical)	Peerless/3AE9	500 gpm/185 feet	40	VFD

2.7 Flow Control Valves

There are eight flow control valves (FCVs) in the City's water system. Details for the FCVs are listed in Table 2-3.

Table 2-3. FCV Summary		
Valve	Control type	Setting
OLWD Valley-View meter station	Pressure regulating	Opens at 40 psi Closes at 50 psi
OLWD Caldwell meter station	Pressure regulating	Opens at 40 psi Closes at 50 psi
12-inch Webster Tank inflow	Altitude valve	51 feet
14–inch Webster Tank inflow	Altitude valve	Off
Kirkwood Tank inflow	Altitude valve	22 feet
Hereford pressure regulating valve (PRV)	Pressure regulating	60 psi
Cornell PRV	Pressure regulating	50 psi
Hanson PRV	Pressure regulating	70 psi

There are also four PRVs in the low-pressure zone along Clarendon Street, which were previously used to regulate pressures from the Ranney Collector system to the downtown area. The 24-inch-diameter main that previously supplied water from the Ranney Collector system is still in use, but since the City switched to the NCCWC supply, this main serves the low-pressure zone and does not require PRVs. The physical condition of the four PRVs is unknown.

2.8 Pipe Network

The City's existing distribution system consists of pipes that range in diameter from 1 to 27 inches. The 27-inch-diameter piping serves as the transmission main that conveys flow from the NCCWC master meter to the low-pressure zone and Webster site. The City also has an existing 24-inch transmission main on Clarendon Street that was used to draw water from the Clackamas River via the Ranney Collector Pump Station. The Ranney Collector Pump Station was removed from service in the mid 1980s, when the City began to receive wholesale water. As mentioned above, the 24-inch-diameter main is still in use to serve the low-pressure zone.

The total length of piping in the system is approximately 207,000 linear feet (LF). Table 2-4 lists the length of piping in the water system by pipe material and diameter. These totals do not include service lines or private and OLWD piping within Gladstone.

Table 2-4. Existing Pipe Network Summary												
Pipe material	Length in LF by pipe diameter in inches											
	1	2	4	6	8	10	12	14	18	24	27	Total
Asbestos cement (AC)			5,410	71,120	11,688							88,218
Cast iron (CI)		1,197	4,261	31,600	3,657	261	2,989					43,965
Concrete cylinder pipe (CCP)										1,812	3,898	5,709
C900[a]				755								755
Ductile iron (DI)			1,797	23,875	18,025	677	12,782	21	1,871	6,175		65,224
Poly-vinyl chloride (PVC)	302	2,672										2,975
Total	302	3,869	11,468	127,350	33,370	938	15,771	21	1,871	7,987	3,898	206,846

[a] *Conforms to American Water Works Association (AWWA) Standard C900 for PVC pipe.*

The distribution of the six pipe materials within the system is depicted as percentages in Figure 2-3.

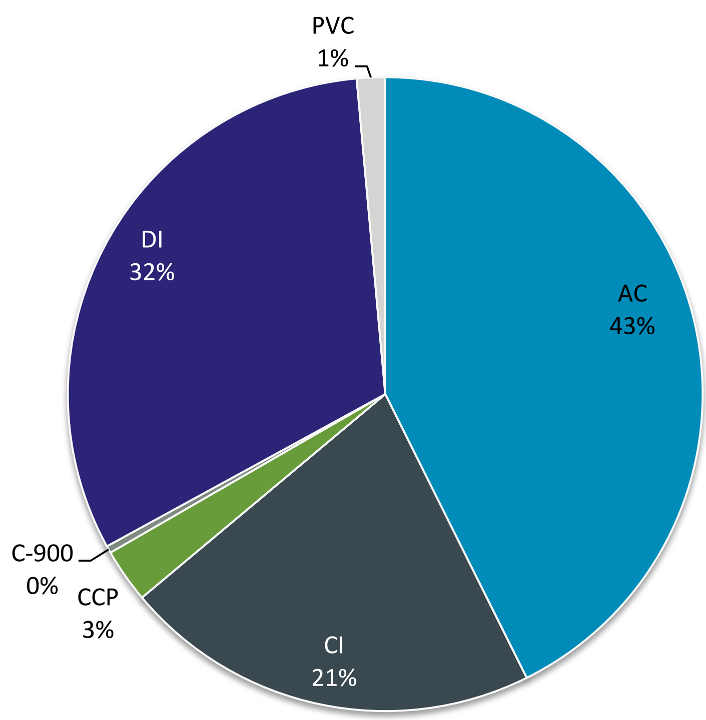


Figure 2-3. Pipe material by percent distribution

As shown in Figure 2-3, AC pipe makes up 43 percent of the City's distribution system. The high- and intermediate-pressure zones contain most of the City's AC pipe, but there are segments of it in the low-pressure zone as well.

AC pipe was a common construction material used for potable water systems beginning in the 1920s and continuing through the 1970s. It was made from a slurry mixture of concrete and chrysotile asbestos fibers and its popularity was due to its low cost, light weight, and ease of installation. Use of AC pipe was widely discontinued in the 1980s due to the asbestos-related health concerns for the workers cutting and installing the pipe.

As the design life of the segments of AC pipe nears, the City is experiencing some main breaks and leakage in areas where AC pipe is installed. A replacement program for AC pipe is discussed in Section 7.

Section 3

Water Demands

This section includes a description of how the water demands were developed for use in evaluating the City's water system and includes a description for existing and future demands. A description of how these demands were allocated in the computer model used for master planning is provided in Section 4.

3.1 Existing System Demands

Existing water system demand scenarios were developed for MDD and ADD. NCCWC provided daily production records that were used in combination with monthly purchase records from OLWD to determine the ADD. Data from 2013 included the most recent full year of data available for this plan. Table 3-1 lists total system demands and resulting scaling factors for the existing water system.

Table 3-1. Total Existing System Demand

Demand condition	Daily demand, mgd	Demand, gpm	Scaling factor from ADD[a]
ADD[b]	1.31	908	1.00
MDD	2.12	1,472	1.62

[a] *Scaling factors are the ratio of the stated demand to the ADD.*

[b] *From 2013 NCCWC daily production records and monthly OLWD purchase records. Daily demands from OLWD were averaged from the monthly records. Outlying data points on January 2 and July 16 and July 17 were removed from the data set.*

The City had a 2010 census population of 11,497 and approximately 3,395 water system billing accounts. The billing accounts were identified using the City's reference ID number, which is unique to each property served and previously corresponded to meter reading routes. Account numbers are unique to each customer and property served, which can result in multiple account numbers for one property; therefore, they were not used. Bi-monthly water demands were calculated for each reference ID for 2013 from the City's water billing database.

Table 3-2 provides a summary of the billed water use, total existing system demand and the difference between the two, which is the percentage of non-revenue water.

Table 3-2. Unaccounted-for Water

Water use	ADD, mgd	MDD, gpm
Billed water use	1.12	Not available
Total existing system demand	1.31	2.12
Percent non-revenue water	16	Not available

To capture the total amount of water distributed throughout the system, individual customer demands for each reference ID were scaled up proportionally to distribute the non-revenue water throughout the system. The customer demands were assigned as model demands to the model junction located nearest to the X and Y coordinates listed for each water meter mapped in the system inventory.

As listed in Table 3-2, the non-revenue water is approximately 16 percent on average. A more typical number for non-revenue water is in the range of 10 percent. While 16 percent is somewhat high, it is not surprising considering the age of the pipes. Per the 2012 AWWA “Water Loss Control: Water Loss Control Terms Defined” publication, non-revenue water is defined to reflect the total distributed volume of water; this is not reflected in customer billings. Non-revenue water is the sum of the following three types of non-revenue water:

- Unbilled Authorized Consumption – water for firefighting, hydrant flushing, etc.
- Apparent Losses – customer meter inaccuracies, unauthorized consumption and systematic data handling errors
- Real Losses – system leakage and storage tank overflows

The percentage listed in Table 3-2 is provided as a snapshot of non-revenue water at this time. See the International Water Association/AWWA Water Audit Method for water audit methods and performance indicators recommended to determine the efficacy of a program to reduce non-revenue water over time.

3.2 Future System Demands

System demands typically increase over time as a city expands its service area or redevelops land at an increased density within the existing service boundary. This increased demand due to population growth can be offset to some extent through the implementation of water conservation measures.

A population growth rate of 0.3 percent annually over the planning period of 20 years is projected by the Portland State University Population Research Center for Gladstone. The projected 2035 population of Gladstone is approximately 12,308. The modest growth rate is due to the limited amount of privately-held vacant lands and expansion area available for development. The current population is estimated to be 11,636. Most future growth is expected in the form of infill.

Demands were calculated for the future 2035 planning horizon assuming a one-to-one relationship between increased population and increased demand because there is no known estimate for a reduction in demand due to water conservation measures. The ratio between the current population and projected population for 2035 is 1.06. This ratio was applied to the existing demands in gpm and converted to mgd. Results are listed in Table 3-3.

Table 3-3. Future System Demands (2035)

Water use	ADD, mgd	MDD, mgd
Total system demand	1.38	2.24

3.3 Fire Flow Demands

Fire flow demands were used to evaluate the system's capacity to supply adequate water for fire suppression. The Oregon Fire Code (OFC) and Insurance Services Office standards were referenced to assign a planning level fire flow demand to each major land-use category within the city, as documented in Section 5. Table 3-4 lists the assigned fire flow rates that were used for existing and future system evaluations.

Table 3-4. Fire Flow Demand by Land Use/Customer Type

Customer class/land use	Required fire demand[a]
1 - Single family residential	1,000 gpm, 1-hour duration
2 - Multi-family residential[b]	2,500 gpm, 2-hour duration
3 – Commercial/industrial/institutional	3,500 gpm, 3-hour duration

[a]Required fire demand while maintaining 20 psi residual pressure.

[b]The Riverview Place Apartments, The Brookside Village, the Fairview Village, the Rivergreens Apartments, and schools will be assigned a fire flow of 3,500 gpm due to their size.

Section 4

Computer Model Development

A hydraulic computer model of the City's water distribution system was developed to be used as a tool for evaluating the existing system and any proposed improvements to the system under estimated future demands. This section provides a basic description of the model, including the process of developing model scenarios, allocating system demands, and calibrating the model. For a detailed description of the model attributes and methodology used to create the model, refer to the Model Creation Memorandum in Appendix A.

4.1 General Model Description

The data collected during the system inventory phase of this project were converted from AutoCAD to GIS and imported into InfoWater modeling software to create a hydraulic computer model of the water distribution system. The system inventory was supplemented by interviews with City staff and site visits to clarify network connectivity and system operations.

The model was created using Innovyze's InfoWater v11.0 and ArcGIS v10.1. A copy of the model was provided to the City on a DVD. The model consists of an ArcGIS .mxd file (Gladstone_W_Model_Build_v6.mxd) and an .IWDB folder, which contains the model attribute data (GLADSTONE_W_MODEL_BUILD_V6.IWDB). A map of the model is viewable in ArcGIS by opening the .mxd file; however, viewing model attributes and operating the model requires an InfoWater software license.

4.2 Model Scenarios

Several scenarios were created for this project to simulate system performance with different system demands and operational settings. Scenarios were also added to the model to include different facility improvements for future planning purposes. All of the scenarios included in the model were categorized as follows:

- Base: this was not used for evaluation purposes, only to store existing model facility data for the other scenarios.
- Calibration: this was used to simulate the system at the time of each hydrant test and used to calibrate the model to observed field data.
- Existing system (2015): this was a post-calibration scenario used to evaluate the existing system.
- Future system: this was a post-calibration scenario used to include future demands and to evaluate the proposed future improvements for the 20-year planning horizon (2035).

4.3 Model Demand Allocation

The existing and future demands described in Section 3 were allocated in the model as described below.

4.3.1 Existing System Demand Allocation

The existing system demand allocation consisted of distributing the total system demand appropriately in the computer model. The following steps describe how the existing system demands were assigned to the model:

1. Obtained billing data, including the water billing reference ID, for each property and calculated the MDD for each property (described in Section 3).
2. Geocoded (located geographically) each of the customers by matching the property reference ID in the billing data with the reference ID included in the water meter inventory (described in Section 3).
3. Calculated the total demand at each demand junction as the sum of the demand for the customers closest to the pipes connecting to the junction.
4. Scaled up the system demand at each junction to distribute the non-revenue water (described in Section 3) throughout the water system demand junctions.

4.3.2 Future System Demand Allocation

Future system demand allocation involved city-wide application of the projected increase (0.3 percent annually for 20 years) in population over the planning period to the existing system demands in the model. This method was used because the City does not have large growth areas planned that would require expansion of the existing network.

4.3.3 Fire Flow Demand Allocation

Fire flow sets were created for the fire flow evaluation of the existing and future system. Fire flow requirements by land use type are listed in Table 3-4. Each hydrant mapped during the system inventory was assigned a fire flow demand based on the surrounding land use types.

All large multi-family developments were reviewed individually to determine if the building footprint was too large for a fire flow demand of 2,500 gpm per the OFC. The Riverview Place Apartments, the Brookside Village, the Fairview Village and the Rivergreens Apartments were assigned a fire flow of 3,500 gpm.

4.4 Steady-State Model Calibration

The purpose of steady-state calibration is to verify pipe connectivity (how pipes connect to other pipes), pipe roughness factors, and the elevation of facilities (i.e., tanks, pumps, and valves) in the model. To obtain field data for calibration, four hydrant tests were performed on the system and used for the steady-state calibration. A dynamic calibration was not conducted because supervisory control and data acquisition (SCADA) system information was not available to determine the system diurnal curve and continuous system operations. The calibration test plan followed during the hydrant testing is located in Appendix B.

The steady-state calibration scenarios in the model were set up to represent the system on the day of testing. City operations and maintenance staff were staged at the NCCWC master meter, OLWD interties and the Webster Tank and Pump Station during the test to record flows on 1-minute intervals. Flow at OLWD was read by observing the position of the hand sweep valve which indicates a flow of 100 cubic feet for every revolution. Tank levels and pump discharge pressure were obtained from circle charts at the Webster Tank, Kirkwood Tank, and Webster Pump Station.

The NCCWC master meter reads data in increments of 10,000 gallons, which did not provide enough resolution for the amount of flow coming into the system during each test. Demands for each scenario were scaled to match system demands at the time of the test based on the Gladstone daily average production value provided by the NCCWC and readings taken at the OLWD interties during the tests.

Adjustments were made to the model until pressures in the model matched the recorded field data from before and during the hydrant tests. The following sections describe the specific results from the four hydrant tests.

4.4.1 High-Pressure Zone Test – Crownview Drive

The high-pressure zone is supplied by the OLWD intertie at Valley View Road and the Webster Pump Station. Visual readings were taken at the OLWD intertie, the Webster Pump Station, and the hydrants where flow and pressure were recorded on Crownview Drive. A pressure logger was installed at the intersection of Lancaster Drive and Buckingham Drive to record pressure throughout all four tests.

The pressures at the pressure hydrant and pressure logger matched well with the data collected during the hydrant testing (see Table 4-1). Therefore, no adjustments were made to Hazen-Williams roughness coefficient values. The flow balance between OLWD and the Webster Pump Station was adjusted in the model to match observed values.

Table 4-1. Model Calibration Results

Test no.	Pressure zone	Static pressure (before flowing hydrant), psi		Test pressure (while flowing hydrant), psi		Comment
		Field	Difference in model[a]	Field	Difference in model[a]	
1	High	59.5	1.5	53.5	-1.1	
2	Intermediate	58.5	-6.5	35.5	1.5	
3	Low	84.0	0.6	79.0	4.0	Hydrant was not fully open during test
4	High	86.5	1.5	61.5	-4.0	Previously thought to be in the intermediate-pressure zone. Calibration efforts identified an unmapped connection to the high-pressure zone.

[a] *A negative value indicates that model results were less than field measurements.*

4.4.2 Intermediate-Pressure Zone Test – Collins Crest

The intermediate-pressure zone is supplied by the 0.6-MG Kirkwood Tank located at the end of Kirkwood Drive via the Kirkwood Booster Pumps located at the Webster site. The OLWD Caldwell Road intertie supplies an on-demand backup and emergency source for this zone, but was not operating at the time of this test.

The initial results for this test did not provide a good match between modeled and observed pressures. Further investigation of the model connectivity resulted in the following corrections:

- Check valves between the low- and intermediate-pressure zones at Caldwell Road, Glen Echo Road, and Collins Crest Road were labeled as closed valves in the system inventory. A meeting with the City on June 18, 2014 confirmed that these are actually operating single-swing check valves. Flow through the Collins Crest check valve occurred during this test upon revision of the model.
- Following correction of the check valves, the model static pressure prior to flowing the hydrant was lower than the observed value at the pressure hydrant by approximately 15 psi. Due to the hydraulic grade measured at the pressure hydrant prior to the test and the response at the Web-

ster Pump Station during the test, it was determined that there is an unintentional connection that exists to the high-pressure zone. The two locations where this may be occurring are at the singles-swing check valve at Park Way and the closed gate valve at Ridgegate Drive.

Following corrections and verification of the model connectivity, no adjustments to C-factors were made. The leaky connection between the high- and intermediate-pressure zones that was identified in the intermediate zone test at Collins Crest did not result in corrections to the model that will be carried forward to the system evaluation. A proposed project to identify and repair the leaky connection is described in Section 6.

4.4.3 Low-Pressure Zone Test – Gloucester Street

The low-pressure zone is primarily supplied by the NCCWC master meter station via a PRV at Hanson Court and 82nd Drive near the master meter with a setting of 85 psi and a PRV at Hereford Road and Oatfield Road with a setting of 60 psi. There is also a PRV between the intermediate and low zones on Cornell Avenue, north of Landon Street. This PRV is on private property and was not found during the system inventory. A setting of 55 psi was assumed for this PRV.

No adjustments were made to the hydraulic connectivity or Hazen-Williams roughness coefficients as a part of the model calibration. Model results matched observed values within 5 psi.

4.4.4 Intermediate-Pressure Zone Test - Ridgewood

This test was originally intended to be an additional test for the intermediate zone; however initial model results indicated a poor match to observed pressures. Other observations included an observed spike in the Webster Pump Station and a dip in the high-pressure zone pressure logger value at the time of this test. The City confirmed that there could be a connection between the high- and intermediate-pressure zones near Ridgewood Drive and Webster Road that was not found or mapped during the system inventory. However, further investigation into the system's HGL indicated that the homes served along Ridgewood Drive are connected directly to the high-pressure zone, with no open connection to the intermediate zone.

No adjustments to Hazen-Williams roughness coefficients were made. Following the correction of model connectivity, the modeled pressures matched observed pressures within 5 psi.

4.4.5 Steady-State Model Calibration Summary

The steady-state model was calibrated to observed readings during each hydrant test by correcting system connectivity issues described above. The field test data and the steady-state calibration results are summarized in Table 4-1 and Appendix E.

Section 5

Evaluation Criteria

This section describes the criteria that were used for evaluating the existing water system and developing the future improvements for the City. The criteria were developed to provide the desired level of service to each customer and to maximize the efficiency of the future system.

5.1 Reference Documents

The documents listed below were reviewed for the development of these criteria. The criteria listed meet state regulations and are in keeping with industry standards.

1. OAR 333-061-0050 [OAR, 2014] – This document contains the state regulations for transmission, supply, pumping, and storage facilities.
2. Recommended Standards for Water Works [WSC, 2012] – This document, frequently referred to as the Ten State Standards, is produced by the Water Supply Committee of the Great Lakes--Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (WSC) and is widely accepted in the industry. This document was referenced where criteria were not provided by the OAR.
3. *Water Supply: Determining Distribution System Storage Needs* [AWWA, 2005] – This document was referenced where tank storage criteria were not provided by the documents listed above.
4. OFC 2014 [OFC 2014] – All fire flow criteria were based on this document and should be accepted by the fire department.

The criteria, described in more detail below, include the specific capacity, operations, and reliability requirements for supply, piping, pumping, and storage facilities in the water system.

5.2 Supply Criteria

The City obtains its water through wholesale agreements with NCCWC and OLWD, regional water providers that supply water to several other neighboring communities. Water is delivered to the City's system through master meters stations. The overall supply reliability from the providers was not evaluated for this plan. Table 5-1 lists the criteria that were used to evaluate City supply sources.

Table 5-1. Supply Criteria

Criterion		Value/description	Reference, if applicable
Capacity	Flow rate	Equal to average of MDD	[WSC, 2012]
	Head	Maintain a hydraulic grade sufficient to refill the Webster Tanks	
Reliability	Redundant capacity	Meet capacity requirements with the largest producing pump out of service	[WSC, 2012]
	Power supply	At least two independent power sources or a standby/auxiliary source should be provided (e.g., generator)	

5.3 Pipe Criteria

The piping criteria were used to do the following:

- Identify existing pipes that are inadequately sized
- Determine the appropriate size for future piping improvements
- Identify pipes that should be relocated or extended for reliability purposes

Table 5-2 lists the capacity and reliability criteria for evaluating and designing the water system piping.

Table 5-2. Pipe Criteria

Criterion		Value/description	Reference, if applicable
Diameter	Required size (for mains)	As calculated based on flow demand to satisfy pressure, velocity, and head loss requirements listed below. Should not be smaller than 6 inches.	[WSC, 2012]
System pressures	• Maximum • Minimum working pressure • Minimum under any demand condition (including fire) • Normal working pressure	• 100 psi • 35 psi • 20 psi • 60 to 80 psi	[OAR, 2014] [WSC, 2012]
Velocity (transmission and distribution)[a]	• Maximum for MDD • Maximum (peak hour demand (PHD) or fire flow with MDD for small diameter mains)	• 5 feet per second (fps) • 10 fps	
Maximum headloss for MDD[b]	• Transmission pipe (≥12 inches in diameter) • Distribution pipe (<12 inches in diameter)	• 2 feet/1,000 feet • 6 feet/1,000 feet	
Reliability	Distribution system pipe	Dead ends should be minimized by looping	[OAR, 2012] [WSC, 2012]
Location	Transmission and distribution piping	Water mains should be installed in public streets or other public access ways wherever possible. Existing water lines that are in easements and/or right-of-ways in alley ways or behind houses/buildings will be relocated wherever feasible.	City[c]

[a] A maximum velocity of 10 fps for fire flow with MDD is specified due to the potential to damage pipes through water hammer and cavitation at velocities of greater than 10 fps. Note that design velocities for new mains will be lower. This criterion will be used to design proposed improvements. It is not intended to serve as an independent justification to replace existing facilities.

[b] Used in the design of new mains. AWWA recommends this criterion to avoid high operating costs. The cost of adding piping to meet it may exceed the benefit; therefore, it is provided by way of recommendation rather than requirement.

[c] Based on interviews with City staff.

5.4 Fire Flow Criteria

Fire flow is the water available for fire suppression at fire hydrants within the water distribution system. The fire flow criteria were used to determine the fire demand required at each hydrant during the MDD scenario. These criteria were used to identify hydraulic constraints in the system that result in inadequate fire flows.

The OFC [OFC 2014] was used to identify fire flow criteria for the City's three customer types, which include single-family residential (class code 1), multi-family residential (class code 2) and commercial, industrial or institutional (class code 3).

Single-family residential

The fire flow criteria for single-family residential land use are based on building square footage. Appendix B, B105.2 of the OFC specifies a minimum fire flow of 1,000 gpm for 1 hour for one- and two-family dwellings with a fire-flow calculation area that does not exceed 3,600 square feet. The minimum fire flow for dwellings larger than 3,600 square feet is 1,500 gpm and is specified in OFC Appendix B, Table B 105.2, as modified by applicable occupancy hazards listed in B105.4. The average square footage of buildings in class code 1 within the City is approximately 1,800 square feet. A fire flow capacity of 1,000 gpm was evaluated in the hydraulic model for single-family accounts.

Multi-family residential

The fire flow criteria for multi-family residential land use are based on building square footage and type of construction per OFC Appendix B, Table B 105.2, as modified by applicable occupancy hazards listed in B105.4. Buildings within this category within Gladstone typically have a footprint of less than 8,000 square feet. However, there are four large apartment complexes in Gladstone that exceed this size. A fire flow of 2,500 gpm was assigned to buildings with a footprint of less than 8,000 square feet. The Riverview Place Apartments, The Brookside Village, the Fairview Village, the Rivergreens Apartments, and schools were assigned a higher fire flow of 3,500 gpm due to their size.

Industrial, Commercial and Institutional

A maximum fire demand of 3,500 gpm with a 3-hour duration was used to evaluate the water distribution system within industrial, commercial, and institutional land uses that are associated with class code 3. A maximum fire flow of 3,500 gpm is used by the Insurance Services Office to calculate a community's Public Protection Classification. It is assumed that any development with a fire demand of greater than 3,500 gpm is equipped with onsite fire suppression facilities.

A summary of these demands is listed in Table 5-3.

Table 5-3. Fire Demand by Land Use/Customer Type

Customer class/land use	Required fire demand[a]
1 - Single-family residential	1,000 gpm, 1-hour duration
2 - Multi-family residential[b]	2,500 gpm, 2-hour duration
3 – Commercial/industrial/institutional	3,500 gpm, 3-hour duration

[a] Required fire demand while maintaining 20 psi residual pressure.

[b] The Riverview Place Apartments, the Brookside Village, the Fairview Village and the Rivergreens Apartments were assigned a higher fire flow of 3,500 gpm due to their size.

5.5 Pump Station Criteria

Two types of pump stations were considered in this study: booster and closed-loop pump stations. Booster pump stations add energy, or head, to maintain a flow rate and/or a hydraulic grade from one pressure zone or water system to another that is served by one or more storage tanks. Closed-loop pump stations pump from one pressure zone to a higher pressure zone that is not served by a storage tank. Closed-loop systems are often less reliable than systems served by a storage tank and should be avoided where possible. Table 5-4 summarizes the evaluation and design criteria for the existing and future pump stations.

Table 5-4. Pump Station Criteria

Criteria		Value/description	Reference
Minimum capacity	Booster	Average of MDD	[WSC, 2012]
	Closed-loop	MDD plus fire flow demand	
Reliability	Redundancy	Areas served by pumps should have a minimum of two supply pumps	[OAR, 2014] [WSC, 2012]
	Redundant pump sizing	Pumps should be sized to meet the minimum capacity requirement with the largest pump out of service (redundant fire pumps are not necessary)	
	Power supply	At least two independent power sources or a standby/auxiliary source (e.g., generator) should be provided	
	Suction tanks	Wherever possible, booster pumps shall take suction from tanks and reservoirs to avoid the potential for negative pressures on the suction line which can result when the pump suction is directly connected to a distribution main	
Operations	Minimum suction pressure	Pumps that take suction from distribution mains for the purpose of serving areas of higher elevation shall be provided with a low-pressure cutoff switch on the suction side set at no less than 20 psi	[OAR, 2014]
	Control settings	Adequate range shall be provided between high-/low-pressure or tank level settings to prevent excessive cycling of the pump	

5.6 Storage Criteria

A variety of methods are used to calculate the volume of storage required for a service area. A commonly used method states that the volume of required storage consists of three components: equalization, fire, and emergency storage. The following describes each storage component and its respective storage criteria.

5.6.1 Equalization Storage

Equalization storage capacity is used to meet peak demands when the available water supply to the system is exceeded. This criterion is often calculated as the difference between the PHD and the MDD. When actual PHD data are unavailable, an equalization storage criterion of 25 percent of MDD is a generally accepted industry standard. The following storage volumes were used as criteria for the existing and future system scenarios:

- Required equalization criteria for existing demands = 0.53 MG (Based on 25 percent of 2.12 MG)
- Required equalization criteria for future demands = 0.56 MG (Based on 25 percent of 2.24 MG)

5.6.2 Fire Storage

Fire storage capacity is reserved to supply the highest fire demand for the duration of a fire event. The required fire storage volume under these criteria is equal to the 3,500 gpm demand over a 3-hour duration, which equals 630,000 gallons (0.63 MG)

5.6.3 Emergency Storage

Emergency storage capacity is reserved to provide water during events such as power outages, standard maintenance procedures, natural disasters, facility failures, etc. Emergency storage criteria are highly subjective and dependent upon local conditions and possible emergency scenarios. Oregon does not have a standard for determining the volume of emergency storage required, which leaves cities to set the level of service for emergency storage based on the desired level of risk and reliability of system infrastructure. Examples of emergencies that could warrant use of emergency storage in this area include power outages, earthquakes, equipment failures, and pipeline failures.

Two days of ADD is a typical value that is used with some consideration given to the reliability of supply sources. Two average days are equal to 2.62 MG for the existing ADD and 2.76 MG for the future ADD.

5.6.4 Storage Criteria Summary

Table 5-5 summarizes the total volume needed to meet the three required components of storage capacity. In addition to the storage volume criteria, operations criteria include avoiding excessive storage capacity to prevent water quality issues and maintaining adequate control to maintain levels in storage tanks.

Table 5-5. Storage Criteria Summary

Criterion		Existing storage needs, MG	Future storage needs, MG
Capacity	Equalization	0.53	0.56
	Fire	0.63	0.63
	Emergency	2.62	2.76
Total		3.78	3.95

5.7 Operation and Maintenance

The purpose of an O&M program is to ensure satisfactory management of a water system's operation in accordance with the pertinent requirements of OAR 333-061-0065. A comprehensive O&M program includes guidance for water system staff to identify the necessary tasks required to ensure that the system and utility asset life are maximized, utility costs are appropriately managed, and safe and reliable public water supply is maintained. The following sections include a summary of existing staffing and guidelines for O&M activities to include in a documented O&M plan.

5.7.1 Management and Staffing

City staff manages, operates, and maintain the water system as a local government function under City governance. City governance is organized under a City Council, composed of six elected members and an elected Mayor, charged with executing policies set forth by the City Council. The day-to-day management is the responsibility of the Public Works Supervisor, supported by staff members in maintenance, clerical services, and billing.

City Council. The City Council sets policy and water system rate schedules, approves ordinances, and serves as a sounding board for public response, feedback, and guidance. The City Council also approves the water system budgets, sets City-wide priorities, and provides funding and support for water system projects.

City Administrator. The City Administrator works with the Public Works Supervisor and City Council regarding policy development, project issues, and annual water system budget preparation.

Public Works Supervisor. The Public Works Supervisor works directly with City staff to ensure system operations. The Public Works Supervisor oversees the day-to-day work necessary to maintain, operate, test, and analyze the water system to ensure proper function. Additional responsibilities include staff oversight and responding to customer complaints.

Maintenance Staff. There are currently five staff supervised by the Public Works Supervisor. These individuals perform monthly meter reading for use in preparing the monthly water bills. They also work with the Public Works Supervisor to coordinate and schedule necessary repair and maintenance tasks.

The Public Works Supervisor and Maintenance Staff have multiple areas of responsibility and are not dedicated solely to O&M of the water system. Other responsibilities include O&M of the storm system, sanitary system, roads, and parks. Due to these multiple responsibilities, water system maintenance is typically conducted on a reactionary basis, as sufficient staff are not available for preventive maintenance activities.

Operator Certification is prescribed by OAR 333-061-0210 through 333-061-0272, which mandate that public water systems retain in their employment individuals who are certified by examination as competent in water supply operation and management as determined by the OHA. The OHA determines the required level and number of certified positions based on the population and complexity of the water system. For the City, this is a Distribution Class 2 Certification level for the person in Direct Responsible Charge. The Public Works Supervisor maintains this certification.

To promote and maintain expertise as required for operator certification, the Public Works Supervisor attends short schools and workshops to achieve required continuing education units (CEUs).

Besides annual training for the Public Works Supervisor to maintain required CEUs, all water system staff should have training in the following safety-related areas:

- Chlorination O&M
- Trench safety/cave-in protection
- Confined space entry
- Asbestos pipe handling
- Backhoe safety
- Safety awareness
- Cardiopulmonary resuscitation/first aid
- Defensive driving/vehicle inspections
- Flagging/work zone safety

5.7.2 O&M Guidelines

The City does not currently have a documented O&M plan/manual for the water system. Development of a manual is recommended to document expectations regarding activities and frequencies. In the development of an O&M plan, the following activities should be considered and/or included:

Pipe Mains and Valves

- Flush water mains approximately every 3 years with dead-end mains and those with periodic water quality issues as customer complaints arise.
- Exercise critical valves approximately every 6 months.
- Exercise non-critical valves approximately every 3 years or in conjunction with the main flushing program.

Hydrants

Flush hydrants flushing on a routine cycle (e.g., every 5 years).

Tanks

- Operate the water system to achieve complete turnover in each tank every 3 to 5 days, to keep water fresh and maintain disinfection residual.

- Inspect reservoir exteriors routinely.
- Maintain coating as needed (approximately every 20 to 30 years depending on exposure).
- Conduct an interior diving inspection (as recommended by USEPA) at least every 5 years.

Pumps

Record and track pump data such as voltage, pump speed, and pump output to identify any performance changes that would require maintenance.

System Performance Evaluation

Conduct routine/daily system performance evaluation for parameters including the following:

- Normal pump station operations and performance
- Storage tank levels within expected norms
- Customer complaints, if applicable
- General system performance
- Main breaks and other repairs

Comprehensive Monitoring Plan

Water quality sampling requirements are established primarily by federal rule, adopted by the state, and enforced by OHA. The City's sample collection and analysis procedures should be conducted according to department-approved methods as detailed in OAR 333-061-0036 at required frequencies.

Cross-Connection Control Program

Document the City's cross-connection control and backflow prevention program.

Emergency Response Program

Document emergency response planning to identify and prioritize procedures to be used in the event of an emergency. Emergency situations may include major water supply line breaks, fire, weather events, earthquakes, droughts, or damage to key facilities.

Water Use Records

Collect and maintain data to record equipment operational status and key process variables such as tank water levels, pipeline pressures, and pump running speeds.

Additional staff resources will be needed to implement O&M guidelines as recommended above because the City does not have sufficient staff to support a preventive maintenance program. Implementation of a preventive maintenance program will limit future infrastructure and equipment failures and reduce the need for reactive repairs of system components.

In conjunction with the preventive O&M activities, there are additional O&M activities that result from the Capital Maintenance Plan (see Section 7.2) and should be documented in the O&M manual (e.g., AC pipe replacement).

OAR 333-061-0060(5)(a) requires the City to maintain a current Water System Master Plan that is prepared by a professional engineer and approved by the Oregon Health Authority's Drinking Water Program. It is recommended that the CIP be updated annually as projects are completed and that a comprehensive review of the master plan is completed every 10 years or as needed based on changes to land use, system improvements, or system supply.

Section 6

System Evaluation Results

This section summarizes the evaluation of the City's water distribution and storage system based on the criteria provided in Section 5. It includes findings for both the existing and future system evaluation.

6.1 Existing System Evaluation

The existing water system evaluation included an analysis of the City's supply, transmission piping, pumping, and storage facilities. The water system model was used to simulate the demand conditions that represent the greatest strain on the system: a steady-state MDD simulation and a steady-state MDD plus fire flow simulation. Model results were compared to the criteria listed in Section 5. Areas in the existing system that did not meet the criteria were identified as deficiencies that should be addressed.

6.1.1 Supply

The system supply was evaluated based on capacity, quality, and reliability. NCCWC and OLWD are responsible for the quality and reliability of the water supply at the master meter and intertie points. Water quality testing performed by the City, as described in Section 2, indicates that the water supply meets state and federal regulations for quality.

The IGA with NCCWC allocates a minimum of 2.5 mgd to the City, which is greater than the City's existing and future MDD and meets the flow rate supply criteria.

The supplied hydraulic grade should be sufficient to fill the Webster Tanks. Based on circle chart data obtained during hydrant testing, the 50-foot Webster Tanks have a water level of approximately 43.9 feet. Future storage improvements should account for the supplied hydraulic grade from NCCWC and set the maximum tank level(s) accordingly. It should be noted that diurnal readings were not available so fluctuations in the supply system and varying periods to fill the tank relative to peak demand were not evaluated.

6.1.2 Piping

Evaluation of the existing system piping included analysis of standard operating pressures, velocity, head loss and fire flow capacity as described in the following subsections.

6.1.2.1 Operating Pressures

Operating pressures were evaluated during the MDD scenario and found generally to meet the evaluation criteria. There were no areas in the system with customer demands where water pressure was estimated by the model to drop below the minimum allowable pressure of 35 psi.

There are two areas in the system where the water pressure was estimated to exceed the maximum allowable pressure of 100 psi. The first area is located at the end of Meldrum Bar Park Road, where pressures were model-estimated to range between 100 and 105 psi. The second area is located at the end of Hardway Court, where pressures were model-estimated to reach 102 psi.

City staff were interviewed to validate these model results. The City did not report any pressure complaints within the system during normal operations. However, the City does receive low-pressure complaints in some areas during fire flow testing. Projects to address this were not proposed because the pressures are still estimated to meet criteria.

6.1.2.2 Velocity and Head Loss

Model results showed that the existing system is expected to meet the velocity criterion/requirement of less than 5 fps for the MDD and the headloss criterion listed in Table 5-2.

6.1.2.3 Fire Flow Deficiencies

Fire flow was evaluated for each hydrant in the model based on the criteria provided in Section 5.4. Hydrants with residual pressures of lower than 20 psi at the required fire flow are shown as fire flow deficiencies in Figure 6-1. The majority of the deficiencies are due to undersized distribution piping and a lack of looping. Recommendations to eliminate fire flow deficiencies can be found in Section 7.

6.1.2.4 Reliability

The degree of distribution system reliability varies by area within the city. The piping in the low-pressure zone south of Hereford Street has very good system looping that follows the gridded layout of the streets. The street layout in the northern portion of the low-pressure zone and the intermediate- and high-pressure zones provides fewer opportunities for system looping with many dead-end streets and steeper terrain. Specific locations that lack system looping include the following:

- Customers on Ridge Drive, Cason Circle, and Rivergate School Drive are served by a single 6-inch AC pipeline that is aligned between lots from Ridgewood Drive to Ridge Drive. The access to this pipeline is limited and there are concerns with its condition due to its material type. A project to improve reliability in this area is discussed in Section 7 (see Cason Rd. PRV and Pipe Replacement CIP).
- Customers north of Buckingham Drive in the high-pressure zone are served by a single 8-inch AC pipeline on Lancaster Drive. A project to improve reliability is discussed in Section 7 (see Sherwood Neighborhood Pipe Replacement CIP).

6.1.3 Pump Stations

Two pump stations within the existing system are discussed in this section. The Webster Pump Station boosts pressures from the Webster Tanks to supply the high-pressure zone and the Kirkwood Pump Station boosts pressures from the Webster Tanks to fill the Kirkwood Tank, that serves the intermediate-pressure zone.

There are two identical 500-gpm pumps at the Webster Pump Station. These pumps would be able to serve the existing MDD of 267 gpm in the high-pressure zone with one pump out of service, but do not have the ability to meet the existing MDD with fire flow demand. However, during fire flow events or testing, the OLWD intertie at Valley View opens and supplies the remaining demand. A project would be needed to address pump capacity only if the City does not remain reliant on the intertie. The largest fire flow demand within the high-pressure zone is 3,500 gpm, which is assigned to the fire hydrant serving Kraxburger Middle School. All other fire flow demands within the high-pressure zone were set to 1,000 gpm. There is also a propane pump within the Webster Pump Station that is intended to serve as a backup pump for the high-pressure zone in the case of a power outage. According to City staff, the pump has not been exercised regularly and is not reliable.

The Kirkwood Pump Station has two 350-gpm pumps that are housed in a stainless steel enclosure at the Webster site. These pumps would be able to serve the existing MDD of 125 gpm in the intermediate-pressure zone with one pump out of service. Because the intermediate zone is served

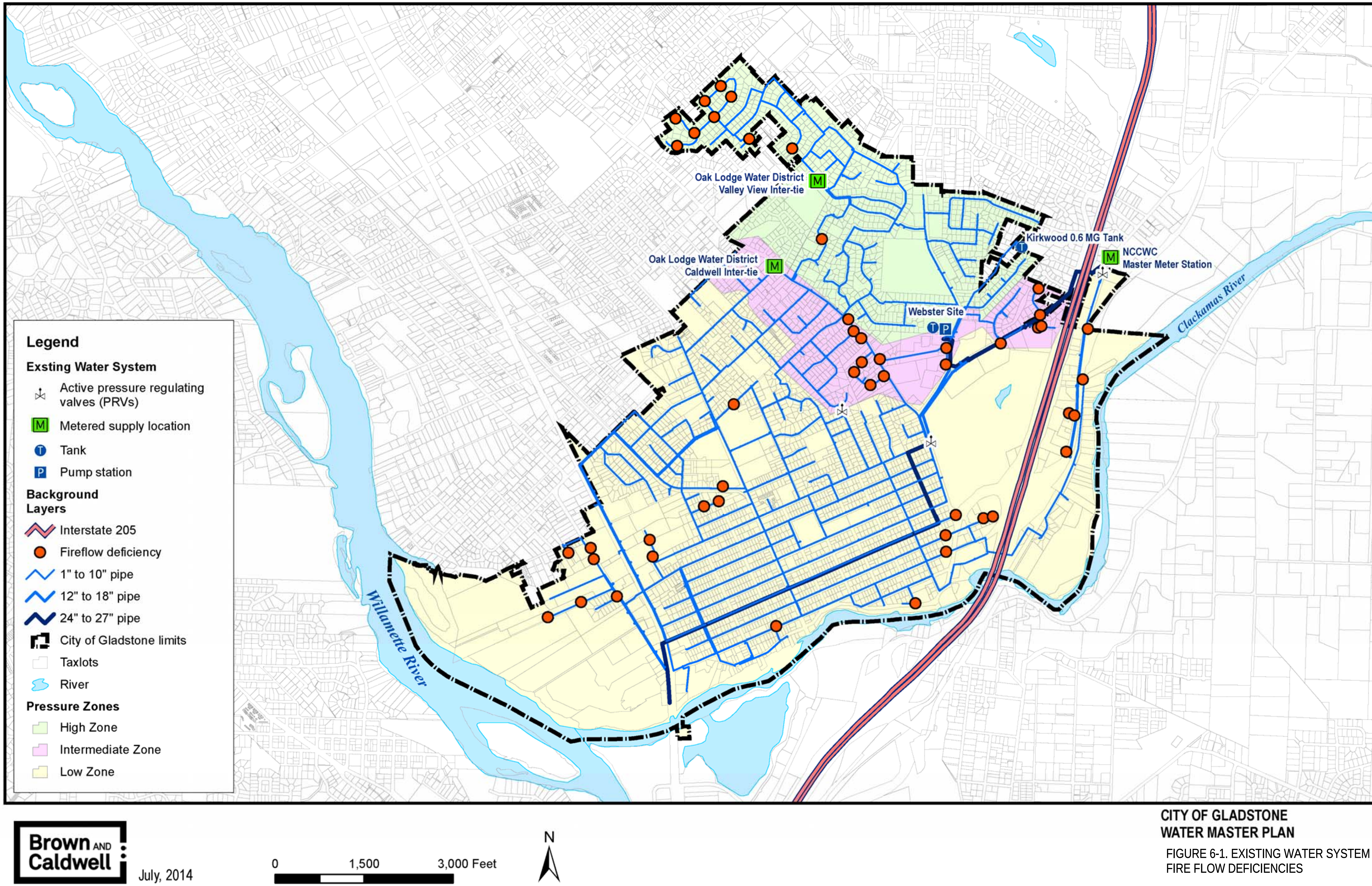


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FIGURE 6-1. EXISTING WATER SYSTEM FIRE FLOW DEFICIENCIES

by the Kirkwood Tank, the Kirkwood Pump Station does not need to be sized to provide fire demand. If pressures in the intermediate-pressure zone drop to below 40 psi at the OLWD intertie, the backup source would be anticipated to supply the zone until pressures reach 50 psi.

6.1.4 Storage

Available storage capacity was compared to the criteria for equalization, fire, and emergency storage for the system. As indicated in Table 6-1, an additional 1.58 MG is needed to meet storage criteria for the existing system. A project to increase system storage is discussed in Section 7.

Table 6-1. Existing Storage System Analysis

Available storage (Kirkwood and Webster tanks)	Required storage				Storage deficiency
	Equalization	Fire flow (3,500 gpm for 3 hours)	Emergency (2 days of ADD)	Total	
2.2	0.53	0.63	2.62	3.78	1.58

6.2 Future System Analysis

This section presents a summary of the future 2035 system evaluation scenario. This scenario was developed to identify the improvements needed to meet the evaluation criteria presented in Section 5, given a future 2035 population of 12,308. Figure 6-2 shows the layout of the future system at year 2035 and Figure 6-3 shows the hydraulic schematic of the future system.

6.2.1 Supply

The IGA with NCCWC allocates a minimum of 2.5 mgd to Gladstone, which is greater than the City's future MDD and meets the flow rate supply criteria. The supplied hydraulic grade should be sufficient to fill the Webster Tanks.

No improvements to the existing system supply were identified based on demand. Reliability of supply was not evaluated for this plan.

The City's previous Ranney Collector supply system has not been in operation since the mid 1980s, but was never formally decommissioned. Permitting and construction needs associated with decommissioning are unknown at this time, but the City is in the process of coordinating with contractors to aid in this effort. A project is identified in Section 7 to pursue decommissioning of the Ranney Collector system with a $50,000 placeholder given the unknown scope of work.

6.2.2 Piping

The primary drivers for improvements to distribution system piping are undersized pipes, aging AC pipe and a lack of system looping. Undersized pipes and lack of system looping resulted in the fire flow deficiencies described in Section 6.1.2.3. Proposed pipe replacement projects (see Figure 6-2) were developed to provide adequate capacity to meet fire flow requirements. These piping improvements are needed as soon as possible given that the current system does not meet criteria specified in the OFC.

The City owns approximately 17 miles of AC pipe, which make up approximately 43 percent of the distribution system. Main breaks have occurred in areas of AC pipe in recent years and the City is concerned about the condition of the aging pipes. In response to concerns about pipe condition, fire flow testing has been severely limited in the high-pressure zone, which is comprised almost entirely of AC pipe. Much of this pipe was installed behind the curb in common trenches with other utilities, making inspection and maintenance difficult. Figure 6-4 highlights areas of AC pipe within the system. A replacement program is needed and is presented in Section 7. In addition, a condition assessment is recommended to prioritize pipe replacements. The condition assessment would include all pipe types because there may be pipes constructed of other materials that warrant near-term replacement. A condition assessment would ensure replacements are conducted in order of greatest need. A leak detection program could also be conducted to prioritize pipe replacements where leaks currently exist.

6.2.3 Pump Stations

The Webster and Kirkwood Pump Stations are powered from the 480-volt, 200-amp, three-phase electrical service panel in the Webster Pump Station Building. This electrical service does not have a backup emergency power source large enough to operate both the Webster and Kirkwood pumps in the event of a utility power outage. The Webster Pump Station currently has backup power supply from a dated propane engine pump. There is no backup power supply for the Kirkwood pumps.

For reliability, it is recommended that a new diesel electric standby emergency generator be installed at the site to accommodate all normal duty pumps (Webster pumps and Kirkwood pumps) and ancillary electric loads currently supplied from the existing electrical service panel. It is further recommended that the dated propane pump and small ancillary generator be retired from service and removed from the building. Removing the obsolete equipment from the building would create much needed work space and room for new electrical equipment necessary for the operation of the backup emergency generator system. A cost estimate for procurement and installation is presented in Section 7.

Additionally, the Webster and Kirkwood Pump Stations' instrumentation data logging and alarm annunciation are currently conducted with existing chart recorders and an analog alarm dialer connected to the land line phone system. There is no method to retrieve and store the data remotely, and the existing equipment is prone to failure. The alarm autodialer is also prone to sending false alarms and must be reset locally, requiring staff to drive to the site. It is recommended that data logging and alarming functions be upgraded by using a SCADA monitoring service. Due to the size of the pump station and the number of data and alarm points, purchase, installation, and maintenance of a City-owned and operated SCADA system is not warranted. An outside SCADA monitoring and alarm handling service is economical and would improve the reliability of the system operation. A typical system is detailed along with a budget estimate in Section 7.

6.2.4 Storage

Available storage capacity was compared to the criteria for equalization, fire, and emergency storage for the future demand scenario. As indicated in Table 6-2, an additional 1.75 MG of storage is needed to meet criteria for the existing system.

Table 6-2. Future Storage System Analysis

Available storage (Kirkwood and Webster tanks)	Required storage, MG				Storage deficiency, MG
	Equalization	Fire flow (3,500 gpm for 3 hours)	Emergency (2 days of ADD)	Total	
2.2	0.56	0.63	2.76	3.95	1.75

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To address the storage deficiency, a new 2.0-MG tank south of the existing Webster site is proposed. The 2.0-MG volume was determined by using the storage deficiency plus an additional 0.25 MG to account for unused storage space in the Webster Tanks, as they are not being operated full. The City owns 11.7 acres of vacant land between Oatfield Road and Webster Road, which was identified previously as a potential storage location. The proposed new tank would provide equalization, fire flow, and emergency storage for the City's system. The tank would supply the low-pressure zone by gravity and would maintain the same hydraulic grade as the Webster Tanks to supply the intermediate- and high-pressure zones by the Kirkwood and Webster Pump Stations, respectively. This additional storage is shown to be needed for emergency storage. As discussed in Section 5, emergency storage criteria are highly subjective and dependent upon local conditions and possible emergency scenarios. Two days of ADD was the value chosen for emergency storage in this evaluation.

6.3 Field Identified Operational Problems

Some water system problems were identified by staff during completion of field work and ongoing maintenance. These issues included necessary upgrades at the Webster Pump Station and replacement of specific PRVs. The Webster Pump Station upgrades are addressed in section 6.2.3. The PRVs that require replacement include the following:

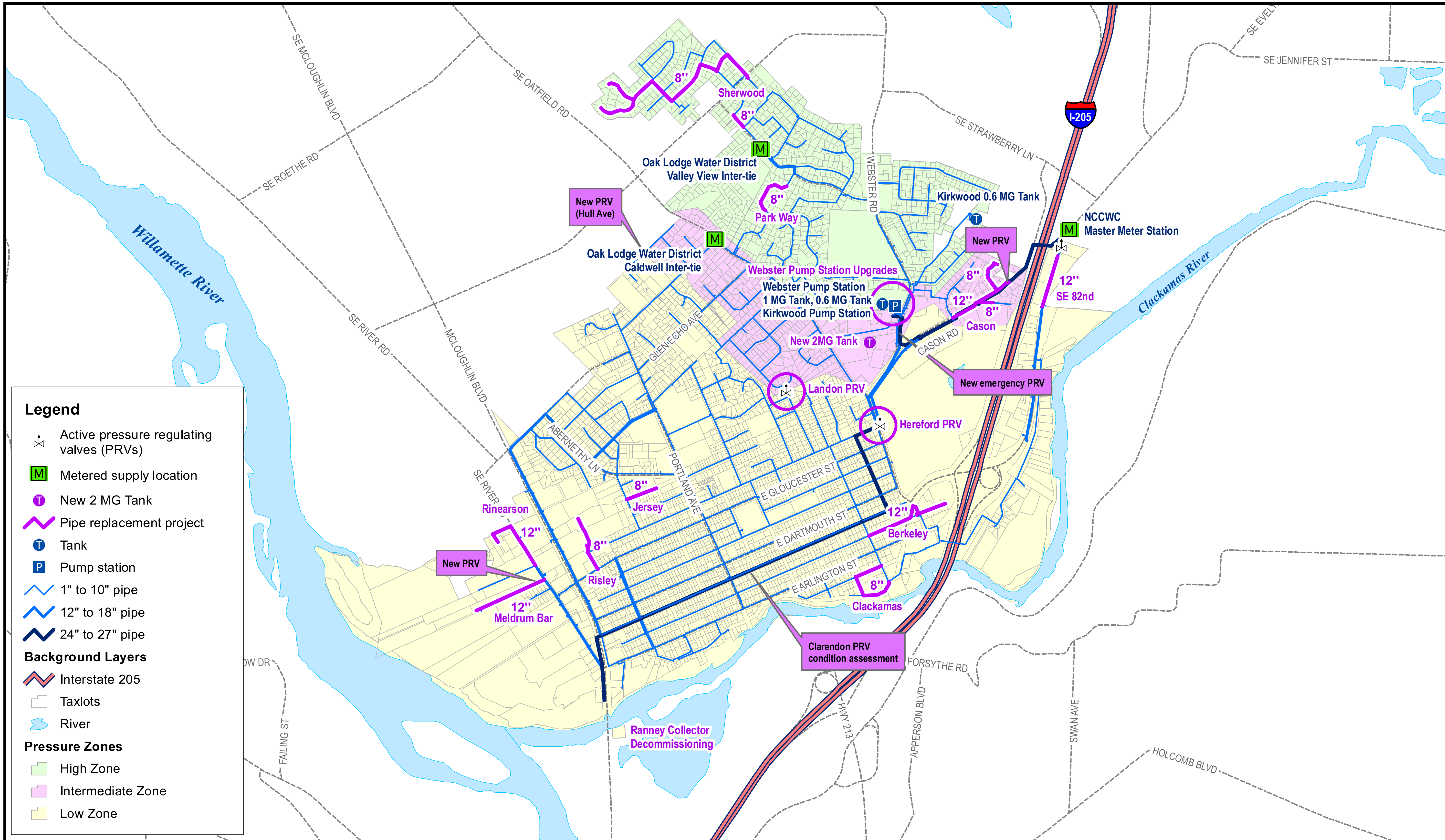
- Hereford PRV because it is submerged in the existing vault and known to be in poor condition.
- Landon PRV due to lack of access. This PRV appears to be buried on private property.
- A leaky connection was identified between the high- and intermediate-pressure zones at Collins Crest. This connection is in need of repair.
- Clarendon PRVs. There are also four PRVs in the low-pressure zone along Clarendon Street that were used previously to regulate pressures from the Ranney Collector system to the downtown area. The physical condition of the four PRVs is unknown. This plan includes a recommendation (Section 7.2) to investigate the condition of these PRVs to ensure that they are not hindering pressures and/or do not require decommissioning.

6.4 Summary of Identified Problems/Issues

The system evaluation identified the following problems/issues for correction with proposed capital improvements as summarized in Section 7:

1. The Ranney intake system could require decommissioning prior to sale of property.
2. Fire flow deficiencies are estimated at 49 locations (due to undersized pipes and lack of looping). Specific locations of dead-end systems include Ridge Drive, Cason Circle, Rivergate School Drive, and Lancaster Drive, which also have limited access.
3. There is concern regarding the age and condition of the 17 miles of AC piping in the city.
4. Operating pressures exceed allowable pressures in pipes located at Meldrum Bar Park Road and at the end of Hardway Court.
5. The current location and configuration of a number of PRVs limits the City's ability to test and maintain them.
6. The backup propane pump at the Webster Pump Station is not reliable.
7. An updated data collection system is needed at the Webster Pump Station.
8. A leaky connection was identified between the high- and intermediate-pressure zones at Collins Crest.
9. An additional storage capacity of 2.0 MG is needed to meet emergency storage criteria.

Proposed improvements to address these issues are described in Section 7.



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0 1,500 3,000 Feet

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FUTURE SYSTEM LAYOUT

FIGURE 6-2

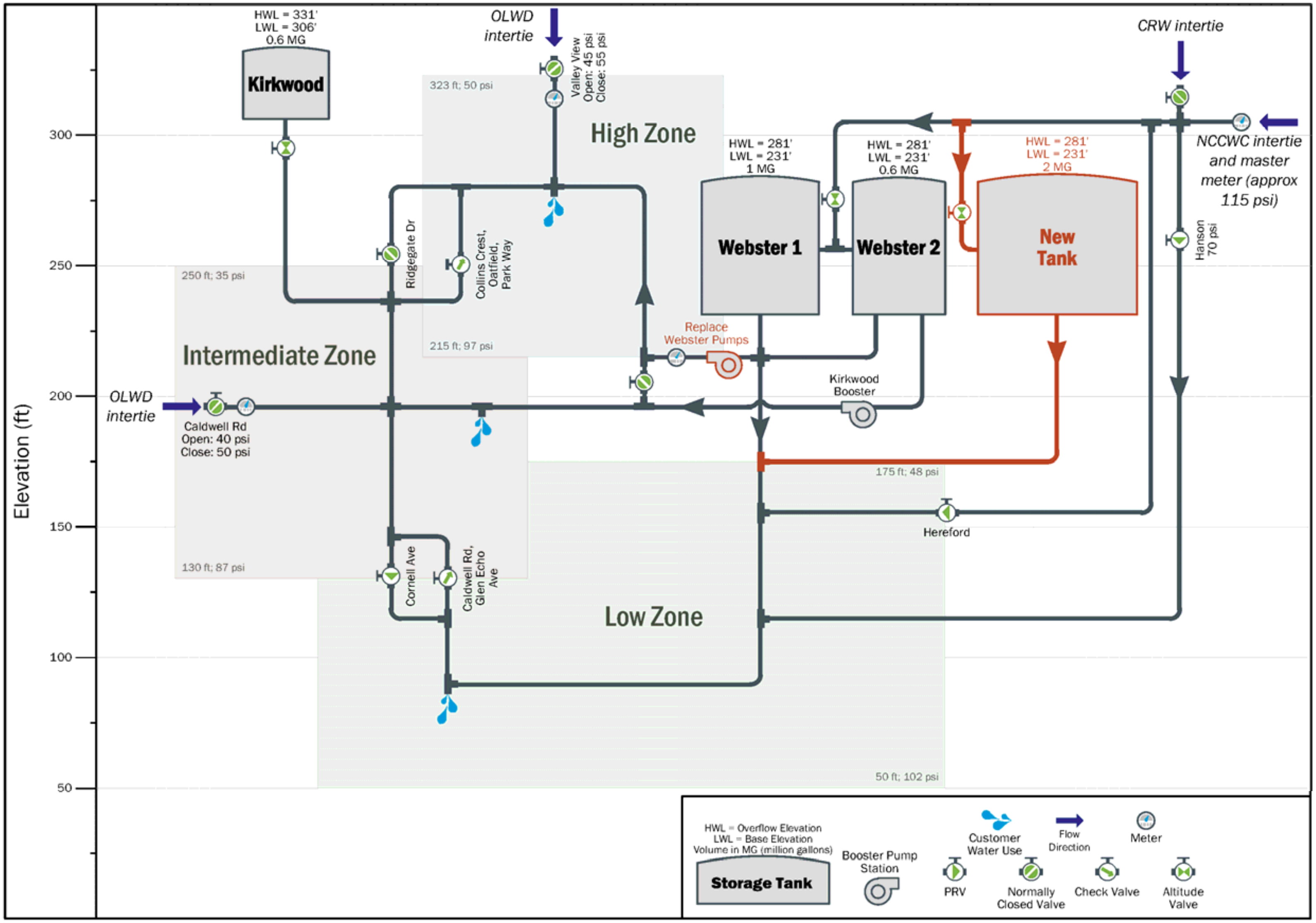

Figure 6-3. Future system hydraulic schematic

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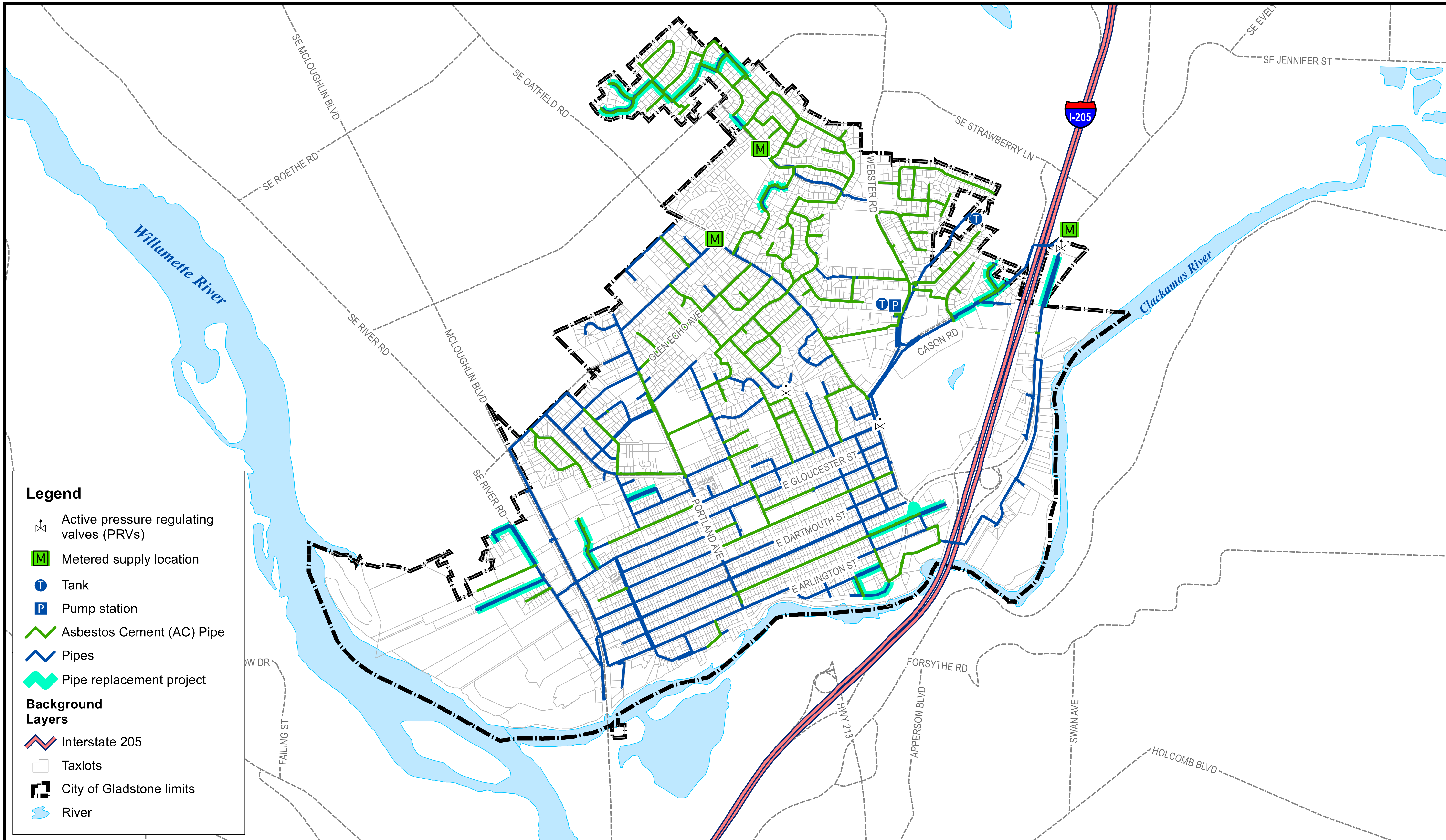

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0 1,500 3,000 Feet

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AC PIPE DISTRIBUTION

FIGURE 6-4

Section 7

Recommended Improvements

This section presents CIPs designed to address existing system deficiencies and future system demands through 2035 per the evaluation criteria described in Section 5. A summary of the proposed CIPs, the basis for cost estimates, and project prioritization are included in this section.

7.1 CIP Descriptions

A summary of each proposed CIP is provided below and includes identification of the project objective, statement of need, project description, estimated project cost, and associated design assumptions. Projects are listed alphabetically for each facility type.

Proposed projects are shown in Figure 6-2.

7.1.1 Supply

CIP name	Ranney Intake System Decommissioning
No. of problem addressed from Section 6.4	1
Objective addressed	Supply
Pressure zone	N/A
Statement of need	The Ranney Collector system intake has not been used since the mid 1980s, but was never formally decommissioned.
Project description	In conjunction with current City efforts, formally decommission the Ranney Collector system intake to allow for potential future sale of the property.
Estimated total project cost	$50,000
Design assumptions	• Scope and level of effort are currently unknown. The City is currently coordinating with a contractor to develop a scope of work. A placeholder of $50,000 was included for purposes of CIP development and documentation. • Coordination with DEQ will be required to confirm requirements related to access and in-water work. • Decommissioning efforts should include the 16-inch intake waterline along Highway 99E.

7.1.2 Piping

CIP name	Berkeley Street Pipe Replacement
No. of problem addressed from Section 6.4	2 and 3
Objective addressed	Existing fire flow deficiency
Pressure zone	Low
Statement of need	The fire flow deficiencies along Berkeley Avenue are due to undersized piping. These hydrants serve light industrial and commercial properties near Southeast 82nd Drive and Berkeley Avenue.
Project description	Replace 1,604 LF of existing 6-inch asbestos cement (AC) and ductile iron (DI) pipe with new fully restrained, 12-inch DI pipe to be located on Berkeley Avenue between Columbia Avenue and Interstate 205.
Estimated total project cost	$960,000

CIP name	Berkeley Street Pipe Replacement (continued)
Design assumptions	• Acquisition of easements may be required due to the existing pipe alignment on private property. • Approximately 225 feet of this pipeline is currently aligned on private property at 250 Princeton Avenue. This CIP includes re-routing the pipeline alignment to the north to eliminate crossing private property. • Approximately 625 feet of this CIP is aligned on SE 82nd Drive and Princeton Avenue, which are arterial roadways requiring traffic control during construction. Traffic control was assumed as part of the CIP cost estimate. • Hydrant replacement is proposed in the same location as existing. • The CIP cost estimate does not reflect decommissioning and/or removal of existing AC pipe. Such activity is likely to impact the CIP cost if required. Coordination with DEQ may be needed to ensure appropriate environmental precautions are taken.

CIP name	Cason Road PRV and Pipe Replacement
No. of Problems Addressed from Section 6.4	2 and 3
Objective addressed	Existing fire flow deficiency, reliability
Pressure zone	Low
Statement of need	The intermediate zone east of the Webster site and south of Ridgewood Drive is served via a 640 foot, 6-inch AC pipeline that is aligned between tax lots from 17928 Webster Road to 7495 Ridge Drive. This pipeline is undersized to meet fire flow requirements and is difficult to access due to its alignment on private property. As a result of the undersized 6-inch piping and a lack of system looping, fire flow deficiencies occur on Cason Circle Cason Drive, and Ohlson Road. Limited fire flow capacity is currently available to serve the Rivergate Adventist Elementary School, Gladstone Park Seventh Day Adventist Church, Somerset Retirement Living and other residences in this area.
Project description	This project includes a new PRV and vault, which would be used to regulate pressures so that the 27-inch CCP main could be used to serve properties off of Ridge Drive, Cason Circle and Ohlson Road. This option also includes a new 12-inch pipeline from Ridge Drive to 8396 Cason Road and 8-inch pipelines on Cason Circle and Ohlson Road. The alternative to supplying this area with the intermediate zone would require a new pipeline along Webster Road and Cason Road, which was determined to be a more expensive alternative and was not reflected in the cost estimate. To provide emergency service to these properties off of Ridge Drive, Cason Circle and Ohlson Road in the event that the NCCWC connection is disabled, an emergency connection PRV will be located between the intermediate zone and the 27-inch supply pipe from NCCWC. This will allow service and fire flow from the Kirkwood tank in the event that the NCCWC connection is disabled.
Estimated total project cost	$1,260,000
Design assumptions	• Acquisition of easements may be required due to the existing pipe alignment on private property. • This CIP is located within the ROW, thus traffic control may be required during construction. Traffic control was assumed as part of the CIP cost estimate. • The emergency service PRV is proposed to ensure this area has a backup source of water service and fireflow to the main system in the event the NCCWC master meter is disabled. Alternatively, the existing 6-inch AC pipeline (proposed for decommissioning) may be preserved to provide domestic service from the Kirkwood tanks in the event the NCCWC master meter is disabled; however it would not provide adequate fireflow. • The PRV for emergency service should be set to 45 psi, and for purposes of this CIP has been located south of the Webster pump station in the ROW. It may be located at the Webster pump station dependent on available space . Sixty feet of 8-inch DI pipe was estimated for connection. • The PRV cost estimate is based on quote by Carol Wells at GC Systems Inc. and includes a packaged 4-inch PRV with 1 ½-inch bypass and a pressure relief valve. Installation to be completed by general contractor. Vault size is 10 feet x 5 feet x 7.5 feet. • Hydrant replacement is proposed in the same location as existing. • The CIP cost estimate does not reflect decommissioning and/or removal of existing AC pipe. Such activity is likely to impact the CIP cost if required. Coordination with DEQ may be needed to ensure appropriate environmental precautions are taken.

CIP name	Clackamas Boulevard Pipe Replacement
No. of problem addressed from Section 6.3	2 and 3
Objective addressed	Existing fire flow deficiency, reliability
Pressure zone	Low
Statement of need	The fire flow deficiency at the hydrant on Cornell Avenue and Clackamas Boulevard is due to undersized piping and a lack of system looping.
Project description	• Replace 1,309 LF of existing 4-inch DI pipe and 6-inch AC pipe with new fully restrained, 8-inch DI pipe to be located within the roadway on First Street between Columbia Avenue and Cornell Avenue and also on Cornell Avenue between First Street and Clackamas Boulevard. • Improve system looping by installing 527 LF of new fully restrained, 8-inch DI pipe between Columbia Avenue and Clackamas Boulevard.
Estimated total project cost	$840,000
Design assumptions	• Property acquisition is not included in the cost estimate. The City may need to obtain easements. • Hydrant replacement is proposed in the same location as existing. • This CIP is located within the ROW, thus traffic control may be required during construction. Traffic control was assumed as part of the CIP cost estimate. • The CIP cost estimate does not reflect decommissioning and/or removal of existing AC pipe. Such activity is likely to impact the CIP cost if required. Coordination with DEQ may be needed to ensure appropriate environmental precautions are taken.

CIP Name	Clarendon PRV Condition Assessment
No. of problem addressed from Section 6.3	5
Objective addressed	Reliability
Pressure zone	Low
Statement of need	There are four PRVs in the low zone along Clarendon Street, which were previously used to regulate pressures from the Ranney Collector system to the downtown area. The physical condition of the four PRVs is unknown.
Project description	Conduct a condition assessment of the four PRVs to ensure they are not hindering pressures and/or require decommissioning
Estimated total project cost	$10,000
Design assumptions	None.

CIP name	Hereford PRV
No. of problem addressed from Section 6.3	5
Objective addressed	Reliability
Pressure zone	Low
Statement of need	The existing Hereford PRV reduces pressures from the incoming 27-inch main to supply the low pressure zone. This PRV is reported to be submerged in the existing vault and in poor condition according to City staff.
Project description	Replace the existing Hereford PRV and vault.
Estimated total project cost	$110,000
Design assumptions	• This CIP was identified from City staff input. • The PRV cost estimate is based on quote by Carol Wells at GC Systems Inc. and includes a packaged 4-inch PRV with 1 ½-inch bypass and a pressure relief valve. Installation to be completed by general contractor. Vault size is 10 feet x 5 feet x 7.5 feet. • The CIP cost estimate assumes 100 feet of 12-inch DI piping for hook up.

CIP name	Hull Avenue PRV
No. of problem addressed from Section 6.3	4
Objective addressed	Operating pressures exceed allowable pressures
Pressure zone	Low
Statement of need	Operating pressures along Hardway Court exceed allowable pressures. A PRV is needed to reduce pressures below 100 psi.
Project description	Install 1 PRV on Hull Ave between Hardway Court and Scutton Lane.
Estimated total project cost	$110,000
Design assumptions	• The PRV cost estimate is based on quote by Carol Wells at GC Systems Inc. and includes a packaged 4-inch PRV with 1 ½-inch bypass and a pressure relief valve. Installation to be completed by general contractor. Vault size is 10 feet x 5 feet x 7.5 feet. • The CIP cost estimate assumes 100 feet of 12-inch DI piping for hook up.

CIP name	Jersey Street Pipe Replacement
No. of problem addressed from Section 6.3	2
Objective addressed	Existing fire flow deficiency
Pressure zone	Low
Statement of need	Fire flow deficiencies along Jersey Street, east of Beatrice Avenue are due to undersized distribution piping and a lack of looping.
Project description	Replace 510 feet of existing 4-inch CI pipe with new fully restrained, 8-inch DI pipe to be located within the roadway on Jersey Street, east of Beatrice Avenue.
Estimated total project cost	$330,000
Design assumptions	• System looping was not included in this CIP due to the location of the existing 48-inch storm drain which conveys flows to Rinearson Creek and crosses Jersey Street and Bellevue Avenue to the east and south of the project pipe. • This CIP is located within the ROW, thus traffic control may be required during construction. Traffic control was assumed as part of the CIP cost estimate. • Hydrant replacement is proposed in the same location as existing.

CIP name	Landon PRV
No. of problem addressed from Section 6.3	5
Objective addressed	Reliability
Pressure zone	Low
Statement of need	The existing PRV north of Landon Street and Cornell Avenue provides a connection between the intermediate and low pressure zones. The PRV was not found during the system inventory phase of this project because it is buried on private property. The City is unable to maintain this PRV in its current location.
Project description	Replace the existing Landon PRV with a new valve and vault located within the ROW of Cornell Avenue.
Estimated total project cost	$110,000
Design assumptions	• This CIP was identified from City staff input. • The PRV cost estimate is based on quote by Carol Wells at GC Systems Inc. and includes a packaged 4-inch PRV with 1 ½-inch bypass and a pressure relief valve. Installation to be completed by general contractor. Vault size is 10 feet x 5' x 7.5 feet. • The CIP cost estimate assumes 100 feet of 12-inch DI piping for hook up. • Property acquisition is not included in the cost estimate. The City may need to obtain easements.

CIP name	Meldrum Bar Park Road PRV and Pipe Replacement
No. of problem addressed from Section 6.3	2 and 4
Objective addressed	Existing fire flow deficiency and operating pressures exceed allowable pressures
Pressure zone	Low
Statement of need	Fire flow deficiencies along Meldrum Bar Park Road are due to undersized piping and a lack of looping. In addition to serving fire flow demands in Meldrum Bar Park, the hydrants along Meldrum Bar Park Road also have the potential to provide backup fire flow to the mobile home park to the north and subdivision to the south. Additionally, the operating pressures along Meldrum Bar Park Road exceed allowable pressures. A PRV is needed to reduce pressures below 100 psi.
Project description	• Replace 1,194 feet of existing 6-inch DI pipe with new fully restrained, 12-inch DI pipe to be located within the roadway on Meldrum Bar Park Road. • Install 1 PRV near the intersection of Meldrum Bar Park Road and River Road.
Estimated total project cost	$680,000
Design assumptions	• System looping was not included in this CIP because the system terminates at the end of the project pipe with no available looping opportunities within the right of way nearby. • The PRV cost estimate is based on quote by Carol Wells at GC Systems Inc. and includes a packaged 4-inch PRV with 1 ½-inch bypass and a pressure relief valve. Installation to be completed by general contractor. Vault size is 10 feet x 5 feet x 7.5 feet. • This CIP is located within the ROW, thus traffic control may be required during construction. Traffic control was assumed as part of the CIP cost estimate. • Hydrant replacement is proposed in the same location as existing. • No service line connections were included in this CIP. The service line for the mobile home park is a separate 620 foot, 2-inch steel line not assumed to be replaced as part of this CIP.

CIP name	Park Way Pipe Replacement
No. of problem addressed from Section 6.3	2 and 3
Objective addressed	Existing fire flow deficiency, reliability
Pressure zone	High
Statement of need	Fire flow deficiencies along Park Way between Los Verdes Drive and Oatfield Road are due to undersized distribution system piping. This neighborhood is also served by AC pipe which is nearing the end of its useful life and has prevented the City from completing fire flow testing due to concerns of main failures.
Project description	• Replace 155 feet of existing 6-inch AC pipe with new fully restrained, 8-inch DI pipe to be located within the roadway on Park Way between Oatfield Road and the first hydrant on the Park Way line. • Replace 750 feet of existing 6-inch AC pipe with new fully restrained, 8-inch DI pipe to be located within the roadway on Park Way between house numbers 6820 and 6703.
Estimated total project cost	$510,000
Design assumptions	• This CIP is located within the ROW, thus traffic control may be required during construction. Traffic control was assumed as part of the CIP cost estimate. • The cost estimate assumes replacement of hydrants in the same location as existing, plus one additional hydrant. • The CIP cost estimate does not reflect decommissioning and/or removal of existing AC pipe. Such activity is likely to impact the CIP cost if required. Coordination with DEQ may be needed to ensure appropriate environmental precautions are taken.

CIP name	Sherwood Neighborhood Pipe Replacement
No. of problem addressed from Section 6.3	2 and 3
Objective addressed	Existing fire flow deficiency, reliability
Pressure zone	High
Statement of need	Fire flow deficiencies in the Sherwood Forest neighborhood north of Jennings Avenue are due to undersized distribution system piping and a lack of looping. This neighborhood is also served by AC pipe which is nearing the end of its useful life and has prevented the City from completing fire flow testing due to concerns of main failures. Much of the existing piping in this neighborhood was installed behind the curb in common trenches with other utilities, which has made maintenance and repair difficult.
Project description	• Improve system looping by installing 260 feet of new fully restrained, 8-inch DI pipe on Valley View Drive between Churchill Drive and Buckingham Drive. • Replace 3,930 feet of existing 6-inch AC pipe with new fully restrained, 8-inch DI pipe to be located within the roadway.
Estimated total project cost	$2,170,000
Design assumptions	• This CIP is located within the ROW, thus traffic control may be required during construction. Traffic control was assumed as part of the CIP cost estimate. • Hydrant replacement is proposed in the same location as existing. • The CIP cost estimate does not reflect decommissioning and/or removal of existing AC pipe. Such activity is likely to impact the CIP cost if required. Coordination with DEQ may be needed to ensure appropriate environmental precautions are taken.

CIP name	Rinearson Road Pipe Replacement
No. of problem addressed from Section 6.3	2
Objective addressed	Existing fire flow deficiency
Pressure zone	Low
Statement of need	Fire flow deficiencies along River Road and Rinearson Road, north of Meldrum Bar Park Road are due to undersized distribution piping and a lack of looping. The hydrants along this line serve two apartment complexes west of River Road.
Project description	Replace 1,207 feet of existing 6-inch DI pipe with new fully restrained, 8-inch DI pipe to be located within the roadway on River Road and Rinearson Road.
Estimated total project cost	$590,000
Design assumptions	• System looping was not included in this CIP because the system terminates at the end of the project pipe with no available looping opportunities nearby. • This CIP is located within the ROW, thus traffic control may be required during construction. Traffic control was assumed as part of the CIP cost estimate. • Hydrant replacement is proposed in the same location as existing.

CIP name	Risley Avenue Pipe Replacement
No. of problem addressed from Section 6.3	2 and 3
Objective addressed	Existing fire flow deficiency
Pressure zone	Low
Statement of need	Fire flow deficiencies along Risley Avenue, north of Gloucester Street are due to undersized distribution piping and a lack of looping. The hydrants at the end of Risley Avenue serve an apartment building complex. This neighborhood is also served by AC pipe.
Project description	Replace 893 feet of existing 6-inch AC pipe with new fully restrained, 8-inch DI pipe to be located within the roadway on Risley Avenue.
Estimated total project cost	$460,000
Design assumptions	• System looping was not included in this CIP because Risley Avenue is a dead end street, which terminates at Rinearson Creek. • This CIP is located within the ROW, thus traffic control may be required during construction. Traffic control was assumed as part of the CIP cost estimate. • Hydrant replacement is proposed in the same location as existing. • The CIP cost estimate does not reflect decommissioning and/or removal of existing AC pipe. Such activity is likely to impact the CIP cost if required. Coordination with DEQ may be needed to ensure appropriate environmental precautions are taken.

CIP name	SE 82nd Drive Pipe Replacement
No. of problem addressed from Section 6.3	2
Objective addressed	Existing fire flow deficiency
Pressure zone	Low
Statement of need	The fire flow deficiencies along SE 82nd Drive are due to a section of undersized 8-inch piping.
Project description	Replace 860 feet of existing 8-inch DI pipe with new fully restrained, 12-inch DI pipe to be located between 17765 82nd Drive and 1250 SE 82nd Drive.
Estimated total project cost	$470,000
Design assumptions	• This CIP is located on 82nd Drive, an arterial roadways requiring traffic control during construction. Traffic control was assumed as part of the CIP cost estimate. • Hydrant replacement is proposed in the same location as existing.

7.1.3 Pump Station

CIP name	Webster Pump Station Upgrades (Generator Set)
No. of problem addressed from Section 6.3	6
Objective addressed	Provide a backup emergency power source large enough to operate both the Webster and Kirkwood pumps in the event of a utility power outage.
Pressure zone	N/A
Statement of need	The current electrical service for the Webster and Kirkwood Pumps does not have a sufficient backup emergency power source.
Project description	• Install a new Diesel Electric standby emergency generator at the Webster pump station building to include the following: • 125 KW, 480 volt, 3 phase outdoor standby emergency generator set with an integral 250 gallon sub-base mounted fuel storage tank. • 480 volt, 200 amp, 3 pole, 100 percent load rated service entrance rated circuit breaker cabinet installed inside the pump room. • 480 volt, 200 amp, 4 pole automatic transfer switch cabinet installed inside the pump room. • New power conduit and cabling reconnecting the Utility Electrical Service from the meter box to the new main circuit breaker, new power conduit and cabling connecting the new main circuit breaker and generator set to the automatic transfer switch and new power conduit and cabling connecting the automatic transfer switch to the existing pump station power panel. • New control conduit and cabling connecting the generator set, automatic transfer switch and SCADA monitoring system.
Estimated total project cost	$150,000
Design assumptions	• This CIP does not include replacement of the existing Webster or Kirkwood pumps. Analysis of the system found the pumps to be insufficient for addressing fire flow demand in the high zones. However, this demand is met with a reliance on the OLWD inter-ties. The City will continue to rely on the inter-ties to meet this demand. • The generator set should be installed in a weatherproof residential area-rated sound insulated enclosure. • A 250 gallon fuel reserve provides approximately 25 hours continuous run time at full load. Average loading for this station under heavy use is assumed to be approximately 75 percent which would allow approximately 33 hours continuous runtime before requiring refueling. • Prices for the generator, fuel tank and quit zone enclosure were provided by Pacific Power Products in Kent, WA, a local distributor for MTU Onsite Energy products. • Price for the power service was provided by Eaton Power Products (local contact in Wilsonville, Ore.). • Installation to be provided by contractor. A general installation cost of $25,600 was reflected in the CIP cost estimate. • AC pipe replacement in the vicinity of the pump station was not reflected in the cost estimate. AC pipe replacement may be prioritized in this location per the annual replacement program at the time of construction.

CIP name	Webster Pump Station SCADA System
No. of problem addressed from Section 6.3	7
Objective addressed	Provide updated system to collect and store data from the Webster and Kirkwood pump stations.
Pressure zone	N/A
Statement of need	The current system to log data and trigger alarms is outdated, it does not allow remote access, and it is prone to failure.
Project description	Update the data logging and alarming functions using a SCADA monitoring service. Use an outside SCADA monitoring and alarm handling service to improve the reliability of the system operation. This would include installing SCADA systems meters at the Webster Road pump station building, the NCCWC master meter main station, the OLWD Valley View intertie meter station and the OLWD Caldwell intertie meter station.
Estimated total project cost	$20,000
Design assumptions	• SCADA system components including the RTU System, analog expansion module, and antenna cable were provided by Mission Communications (local distributor is Correct Equipment in Canby, Ore.). • SCADA system freight charges, set up charges, and onsite training charges were provided by Mission Communications (local distributor is Correct Equipment in Canby, Ore.). • Installation to be provided by contractor. A general installation cost of $2,000 was reflected in the CIP cost estimate for the pump station and $750 for each meter location. • Annual maintenance is required when using an outside SCADA monitoring and alarm service. A total annual maintenance cost estimate is approximately $2,500 as provided by Mission Communications (local distributor is Correct Equipment in Canby, Ore.).

7.1.4 Storage

CIP name	New 2MG Storage Tank
No. of problem addressed from Section 6.3	9
Objective addressed	Provide additional storage capacity to meet future emergency storage demands.
Pressure zone	N/A
Statement of need	Available storage capacity in the Webster and Kirkwood tanks does not exist to meet an emergency storage demand (defined as two days of average daily water demand). Such emergency storage demand is a subjective criteria as stated in Section 5.6.3.
Project description	Install a 2 MG steel or reinforced concrete tank at the City-owned Oatfield Road and Webster Road location to provide equalization, fire flow and emergency storage for the City's system. The tank would supply the low pressure zone by gravity.
Estimated total project cost	• $4,500,000 (steel)
Design assumptions	• The proposed location of the facility is on the 11.7 acre vacant, City-owned lot at Oatfield Road and Webster Road. A 250' x 250' tank placement area was assumed for purposes of cost estimating (site preparation and clearing). • Placement of the tank is assumed in the center of the tax lot, at the same elevation and height as the Webster tanks. • An alternative cost estimate was prepared for a reinforced concrete tank (see Appendix F). • Inlet pipe connection (to the existing 27" main) is not included in the cost estimate. 1000' of 12" DI pipe was included in the cost estimate for site piping. • An altitude valve and vault and mixer for water quality are not specifically included in the cost estimate. • An access road was included in the cost estimate. The proposed facility access road is estimated as 600' x 24' paved, with a 16' shoulder. • Unit tank construction costs include continuous footings, grade, and tie beams, foundation slabs, painting and surface finishes.

7.2 Capital Maintenance Program

7.2.1 AC Pipe Replacement and Pipe Condition Assessment

The City's water distribution system includes approximately 17 miles of AC pipe as shown on the AC pipe distribution (Figure 6-4). The size distribution of the AC pipe includes 5,410 LF of 4-inch, 71,120 LF of 6-inch and 11,690 LF of 8-inch-diameter pipes. AC pipes have been prone to failure in recent years and are difficult to work with due to special precautions that must be taken when working with the material. It is recommended that the City begin an AC replacement program, with the goal of replacing all existing AC pipe. At the time of replacement, 8-inch-diameter should be used as a minimum pipe size to meet fire flow requirements. Connections to existing AC pipe are difficult to make and have the tendency to leak, so it is recommended that the City strategize the replacement of their AC pipe to minimize the need for connections to existing AC pipe.

The total cost in 2014 dollars to replace all existing AC pipe, excluding the pipe replacement already reflected in existing CIP projects to address fire flow deficiencies is anticipated to be approximately $24,600,000. This cost includes the net construction cost and associated gross markups (see Appendix F). An annual cost of $820,000 is recommended for AC pipe replacement, in order to complete replacement over a 30-year implementation period.

While AC pipe replacement is recommended, prior to initiating replacement efforts, a leak detection survey and/or pipe conditions assessment is highly recommended to assist in prioritizing replacement. It is possible that higher priority maintenance problems may also exist in other areas of the system. Please note that a leak has already been detected at Collins Crest. A lump sum of $75,000 has been incorporated into the 2014 water utility funding analysis/rate evaluation to conduct a leak detection survey prior to AC pipe replacement efforts. At this time, cost for a condition assessment of the entire water conveyance system has not been included.

7.2.2 Preventative Maintenance Program

Preventative maintenance is essential to optimizing functionality and performance of a water system. As described in Section 5.7.2, the City currently does not have a documented O&M program, or current staffing to conduct preventative maintenance efforts at the recommended frequency. Implementation of this Master Plan and CIP projects is dependent upon the addition of staff to conduct/oversee preventative maintenance efforts. The addition of two full time staff has been incorporated into the 2014 water utility funding analysis/rate evaluation to supplement existing staff in support of a preventative water system maintenance program.

7.2.3 Third-Party SCADA System Maintenance

An additional capital maintenance item includes annual maintenance of the SCADA system proposed as a CIP above. This is estimated to be approximately $2,500 per year.

7.3 Cost Estimates for CIP Development

Cost estimates for CIP design and construction were based on the total capital investment necessary to complete a project (i.e., engineering through construction). Expenditures were calculated for construction or capital elements, based on the CIP design and representing material costs, labor costs, other services (traffic control, erosion control), and contingency. Expenditures were calculated separately for administrative and design services, including engineering and permitting. It should be noted that construction contingencies in this plan of 40 percent are higher than these used for cost estimating CIPs in the stormwater master plan. This is due to added complexities or constructing pressurized water pipe (as opposed to gravity-fed storm pipes) and the unknown issues associated with proper decommissioning and disposal of asbestos concrete pipe.

Unit cost information for construction or capital elements of the CIP facilities was compiled from the Association for the Advancement of Cost Engineering International Criteria (see Appendix F). Land acquisition and easement costs are not included in the cost estimates, as most projects proposed are located on City property or within the City ROW. It is assumed that the City will obtain necessary easements for work conducted on private property.

Unit cost information and individual cost estimates for CIPs are included in Appendix F. CIPs in Appendix F follow the same order as CIP descriptions listed in Section 7.1. For planning purposes in Section 7.1, the cost for CIPs under $100,000 were rounded to the nearest $1,000; CIPs over $100,000 were rounded to the nearest $10,000.

A summary of CIP costs is provided in Table 7-1.

Table 7-1. CIP Estimated Cost Summary

CIP name	Total cost ($)
Supply	
Ranney Intake System Decommissioning	50,000
Piping	
Berkeley Street Pipe Replacement	960,000
Cason Road PRV and Pipe Replacement	1,260,000
Clackamas Boulevard Pipe Replacement	840,000
Clarendon PRV Condition Assessment	10,000
Hereford PRV	110,000
Hull Avenue PRV	110,000
Jersey Street Pipe Replacement	330,000
Landon PRV	110,000
Meldrum Bar Park Road PRV and Pipe Replacement	680,000
Park Way Pipe Replacement	510,000
Sherwood Neighborhood Pipe Replacement	2,170,000
Rinearson Road Pipe Replacement	590,000
Risley Avenue Pipe Replacement	460,000
SE 82nd Drive Pipe Replacement	470,000
AC Pipe Replacement[a]	24,600,000
Pump Station	
Webster Pump Station Upgrades (Generator Set)	150,000
Webster Pump Station SCADA System	20,000
Storage	
New 2 MG Storage Tank	4,500,000
Total	$37,930,000

[a] *Recommended as an annual line item in the CIP of $820, 000. A leak detection survey is recommended prior to pipe replacement to prioritize the location of replacements.*

7.4 CIP Prioritization and Implementation

This section summarizes the general process the City used to prioritize identified CIPs. The City conducted its CIP prioritization in conjunction with its water utility rate evaluation (separate deliverable).

7.4.1 CIP Prioritization Criteria and Process

As described in Section 7.1, a total of 19 CIPs were developed to address water system supply, piping, pump stations, and storage deficiencies. Due to the significant cost of the CIPs proposed, an extended implementation period was used for the water system rate evaluation. Therefore, the 30-year implementation period as opposed to the traditional 20-year planning horizon was used for CIP scheduling.

Per discussion with the City on September 18, 2014, all CIPs are considered viable and necessary projects, but some CIPs were identified as lower priority that could be constructed later in the 30-year implementation timeframe. Lower priority CIPs included those where modeling alone indicated deficiencies but there were no reported complaints. Lower priority CIPs also included those that did not address established evaluation criteria.

In conjunction with identification of lower priority CIPs, City staff identified general guidelines to be used to identify higher priority CIPs. Guidelines included whether the CIP addresses ongoing maintenance issues/concerns, whether the CIP addresses modeled fire flow deficiencies, whether the CIP is located in the high pressure zone (with an ongoing history of citizen complaints), and whether the CIP includes replacement of AC pipe. Identified higher priority CIPs are recommended for scheduling earlier in the 30-year CIP implementation process.

7.4.2 CIP Scheduling

Results of the CIP prioritization efforts are documented in Table 7-2. CIPs were not specifically ranked but rather grouped according to whether they were identified as a lower priority project or higher priority project. Again, lower priority projects would be targeted for construction toward the end of the 30-year CIP implementation period, and higher priority projects would be targeted for construction toward the beginning of the 30-year CIP implementation period. CIPs not indicated as lower or higher priority would be constructed within the 30-year CIP implementation period as funding is available and at the discretion of City staff.

Table 7-2. CIP Implementation Schedule		
CIP name	Priority	Rationale for schedule
Supply		
Ranney Intake System Decommissioning	L	Does not address established evaluation criteria
Piping		
Berkeley Street Pipe Replacement	H	Fire flow deficiency, AC pipe
Cason Road PRV and Pipe Replacement	H	Fire flow deficiency, AC pipe
Clackamas Boulevard Pipe Replacement	H	Fire flow deficiency, AC pipe
Clarendon PRV Condition Assessment	L	Does not address established evaluation criteria
Hereford PRV	↔	
Hull Avenue PRV	L	Service may transfer to OLWD
Jersey Street Pipe Replacement	L	Recently replaced (still undersized), no reported complaints
Landon PRV	↔	
Meldrum Bar Park Road PRV and Pipe Replacement	L	No residential or commercial services affected
Park Way Pipe Replacement	H	Fire flow deficiency, AC pipe, high pressure zone
Sherwood Neighborhood Pipe Replacement	H	Fire flow deficiency, AC pipe, high pressure zone
Rinearson Road Pipe Replacement	↔	
Risley Avenue Pipe Replacement	↔	
SE 82nd Drive Pipe Replacement	↔	
Pump Station		
Webster Pump Station Upgrades (Generator Set)	H	Ongoing maintenance concern
Webster Pump Station SCADA System	H	Ongoing maintenance concern
Storage		
New 2 MG Storage Tank	↔	

H = Higher priority projects targeted for construction toward the beginning of the 30-year CIP implementation period.

L = Lower priority projects targeted for construction toward the end of the 30-year CIP implementation period.

↔ *= Projects would be constructed within the 30-year CIP implementation period as funding is available and at the discretion of City staff.*

7.4.3 CIP Implementation

As stated above, CIP implementation is projected over a 30-year period. The financial analysis and water utility rate evaluation effort considers the CIP project costs and anticipated project scheduling in development of recommended water utility rates.

In addition, the financial analysis considers capital maintenance costs and expenditures in the calculation of rates (Section 7.2). An annual cost of $820,000 is included for implementation of the AC Pipe Replacement effort. An annual cost of $2,500 is dedicated for maintenance of the proposed SCADA system. A lump sum of $75,000 is proposed for the beginning of the CIP implementation period to conduct a leak detection investigation in order to prioritize pipes (including AC pipe) for replacement.

Historically, due to limited staff availability, preventative maintenance of the water system has not been performed routinely and proactively. The City's existing public works department consists of six full time staff that are shared amongst stormwater, sanitary, water, parks, and streets. There is no dedicated water department staff. Preventative maintenance is essential to optimizing functionality and performance of a water system. The financial analysis includes the addition of two full-time employees (FTE) to supplement existing staff in support of a preventative water system maintenance program. With the addition of staff, and as preventative maintenance activities are conducted and tracked at specified intervals, the staffing allocation should be revisited amongst all utilities to ensure that adequate levels of service are achieved.

Section 8

Limitations

This document was prepared solely for the City of Gladstone (City) in accordance with professional standards at the time the services were performed and in accordance with the contract between the City and Brown and Caldwell dated October 1, 2012. This document is governed by the specific scope of work authorized by the City; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the City and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Section 9

References

American Water Works Association (AWWA). (2012). AWWA Manual of Water Supply Practices, M32 Computer Modeling of Water Distribution Systems, Third Edition.

Oregon Administrative Rules (OAR). (2014). Chapter 333, Division 061-0050. Public Water Systems, Construction Standards.

State of Oregon. (OFC). (2012). *Oregon Fire Code*.

Water Supply Committee (WSC) of the Great Lakes--Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. (2012). *Recommended Standards for Water Works, 2012 Edition.*

Appendix A: Model Creation TM

Brown AND Caldwell

6500 SW Macadam Avenue, Suite 200
Portland, OR 97239
Phone: 503-244-7005
Fax: 503-244-9095

Technical Memorandum

Prepared for: City of Gladstone

Project Title: Stormwater and Water Master Plan

Project No: 142799

Draft Technical Memorandum

Subject: Water Distribution System Model Development, Task 4

Date: September 5, 2014

To: Scott Tabor, City of Gladstone

From: Krista Reininga, Brown and Caldwell

Prepared by: Janice Keeley, Brown and Caldwell

Reviewed by: Colin Ricks, Brown and Caldwell

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Section 1: Introduction

Prior to this Water Master Plan project, the City of Gladstone (City) maintained a paper copy map of its water system. The first phase of this project involved taking an inventory of the City's water system. The inventory was developed by Sisul Engineering using site survey, interviews with City staff and as-built drawing review. The inventory was documented in AutoCAD. To add accuracy and detail to the master planning effort and future modeling work done by the City, Brown and Caldwell (BC) created a computer model of the water system. The AutoCAD-based inventory was converted to ArcGIS and used as the basis for the computer model, which includes all City-owned distribution mains.

This technical memorandum (TM) describes the methods and data that were used to create the model including the modeling software and workflow, model element information, demand allocation, and quality assurance protocols. Model calibration is documented in the Model Calibration Plan TM and in the final report.

Section 2: Computer Modeling Software and Workflow

The hydraulic model of the City's water system was created using Innovyze's InfoWater. InfoWater is an ArcGIS-based water distribution system modeling software and is well suited for modeling the City's water system. InfoWater is based on the U.S. Environmental Protection Agency's EPANET modeling engine. The final model will be provided to the City in both InfoWater and EPANET formats.

Figure 1 outlines the workflow that was followed to develop the model.

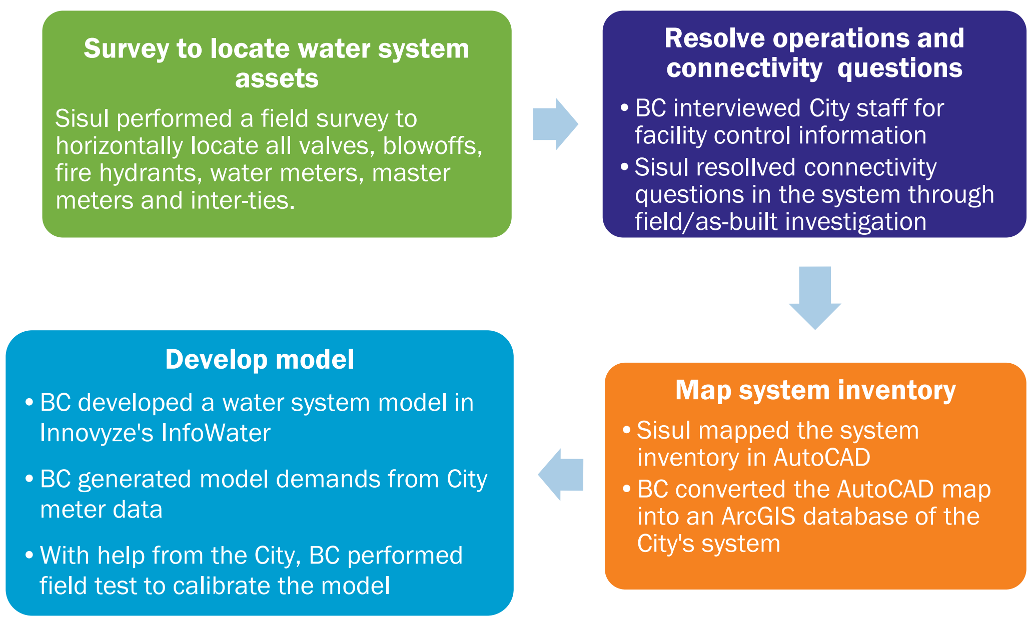

Figure 1. Model development workflow

Section 3: Model Facilities

This section describes how the model facilities were developed from the CAD data. Facility information that was used in the computer calculations, or that can be useful to the model user is stored as attributes in the database files of the model. Table 1 describes the model attributes that apply to all facilities. The data processing and model attributes specific to each element type (e.g., junctions, pipes, etc.) are described in the following sub-sections.

Table 1. Common Attributes

Attribute	Value
ID	ID numbering is alphanumeric, with a prefix and a unique identifier. The prefix indicates element type and the unique identifier includes text describing the facility or a unique number.
Year of installation	This value is used to specify that a facility will be active in a scenario. For example, a facility with an installation year of 2035 or before will be active in a 2035 scenario. This value will be set to 0 if the installation year is unknown.
Year of retirement	This value is used to specify that a facility will be retired (not active) in a scenario. For example, a facility with a retirement year of 2035 or before will not be active in a 2035 scenario.

3.1 Junctions

Junction nodes were created in the model at all changes in pipe diameter, pipe connections, intersections, dead ends, water system valves, water control valves, and hydrant locations, where provided in CAD. New junctions were added at pipe endpoints in the model where existing CAD data did not have a feature already. Demands were applied to junctions in the model (see Section 4 for more detail on how the demands were allocated to each of the junctions). Table 2 lists the attributes applied to the junctions.

Table 2. Junction Attributes

Attribute	Value	
ID	The model junctions were imported from the CAD data and given a descriptive ID representing the junction type from CAD. A description of the various prefixes used to create the junctions is provided below.	
	Prefix BV (blow-off valve) HYD (hydrant) J (model only junction) V (valve)	*Sample ID* BV1023 HYD040 J1354 V1517
Demand 1	The model demand at a junction (see Section 4).	
Elevation	Digital elevation model (DEM) data were used to set the junction elevation. The DEM was based on Light Detection and Ranging data from the City.	

3.2 Pipes

Model pipes were created from CAD data provided by Sisul. In addition to the transmission and distribution system piping, the CAD data include small-diameter service connections. These service connections were not included in the model. Some cleanup of the pipe network was required after the CAD data were imported into the model. A description of the cleanup work performed is described below.

3.2.1 Pipe Network Cleanup

The following steps were taken to clean up the pipe network in the model.

Deleted Very Short Pipes. The imported model pipes included a number of pipes with a length of 1 foot or less. For the most part, the short pipes resulted from pipes in the CAD data that were not snapped directly to a water fitting feature. These short pipes interfere with the other cleanup procedures and add unnecessary calculation nodes to the model. All short pipes that did not connect two water fitting features were deleted. Pipes formerly connected by the small pipes were connected to each other at a common junction.

Deleted Duplicate Pipes. The imported CAD pipes included a number of duplicate overlapping pipes. BC used tools provided in InfoWater to review and delete unnecessary pipes.

Corrected Connectivity. The model software requires that pipes be broken at connections between water mains. Many locations were identified in the CAD data where pipes were not broken at connections. Many locations were also identified where pipe endpoints were drawn very close to each other but not snapped together. BC used tools provided in InfoWater to review all dead-end pipes that did not end at a hydrant. Pipes were split and endpoints were connected where appropriate.

3.2.2 Pipe Attributes

Pipe attributes were used for hydraulic calculations and/or management of model data. InfoWater uses the Hazen-Williams equation to determine friction-related headloss. The roughness factor (C-Factor) used in the equation is assumed for each pipe based on pipe material, lining, and age (if known). Lower factors equate to higher headloss. Pipes in the model were assigned C-Factors taken from industry standards. Table 3 summarizes how the attributes are used in the model.

<table>
<tr><th colspan="5">Table 3. Pipe Attributes</th></tr>
<tr><th>Attribute</th><th colspan="4">Value</th></tr>
<tr><td>ID</td><td colspan="2">Prefix
P
CV (check valve)
GV (gate valve)</td><td>Unique suffix
A unique number
A unique description</td><td>Sample ID
P6609
CV_PARKWAY
GV_RIDGEGATE</td></tr>
<tr><td>Length</td><td colspan="4">Calculated in the model based on the actual GIS length of the pipe</td></tr>
<tr><td>Diameter</td><td colspan="4">Inside diameter from the CAD</td></tr>
<tr><td>Material</td><td colspan="4">Pipe material from the CAD</td></tr>
<tr><td rowspan="8">Roughness</td><td>Material</td><td>C Factor</td><td>Source</td><td>Notes</td></tr>
<tr><td>Default/blank/other</td><td>130</td><td>Assumed</td><td>Pipes with unspecified pipe material were assigned a roughness factor that is typical for ductile iron (DI) pipe. The CAD data indicate that asbestos cement and DI are the most common materials in the system.</td></tr>
<tr><td>Asbestos cement</td><td>140</td><td>Linsley, Lindeburg</td><td>Values are only given for clean pipe in the M32 manual</td></tr>
<tr><td>Cast iron</td><td>130 (New)
120 (5 years old)
100 (20 years old)</td><td>Linsley, Lindeburg</td><td>Interviews with the City indicated most of the cast iron pipe was installed 20 or more years ago. In the absence of more detailed information, a value of 100 was used for all cast iron pipe.</td></tr>
<tr><td>Concrete cylinder</td><td>130</td><td>Linsley, Lindeburg</td><td></td></tr>
<tr><td>DI</td><td>130</td><td>Linsley</td><td>Not listed in American Water Works Association's (AWWA) M32 manual</td></tr>
<tr><td>Poly-vinyl chloride/C900</td><td>140</td><td>AWWA, InfoWater</td><td>Using lower end of range of values to be conservative</td></tr>
<tr><td>Minor loss</td><td colspan="4">Set to 0 unless a valve or other facility causes a known headloss at a specific location. The C Factor is more appropriate to account for losses due to bends and fittings because it accounts for losses based on the length of a pipe. If a minor loss is used, it causes the same headloss for short and long pipes.</td></tr>
<tr><td>Check valve</td><td colspan="4">Set to Yes if there is a check valve on a pipe.</td></tr>
<tr><td>Zone</td><td colspan="4">Set to the pressure zone the pipe is a part of.</td></tr>
</table>

3.3 Tanks

Tank information from the City's as-built drawings was used for tank attributes. Table 4 lists the model's tank attributes.

Table 4. Tank Attributes

Attribute	Value		
ID	*Prefix* T-	*Unique suffix* Tank description	*Sample ID* T-WEBSTER_1MG
Type	Set to Cylindrical for all tanks		
Elevation	The elevation of the bottom of the tank		
Minimum level	The minimum depth of water in the tank to which the tank can physically drain; set to 0 if unknown. Minimum water levels controlled by a pump or valve were set by adding controls to the pump or valve.		
Maximum level	The maximum possible depth of water in the tank, set as the depth from the bottom of the tank to the tank overflow or the tank roof (if overflow depth was not available).		
Initial level	Set to an average depth of water in the tank at the start of a day. This value was based on staff interviews.		
Diameter	The tank diameter		

3.4 Supply Points

The supply connection from North Clackamas County Water Commission (NCCWC) and Oak Lodge Water District (OLWD) were modeled as fixed-head reservoirs with valves to control the flow. The NCCWC connection is the primary source of supply to the City and is delivered through a dedicated pipe from the NCCWC treatment plant. The conditions upstream of the connection were represented with a general purpose valve with a headloss-flow curve developed from field investigation and production records. Table 5 lists the model's supply point attributes.

Table 5. Supply Point Attributes

Attribute	Value		
ID	*Prefix* RES-	*Unique suffix* Supply description	*Sample ID* RES-NCCWC
Type	Set to Fixed Head		
Head	The hydraulic grade line of a supply point		

3.5 Pumps

All pumps were included in the model. The pump curves were developed from City records and entered into the model using the multipoint curve option. Table 6 lists the model's pump attributes.

Table 6. Pumps

Attribute	Value			
ID	*Prefix* BP- (booster pump)	*Unique suffix* Description of the facility	*Suffix* Pump number	*Sample ID* BP-WEBSTER_1
Type	Multiple point curve - the most accurate representation of a pump, used when a pump curve is available			
Elevation	Pump elevation from DEM			

3.6 Valves

The City's water distribution system includes isolation and tank altitude valves, and pressure-reducing valves (PRVs). Isolation valves were modeled by adding controls to pipes in the model (i.e., by opening or closing a pipe). The tank altitude valves were represented as PRVs in the model. A PRV also was used to simulate the variable-speed Webster pumps. Table 7 lists the model's valve attributes.

Table 7. Valves			
Attribute	Value		
ID	*Prefix* AV- (altitude valve) MMS- (master meter at NCCWC) PRV	*Unique suffix* A description of the facility or a unique number	*Sample ID* AV-KIRKWOOD MMS-NCCWC PRV-HEREFORD
Type	PRV General purpose valve (GPV)		
Elevation	Valve elevation supplied by the City, otherwise set the elevation from the DEM		
Diameter	The diameter of the valve		
Setting	Settings were based on the information from the City and field tests. For PRVs this is the downstream pressure setting.		
Minor loss	Minor loss coefficient, K. InfoWater calculates the minor loss as k(V*2)/2g. This field is optional.		
Curve	Only used for MMS-NCCWC. A curve defining the headloss in feet as a function of the flow in gallons per minute.		

Section 4: Section 4: Model Demands

Accuracy of a model is highly dependent on the accuracy of the distribution of demands in the model. Two demand sets, maximum day demand (MDD) and average day demand (ADD) were developed for both the existing and future systems. The different methods used for allocating those demands to the model nodes are described below followed by a discussion on the fire flow demand allocation method.

4.1 Existing System Demand Allocation

Existing system demand allocation consists of appropriately distributing the total system demand in the computer model of the water system. Total existing system demand was calculated using the City's water billing data and daily water meter data from OLWD and NCCWC. Demands were assigned to nodes referred to as demand junctions in the computer model. Demand junctions were designated as all nodes not located on dedicated transmission piping or near pump stations and storage tanks.

InfoWater tools were used to assign the geocoded customer demands to the closest demand junction. The following steps summarize the demand allocation process that was followed for this project:

1. Obtain billing data (including location) for each customer and calculate the MDD and ADD for each customer.
2. Geocode (locate geographically) each customer by matching the customer to a parcel, street address, or global positioning system point.
3. Flag each junction in the model as a demand or non-demand junction. Non-demand junctions include transmission pipelines or pump stations.
4. Calculate the total demand at each demand junction as the sum of the demand for the customers closest to each junction.

4.2 Future System Demand Allocation

The total future demand was calculated using the projected population growth. The existing demands were scaled by the population growth rate.

4.3 Fire Flow Demand Allocation

Fire flow demands were calculated and assigned to the closest model hydrant nodes.

Section 5: Quality Assurance Protocols

In addition to daily input on the modeling work, senior level engineering staff provided detailed quality control reviews at four pre-established milestones in the computer modeling process. The review performed at each of the milestones is listed below.

1. Model Build – This review was performed upon completion of building the model and loading the demands into the model. It included a review of the input data (e.g., facility information, elevations, controls) and demand allocation.
2. Calibration – This review was performed upon completion of the model calibration. It included a review of the calibration results and the modifications made to the model to achieve those results.
3. System Evaluation – This review was performed upon completion of the existing and future system evaluation. It included a review of the MDD, ADD, and fire flow evaluations to verify that criteria established to evaluate the system were used appropriately.
4. Capital Improvement Plan (CIP) Development – This review was performed after modeling work to develop capital improvement projects was completed and prior to completion of the CIP. During this review, each project was scrutinized to verify that the evaluation criteria were satisfied and that there were no undesirable ancillary outcomes from the projects (e.g., unmanageable water age).

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American Water Works Association, *Computer Modeling of Water Distribution Systems, M32*, Third Edition, AWWA, Denver, 2012, pp. 33.

Innovyze, *InfoWater Help*, 2012.

Lindeburg, *Civil Engineering Reference Manual for the PE Exam*, Eighth Edition, Professional Publications, Inc., Belmont, CA, 2001, pp. A-25.

Linsley, R. K. and Franzini, J. B., *Water Resources and Environmental Engineering*, Third Edition, McGraw-Hill Book Company, 1979, pp. 281.

Ray, R., Moore, P.B., Harrington, D.A, and Hauffen, P. M. 2008. The Achilles' Heel of GIS-built Hydraulic Models: Maintaining/Updating a Model from GIS Data. In *AWWA Conference Proceedings*. June 2008

Appendix B: Calibration Test Plan

6500 SW Macadam Avenue, Suite 200
Portland, OR 97239
Phone: 503-244-7005
Fax: 503-244-9095

Technical Memorandum

Prepared for: City of Gladstone

Project Title: Gladstone Stormwater and Water Master Plan

Project No: 143454

Technical Memorandum

Subject: Water Model Calibration Test Plan, Subtask 4.4

Date: April 14, 2014

To: Scott Tabor, City of Gladstone

From: Jim Harper, Brown and Caldwell

cc: Janice Keeley, Brown and Caldwell

Prepared by: Colin Ricks, Brown and Caldwell

Reviewed by: Shem Liechty, Brown and Caldwell

Section 1: Introduction

This technical memorandum (TM) describes the methods for gathering the information required to calibrate the City of Gladstone's (City) water distribution system model that Brown and Caldwell (BC) is creating. The data gathered will be compared to model results to verify that the model is well-calibrated. The effort will include operational data gathering and hydrant flow tests performed over 1 to 2 days.

Section 2: Operations Data Gathering

Operations data are used in the calibration to verify that facility controls and settings have been represented appropriately in the model. These data will need to be recorded during the field tests. The operational data needed to verify model calibration include the following:

- *Pump Discharge Flow Rate*, *Suction Pressure, and Discharge Pressure*. Pumps that are off before the test should remain off during the test. Pumps that are on before the test should remain on during the test. The pump discharge rates before and during the tests should be recorded at 1- to 2-minute intervals. Suction and discharge pressures at the pump also should be recorded.
- *Tank water levels*. Tank water levels should be obtained from the tank circle chart recorders. Copies of the circle charts for all days of field testing should be provided to BC.
- *Pressure Relief Valve (PRV) Settings*. PRV settings should be obtained from City staff or measured in the field.
- *Pressure Logger Data*. Pressure loggers should be installed at the locations described in Section 4 of this TM for the selected data gathering period. The pressure logger ID used at each location should be noted so that BC can calibrate the pressure loggers after field testing is complete. The pressure loggers should be set to record pressure at a 1- to 2-minute time step and should be set to record for the duration of the hydrant flow tests.
- *Master Meter Flow Rates*. BC understands that the City is supplied by several interconnects with neighboring water utilities. Any flow through interconnects must be accounted for in the calibration process. It is very important to manage and/or monitor the flow through interconnects during the calibration data gathering period following the approaches listed below.
  - Close all interconnects that do not have a contractual or hydraulic requirement to leave them open. These interconnects should be closed to prevent flow transfers during the hydrant flow tests.
  - Interconnects that must be left open should be monitored during the testing by sending a City operations and maintenance staff member to measure and record the flow rate. The flow rate through the master meter should be recorded every 1 minute during the hydrant tests. The master meter can be recorded every 10 minutes between hydrant tests.

Section 3: Field Tests

Field test data are used to verify that system hydraulics have been represented correctly in the model. The required personnel, equipment, and operations data and the test procedures for the field tests are described below. It is expected that all field testing will be complete within a 2-day time period, as described in Section 5 of this TM.

Personnel

One representative from BC will be present to coordinate the calibration testing and to help collect and record test data. At least two City staff members are needed to escort BC staff, assist with data collection, and operate hydrants, pumps, etc.

Preparation and Necessary Equipment

Some preparation of equipment for hydrant testing will be required of both BC and the City. Table 3-1 lists the equipment needed for the calibration testing. Equipment will be checked prior to the day of testing to verify that it is functional and/or accurate. Watches used to record the time of each test should be synchronized to ensure that the test data can be correlated accurately. The City will be responsible for providing transportation of City staff and equipment to each test location.

Table 3-1. Required Equipment for Calibration Testing

Item	Quantity	Provided by
Hydrant key	2	City
Valve wrench	2	City
Flow-metering hydrant flow diffuser	2	City
Radios	3	City
Hydrant cap with 1/4-inch threaded tap (for pressure gauges/logger)	5	BC
Crescent wrench sets	2	BC
Digital camera	1	BC
Watch	2	BC
Calibrated 200 pounds per square inch (psi) pressure gauge	4	BC
Hose bib connection for pressure gauge/logger	4	BC

Collection of Operations Data

The operations data described in Section 2 of this TM should be gathered for the days of field testing. This will make it possible to match the operational conditions in the model to the system operations at the time of each test.

Test Procedures

Hydrant flow tests and site inspections of the storage and pump facilities will be performed during the calibration testing visit. Each test and inspection should follow the procedures described below. The testing is expected to take approximately 1 to 2 days. All data and comments should be recorded on the forms provided by BC. During the testing period, any valves in the system that are known or suspected to be closed should be reported to the BC representative as along with any pipe breaks or other water system emergency.

Important note*: The pressure loggers installed for the operations data gathering should not be removed until after all hydrant flow tests are completed. The pressure loggers will record valuable information during the tests.*

Hydrant Flow Tests

The objective of hydrant flow tests is to obtain instantaneous flow and pressure data at various locations throughout the distribution system. Up to four flow tests will be performed: a minimum of three tests with one additional optional test. The flow tests must stress the distribution system so that the calibration data will reflect the system's reactions to a range of operating conditions.

To accomplish this, water is released during each test from one or more hydrants until a minimum pressure drop of 5 psi (10 psi desired) is experienced at the test location. (Note: these tests are not the same as hydrant tests performed by the fire department to determine available flow from a hydrant.) Step-by-step instructions for setting up the hydrant flow tests are listed in the attached field forms.

The test coordinator will instruct the person monitoring the master meter to begin recording the flow rate every 1 minute for the duration of the flow test.

Storage/Pump Facility Inspections

Each storage/pump facility will be inspected to test pump performance and review equipment condition and strategy for pumping and tank fill controls. Site conditions will be documented with photos and the pump and tank name plate information and controls will be recorded on the appropriate forms. Pump performance will be tested at each pump at each facility using the following procedure:

Step 1. Verify that the pump is on.

Step 2. Attach a pressure gauge on the discharge side (and suction side if possible) and record the pressure.

Step 3. Record the time.

Step 4. Collect flow from the supervisory control and data acquisition software system or a flow meter for the pump at the time the pressure is recorded.

Step 5. If the pump has a variable-frequency drive, record the pump speed.

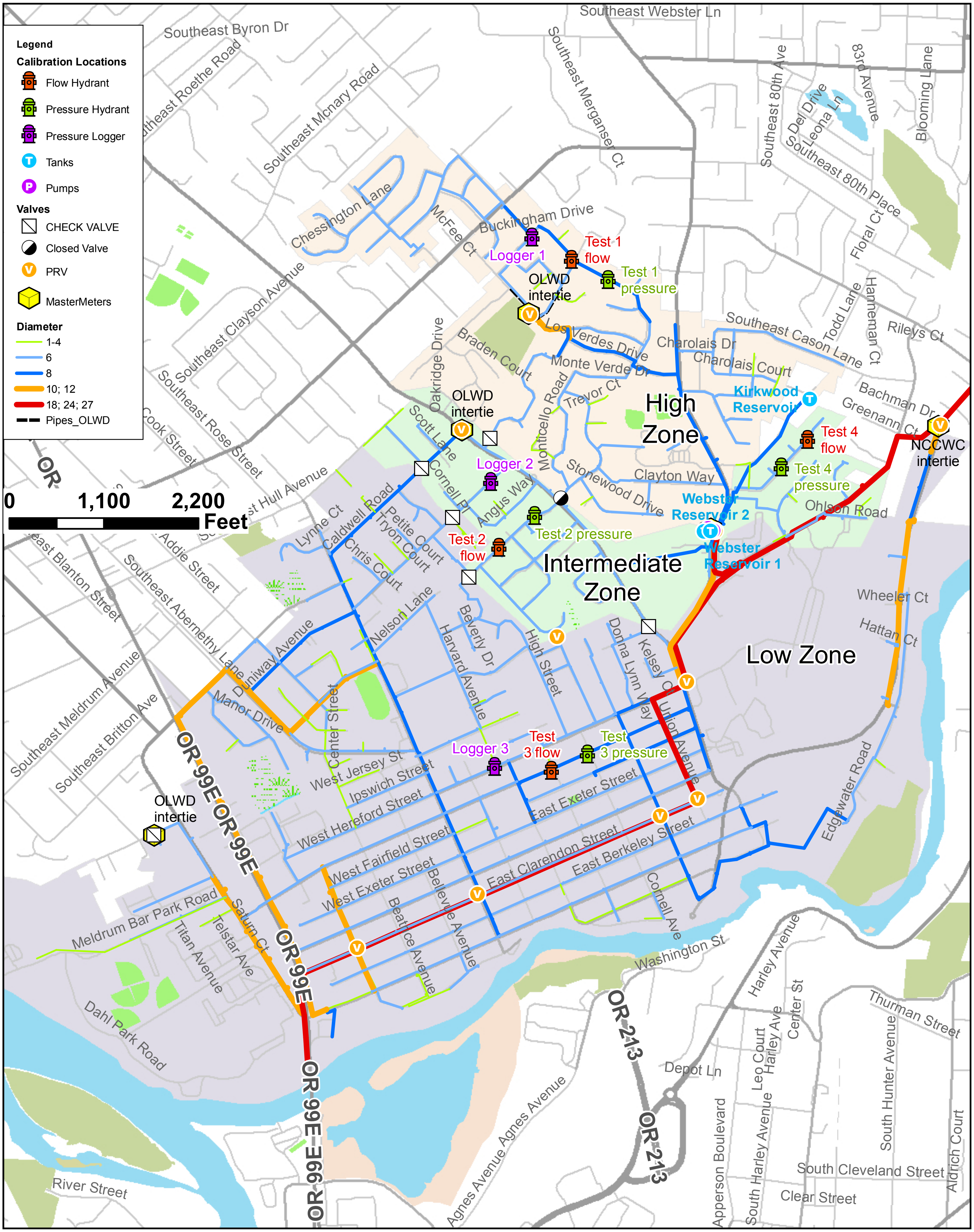
Section 4: Test Locations

This section specifies the flow test locations and the locations where the pressure loggers should be installed and the hydrant tests performed. Up to four flow tests will be performed throughout the system. Tests 1 through 3 must be completed. If time permits, test 4 will be performed also.

Figure 4-1 shows an overall view of flow tests and the pressure logger locations. Figures 4-2, 4-3, 4-4, and 4-5 show detailed views of each site. Tables 4-1 and 4-2 list the approximate addresses for the loggers and tests.

Table 4-1. Pressure Logger Approximate Locations

Logger	Address
Logger 1	Buckingham Drive/Lancaster Drive
Logger 2	6830 Glen Echo Avenue
Logger 3	270 East Hereford Street

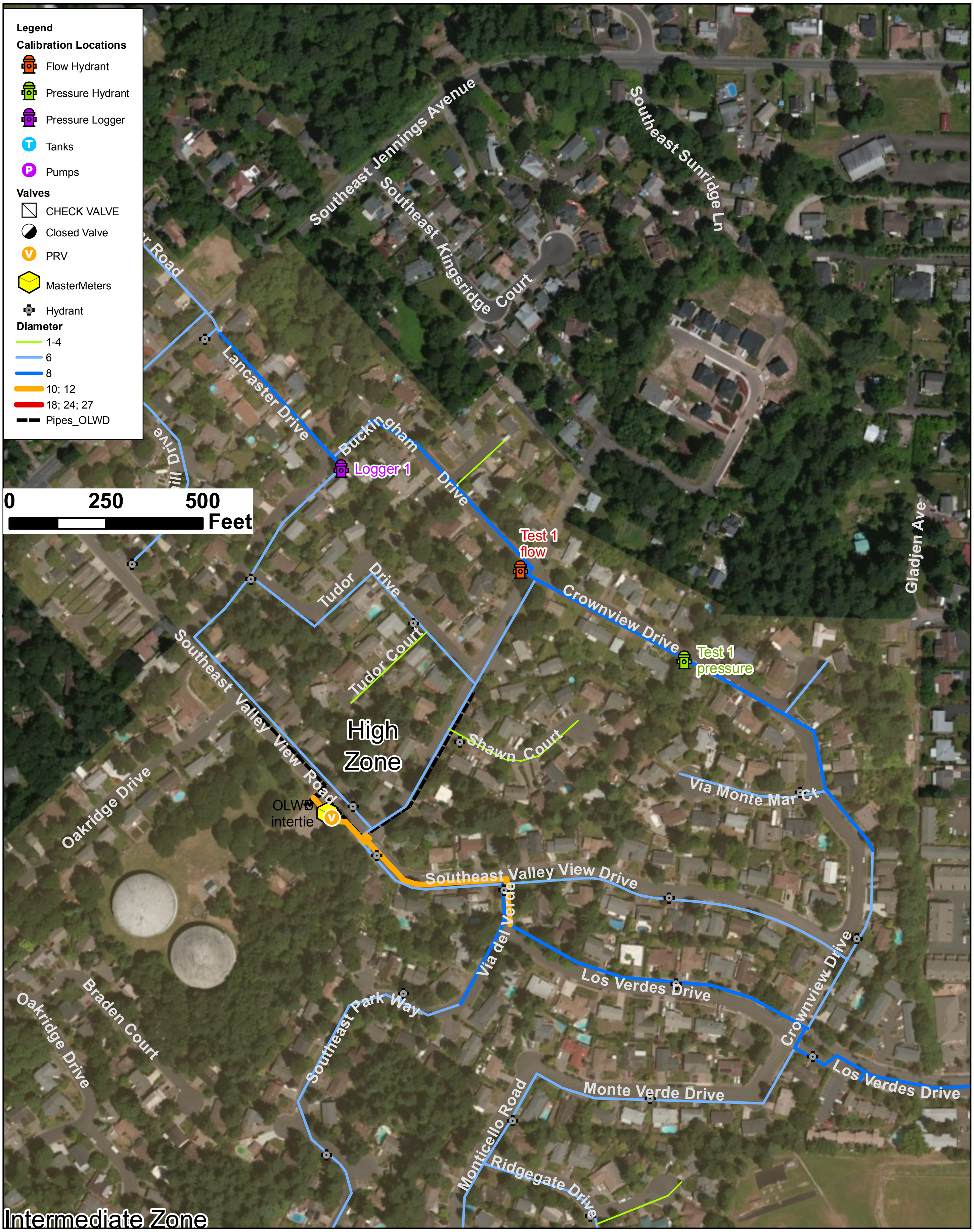


Brown AND Caldwell

City of Gladstone Water System Master Plan

Calibration Locations

Figure 4-1. Hydrant test and logger locations

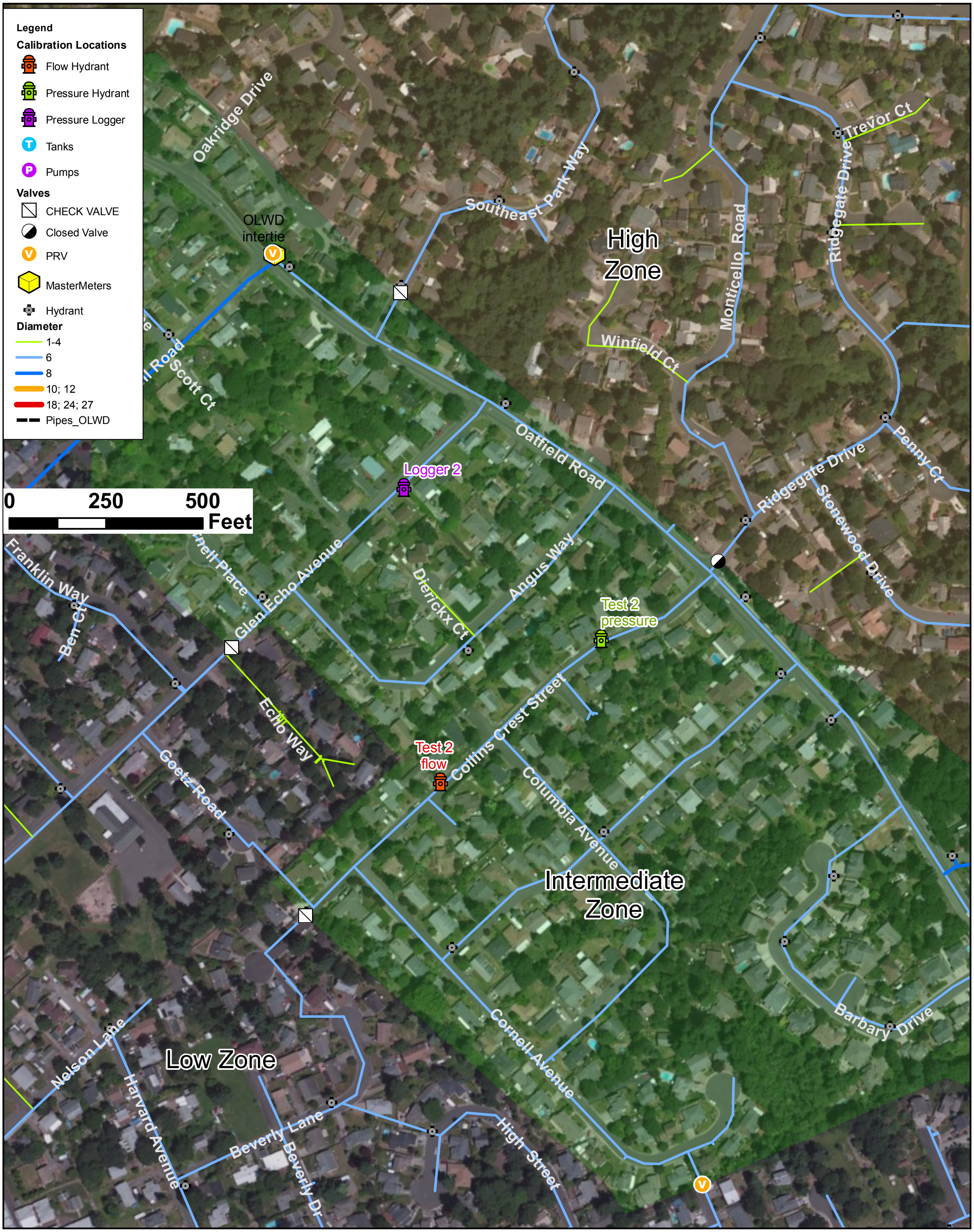


Brown AND Caldwell

City of Gladstone Water System Master Plan

Calibration Locations

Figure 4-2. Hydrant test 1 and Logger 1

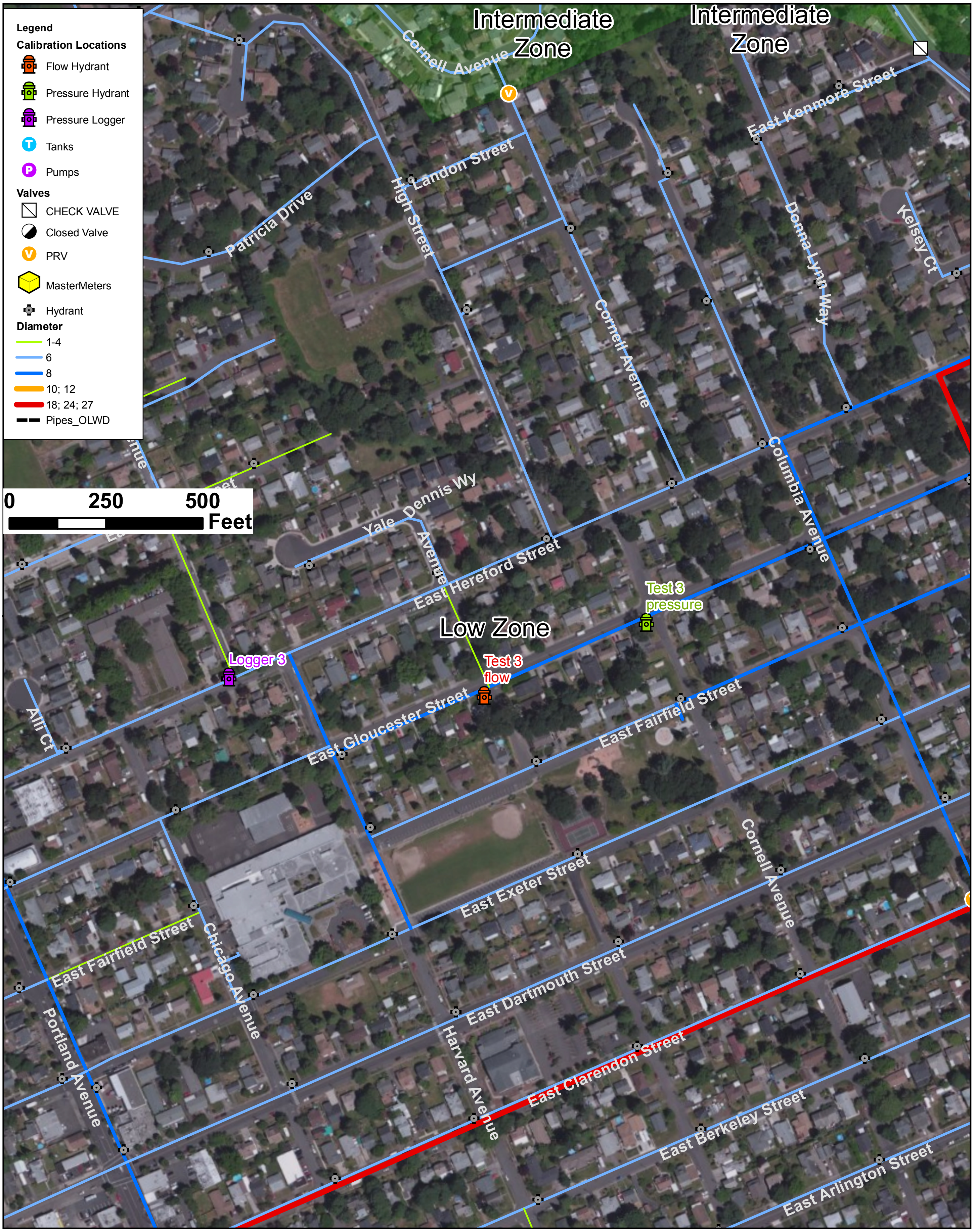


Brown AND Caldwell

City of Gladstone Water System Master Plan

Calibration Locations

Figure 4-3. Hydrant test 2 and Logger 2



Brown AND Caldwell

City of Gladstone Water System Master Plan

Calibration Locations

Figure 4-4. Hydrant test 3 and Logger 3

Brown AND Caldwell

City of Gladstone Water System Master Plan

Calibration Locations

Figure 4-5. Hydrant test 4 (optional)

Table 4-2. Test Hydrant Approximate Locations		
Test	Flow hydrant address	Pressure hydrant address
Flow Test 1	16790 Buckingham Drive	17299 Crownview Drive
Flow Test 2	585 Collins Crest Street	663 Collins Crest Street
Flow Test 3	377 E Gloucester Street	482 E Gloucester Street
Flow Test 4	7599 Ridgewood Drive	7615 Ridgewood Drive

Hydrant test flows may cause flooding or erosion damage. City staff should check the hydrant flow test locations prior to the day of testing to verify that there is little potential for flooding or erosion damage at each site. If any of the locations are found to be unsuitable or inoperable during field inspection or calibration testing, an alternate site will be selected and documented with approval of a BC representative.

Section 5: Testing Schedule

Pressure logger data should be gathered for the duration of all hydrant tests. The field tests will be performed in April 2014 according to the following schedule:

Day 1 – April 21

8:30 a.m. – Meet with City staff to coordinate testing and document control strategy.

10:00 a.m. – Inspect Webster tanks, Kirkwood tank, and pump stations.

11:30 a.m. – Install pressure loggers 1 through 3.

12:30 p.m. – Lunch

1:00 p.m. – Conduct hydrant flow tests.

Day 2 – April 22

8:30 a.m. – Meet with city staff to coordinate testing.

9:30 a.m. – Complete remaining hydrant flow tests and remove pressure loggers when finished.

FORMS

Gladstone Water System Testing

Hydrant Test

Collected By ____

Zone / Test No.	Pressure Readings				Flow Readings			Notes
	Gauge ID(s)	Reading	Date / Time	Pressure (psi)	Diff-user	Gauge ID	Pressure (psi)	
		Before:			1			
		During:			2			
		After:			3			
		Before:			1			
		During:			2			
		After:			3			
		Before:			1			
		During:			2			
		After:			3			
		Before:			1			
		During:			2			
		After:			3			
		Before:			1			
		During:			2			
		After:			3			

Step 1. Confirm that SCADA is operating and recording data at each of the required sites.

Step 2. Attach a pressure gauge to the residual hydrant. Use the bleeder valve on the hydrant cap assembly to release air and protect the gauge while opening the hydrant.

Step 3. Attach the hydrant diffuser to the flow hydrant.

Step 4. Record the static pressure at the residual hydrant and the time of test.

Step 5. Instruct to start opening the flow hydrant **SLOWLY** until get minimum 5 psi (10 psi if possible) drop at the residual hydrant. If cannot get sufficient pressure drop, turn the flow hydrant off **SLOWLY**, add another diffuser to the other hydrant nozzle or a nearby hydrant (record which hydrant is used), and re-start the test at step 4.

Step 6. When the pressure at the residual hydrant stabilizes (usually 3-5 minutes), record the time and residual pressure and signal the flow hydrant operator to record the flow.

Step 7. Instruct the flow hydrant to be closed **SLOWLY**.

Step 8. Record the static pressure again at the residual hydrant.

Step 9. Remove the equipment. **Be sure to open the bleeder valve on the pressure gauge hydrant cap assembly while closing the hydrant to avoid drawing a negative pressure on the gauge.**

Gladstone Water System Testing

Tanks

Brown AND Caldwell

Collected By ______________________________ Date ______________________

Item	Tank 1	Tank 2
Tank Name		
Location		
Type and Shape (Elevated, Ground)		
Material		
Volume		
Diameter / Dimensions		
Floor Elevation		
Height		
Overflow Height		
Fill (e.g. from PS)		
Feeds (e.g. to System)		
Diagram		

Gladstone Water System Testing

Pump Test

Collected By ____

Pump Name	Date/Time	Flow (gpm)	Upstream Pressure (psi) /Tank Elev (ft)	Downstream Pressure (psi)	Elev Diff from Up/Down Pressures (ft)	Notes

Step 1. Attach pressure gauge(s) on the discharge side and the suction side (if a booster pump) of each pump. Note: If there are gauges on the pump, remove them and use the testing gauges if possible. The vibration of the pumps can cause the gauges on the pumps to be inaccurate.

Step 2. Record the difference in elevation between the two gauges.

Step 3. Record the time, flow rate, and pressures before, during and after operating the pump. The pump should be operated long enough that readings stabilize (at least 5 minutes).

Gladstone Water System Testing

Pump Station Information

Pump Station Name / Location ____

Collected By ______________________________ Date ______________________

Item	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5
Pump Name / ID					
Type					
Speed (Constant / VFD)					
Design Head (ft)					
Design Flow (gpm)					
Horsepower					
Number of Stages					
Impeller Diameter (in)					
Manufacturer					
Serial Number					
Model Number / Type / Size					
Pump Operation (Lead / Lag / Standby)					
How Pump Controlled (Tank Level, etc.)					
On / Off Settings					

Notes / Diagrams (Use back of sheet for additional notes):

Gladstone Water System Testing

Brown AND Caldwell

PRVs

PRV Name / Location ____

Collected By ______________________________ Date ____________________

Category	Item	Value	Notes
Traffic control	Requires traffic control (Y/N)		
Vault cover	Requires crane (Y/N)		
	Hatch is accessible (Y/N)		
Vault Interior	PRV is accessible (Y/N)		
	Vault is Flooded (Y/N)		
	Vault filled with debris (Y/N)		
PRV	PRV is Operational (Y/N)		
	Flow is going through PRV (Y/N)		
	Taps are Accessible		
	Describe needed fittings for pressure gauge		
Pressure at PRV	Upstream Pressure (psi)		
	Downstream Pressure (psi)		
Exterior	Locate nearby hydrants and valves for testing PRV, mark on map		
Photos	Area around vault		
	Vault cover		
	Vault Interior		
	PRV		

Step 1. Do a condition assessment on the PRV. See if the PRV is accessible, pressures can be read at the PRV, etc.

Step 2. If the PRV is active but pressures cannot be read (e.g. vault needs cleaned out), clean vault and/or obtain with equipment needed to read pressures. Make a return trip and take pressures.

Notes:

A. To verify if flow is going through the PRV (note that a pressure differential across the PRV does not mean that flow is going through the PRV):

Option 1 – Flow already going through PRV . At times a humming noise through the PRV signifies flow through the PRV.

Option 2 – Attach flow diffuser . If there is no flow through the PRV or if you are unsure, place a flow diffuser at a downstream hydrant (mark hydrant on map) and turn on the hydrant SLOWLY.

B. If a PRV vault has 2 PRVs, the 2 PRVs may have different settings for low and high flows. If possible, obtain both settings.
For example, if flow is going through a smaller PRV (for lower flows), record that pressure and then add a diffuser to get flow through the larger PRV.

Gladstone Water System Testing

Choked Valves

Collected By ____

Date / Time	Location / Description	Valve Type (butteryfly, gate, etc. if known)	Amount Open (Number Turns, %, etc.)	Notes

Step 1. Locate the choked valve and mark the location on a map.

Step 2. If possible, find out how many turns the valve is closed out of the total number of turns.

Gladstone Water System Testing

Pressure Loggers

Collected By ____

Logger ID	Location / Description	Date / Time Installed	Date / Time Removed	Notes

Step 1. Locate the hydrant identified for pressure logger installation from maps.

Step 2. Flush the hydrant, and then install a pressure **gauge** mounted on a hydrant cap.

Step 3. Open the hydrant nut **completely**, then read and record the pressure. Confirm that the recorded pressure is not close to or over the pressure rating of the pressure logger.

Step 4. After opening the bleeder valve on the pressure gauge/hydrant cap assembly (this prevents drawing a negative pressure which will ruin the gauge), close the hydrant nut and replace the pressure gauge/hydrant cap assembly with a pressure **logger** mounted on a hydrant cap.

Step 5. Open the hydrant nut **completely** with the bleeder valve on the pressure logger/hydrant cap assembly open to allow the release of air from the hydrant. Check to see that there are no leaks from the hydrant or the ground around the hydrant.

Step 6. Connect computer to the logger to confirm that the logger is sensing and logging data.

Step 7. Record the address, hydrant ID, and mark on the map the location of the logger.

Step 8. Before removing the logger, connect the computer to the logger to confirm that data has been recording. Data download can be performed at this point or postponed until later.

Step 9. While closing the hydrant nut to remove the logger, leave the bleeder valve on the pressure logger/hydrant cap assembly open to avoid ruining the loggers by drawing a negative pressure.

Step 10. Check to see that all hydrant caps are replaced and the hydrant nut is fully closed prior to leaving the test site.

Gladstone Water System Testing

Notes

Collected By ____

Appendix C: Detailed System Map

Appendix D: IGAs

INTERGOVENMENTAL COOPERATIVE AGREEMENT

This agreement is made and entered into by and between the City of Gladstone, Oregon, an Oregon municipal corporation, hereinafter referred to as "City"; and the Oak Lodge Water District, a domestic water supply district created pursuant to ORS Chapter 264, hereinafter referred to as "District".

W I T N E S S E T H:

RECITALS

1. In 1990, the parties hereto entered into an intergovernmental cooperative agreement to provide for the construction and maintenance of a water system interties between the City's water supply system and the water supply system of the District. The purposes of that intertie in Valley View Road are to provide emergency water supply between the two systems of the District and City and an on-demand supplemental source of water to the City's high level service zone from the District as hereinafter described in this agreement.

2. In 1998 the parties subsequently amended that agreement to provide for construction and maintenance of a second water system intertie in Oatfield Road to provide supplemental water service to the City's intermediate level service zone.

3. Purposes of this current agreement are to incorporate the intent of earlier agreements, to provide for construction and maintenance of a third water system intertie in Rinearson Road and to provide supplemental water service for fire suppression to a portion of the City's lower level service zone.

The parties acknowledge that they have authority to execute this cooperative intergovernmental agreement pursuant to the terms of ORS 190.010.

NOW, THEREFORE, the premises being in general as stated in the foregoing recital, it is agreed by and between the parties hereto as follows:

1. Emergency Condition Defined. An emergency condition is considered to be an occurrence created by a physical failure of facilities, fire suppression activities or premeditated shutdown of water supply facilities whereby insufficient supply to water customers of either party would threaten the health or safety of those customers. Such emergency condition includes failure of water supply transmission pipelines.

2. On-Demand Condition Defined. An on-demand condition is considered to be an occurrence which results in a decrease in the water pressure normally present. Such decrease in pressure below a predetermined level will result in the utilization of a pressure regulating facility, through which District water will flow, augmenting the City's water supply.

3. Location. The location of the water system interties between City and District are in the vicinity of the intersections of: Valley View Drive and Valley View Road; Oatfield Road and Caldwell Road; and in Rineason Road about 500 feet west of River Road.

4. Cost, Construction Maintenance and Ownership. Interties in Valley View Road and Oatfield Road exist at the time of this agreement and therefore no further installation cost is anticipated. For the intertie in Rinearson Road, the District agrees to extend, maintain and own a 6" diameter water main from the northerly to the southerly side of River Road terminating in a vault recently installed by the City. The City agrees to install, maintain and own water appurtenances in the vault including a meter to measure water consumption, a pressure valve and 6" diameter water piping extending from the vault to a proposed 12" diameter water main that will extend in River Road from Rinearson Road to River Road's intersection with McLoughlin Blvd.

5. Quantity of Water Supplied in Emergency Conditions. The party supplying water during an emergency condition as defined herein shall endeavor to supply the maximum quantity of water to the other and take all reasonable actions necessary to accomplish the same so long as such actions are consistent with minimum standards for the operation of its own internal water system.

6. Quantity of Water Supplied in On-Demand Conditions. The party supplying water during an on-demand condition as defined herein shall endeavor to supply the maximum quantity of water to the other and take all reasonable actions necessary to accomplish the same so long as such actions are consistent with minimum standards for the operation of its own internal water system.

7. Cost of Water Provided. District agrees to pay monthly to City for all water provided to District through the interties at the same wholesale rate charged by the North Clackamas County Water Commission (NCCWC) per 100 cubic feet plus an additional charge of 5¢ per 100 cubic feet to cover the cost of pumping. City agrees to pay monthly to the District for water provided to City at the same wholesale rate charged by NCCWC per 100 cubic feet plus an additional charge of 5¢ for inteties in Oatfield Road and Rineason Road, and an additional charge of 15¢ per 100 cubic feet for the intertie in Valley View Road to cover the cost of the existing in-place facilities including reservoirs owned and operated by District which allow the District to provide surplus water to the City high level system at a volume and pressure greater than can be provided by existing City facilities. The volume of water delivered to City from District shall be calculated by District through the metered interconnection between the parties.

8. Amendment Provisions. The terms of this agreement may be amended by mutual agreement of the parties. Any amendments shall be in writing and shall refer specifically to this agreement, and shall be executed by the parties.

9. Prior Agreements. This agreement shall replace and supersede the previous agreements between the parties referred to in the recitals.

10. Termination of Agreement. This agreement shall continue in effect until terminated by City or District with written notice of such intent to terminate provided to the other party. Notice to terminate must be provided by July 1 of any year, with termination effective January 1 of the succeeding year.

11. Written Notice Addresses. All written notices required under this agreement shall be sent to:

Oak Lodge Water District	Manager Oak Lodge Water District 14496 SE River Road Milwaukie, OR 97222
Gladstone:	City Administrator City of Gladstone 525 Portland Avenue Gladstone, OR 97027

IN WITNESS WHEREOF, the parties have set their hands and affixed their seals as of the date and year hereinabove written.

Oak Lodge Water District has acted in this matter pursuant to Resolution No. _____, adopted by its Board of Commissioners on the ________ day of ___________________, 2007.

Adopted by the Gladstone City Council on the 8th day of May 2007.

Oak Lodge Water District
by and through its District Board

By: ______________________
Chairman

By: ______________________
Secretary

Approved as to form:

By: ______________________
District Counsel

City of Gladstone,
by and through its City Officials

By: ______________________
Mayor

By: ______________________
City Recorder

WATER SERVICE AGREEMENT

THIS AGREEMENT, made and entered into this 14th day of November, 1994, by and between OAK LODGE WATER DISTRICT, a domestic water supply district created pursuant to ORS Chapter 264, hereinafter referred to as Oak Lodge, and CITY OF GLADSTONE, an Oregon municipal corporation, hereinafter referred to as Gladstone.

W I T N E S S E T H:

WHEREAS, the parties to this agreement, Oak Lodge and Gladstone, were each formed pursuant to Oregon Revised Statutes for the purpose, among others, of providing domestic water service to water users within their respective boundaries; and

WHEREAS, presently there are few properties located within the boundaries of Oak Lodge and Gladstone for which the other party currently provides domestic water and these said properties receive the benefit of the "inside user" rate; and

WHEREAS, currently the majority of said properties are within the boundaries of Gladstone; and

WHEREAS, in accordance with the present rate charges of Oak Lodge and Gladstone, unless specific agreement is entered into between said parties, it may be necessary for said parties to incur unnecessary construction expense or for owners of said properties to be charged an "outside" user rate, and it is the desire of said parties to continue existing cooperation so an "inside" water rate applies to said properties and as a result thereof; and

WHEREAS, Oak Lodge and Gladstone have authority to execute this intergovernmental agreement pursuant to the terms of ORS 190.010 to provide for appropriate understanding, resolution and agreement of matters of mutual interest;

NOW, THEREFORE, said parties mutually agree as follows:

1. Oak Lodge and Gladstone will continue to provide domestic water service to properties specifically designated in Exhibit A attached hereto and by this reference made a part hereof, even though said properties are located within the boundaries of the other, to-wit: Oak Lodge and Gladstone, respectively.

2. In recognition of the community, cooperation and other practical considerations, each party hereto agrees that they will charge said properties for providing domestic water service at an inside user rate the same as those charges against other like properties within their own boundaries.

3. Gladstone will continue to read water meters to determine the amount of water provided to said properties as shown by Exhibit A and bill customers of said properties. Oak Lodge will continue to read meters for those said properties in Gladstone where water is provided by Oak Lodge and bill Gladstone; otherwise Gladstone will send meter data to Oak Lodge and Oak Lodge will bill Gladstone.

4. This agreement repeals a memorandum of understanding entered into on the 1st day on May, 1978 between Oak Lodge and Gladstone; this agreement shall have no affect upon an intergovernmental cooperative agreement for distribution system interties presently in effect between the parties hereto.

5. No additional properties may be made subject to nor receive the benefits of this agreement without mutual written consent by the General Manager of Oak Lodge and City Administrator of Gladstone.

6. This agreement may be cancelled or terminated without cause by either party hereto upon the giving of a notice in writing to the other 180 days in advance of the desired termination date.

7. This contract shall be in full force and effect from and after the 14th day of November, 1994.

IN WITNESS WHEREOF, the parties hereto do each authorize their elected and appointed officials to execute this Agreement in duplicate as of the 14th day of November, 1994.

OAK LODGE WATER DISTRICT

By: Allen F. Hert
President of Board

By: Lester E. Larson
Secretary of Board

Oak Lodge Water District
14496 S. E. River Road
Milwaukie, OR 97222

CITY OF GLADSTONE

By: Wade Byers
Mayor

By: Verna Howell, CMC
City Recorder

City of Gladstone
525 Portland Avenue
Gladstone, OR 97027

Exhibit A

Properties in Gladstone and where water is provided by Oak Lodge

Address	Oak Lodge Acct. #	Gladstone Acct. #
18105 Hardway Court	560072	1606340
18115 Hardway Court	560073	1606350
18125 Hardway Court	560074	1606360
18120 Hardway Court	560075	1606370
18110 Hardway Court	560076	1606380
18100 Hardway Court	560077	1606390
17651 Oatfield Road	560840	1702450
17707 Oatfield Road	560850	1702500
17711 Oatfield Road	560860	1702550
17717 Oatfield Road	560870	1702600
5306 Rinearson Road	400990	1802950
5202 Rinearson Road	400985	1803000
16455 Ormae Road*		
16465 Ormae Road*		

*Assigned addresses for future lots approved by Gladstone Planning Commission, File No. PART-94-4.

Properties in Oak Lodge where water is provided by Gladstone

18221 S. E. Portland Avenue	N/A	1607410

F:\WP_DATA\WATRSERV.AGR

ADDENDUM No. 1 TO THE SECOND AMENDED INTERGOVERNMENTAL AGREEMENT FOR THE NORTH CLACKAMAS COUNTY WATER COMMISSION TO ADD THE CITY OF GLADSTONE AS A MEMBER OF THE COMMISSION

Dated ~~June~~ July 18, 2005

Agreement Between

The Sunrise Water Authority,

The Oak Lodge Water District,

And

The City of Gladstone

ADDENDUM No. 1
TO THE SECOND AMENDED INTERGOVERNMENTAL AGREEMENT FOR THE NORTH CLACKAMAS COUNTY WATER COMMISSION TO ADD THE CITY OF GLADSTONE AS A MEMBER OF THE COMMISSION

This INTERGOVERNMENTAL AGREEMENT is made this ___ day of June, 2005, by and between the Sunrise Water Authority ("Sunrise"), the Oak Lodge Water District ("Oak Lodge") and the City of Gladstone ("Gladstone"), hereinafter collectively referred to as the Parties.

RECITALS:

WHEREAS, the North Clackamas County Water Commission ("NCCWC" or the "Commission") is an intergovernmental agency organized under ORS Chapter 190 by Oak Lodge and Sunrise to process water from the Clackamas River into safe, clean drinking water and to supply the treated water to members of the Commission; and

WHEREAS, Gladstone is an Oregon home rule city authorized by law to operate a municipal water supply system and to enter into intergovernmental agreements under ORS Chapter 190; and

WHEREAS, the Parties desire that Gladstone become a member of the NCCWC;

NOW THEREFORE, in consideration of the mutual covenants and agreements contained herein, the Sunrise Water Authority, the Oak Lodge Water District and the City of Gladstone agree as follows:

AGREEMENT

1. Addendum.

This Addendum No. 1 is to the Second Amended Intergovernmental Agreement between Oak Lodge and Sunrise, dated September 3, 2004, which is incorporated and referred to herein as the "Second Amended IGA". The City of Gladstone adopts and agrees to be bound by the terms of the Second Amended IGA as if they were fully set out in this Addendum. Unless modified in this Addendum No. 1, all terms and conditions in the Second Amended IGA shall remain in effect. Conflicts shall be resolved in favor of Addendum No. 1. This Addendum confers no rights or power to enforce its terms upon any other person or Party not specifically mentioned in either document except for the Sunrise Water Authority, the Oak Lodge Water District, the City of Gladstone or the North Clackamas County Water Commission.

2. Reconstituted Commission.

(a) The reconstituted Commission shall be composed of seven (7) members. Three (3) members shall be selected by the Board of Commissioners of Oak Lodge, three (3) members shall be selected by the Board of Commissioners of Sunrise and one (1) member shall be selected by the City Council of Gladstone.

(b) A Commissioner shall be a voting member of the governing body, council or board of commissioners of the Party making the selection.

(c) The Commission shall select a Chair from among its members to serve a term of one year beginning July 1st of each year. The position of Chair shall rotate each year to represent each Party beginning with Sunrise, then Oak Lodge and then Gladstone. The Commissioners shall also select a Vice Chair to serve in the absence of the Chair.

(d) Each Commissioner shall have one vote on any matter coming before the Commission. Five (5) Commissioners shall be present to meet the requirement for quorum of the Commission. Five (5) affirmative votes shall be needed to adopt any measure, ordinance or resolution.

3. Commission Assets.

(a) Each Party to this Addendum No. 1 shall have an undivided interest in the assets of the Commission in the following percentages: Sunrise – forty eight percent (48%), OLWD --forty two percent (42%), and, Gladstone – ten percent (10%).

(b) Gladstone shall pay $2.5 million in cash for its ten percent interest in the assets and liabilities of the Commission and the entitlement to an Allocation of 2.5 million gallons per day (MGD) of treated water from the Commission. $2.0 million shall be paid to Oak Lodge and $0.5 million shall be paid to Sunrise. In addition, Gladstone shall assign or transfer a total of 8.9 MGD of Clackamas River water rights. 5 MGD which includes water rights on the Clackamas River certificated at the time of this Addendum to the Commission and 3.9 MGD to Sunrise. Payment of money due from Gladstone under the terms of this Addendum shall be made within thirty (30) days of the receipt of proceeds from bonds sold to finance the purchase or by December 31, 2005, whichever first occurs.

(c) Gladstone shall support substitution of NCCWC for itself as a member of the Willamette Water Resources Commission (WWRC) and shall support NCCWC efforts to secure the largest possible access to Willamette River water rights.

4. Water Allocations.

(a) Each Party shall have a right to call upon the Commission to supply the Party with treated water up to the amount of its Allocation as provided in this paragraph. The Allocations of the Parties upon completion of the expansion of the NCCWC treatment plant referred to in section 4 of the Second Amended IGA are, at a minimum: Sunrise 12 MGD, Oak Lodge Water District 10.5 MGD and Gladstone 2.5 MGD. If the operating capacity of the expanded plant exceeds the designed capacity of 25 MGD, then Sunrise shall be entitled to call upon eighty percent (80%) and Oak Lodge twenty percent (20%) of the exceedance.

Oak Lodge and Gladstone agree to grant to Sunrise a first right to purchase any part of their Allocation not needed to serve their customers and ratepayers, at a price to be based upon cost of service at the time of purchase and without a premium. To facilitate planning, Oak Lodge and Gladstone will each provide Sunrise with a rolling five (5) year forecast of projected water use by January 1 of each year. By March 1 of each year, Sunrise will provide Oak Lodge and Gladstone with a firm commitment of its need for water from the Oak Lodge Allocation, for the five (5) year period. Sunrise may, but is not obligated to, purchase such excess Allocation from Oak Lodge or Gladstone before using (a) groundwater from wells in use listed in paragraph 6.02 B. of the Second Amended IGA; (b) water from Clackamas River Water contract dated March 8, 2001; and (c) water as may be authorized for use under permit application No. S-74056 now pending before the Water Resources Department.

5. Use of the Facilities and Improvements of Other Commission Members.

(a) Each Party shall make its facilities available for the use of every other Party to this Addendum and to the Commission to the extent such facilities are not presently required to serve the customers and ratepayers of the party that owns them. The owner of the facility shall be entitled to a fee for its use. Fees charged by a Party to this Addendum to any other Party or to the Commission shall be established on a cost of service basis.

(b) Facilities owned by Parties to be made available under this paragraph include but are not limited to Oak Lodge's 24" transmission line and the Valley View Reservoirs, the Oak Lodge pump station from Clackamas River Water and the City of Gladstone 27" transmission line. These facilities may be used by any Party, as needed, on a cost of service basis, provided as above that ownership of the facility remains with the Party providing it and that Party shall have first priority in its use. The right to use a facility under this Addendum shall cease if the facility is sold or transferred to another by the owner or retired from service by the owner.

(c) In case a facility or improvement that is owned by a Party and which is used by the Commission or by a Party to the Agreement or this Addendum is to be retired, sold or transferred, the owner of the facility or improvement shall notify the other Parties and the Commission in writing at least sixty days prior being irrevocably committed to the sale, transfer or retirement. In no case shall use by a Party to this Addendum other than the owner be used as grounds in any proceeding or litigation of any kind the intent or effect of which is to interfere with the facility owner's right to sell, transfer or retire the facility. Should a Party to the Agreement or this Addendum elect to sell, transfer or retire an improvement or facility used by another Party to the Agreement or Addendum the Commission or a Party to the Agreement or to this Addendum shall have a "right of first refusal" to purchase the facility which shall be exercised within sixty (60) days of receipt of the notice above provided for.

6. Termination.

(a) The Parties have transferred a total of 48.9 MGD of water rights permits and applications to the Commission. Upon termination of this Addendum No. 1 or dissolution of the NCCWC with the first phase of the facility expansion completed, but the second phase not completed, the Parties shall be deemed to be the owners of 25 MGD of Clackamas River water rights held by the Commission for use at the site. The share of ownership for each party shall be in the same proportions as its undivided ownership in the Commission. In addition to its partial ownership of the 25 MGD, Sunrise shall also be deemed to be the owner of 10 MGD of the remaining 23.9 MGD and Oak Lodge shall be deemed the owner of 10 MGD of the remaining 23.9 MGD and Gladstone shall be deemed the owner of 3.9 MGD. Gladstone's share of water rights shall include those Clackamas River water rights certificated at the time of this Addendum given to the Commission by Gladstone (2.6 MGD).

(b) Upon termination of this Addendum No. 1 or dissolution of the NCCWC after both phases of construction of the membrane filter, the Parties shall be deemed to be joint owners of Clackamas River water rights, permits and certificates held by the Commission, up to the maximum beneficial use Commission facilities are capable of delivering at that time. Water rights certificates and permits given to the Commission by the Parties to the Second Amended IGA that cannot be used at the Commission site shall be distributed to Sunrise up to the amount in section 6.03 C of the Second Amended IGA, provided that, Gladstone shall be entitled to 3.9 MGD of Clackamas River water rights contributed to the Commission including the certificated water rights held by the Commission received from Gladstone. Water rights held separately by the Parties shall be unaffected.

(c) Unless otherwise agreed, upon dissolution of the NCCWC the disposition of assets shall be in accordance with section 8.02 of the Second Amended IGA, provided that Gladstone shall have the same rights as Oak Lodge. In the event neither Sunrise nor Oak Lodge purchases the assets of the Commission upon termination, Gladstone may do so. If a Party withdraws from the NCCWC or if termination occurs under section 8.03 of the Second Amended IGA, and if the remaining Parties wish to continue the Commission, the remaining Parties shall purchase the interest of the terminating Party.

Effective Date. This Addendum No. 1 shall be effective on the 17th day of August, 2005.

Address of the Parties. The physical addresses of the Parties are as follows:

Sunrise Water Authority:	Sunrise Water Authority 10602 SE 129th Ave. Portland, OR 97236
Oak Lodge Water District:	Oak Lodge Water District 14496 SE River Rd. Oak Grove, OR 97267
City of Gladstone:	City of Gladstone City Hall 525 Portland Avenue Gladstone, OR 97027

7. Execution of Counterparts and Duplicate Originals.

This Agreement may be executed in counterparts and by the Parties on separate counterparts. The Agreement shall be made when each Party has executed a counterpart. There shall be at least three (3) duplicate originals containing the signatures of the representatives of all Parties. One original shall be retained by each Party and one original shall be kept in the files of the Commission.

IN WITNESS WHEREOF, the Parties have, pursuant to the official action of their governing bodies, duly authorizing the same, caused their respective officers to execute this instrument.

SUNRISE WATER AUTHORITY

By Robert L. Fentress

Attest

OAK LODGE WATER DISTRICT

By Jim Knapp

Attest

CITY OF GLADSTONE

By________________________

Attest________________________

Sunrise Water Authority:	Sunrise Water Authority 10602 SE 129th Ave. Portland, OR 97236
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SUNRISE WATER AUTHORITY

By____________________________

Attest____________________________

OAK LODGE WATER DISTRICT

By____________________________

Attest____________________________

CITY OF GLADSTONE

By Wade Byers

Attest Jonathan Block

Appendix E: Field Data and Calibration Results

Table E-1. Steady-State Calibration Results																
Test No.	Zone	Model pressure junction	Model flow junction	Date, 2014	Time	Pressure	Time	Pressure	Diffuser flow	Time	Pressure	Before pressure	During pressure	Before	During	Notes
CALIB_1	High	HYD401	HYD400	4/23	11:50 a.m.	59.5	11:58 a.m.	53.5	1260	12:05 p.m.	59.5	61	52	1.5	-1.1	Pressure at logger during test = 53.3, P in model = 49 psi.
CALIB_2	Intermediate Collins Crest	HYD166	HYD177	4/23	9:51 a.m.	58.5	10:00 a.m.	35.5	875	10:06 a.m.	57	52	37	-6.5	1.5	Not a good match on static pressure prior to the test. With a 1-inch connection at the Park Way check valve, the static pressure prior to the test is 52 psi and 37 psi during the test. The Webster station circle chart read approximately 340 gpm at the time of the test. The modeled pump station supplies 360 gpm at the time of the test given this connection. This connection should be closed for the evaluation.
CALIB_3	Low	HYD283	HYD284	4/22	1:45 p.m.	84	1:58 p.m.	79	619	2:04 p.m.	84	85	83	0.57	4	Hydrant was not fully open during test
CALIB_4	High Ridgewood	HYD071	HYD070	4/23	9:08 a.m.	86.5	9:18 a.m.	61.5	1240	9:22 a.m.	82.5	88	58	1.48	-3.97	The Ridgewood neighborhood was previously thought to be in the intermediate zone, however, there is an unmapped connection to the high zone. The OLWD - high zone inter-tie was not monitored during the intermediate zone tests, but is now set to the remaining demand in the high zones minus the reading at Webster

Appendix F: Basis of Estimate Report

Appendix F

Basis of Estimate Report

Introduction

Brown and Caldwell's opinion of the probable construction cost (estimate) for the Gladstone Water Master Plan is presented below.

Summary

This Basis of Estimate contains the following information:

- Scope of work
- Background of this estimate
- Class of estimate
- Estimating methodology
- Direct cost development
- Indirect cost development
- Bidding assumptions
- Estimating assumptions
- Estimating exclusions
- Allowances for known but undefined work
- Contractor and other estimate markups

Scope of Work

This cost estimate includes preliminary pricing for the following water system features:

1. Unit price for installation of a 6-, 8- and 12-inch DI water mains which includes patching of asphalt.
2. Unit Price for fire hydrant installation with 40 LF of 6" ductile iron pipe.
3. Unit price for 1.5 inches of milling and over-lay of asphalt based on 1 foot L x 12 foot W area.
4. Unit price for a typical copper domestic water service (40 LF of 1-inch copper pipe).
5. Installation of a 600 LF x 24-foot-wide asphalt access road to the 2 MG water tank.
6. Installation of a 2MG concrete water tank.
7. Alternate price as a separate estimate to install a 2MG welded steel water tank.

Background of this Estimate of Probable Construction Cost

The attached estimate of probable construction cost is based on documents dated July 21, 2014, received by the ESG. These documents are described as 0 – 2 percent complete based on the current project progression, additional or updated scope and/or quantities, and ongoing discussions with the project team. Further information can be found in the detailed estimate reports.

AACEI Estimate Classification

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, this is a Class 5 estimate. A Class 5 estimate is defined as a Conceptual Level or Project Viability Estimate. Typically, engineering is from 0 to 2 percent complete. Class 5 estimates are used to prepare planning level cost scopes or evaluation of alternative schemes, long range capital outlay planning and can also form the base work for the Class 4 Planning Level or Design Technical Feasibility Estimate.

Expected accuracy for Class 5 estimates typically ranges from -50 to +100 percent, depending on the technological complexity of the project, appropriate reference information and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

Estimating Methodology

This estimate was prepared using quantity take-offs, vendor quotes and equipment pricing furnished either by the project team or by the estimator. The estimate includes direct labor costs and anticipated productivity adjustments to labor, and equipment. Where possible, estimates for work anticipated to be performed by specialty subcontractors have been identified.

Construction labor crew and equipment hours were calculated from production rates contained in documents and electronic databases published by R.S. Means, Mechanical Contractors Association (MCA), National Electrical Contractors Association (NECA), and Rental Rate Blue Book for Construction Equipment (Blue Book).

This estimate was prepared using BC's estimating system, which consists of a Windows-based commercial estimating software engine using BC's material and labor database, historical project data, the latest vendor and material cost information, and other costs specific to the project locale.

Direct Cost Development

Costs associated with the General Provisions and the Special Provisions of the construction documents, which are collectively referred to as Contractor General Conditions (CGC), were based on the estimator's interpretation of the contract documents. The estimates for CGCs are divided into two groups: a time-related group (e.g., field personnel), and non-time-related group (e.g., bonds and insurance).Labor burdens such as health and welfare, vacation, union benefits, payroll taxes, and workers compensation insurance are included in the labor rates. No trade discounts were considered.

Indirect Cost Development

A percentage allowance for contractor's home office expense has been included in the overall rate markups. The rate is standard for this type of heavy construction and is based on typical percentages outlined in Means Heavy Construction Cost Data.

The contractor's cost for builder's risk, general liability and vehicle insurance has been included in this estimate. Based on historical data, this is typically two to four percent of the overall construction contract amount. These indirect costs have been included in this estimate as a percentage of the gross cost, and are added after the net markups have been applied to the appropriate items.

Bidding Assumptions

The following bidding assumptions were considered in the development of this estimate.

1. Bidders must hold a valid, current Contractor's credentials, applicable to the type of project.
2. Bidders will develop estimates with a competitive approach to material pricing and labor productivity, and will not include allowances for changes, extra work, unforeseen conditions or any other unplanned costs.
3. Estimated costs are based on a minimum of four bidders. Actual bid prices may increase for fewer bidders or decrease for a greater number of bidders.
4. Bidders will account for General Provisions and Special Provisions of the contract documents and will perform all work except that which will be performed by traditional specialty subcontractors as identified here:
   - Electrical and Instrumentation
   - HVAC systems
   - Paintings and Coatings

Estimating Assumptions

As the design progresses through different completion stages, it is customary for the estimator to make assumptions to account for details that may not be evident from the documents. The following assumptions were used in the development of this estimate.

1. Contractor performs the work during normal daylight hours, nominally 7 a.m. to 5 p.m., Monday through Friday, in an 8-hour shift. No allowance has been made for additional shift work or weekend work.
2. Contractor has complete access for lay-down areas and mobile equipment.
3. Equipment rental rates are based on verifiable pricing from the local project area rental yards, Blue Book rates and/or rates contained in the estimating database.
4. Contractor markup is based on conventionally accepted values that have been adjusted for project-area economic factors.
5. Major equipment costs are based on both vendor supplied price quotes obtained by the project design team and/or estimators, and on historical pricing of like equipment.
6. Process equipment vendor training using vendors' standard Operations and Maintenance (O&M) material, is included in the purchase price of major equipment items where so stated in that quotation.
7. Bulk material quantities are based on manual quantity take-offs.
8. There is sufficient electrical power to feed the specified equipment. The local power company will supply power and transformers suitable for this facility.
9. Soils are of adequate nature to support the structures. No piles have been included in this estimate.
10. The asphalt access road is estimated as 600 LF long by 24 wide asphalt.

    A 16' shoulder/ ditch will be located on one side of the access road for a total width 40 feet per Angela Wieland's request. The estimate assumes grading 4' of dirt over half the area for the access road (12,000 SF), resulting in 1,778 CY of earth movement.
11. The tank clearing area is 250' x 250'. The earth movement quantity is based on moving 4' of dirt over half the area (31,250 SF), resulting in 4,629 CY of earth movement.

Estimating Exclusions

The following estimating exclusions were assumed in the development of this estimate.

1. Hazardous materials remediation and/or disposal.
2. O&M costs for the project with the exception of the vendor supplied O&M manuals.
3. Utility agency costs for incoming power modifications.
4. Permits beyond those normally needed for the type of project and project conditions.
5. SCADA for water tank operation

Allowances for Known but Undefined Work

The following allowances were made in the development of this estimate.

1. Chain Link Fence - 1,000 LF
2. Gravel at perimeter of tank – 416 CY
3. Excavate & fill for access road – 1,778 CY
4. Excavate & fill for tank 4,629 CY

Contractor and Other Estimate Markups

Contractor markup is based on conventionally accepted values which have been adjusted for project-area economic factors. Estimate markups are listed in Table 1.

Table 1 Estimate Markups

Item	Rate (%)
Net cost markups	
Labor (employer payroll burden)	10
Materials and process equipment	10
Equipment (construction-related)	10
Subcontractor	5
Material shipping and handling	2
Gross cost markups	
Contractors general conditions	10
Traffic control (in lieu of 2% for contractor start-up, training and O&M)	2
Undesigned/undeveloped detail construction contingency	40
Builders risk, liability and auto insurance	2
Performance and payment bonds	1.5
Escalation to midpoint of construction	0

Net Cost Markups

Net cost markups are applied to specific components of the net construction cost. Net costs plus net cost markups are reflected in the unit pricing for system components as shown in the individual capital improvement project cost estimates.

Labor Markup

The labor rates used in the estimate were derived chiefly from the latest published State Prevailing Wage Rates. These include base rate paid to the laborer plus fringes. A labor burden factor is applied to these such that the final rates include all employer paid taxes. These taxes are FICA (which covers social security plus Medicare), Workers Comp (which varies based on state, employer experience and history) and unemployment insurance. The result is fully loaded labor rates. In addition to the fully loaded labor rate, an overhead and profit markup is applied at the back end of the estimate. This covers payroll and accounting, estimator's wages, home office rent, advertising and owner profit.

Materials and Process Equipment Markup

This markup consists of the additional cost to the contractor beyond the raw dollar amount for material and process equipment. This includes shop drawing preparation, submittal and/or re-submittal cost, purchasing and scheduling materials and equipment, accounting charges including invoicing and payment, inspection of received goods, receiving, storage, overhead and profit.

Equipment (Construction) Markup

This markup consists of the costs associated with operating the construction equipment used in the project. Most GCs will rent rather than own the equipment and then charge each project for its equipment cost. The equipment rental cost does not include fuel, delivery and pick-up charges, additional insurance requirements on rental equipment, accounting costs related to home office receiving invoices and payment. However, the crew rates used in the estimate do account for the equipment rental cost. Occasionally, larger contractors will have some or all of the equipment needed for the job, but in order to recoup their initial purchasing cost they will charge the project an internal rate for equipment use which is similar to the rental cost of equipment. The GC will apply an overhead and profit percentage to each individual piece of equipment whether rented or owned.

Subcontractor Markup

This markup consists of the GC's costs for subcontractors who perform work on the site. This includes costs associated with shop drawings, review of subcontractor's submittals, scheduling of subcontractor work, inspections, processing of payment requests, home office accounting, and overhead and profit on subcontracts.

Material Shipping and Handling

This can range from 2 to 6 percent, and is based on the type of project, material makeup of the project, and the region and location of the project. Material shipping and handling covers delivery costs from vendors, unloading costs (and in some instances loading and shipment back to vendors for rebuilt equipment), site paper work, and inspection of materials prior to unloading at the project site. BC typically adjusts this percentage by the amount of materials and whether vendors have included shipping costs in the quotes that were used to prepare the estimate. This cost also includes the GC's cost to obtain local supplies; e.g., oil, gaskets and bolts that may be missing from the equipment or materials shipped.

Gross Cost Markups

Gross cost markups are applied to the net construction cost plus net cost markups. Gross cost markups are applied to the accumulative cost in the order of markups reflected in Table 1.

General Conditions

General conditions are associated with contractor start-up costs and reflect scheduling, mobilization, and demobilization.

Traffic Control

A 2% markup was assigned for traffic control, given construction primarily in the public right-of-way (i.e., pipe replacement).

Undesigned/Undeveloped Detail Construction Contingency

The contingency factor covers unforeseen conditions, area economic factors, and general project complexity. This contingency is used to account for those factors that cannot be addressed in each of the labor and/or material installation costs. Based on industry standards, completeness of the project documents, project complexity, the current design stage and area factors, construction contingency can range from 10 to 50 percent. Contingency is applied at the estimators discretion based on the amount of Undesigned/undeveloped detail for the particular project. Specific for this master plan-level assessment, contingency was more conservatively estimated.

Builders Risk, Liability, and Vehicle Insurance

This percentage comprises all three items. There are many factors which make up this percentage, including the contractor's track record for claims in each of the categories. Another factor affecting insurance rates has been a dramatic price increase across the country over the past several years due to domestic and foreign influences. Consequently, in the construction industry we have observed a range of 0.5 to 1 percent for Builders Risk Insurance, 1 to 1.25 percent for General Liability Insurance, and 0.85 to 1 percent for Vehicle Insurance. Many factors affect each area of insurance, including project complexity and contractor's requirements and history. Instead of using numbers from a select few contractors, we believe it is more prudent to use a combined 2 percent to better reflect the general costs across the country. Consequently, the actual cost could be higher or lower based on the bidder, region, insurance climate, and on the contractor's insurability at the time the project is bid.

Performance and Payment Bonds

Based on historical and industry data, this can range from 0.75 to 3 percent of the project total. There are several contributing factors including such items as size of the project, regional costs, and contractor's historical record on similar projects, complexity and current bonding limits. BC uses 1.5 percent for bonds, which we have determined to be reasonable for most heavy construction projects.

Escalation to Midpoint of Construction for All Project Cost

Typically for design estimates, in addition to contingency, it is customary for projects that will be built over several years to include an escalation to midpoint of anticipated construction to account for the future escalation of labor, material and equipment costs beyond values at the time the estimate is prepared. For this project, given the unknown nature of construction schedule, costs are reflected in 2014 dollars, and no escalation to midpoint of construction has been estimated.

Attachment A
Estimate of Probable Construction Cost

Unit Costs		
Item	Unit	Cost
Water Facility Installation		
PRV Station	EA	$30,000
6-inch Ductile-Iron Pipe with asphalt patch	LF	$154
8-inch Ductile-Iron Pipe with asphalt patch	LF	$179
12-inch Ductile-Iron Pipe with asphalt patch	LF	$212
Service Line Connection (40' of 1" Copper Domestic Service)	EA	$2,473
Hydrant Replacement	EA	$9,615
Hydrant Removal	EA	$884
Site Clearing (access road)	AC	$26,417
Cut and Fill (access road)	CY	$18.84
Site Clearing (storage tank)	AC	$29,844
Cut and Fill (storage tank/ vault)	CY	$11.56
Scaffolding (tank construction)	LS	$43,200.00
Concrete Tank Construction	GAL	$0.85
Steel Tank Construction	GAL	$0.84
SCADA - Model M-800 SCADA RTU System, NEMA 1	EA	$1,995.00
SCADA - Model M-800 SCADA RTU System, NEMA 4X	EA	$2,095.00
SCADA - Analog Input Expansion Module	EA	$495.00
SCADA - 50' Antenna Cable	EA	$75.00
MTU Onsite Power, 125 kW diesel Generator, Sub Base Fuel Tank and Quiet Zone Enclosure	EA	$51,569.00
Eaton Power Products, 480V, 200A, 3 Pole Service Entrance ATS	EA	$6,500.00
Misc. Electrical Materials (conduit, cable, hardware) for gen set installation	LS	$6,200.00
Restoration/ Resurfacing		
Milling, Asphalt and Overlay (one lane width for pipe install)	LF	$15
Asphaltic Paving	SF	$5.06
Fencing/ Exterior Stonework	LF	$58.54
Gross Markups (applied to project subtotals)		
Contractors General Conditions (%)	LS	10%
Traffic Control (%)	LS	2%
Construction Contingency (%)	LS	40%
Builders Risk, Liability and Auto Insurance (%)	LS	2%
Performance and Payment Bonds (%)	LS	1.50%
Design/ Administrative		
Engineering and Permitting (%)	LS	Varies (20-40%)
Construction Administration (%)	LS	5%
SCADA System - Freight Charges	LS	$35.00
SCADA System - Set Up Fee and Onsite Training	LS	$250.00
SCADA System - Install (Pump Station)	LS	$2,000.00
SCADA System - Install (Meter)	LS	$750.00
Gen Set - Install	LS	$25,600.00
Maintenance		
SCADA - Service Plan Fee	Annual	$570.00
SCADA - Analog Expansion Service Fee	Annual	$60.00

Berkeley Street Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
12-inch Ductile-Iron Pipe with asphalt patch	1,604	LF	$212	$340,048
Service Line Connection (40' of 1" Copper Domestic Service)	26	EA	$2,473	$64,298
Hydrant Removal	4	EA	$884	$3,536
Hydrant Replacement	4	EA	$9,615	$38,460
Milling, Asphalt and Overlay (one lane width for pipe install)	1,604	LF	$15	$24,060
Capital Expense Subtotal				$470,402
Gross Markups				
Contractors General Conditions (%)		LS	10%	$47,040
Traffic Control (%)		LS	2%	$10,349
Construction Contingency (%)		LS	40%	$211,116
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$14,778
Performance and Payment Bonds (%)		LS	1.5%	$11,305
Project Subtotal				$764,991
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$152,998
Construction Administration (%)		LS	5%	$38,250
Administrative Expense Total				$191,248
Capital Implementation Cost Total				$956,239

Cason Road PRV and Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
8-inch Ductile-Iron Pipe with asphalt patch	817	LF	$179	$146,243
8-inch Ductile-Iron Pipe with asphalt patch	60	LF	$179	$10,740
12-inch Ductile-Iron Pipe with asphalt patch	1,088	LF	$212	$230,656
Service Line Connection (40' of 1" Copper Domestic Service)	32	EA	$2,473	$79,136
Hydrant Removal	6	EA	$884	$5,304
Hydrant Replacement	6	EA	$9,615	$57,690
Milling, Asphalt and Overlay (one lane width for pipe install)	1,905	LF	$15	$28,575
PRV Station	2	EA	$30,000	$60,000
Cut and Fill (storage tank/ vault)	56	CY	$12	$647
Capital Expense Subtotal				$618,991
Gross Markups				
Contractors General Conditions (%)		LS	10%	$61,899
Traffic Control (%)		LS	2%	$13,618
Construction Contingency (%)		LS	40%	$277,803
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$19,446
Performance and Payment Bonds (%)		LS	1.5%	$14,876
Project Subtotal				$1,006,634
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$201,327
Construction Administration (%)		LS	5%	$50,332
Administrative Expense Total				$251,659
Capital Implementation Cost Total				$1,258,293

Clackamas Blvd Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
8-inch Ductile-Iron Pipe with asphalt patch	1,836	LF	$179	$328,644
Service Line Connection (40' of 1" Copper Domestic Service)	14	EA	$2,473	$34,622
Hydrant Removal	2	EA	$884	$1,768
Hydrant Replacement	2	EA	$9,615	$19,230
Milling, Asphalt and Overlay (one lane width for pipe install)	1,836	LF	$15	$27,540
Capital Expense Subtotal				$411,804
Gross Markups				
Contractors General Conditions (%)		LS	10%	$41,180
Traffic Control (%)		LS	2%	$9,060
Construction Contingency (%)		LS	40%	$184,818
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$12,937
Performance and Payment Bonds (%)		LS	1.5%	$9,897
Project Subtotal				$669,696
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$133,939
Construction Administration (%)		LS	5%	$33,485
Administrative Expense Total				$167,424
Capital Implementation Cost Total				$837,120

Hereford PRV				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
12-inch Ductile-Iron Pipe with asphalt patch	100	LF	$212	$21,200
Milling, Asphalt and Overlay (one lane width for pipe install)	100	LF	$15	$1,500
PRV Station	1	EA	$30,000	$30,000
Cut and Fill (storage tank/ vault)	28	CY	$12	$324
Capital Expense Subtotal				$53,024
Gross Markups				
Contractors General Conditions (%)		LS	10%	$5,302
Traffic Control (%)		LS	2%	$1,167
Construction Contingency (%)		LS	40%	$23,797
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$1,666
Performance and Payment Bonds (%)		LS	1.5%	$1,274
Project Subtotal				$86,230
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$17,246
Construction Administration (%)		LS	5%	$4,311
Administrative Expense Total				$21,557
Capital Implementation Cost Total				$107,787

Hull PRV				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
12-inch Ductile-Iron Pipe with asphalt patch	100	LF	$212	$21,200
Milling, Asphalt and Overlay (one lane width for pipe install)	100	LF	$15	$1,500
PRV Station	1	EA	$30,000	$30,000
Cut and Fill (storage tank/ vault)	28	CY	$12	$324
Capital Expense Subtotal				$53,024
Gross Markups				
Contractors General Conditions (%)		LS	10%	$5,302
Traffic Control (%)		LS	2%	$1,167
Construction Contingency (%)		LS	40%	$23,797
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$1,666
Performance and Payment Bonds (%)		LS	1.5%	$1,274
Project Subtotal				$86,230
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$17,246
Construction Administration (%)		LS	5%	$4,311
Administrative Expense Total				$21,557
Capital Implementation Cost Total				$107,787

Jersey Street Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
8-inch Ductile-Iron Pipe with asphalt patch	510	LF	$179	$91,290
Service Line Connection (40' of 1" Copper Domestic Service)	17	EA	$2,473	$42,041
Hydrant Removal	2	EA	$884	$1,768
Hydrant Replacement	2	EA	$9,615	$19,230
Milling, Asphalt and Overlay (one lane width for pipe install)	503	LF	$15	$7,545
Capital Expense Subtotal				$161,874
Gross Markups				
Contractors General Conditions (%)		LS	10%	$16,187
Traffic Control (%)		LS	2%	$3,561
Construction Contingency (%)		LS	40%	$72,649
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$5,085
Performance and Payment Bonds (%)		LS	1.5%	$3,890
Project Subtotal				$263,247
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$52,649
Construction Administration (%)		LS	5%	$13,162
Administrative Expense Total				$65,812
Capital Implementation Cost Total				$329,059

Landon PRV				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
12-inch Ductile-Iron Pipe with asphalt patch	100	LF	$212	$21,200
Milling, Asphalt and Overlay (one lane width for pipe install)	100	LF	$15	$1,500
PRV Station	1	EA	$30,000	$30,000
Cut and Fill (storage tank/ vault)	28	CY	$12	$324
Capital Expense Subtotal				$53,024
Gross Markups				
Contractors General Conditions (%)		LS	10%	$5,302
Traffic Control (%)		LS	2%	$1,167
Construction Contingency (%)		LS	40%	$23,797
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$1,666
Performance and Payment Bonds (%)		LS	1.5%	$1,274
Project Subtotal				$86,230
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$17,246
Construction Administration (%)		LS	5%	$4,311
Administrative Expense Total				$21,557
Capital Implementation Cost Total				$107,787

Meldrum Bar Park Road PRV and Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
12-inch Ductile-Iron Pipe with asphalt patch	1,194	LF	$212	$253,128
Service Line Connection (40' of 1" Copper Domestic Service)	-	EA	$2,473	$-
Hydrant Removal	3	EA	$884	$2,652
Hydrant Replacement	3	EA	$9,615	$28,845
Milling, Asphalt and Overlay (one lane width for pipe install)	1,194	LF	$15	$17,910
PRV Station	1	EA	$30,000	$30,000
Cut and Fill (storage tank/ vault)	28	CY	$12	$324
Capital Expense Subtotal				$332,859
Gross Markups				
Contractors General Conditions (%)		LS	10%	$33,286
Traffic Control (%)		LS	2%	$7,323
Construction Contingency (%)		LS	40%	$149,387
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$10,457
Performance and Payment Bonds (%)		LS	1.5%	$8,000
Project Subtotal				$541,311
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$108,262
Construction Administration (%)		LS	5%	$27,066
Administrative Expense Total				$135,328
Capital Implementation Cost Total				$676,639

Park Way Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
8-inch Ductile-Iron Pipe with asphalt patch	905	LF	$179	$161,995
Service Line Connection (40' of 1" Copper Domestic Service)	18	EA	$2,473	$44,514
Hydrant Removal	2	EA	$884	$1,768
Hydrant Replacement	3	EA	$9,615	$28,845
Milling, Asphalt and Overlay (one lane width for pipe install)	905	LF	$15	$13,575
Capital Expense Subtotal				$250,697
Gross Markups				
Contractors General Conditions (%)		LS	10%	$25,070
Traffic Control (%)		LS	2%	$5,515
Construction Contingency (%)		LS	40%	$112,513
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$7,876
Performance and Payment Bonds (%)		LS	1.5%	$6,025
Project Subtotal				$407,696
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$81,539
Construction Administration (%)		LS	5%	$20,385
Administrative Expense Total				$101,924
Capital Implementation Cost Total				$509,620

Sherwood Neighborhood Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
8-inch Ductile-Iron Pipe with asphalt patch	4,190	LF	$179	$750,010
Service Line Connection (40' of 1" Copper Domestic Service)	65	EA	$2,473	$160,745
Hydrant Removal	9	EA	$884	$7,956
Hydrant Replacement	9	EA	$9,615	$86,535
Milling, Asphalt and Overlay (one lane width for pipe install)	4,190	LF	$15	$62,850
Capital Expense Subtotal				$1,068,096
Gross Markups				
Contractors General Conditions (%)		LS	10%	$106,810
Traffic Control (%)		LS	2%	$23,498
Construction Contingency (%)		LS	40%	$479,361
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$33,555
Performance and Payment Bonds (%)		LS	1.5%	$25,670
Project Subtotal				$1,736,990
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$347,398
Construction Administration (%)		LS	5%	$86,850
Administrative Expense Total				$434,248
Capital Implementation Cost Total				$2,171,238

Rinearson Road Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
8-inch Ductile-Iron Pipe with asphalt patch	1,207	LF	$179	$216,053
Service Line Connection (40' of 1" Copper Domestic Service)	10	EA	$2,473	$24,730
Hydrant Removal	3	EA	$884	$2,652
Hydrant Replacement	3	EA	$9,615	$28,845
Milling, Asphalt and Overlay (one lane width for pipe install)	1,207	LF	$15	$18,105
Capital Expense Subtotal				$290,385
Gross Markups				
Contractors General Conditions (%)		LS	10%	$29,039
Traffic Control (%)		LS	2%	$6,388
Construction Contingency (%)		LS	40%	$130,325
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$9,123
Performance and Payment Bonds (%)		LS	1.5%	$6,979
Project Subtotal				$472,238
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$94,448
Construction Administration (%)		LS	5%	$23,612
Administrative Expense Total				$118,060
Capital Implementation Cost Total				$590,298

Risley Avenue Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
8-inch Ductile-Iron Pipe with asphalt patch	893	LF	$179	$159,847
Service Line Connection (40' of 1" Copper Domestic Service)	12	EA	$2,473	$29,676
Hydrant Removal	2	EA	$884	$1,768
Hydrant Replacement	2	EA	$9,615	$19,230
Milling, Asphalt and Overlay (one lane width for pipe install)	893	LF	$15	$13,395
Capital Expense Subtotal				$223,916
Gross Markups				
Contractors General Conditions (%)		LS	10%	$22,392
Traffic Control (%)		LS	2%	$4,926
Construction Contingency (%)		LS	40%	$100,494
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$7,035
Performance and Payment Bonds (%)		LS	1.5%	$5,381
Project Subtotal				$364,143
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$72,829
Construction Administration (%)		LS	5%	$18,207
Administrative Expense Total				$91,036
Capital Implementation Cost Total				$455,179

SE 82nd Drive Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
12-inch Ductile-Iron Pipe with asphalt patch	860	LF	$212	$182,320
Service Line Connection (40' of 1" Copper Domestic Service)	2	EA	$2,473	$4,946
Hydrant Removal	3	EA	$884	$2,652
Hydrant Replacement	3	EA	$9,615	$28,845
Milling, Asphalt and Overlay (one lane width for pipe install)	860	LF	$15	$12,900
Capital Expense Subtotal				$231,663
Gross Markups				
Contractors General Conditions (%)		LS	10%	$23,166
Traffic Control (%)		LS	2%	$5,097
Construction Contingency (%)		LS	40%	$103,970
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$7,278
Performance and Payment Bonds (%)		LS	1.5%	$5,568
Project Subtotal				$376,742
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$75,348
Construction Administration (%)		LS	5%	$18,837
Administrative Expense Total				$94,185
Capital Implementation Cost Total				$470,927

Webster Pump Station Upgrades (Generator Set)				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
MTU Onsite Power, 125 kW diesel Generator, Sub Base Fuel Tank and Quiet Zone Enclosure	1	EA	$51,569	$51,569
Eaton Power Products, 480V, 200A, 3 Pole Service Entrance ATS	1	EA	$6,500	$6,500
Misc. Electrical Materials (conduit, cable, hardware) for gen set installation	1	LS	$6,200	$6,200
Capital Expense Subtotal				$64,269
Gross Markups				
Contractors General Conditions (%)		LS	10%	$6,427
Traffic Control (%)		LS	0%	$-
Construction Contingency (%)		LS	40%	$28,278
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$1,979
Performance and Payment Bonds (%)		LS	1.5%	$1,514
Project Subtotal				$102,468
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$20,494
Construction Administration (%)		LS	5%	$5,123
Gen Set - Install	1	LS	$25,600	$25,600
Administrative Expense Total				$51,217
Capital Implementation Cost Total				$153,685

Webster Pump Station SCADA System Upgrades				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
Webster Pump Station Building (includes Kirkwood Pumps)				
SCADA - Model M-800 SCADA RTU System, NEMA 1	1	EA	$1,995	$1,995
SCADA - Analog Input Expansion Module	1	EA	$495	$495
SCADA - 50' Antenna Cable	1	EA	$75	$75
Remote Locations (3)				
SCADA - Model M-800 SCADA RTU System, NEMA 4X	3	EA	$2,095	$6,285
Capital Expense Subtotal				$8,850
Gross Markups				
Contractors General Conditions (%)		LS	10%	$885
Traffic Control (%)		LS	0%	-
Construction Contingency (%)		LS	40%	$3,894
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$273
Performance and Payment Bonds (%)		LS	1.5%	$209
Project Subtotal				$14,110
Administrative Expenses				
Engineering and Permitting (%)		LS	0%	-
Construction Administration (%)		LS	5%	$706
SCADA System - Freight Charges	4	LS	$35	$140
SCADA System - Set Up Fee and Onsite Training	4	LS	$250	$1,000
SCADA System - Install (Pump Station)	1	LS	$2,000	$2,000
SCADA System - Install (Meter)	3	LS	$750	$2,250
Administrative Expense Total				$6,096
Capital Implementation Cost Total				$20,206
Annual Maintenance Expenses				
SCADA - Service Plan Fee	4	Annual	$570	$2,280
SCADA - Analog Expansion Service Fee	1	Annual	$60	$60
Annual Maintenance Cost Total				$2,340

Storage Tank-Alternative A (Steel)				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
Access Road				
Site Clearing (access road)	0.6	AC	$26,417	$15,850
Cut and Fill (access road)	1,778	CY	$19	$33,498
Asphaltic Paving	15,000	SF	$5	$75,900
Site Preparation				
Site Clearing (storage tank)	1.4	AC	$29,844	$41,782
Cut and Fill (storage tank/ vault)	4,629	CY	$12	$53,511
Tank Construction				
Scaffolding (tank construction)	1	LS	$43,200	$43,200
Steel Tank Construction	2,000,000	GAL	$0.84	$1,680,000
Fencing/ Exterior Stonework	1,000	LF	$59	$58,540
12-inch Ductile-Iron Pipe with asphalt patch	1,000	LF	$212	$212,000
Capital Expense Subtotal				$2,214,281
Gross Markups				
Contractors General Conditions (%)		LS	10%	$221,428
Traffic Control (%)		LS	2%	$48,714
Construction Contingency (%)		LS	40%	$993,769
Builders Risk, Liability and Auto Insurance (%)		LS	2%	$69,564
Performance and Payment Bonds (%)		LS	1.5%	$53,216
Project Subtotal				$3,600,972
Administrative Expenses				
Engineering and Permitting (%)		LS	20%	$720,194
Construction Administration (%)		LS	5%	$180,049
Administrative Expense Total				$900,243
Capital Implementation Cost Total				$4,501,215