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TECHNICAL MEMORANDUM

DATE: June 10, 2008

PROJECT: 07-0848.405

TO: Mr. Dennis Wright, P.E., Engineering Director
City of West Linn

FROM: Chris H. Uber, P.E.
Brian M. Ginter, P.E.
Murray, Smith & Associates, Inc.

RE: Technical Memorandum #6: City of West Linn - Water System Master Plan
Task 5 Deliverable: Perform Hydraulic Modeling and Identify Capital Improvement Projects

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DRAFT

June 10, 2008 Revision

Purpose

This memorandum presents the planning and analysis criteria, summarizes the analysis process and presents findings for the water distribution system analysis element of the City of West Linn's (City) Water System Master Plan.

Criteria are presented for distribution system piping and service pressures. Storage needs and the storage and pumping analysis is presented in Technical Memorandum #4. These distribution system analysis criteria are used in conjunction with the water demand forecasts presented in Technical Memorandum #2 to complete the analysis of the City's water distribution system. A computerized hydraulic model of the distribution system was used to evaluate system performance under a number of demand and fire flow conditions and the results, which include all modeling parameters, relevant modeling approaches, analysis scenarios and subsequent system improvement recommendations are presented below.

Distribution System Analysis Criteria

The City's water distribution system should be capable of operating within certain system performance limits, or guidelines, under varying demand and operational conditions. The recommended criteria used for this plan are based on the following performance guidelines, which have been developed through a review of State requirements, American Water Works Association (AWWA) acceptable practice guidelines, operational practices of similar water providers, and discussions with City water system operations staff. The performance guidelines and assumed conditions for the analysis are as follows:

1. Supply to the City is via the 24-inch diameter supply main crossing the Willamette River from the Division Street Pump Station and the South Fork Water Board (SFWB) Water Treatment Plant (WTP).
2. The distribution system should be capable of supplying the peak hourly demand while maintaining minimum service pressures of not less than approximately 80 percent of normal system pressures. The system should meet this criterion with the reservoirs at approximately three-quarters full. The analysis discussion presented in Technical Memorandum #4 outlines the basis for the three-quarters full reservoir condition.
3. The distribution system should also be capable of providing the recommended fire flow to a given location while, at the same time, supplying the maximum daily demand and maintaining a minimum residual service pressure at any meter in the system of 20 pounds per square inch (psi). This is the minimum water system pressure required by the State of Oregon Department of Human Services, Drinking Water Program. The system should meet this criterion with the reservoirs approximately three-quarters full.

Typically, proposed or new water mains should be at least 8 inches in diameter in order to supply minimum fire flows. In special cases, 6-inch diameter mains are acceptable if no fire hydrant connection is required, there are limited services on the main, the main is dead-ended, and looping or future extension of the main is not anticipated.

Comment [d1]: I thought looping made this configuration satisfactory

Service Pressure Criteria

Water distribution systems are typically separated into pressure zones or service levels to provide service pressures within an acceptable range to all customers. As previously discussed, the City's existing water service area distribution system is divided into six main service levels, or pressure zones, and fifteen subzones. Pressure zones are usually

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determined by ground topography and designated by overflow elevations of water storage facilities or outlet settings of pressure reducing facilities serving the zone. Typically, water from a reservoir will serve customers by gravity within a specified range of ground elevations so as to maintain acceptable minimum and maximum water pressures at individual service connections. When it is not feasible or practical to have a separate reservoir serving each pressure zone, pumping facilities or pressure reducing facilities are used to serve customers in different pressure zones from a single reservoir.

Generally, 100 psi is considered the desirable upper static pressure limit and 40 psi the lower limit. Whenever feasible, it is desirable to achieve the 40 psi lower limit at the point of the highest fixture within a given building being served. Conformance to this pressure range may not always be possible or practical due to topographical relief, existing system configurations and economic considerations. Maximum pressures typically should not exceed 125 psi. Table 5-1 summarizes the service pressure criteria used in the analysis of the water system. The pressure zone analysis performed for this planning effort will review previous analyses and recommendations regarding the City's pressure zones.

Table 5-1
Recommended Service Pressure Criteria

Condition	Pressure (psi)
Minimum Service Pressure Under Fire Flow Conditions	20
Minimum Normal Static Service Pressure	40
Desired Maximum Static Service Pressure	100

Pressure Zone Analysis

As discussed above, the City's service area is currently divided into six main pressure zones and eight smaller lower elevation sub-zones supplied by pressure reducing valve (PRV) stations from the main zones. Table 5-2 summarizes the highest elevation in each of the main pressure zones, the overflow elevation of the reservoir serving the zone and the static pressure at the highest elevation location. As Table 5-2 shows the existing pressure zone boundaries are generally adequate to provide the recommended minimum service pressures throughout the water system.

Table 5-2
Pressure Zone Service Pressure Analysis Summary

Pressure Zone	Highest Ground Elevation (feet)	Reservoir Overflow Elevation (feet)	Static Service Pressure (psi)
Robinwood	207	327	52
Willamette	257	351	40
Bolton	336	440	45
Bland	490	585	41
Horton	632	730	42
Rosemont	754	860	45

Fire Flow Criteria

While the water distribution system provides water for domestic uses, it is also expected to provide water for fire suppression. The amount of water recommended for fire suppression purposes is typically associated with the local building type or land use of a specific location within the distribution system. Fire flow recommendations are typically much greater in magnitude than the normal maximum day demand present in any local area. Adequate hydraulic capacity must be provided for these large occasional fire flow demands.

Fire protection for the City's service area is provided by Tualatin Valley Fire and Rescue (TVFR). TVFR has established guidelines for determining fire flow requirements based on the 2007 Edition of the State of Oregon Fire Code and ordinances adopted by TVFR. The following definitions are based on current TVFR ordinances and are the basis for developing recommended fire flows within the City.

- ***Required Fire Flow:*** The amount of water necessary to fight a fire for a particular building. The required fire flow is based on the type of construction, building size, and fire hazard of the occupancy. TVFR does not allow new building construction or alterations to existing buildings which creates a need for a required fire flow greater than 3,000 gallons per minute (gpm). The required fire flow cannot exceed either the available or applicable fire flow (3,000 gpm).
- ***Available Fire Flow:*** The amount of water available at the hydrants.

Residential Fire Flow Criteria

According to TVFR, dwelling units whose fire area is 3,600 square feet or less shall have a minimum fire flow requirement of 1,000 gpm. Buildings with fire areas greater than 3,600 square feet shall have a minimum fire flow requirement of 1,500 gpm. The City's previous Water System Master Plan recommended a residential fire flow of 1,000 gpm based on TVFR and State of Oregon Fire Code requirements at that time. Recent adoption (2007) of the new International Fire Code by the State of Oregon has resulted in a high fire flow standard, especially for larger sized homes. For the purpose of this plan, a minimum residential fire flow of 1,500 will be used. Based on a review of the size of typical residential development within the City, it is recommended that a minimum available fire flow of 1,500 gpm be used for planning purposes.

Discussions with TVFR staff indicate that certain areas designated for medium-high density residential development should be provided with a minimum available fire flow of 3,000 gpm. This is because the "medium-high density" designation may allow for attached housing units or apartments and therefore constitutes a "commercial fire event".

Commercial and Industrial Fire Flow Criteria

As previously discussed, TVFR does not allow new building construction or alterations to existing buildings which creates a need for a required fire flow greater than 3,000 gpm. Discussions with TVFR officials indicate that, even though commercial and institutional facilities exist within the City that may have been constructed prior to current building regulations, available flow capacities of 3,000 gpm are sufficient for planning purposes. It is therefore recommended that 3,000 gpm be established as the minimum available fire flow for areas of existing and proposed commercial, industrial and institutional development.

A summary of fire flow recommendations by land use designation is presented in Table 5-2. The recommended fire flows presented in Table 5-3 were developed through discussions with TVFR officials, fire flow guidelines as developed by the AWWA, the National Fire Protection Association (NFPA), the Insurance Services office (ISO) and a review of fire flow criteria adopted by similar communities.

Comment [b2]: This should be 5-3

Fire flow requirements for structures with fire sprinkler systems were examined as part of the development of recommended fire flows. Fire flow requirements can be reduced for structures with sprinkler systems. Discussions with TVFR officials indicate that required fire flows may be reduced by up to 50 percent depending on building construction and the type of fire extinguishing system installed. The application of these flow reductions, however, must be examined on a case by case basis.

For the purposes of this study it is assumed that the water distribution system must provide fire flows for unsprinklered service conditions for the following reasons:

- Major portions of the City are already developed. While a number of buildings have fire sprinkler systems, many existing buildings do not.
- In order for reductions to be considered, all buildings in an area must have sprinkler systems. In most cases this is not realistic or feasible.

Table 5-3
Summary of Land Use and Recommended Fire Flows

Zone	Zoning Description	Recommended Fire Flow (gpm)	Duration (Hours)
LDR	Low Density Residential	1,500	2
MDR	Medium Density Residential	1,500	2
MHDR	Medium-High Density Residential	1,500	2
MU	Mixed Use Transition	3,000	3
NC	Neighborhood Commercial	3,000	3
GC	General Commercial	3,000	3
OBC	Office-Business Center	3,000	3
CI	Campus Industrial	3,000	3
GI	General Industrial	3,000	3
FU-10	Future Urban	1,500	2
	No Zoning (River and Freeway ROW)	N/A	N/A
FU-10	Area Outside City Limits (within UGB)	1,500	2

Distribution System Analysis

A hydraulic network analysis computer program was used to evaluate the performance of the existing distribution system and to aid in the development of proposed system improvements. The network analysis program utilizes a digital base map of the water distribution system prepared using AutoCAD computer aided drafting (CAD) software and H2ONet hydraulic network analysis software. The purpose of the computer network modeling is to determine pressure and flow relationships throughout the distribution system under critical hydraulic conditions. System performance and adequacy is evaluated based on the criteria presented above to identify areas of deficiency and develop recommended system improvements.

Computerized Hydraulic Network Analysis Model

For modeling purposes, the water distribution system was digitized onto a digital base map drawing file. This drawing file was then used to perform the system analysis and to illustrate recommended improvements. This drawing file is presented as Plate 1 in Appendix A.

All pipes on the map are shown as "links" between "nodes" which represent pipeline junctions or changes in pipe size. Pipes and nodes are numbered to allow for easy system updating and revision. These numbers have not been shown on Plate 1 for drawing clarity but are available within the computer model for future use. Diameter and length are specified for each pipe, and an approximate ground elevation is specified for each node. For

provide service pressures within an acceptable range to all customers. As previously discussed, the City's existing water service area distribution system is divided into six main service levels, or pressure zones, and fifteen subzones. Pressure zones are usually

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Pressure Zone	Street	Existing Pipe Diameter (in)	Proposed Pipe Diameter (in)	Existing Material	Length (ft)	Notes
	Rosmarie Dr	8	10	DI	640	
	Farrvista St	6	10	DI	420	Looped
	Margery St	6	8	DI	600	From Farrvista north
	Tamarisk Dr	6	10	DI	460	Debok to Troy Ct.
	Troy Ct	6	8	DI	550	
Bland	Killarney Dr	6	10	CI/DI	940	Debok east
	Killarney Dr	6	8	DI	360	
	Donegal Ct	6	8	CI	400	
	Limerick Ln	6	10	CI	370	
	South Salamo Rd	10	16	DI	850	Barrington to Greene
	Greene St	10	16	DI	1920	S Salamo Rd to Tannler Dr
	Tannler Dr	10	16	DI	680	Greene St to Remington Dr
	Tannler Dr	10	16	DI	1000	Bolton Res to Remington Dr
	Barnes Circle	6	8	CI	1120	Greene St to Lois Lane
	Riverknoll Ct	6	10	DI	550	
Horton	Sunset Ct	4	6	CI	280	
	Oak	4	8	CI	180	
	Sussex St	6	8	CI	580	Bland PZ boundary to 250' south of Sunset Ave
	Sussex St	4	8	CI	250	Between Bland PZ boundary and Sunset Ave
	Skyline Dr & Clark St	6	8	CI	870	Looped
	Skyline Circle	4	8	CI	320	
	Linn Ln	6	8	CI	1080	Rosemont Rd to Nelco Circle
	Rosepark Dr	6	8	DI	650	Lupine Ct south to end
	Parkview Terrace	6	12	DI	720	Lupine Ct to Horton Rd
	Horton Rd	14	20	DI	3440	Horton Reservoir to Serango Dr
	Pimlico Dr and Subdivision	6	8	AC	7800	Pimlico Drive and all AC pipe inside subdivision
Rosemont	Rosemont Rd	8	12	DI	2400	Salamo Rd to Shannon Ln
	Rosemont Rd	6	12	CI	3100	Shannon Ln to Gloria Dr. To be looped
	Conestoga Ln	6	8	CI	240	Install fitting 400' from end
	Surrey Ln	4	8	DI	100	Derby St west. Install fitting 400' from end.

Pressure Zone	Street	Existing Pipe Diameter (in)	Proposed Pipe Diameter (in)	Existing Material	Length (ft)	Notes
	Carriage Way	8	12	AC	620	Suncrest Dr west
	Kapteyns St	6	12	AC	2120	Marylhurst Dr south
	Marylhurst Circle	4	8	AC	530	AC
	Arran Ct	4	8	DI	200	No F.H., install 400' from end
	View Dr	6	8	AC	1500	PRV station to Rydman (AC)
	Marylhurst Dr	6	10	AC	240	Between View Dr and Midhill Circle
	Upper Midhill Dr	4	10	CI	800	Robinwood Way to Marylhurst Dr. Looped
	South of Robinwood Way	2	6	PVC	500	Parallel to Lower Midhill Dr. Consider new alignment. No F.H.
	Lower Midhill Dr	6	10	AC	1740	Arbor Dr to Marylhurst Dr. Looped
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