Home of the Tualatin River National Wildlife Refuge

CITY COUNCIL MEETING PACKET

FOR

Tuesday, April 21, 2015

Sherwood City Hall
22560 SW Pine Street
Sherwood, Oregon

5:30 pm Work Session

7:00 pm City Council Regular Meeting

URA Board of Directors Meeting
(following the City Council meeting)

City of Sherwood Oregon

Home of the Tualatin River National Wildlife Refuge

AGENDA

SHERWOOD CITY COUNCIL
April 21, 2015

5:30 pm Work Session

7:00 pm City Council Meeting

URA Board of Directors Meeting
(following the Council Mtg.)

Sherwood City Hall
22560 SW Pine Street
Sherwood, OR 97140

5:30 PM WORK SESSION

A. Water Master Plan, Rates and SDC (Craig Sheldon, Julie Blums)

REGULAR CITY COUNCIL MEETING

1. CALL TO ORDER

2. PLEDGE OF ALLEGIANCE

3. ROLL CALL

4. APPROVAL OF AGENDA

5. CONSENT AGENDA

- **A. Approval of April 7, 2015 City Council Meeting Minutes**
- **B. Resolution 2015-041 Appointing Meerta Meyer to the Budget Committee**
- **C. Resolution 2015-042 Authorizing the City Manager to take actions necessary for accepting the State of Oregon Department of Transportation's request for transfer of State road right-of-way (portions of SW Langer Drive) into City jurisdiction and maintenance control**
- **D. Resolution 2015-044 Authorizing appointment of Eric Kneifel to Parks and Recreation Board**
- **E. Resolution 2015-045 Authorizing appointment of Brian Amer to Parks and Recreation Board**

6. PRESENTATIONS

- **A. Proclamation, Recognition of Sherwood Resident**
- **B. Oregon Accreditation Alliance - Ed Boyd** (Jeff Groth, Police Chief)
- **C. Sherwood Main Street Presentation - Lee Weislogel** (Tom Pessemier, Assistant City Manager)

7. CITIZEN COMMENTS

8. NEW BUSINESS

- **A. Resolution 2015-043 Authorizing the City Manager to sign an Intergovernmental Agreement (IGA) with the Washington County Emergency Management Co-operative for the purpose of becoming a partner agency** (Jeff Groth, Police Chief)

9. PUBLIC HEARINGS

A. **Ordinance 2015-004 Amending Chapter 7 of Volume II of the Sherwood Comprehensive Plan and adopting the Sherwood Water System Master Plan** (Brad Kilby, Planning Manager), (1st Reading)

10. CITY MANAGER REPORT

11. COUNCIL ANNOUNCEMENTS

12. ADJOURN TO URA BOARD OF DIRECTORS MEETING

How to Find Out What's on the Council Schedule:
City Council meeting materials and agenda are posted to the City web page at www.sherwoodoregon.gov, by the Friday prior to a Council meeting. Council agendas are also posted at the Sherwood Library/City Hall, the YMCA, the Senior Center, and the Sherwood Post Office. Council meeting materials are available at the Sherwood Public Library.

To Schedule a Presentation before Council:
If you would like to schedule a presentation before the City Council, please submit your name, phone number, the subject of your presentation and the date you wish to appear to the City Recorder Sylvia Murphy, 503-625-4246 or murphys@sherwoodoregon.gov

SHERWOOD CITY COUNCIL MEETING MINUTES
22560 SW Pine St., Sherwood, Or
April 7, 2015

WORK SESSION

1. **CALL TO ORDER:** Mayor Krisanna Clark called the meeting to order at 6:32 pm.

2. **COUNCIL PRESENT:** Mayor Krisanna Clark, Council President Sally Robinson, Councilors Linda Henderson, Dan King, Jennifer Harris, Jennifer Kuiper. Councilor Beth Cooke was absent.

3. **STAFF PRESENT:** City Manager Joseph Gall, Assistant City Manager Tom Pessemier, Police Captain Mark Daniel, Human Resources Analyst Sherryl Childers, Administrative Assistant Colleen Resch and City Recorder Sylvia Murphy.

4. **TOPICS:**

A. City County Insurance Services Video Presentation

Assistant City Manager Pessemier introduced the City's insurance agents WSC Director of Executive Risk Alycia Johnson and WSC Account Executive Lynn Omey and gave a brief explanation of the services provided to the City. He said the City County Insurance Services (CIS) has offered a $1000 premium discount for viewing the video that will be presented.

Human Resources Analyst Sherryl Childers stated the City used to work directly with CIS but realized the need for a broker. She said the City now partners with WCS and explained the role they play as insurance brokers.

Alycia Johnson said WSC focuses on public entities and specialized types of insurance, risk management and policies and procedures that local governments have to deal with as it relates to citizens and administration. She said she helps with policy reviews, contracts and best practices. She stated they work alongside the CIS representative to reduce the overall premiums and to mitigate risk.

Lynn Omey stated she specialized in worker's compensation and serves as a second set of eyes to make sure the audits are correct, the experience modification is correct and provides assistance with claims to get additional discounts.

The Council watched the CIS video.

Councilor Henderson shared an experience of riding in a City vehicle with staff and not being covered under CIS and had to make a claim through her own insurance. Ms. Omey said that is part of the volunteer resolution and all cities have an option to cover their volunteers under worker's comp or elect not to. She said changes can be made to make sure that any injuries sustained on city business can be covered as a worker's comp claim.

Councilor Kuiper asked if volunteers have any coverage under the current plan for conducting business. Mr. Omey said she will look that up and email the information to Ms. Childers.

With no further questions, Mayor Clark adjourned the meeting.

5. ADJOURN

Mayor Clark adjourned the work session at 6:55 pm and convened to a regular Council meeting.

REGULAR SESSION

1. **CALL TO ORDER:** Mayor Clark called the meeting to order at 7:03 pm.

2. **COUNCIL PRESENT:** Mayor Krisanna Clark, Council President Sally Robinson, Councilors Linda Henderson, Dan King, Jennifer Harris, and Jennifer Kuiper. Councilor Beth Cooke arrived at 7:08 pm.

3. **STAFF PRESENT:** City Manager Joseph Gall, Assistant City Manager Tom Pessemier, Police Captain Mark Daniel, Public Works Director Craig Sheldon, Administrative Assistant Colleen Resch, and City Recorder Sylvia Murphy.

4. APPROVAL OF AGENDA:

MOTION: FROM COUNCILOR KUIPER TO APPROVE THE AGENDA, SECONDED BY COUNCILOR HARRIS. MOTION PASSED 6:0, ALL PRESENT MEMBERS VOTED IN FAVOR. (COUNCILOR COOKE WAS ABSENT).

Mayor Clark addressed the next item on the agenda.

5. CONSENT AGENDA:

A. **Approval of March 17, 2015 City Council Meeting Minutes**
B. **Resolution 2015-035 Approving the City Recorder's canvassing of the returns of the March 10, 2015 Washington County Election and directing the City Recorder to enter the results into the record**
C. **Resolution 2015-036 Appointing Kurt Studer to the Budget Committee**
D. **Resolution 2015-037 Appointing Christopher Flores to the Planning Commission**
E. **Resolution 2015-038 Appointing Michael Meyer to the Planning Commission**
F. **Resolution 2015-039 Reappointing Christine McLaughlin to the Library Advisory Board**

MOTION: FROM COUNCILOR HARRIS TO APPROVE THE CONSENT AGENDA, SECONDED BY COUNCILOR KUIPER. MOTION PASSED 6:0, ALL PRESENT MEMBERS VOTED IN FAVOR. (COUNCILOR COOKE WAS ABSENT).

Mayor Clark addressed the next item on the agenda.

6. PRESENTATIONS:

A. Eagle Scout Recognition

Mayor Clark congratulated Miles Camp for earning his Eagle Scout Award. Mayor Clark asked Miles to explain his Eagle Scout project. Miles stated he built a new sign for Cedar Creek Church. He said he obtained a permit from the City, received donated materials from Home Depot, and explained the scope of work. Mayor Clark thanked him for his service and contributions and presented him with a Certificate of Achievement.

Mayor Clark congratulated Riley Dixon for earning his Eagle Scout Award. Mayor Clark asked Riley to explain his Eagle Scout project. Riley stated he built 6, 4'x8' flower boxes from Middleton Elementary School. He said Griffin Gardens donated the materials and he explained the scope of work. Mayor Clark thanked him for his service and contributions and presented him with a Certificate of Achievement.

Mayor Clark addressed the next item on the agenda.

7. CITIZEN COMMENTS:

Jim Folske, Sherwood resident at 14391 SW Fairoaks Drive approached the Council and said everyday weather permitting he and his wife walk their dog and have to cross Murdock from Fairoaks Drive and would like to see a crosswalk put there. He stated he listens to the daily news and it seems everyday there is a fatality in the Portland area and he would hate to see one here. He said this is a tough road to cross at times and anything that could be done to accelerate the process in getting a crosswalk at Fairoaks and Murdock would be greatly appreciated.

Cynthia Folske, Sherwood resident on Fairoaks Drive came forward and stated there are about 11 children in the Fairoaks area that cross this street at least twice a day. She stated people drive down that hill and come down pretty fast. She stated that they have found while out walking that while standing at the intersection drivers will not stop. She said it would be great to have a button to push with a flashing light, but just stripes on the road is a start.

Councilor Kuiper asked where this intersection is in regards to Fairoaks.

Ms. Folske said one street would be Willamette Street and Fairoaks Drive, just past the Murdock Apartments going up the hill.

Kurt Kristensen, Sherwood resident on Fairoaks Drive approached the Council and said they have been working on this project for almost a year. He said he recently received an email from Joe stating staff was working on it. He said the safety study done by City Engineer Bob Galati a year ago has some impressive numbers. He said the information indicated that in the middle of the day there are between 200 and 300

cars per hour coming across Murdock. He said it is difficult to cross the road and the cars do not stop and are going 55 mph going downhill. He said he has a copy of the study for the Council members and provided it to the City Recorder. He commented on other areas along Sunset near Archer Glen where the cars are not stopping and said we should take a look at safe crosswalks all over the City so that we don't have a fatality. He said if the City constructs a cool crosswalk he would appreciate that, but would appreciate it more if we get something put up in the meantime. He noted the Police Department had their flashing signal in this area and in his observation over a weeks' time it changed the behavior of the drivers and was very effective. He commented about the traffic control devise near Archer Glen and the effectiveness of modifying driver's behavior. He said he appreciates that design parameters and budgeting needs that need to be done and said in the meantime even a blinking signal or something similar would be useful.

Nancy Batz, Sherwood resident came forward and said she resides in the Fairoaks division and is in support of traffic control at the intersection of Murdock, Fairoaks and Willamette Drive. She said she has been a resident for 24 years and for the past year, the residents have attempted to get some sort of traffic control in that area. She said her and her husband walk daily and it is very difficult to cross that intersection and very few drivers recognize their obligation to stop at the intersection. She referred to the commonality of 20 or more cars driving by without stopping and stated they have observed a Portland Police Officer driving by without stopping. She referred to the speed studies done by the City in the past year that have shown a significant percentage of drivers going over the 35 mph limit. She said she strongly encourages the City to introduce some form of measures to control this intersection so both pedestrians and drivers can be safe in negotiating the intersection.

Mayor Clark thanked the Fairoaks neighborhood for coming forward and said she appreciates hearing their concerns and echoes the concerns. She said she attended the Washington County coordinating meeting and there was a presentation from the Safe Routes to School Program and said she will join City Manager Gall in meeting with them regarding having safe routes to schools all over our City. She commented that these improvements don't come without costs and if we can find the costs in these programs we want to make sure we are looking for that. Mayor Clark said she would add this request to the list for when she meets with them.

Wade Anderson, Sherwood resident approached the Council and informed them of two "shovel ready" community gardens in Sherwood and said both are open to the public. He said one is at the Sherwood Community Friends Church, 23264 SW Main Street and their website is sherwoodfriends.org and the other is at the Cedar Creek Church, 21901 SW Sherwood Blvd and their website is cedarcreeksherwood.org. He stated by far, of the Cedar Creek Church's plots most are held by nonmembers and said their planting day is Saturday, April 11 from 9 to 11 am. He said on May 16 from 9-11 am there is a meet and greet for fellow gardeners and a local nursery will be providing warm crop items such as tomatoes at discounted prices. He said both gardens are a great resource to our community. He announced the Running Water 5k will be on Saturday, May 9 at 8:30 am, gathering at the Senior Center parking lot. He commented on the need for clean water and said 100% of the proceeds go to providing fresh water wells to the residents of Zambia, Africa. He encouraged citizens to attend or sponsor someone who will run in their place.

Mayor Clark addressed the next item on the agenda.

8. NEW BUSINESS:

A. Resolution 2015-040 Authorizing the City Manager to execute a construction contract for the Highland and Orcutt Sanitary Sewer Rehabilitation Project

Public Works Director Craig Sheldon presented the staff report and said during routine maintenance video inspections they discovered two sets of bad sewer lines that had bad ratings. He said there is a scale of 5 when you rate sewer lines and there were a lot of 4's and 5's which can create issues for maintenance as well as property owners in the future. He stated this project would replace these two sections of sewer line. He said the project would use a pipe bursting method to minimize the impact to the property owners. He said the City advertised on March 11 and 13 in the Daily Journal of Commerce with a mandatory bidding on March 17 and K & R was the lowest bidder. He stated the contract is for $172,884 with a contingency of 15% for a total of $198,816.

Council President Robinson asked what the next highest bid was.

Mr. Sheldon said the next highest bid was $192,292.

Council President Robinson asked if there is any concern that the project cannot be done for $172,000.

Mr. Sheldon said it can be done for $172,000 and said there are areas where they can save but said when you try to hook up to existing sewer lines there could be additional costs. He said they will certainly use some of the contingency.

With no other questions, the following motion was received.

MOTION: FROM COUNCIL PRESIDENT ROBINSON TO APPROVE RESOLUTION 2015-040, SECONDED BY COUNCILOR KUIPER. MOTION PASSED 7:0, ALL PRESENT MEMBERS VOTED IN FAVOR.

Mayor Clark addressed Council Announcements.

9. COUNCIL ANNOUNCEMENTS:

Councilor King thanked everyone that voted in the last election and supporting him.

Councilor Harris stated Tonya Russo Hamilton and illustrator Britta Nicholson will be at the library on Saturday at 1 pm to discuss growing, harvesting and preparing your own food. She said National Library Week is coming up and events are listed on the City website. She announced the Art of Storytelling event scheduled for April 18 at the Sherwood Center for the Arts at 6:30 pm. She said the event is free and 503 Uncorked will be there.

Council President Robinson comment on the Citizen Advisory meeting with the Sherwood West Concept Plan last week at the Police Station. She said they discussed the Sherwood housing needs analysis. She encouraged everyone to attend future meetings and said the information is on the City website. She said there will be a Planning Commission public hearing on April 14 regarding medical marijuana dispensaries. She stated the Planning Commission recommendation will likely come to the Council on April 28.

Councilor Henderson announced the High School is doing a production of *Thoroughly Modern Millie* on April 24-26 and May 1-3. She stated there will be auditions for *Into the Woods* on April 16-17 at Cross Roads Church. She commented on the first Police Advisory Board meeting on March 19 and provided a brief recap of the meeting and said they elected a Chair and a Vice Chair. She asked staff about political signs in County right of way.

Assistant City Manager Pessemier said he will check to see if the City can enforce the sign code in a County right of way.

Councilor Cooke announced the Archer Glen Eagle Market Place and Fair on April 17 at 4:00 pm.

Councilor Kuiper stated the Parks and Recreation Board met on April 6 and reported there will be a neighborhood public meeting on April 20 upstairs at City Hall at 7:00 pm to display the final design for Woodhaven Park Phase II and the citizen's comments will come before the Parks Board in May. She announced staff is in the process of finalizing the design for the Dog Park and they will break ground in July. She said the Hopkins Hoop De Do Carnival is Friday, April 10. She said the Robin Hood Festival is accepting applications for the Maid Marian Courts.

Mayor Clark addressed the City Manager Report on the agenda.

10. CITY MANAGER REPORT:

City Manager Gall said the Dog Park will be in the proposed budget and announced that the *Bark for your Park* national competition is going to start again in May and will encourage the community to participate and support the Dog Park. He said the winning community will receive $100,000 and there are 4 runner-up communities that will receive $25,000. He said Sherwood was close to receiving funds last year. He commented on the traffic situation on Murdock and said that staff has been working on some alternatives. He noted it is budget season and he is working on other pedestrian safety improvements and requests from neighborhoods. He said there are budget constraints and Murdock is being evaluated. He stated another concern was the stop sign by Snyder Park and they need enhancements to emphasize the stop sign. He said the budget cannot fund all of these requests and he will be seeking input from the Council in terms of priorities. He stated he is in the process of finalizing the budget and it will be released on May 1 and the first Budget Committee Meeting is on May 13.

Mr. Pessemier reminded the Council that they are soliciting requests for proposals for the lease space at the Sherwood Center for the Arts and have advertised in the Sherwood Gazette, Tigard Times and the Daily Journal of Commerce. He stated there are signs on the building and a real estate firm has been selected.

Mayor Clark said she toured the Beaverton Community Gardens with Councilor Harris and a number of staff and they are planning on tapping into those resources to give Sherwood the best product possible. She said on April 1 she attended the Industrial Partners Recognition Awards where Cascade Columbia Distribution of Sherwood received an award from Clean Water Services for responsible stewardship of the Tualatin Watershed. She commented on the Egg Hunt for Hope benefit for Emma Aanderud and the Rose Family Fundraiser put on by the Sherwood Dance Academy at the Sherwood High School. She attended both and they benefitted citizens in Sherwood that are fighting cancer. She announced that Congresswoman Suzanne Bonamici will visit Sherwood on Thursday, April 9 and she will visit the

Sherwood Center for the Arts and Mud Puddles. She announced the Arbor Day planting on Friday, April 10 at 2:30 pm at the terrace in Sherwood View Estates. She stated she is attending the TVFR volunteer's dinner on Saturday. She announced the Library will have an open house for the staff and elected officials on Tuesday, April 14 at 9-10 am. She said there will be a Volunteer Appreciation Dinner on April 14 at the Center for the Arts.

11. ADJOURN:

MOTION TO ADJOURN: COUNCILOR KUIPER MOTIONED TO ADJOURN, SECONDED BY COUNCILOR HARRIS. MOTION PASSED 7:0, ALL PRESENT MEMBERS VOTED IN FAVOR.

Mayor Clark adjourned the regular meeting at 7:45 pm.

Submitted by:

Sylvia Murphy, MMC, City Recorder

Krisanna Clark, Mayor

City Council Meeting Date: April 21, 2015

Agenda Item: Consent Agenda

TO: Sherwood City Council

FROM: Julie Blums, Finance Director
Through: Joseph Gall, ICMA-CM, City Manager

SUBJECT: Resolution 2015-041 Appointing Meerta Meyer to Budget Committee

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Issue:
Should the City Council appoint Meerta Meyer to the Budget Committee?

Background:
The Budget Committee consists of the City Council and seven Sherwood citizens. There is currently one position open on the Budget Committee. Staff received four applications to serve on the Committee and Mayor Clark, Neil Shannon, Citizen Member of the Budget Committee, and I interviewed three of the candidates. The Mayor, Mr. Shannon, and I recommend that Meerta Meyer be appointed to the Budget Committee to serve the remainder of the unexpired term of former member Tim Carkin's three year term ending June 30, 2016.

Financial Impacts:
None

Recommendation:
Staff respectfully recommends City Council adoption of Resolution 2015-041 appointing Meerta Meyer to the Budget Committee.

City of Sherwood Oregon
Home of the Tualatin River National Wildlife Refuge

RESOLUTION 2015-041

APPOINTING MEERTA MEYER TO THE BUDGET COMMITTEE

WHEREAS, there is one vacancy on the Budget Committee for a citizen member; and

WHEREAS, the City advertised the vacancy and received four applications for consideration; and

WHEREAS, Meerta Meyer was among three applicants interviewed by Mayor Clark, the Council liaison to the Budget Committee, Finance Director Julie Blums, and Budget Committee Citizen member Neil Shannon; and

WHEREAS, Meerta Meyer was endorsed by the interview panel.

NOW, THEREFORE, THE CITY OF SHERWOOD RESOLVES AS FOLLOWS:

Section 1. Meerta Meyer is hereby appointed to the Budget Committee to complete the three year term of former member Tim Carkin, ending June 30, 2016.

Section 2. This Resolution shall be effective upon its approval and adoption.

Duly passed by the City Council this 21st day of April 2015.

_____
Krisanna Clark, Mayor

Attest:

_____
Sylvia Murphy, MMC, City Recorder

City Council Meeting Date: April 21, 2015

Agenda Item: Consent Agenda

TO: Sherwood City Council

FROM: Bob Galati PE, City Engineer
Through: Joseph Gall, ICMA-CM, City Manager
Julia Hajduk, Community Development Director
Craig Sheldon, Public Works Director

SUBJECT: **Resolution 2015-042, Authorizing City Manager to Take Actions Necessary for Accepting the State of Oregon Department of Transportation's Request for Transfer of State Road Right-of-Way (portions of SW Langer Drive) into City Jurisdiction and Maintenance Control**

Issue:
Shall the City Council authorize the City Manager to take necessary actions for accepting the State of Oregon Department of Transportation's (ODOT) request for the transfer of State road right-of-way into City jurisdiction and maintenance control? Specifically, ODOT wishes to transfer portions of SW Langer Drive right-of-way still currently under ODOT jurisdictional control to the City.

Background:
On February 23, 2015, an Oregon Department of Transportation (ODOT) representative notified City staff in writing of an apparent issue of jurisdictional ownership of public right-of-way along SW Langer Drive. During ODOT's construction of the Highway 99W and Six Corners project in 1990, ODOT had entered into an agreement (MC&A 9869) in which one requirement stated that *"State shall relinquish jurisdiction and maintenance responsibilities to County for the existing road connection between North Sherwood Road and Edy Road on the east side of Pacific Highway West".* It should be noted that the ODOT documents and correspondence refer to the street as Edy Road; however, this section was renamed to Langer Drive subsequent to these documents.

Based on the information provided by ODOT, it appears that transfer of jurisdiction and maintenance control never was concluded. During the intervening time, Washington County has relinquished control over the majority of the roadways within the City limits, including those portions of SW Langer Drive not under the authority of ODOT.

This action is in conformance with the City's intent to have jurisdiction and maintenance control of all roadways within the City limits with classifications of arterial, collector, neighborhood and local streets. For all intents and purposes, the City has been treating this section of SW Langer Drive as a City owned right-of-way and been maintaining the roadway accordingly.

These sections of SW Langer Drive meet the City's roadway design standards with the exception of not having sidewalk along its west side in some areas. However, since the east side frontage does have sidewalk, and ODOT has previously indicated that they are unable to provide additional funds to facilitate the completion of this type of transfer, conditioning acceptance of transfer with the requirement of constructing sidewalk is not recommended.

The physical condition of the asphalt pavement surface is deemed acceptable for acceptance of the roadway sections.

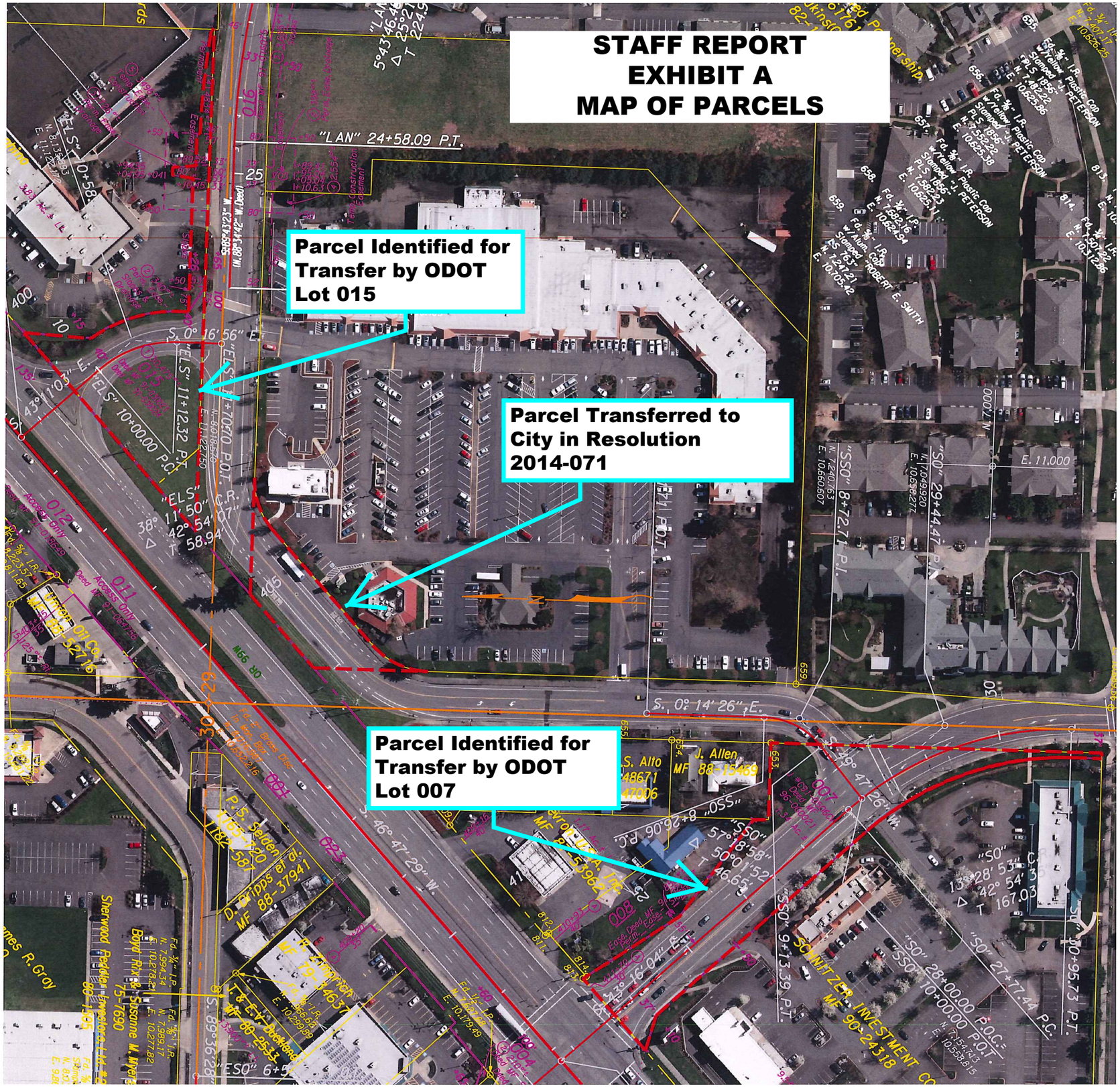
Financial Impacts:
Acceptance of jurisdiction and maintenance responsibilities for the subject portion of SW Langer Drive will have no financial impact on the City, as this road is already part of the City's ongoing street maintenance plans.

Recommendation:
Staff respectfully requests City Council adoption of Resolution 2015-042, authorizing the City Manager to take actions necessary for accepting the State of Oregon Department of Transportation's request for the transfer of State road right-of-way into City jurisdiction and maintenance control.

Attachments:

- Copy of ODOT Miscellaneous Contracts & Agreements #9869
- Maps depicting location and area of right-of-way in question.

STAFF REPORT
EXHIBIT A
MAP OF PARCELS



City of Sherwood Oregon
Home of the Tualatin River National Wildlife Refuge

RESOLUTION 2015-042

AUTHORIZING THE CITY MANAGER TO TAKE ACTIONS NECESSARY FOR ACCEPTING THE STATE OF OREGON DEPARTMENT OF TRANSPORTATION'S REQUEST FOR TRANSFER OF STATE ROAD RIGHT-OF-WAY (PORTIONS OF SW LANGER DRIVE) INTO CITY JURISDICTION AND MAINTENANCE CONTROL

WHEREAS, an April 30, 1990, Cooperative Improvement Agreement, (MC&A #9869, Exhibit A) between the State of Oregon and Washington County, undertook the reconstruction of the "Six-Corners" intersection area; and

WHEREAS, in the Agreement under State Obligations, Section 4 states that at the completion of the project construction the State of Oregon would relinquish jurisdiction and maintenance responsibilities of SW Langer Drive to Washington County; and

WHEREAS, this relinquishment requirement of the Agreement was not officially completed and in the intervening time Washington County has relinquished jurisdiction and maintenance responsibilities of most of the County roadways to the City of Sherwood; and

WHEREAS, because of this oversight several portions of SW Langer Drive right-of-way (Map, Exhibit B), still officially remains within State of Oregon jurisdiction and maintenance control; and

WHEREAS, it is a City of Sherwood policy to have jurisdiction and maintenance control of all roadways within the City limits with street classifications of arterial, collector, neighborhood or local; and

WHEREAS, City staff has performed an inspection of the subject portion of SW Langer Drive right-of-way and have determined that the pavement material has sufficient design life remaining to recommend acceptance of the transfer without conditions.

NOW, THEREFORE, THE CITY OF SHERWOOD RESOLVES AS FOLLOWS:

Section 1. That the City of Sherwood acknowledges and accepts the obligations for transfer of jurisdiction and maintenance responsibilities for that section of SW Langer Drive currently under State of Oregon control, as shown on the map in Exhibit B.

Section 2. That the City Manager is directed to take all necessary actions to complete the transfer of SW Langer Drive right-of-way currently under the State of Oregon jurisdiction control to the City of Sherwood.

Section 3: This Resolution shall become effective upon approval and adoption.

Duly passed by the City Council this 21st day of April 2015.

_____
Krisanna Clark, Mayor

Attest:

_____
Sylvia Murphy, MMC, City Recorder

EXHIBIT A

Approved: OHSD Staff
EDM
April 30, 1990

Misc. Contracts & Agreements
No. 9869

COOPERATIVE IMPROVEMENT AGREEMENT
CONSTRUCTION FINANCE AND MAINTENANCE

MISC. CONTRACTS and AGREEMENTS No. 9869

THIS AGREEMENT is made and entered into by and between THE STATE OF OREGON, acting by and through its Department of Transportation, Highway Division, hereinafter referred to as "State"; and WASHINGTON COUNTY, a political subdivision of the State of Oregon, acting by and through its elected officials, hereinafter referred to as "County".

W I T N E S S E T H

RECITALS

1. Pacific Highway West is a part of the state highway system under the jurisdiction and control of the Oregon Transportation Commission, and Tualatin-Sherwood/Edy Rd. is a part of the County Road System, under the jurisdiction and control of County.

2. For the purpose of providing acceptable traffic patterns on public highways, State plans and proposes to reconstruct and signalize Pacific Highway West @ Edy Road, Scholls Highway (Six Corners), hereinafter referred to as "project". The County proposes improvements to Tualatin-Sherwood/Edy Rd. which intersects the project and includes two private parcels of land (Langer parcels) that are common to both roadway projects. The location of the project is approximately as shown on the sketch map attached hereto, marked Exhibit A, and by this reference made a part hereof.

3. Full improvements in the Six Corners intersection area are estimated to cost $5,400,000 for right-of-way and construction. The cost sharing of Six Corners as agreed on July 21, 1989 is as follows:

a. Washington County shall contribute a maximum of $500,000 for "urbanization" improvements (curbs, sidewalks, drainage, and street lighting) along both North Sherwood Road and Edy Road.

b. State will be responsible for the estimated 4.9 million to complete funding of the Six Corners project as well as cover any additional project costs. State financing of this project is covered by Access Oregon Highways funds.

Contract No. 9869
WASHINGTON COUNTY

4. By the authority granted in ORS 366.770, and 366.775, State may enter into cooperative agreements with the counties and cities for the performance of work on certain types of improvement projects with the allocation of costs on terms and conditions mutually agreeable to the contracting parties. Traffic signal work on the project will conform to the current State standards and specifications.

5. By the authority granted in ORS 810.210, State is authorized to determine the character or type of traffic control signals to be used, and to place or erect them upon State highways at places where State deems necessary for the safe and expeditious control of traffic. No traffic control signals shall be erected or maintained upon any State highway by any authority other than State, except with its written approval.

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

STATE OBLIGATIONS

1. State shall, conduct the necessary field surveys, foundation explorations and hydraulic studies, identify and obtain all required permits, and perform all preliminary engineering and design work required to produce final plans, preliminary/final specifications and cost estimates.

2. State shall acquire in the name of State the necessary right-of-Way and easements for the project within State jurisdiction including the new road connection to existing Edy Road, east of Pacific Highway West.

3. State shall acquire in the name of County the necessary right-of-Way and easements for the project within County jurisdiction except the Langer Parcels.

4. State shall relinquish jurisdiction and maintenance responsibilities to County for the existing road connection between North Sherwood Road and Edy Road on the east side of Pacific Highway West.

5. State shall, upon award of a construction contract, furnish all construction engineering, field testing of materials, technical inspection and project manager services for administration of the contract.

6. State shall, upon satisfactory signal turn-on and completion of the illumination, perform all necessary maintenance of the traffic signals and illumination and will initially pay for maintenance and power costs. State will bill County annually for its share of the maintenance and power costs. The State shall retain complete jurisdiction and control of the timing established for operation of the traffic signals.

COUNTY OBLIGATIONS

1. County shall prepare right-of-way descriptions and purchase the Langer parcel, and provide the required right-of-way from the Langer file for both transportation improvements.

2. County shall forward an advance deposit to State prior to State advertising for bids for the project. The actual amount deposited will equal $500,000 minus County right-of-way description/acquisition costs of the Langer property required by the State for the project. Any portion of said advance deposit which is in excess of the total actual cost will be refunded or released to County.

3. County hereby grants State the right to enter into and occupy County road right-of-way for the performance of necessary maintenance of the traffic signal equipment, including vehicle detector loops.

4. County shall maintain the asphaltic concrete pavement surrounding the vehicle detector loops installed in County road in such a manner as to provide adequate protection for said detector loops, and shall adequately maintain the pavement markings and signing installed in accordance with the plans and specificaitons.

5. County shall, upon request by State, relocate or reconstruct, or cause to be relocated or reconstructed, all privately or publicly-owned utility conduits, lines, poles, mains, pipes, and all other such facilities of every kind and nature, where such utilities or facilities are located within the right-of-way of any presently existing County road where such relocation or reconstruction is necessary in order to conform the utilities or facilities to the plans for the project. County may request State to arrange for said relocation, acting on behalf of County.

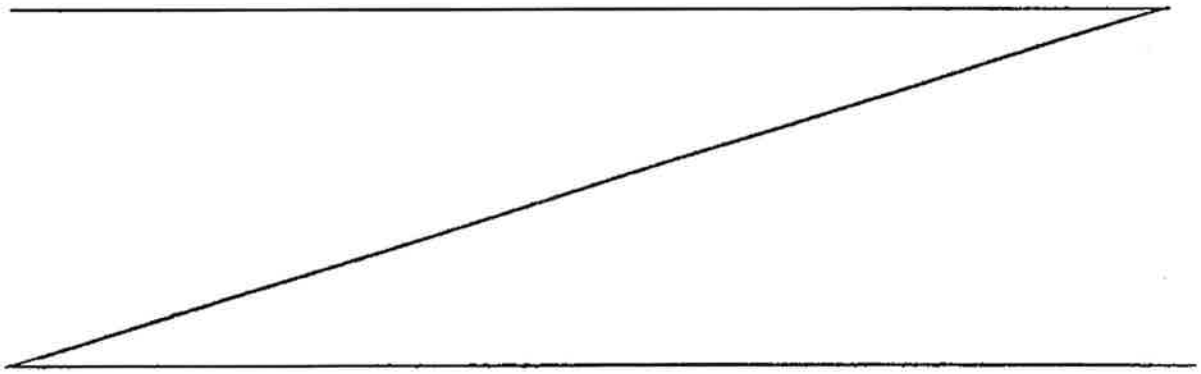
6. County shall, upon completion of project, annually reimburse State for it's share of the maintenance and power costs. Currently, County shall pay 50 percent of the maintenance and power costs attributed to the operation of the signals, and 75 percent of the maintenance and power costs attributed to the operation of the illumination, until such time as it is renegotiated.

7. County shall authorize execution of this agreement during a regularly convened session of its Board of County Commissioners.

GENERAL PROVISIONS

1. State and County agree and understand that a mutual review of the project plans will be conducted prior to advertisement for construction bid proposals.

2. Subject to the limitations of the Oregon Constitution and statutes; County and State each shall be solely responsible for any loss or injury caused to third parties arising from County's or State's own acts or omissions under this agreement, and County or State shall defend, hold harmless and indemnify the other party to this agreement with respect to any claim, litigation or liability arising from County's or State's own acts or omissions under this agreement.



3. The Contractor, its subcontractors, if any, and all employers working under this Agreement are subject employers under the Oregon Workers' Compensation Law and shall comply with ORS 656.017, which requires them to provide workers' compensation coverage for all their subject workers.

Contract No. 9869
WASHINGTON COUNTY

IN WITNESS WHEREOF, the parties hereto have set their hands and affixed their seals as of the day and year hereinafter written.

This project was approved by the Oregon Transportation Commission on August 16, 1988, as part of the Six Year Highway Improvement Program (Page 57). The Oregon Transportation Commission by a duly adopted delegation order authorized the State Highway Engineer to sign this agreement for and on behalf of the Commission. Such authority is set forth in the Minutes of the Oregon Transportation Commission.

APPROVAL RECOMMENDED
By _____
Region Engineer

Date 5/24/90

APPROVED AS TO
LEGAL SUFFICIENCY
By Dale R. Hohmann
Asst. Attorney General

Date 8/9/90

APPROVED AS TO
LEGAL SUFFICIENCY
By _____
County Counsel

Date 6-11-90

WASHINGTON COUNTY
Billing Address:

Washington County
150 North First Street
Hillsboro, OR 97124

STATE OF OREGON, by and through its Department of Transportation, Highway Division

By William Kuhlke
for State Highway Engineer

Date 8/16/90.

WASHINGTON COUNTY, by and through its Elected Officials

By Bonnie L. Hays
Chairman

By _____
Commissioner

By _____
Commissioner

Date _____

APPROVED WASHINGTON COUNTY
BOARD OF COMMISSIONERS
MINUTE ORDER # 90-285
DATE 7-10-90
BY Nancy Pinke
CLERK OF THE BOARD

B1190003

EXHIBIT B
IDENTIFIED AREAS OF TRANSFER

Lot 016 Transferred to Washington County in 1994 Subsequently transferred to City under Resolution 96-653

Lot 007 ODOT Requested Area of Transfer

Lot 015 ODOT Requested Area of Transfer

Area Transferred to City under Resolution 2014-071

"LAN" 20+15.57 P.C.

"LAN" 24+

"LAN" 26+50.00 P.O.T.
N. 8 010.745
E.11 196.465

Fd. 5/8" I.R.
6832.52
E. 10689.56

S.W. LANGER DR.
(FORMERLY EDY RD.)

S.W. LANGER DR.
(FORMERLY BORCHERS DR.)

CROSS OVER BETWEEN EDY & BORCHERS

CONNECTION FROM LANGER TO PACIFIC

S.W. SHERWOOD BLVD.

SCHNITZER INVE
MF 90-2

016
Deed MF 91-016075

007
J #C91-0506CV
Deed MF
92-060021
1.34 Ac.±

015
Deed MF 91-030023
Deed MF 91-030024
30,475 ft²±

008

013
Deed MF 91-015734

012
Access Only
Deed MF 91-018649

011
Access Only
Deed MF 91-064756

004
2 210 ft²±
Deed MF 91-059331
Deed MF 91-059332

027
Access Only

Deed 2003-165212
6007317 2.399 ft²±

1 20 ft²±
2 989 ft²±
Perm. Ease. Drainage
3 726 ft²±
Perm. Ease.- Drainage
4 2,554 ft²±
Temp. Construction Easement
5 3496 ft²±
Temp. Ease.- Construction
2 340 ft²±
Perm. Ease.- Slopes & Drainage
1 30,475 ft²±
850 ft²±
Ease. Deed MF 91-022937
Perm. Ease. Slopes

Fd. 2" Brass Disc
in Mon. Box
N. 8.016.987
E. 10.652.216

Fd. 5/8" I.R.
N. 8.433.04
E. 11.029.51

Fd. 1" Axle w/3" Gear
N. 8.283.51
E. 10,870.16

Fd. 5/8" I.R.
N. 8.223.57
E. 10,811.65

Fd. 1/2" I.P.
N. 7.627.68
E. 10.179.49

Fd. 5/8" I.R.
N. 7.420.58
E. 9,958.98

Fd. 5/8" I.R.
N. 7.293.73
E. 10,078.13

Union Oil Co.
MF 88-52716

P. S. Selden
1165-720
1182-587

J. Allen
MF 88-15469

J.F. & D.S. Alto
MF 86-48671
MF 86-47006

R. Bahr et al.
MF 84-33103

Chevron U.S.A. Inc.
MF 87-53962

Sold to
D.A. & W. Kang
Deed MF 95 011900

L. Cereghino
P-9892
3.83 Ac.± Lt.

1.17 Ac.± Lt.

9.54 Ac.

83.585 ft²± Rt.

A. Edwards
153

Council Meeting Date: April 21, 2015

Agenda Item: Consent Agenda

TO: Sherwood City Council

FROM: Kristen Switzer, Community Services Director
Through: Joseph Gall, ICMA-CM, City Manager

SUBJECT: Resolution 2015-044 Authorizing Appointment of Eric Kneifel to the Parks and Recreation Board

---

ISSUE:
Should the City Council appoint Eric Kneifel to the Parks and Recreation Board?

BACKGROUND:
The Parks and Recreation Board currently has vacancies and Eric Kneifel has applied for appointment. Interviews were conducted and the Council Liaison Kuiper, the Chair of the Parks and Recreation Board, with assistance of staff, is recommending Eric Kneifel for appointment.

According to Chapter 2.16 of the Sherwood Municipal Code, members of the Parks and Recreation Board shall be appointed by the Mayor with consent of the City Council.

RECOMMENDATION:
Staff respectfully recommends City Council approval of Resolution 2015-044 authorizing appointment of Eric Kneifel to the Parks and Recreation Board.

City of Sherwood Oregon
Home of the Tualatin River National Wildlife Refuge

RESOLUTION 2015-044

AUTHORIZING APPOINTMENT OF ERIC KNEIFEL TO THE PARKS AND RECREATION BOARD

WHEREAS, the Parks and Recreation Board currently has vacancies and Eric Kneifel has applied for appointment; and

WHEREAS, Council Liaison Jennifer Kuiper, and the Chair of the Parks Board, with assistance of staff, are recommending Eric Kneifel for appointment; and

WHEREAS, according to Chapter 2.16 of the Sherwood Municipal Code, members of the Parks and Recreation Board shall be appointed by the Mayor with consent of the City Council.

NOW, THEREFORE, THE CITY OF SHERWOOD RESOLVES AS FOLLOWS:

Section 1. The Mayor is authorized to appoint Eric Kneifel to a two year term, expiring April 2017.

Section 2. This Resolution is effective upon its approval and adoption.

Duly passed by the City Council this 21st day of April 2015.

_____
Krisanna Clark, Mayor

Attest:

_____
Sylvia Murphy, MMC, City Recorder

Council Meeting Date: April 21, 2015

Agenda Item: Consent Agenda

TO: Sherwood City Council

FROM: Kristen Switzer, Community Services Director
Through: Joseph Gall, ICMA-CM, City Manager

SUBJECT: Resolution 2015-045 Authorizing Appointment of Brian Amer to the Parks and Recreation Board

---

ISSUE:
Should the City Council appoint Brian Amer to the Parks and Recreation Board?

BACKGROUND:
The Parks and Recreation Board currently has vacancies and Brian Amer has applied for appointment.

Interviews were conducted and the Council Liaison Kuiper, the Chair of the Parks and Recreation Board, with assistance of staff, is recommending Brian Amer for appointment.

According to Chapter 2.16 of the Sherwood Municipal Code, members of the Parks and Recreation Board shall be appointed by the Mayor with consent of the City Council.

RECOMMENDATION:
Staff respectfully recommends City Council approval of Resolution 2015-045 authorizing appointment of Brian Amer to the Parks and Recreation Board.

City of Sherwood Oregon
Home of the Tualatin River National Wildlife Refuge

RESOLUTION 2015-045

AUTHORIZING APPOINTMENT OF BRIAN AMER TO THE PARKS AND RECREATION BOARD

WHEREAS, the Parks and Recreation Board currently has vacancies and Brian Amer has applied for appointment; and

WHEREAS, Council Liaison Jennifer Kuiper, and the Chair of the Parks Board, with assistance of staff, is recommending Brian Amer for appointment; and

WHEREAS, according to Chapter 2.16 of the Sherwood Municipal Code, members of the Parks and Recreation Board shall be appointed by the Mayor with consent of the City Council.

NOW, THEREFORE, THE CITY OF SHERWOOD RESOLVES AS FOLLOWS:

Section 1. The Mayor is authorized to appoint Brian Amer to a two year term, expiring April 2017.

Section 2. This Resolution is effective upon its approval and adoption.

Duly passed by the City Council this 21st day of April 2015.

_____
Krisanna Clark, Mayor

Attest:

_____
Sylvia Murphy, MMC, City Recorder

City Council Meeting Date: April 21, 2015

Agenda Item: New Business

TO: Sherwood City Council

FROM: Jeff Groth, Police Chief
Through: Joseph Gall, ICMA-CM, City Manager and Paul Elsner, City Attorney

SUBJECT: **Resolution 2015-043 authorizing the City Manager to sign an Intergovernmental Agreement (IGA) with the Washington County Emergency Management Co-operative for the purpose of becoming a partner agency**

Issue:
Should the City Council authorize the City Manager to sign an intergovernmental agreement (IGA) with the Washington County Emergency Management Co-Op for the purpose of becoming a partner agency?

Background:
Several agencies in Washington County have previously joined to form the Washington County Emergency Management Co-Op, for the purpose of shared resources, economy of scale and effective partnerships. Sherwood has been invited to join the existing Co-Op as a partner agency.

The City Council was provided information, including possible financial costs and benefits of joining the Co-Op during a City Council work session on March 17, 2015.

Financial Impacts:
The City Manager is proposing $10,000 for FY2016 to be a full voting member of the Emergency Management Co-operative.

Recommendation:
Staff respectfully requests City Council adoption of Resolution 2015-043 authorizing the City Manager to sign an Intergovernmental Agreement (IGA) with the Washington County Emergency Management Co-operative for the purpose of becoming a partner agency.

RESOLUTION 2015-043

AUTHORIZING THE CITY MANAGER TO SIGN AN INTERGOVERNMENTAL AGREEMENT (IGA) WITH THE WASHINGTON COUNTY EMERGENCY MANAGEMENT CO-OPERATIVE FOR THE PURPOSE OF BECOMING A PARTNER AGENCY

WHEREAS, the duly elected governing body of the City of Sherwood, Oregon, having been presented with information about the value of becoming a partner agency in the Washington County Emergency Management Co-Operative; and

WHEREAS, there exists a public safety need to continue our efforts in emergency management and disaster preparedness and becoming a member of the Washington County Emergency Management Co-Operative will allow for shared resources and economy of scale and will benefit Sherwood; and

WHEREAS, the Sherwood City Council recognizes the value of becoming a partner agency and authorizes the City Manager to sign an IGA with the Washington County Emergency Management Co-Operative for the purpose of becoming a partner agency.

NOW, THEREFORE, THE CITY OF SHERWOOD RESOLVES AS FOLLOWS:

Section 1. The City Manager is authorized to sign the IGA, attached as Exhibit A, with the Washington County Emergency Management Co-Operative.

Section 2. This Resolution shall be effective upon its approval and adoption.

Duly passed by the City Council this 21st day of April 2015.

_____
Krisanna Clark, Mayor

Attest:

_____
Sylvia Murphy, MMC, City Recorder

INTERGOVERNMENTAL AGREEMENT

EMERGENCY MANAGEMENT COOPERATIVE OF WASHINGTON COUNTY

This Agreement is entered into, pursuant to ORS 190.010, by and among Washington County (the County) and other public sector jurisdictions within Washington County (herein collectively "participating jurisdictions") and supersedes previous agreements for the coordination of emergency management programs in Washington County.

WITNESSETH

WHEREAS ORS 401.305 (3) requires the local governing bodies of counties and cities that have both city and county emergency management programs to jointly establish policies which provide direction and identify and define the purpose and roles of the individual emergency management programs, specify the responsibilities of the emergency program managers and staff and establish lines of communication, succession and authority of elected officials for an effective and efficient response to emergency conditions; and

WHEREAS the participating jurisdictions desire to collaborate beyond statutory requirements and cooperatively identify, design, implement, and test the structure, systems, facilities, plans, and procedures of a comprehensive, countywide emergency management system; and

WHEREAS the goal of such collaboration is to enhance the level of disaster and emergency preparedness within and across the boundaries of the participating jurisdictions and to develop and maintain an effective multi-agency coordination system; and

WHEREAS improved preparedness will be achieved through coordination among the participating jurisdictions and among the various emergency service functions provided within those jurisdictions; and

WHEREAS many of the participating jurisdictions entered into an Intergovernmental Agreement in November 1995, which has been subsequently amended and revised, to improve the level of disaster and emergency coordination and preparedness within the boundaries of the participating jurisdictions

TERMS AND CONDITIONS

I. EMERGENCY MANAGEMENT COOPERATIVE

The participating jurisdictions hereby create an emergency management cooperative responsible for the development, enhancement, maintenance, and

coordination of emergency management structures, systems, facilities, plans, procedures, training, and exercising within (and between) the jurisdictions of the participating entities and agree that the organization shall be known as the EMERGENCY MANAGEMENT COOPERATIVE (EMC).

II. PURPOSE OF AGREEMENT

The purpose of the EMC is to enhance the level of disaster and emergency preparedness and coordination within and across the boundaries of the participating jurisdictions by focusing on improvements to emergency management structures, systems, facilities, plans, procedures, training, and exercising.

III. MEMBERSHIP

A. Eligibility: Washington County and all Washington County public sector jurisdictions with an emergency management program.

B. Membership Types:

1. Voting Member: Participating jurisdictions that make a financial contribution per section VII of this Agreement.
2. Non-Voting Member: Participating jurisdictions that do not make a financial contribution per section VII of this Agreement.

IV. ORGANIZATION

A. Director: The work of the cooperative will be managed and coordinated by an EMC Director. The Director will serve at the pleasure of the County, with input from the Executive Committee, and be housed by the County unless otherwise approved by the Executive Committee. The Director's primary duties will be to: 1) develop and maintain comprehensive, integrated, and effective emergency management and multi-agency coordination systems in concert with the participating jurisdictions; 2) oversee implementation of the annual EMC work plan and budget; 3) coordinate emergency management activities within and between the participating jurisdictions; and 4) coordinate emergency management activities with other local, regional, and state agencies and organizations.

B. Staff: The participating jurisdictions will identify staff to work with the EMC. Staff assigned to work with the EMC will be housed at their respective jurisdictions. The County will provide work space for staff of participating jurisdictions to temporarily or periodically collocate in order to enhance coordination and coproduction efforts.

C. Work Teams:

1. Emergency Management Team (EMT):
   a. The EMT consists of the EMC Director and designated emergency management staff from participating jurisdictions. The team is

tasked to 1) collaboratively identify, design, implement, and test the structure, systems, facilities, plans, and procedures of a comprehensive, integrated, countywide emergency management system; 2) participate in the development of the annual work plan and budget; and 3) assist in the planning and conduct of training and exercises.

b. The team will receive administrative support from the County.

2. Multi-Agency Coordination System (MACS) Planning Team:
   a. The MACS Planning Team consists of law enforcement, fire, public works, public health, other emergency responder, and emergency management representatives of the participating jurisdictions. The team will only meet with the consent and support of the participating jurisdictions' first responder departments. The team will be responsible for developing the countywide plan for multi-agency incident coordination.
   b. The team will receive administrative support from the County.

V. GOVERNANCE

A. Executive Committee:

1. The EMC will be governed by an Executive Committee consisting of the chief executive officer of each participating jurisdiction. Each of these primary representatives may designate an alternative representative who may attend Executive Committee meetings and act in the absence of the participating jurisdiction's primary representative.
2. The representative of each voting member jurisdiction has the right to vote on all matters before the Committee. Representatives of non-voting jurisdictions may participate in all Committee discussions and deliberations but cannot vote. An affirmative act of the Executive Committee requires that a majority of the voting member representatives are present and the decision is unanimous.
3. The Executive Committee will be chaired by a voting member representative selected by the Committee. Chair of the Executive Committee may be rotated among the voting member representatives on an annual basis.
4. The Executive Committee will be responsible for:
   a. Approving the annual EMC work plan and budget;
   b. Approving policies related to EMC functions;
   c. Coordinating EMC actions and activities with jurisdictional elected officials and other key decision makers; and
   d. Reviewing the efficacy of the EMC and this Agreement on an annual basis.

B. Disputes: Any disputes as to the interpretation of this Agreement between two or more of the participating jurisdictions will be resolved by a unanimous decision of the Executive Committee.

C. Administrative Support: Administrative support for Executive Committee meetings will be provided by the County.

VI. OPERATING GUIDELINES

A. National Standards: The participating jurisdictions agree to adopt and implement the National Incident Management System (NIMS) and Incident Command System (ICS) as the incident management organization required by ORS 401.305(5)(b).

B. Local Standards: Participating jurisdictions agree to work toward attaining and maintaining minimum emergency management performance standards, which include, but are not limited to:

1. Developing and maintaining a functional Emergency Operations Center (EOC), including written position descriptions, trained emergency management staff, displays, communication equipment, etc.
2. Developing and maintaining a multi-hazard functional Emergency Operations Plan (EOP) that is consistent with Federal Emergency Management Agency (FEMA) and state guidance.
3. Developing and maintaining a Natural Hazards Mitigation Plan (NHMP) that is consistent with FEMA and state guidance.
4. Developing and maintaining a Continuity of Operations (COOP) Plan that is consistent with FEMA and state guidance.
5. Conducting at least an annual exercise of the EOC and emergency management plans at a functional or full scale level.
6. Providing educational materials and programs on disaster preparedness for individuals, families, and businesses.

C. EMC Work Plan: The Emergency Management Team will develop, for Executive Committee consideration and approval, an annual work plan detailing the purposeful actions to be pursued on behalf of the collaborative. The work plan will identify specific tasks to enhance the systems, facilities, plans, procedures, training, and exercising of the countywide emergency management and multi-agency coordination systems and include an implementation plan with timelines, descriptions of required resources and operational implications, and lead agency contact information.

D. EMC Budget:

1. The Emergency Management Team will develop, for Executive Committee consideration and approval, an annual budget detailing the costs associated with implementing the annual work plan and supporting EMC operation and administration.
2. The Executive Committee may amend the approved budget mid-year, as needed, subject to the funding methodology outlined in section VII of this Agreement.

VII. EMC FUNDING

A. Method: Washington County will fund 51% of annually approved EMC expenditures. Other participating jurisdictions will collectively fund the remaining 49%. The funding allocation between the County and other participating jurisdictions may be adjusted during the annual budget development process. The method for allocating the non-county share amongst the other participating jurisdictions will be determined each year as part of the budget process and may be based on proportionality or any other method approved by the Executive Committee.

B. Voting/Non-Voting Members: The Executive Committee may establish a minimal membership fee for a participating jurisdiction to receive voting privileges on the Executive Committee. Non-paying jurisdictions, or those under the established threshold, will be considered non-voting members.

C. Payments: The County will invoice all financially contributing members based on the allocations approved by the Executive Committee. The invoices will be distributed during the month of July for the new fiscal year (July 1 – June 30 fiscal year). Payments are due within 45 days of receipt of invoice unless other arrangements have been made with the County.

VIII. DURATION, WITHDRAWAL, AND TERMINATION

A. Effective Date: This Agreement will go into effect on July 1, 2013, following its authorization by the governing bodies of the jurisdictions participating in the intergovernmental agreement for consolidated emergency management as of January 1, 2013 (City of Beaverton, City of Hillsboro, City of Tigard, Tualatin Valley Fire and Rescue, and Washington County).

B. Termination: This Agreement will remain in effect until June 30, 2018, unless the participating jurisdictions unanimously agree in writing to an earlier termination, extension, or modification of its terms.

C. Withdrawal: A participating jurisdiction may withdraw at the end of a fiscal year by providing written notice of its intent to withdraw to all other participating jurisdictions no less than 90 days before the end of that fiscal year. A participating jurisdiction may also withdraw effective as of any other date provided the withdrawing jurisdiction receives unanimous approval of the Executive Committee. The remaining funding obligation of a jurisdiction withdrawing under this circumstance will be determined by the Executive Committee at the time the withdrawal is approved.

D. Non-Appropriation: Notwithstanding any other provisions provided herein, a participating jurisdiction's continuation in the EMC is subject to the jurisdiction's annual budget appropriation of funds in support of the EMC.

IX. AMENDMENTS

Proposed amendments to this Agreement shall be approved by unanimous consent of the Executive Committee and must be subsequently approved by each of the participating jurisdiction's governing bodies.

X. ADDITIONAL JURISDICTIONS

Any jurisdiction not a party to this Agreement may become a party by first obtaining the unanimous approval of the Executive Committee and then securing approval of the terms in this Agreement and any accompanying amendments from its governing body.

XI. RESPONSIBILITY FOR ACTS

Each of the participating jurisdictions shall be solely responsible for its own acts and the acts of its employees and officers under this Agreement. No participating jurisdiction shall be responsible or liable for consequential damages to any other participating jurisdiction arising out of the performance of the terms and conditions of this Agreement.

XII. INSURANCE

Each of the participating jurisdictions shall contribute to the purchase and maintenance of such insurance as will protect the EMC from claims of third parties arising from its performance under this Agreement. The amount of insurance shall be not less than the organization's liability under the Oregon Tort Claims Act.

XIII. SEVERABILITY

The terms of this Agreement are severable and a determination by an appropriate body having jurisdiction over the subject matter of this Agreement that results in the invalidity of any part shall not affect the remainder of the Agreement.

XIV. INTERPRETATION

The terms and conditions of this Agreement shall be liberally construed in accordance with the general purposes of the Agreement.

SUBSCRIBED TO AND ENTERED INTO by the appropriate officer(s) who are duly authorized to execute this Agreement on behalf of the governing body of the below-named unit of local government.

DATED this _____day of _____, 2013.

_____
[Agency Name]

APPROVED AS TO FORM

_____

City Council Meeting Date: April 21, 2015

Agenda Item: Public Hearing, 1st Reading

TO: Sherwood City Council

FROM: Brad Kilby, AICP, Planning Manager
Through: Joseph Gall, ICMA-CM City Manager and Julia Hajduk, Community Development Director

SUBJECT: Ordinance 2015-004, amending Chapter 7 of Volume II of the Sherwood Comprehensive Plan and adopting the Sherwood Water System Master Plan

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Issue:
Shall the City Council adopt an ordinance amending Chapter 7 of Volume II of the Sherwood Comprehensive Plan and adopting the Sherwood Water System Master Plan?

Summary:
The City is proposing to amend the Table of Contents and Chapter 7 Community Facilities and Services, of the Sherwood Comprehensive Plan, Part 2, and to adopt the 2015 City of Sherwood Water Master Plan as a technical appendix to the Comprehensive Plan. The proposed amendments coincide with an update of the City's Water System Master Plan. Although the Water System Plan was updated in 2005, the language within the Comprehensive Plan was never updated to reflect the changes to the system in 2005. The proposed amendments to the text would delete and replace the existing language within the Comprehensive Plan to be aligned with the 2015 Water Master Plan Update. Adoption of the plan as a technical appendix is consistent with the single goal and eight policies that relate to community facilities and services.

Murray Smith and Associates was hired to perform an analysis of the City of Sherwood's water system, document water system upgrades, estimate future water requirements, identify deficiencies, update the City's capital improvement program (CIP), and evaluate the City's existing water rates and system development charges (SDCs). Adoption of the Water System Master Plan update will inform the community on needed changes to the CIP, water rates, and SDC's.

The Planning Commission held a public hearing on March 24, 2015 and forwarded a recommendation of approval to the City Council. The Planning Commission recommendation is attached as Attachment 1.

Previous Council Action:
Under Resolution 2013-052, the City Council authorized the City Manager to enter into an agreement with Murray Smith and Associates to update the City's Water Master Plan.

Background:
The Planning Commission held a Work Session on February 24, 2015. The Public Works Department held a public meeting the following night on February 25, 2015. The requirement to prepare a Water System Master Plan can be found in Oregon Administrative Rules (OAR) Chapter 333, Division 61.

Financial Impacts:
The financial impacts associated with making the proposed amendments are paid for by staff time through the general fund, and included in the cost of the contract with Murray Smith and Associates. Updates to water rates, SDC's and water utility funding are independent of the Water System Master Plan Update. Updates to water rates, SDC's and water utility funding will be presented to the City Council for review and adoption consistent with Sherwood policies. Of the $36.2 million total estimated cost for recommended capital improvement projects, only $2.2 million is anticipated to be paid by existing customers through saturation development, the remaining projects in the CIP are for water system expansion to serve growth, as development occurs. These improvements will be funded through the collection of System Development Charges (SDCs).

Recommendation:
Staff respectfully recommends that City Council conduct their first hearing and reading of Ordinance 2015-004, schedule their second hearing and reading for May 5, 2015 and approve Ordinance 2015-004, amending Chapter 7 of Volume II of the Sherwood Comprehensive Plan and adopting the Sherwood Water System Master Plan.

City of Sherwood **March 26, 2015**
Planning Commission recommendation to the City Council:
File No: PA 15-01 Code Update

Planning Commission Public Hearing: The Planning Commission held a public hearing on March 24, 2015 to take testimony and consider the Sherwood Water System Master Plan and proposed text amendments to the Sherwood Comprehensive Plan. After considering the staff report and public testimony, the Commission voted to recommended approval of the proposed Water System Master Plan and proposed text amendments to the Comprehensive Plan with addition of language at the end of the Water Service Plan "Introduction," paragraph reflecting that the Water System Master Plan itself would be a technical appendix to volume II of the City of Sherwood Comprehensive Plan.

Proposal: The City is proposing to amend the Table of Contents and Chapter 7 *Community Facilities and Services*, of the Sherwood Comprehensive Plan, Part 2, and to adopt the 2015 City of Sherwood Water Master Plan as a technical appendix to the Comprehensive Plan. The proposed amendments coincide with an update of the City's Water System Master Plan. Although the Water System Plan was updated in 2005, the language within the Comprehensive Plan was never updated to reflect the changes to the system in 2005. The proposed amendments to the text would delete and replace the existing language within the Comprehensive Plan to be aligned with the 2015 Water Master Plan Update. Adoption of the plan as a technical appendix is consistent with the single goal and eight policies that related to community facilities and services.

I. BACKGROUND

A. Applicant: This is a City initiated text amendment.

B. Location: The proposed amendment is to the text of the Comprehensive Plan and applies citywide.

C. Review Type: The proposed text amendments are legislative and require a Type V review, which involves public hearings before the Planning Commission and City Council. Any appeal of the City Council's decision relating to this matter will be considered by the Oregon Land Use Board of Appeals.

D. Public Notice and Hearing: Notice of the March 24, 2015 Planning Commission hearing on the proposed amendment was published in *The Times* on February 26, 2015 and March 19, 2015. Notice was also posted in five public locations around town on March 4, 2015, and on the City of Sherwood web site on February 18, 2014.

Oregon Department of Land Conservation and Development (DLCD) notice was submitted on February 3, 2015.

E. Review Criteria:
The required findings for the Plan Amendment are identified in Section 16.80.030 of the SZCDC.

F. Background:

The City Public Works Department along with the consultant, Murray Smith and Associates, have been working on the plan for the past year, and were charged with ensuring that the plan complies with the Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61.

II. AFFECTED AGENCY, PUBLIC NOTICE, AND PUBLIC COMMENTS

Agencies:
DLCD notice was submitted on February 3, 2015, but has not submitted any comments as of the date of this report..

Public:
The Planning Commission held a Work Session to discuss the Water System Plan Update on February 24, 2015. In addition, a public meeting hosted by Public Works and the Project team was conducted on February 25, 2015. Individual invitations to that meeting were provided to all customers of the Sherwood Water System. Many of the comments raised in the public open house were related to a frustration with the existing water rates.

III. REQUIRED FINDINGS FOR A PLAN TEXT AMENDMENT

The applicable Plan Text Amendment review criteria are 16.80.030.A and C

16.80.030.A - Text Amendment Review

An amendment to the text of the Comprehensive Plan shall be based upon the need for such an amendment as identified by the Council or the Commission. Such an amendment shall be consistent with the intent of the Comprehensive Plan, and with all other provisions of the Plan and Code, and with any applicable State or City statutes and regulations.

With respect to the proposed changes, the Comprehensive Plan would be updated with current language that reflects the Master Plan. Specific changes include:

- Updating the table of contents page
- Updating Objective B.7 to remove old plan dates and make relevant to the current time period
- Update Table VII-1 to reflect the name change of “unified sewerage agency” to “clean water services” and to remove reference to telephone and cable providers (housekeeping)
- Replace entire section under “water service plan”, including the introduction, existing water system conditions, analysis of the existing water system and recommended improvements to the existing water system, with up to date information from the 2015 Master Plan
- Adopt the 2015 Water Master Plan by reference

.

It should be noted that the Comprehensive Plan was not updated with the 2005 update to the Water System Plan, and that the Comprehensive Plan is in dire need of a complete update. Staff has identified recommended changes to reflect the updated Water Master Plan and some minor housekeeping items but it is recognized that there are other areas within the comprehensive plan that are out of date. Staff is currently working with the Council, the Planning Commission, and the State of Oregon to enter into the periodic review process to update the Sherwood Comprehensive Plan.

The proposal seeks to amend chapter 7 of Volume II of the Comprehensive Plan to reflect the updated Water Master Plan. The Council authorized the Water System Master Plan by both approving a budget that included the update and by authorizing contracts for the update, therefore it can be assumed that the Council identified a need to update the Master Plan.

There is only one stated goal in chapter 7 which is "To insure the provision of quality community services and facilities of a type, level and location which is adequate to support existing development and which encourages efficient and orderly growth at the least public cost."

There are 8 objectives under this policy statement:

1. Develop and implement policies and plans to provide the following public facilities and services; public safety fire protection, sanitary facilities, water supply, governmental services, health services, energy and communication services, and recreation facilities.

2. Establish service areas and service area policies so as to provide the appropriate kinds and levels of services and facilities to existing and future urban areas.

3. Coordinate public facility and service plans with established growth management policy as a means to achieve orderly growth.

4. Coordinate public facility and service provision with future land use policy as a means to provide an appropriate mix of residential, industrial and commercial uses.

5. Develop and implement a five-year capital improvements and service plan for City services which prioritizes and schedules major new improvements and services and identifies funding sources.

6. The City will comply with the MSD Regional Solid Waste Plan, and has entered into an intergovernmental agreement with Washington County to comply with the County's Solid Waste and Yard Debris Reduction Plan, 1990.

7. Based on the Sewer, Water and Transportation Plan updates in 1989 and 1990, the City shall prepare a prioritized list of capital improvement projects to those systems and determine funding sources to make the improvements by the end of 1991.

8. It shall be the policy of the City to seek the provision of a wide range of public facilities and services concurrent with urban growth. The City will make an effort to seek funding mechanisms to achieve concurrency.

The updated Master Plan is necessary to the achieving the objectives with the exception of objective 7. The language within this policy has been updated to reflect the 2014 update to the Transportation System Plan, and the 2015 updates to the Sewer and Water Plans.

The need to update the policy language, and in turn the background language of Chapter 7 as it relates to the City's Water System Master Plan is evident in the fact that the current language speaks to plans that were to be adopted in 1989 and 1990. That is over 25 years ago, adding additional evidence that a clear need for the update has been established.

Applicable Regional (Metro) Standards

There are no specific Metro standards that would conflict with the proposed amendments. The Urban Growth Management Functional Plan does not speak specifically to subarea Water System Master planning.

Consistency with Statewide Planning Goals

Because the comprehensive plan policies and strategies are not changing and the comprehensive plan has been acknowledged by the State, there are no known conflicts with these proposed changes. Below is an analysis of how the proposed Water Master Plan update and Comprehensive Plan amendments are consistent with the applicable statewide planning goals 1, 2 and 11.

Goal 1

The Planning Commission held a public work session, and the project team held a city-wide meeting on the plan. Formal notice was also published in *The Times* two weeks prior to the hearing and again five days prior to the hearing. The hearing has been posted around town in five conspicuous places and on the City's website since March 4, 2015. Public works also maintained a project website for the course of the project.

Goal 2

Goal 2 speaks to comprehensive planning and acknowledges that plans for public facilities are more specific than those included in the comprehensive plan. They are intended to show the size, location, and capacity serving the City, but are not as detailed as construction drawings. The Water System Master Plan is a tool that helps communities to implement their plan.

In Sherwood's case, the plan is being updated to ensure compliance with the requirements outlined by the state as they relate to water system master plans. The requirement to prepare a Water System Master Plan can be found in Oregon Administrative Rules (OAR) Chapter 333, Division 61. The Water System Master Plan itself, is a much more technical document that Public Works staff is charged with preparing and ensuring compliance with these rules. The subject of this review is to ensure that the proposed plan is consistent with the current Comprehensive Plan.

One could argue that because the Comprehensive Plan is out of date, that the policy assumptions are not correct, but we will not know this until we go through a formal goals and policy update with the community as part of a periodic review. There have been many plans updated without thought to the Comprehensive Plan, goals, policies, and community assumptions in the past, and as currently drafted there are no conflicts with the proposed language and the current language as it applies to the single goal and policies that are affected by this change.

Goal 11

Goal 11 of state land use planning relates to Public Facilities and Services. Within this goal, communities are charged with preparing facilities plans that coordinates the type, locations and delivery of public facilities and services in a manner that best supports the existing and proposed land uses. In this case, the plan considers the existing needs of the community as well as those of the Tonquin Employment Area, the Brookman area, and urban reserves associated with both Tonquin and Sherwood West. The numbers assumed for these areas were derived from previously adopted plans and the best available information at the time that they were being prepared.

It should be noted that information is constantly being updated and refined with new information and it is possible that current projects underway or updated plans result in more or less growth than the Water System Master Plan assumes. For these reasons, the Water System Master Plan is a flexible document. If all improvements envisioned in the Water System Master plan are not needed, they will not be constructed and if improvements are needed sooner than envisioned, they will be planned for.

FINDING: As discussed above in the analysis, there is a need for the proposed amendments in order to update the language within the Comprehensive Plan. The proposed amendments are not applicable to Metro's Urban Growth Management Functional Plan. The proposed amendments are consistent with the applicable Comprehensive Plan and applicable City, regional and State regulations and policies.

16.80.030.3 – Transportation Planning Rule Consistency

A. Review of plan and text amendment applications for effect on transportation facilities. Proposals shall be reviewed to determine whether it significantly affects a transportation facility, in accordance with OAR 660-12-0060 (the TPR). Review is required when a development application includes a proposed amendment to the Comprehensive Plan or changes to land use regulations.

FINDING: The proposed amendments do not affect the functional classification of any street and is not triggered by any single development application.

IV. RECOMMENDATION

Based on the above findings of fact, and the conclusion of law based on the applicable criteria, the staff recommends approval of PA 15-01.

V. EXHIBITS

A. PA 15-01 Proposed Code Amendments –track change version
B. PA 15-01 Proposed Code Amendments – clean version
C. Letter to the Planning Commission from Craig Sheldon dated March 11, 2015
D. Draft Water System Master Plan - 2015
E. Memo, Water Master Plan Open House, dated March 24, 2015

TABLE OF CONTENTS - Part 2 Sherwood Development Plan

COMMUNITY FACILITIES AND SERVICES

A. GENERAL INTRODUCTION

Community facilities and services in the Sherwood Planning Area are provided by Washington County, the City of Sherwood, special service districts, semi-public agencies and the State and Federal government, (see Table VII-1). Public facilities and services include sewer, water, fire and police protection, libraries, drainage, schools, parks and recreation, solid waste and general governmental administrative services. Semi-public facilities and services are those which are privately owned and operated but which have general public benefit. They include health facilities, energy and communication utilities, and day care.

Although a small community, Sherwood has learned well the importance of adequate community facilities and services to orderly urban growth. Lack of sewer treatment capacity curtailed growth in the City in the 1970's. Planning for public facilities and services in response to growth rather than in advance of growth results in gaps in facilities and services. As population growth and density increase in the Sherwood Planning Area, greater facility and service support will be required. In recognition of this basic fact, the Plan stresses the need for provision of necessary facilities and services in advance of, or in conjunction with, urban development.

The Community Facilities and Services element identifies general policy goals and objectives; service areas and providers, problems, and service plans, and potential funding for key public and semi-public facilities and services. Park and recreation facilities are treated in Chapter 5, Environmental Resources. Transportation facilities are treated in Chapter 6, Transportation. This element was updated in 1989 to comply with OAR 197.712(2)(e).

B. POLICY GOAL AND OBJECTIVES

To insure the provision of quality community services and facilities of a type, level and location which is adequate to support existing development and which encourages efficient and orderly growth at the least public cost.

OBJECTIVES

1. Develop and implement policies and plans to provide the following public facilities and services; public safety fire protection, sanitary facilities, water supply, governmental services, health services, energy and communication services, and

recreation facilities.

2. Establish service areas and service area policies so as to provide the appropriate kinds and levels of services and facilities to existing and future urban areas.

3. Coordinate public facility and service plans with established growth management policy as a means to achieve orderly growth.

4. Coordinate public facility and service provision with future land use policy as a means to provide an appropriate mix of residential, industrial and commercial uses.

5. Develop and implement a five-year capital improvements and service plan for City services which prioritizes and schedules major new improvements and services and identifies funding sources.

6. The City will comply with the MSD Regional Solid Waste Plan, and has entered into an intergovernmental agreement with Washington County to comply with the County's Solid Waste and Yard Debris Reduction Plan, 1990.

7. Based on ~~the~~ Sewer, Water, Stormwater, and Transportation Plan updates ~~in 1989 and 1990~~, the City shall prepare a prioritized list of capital improvement projects to those systems and determine funding sources to ~~make~~ realize the improvements ~~by the end of 1991~~envisioned in those plans.

8. It shall be the policy of the City to seek the provision of a wide range of public facilities and services concurrent with urban growth. The City will make an effort to seek funding mechanisms to achieve concurrency.

C. PUBLIC AND SEMI-PUBLIC UTILITIES

Public utilities including water, sanitary sewer, drainage, and solid waste, as well as semi-public utilities including power, gas and telephone services are of most immediate importance in the support of new urban development. Water, sewer collection, and drainage facilities are the major services for which the City of Sherwood has responsibility. Service plans for these key services are contained in this section. The other utilities referred to above are the principal responsibilities of those agencies listed in Table VII-1. These agencies have been contacted for the purpose of coordinating their service planning and provision with the level and timing of service provision required to properly accommodate growth anticipated by the Plan.

TABLE VII-1
FACILITY AND SERVICE PROVIDERS
IN THE SHERWOOD PLANNING AREA

1. Public Utilities

   a. Public Water Supply
      City of Sherwood

   b. Sanitary Sewer System
      (1) ~~Unified Sewerage Agency~~Clean Water Services
      (2) City of Sherwood

   c. Storm Drainage System
      (1) City of Sherwood
      (2) Washington County
      (3) State of Oregon

2. Private/Semi-Public Utilities

   a. Natural Gas
      Northwest Natural Gas Co.

   b. Electric Power
      Portland General Electric

   ~~c. Telephone~~
   ~~General Telephone and Electric Co.~~

   ~~d. Cable Television: Columbia Cable~~

   ~~e~~c. Solid Waste: Pride Disposal Co.

3. Transportation

   a. Paved Streets, Traffic Control, Sidewalks, Curbs, Gutters, Street Lights
      (1) City of Sherwood
      (2) Washington County
      (3) State of Oregon

b. Bikeways
   (1) City of Sherwood
   (2) Washington County
   (3) State of Oregon

c. Public Transit
   Tri-Met

4. Public Health and Safety

a. Police Protection
(1) City of Sherwood
(2) Washington County
(3) State of Oregon

b. Fire Protection
Tualatin -Valley Fire and Rescue

c. Animal Control
Washington County

5. Recreation

a. Parks and Recreation
City of Sherwood

b. Library
City of Sherwood

6. Schools
Sherwood School District 88J

D. SEWER SERVICE PLAN

INTRODUCTION

The Sewer Service Plan of the Comprehensive Plan was updated in 1990 and is included as an appendix to the Plan, and is incorporated into this chapter. The following describes the existing sewer system, recommended improvements to the existing system, recommended expansion of the sewer system and estimated costs.

EXISTING SEWER SYSTEM

The City of Sherwood's existing sewer system is as shown on Figure VII-1. The system is located in USA's Durham South Basin which consists of two sub-basins are centered around Cedar Creek and Rock Creek, respectively, and will be referred to as the Cedar Creek basin and the Rock Creek basin throughout the remainder of this section.

The Rock Creek Basin system currently serves a residential area bounded by Lincoln Street to the west, West Sunset Boulevard to the south, Oregon Street to the north and the UGB to the east. Rock Creek Basin also contains approximately 71.2 acres of land, north of Oregon Street, which is currently zoned and developed for industrial use. The remaining northern portion of the Basin is essentially undeveloped and zoned primarily for industrial use. Flow is by gravity from south to north, eventually connecting to USA's Rock Creek trunk. This trunk then follows Rock Creek until it connects with the Upper Tualatin Interceptor which transports sewage to the Durham treatment plant.

The Cedar Creek Basin system serves the majority of Sherwood. Drainage is again from south to north and the main trunk of the system follows Cedar Creek from Sunset Boulevard under Pacific Highway continuing north until it connects with the Upper Tualatin Interceptor. From this point sewage is transported to the Durham Treatment plant.

insert map

ANALYSIS OF EXISTING SEWER SYSTEM

The population for the City of Sherwood in the year 2008 is estimated to be 7,000 people. The 1979 Sewer Service Plan estimated a population of 10,600 people in the year 2008, and a full-development population within the Sherwood Urban Growth Boundary (UGB) of 18,900 people.

In order to accentuate any deficiencies in the existing sanitary sewer system, peak flowrates were generated based on full development or saturation of the Sherwood UGB. This analysis was used for the following reasons. Maximum design flows for sanitary sewers are far less than peak storm sewer flows. Very often sanitary sewer pipes are sized at a minimum 8-inch diameter for maintenance purposes; consequently the majority of these pipes are flowing at a minimum of their capacity. A full-development demand analysis was the most conservative and efficient way of analyzing the system for all deficiencies.

Wastewater flow criteria for the analysis was taken from USA's 1985 Master Sewer Plan Update and is based on land use designation as listed below:

TABLE VII-2
WASTEWATER FLOW DESIGN CRITERIA
DESIGN UNIT FLOW RATE

LAND USE DESIGNATION	EXISTING	FUTURE
RESIDENTIAL	75 gpcd	75 gpcd
COMMERCIAL	1000 gpad	1000 gpad
INDUSTRIAL	3000 gpad	3000 gpad
INSTITUTIONAL	500 gpad	500 gpad
PEAK ANNUAL	4000 gpad	4000 gpad

The City of Sherwood Zoning Map was used to determine the amount of acreage of each land use designation. This acreage was then applied to tributary basins contributing to their respective sewers and multiplied by the appropriate land use design unit flowrate in order to generate the total design flowrate. An average of residential densities per tributary basin was used to account for the five different residential zoning densities shown on the current City Zoning Map.

The domestic sewage flow allowance for the 1979 Sewer Plan followed the 1969 USA Master Plan value of 90 gallons per capita per day (gpcd). The updated, June 1985 USA Master Plan, has reduced this value to 75 gpcd.

In order to account for periods of maximum use, flowrates are multiplied by factors which result in peak flowrates. The 1979 Sewer Service Plan used peak factors of 3.0 for lateral sewers and 2.7 for trunk sewer lines. The 1985 USA Master Plan Update requires peak factors ranging from 1.5 to 2.0. These lower values are based on actual dry-weather flow monitoring, performed in June and

July of 1984, at points throughout the Durham Basin.

The July 1979 Sewer Service Plan used values ranging from 500 gallons per acre per day (gpad) to 700 gpad for inflow and infiltration (I&I), depending on land use designation. These values were concurrent with past EPA design standards and were based on the assumption that rehabilitation measures would remove 60 to 90 percent of excessive I&I. According to USA's 1985 Master Plan these abatement techniques proved to be ineffective. USA's review of the Durham treatment facility led to the design rate of 4000 gpad for the existing peak annual occurrence for infiltration and inflow. This value is not anticipated to decrease for the Durham basin and is therefore also used for the future design flowrates.

Two areas of special concern exist inside the current City of Sherwood UGB. Both areas are recent additions to the UGB and have not yet been assigned a land use. Rather than assume zoning designations for the areas they were both excluded from the model. Both areas can be served by gravity and neither will cause deficiencies in the system. Their service routes are discussed below.

The first area is located in the southwest corner of the UGB in the Cedar Creek Basin, between Pacific Highway and Old Highway 99W. This area can be served by line number 1 in area A (Figure VII-2). The northern half of this area may also be served by connecting to the southern most extension of line number 2 in area B. The second area is located east of Pacific Highway and north of Edy Road, in the Rock Creek Basin. The southern portion should be incorporated in line number 3 extending from Rock Creek west along Edy Road (Figure VII-2). The northern half must be served using a direct lateral to the area from the Rock Creek trunk.

RECOMMENDED IMPROVEMENTS TO EXISTING SEWER SYSTEM

The analysis of the existing system shows no size deficiencies in any of the City maintained pipes. City officials have confirmed that there are areas of surcharge in the system due to pipe under sizing. Surcharge due to blockage of the system has occurred but has since been remedied.

Improvements are recommended to the existing sewer systems main trunk lines. These improvements are required due to very slight slips which occur in the northern sections of the Rock Creek and Cedar Creek main trunk lines.

The Rock Creek trunk requires improvements from manhole number 11663, which is located at the confluence of the Rock Creek and Cedar Creek trunk lines, south to a manhole located near the Southern Pacific crossing of Rock Creek. The existing 18-inch diameter pipe has a length of 6,035 feet and an existing slope of 0.0031 feet/feet. The USA master plan recommends that a 15-inch diameter pipe be placed parallel to the existing 18-inch in order to convey future flows based on 20-year ultimate development peak flowrates. Our analysis is based on total ultimate development of the Sherwood UGB and therefore suggests that an 18-inch diameter pipe parallel the existing 18-inch at the existing slope of 0.0031 feet/feet.

The Cedar Creek Trunk presents similar slope problems along the northern trunk. USA's Master Plan breaks these into three sections but this report will combine them for simplicity. The section of sewer begins at manhole 11663, which is located at the confluence of the Rock Creek and Cedar Creek trunks, and continues south to manhole number 11752 which is 200 feet south of Edy Road and slightly west of the UGB. (see Fig.1) The entire 12,640 feet of this line is outside of the UGB, and has a slope averaging between 0.0016 feet/feet and 0.0025 feet/feet. Depending on existing slopes a parallel system will be required ranging from 18 to 30-inches in diameter.

insert Figure VII-2

RECOMMENDED SEWER SYSTEM EXPANSION

The City of Sherwood's Urban Growth Boundary includes significant areas that are currently not served by the existing sanitary sewer system. All of these areas are part of either the Rock Creek Basin system or the Cedar Creek Basin system and can be easily served by extending laterals off the respective trunk lines of each basin. These new laterals have no special priority except to serve those who require sewer service. The locations of the recommended sewers are shown on Figure VII-3.

All new sewer lines should have a minimum diameter of 8-inches for ease of serviceability. These new laterals were designed by setting the slope of the sewer pipe invert, equal to the slope of the existing ground along the sewer line path. Individual pipe slopes may be required to be less than natural ground slopes in order to serve isolated areas of low ground elevation.

The sewer expansions are listed below under the basin in which they occur. The costs are listed by pipe diameter and are in 1990 dollars. These costs are typically paid for by the land developments that create the need for the extensions. The costs include design and construction. Land acquisition may be required but those costs are not included in the estimates below.

1.	Sewer Trunk Lines		
	Cedar Creek Parallel (15"-30")	12,640LF	$991,000
	Rock Creek Parallel (18")	6,750 LF	$378,000
2.	Rock Creek Basin Lines (All 8")		
	Tonquin	1400 LF	$ 47,000
	Highland/12th	3000 LF	$100,800
	Tualatin-Sherwood	2300 LF	$ 77,300
	Onion Flats W.	5000 LF	$168,000
	Onion Flats E.	2900 LF	$ 97,500
3.	Cedar Creek Basin Lines (8" except as noted)		
	Steeplechase S. (10")	4100 LF	$160,700
	Steeplechase N. (12")	650 LF	$ 29,100
	Steeplechase N. (10")	4100 LF	$161,000
	E. Sunset	1300 LF	$ 43,700
	W. Sunset	3500 LF	$117,600
	Scholls-Sherwood W.	1200 LF	$ 40,300
	Scholls-Sherwood E.	3100 LF	$104,200
	BPA#	3500 LF	$117,600

insert Figure VII-3

WATER SERVICE PLAN

INTRODUCTION

The City draws the majority of its water supply from the Willamette River Water Treatment Plant (WRWTP) in the City of Wilsonville, approximately 6 miles southeast of Sherwood. The City owns 5 million gallons per day (MGD) of production capacity in the existing WRWTP facilities. Sherwood also maintains four groundwater wells within the city limits for back-up supply. Prior to 2011, the City also purchased water from the Portland Water Bureau (PWB) through the City of Tualatin's water system and maintains an emergency connection and transmission piping associated with this supply source.

~~This is a 1988 update to the Water Service Plan element of the Sherwood Comprehensive Plan dated July, 1979.~~

The City's future water service area is comprised of five different planning areas:

1. Sherwood city limits
2. Tonquin Employment Area (TEA)
3. Brookman Annexation Area
4. West Urban Reserve
5. Tonquin Urban Reserve

Each of these areas has their own land use characteristics, approximate development timelines and existing planning information. Estimates of future growth and related water demand are developed using the best available information for each area including Sherwood buildable lands geographic information system (GIS) data, population growth projections, development area concept plans and current water demand data.

Water demand growth is projected at 10 years, 20 years and at saturation development. Estimated water demands at saturation development are used to size recommended transmission and distribution improvements. ~~.The population projections used in this analysis are for the year 2008. The following is fully described in the City of Sherwood "Water Service Plan Update," May 1988.~~

~~The year 2008 population projections are significantly lower today than were anticipated in the original Water Service Plan. This population projection difference, upgrades to the City's water system, and the growth that has actually occurred since 1979, warrant an update to the 1979 Water Service Plan.~~

~~In this update, the City's existing major water distribution lines were analyzed for their ability to deliver peak domestic and fire flows with adequate pressure to all developed areas of the City. The amount of water needed supply to meet future growth is also reviewed.~~

~~Specific improvements are recommended to the existing water system to meet the year 2008 needs~~

50.1

~~in currently served areas of the City. Major water lines required as extensions to areas without service are also identified. The cost of all recommended and identified improvements are listed in 1990 dollars.~~

~~The amount of growth that can occur within distinct areas and neighborhoods within the City's Urban Growth Boundary without creating pressure or overall supply problems is also estimated.~~

~~1. The City's existing reservoir capacity of 2.5 million gallons (MG) is adequate to cover the needs of the City until a population of 8,200 is reached.~~

EXISTING WATER SYSTEM CONDITIONS

Pressure Zones

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The City's existing distribution system is divided into three major pressure zones. Pressure zone boundaries are defined by ground topography in order to maintain service pressures within an acceptable range for all customers in the zone. The hydraulic grade line (HGL) of a zone is designated by overflow elevations of water storage facilities or outlet settings of pressure reducing valves (PRVs) serving the zone.

The majority of Sherwood customers are served from the 380 Pressure Zone which is supplied by gravity from the City's Sunset Reservoirs. The 535 Pressure Zone, serving the area around the Sunset Reservoirs, is supplied constant pressure by the Sunset Pump Station, and the 455 Pressure Zone serves higher elevation customers on the western edge of the City by gravity from the Kruger Reservoir.

Storage Reservoirs

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Sherwood's water system has three reservoirs with a total combined storage capacity of approximately 9.0 million gallons (MG). Two reservoirs, Sunset Nos. 1 and 2, provide 6.0 million gallons (MG) of gravity supply to the 380 Pressure Zone. The other reservoir, Kruger Road, provides 3.0 mg of gravity supply to the 455 Pressure Zone.

Pump Stations

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Sherwood's water system includes two booster pump stations, the Sunset Pump Station and the Wyndham Ridge Pump Station.

The Sunset Pump Station is located in Snyder Park adjacent to the Sunset Reservoir complex and has an approximate total capacity of 3,770 gallons per minute (gpm). This station provides constant pressure service and fire flow to the 535 Pressure Zone.

The Wyndham Ridge Pump Station is located on SW Handley Street west of Highway 99W. Two 40-hp pumps supply a total capacity of approximately 1,200 gpm from 380 Zone distribution piping to the Kruger Road Reservoir.

Distribution System

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The City's distribution system is composed of various pipe materials in sizes up to 24 inches in diameter. The total length of piping in the service area is approximately 77.4 miles. Pipe materials include cast iron, ductile iron, PVC and copper. The majority of the piping in the system is ductile iron. ~~The City of Sherwood's existing water system is as shown on Figure VII-4. The source of all of the City's water is from three wells. A single 2.0 million gallon reservoir is the sole source of storage and controls operating pressures throughout the City. The major pipelines that distribute the flows to the users range in size from 16 inch diameter to 6 inch diameter. Many smaller diameter lines are not analyzed because they are not relied upon for the distribution of large amounts of flow to general areas of the City. It is, however, recommended that the City continue its recent active policy of upgrading these smaller lines through the processes of annexation, development, and direct City cost sharing.~~

~~The three wells are located at the intersection of S.E. Pine and E. Willamette streets in Old Town, near Pacific Highway by S.W. Meinecke Road, and on W. Sunset Boulevard near St. Charles Way. The storage reservoir is located on high elevation ground in the southeastern portion of the City on E. Division Street. The distribution system is characterized by looped water lines in Old Town and nearby established residential areas. The water lines in the vicinity of Edy Road extend as unlooped single lines for long distances.~~

~~One small residential area bounded by E. Division Street on the north and S. Pine Street on the west in the vicinity of the water storage reservoir is in a separate pressure zone from the remainder of the City. This area is too high in elevation to rely on gravity to provide required pressures. A booster pump station adjacent to the reservoir provides the needed pressure.~~

~~Data on all the physical aspects of the water system was provided by the City of Sherwood staff. The physical system was modeled using the Pressure Pipe Network Analysis water distribution computer model.~~

~~Data on population projections were also provided by City staff. Design flow considerations were based on the information provided in the City of Sherwood's 1979 Water Service Plan.~~

ANALYSIS OF EXISTING WATER SYSTEM

Water Supply

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Sherwood's supply from the WRWTP is sufficient to meet MDD through the 10-year planning

51.1

horizon with an additional 1 mgd of capacity required at 20 years and an additional 4 mgd needed at build-out. Existing City groundwater wells provide an effective emergency supply to complement emergency storage in the City's reservoirs.

Pumping and Storage

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The City's distribution system has adequate storage and pumping capacity to meet existing service area demands through 2034. Due to significant uncertainty related to long-term growth and system expansion, minor storage and pumping deficiencies at build-out should be re-evaluated with the next Water Master Plan Update or as development warrants. Additional pump stations are recommended to serve proposed high-elevation closed pressure zones in the water service expansion areas: Brookman Annexation and West Urban Reserve.

Distribution Piping

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Sherwood's distribution piping is sufficiently looped to provide adequate fire flow capacity to commercial, industrial and residential customers. Few piping improvement projects are needed to meet fire flow criteria. Extensive large diameter mains will be needed to expand the City's water service area to supply the Brookman Annexation, TEA and West Urban Reserve as development occurs.~~Peak Domestic Flows Analysis~~

~~The total peak domestic flow rate for the year 2008 used in this analysis is 3,000 gallons per minute. The domestic flow is the combination of all residential, commercial, and industrial uses other than those for fire protection. Domestic use also accounts for summertime irrigation of lawns and landscaping.~~

~~The total peak domestic flow rate of 3,000 gallons per minute is derived from the detailed data published in the 1979 Water Service Plan and has been increased by approximately 15 percent as a conservative measure for unexpected conditions such as excessive water line leakage, high volume users, etc.~~

~~The 1979 Water Service Plan estimated the water usage by the City's commercial and industrial customers to be 30 percent of the residential use when the City's population reached 7,800 people. This percentage was used in the determination of the peak domestic flow rates in this analysis. The total peak domestic flow rate is based on a maximum peak consumption of 410 gallons per capita per day, and is consistent with the 1979 Water Service Plan.~~

~~insert Figure VII-4~~

52.1

~~The total 3,000 gallons per minute peak domestic flow was proportioned throughout the existing developed areas of the City, based on knowledge of the amounts and types of potential development that can occur in each area. Within each area of the City the proportioned flow was concentrated at "worst case" locations so that deficiencies in the City's water system would be highlighted.~~

~~Computer models require calibration to known data to assure that they represent the physical system. Known information on the pumping capacity and characteristics of the City's three wells, including their effect on the groundwater table and the historical operation of the wells and the water storage reservoir, was used to calibrate the factors in the computer model. The computer model accurately matches the operation of the City's wells and water storage reservoir during peak use.~~

~~**Peak Domestic Flows Results**~~

~~The existing water system for the City of Sherwood meets the needs of the peak domestic flows in the year 2008. There are no areas requiring improvements to meet these domestic needs. The resulting operating pressures during the peak flows range from 40 to 85 psi (pounds per square inch) throughout the City. The acceptable range for water line pressures is 20 to 100 psi.~~

~~**Fire Protection Flows Analysis**~~

~~The flow rate required to provide adequate fire protection varies with the type of building. Single family residential requires fire flows of only 1,500 gallons per minute, whereas large industrial and commercial structures without fire sprinklers can require fire flows in excess of 4,000 gallons per minutes. Most new construction of larger structures is required to have fire sprinklers for increased fire/life safety. Fire sprinklers reduce the flow requirements for fire protection.~~

~~For a City the size of Sherwood, it can only be expected that adequate flows for one major fire at a time can be provided. The low probability of multiple major fires at one time does not warrant the major expense of providing the additional supply sources and the larger diameter pipe lines. Also, because of the expense, it is cost effective to require fire sprinklers in structures that would require excessive amounts of flow for fire protection.~~

~~For this analysis, a fire flow of 2,000 gallons per minute is used to determine the adequacy of the water supply and distribution system to provide fire flows at an adequate operating pressure. The fire flow is assumed to be concurrent in time with the peak domestic flows.~~

~~**Fire Protection Flows Results**~~

~~The computer model was used to simulate the need for fire flows to every area of the city. In general, the ability to adequately supply fire flows in most areas of the City is good. There are three~~

areas where the flows could not be delivered at desired pressures. They are as follows:

1. Edy Road Area near Tualatin/Sherwood Road.

2. Scholls-Sherwood Road area north of Highway 99W.

3. Area at the southern end of E. Roy Street.

The water lines in these three deficient areas are unlooped single lines. Additional lines were added to the computer model to assess the impact of connecting these lines to other existing water lines to form loops. Modeling results show that this improvement to the existing system is sufficient to adequately provide fire flows at adequate operating pressures. Fire flows in excess of 2,000 gallons per minute can be provided to all other areas of the City. Some areas can deliver fire flows in excess of 4,000 gallons per minute.

Water Supply Capacity Analysis

Three wells are the sole source of water for the City. Combined, they provide nearly 2,000 gallons per minute of flow. The pressures they provide are nearly identical to the gravity pressure provided by the water storage reservoir. The pressure supply system is therefore well balanced. The three well pumps and booster pump, at the reservoir, all rely on electrical power only. There is no emergency stand-by power.

The normal operation of the reservoir and the wells is for the reservoir to supply all the needed water until the reservoir is 225,000 gallons short of being full. At this point, the wells are used to supplement supply to the users and refill the tank. Normally only one well is operating at a time unless the demand is greater than can be provided by the one well. This is a very efficient system and provides a high margin of safety during emergencies as normal operation never allows the reservoir to be less than 89 percent full. This high margin of safety is very unusual foal for communities the size of Sherwood. Many cities must pump constantly for all their water use while having little or no storage for emergencies. This excellent supply system would be considered a luxury to most small cities.

In the event of a fire, the reservoir can supply adequate fire protection flows even if all the pumps in the wells are inoperative. The reservoir alone can provide 5,000 gallons per minute of flow for 6.6 hours and 7,000 gallons per minute of flow for 4.7 hours. Five thousand gallons per minute is equal to the year 2008 peak domestic flows and a simultaneous 2,000 gallon per minute fire flow.

Water Supply Capacity Results

The water supply sources and the pressures they provide are well balanced and more than adequate to meet the demand needs through the year 2008. New sources of water are not necessary to provide additional quantities.

53.1

~~Emergency stand-by power would provide an additional margin of safety during periods of total power loss. The booster pump at the water storage reservoir is the only source of pressure for the residents in the E. Division Street and upper S. Pine Street area. During power outages, this area is without adequate water service. Stand-by power is recommended for this booster pump to eliminate this potential problem.~~

~~Although the water storage reservoir provides ample volumes of water for emergencies, it is recommended that stand-by power be provided at one of the wells as an added precautionary measure for extended periods of power outage. Since Well No. 3 is the City's largest well, stand-by power is recommended for that well. Completion of a manually-operated interconnect at Cipole Road with the City of Tualatin water system is also recommended as an additional safeguard against a catastrophic interruption in the City of Sherwood's system.~~

RECOMMENDED IMPROVEMENTS TO EXISTING WATER SYSTEM

Recommended improvements for the City's water system include proposed supply, pump station and water line projects.

Cost Estimating Data

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An estimated project cost has been developed for each improvement project recommended. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The cost estimates presented have an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs.

Capital Improvement Program

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A summary of all recommended improvement projects and estimated project costs is presented in Table ES-3 of the 2015 City of Sherwood Water System Master Plan Update. The table provides for project sequencing by showing fiscal year-by-year project priorities for the first five fiscal years, then prioritized projects in 5-year blocks for the 10-year, 20-year and Beyond 20 year timeframes. The total estimated cost of these projects is approximately $24.6 million through FY 2034. Approximately $19.9 million of the total estimated cost is for projects needed within the 10-year timeframe and $5.4 million of these improvements are required in the next 5 years.~~Improvements are recommended to the existing water system to provide adequate fire protection capability to three areas of the City. Improvements are not necessary for year 2008 population projections. These recommendations are based upon the assumption that water lines are not required to be extended~~

~~into areas currently not needing services.~~

~~The recommended improvements are shown on Figure VII-5 and are listed below. Improvements numbered 1,2, and 3 are deemed to be of greater priority. The projects can be constructed in almost any order however. The only exception is that the Edy Road Loop Completion should precede the Edy Road to Oregon Street Loop Completion in order to provide the greatest benefit to the users along Edy Road. The costs are in 1990 dollars and include design and construction. Land acquisition may be required but those costs are not included in the estimates below.~~

54.1

~~Recommended Improvements to Existing Water System~~

~~1. Loop Projects~~

~~Tualatin-Sherwood~~	~~3800 LF~~	~~$238,000~~
~~Scholls-Sherwood~~	~~2800 LF~~	~~$178,500~~
~~Murdock/Roy~~	~~600 LF~~	~~$ 59,500~~
~~Highland Extension~~	~~2700 LF~~	~~$178,500~~
~~Tualatin-sherwood Relocate~~	~~2130 LF~~	~~$ 74,100~~

~~2. Supply Projects~~

~~Well No. 6 (Murdock)~~	~~800' deep~~	~~$236,500~~
~~Reservoir Booster Pump~~	~~35 hp gen.~~	~~$ 59,500~~
~~Well No. 3 Standby Power~~	~~75 hp gen.~~	~~$119,000~~
~~Cipole Road Intertie with City of Tualatin~~		~~$ 23,400 (50%)~~

~~3. 4-Inch Waterline Replacements~~

~~Old Town (8")~~	~~1600 LF~~	~~$ 76,800~~
~~Ladd Hill (12")~~	~~1300 LF~~	~~$ 92,300~~
~~Meinecke/99W (8")~~	~~2000 LF~~	~~$ 96,000~~
~~W. Sunset (10")~~	~~1500 LF~~	~~$ 88,500~~

~~4. 6-Inch Waterline Replacements (all 8")~~

~~Old Town~~	~~1600 LF~~	~~$ 76,800~~
~~Lower Lincoln~~	~~1000 LF~~	~~$ 48,000~~
~~Lower Roy~~	~~1300 LF~~	~~$ 62,400~~
~~Oregon~~	~~1300 LF~~	~~$ 62,400~~
~~Upper Washington~~	~~1300 LF~~	~~$ 62,400~~
~~Gleneagle~~	~~3000 LF~~	~~$144,000~~
~~Upper Roy~~	~~900 LF~~	~~$ 43,400~~

~~5. Other Waterline Extensions~~

~~12 Inch~~	~~18,500 LF~~	~~$1,313,500~~
~~10 Inch~~	~~32,800 LF~~	~~$1,935,200~~
~~8 Inch~~	~~25,400 LF~~	~~$1,219,200~~

~~Beyond these recommended improvements, the City should continue its existing undersized water lines replacement program.~~

~~RECOMMENDED WATER SYSTEM EXPANSION~~

~~The City of Sherwood's Urban Growth Boundary includes significant areas that are currently not served by the existing water system. Major water lines are required for expansion of the existing water system into these areas as they develop, and are as shown on Figure VII-5. These line extensions have no special priority except to serve those who require the water service. The locations of the recommended waterlines on Figure VII-6 are schematic only and generally should be conformed to an updated City Transportation Plan for maximum economy and efficiency.~~

~~The critical element for expanding the water system in segments is to not construct unlooped single lines for long distances. The maximum length will vary depending on the diameter of the water line and the elevation of the site being served. It would be ideal if unlooped line extensions did not extend so far as to not be able to provide 2,000 gallons per minute of flow with an available end operating pressure of 20 psi. It is recommended that the minimum City of Sherwood standard for water line size be eight inches in diameter for all public lines.~~

~~-insert Fig. VII-5~~

~~As noted on Figure VII-5, the existing booster pump near the water storage reservoir may need modification as the service area of that pressure zone is expanded. Also noted is another area (#1) at the western edge of the Urban Growth Boundary just north of Pacific Highway and along Elwert Road that will require a booster pump and its own pressure zone water lines. This is a high elevation area where the 1979 Water Service Plan identified the location for a future water storage reservoir.~~

~~The 1979 Water Service Plan recommended water line loop expansions outside the Sherwood Urban Growth Boundary. These have been re-routed in this update to be completed within the Urban Growth Boundary. The number of major loops have been reduced from the 1979 Water Service Plan and the area each loop serves increased to provide a more cost efficient future water system.~~

~~The costs of these smaller pressure zone expansion improvements are difficult to estimate. These costs are relatively small compared to the $4.5 million cost to expand the water system in all the other areas. For the purposes of this report, a cost of $500,000 is used, making the entire total system expansion cost $5,000,000.~~

56.1

~~Insert Fig VII-6~~

F. DRAINAGE PLAN

INTRODUCTION

The Sherwood Planning Area is located within the Willamette River-Tualatin River Basin as identified in the Portland-Vancouver Metropolitan Area Water Resources Study (PMAWRS). The Cedar Creek and Rock Creek sub-basins channel surface runoff to the Tualatin River just north of the Planning Area. Within these sub-basins there exists considerable variation in slope. A highland area known as Washington Hill has some erosion and sedimentation potential. High groundwater and poorly drained soils in portions of the northern half of the Planning Area will require measures to regulate excavation and site drainage.

In March 1989, DEQ issued draft rules for storm water quality control to all jurisdictions in the Tualatin River sub-basin. The City of Sherwood is required to comply with the rules and participate in the development of a Surface Water Drainage Management Plan for the region. When the Plan is completed and adopted this section will be amended accordingly.

Objectives

1. Comply with DEQ Storm water quality control rules until completion of a Drainage Management Plan.

2. Cooperate with United Sewerage Agency, Washington County, and DEQ in the preparation of a Drainage Management Plan.

Findings

1. A storm drainage plan for the City's urban growth area has been developed and is illustrated on Figure VII-7. Major storm sewers are recommended for construction in accordance with the Plan; minor storm sewers are not shown on the proposed storm drainage plan. This Plan will be updated upon completion of the regional Drainage Plan.

2. Cedar Creek, Rock Creek, and Chicken Creek shall continue to be the City's primary conveyance systems for storm runoff.

3. Existing flood areas have been identified and are analyzed and described in Section VII Background Data and Analysis. It is anticipated, all but one of the problem areas will be eliminated by implementation of the Plan. An area of flooding at N.W. 12th Street and Highway 99W remains to be resolved by construction of a minor storm sewer, which is not shown on the Plan.

4. The rational method formula was used to estimate runoff to proposed storm sewers. This method has a tendency to overestimate design flows when applied to large basins. Runoff coefficients used in the rational method are predicted on the City's Comprehensive Plan. During final design of storm sewers, actual development within the basin should be reviewed to verify previous assumptions in selection of a runoff coefficient.

5. Cost estimates for proposed storm sewer improvements have been prepared, based on 1980 construction costs and increased in 1990 by 1.25%, and on Engineering News Record (ENR) index of 3264. These estimates are presented in Table 2 of the Appendix.

6. Design of relief culverts in Cedar Creek and Rock Creek may significantly alter hydraulic control sections used by the U.S. Army Corps of Engineers to establish water surface elevations and limits of the flood plain as set forth in Flood Insurance Study, City of Sherwood, Oregon, and provided to the City in preliminary draft, dated December 17, 1980. Design of relief culverts should be coordinated with the U.S. Army Corps of Engineers to insure integrity of their flood insurance study.

Implementation

1. The City will endeavor to establish a source of revenue to finance the cost of storm sewer construction, acquisition of lands along creeks, maintenance of storm sewers and waterways, and administration of the storm plan in accordance with the regional Surface Water Drainage Management Plan.

2. Until user fees are in effect, the City should obtain waivers of remonstrance to future storm drainage improvements projects from all property owners wishing to develop their land, and the City should also require all developers to provide adequate storm sewers to serve their property as well as those properties that would naturally drain to the proposed storm sewer.

SOLID WASTE

Solid waste disposal is a regional concern requiring regional solutions. The City of Sherwood recognizes MSD's responsibility and authority to prepare and implement a solid waste management plan and supports the MSD Solid Waste Facilities Model Siting Ordinance and will participate in these procedures as appropriate. There are no landfills in Sherwood.

The Model Siting Ordinance will be incorporated into this Plan when approved by METRO. In addition, the City conducted extensive hearings on solid waste incineration in 1990 and determined incineration is generally not a form of solid waste disposal environmentally compatible in the community except in limited circumstances. Therefore, solid waste incineration is generally prohibited by this Plan.

Electrical Power

The Sherwood Planning Area is well served by major power facilities. Portland General Electric Co. (PGE) runs and operates a major regional sub-station in the northern portion of the Planning Area and has a network of major transmission lines which cross the Planning Area. Minor sub-station siting and construction, if needed in response to development, will be coordinated with PGE.

Natural Gas

The Sherwood Planning Area is served by Northwest Natural Gas Co. (NNG) lines. The existing system consists of a 6" high pressure line extended to the Planning Area via Tualatin-Sherwood Road, So. Sherwood Blvd. and Wilsonville Road. The distribution system is adequate to serve immediate development. NNG reports that the 6" main will be adequate to serve growth projected by the Plan with new lateral line extensions and attention to proper "looping" of existing lines.

Telephone

General Telephone services the Sherwood Planning Area. Planned improvements should have the capability of handling projected growth demands in the Area.

H. SCHOOLS

INTRODUCTION

The Sherwood Planning Area is wholly contained within Sherwood School District 88J. Although the City of Sherwood is the only currently urbanized area within the district, district boundaries include approximately 44 square miles and parts of Washington, Clackamas, and Yamhill Counties. The District is currently predominately rural but, by the year 2000, the Sherwood Planning Area will contribute most of the total student enrollment.

FUTURE ENROLLMENT/FACILITY NEEDS

The School District completed a School Enrollment Study (Metro Service District Analysis) in the Fall of 1990. Revisions were made in the Spring of 1991. The study data suggests that school enrollments will be increasing sharply in the coming years. The growth assumption is supported by record-setting residential building permit issuance during 1990. Major arterial road improvements between I-5 and 99W will also cause further growth and development.

ELEMENTARY AGE STUDENTS (K-5)

J. Clyde Hopkins Elementary School has a capacity to house 600 students. Currently, 670 students are enrolled in grades K-5. Three double portable classrooms and one single portable classroom are utilized to address the growing elementary age population.

INTERMEDIATE AGE STUDENTS (6-8)

Approximately 300 students are enrolled in grades 6-8. The Intermediate School building capacity is 400 students. This capacity can be accessed by relocating District office services, which occupy a four classroom wing of the building.

HIGH SCHOOL AGE STUDENTS (9-12)

Sherwood High School has a capacity of 500 students. Approximately 420 students are currently enrolled. No major housing issues exist in this 1971 constructed facility.

SCHOOL FACILITY PLANNING

The School District is preparing to undertake a detailed facility development plan. The most immediate need for the District is to expand housing of elementary age school children (K-5). During the Fall of the 1990-91 school year, the District completed the purchase of a new elementary school site located within the City limits of Sherwood. The District also owns a school site (purchased in 1971) in the proximity of the Tualatin portion of the school district.

The intent of the District is to seek voter approval of a bond measure to address short and long-term housing needs. The measure is planned to be submitted in the Fall of 1991 or the Spring of 1992 in order to construct an additional elementary school.

I. PUBLIC SAFETY

POLICE PROTECTION

The City of Sherwood, Washington County and the State Police co-ordinate police protection within the Planning Area. In 1989 the Sherwood Police Force consisted of five officers. In order to meet future demand it is anticipated that the department will need additional patrolmen proportional to the projected increase in population. The State formula for City police protection is one officer per 500 people. The police force should expand accordingly.

FIRE PROTECTION

The Planning Area is wholly contained within the Tualatin Valley Consolidated Fire and Rescue

District. One engine house is located within the City. The District feels that present physical facilities will be adequate to serve the projected year 2000 growth in the area with some increase in manpower and equipment. The District currently employs a 5-year capital improvement planning process which is updated annually. The City will co-ordinate its planning with the district to assure the adequacy of fire protection capability in the Planning Area.

J. GENERAL GOVERNMENTAL SERVICES

As a general purpose governmental unit, the City of Sherwood intends to fulfill its responsibilities in the principal areas of general administration, planning, public works, and library services. With expected growth in Sherwood, additional manpower and facilities will be required.

1. Manpower Needs

   In 1989 there are currently seventeen (17) City staff in general governmental services. A review of cities which have reached Sherwood's projected five and twenty year growth levels indicate that new staffing will be needed proportional to population increases in most departments. Using this assumption a full-time staff of 15-20 persons will be required by 1985 and a staff of 20-40 will be needed by the year 2000. Most critical immediate needs are in the area of clerical staff to support existing departmental work loads.

2. Space Needs

   The City offices, water department, police department, planning department and public works, are currently housed in a remodeled turn-of-the-century house. Although the structure is significant historically and should be saved, it may not meet the long term functional or space needs of a City Hall.

   In 1982 the Senior and Community Center was built and provides meeting space for the City Council and Planning Commissions.

K. HEALTH FACILITIES

The local health system is linked to a number of organizations and institutions that can and do affect how it will develop. The latest planning legislation P.L. 93-641 and its recent amendments has placed Health care delivery systems planning are under the auspices of the State Certificate of Need laws and the Federal Health System Agency (HSA) planning regulations. Sherwood is located in the six county Northwest Oregon Health Systems Agency (NOHS) which is charged with reviewing new service proposals, expenditures involving public funds and the development of a health system plan for the area. The first HSA plan was adopted in 1978. State agencies administer HSA regulations. NOHS established subdistricts within the six county service area. Sherwood is located in the south-rural sub-district (see Figure VII-8). The only hospital located in the sub-district is Meridian Park Hospital in Tualatin.

Sherwood is served by various Metropolitan area hospitals depending on local physician affiliations. The City currently has only one doctor with offices in the Planning Area. St. Vincent's Hospital in Beaverton has expressed interest in establishing a satellite clinic in Sherwood.

The City will encourage the decentralization of Metropolitan health care delivery to assure that a broad range of inpatient, outpatient and emergency medical services are available to Sherwood residents. To that end the City will support the location of a St. Vincent's Satellite Center in Sherwood and encourage the appropriate expansion of Meridian Park facilities to meet the growing needs of the Planning Area.

L. SOCIAL FACILITIES AND SERVICES

A broad range of social services will be needed in the Planning Area to serve a growing urban population. Sherwood will continue to depend on metropolitan area services for which the demand does not justify a decentralized center. Multi-purpose social and health services and referral are offered by the Washington County Satellite Center in Tigard. The City will encourage the continued availability of such services.

Sherwood is located in Region 8 of the State Department of Human Resources Service Area and benefits from that agency's services. State services are administered through the County's Washington County office located in Hillsboro. In addition to public social service programs, many private organizations serve the Sherwood area.

The City is particularly interested in locating a multi-purpose social and health service referral agency in Sherwood so that residents of Sherwood would be able to get timely information on the available services. The City also supports the development of a Comprehensive Social and health services delivery plan for the Planning Area to identify gaps in needed services and develop an ongoing strategy for their provision. Of particular concern are day care and senior citizens services.

Day Care

A growing need exists for day care. State standards for the establishment of day care centers are supplemented by City standards. Currently day care has been carried on by churches and small home operations. The City recognizes and supports the proper siting and housing of day care services.

Senior Citizens Services

With an increasing proportion of the Planning Areas population reaching the age of 60, Sherwood will require additional specialized services and facilities for senior citizens. The City was awarded a grant from HUD for a Senior Citizen Community Center was completed in 1982. Community Center functions will be carried out under the authority of the City. It is the intent of the City that the Center be the focus for the Community activities requiring meeting and multi-purpose areas with particular emphasis on Senior Citizens programs and activities.

COMMUNITY FACILITIES AND SERVICES

A. GENERAL INTRODUCTION

Community facilities and services in the Sherwood Planning Area are provided by Washington County, the City of Sherwood, special service districts, semi-public agencies and the State and Federal government, (see Table VII-1). Public facilities and services include sewer, water, fire and police protection, libraries, drainage, schools, parks and recreation, solid waste and general governmental administrative services. Semi-public facilities and services are those which are privately owned and operated but which have general public benefit. They include health facilities, energy and communication utilities, and day care.

Although a small community, Sherwood has learned well the importance of adequate community facilities and services to orderly urban growth. Lack of sewer treatment capacity curtailed growth in the City in the 1970's. Planning for public facilities and services in response to growth rather than in advance of growth results in gaps in facilities and services. As population growth and density increase in the Sherwood Planning Area, greater facility and service support will be required. In recognition of this basic fact, the Plan stresses the need for provision of necessary facilities and services in advance of, or in conjunction with, urban development.

The Community Facilities and Services element identifies general policy goals and objectives; service areas and providers, problems, and service plans, and potential funding for key public and semi-public facilities and services. Park and recreation facilities are treated in Chapter 5, Environmental Resources. Transportation facilities are treated in Chapter 6, Transportation. This element was updated in 1989 to comply with OAR 197.712(2)(e).

B. POLICY GOAL AND OBJECTIVES

To insure the provision of quality community services and facilities of a type, level and location which is adequate to support existing development and which encourages efficient and orderly growth at the least public cost.

OBJECTIVES

1. Develop and implement policies and plans to provide the following public facilities and services; public safety fire protection, sanitary facilities, water supply, governmental services, health services, energy and communication services, and recreation facilities.

2. Establish service areas and service area policies so as to provide the appropriate kinds and levels of services and facilities to existing and future urban areas.

3. Coordinate public facility and service plans with established growth management policy as a means to achieve orderly growth.

4. Coordinate public facility and service provision with future land use policy as a means to provide an appropriate mix of residential, industrial and commercial uses.

5. Develop and implement a five-year capital improvements and service plan for City services which prioritizes and schedules major new improvements and services and identifies funding sources.

6. The City will comply with the MSD Regional Solid Waste Plan, and has entered into an intergovernmental agreement with Washington County to comply with the County's Solid Waste and Yard Debris Reduction Plan, 1990.

7. Based on Sewer, Water, Stormwater, and Transportation Plan updates, the City shall prepare a prioritized list of capital improvement projects to those systems and determine funding sources to realize the improvements envisioned in those plans.

8. It shall be the policy of the City to seek the provision of a wide range of public facilities and services concurrent with urban growth. The City will make an effort to seek funding mechanisms to achieve concurrency.

C. PUBLIC AND SEMI-PUBLIC UTILITIES

Public utilities including water, sanitary sewer, drainage, and solid waste, as well as semi-public utilities including power, gas and telephone services are of most immediate importance in the support of new urban development. Water, sewer collection, and drainage facilities are the major services for which the City of Sherwood has responsibility. Service plans for these key services are contained in this section. The other utilities referred to above are the principal responsibilities of those agencies listed in Table VII-1. These agencies have been contacted for the purpose of coordinating their service planning and provision with the level and timing of service provision required to properly accommodate growth anticipated by the Plan.

TABLE VII-1
FACILITY AND SERVICE PROVIDERS
IN THE SHERWOOD PLANNING AREA

1. Public Utilities

   a. Public Water Supply
      City of Sherwood

   b. Sanitary Sewer System
      (1) Clean Water Services
      (2) City of Sherwood

   c. Storm Drainage System
      (1) City of Sherwood
      (2) Washington County
      (3) State of Oregon

2. Private/Semi-Public Utilities

   a. Natural Gas
      Northwest Natural Gas Co.

   b. Electric Power
      Portland General Electric

   c. Solid Waste: Pride Disposal Co.

3. Transportation

   a. Paved Streets, Traffic Control, Sidewalks, Curbs, Gutters, Street Lights
      (1) City of Sherwood
      (2) Washington County
      (3) State of Oregon

   b. Bikeways
      (1) City of Sherwood
      (2) Washington County
      (3) State of Oregon

c. Public Transit
Tri-Met

4. Public Health and Safety

a. Police Protection
(1) City of Sherwood
(2) Washington County
(3) State of Oregon

b. Fire Protection
Tualatin Valley Fire and Rescue

c. Animal Control
Washington County

5. Recreation

a. Parks and Recreation
City of Sherwood

b. Library
City of Sherwood

6. Schools
Sherwood School District 88J

D. SEWER SERVICE PLAN

INTRODUCTION

The Sewer Service Plan of the Comprehensive Plan was updated in 1990 and is included as an appendix to the Plan, and is incorporated into this chapter. The following describes the existing sewer system, recommended improvements to the existing system, recommended expansion of the sewer system and estimated costs.

EXISTING SEWER SYSTEM

The City of Sherwood's existing sewer system is as shown on Figure VII-1. The system is located in USA's Durham South Basin which consists of two sub-basins are centered around Cedar Creek and Rock Creek, respectively, and will be referred to as the Cedar Creek basin and the Rock Creek basin throughout the remainder of this section.

The Rock Creek Basin system currently serves a residential area bounded by Lincoln Street to the west, West Sunset Boulevard to the south, Oregon Street to the north and the UGB to the east. Rock Creek Basin also contains approximately 7l.2 acres of land, north of Oregon Street, which is currently zoned and developed for industrial use. The remaining northern portion of the Basin is essentially undeveloped and zoned primarily for industrial use. Flow is by gravity from south to north, eventually connecting to USA's Rock Creek trunk. This trunk then follows Rock Creek until it connects with the Upper Tualatin Interceptor which transports sewage to the Durham treatment plant.

The Cedar Creek Basin system serves the majority of Sherwood. Drainage is again from south to north and the main trunk of the system follows Cedar Creek from Sunset Boulevard under Pacific Highway continuing north until it connects with the Upper Tualatin Interceptor. From this point sewage is transported to the Durham Treatment plant.

insert map

ANALYSIS OF EXISTING SEWER SYSTEM

The population for the City of Sherwood in the year 2008 is estimated to be 7,000 people. The 1979 Sewer Service Plan estimated a population of 10,600 people in the year 2008, and a full-development population within the Sherwood Urban Growth Boundary (UGB) of 18,900 people.

In order to accentuate any deficiencies in the existing sanitary sewer system, peak flowrates were generated based on full development or saturation of the Sherwood UGB. This analysis was used for the following reasons. Maximum design flows for sanitary sewers are far less than peak storm sewer flows. Very often sanitary sewer pipes are sized at a minimum 8-inch diameter for maintenance purposes; consequently the majority of these pipes are flowing at a minimum of their capacity. A full-development demand analysis was the most conservative and efficient way of analyzing the system for all deficiencies.

Wastewater flow criteria for the analysis was taken from USA's 1985 Master Sewer Plan Update and is based on land use designation as listed below:

TABLE VII-2
WASTEWATER FLOW DESIGN CRITERIA
DESIGN UNIT FLOW RATE

LAND USE DESIGNATION	EXISTING	FUTURE
RESIDENTIAL	75 gpcd	75 gpcd
COMMERCIAL	1000 gpad	1000 gpad
INDUSTRIAL	3000 gpad	3000 gpad
INSTITUTIONAL	500 gpad	500 gpad
PEAK ANNUAL	4000 gpad	4000 gpad

The City of Sherwood Zoning Map was used to determine the amount of acreage of each land use designation. This acreage was then applied to tributary basins contributing to their respective sewers and multiplied by the appropriate land use design unit flowrate in order to generate the total design flowrate. An average of residential densities per tributary basin was used to account for the five different residential zoning densities shown on the current City Zoning Map.

The domestic sewage flow allowance for the 1979 Sewer Plan followed the 1969 USA Master Plan value of 90 gallons per capita per day (gpcd). The updated, June 1985 USA Master Plan, has reduced this value to 75 gpcd.

In order to account for periods of maximum use, flowrates are multiplied by factors which result in peak flowrates. The 1979 Sewer Service Plan used peak factors of 3.0 for lateral sewers and 2.7 for trunk sewer lines. The 1985 USA Master Plan Update requires peak factors ranging from 1.5 to 2.0. These lower values are based on actual dry-weather flow monitoring, performed in June and July of 1984, at points throughout the Durham Basin.

The July 1979 Sewer Service Plan used values ranging from 500 gallons per acre per day (gpad) to 700 gpad for inflow and infiltration (I&I), depending on land use designation. These values were concurrent with past EPA design standards and were based on the assumption that rehabilitation measures would remove 60 to 90 percent of excessive I&I. According to USA's 1985 Master Plan these abatement techniques proved to be ineffective. USA's review of the Durham treatment facility led to the design rate of 4000 gpad for the existing peak annual occurrence for infiltration and inflow. This value is not anticipated to decrease for the Durham basin and is therefore also used for the future design flowrates.

Two areas of special concern exist inside the current City of Sherwood UGB. Both areas are recent additions to the UGB and have not yet been assigned a land use. Rather than assume zoning designations for the areas they were both excluded from the model. Both areas can be served by gravity and neither will cause deficiencies in the system. Their service routes are discussed below.

The first area is located in the southwest corner of the UGB in the Cedar Creek Basin, between Pacific Highway and Old Highway 99W. This area can be served by line number 1 in area A (Figure VII-2). The northern half of this area may also be served by connecting to the southern most extension of line number 2 in area B. The second area is located east of Pacific Highway and north of Edy Road, in the Rock Creek Basin. The southern portion should be incorporated in line number 3 extending from Rock Creek west along Edy Road (Figure VII-2). The northern half must be served using a direct lateral to the area from the Rock Creek trunk.

RECOMMENDED IMPROVEMENTS TO EXISTING SEWER SYSTEM

The analysis of the existing system shows no size deficiencies in any of the City maintained pipes. City officials have confirmed that there are areas of surcharge in the system due to pipe under sizing. Surcharge due to blockage of the system has occurred but has since been remedied.

Improvements are recommended to the existing sewer systems main trunk lines. These improvements are required due to very slight slips which occur in the northern sections of the Rock Creek and Cedar Creek main trunk lines.

The Rock Creek trunk requires improvements from manhole number 11663, which is located at the confluence of the Rock Creek and Cedar Creek trunk lines, south to a manhole located near the Southern Pacific crossing of Rock Creek. The existing 18-inch diameter pipe has a length of 6,035 feet and an existing slope of 0.0031 feet/feet. The USA master plan recommends that a 15-inch diameter pipe be placed parallel to the existing 18-inch in order to convey future flows based on 20-year ultimate development peak flowrates. Our analysis is based on total ultimate development of the Sherwood UGB and therefore suggests that an 18-inch diameter pipe parallel the existing 18-inch at the existing slope of 0.0031 feet/feet.

The Cedar Creek Trunk presents similar slope problems along the northern trunk. USA's Master Plan breaks these into three sections but this report will combine them for simplicity. The section of sewer begins at manhole 11663, which is located at the confluence of the Rock Creek and Cedar

Creek trunks, and continues south to manhole number 11752 which is 200 feet south of Edy Road and slightly west of the UGB. (see Fig.1) The entire 12,640 feet of this line is outside of the UGB, and has a slope averaging between 0.0016 feet/feet and 0.0025 feet/feet. Depending on existing slopes a parallel system will be required ranging from 18 to 30-inches in diameter.

insert Figure VII-2

RECOMMENDED SEWER SYSTEM EXPANSION

The City of Sherwood's Urban Growth Boundary includes significant areas that are currently not served by the existing sanitary sewer system. All of these areas are part of either the Rock Creek Basin system or the Cedar Creek Basin system and can be easily served by extending laterals off the respective trunk lines of each basin. These new laterals have no special priority except to serve those who require sewer service. The locations of the recommended sewers are shown on Figure VII-3.

All new sewer lines should have a minimum diameter of 8-inches for ease of serviceability. These new laterals were designed by setting the slope of the sewer pipe invert, equal to the slope of the existing ground along the sewer line path. Individual pipe slopes may be required to be less than natural ground slopes in order to serve isolated areas of low ground elevation.

The sewer expansions are listed below under the basin in which they occur. The costs are listed by pipe diameter and are in 1990 dollars. These costs are typically paid for by the land developments that create the need for the extensions. The costs include design and construction. Land acquisition may be required but those costs are not included in the estimates below.

1.	Sewer Trunk Lines		
	Cedar Creek Parallel (15"-30")	12,640LF	$991,000
	Rock Creek Parallel (18")	6,750 LF	$378,000
2.	Rock Creek Basin Lines (All 8")		
	Tonquin	1400 LF	$ 47,000
	Highland/12th	3000 LF	$100,800
	Tualatin-Sherwood	2300 LF	$ 77,300
	Onion Flats W.	5000 LF	$168,000
	Onion Flats E.	2900 LF	$ 97,500
3.	Cedar Creek Basin Lines (8" except as noted)		
	Steeplechase S. (10")	4100 LF	$160,700
	Steeplechase N. (12")	650 LF	$ 29,100
	Steeplechase N. (10")	4100 LF	$161,000
	E. Sunset	1300 LF	$ 43,700
	W. Sunset	3500 LF	$117,600
	Scholls-Sherwood W.	1200 LF	$ 40,300
	Scholls-Sherwood E.	3100 LF	$104,200
	BPA#	3500 LF	$117,600

insert Figure VII-3

WATER SERVICE PLAN

INTRODUCTION

The City draws the majority of its water supply from the Willamette River Water Treatment Plant (WRWTP) in the City of Wilsonville, approximately 6 miles southeast of Sherwood. The City owns 5 million gallons per day (MGD) of production capacity in the existing WRWTP facilities. Sherwood also maintains four groundwater wells within the city limits for back-up supply. Prior to 2011, the City also purchased water from the Portland Water Bureau (PWB) through the City of Tualatin's water system and maintains an emergency connection and transmission piping associated with this supply source. The Water System Master Plan that provides the supporting documentation to this section is attached as Appendix A to Volume II of the Sherwood Comprehensive Plan.

The City's future water service area is comprised of five different planning areas:
1. Sherwood city limits
2. Tonquin Employment Area (TEA)
3. Brookman Annexation Area
4. West Urban Reserve
5. Tonquin Urban Reserve

Each of these areas has their own land use characteristics, approximate development timelines and existing planning information. Estimates of future growth and related water demand are developed using the best available information for each area including Sherwood buildable lands geographic information system (GIS) data, population growth projections, development area concept plans and current water demand data.

Water demand growth is projected at 10 years, 20 years and at saturation development. Estimated water demands at saturation development are used to size recommended transmission and distribution improvements. .

EXISTING WATER SYSTEM CONDITIONS

Pressure Zones

The City's existing distribution system is divided into three major pressure zones. Pressure zone boundaries are defined by ground topography in order to maintain service pressures within an acceptable range for all customers in the zone. The hydraulic grade line (HGL) of a zone is designated by overflow elevations of water storage facilities or outlet settings of pressure reducing valves (PRVs) serving the zone.

The majority of Sherwood customers are served from the 380 Pressure Zone which is supplied by gravity from the City's Sunset Reservoirs. The 535 Pressure Zone, serving the area around the Sunset Reservoirs, is supplied constant pressure by the Sunset Pump Station, and the 455 Pressure

Zone serves higher elevation customers on the western edge of the City by gravity from the Kruger Reservoir.

Storage Reservoirs

Sherwood's water system has three reservoirs with a total combined storage capacity of approximately 9.0 million gallons (MG). Two reservoirs, Sunset Nos. 1 and 2, provide 6.0 million gallons (MG) of gravity supply to the 380 Pressure Zone. The other reservoir, Kruger Road, provides 3.0 mg of gravity supply to the 455 Pressure Zone.

Pump Stations

Sherwood's water system includes two booster pump stations, the Sunset Pump Station and the Wyndham Ridge Pump Station.

The Sunset Pump Station is located in Snyder Park adjacent to the Sunset Reservoir complex and has an approximate total capacity of 3,770 gallons per minute (gpm). This station provides constant pressure service and fire flow to the 535 Pressure Zone.

The Wyndham Ridge Pump Station is located on SW Handley Street west of Highway 99W. Two 40-hp pumps supply a total capacity of approximately 1,200 gpm from 380 Zone distribution piping to the Kruger Road Reservoir.

Distribution System

The City's distribution system is composed of various pipe materials in sizes up to 24 inches in diameter. The total length of piping in the service area is approximately 77.4 miles. Pipe materials include cast iron, ductile iron, PVC and copper. The majority of the piping in the system is ductile iron.

ANALYSIS OF EXISTING WATER SYSTEM

Water Supply

Sherwood's supply from the WRWTP is sufficient to meet MDD through the 10-year planning horizon with an additional 1 mgd of capacity required at 20 years and an additional 4 mgd needed at build-out. Existing City groundwater wells provide an effective emergency supply to complement emergency storage in the City's reservoirs.

Pumping and Storage

The City's distribution system has adequate storage and pumping capacity to meet existing service area demands through 2034. Due to significant uncertainty related to long-term growth and system expansion, minor storage and pumping deficiencies at build-out should be re-evaluated with the

next Water Master Plan Update or as development warrants. Additional pump stations are recommended to serve proposed high-elevation closed pressure zones in the water service expansion areas: Brookman Annexation and West Urban Reserve.

Distribution Piping

Sherwood's distribution piping is sufficiently looped to provide adequate fire flow capacity to commercial, industrial and residential customers. Few piping improvement projects are needed to meet fire flow criteria. Extensive large diameter mains will be needed to expand the City's water service area to supply the Brookman Annexation, TEA and West Urban Reserve as development occurs.

RECOMMENDED IMPROVEMENTS TO EXISTING WATER SYSTEM

Recommended improvements for the City's water system include proposed supply, pump station and water line projects.

Cost Estimating Data

An estimated project cost has been developed for each improvement project recommended. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The cost estimates presented have an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs.

Capital Improvement Program

A summary of all recommended improvement projects and estimated project costs is presented in Table ES-3 of the 2015 City of Sherwood Water System Master Plan Update. The table provides for project sequencing by showing fiscal year-by-year project priorities for the first five fiscal years, then prioritized projects in 5-year blocks for the 10-year, 20-year and Beyond 20 year timeframes. The total estimated cost of these projects is approximately $24.6 million through FY 2034. Approximately $19.9 million of the total estimated cost is for projects needed within the 10-year timeframe and $5.4 million of these improvements are required in the next 5 years.

F. DRAINAGE PLAN

INTRODUCTION

The Sherwood Planning Area is located within the Willamette River-Tualatin River Basin as identified in the Portland-Vancouver Metropolitan Area Water Resources Study (PMAWRS). The Cedar Creek and Rock Creek sub-basins channel surface runoff to the Tualatin River just north of the Planning Area. Within these sub-basins there exists considerable variation in slope. A highland area known as Washington Hill has some erosion and sedimentation potential. High groundwater and poorly drained soils in portions of the northern half of the Planning Area will require measures to regulate excavation and site drainage.

In March 1989, DEQ issued draft rules for storm water quality control to all jurisdictions in the Tualatin River sub-basin. The City of Sherwood is required to comply with the rules and participate in the development of a Surface Water Drainage Management Plan for the region. When the Plan is completed and adopted this section will be amended accordingly.

Objectives

1. Comply with DEQ Storm water quality control rules until completion of a Drainage Management Plan.

2. Cooperate with United Sewerage Agency, Washington County, and DEQ in the preparation of a Drainage Management Plan.

Findings

1. A storm drainage plan for the City's urban growth area has been developed and is illustrated on Figure VII-7. Major storm sewers are recommended for construction in accordance with the Plan; minor storm sewers are not shown on the proposed storm drainage plan. This Plan will be updated upon completion of the regional Drainage Plan.

2. Cedar Creek, Rock Creek, and Chicken Creek shall continue to be the City's primary conveyance systems for storm runoff.

3. Existing flood areas have been identified and are analyzed and described in Section VII Background Data and Analysis. It is anticipated, all but one of the problem areas will be eliminated by implementation of the Plan. An area of flooding at N.W. 12th Street and Highway 99W remains to be resolved by construction of a minor storm sewer, which is not shown on the Plan.

4. The rational method formula was used to estimate runoff to proposed storm sewers. This method has a tendency to overestimate design flows when applied to large basins. Runoff

coefficients used in the rational method are predicted on the City's Comprehensive Plan. During final design of storm sewers, actual development within the basin should be reviewed to verify previous assumptions in selection of a runoff coefficient.

5. Cost estimates for proposed storm sewer improvements have been prepared, based on 1980 construction costs and increased in 1990 by 1.25%, and on Engineering News Record (ENR) index of 3264. These estimates are presented in Table 2 of the Appendix.

6. Design of relief culverts in Cedar Creek and Rock Creek may significantly alter hydraulic control sections used by the U.S. Army Corps of Engineers to establish water surface elevations and limits of the flood plain as set forth in Flood Insurance Study, City of Sherwood, Oregon, and provided to the City in preliminary draft, dated December 17, 1980. Design of relief culverts should be coordinated with the U.S. Army Corps of Engineers to insure integrity of their flood insurance study.

Implementation

1. The City will endeavor to establish a source of revenue to finance the cost of storm sewer construction, acquisition of lands along creeks, maintenance of storm sewers and waterways, and administration of the storm plan in accordance with the regional Surface Water Drainage Management Plan.

2. Until user fees are in effect, the City should obtain waivers of remonstrance to future storm drainage improvements projects from all property owners wishing to develop their land, and the City should also require all developers to provide adequate storm sewers to serve their property as well as those properties that would naturally drain to the proposed storm sewer.

SOLID WASTE

Solid waste disposal is a regional concern requiring regional solutions. The City of Sherwood recognizes MSD's responsibility and authority to prepare and implement a solid waste management plan and supports the MSD Solid Waste Facilities Model Siting Ordinance and will participate in these procedures as appropriate. There are no landfills in Sherwood.

The Model Siting Ordinance will be incorporated into this Plan when approved by METRO. In addition, the City conducted extensive hearings on solid waste incineration in 1990 and determined incineration is generally not a form of solid waste disposal environmentally compatible in the community except in limited circumstances. Therefore, solid waste incineration is generally prohibited by this Plan.

Electrical Power

The Sherwood Planning Area is well served by major power facilities. Portland General Electric Co. (PGE) runs and operates a major regional sub-station in the northern portion of the Planning

Area and has a network of major transmission lines which cross the Planning Area. Minor sub-station siting and construction, if needed in response to development, will be coordinated with PGE.

Natural Gas

The Sherwood Planning Area is served by Northwest Natural Gas Co. (NNG) lines. The existing system consists of a 6" high pressure line extended to the Planning Area via Tualatin-Sherwood Road, So. Sherwood Blvd. and Wilsonville Road. The distribution system is adequate to serve immediate development. NNG reports that the 6" main will be adequate to serve growth projected by the Plan with new lateral line extensions and attention to proper "looping" of existing lines.

Telephone

General Telephone services the Sherwood Planning Area. Planned improvements should have the capability of handling projected growth demands in the Area.

H. SCHOOLS

INTRODUCTION

The Sherwood Planning Area is wholly contained within Sherwood School District 88J. Although the City of Sherwood is the only currently urbanized area within the district, district boundaries include approximately 44 square miles and parts of Washington, Clackamas, and Yamhill Counties. The District is currently predominately rural but, by the year 2000, the Sherwood Planning Area will contribute most of the total student enrollment.

FUTURE ENROLLMENT/FACILITY NEEDS

The School District completed a School Enrollment Study (Metro Service District Analysis) in the Fall of 1990. Revisions were made in the Spring of 1991. The study data suggests that school enrollments will be increasing sharply in the coming years. The growth assumption is supported by record-setting residential building permit issuance during 1990. Major arterial road improvements between I-5 and 99W will also cause further growth and development.

ELEMENTARY AGE STUDENTS (K-5)

J. Clyde Hopkins Elementary School has a capacity to house 600 students. Currently, 670 students are enrolled in grades K-5. Three double portable classrooms and one single portable classroom are utilized to address the growing elementary age population.

INTERMEDIATE AGE STUDENTS (6-8)

Approximately 300 students are enrolled in grades 6-8. The Intermediate School building capacity is 400 students. This capacity can be accessed by relocating District office services, which occupy a four classroom wing of the building.

HIGH SCHOOL AGE STUDENTS (9-12)

Sherwood High School has a capacity of 500 students. Approximately 420 students are currently enrolled. No major housing issues exist in this 1971 constructed facility.

SCHOOL FACILITY PLANNING

The School District is preparing to undertake a detailed facility development plan. The most immediate need for the District is to expand housing of elementary age school children (K-5). During the Fall of the 1990-91 school year, the District completed the purchase of a new elementary school site located within the City limits of Sherwood. The District also owns a school site (purchased in 1971) in the proximity of the Tualatin portion of the school district.

The intent of the District is to seek voter approval of a bond measure to address short and long-term housing needs. The measure is planned to be submitted in the Fall of 1991 or the Spring of 1992 in order to construct an additional elementary school.

I. PUBLIC SAFETY

POLICE PROTECTION

The City of Sherwood, Washington County and the State Police co-ordinate police protection within the Planning Area. In 1989 the Sherwood Police Force consisted of five officers. In order to meet future demand it is anticipated that the department will need additional patrolmen proportional to the projected increase in population. The State formula for City police protection is one officer per 500 people. The police force should expand accordingly.

FIRE PROTECTION

The Planning Area is wholly contained within the Tualatin Valley Consolidated Fire and Rescue District. One engine house is located within the City. The District feels that present physical facilities will be adequate to serve the projected year 2000 growth in the area with some increase in manpower and equipment. The District currently employs a 5-year capital improvement planning process which is updated annually. The City will co-ordinate its planning with the district to assure the adequacy of fire protection capability in the Planning Area.

J. GENERAL GOVERNMENTAL SERVICES

As a general purpose governmental unit, the City of Sherwood intends to fulfill its responsibilities in the principal areas of general administration, planning, public works, and library services. With expected growth in Sherwood, additional manpower and facilities will be required.

1. Manpower Needs

In 1989 there are currently seventeen (17) City staff in general governmental services. A review of cities which have reached Sherwood's projected five and twenty year growth levels indicate that new staffing will be needed proportional to population increases in most departments. Using this assumption a full-time staff of 15-20 persons will be required by 1985 and a staff of 20-40 will be needed by the year 2000. Most critical immediate needs are in the area of clerical staff to support existing departmental work loads.

2. Space Needs

The City offices, water department, police department, planning department and public works, are currently housed in a remodeled turn-of-the-century house. Although the structure is significant historically and should be saved, it may not meet the long term functional or space needs of a City Hall.

In 1982 the Senior and Community Center was built and provides meeting space for the City Council and Planning Commissions.

K. HEALTH FACILITIES

The local health system is linked to a number of organizations and institutions that can and do affect how it will develop. The latest planning legislation P.L. 93-641 and its recent amendments has placed Health care delivery systems planning are under the auspices of the State Certificate of Need laws and the Federal Health System Agency (HSA) planning regulations. Sherwood is located in the six county Northwest Oregon Health Systems Agency (NOHS) which is charged with reviewing new service proposals, expenditures involving public funds and the development of a health system plan for the area. The first HSA plan was adopted in 1978. State agencies administer HSA regulations. NOHS established subdistricts within the six county service area. Sherwood is located in the south-rural sub-district (see Figure VII-8). The only hospital located in the sub-district is Meridian Park Hospital in Tualatin.

Sherwood is served by various Metropolitan area hospitals depending on local physician affiliations. The City currently has only one doctor with offices in the Planning Area. St. Vincent's Hospital in Beaverton has expressed interest in establishing a satellite clinic in Sherwood.

The City will encourage the decentralization of Metropolitan health care delivery to assure that a broad range of inpatient, outpatient and emergency medical services are available to Sherwood residents. To that end the City will support the location of a St. Vincent's Satellite Center in Sherwood and encourage the appropriate expansion of Meridian Park facilities to meet the growing needs of the Planning Area.

L. SOCIAL FACILITIES AND SERVICES

A broad range of social services will be needed in the Planning Area to serve a growing urban population. Sherwood will continue to depend on metropolitan area services for which the demand does not justify a decentralized center. Multi-purpose social and health services and referral are offered by the Washington County Satellite Center in Tigard. The City will encourage the continued availability of such services.

Sherwood is located in Region 8 of the State Department of Human Resources Service Area and benefits from that agency's services. State services are administered through the County's Washington County office located in Hillsboro. In addition to public social service programs, many private organizations serve the Sherwood area.

The City is particularly interested in locating a multi-purpose social and health service referral agency in Sherwood so that residents of Sherwood would be able to get timely information on the available services. The City also supports the development of a Comprehensive Social and health services delivery plan for the Planning Area to identify gaps in needed services and develop an ongoing strategy for their provision. Of particular concern are day care and senior citizens services.

Day Care

A growing need exists for day care. State standards for the establishment of day care centers are supplemented by City standards. Currently day care has been carried on by churches and small home operations. The City recognizes and supports the proper siting and housing of day care services.

Senior Citizens Services

With an increasing proportion of the Planning Areas population reaching the age of 60, Sherwood will require additional specialized services and facilities for senior citizens. The City was awarded a grant from HUD for a Senior Citizen Community Center was completed in 1982. Community Center functions will be carried out under the authority of the City. It is the intent of the City that the Center be the focus for the Community activities requiring meeting and multi-purpose areas with particular emphasis on Senior Citizens programs and activities.

TABLE OF CONTENTS - Part 2 Sherwood Development Plan

COMMUNITY FACILITIES AND SERVICES

A. GENERAL INTRODUCTION

Community facilities and services in the Sherwood Planning Area are provided by Washington County, the City of Sherwood, special service districts, semi-public agencies and the State and Federal government, (see Table VII-1). Public facilities and services include sewer, water, fire and police protection, libraries, drainage, schools, parks and recreation, solid waste and general governmental administrative services. Semi-public facilities and services are those which are privately owned and operated but which have general public benefit. They include health facilities, energy and communication utilities, and day care.

Although a small community, Sherwood has learned well the importance of adequate community facilities and services to orderly urban growth. Lack of sewer treatment capacity curtailed growth in the City in the 1970's. Planning for public facilities and services in response to growth rather than in advance of growth results in gaps in facilities and services. As population growth and density increase in the Sherwood Planning Area, greater facility and service support will be required. In recognition of this basic fact, the Plan stresses the need for provision of necessary facilities and services in advance of, or in conjunction with, urban development.

The Community Facilities and Services element identifies general policy goals and objectives; service areas and providers, problems, and service plans, and potential funding for key public and semi-public facilities and services. Park and recreation facilities are treated in Chapter 5, Environmental Resources. Transportation facilities are treated in Chapter 6, Transportation. This element was updated in 1989 to comply with OAR 197.712(2)(e).

B. POLICY GOAL AND OBJECTIVES

To insure the provision of quality community services and facilities of a type, level and location which is adequate to support existing development and which encourages efficient and orderly growth at the least public cost.

OBJECTIVES

1. Develop and implement policies and plans to provide the following public facilities and services; public safety fire protection, sanitary facilities, water supply, governmental services, health services, energy and communication services, and

b. Bikeways
(1) City of Sherwood
(2) Washington County
(3) State of Oregon

c. Public Transit
Tri-Met

4. Public Health and Safety

a. Police Protection
(1) City of Sherwood
(2) Washington County
(3) State of Oregon

b. Fire Protection
Tualatin -Valley Fire and Rescue

c. Animal Control
Washington County

5. Recreation

a. Parks and Recreation
City of Sherwood

b. Library
City of Sherwood

6. Schools
Sherwood School District 88J

insert map

July of 1984, at points throughout the Durham Basin.

The July 1979 Sewer Service Plan used values ranging from 500 gallons per acre per day (gpad) to 700 gpad for inflow and infiltration (I&I), depending on land use designation. These values were concurrent with past EPA design standards and were based on the assumption that rehabilitation measures would remove 60 to 90 percent of excessive I&I. According to USA's 1985 Master Plan these abatement techniques proved to be ineffective. USA's review of the Durham treatment facility led to the design rate of 4000 gpad for the existing peak annual occurrence for infiltration and inflow. This value is not anticipated to decrease for the Durham basin and is therefore also used for the future design flowrates.

Two areas of special concern exist inside the current City of Sherwood UGB. Both areas are recent additions to the UGB and have not yet been assigned a land use. Rather than assume zoning designations for the areas they were both excluded from the model. Both areas can be served by gravity and neither will cause deficiencies in the system. Their service routes are discussed below.

The first area is located in the southwest corner of the UGB in the Cedar Creek Basin, between Pacific Highway and Old Highway 99W. This area can be served by line number 1 in area A (Figure VII-2). The northern half of this area may also be served by connecting to the southern most extension of line number 2 in area B. The second area is located east of Pacific Highway and north of Edy Road, in the Rock Creek Basin. The southern portion should be incorporated in line number 3 extending from Rock Creek west along Edy Road (Figure VII-2). The northern half must be served using a direct lateral to the area from the Rock Creek trunk.

RECOMMENDED IMPROVEMENTS TO EXISTING SEWER SYSTEM

The analysis of the existing system shows no size deficiencies in any of the City maintained pipes. City officials have confirmed that there are areas of surcharge in the system due to pipe under sizing. Surcharge due to blockage of the system has occurred but has since been remedied.

Improvements are recommended to the existing sewer systems main trunk lines. These improvements are required due to very slight slips which occur in the northern sections of the Rock Creek and Cedar Creek main trunk lines.

The Rock Creek trunk requires improvements from manhole number 11663, which is located at the confluence of the Rock Creek and Cedar Creek trunk lines, south to a manhole located near the Southern Pacific crossing of Rock Creek. The existing 18-inch diameter pipe has a length of 6,035 feet and an existing slope of 0.0031 feet/feet. The USA master plan recommends that a 15-inch diameter pipe be placed parallel to the existing 18-inch in order to convey future flows based on 20-year ultimate development peak flowrates. Our analysis is based on total ultimate development of the Sherwood UGB and therefore suggests that an 18-inch diameter pipe parallel the existing 18-inch at the existing slope of 0.0031 feet/feet.

insert Figure VII-2

insert Figure VII-3

~~in currently served areas of the City. Major water lines required as extensions to areas without service are also identified. The cost of all recommended and identified improvements are listed in 1990 dollars.~~

~~The amount of growth that can occur within distinct areas and neighborhoods within the City's Urban Growth Boundary without creating pressure or overall supply problems is also estimated.~~

~~1. The City's existing reservoir capacity of 2.5 million gallons (MG) is adequate to cover the needs of the City until a population of 8,200 is reached.~~

EXISTING WATER SYSTEM CONDITIONS

Pressure Zones

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The City's existing distribution system is divided into three major pressure zones. Pressure zone boundaries are defined by ground topography in order to maintain service pressures within an acceptable range for all customers in the zone. The hydraulic grade line (HGL) of a zone is designated by overflow elevations of water storage facilities or outlet settings of pressure reducing valves (PRVs) serving the zone.

The majority of Sherwood customers are served from the 380 Pressure Zone which is supplied by gravity from the City's Sunset Reservoirs. The 535 Pressure Zone, serving the area around the Sunset Reservoirs, is supplied constant pressure by the Sunset Pump Station, and the 455 Pressure Zone serves higher elevation customers on the western edge of the City by gravity from the Kruger Reservoir.

Storage Reservoirs

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Sherwood's water system has three reservoirs with a total combined storage capacity of approximately 9.0 million gallons (MG). Two reservoirs, Sunset Nos. 1 and 2, provide 6.0 million gallons (MG) of gravity supply to the 380 Pressure Zone. The other reservoir, Kruger Road, provides 3.0 mg of gravity supply to the 455 Pressure Zone.

Pump Stations

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Sherwood's water system includes two booster pump stations, the Sunset Pump Station and the Wyndham Ridge Pump Station.

The Sunset Pump Station is located in Snyder Park adjacent to the Sunset Reservoir complex and has an approximate total capacity of 3,770 gallons per minute (gpm). This station provides constant pressure service and fire flow to the 535 Pressure Zone.

horizon with an additional 1 mgd of capacity required at 20 years and an additional 4 mgd needed at build-out. Existing City groundwater wells provide an effective emergency supply to complement emergency storage in the City's reservoirs.

Pumping and Storage

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The City's distribution system has adequate storage and pumping capacity to meet existing service area demands through 2034. Due to significant uncertainty related to long-term growth and system expansion, minor storage and pumping deficiencies at build-out should be re-evaluated with the next Water Master Plan Update or as development warrants. Additional pump stations are recommended to serve proposed high-elevation closed pressure zones in the water service expansion areas: Brookman Annexation and West Urban Reserve.

Distribution Piping

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Sherwood's distribution piping is sufficiently looped to provide adequate fire flow capacity to commercial, industrial and residential customers. Few piping improvement projects are needed to meet fire flow criteria. Extensive large diameter mains will be needed to expand the City's water service area to supply the Brookman Annexation, TEA and West Urban Reserve as development occurs.~~Peak Domestic Flows Analysis~~

~~The total peak domestic flow rate for the year 2008 used in this analysis is 3,000 gallons per minute. The domestic flow is the combination of all residential, commercial, and industrial uses other than those for fire protection. Domestic use also accounts for summertime irrigation of lawns and landscaping.~~

~~The total peak domestic flow rate of 3,000 gallons per minute is derived from the detailed data published in the 1979 Water Service Plan and has been increased by approximately 15 percent as a conservative measure for unexpected conditions such as excessive water line leakage, high volume users, etc.~~

~~The 1979 Water Service Plan estimated the water usage by the City's commercial and industrial customers to be 30 percent of the residential use when the City's population reached 7,800 people. This percentage was used in the determination of the peak domestic flow rates in this analysis. The total peak domestic flow rate is based on a maximum peak consumption of 410 gallons per capita per day, and is consistent with the 1979 Water Service Plan.~~

~~The total 3,000 gallons per minute peak domestic flow was proportioned throughout the existing developed areas of the City, based on knowledge of the amounts and types of potential development that can occur in each area. Within each area of the City the proportioned flow was concentrated at "worst case" locations so that deficiencies in the City's water system would be highlighted.~~

~~Computer models require calibration to known data to assure that they represent the physical system. Known information on the pumping capacity and characteristics of the City's three wells, including their effect on the groundwater table and the historical operation of the wells and the water storage reservoir, was used to calibrate the factors in the computer model. The computer model accurately matches the operation of the City's wells and water storage reservoir during peak use.~~

~~**Peak Domestic Flows Results**~~

~~The existing water system for the City of Sherwood meets the needs of the peak domestic flows in the year 2008. There are no areas requiring improvements to meet these domestic needs. The resulting operating pressures during the peak flows range from 40 to 85 psi (pounds per square inch) throughout the City. The acceptable range for water line pressures is 20 to 100 psi.~~

~~**Fire Protection Flows Analysis**~~

~~The flow rate required to provide adequate fire protection varies with the type of building. Single family residential requires fire flows of only 1,500 gallons per minute, whereas large industrial and commercial structures without fire sprinklers can require fire flows in excess of 4,000 gallons per minutes. Most new construction of larger structures is required to have fire sprinklers for increased fire/life safety. Fire sprinklers reduce the flow requirements for fire protection.~~

~~For a City the size of Sherwood, it can only be expected that adequate flows for one major fire at a time can be provided. The low probability of multiple major fires at one time does not warrant the major expense of providing the additional supply sources and the larger diameter pipe lines. Also, because of the expense, it is cost-effective to require fire sprinklers in structures that would require excessive amounts of flow for fire protection.~~

~~For this analysis, a fire flow of 2,000 gallons per minute is used to determine the adequacy of the water supply and distribution system to provide fire flows at an adequate operating pressure. The fire flow is assumed to be concurrent in time with the peak domestic flows.~~

~~**Fire Protection Flows Results**~~

~~The computer model was used to simulate the need for fire flows to every area of the city. In general, the ability to adequately supply fire flows in most areas of the City is good. There are three~~

~~Emergency stand-by power would provide an additional margin of safety during periods of total power loss. The booster pump at the water storage reservoir is the only source of pressure for the residents in the E. Division Street and upper S. Pine Street area. During power outages, this area is without adequate water service. Stand-by power is recommended for this booster pump to eliminate this potential problem.~~

~~Although the water storage reservoir provides ample volumes of water for emergencies, it is recommended that stand-by power be provided at one of the wells as an added precautionary measure for extended periods of power outage. Since Well No. 3 is the City's largest well, stand-by power is recommended for that well. Completion of a manually-operated interconnect at Cipole Road with the City of Tualatin water system is also recommended as an additional safeguard against a catastrophic interruption in the City of Sherwood's system.~~

RECOMMENDED IMPROVEMENTS TO EXISTING WATER SYSTEM

Recommended improvements for the City's water system include proposed supply, pump station and water line projects.

Cost Estimating Data

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An estimated project cost has been developed for each improvement project recommended. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The cost estimates presented have an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs.

Capital Improvement Program

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A summary of all recommended improvement projects and estimated project costs is presented in Table ES-3 of the 2015 City of Sherwood Water System Master Plan Update. The table provides for project sequencing by showing fiscal year-by-year project priorities for the first five fiscal years, then prioritized projects in 5-year blocks for the 10-year, 20-year and Beyond 20 year timeframes. The total estimated cost of these projects is approximately $24.6 million through FY 2034. Approximately $19.9 million of the total estimated cost is for projects needed within the 10-year timeframe and $5.4 million of these improvements are required in the next 5 years.~~Improvements are recommended to the existing water system to provide adequate fire protection capability to three areas of the City. Improvements are not necessary for year 2008 population projections. These recommendations are based upon the assumption that water lines are not required to be extended~~

~~Recommended Improvements to Existing Water System~~

~~1. Loop Projects~~

~~Tualatin-Sherwood~~	~~3800 LF~~	~~$238,000~~
~~Scholls-Sherwood~~	~~2800 LF~~	~~$178,500~~
~~Murdock/Roy~~	~~600 LF~~	~~$ 59,500~~
~~Highland Extension~~	~~2700 LF~~	~~$178,500~~
~~Tualatin-sherwood Relocate~~	~~2130 LF~~	~~$ 74,100~~

~~2. Supply Projects~~

~~Well No. 6 (Murdock)~~	~~800' deep~~	~~$236,500~~
~~Reservoir Booster Pump~~	~~35 hp gen.~~	~~$ 59,500~~
~~Well No. 3 Standby Power~~	~~75 hp gen.~~	~~$119,000~~
~~Cipole Road Intertie with City of Tualatin~~		~~$ 23,400 (50%)~~

~~3. 4-Inch Waterline Replacements~~

~~Old Town (8")~~	~~1600 LF~~	~~$ 76,800~~
~~Ladd Hill (12")~~	~~1300 LF~~	~~$ 92,300~~
~~Meinecke/99W (8")~~	~~2000 LF~~	~~$ 96,000~~
~~W. Sunset (10")~~	~~1500 LF~~	~~$ 88,500~~

~~4. 6-Inch Waterline Replacements (all 8")~~

~~Old Town~~	~~1600 LF~~	~~$ 76,800~~
~~Lower Lincoln~~	~~1000 LF~~	~~$ 48,000~~
~~Lower Roy~~	~~1300 LF~~	~~$ 62,400~~
~~Oregon~~	~~1300 LF~~	~~$ 62,400~~
~~Upper Washington~~	~~1300 LF~~	~~$ 62,400~~
~~Gleneagle~~	~~3000 LF~~	~~$144,000~~
~~Upper Roy~~	~~900 LF~~	~~$ 43,400~~

~~5. Other Waterline Extensions~~

~~12 Inch~~	~~18,500 LF~~	~~$1,313,500~~
~~10 Inch~~	~~32,800 LF~~	~~$1,935,200~~
~~8 Inch~~	~~25,400 LF~~	~~$1,219,200~~

~~Beyond these recommended improvements, the City should continue its existing undersized water lines replacement program.~~

~~insert Fig. VII-5~~

~~Insert Fig VII-6~~

4. The rational method formula was used to estimate runoff to proposed storm sewers. This method has a tendency to overestimate design flows when applied to large basins. Runoff coefficients used in the rational method are predicted on the City's Comprehensive Plan. During final design of storm sewers, actual development within the basin should be reviewed to verify previous assumptions in selection of a runoff coefficient.

5. Cost estimates for proposed storm sewer improvements have been prepared, based on 1980 construction costs and increased in 1990 by 1.25%, and on Engineering News Record (ENR) index of 3264. These estimates are presented in Table 2 of the Appendix.

6. Design of relief culverts in Cedar Creek and Rock Creek may significantly alter hydraulic control sections used by the U.S. Army Corps of Engineers to establish water surface elevations and limits of the flood plain as set forth in Flood Insurance Study, City of Sherwood, Oregon, and provided to the City in preliminary draft, dated December 17, 1980. Design of relief culverts should be coordinated with the U.S. Army Corps of Engineers to insure integrity of their flood insurance study.

Implementation

1. The City will endeavor to establish a source of revenue to finance the cost of storm sewer construction, acquisition of lands along creeks, maintenance of storm sewers and waterways, and administration of the storm plan in accordance with the regional Surface Water Drainage Management Plan.

2. Until user fees are in effect, the City should obtain waivers of remonstrance to future storm drainage improvements projects from all property owners wishing to develop their land, and the City should also require all developers to provide adequate storm sewers to serve their property as well as those properties that would naturally drain to the proposed storm sewer.

SOLID WASTE

Solid waste disposal is a regional concern requiring regional solutions. The City of Sherwood recognizes MSD's responsibility and authority to prepare and implement a solid waste management plan and supports the MSD Solid Waste Facilities Model Siting Ordinance and will participate in these procedures as appropriate. There are no landfills in Sherwood.

The Model Siting Ordinance will be incorporated into this Plan when approved by METRO. In addition, the City conducted extensive hearings on solid waste incineration in 1990 and determined incineration is generally not a form of solid waste disposal environmentally compatible in the community except in limited circumstances. Therefore, solid waste incineration is generally prohibited by this Plan.

ELEMENTARY AGE STUDENTS (K-5)

J. Clyde Hopkins Elementary School has a capacity to house 600 students. Currently, 670 students are enrolled in grades K-5. Three double portable classrooms and one single portable classroom are utilized to address the growing elementary age population.

INTERMEDIATE AGE STUDENTS (6-8)

Approximately 300 students are enrolled in grades 6-8. The Intermediate School building capacity is 400 students. This capacity can be accessed by relocating District office services, which occupy a four classroom wing of the building.

HIGH SCHOOL AGE STUDENTS (9-12)

Sherwood High School has a capacity of 500 students. Approximately 420 students are currently enrolled. No major housing issues exist in this 1971 constructed facility.

SCHOOL FACILITY PLANNING

The School District is preparing to undertake a detailed facility development plan. The most immediate need for the District is to expand housing of elementary age school children (K-5). During the Fall of the 1990-91 school year, the District completed the purchase of a new elementary school site located within the City limits of Sherwood. The District also owns a school site (purchased in 1971) in the proximity of the Tualatin portion of the school district.

The intent of the District is to seek voter approval of a bond measure to address short and long-term housing needs. The measure is planned to be submitted in the Fall of 1991 or the Spring of 1992 in order to construct an additional elementary school.

I. PUBLIC SAFETY

POLICE PROTECTION

The City of Sherwood, Washington County and the State Police co-ordinate police protection within the Planning Area. In 1989 the Sherwood Police Force consisted of five officers. In order to meet future demand it is anticipated that the department will need additional patrolmen proportional to the projected increase in population. The State formula for City police protection is one officer per 500 people. The police force should expand accordingly.

FIRE PROTECTION

The Planning Area is wholly contained within the Tualatin Valley Consolidated Fire and Rescue

K. HEALTH FACILITIES

The local health system is linked to a number of organizations and institutions that can and do affect how it will develop. The latest planning legislation P.L. 93-641 and its recent amendments has placed Health care delivery systems planning are under the auspices of the State Certificate of Need laws and the Federal Health System Agency (HSA) planning regulations. Sherwood is located in the six county Northwest Oregon Health Systems Agency (NOHS) which is charged with reviewing new service proposals, expenditures involving public funds and the development of a health system plan for the area. The first HSA plan was adopted in 1978. State agencies administer HSA regulations. NOHS established subdistricts within the six county service area. Sherwood is located in the south-rural sub-district (see Figure VII-8). The only hospital located in the sub-district is Meridian Park Hospital in Tualatin.

Sherwood is served by various Metropolitan area hospitals depending on local physician affiliations. The City currently has only one doctor with offices in the Planning Area. St. Vincent's Hospital in Beaverton has expressed interest in establishing a satellite clinic in Sherwood.

The City will encourage the decentralization of Metropolitan health care delivery to assure that a broad range of inpatient, outpatient and emergency medical services are available to Sherwood residents. To that end the City will support the location of a St. Vincent's Satellite Center in Sherwood and encourage the appropriate expansion of Meridian Park facilities to meet the growing needs of the Planning Area.

L. SOCIAL FACILITIES AND SERVICES

A broad range of social services will be needed in the Planning Area to serve a growing urban population. Sherwood will continue to depend on metropolitan area services for which the demand does not justify a decentralized center. Multi-purpose social and health services and referral are offered by the Washington County Satellite Center in Tigard. The City will encourage the continued availability of such services.

Sherwood is located in Region 8 of the State Department of Human Resources Service Area and benefits from that agency's services. State services are administered through the County's Washington County office located in Hillsboro. In addition to public social service programs, many private organizations serve the Sherwood area.

TABLE OF CONTENTS - Part 2 Sherwood Development Plan

COMMUNITY FACILITIES AND SERVICES

A. GENERAL INTRODUCTION

Community facilities and services in the Sherwood Planning Area are provided by Washington County, the City of Sherwood, special service districts, semi-public agencies and the State and Federal government, (see Table VII-1). Public facilities and services include sewer, water, fire and police protection, libraries, drainage, schools, parks and recreation, solid waste and general governmental administrative services. Semi-public facilities and services are those which are privately owned and operated but which have general public benefit. They include health facilities, energy and communication utilities, and day care.

Although a small community, Sherwood has learned well the importance of adequate community facilities and services to orderly urban growth. Lack of sewer treatment capacity curtailed growth in the City in the 1970's. Planning for public facilities and services in response to growth rather than in advance of growth results in gaps in facilities and services. As population growth and density increase in the Sherwood Planning Area, greater facility and service support will be required. In recognition of this basic fact, the Plan stresses the need for provision of necessary facilities and services in advance of, or in conjunction with, urban development.

The Community Facilities and Services element identifies general policy goals and objectives; service areas and providers, problems, and service plans, and potential funding for key public and semi-public facilities and services. Park and recreation facilities are treated in Chapter 5, Environmental Resources. Transportation facilities are treated in Chapter 6, Transportation. This element was updated in 1989 to comply with OAR 197.712(2)(e).

B. POLICY GOAL AND OBJECTIVES

To insure the provision of quality community services and facilities of a type, level and location which is adequate to support existing development and which encourages efficient and orderly growth at the least public cost.

OBJECTIVES

1. Develop and implement policies and plans to provide the following public facilities and services; public safety fire protection, sanitary facilities, water supply, governmental services, health services, energy and communication services, and

recreation facilities.

2. Establish service areas and service area policies so as to provide the appropriate kinds and levels of services and facilities to existing and future urban areas.

3. Coordinate public facility and service plans with established growth management policy as a means to achieve orderly growth.

4. Coordinate public facility and service provision with future land use policy as a means to provide an appropriate mix of residential, industrial and commercial uses.

5. Develop and implement a five-year capital improvements and service plan for City services which prioritizes and schedules major new improvements and services and identifies funding sources.

6. The City will comply with the MSD Regional Solid Waste Plan, and has entered into an intergovernmental agreement with Washington County to comply with the County's Solid Waste and Yard Debris Reduction Plan, 1990.

7. Based on Sewer, Water, Stormwater, and Transportation Plan updates, the City shall prepare a prioritized list of capital improvement projects to those systems and determine funding sources to realize the improvements envisioned in those plans.

8. It shall be the policy of the City to seek the provision of a wide range of public facilities and services concurrent with urban growth. The City will make an effort to seek funding mechanisms to achieve concurrency.

C. PUBLIC AND SEMI-PUBLIC UTILITIES

Public utilities including water, sanitary sewer, drainage, and solid waste, as well as semi-public utilities including power, gas and telephone services are of most immediate importance in the support of new urban development. Water, sewer collection, and drainage facilities are the major services for which the City of Sherwood has responsibility. Service plans for these key services are contained in this section. The other utilities referred to above are the principal responsibilities of those agencies listed in Table VII-1. These agencies have been contacted for the purpose of coordinating their service planning and provision with the level and timing of service provision required to properly accommodate growth anticipated by the Plan.

TABLE VII-1
FACILITY AND SERVICE PROVIDERS
IN THE SHERWOOD PLANNING AREA

1. Public Utilities

   a. Public Water Supply
      City of Sherwood

   b. Sanitary Sewer System
      (1) Clean Water Services
      (2) City of Sherwood

   c. Storm Drainage System
      (1) City of Sherwood
      (2) Washington County
      (3) State of Oregon

2. Private/Semi-Public Utilities

   a. Natural Gas
      Northwest Natural Gas Co.

   b. Electric Power
      Portland General Electric

   c. Solid Waste: Pride Disposal Co.

3. Transportation

   a. Paved Streets, Traffic Control, Sidewalks, Curbs, Gutters, Street Lights
      (1) City of Sherwood
      (2) Washington County
      (3) State of Oregon

   b. Bikeways
      (1) City of Sherwood
      (2) Washington County
      (3) State of Oregon

c. Public Transit
Tri-Met

4. Public Health and Safety

a. Police Protection
(1) City of Sherwood
(2) Washington County
(3) State of Oregon

b. Fire Protection
Tualatin Valley Fire and Rescue

c. Animal Control
Washington County

5. Recreation

a. Parks and Recreation
City of Sherwood

b. Library
City of Sherwood

6. Schools
Sherwood School District 88J

D. SEWER SERVICE PLAN

INTRODUCTION

The Sewer Service Plan of the Comprehensive Plan was updated in 1990 and is included as an appendix to the Plan, and is incorporated into this chapter. The following describes the existing sewer system, recommended improvements to the existing system, recommended expansion of the sewer system and estimated costs.

EXISTING SEWER SYSTEM

The City of Sherwood's existing sewer system is as shown on Figure VII-1. The system is located in USA's Durham South Basin which consists of two sub-basins are centered around Cedar Creek and Rock Creek, respectively, and will be referred to as the Cedar Creek basin and the Rock Creek basin throughout the remainder of this section.

The Rock Creek Basin system currently serves a residential area bounded by Lincoln Street to the west, West Sunset Boulevard to the south, Oregon Street to the north and the UGB to the east. Rock Creek Basin also contains approximately 7l.2 acres of land, north of Oregon Street, which is currently zoned and developed for industrial use. The remaining northern portion of the Basin is essentially undeveloped and zoned primarily for industrial use. Flow is by gravity from south to north, eventually connecting to USA's Rock Creek trunk. This trunk then follows Rock Creek until it connects with the Upper Tualatin Interceptor which transports sewage to the Durham treatment plant.

The Cedar Creek Basin system serves the majority of Sherwood. Drainage is again from south to north and the main trunk of the system follows Cedar Creek from Sunset Boulevard under Pacific Highway continuing north until it connects with the Upper Tualatin Interceptor. From this point sewage is transported to the Durham Treatment plant.

insert map

ANALYSIS OF EXISTING SEWER SYSTEM

The population for the City of Sherwood in the year 2008 is estimated to be 7,000 people. The 1979 Sewer Service Plan estimated a population of 10,600 people in the year 2008, and a full-development population within the Sherwood Urban Growth Boundary (UGB) of 18,900 people.

In order to accentuate any deficiencies in the existing sanitary sewer system, peak flowrates were generated based on full development or saturation of the Sherwood UGB. This analysis was used for the following reasons. Maximum design flows for sanitary sewers are far less than peak storm sewer flows. Very often sanitary sewer pipes are sized at a minimum 8-inch diameter for maintenance purposes; consequently the majority of these pipes are flowing at a minimum of their capacity. A full-development demand analysis was the most conservative and efficient way of analyzing the system for all deficiencies.

Wastewater flow criteria for the analysis was taken from USA's 1985 Master Sewer Plan Update and is based on land use designation as listed below:

TABLE VII-2
WASTEWATER FLOW DESIGN CRITERIA
DESIGN UNIT FLOW RATE

LAND USE DESIGNATION	EXISTING	FUTURE
RESIDENTIAL	75 gpcd	75 gpcd
COMMERCIAL	1000 gpad	1000 gpad
INDUSTRIAL	3000 gpad	3000 gpad
INSTITUTIONAL	500 gpad	500 gpad
PEAK ANNUAL	4000 gpad	4000 gpad

The City of Sherwood Zoning Map was used to determine the amount of acreage of each land use designation. This acreage was then applied to tributary basins contributing to their respective sewers and multiplied by the appropriate land use design unit flowrate in order to generate the total design flowrate. An average of residential densities per tributary basin was used to account for the five different residential zoning densities shown on the current City Zoning Map.

The domestic sewage flow allowance for the 1979 Sewer Plan followed the 1969 USA Master Plan value of 90 gallons per capita per day (gpcd). The updated, June 1985 USA Master Plan, has reduced this value to 75 gpcd.

In order to account for periods of maximum use, flowrates are multiplied by factors which result in peak flowrates. The 1979 Sewer Service Plan used peak factors of 3.0 for lateral sewers and 2.7 for trunk sewer lines. The 1985 USA Master Plan Update requires peak factors ranging from 1.5 to 2.0. These lower values are based on actual dry-weather flow monitoring, performed in June and

July of 1984, at points throughout the Durham Basin.

The July 1979 Sewer Service Plan used values ranging from 500 gallons per acre per day (gpad) to 700 gpad for inflow and infiltration (I&I), depending on land use designation. These values were concurrent with past EPA design standards and were based on the assumption that rehabilitation measures would remove 60 to 90 percent of excessive I&I. According to USA's 1985 Master Plan these abatement techniques proved to be ineffective. USA's review of the Durham treatment facility led to the design rate of 4000 gpad for the existing peak annual occurrence for infiltration and inflow. This value is not anticipated to decrease for the Durham basin and is therefore also used for the future design flowrates.

Two areas of special concern exist inside the current City of Sherwood UGB. Both areas are recent additions to the UGB and have not yet been assigned a land use. Rather than assume zoning designations for the areas they were both excluded from the model. Both areas can be served by gravity and neither will cause deficiencies in the system. Their service routes are discussed below.

The first area is located in the southwest corner of the UGB in the Cedar Creek Basin, between Pacific Highway and Old Highway 99W. This area can be served by line number 1 in area A (Figure VII-2). The northern half of this area may also be served by connecting to the southern most extension of line number 2 in area B. The second area is located east of Pacific Highway and north of Edy Road, in the Rock Creek Basin. The southern portion should be incorporated in line number 3 extending from Rock Creek west along Edy Road (Figure VII-2). The northern half must be served using a direct lateral to the area from the Rock Creek trunk.

RECOMMENDED IMPROVEMENTS TO EXISTING SEWER SYSTEM

The analysis of the existing system shows no size deficiencies in any of the City maintained pipes. City officials have confirmed that there are areas of surcharge in the system due to pipe under sizing. Surcharge due to blockage of the system has occurred but has since been remedied.

Improvements are recommended to the existing sewer systems main trunk lines. These improvements are required due to very slight slips which occur in the northern sections of the Rock Creek and Cedar Creek main trunk lines.

The Rock Creek trunk requires improvements from manhole number 11663, which is located at the confluence of the Rock Creek and Cedar Creek trunk lines, south to a manhole located near the Southern Pacific crossing of Rock Creek. The existing 18-inch diameter pipe has a length of 6,035 feet and an existing slope of 0.0031 feet/feet. The USA master plan recommends that a 15-inch diameter pipe be placed parallel to the existing 18-inch in order to convey future flows based on 20-year ultimate development peak flowrates. Our analysis is based on total ultimate development of the Sherwood UGB and therefore suggests that an 18-inch diameter pipe parallel the existing 18-inch at the existing slope of 0.0031 feet/feet.

The Cedar Creek Trunk presents similar slope problems along the northern trunk. USA's Master Plan breaks these into three sections but this report will combine them for simplicity. The section of sewer begins at manhole 11663, which is located at the confluence of the Rock Creek and Cedar Creek trunks, and continues south to manhole number 11752 which is 200 feet south of Edy Road and slightly west of the UGB. (see Fig.1) The entire 12,640 feet of this line is outside of the UGB, and has a slope averaging between 0.0016 feet/feet and 0.0025 feet/feet. Depending on existing slopes a parallel system will be required ranging from 18 to 30-inches in diameter.

insert Figure VII-2

RECOMMENDED SEWER SYSTEM EXPANSION

The City of Sherwood's Urban Growth Boundary includes significant areas that are currently not served by the existing sanitary sewer system. All of these areas are part of either the Rock Creek Basin system or the Cedar Creek Basin system and can be easily served by extending laterals off the respective trunk lines of each basin. These new laterals have no special priority except to serve those who require sewer service. The locations of the recommended sewers are shown on Figure VII-3.

All new sewer lines should have a minimum diameter of 8-inches for ease of serviceability. These new laterals were designed by setting the slope of the sewer pipe invert, equal to the slope of the existing ground along the sewer line path. Individual pipe slopes may be required to be less than natural ground slopes in order to serve isolated areas of low ground elevation.

The sewer expansions are listed below under the basin in which they occur. The costs are listed by pipe diameter and are in 1990 dollars. These costs are typically paid for by the land developments that create the need for the extensions. The costs include design and construction. Land acquisition may be required but those costs are not included in the estimates below.

1.	Sewer Trunk Lines		
	Cedar Creek Parallel (15"-30")	12,640LF	$991,000
	Rock Creek Parallel (18")	6,750 LF	$378,000
2.	Rock Creek Basin Lines (All 8")		
	Tonquin	1400 LF	$ 47,000
	Highland/12th	3000 LF	$100,800
	Tualatin-Sherwood	2300 LF	$ 77,300
	Onion Flats W.	5000 LF	$168,000
	Onion Flats E.	2900 LF	$ 97,500
3.	Cedar Creek Basin Lines (8" except as noted)		
	Steeplechase S. (10")	4100 LF	$160,700
	Steeplechase N. (12")	650 LF	$ 29,100
	Steeplechase N. (10")	4100 LF	$161,000
	E. Sunset	1300 LF	$ 43,700
	W. Sunset	3500 LF	$117,600
	Scholls-Sherwood W.	1200 LF	$ 40,300
	Scholls-Sherwood E.	3100 LF	$104,200
	BPA#	3500 LF	$117,600

insert Figure VII-3

WATER SERVICE PLAN

INTRODUCTION

The City draws the majority of its water supply from the Willamette River Water Treatment Plant (WRWTP) in the City of Wilsonville, approximately 6 miles southeast of Sherwood. The City owns 5 million gallons per day (MGD) of production capacity in the existing WRWTP facilities. Sherwood also maintains four groundwater wells within the city limits for back-up supply. Prior to 2011, the City also purchased water from the Portland Water Bureau (PWB) through the City of Tualatin's water system and maintains an emergency connection and transmission piping associated with this supply source.

The City's future water service area is comprised of five different planning areas:

1. Sherwood city limits
2. Tonquin Employment Area (TEA)
3. Brookman Annexation Area
4. West Urban Reserve
5. Tonquin Urban Reserve

Each of these areas has their own land use characteristics, approximate development timelines and existing planning information. Estimates of future growth and related water demand are developed using the best available information for each area including Sherwood buildable lands geographic information system (GIS) data, population growth projections, development area concept plans and current water demand data.

Water demand growth is projected at 10 years, 20 years and at saturation development. Estimated water demands at saturation development are used to size recommended transmission and distribution improvements. .

EXISTING WATER SYSTEM CONDITIONS

Pressure Zones

The City's existing distribution system is divided into three major pressure zones. Pressure zone boundaries are defined by ground topography in order to maintain service pressures within an acceptable range for all customers in the zone. The hydraulic grade line (HGL) of a zone is designated by overflow elevations of water storage facilities or outlet settings of pressure reducing valves (PRVs) serving the zone.

The majority of Sherwood customers are served from the 380 Pressure Zone which is supplied by gravity from the City's Sunset Reservoirs. The 535 Pressure Zone, serving the area around the

Sunset Reservoirs, is supplied constant pressure by the Sunset Pump Station, and the 455 Pressure Zone serves higher elevation customers on the western edge of the City by gravity from the Kruger Reservoir.

Storage Reservoirs

Sherwood's water system has three reservoirs with a total combined storage capacity of approximately 9.0 million gallons (MG). Two reservoirs, Sunset Nos. 1 and 2, provide 6.0 million gallons (MG) of gravity supply to the 380 Pressure Zone. The other reservoir, Kruger Road, provides 3.0 mg of gravity supply to the 455 Pressure Zone.

Pump Stations

Sherwood's water system includes two booster pump stations, the Sunset Pump Station and the Wyndham Ridge Pump Station.

The Sunset Pump Station is located in Snyder Park adjacent to the Sunset Reservoir complex and has an approximate total capacity of 3,770 gallons per minute (gpm). This station provides constant pressure service and fire flow to the 535 Pressure Zone.

The Wyndham Ridge Pump Station is located on SW Handley Street west of Highway 99W. Two 40-hp pumps supply a total capacity of approximately 1,200 gpm from 380 Zone distribution piping to the Kruger Road Reservoir.

Distribution System

The City's distribution system is composed of various pipe materials in sizes up to 24 inches in diameter. The total length of piping in the service area is approximately 77.4 miles. Pipe materials include cast iron, ductile iron, PVC and copper. The majority of the piping in the system is ductile iron.

ANALYSIS OF EXISTING WATER SYSTEM

Water Supply

Sherwood's supply from the WRWTP is sufficient to meet MDD through the 10-year planning horizon with an additional 1 mgd of capacity required at 20 years and an additional 4 mgd needed at build-out. Existing City groundwater wells provide an effective emergency supply to complement emergency storage in the City's reservoirs.

Pumping and Storage

The City's distribution system has adequate storage and pumping capacity to meet existing service area demands through 2034. Due to significant uncertainty related to long-term growth and system expansion, minor storage and pumping deficiencies at build-out should be re-evaluated with the next Water Master Plan Update or as development warrants. Additional pump stations are recommended to serve proposed high-elevation closed pressure zones in the water service expansion areas: Brookman Annexation and West Urban Reserve.

Distribution Piping

Sherwood's distribution piping is sufficiently looped to provide adequate fire flow capacity to commercial, industrial and residential customers. Few piping improvement projects are needed to meet fire flow criteria. Extensive large diameter mains will be needed to expand the City's water service area to supply the Brookman Annexation, TEA and West Urban Reserve as development occurs.

RECOMMENDED IMPROVEMENTS TO EXISTING WATER SYSTEM

Recommended improvements for the City's water system include proposed supply, pump station and water line projects.

Cost Estimating Data

An estimated project cost has been developed for each improvement project recommended. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The cost estimates presented have an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs.

Capital Improvement Program

A summary of all recommended improvement projects and estimated project costs is presented in Table ES-3 of the 2015 City of Sherwood Water System Master Plan Update. The table provides for project sequencing by showing fiscal year-by-year project priorities for the first five fiscal years, then prioritized projects in 5-year blocks for the 10-year, 20-year and Beyond 20 year timeframes. The total estimated cost of these projects is approximately $24.6 million through FY 2034. Approximately $19.9 million of the total estimated cost is for projects needed within the 10-year timeframe and $5.4 million of these improvements are required in the next 5 years.

F. DRAINAGE PLAN

INTRODUCTION

The Sherwood Planning Area is located within the Willamette River-Tualatin River Basin as identified in the Portland-Vancouver Metropolitan Area Water Resources Study (PMAWRS). The Cedar Creek and Rock Creek sub-basins channel surface runoff to the Tualatin River just north of the Planning Area. Within these sub-basins there exists considerable variation in slope. A highland area known as Washington Hill has some erosion and sedimentation potential. High groundwater and poorly drained soils in portions of the northern half of the Planning Area will require measures to regulate excavation and site drainage.

In March 1989, DEQ issued draft rules for storm water quality control to all jurisdictions in the Tualatin River sub-basin. The City of Sherwood is required to comply with the rules and participate in the development of a Surface Water Drainage Management Plan for the region. When the Plan is completed and adopted this section will be amended accordingly.

Objectives

1. Comply with DEQ Storm water quality control rules until completion of a Drainage Management Plan.

2. Cooperate with United Sewerage Agency, Washington County, and DEQ in the preparation of a Drainage Management Plan.

Findings

1. A storm drainage plan for the City's urban growth area has been developed and is illustrated on Figure VII-7. Major storm sewers are recommended for construction in accordance with the Plan; minor storm sewers are not shown on the proposed storm drainage plan. This Plan will be updated upon completion of the regional Drainage Plan.

2. Cedar Creek, Rock Creek, and Chicken Creek shall continue to be the City's primary conveyance systems for storm runoff.

3. Existing flood areas have been identified and are analyzed and described in Section VII Background Data and Analysis. It is anticipated, all but one of the problem areas will be eliminated by implementation of the Plan. An area of flooding at N.W. 12th Street and Highway 99W remains to be resolved by construction of a minor storm sewer, which is not shown on the Plan.

4. The rational method formula was used to estimate runoff to proposed storm sewers. This method has a tendency to overestimate design flows when applied to large basins. Runoff

coefficients used in the rational method are predicted on the City's Comprehensive Plan. During final design of storm sewers, actual development within the basin should be reviewed to verify previous assumptions in selection of a runoff coefficient.

5. Cost estimates for proposed storm sewer improvements have been prepared, based on 1980 construction costs and increased in 1990 by 1.25%, and on Engineering News Record (ENR) index of 3264. These estimates are presented in Table 2 of the Appendix.

6. Design of relief culverts in Cedar Creek and Rock Creek may significantly alter hydraulic control sections used by the U.S. Army Corps of Engineers to establish water surface elevations and limits of the flood plain as set forth in Flood Insurance Study, City of Sherwood, Oregon, and provided to the City in preliminary draft, dated December 17, 1980. Design of relief culverts should be coordinated with the U.S. Army Corps of Engineers to insure integrity of their flood insurance study.

Implementation

1. The City will endeavor to establish a source of revenue to finance the cost of storm sewer construction, acquisition of lands along creeks, maintenance of storm sewers and waterways, and administration of the storm plan in accordance with the regional Surface Water Drainage Management Plan.

2. Until user fees are in effect, the City should obtain waivers of remonstrance to future storm drainage improvements projects from all property owners wishing to develop their land, and the City should also require all developers to provide adequate storm sewers to serve their property as well as those properties that would naturally drain to the proposed storm sewer.

SOLID WASTE

Solid waste disposal is a regional concern requiring regional solutions. The City of Sherwood recognizes MSD's responsibility and authority to prepare and implement a solid waste management plan and supports the MSD Solid Waste Facilities Model Siting Ordinance and will participate in these procedures as appropriate. There are no landfills in Sherwood.

The Model Siting Ordinance will be incorporated into this Plan when approved by METRO. In addition, the City conducted extensive hearings on solid waste incineration in 1990 and determined incineration is generally not a form of solid waste disposal environmentally compatible in the community except in limited circumstances. Therefore, solid waste incineration is generally prohibited by this Plan.

Electrical Power

The Sherwood Planning Area is well served by major power facilities. Portland General Electric Co. (PGE) runs and operates a major regional sub-station in the northern portion of the Planning Area and has a network of major transmission lines which cross the Planning Area. Minor sub-station siting and construction, if needed in response to development, will be coordinated with PGE.

Natural Gas

The Sherwood Planning Area is served by Northwest Natural Gas Co. (NNG) lines. The existing system consists of a 6" high pressure line extended to the Planning Area via Tualatin-Sherwood Road, So. Sherwood Blvd. and Wilsonville Road. The distribution system is adequate to serve immediate development. NNG reports that the 6" main will be adequate to serve growth projected by the Plan with new lateral line extensions and attention to proper "looping" of existing lines.

Telephone

General Telephone services the Sherwood Planning Area. Planned improvements should have the capability of handling projected growth demands in the Area.

H. SCHOOLS

INTRODUCTION

The Sherwood Planning Area is wholly contained within Sherwood School District 88J. Although the City of Sherwood is the only currently urbanized area within the district, district boundaries include approximately 44 square miles and parts of Washington, Clackamas, and Yamhill Counties. The District is currently predominately rural but, by the year 2000, the Sherwood Planning Area will contribute most of the total student enrollment.

FUTURE ENROLLMENT/FACILITY NEEDS

The School District completed a School Enrollment Study (Metro Service District Analysis) in the Fall of 1990. Revisions were made in the Spring of 1991. The study data suggests that school enrollments will be increasing sharply in the coming years. The growth assumption is supported by record-setting residential building permit issuance during 1990. Major arterial road improvements between I-5 and 99W will also cause further growth and development.

ELEMENTARY AGE STUDENTS (K-5)

J. Clyde Hopkins Elementary School has a capacity to house 600 students. Currently, 670 students

are enrolled in grades K-5. Three double portable classrooms and one single portable classroom are utilized to address the growing elementary age population.

INTERMEDIATE AGE STUDENTS (6-8)

Approximately 300 students are enrolled in grades 6-8. The Intermediate School building capacity is 400 students. This capacity can be accessed by relocating District office services, which occupy a four classroom wing of the building.

HIGH SCHOOL AGE STUDENTS (9-12)

Sherwood High School has a capacity of 500 students. Approximately 420 students are currently enrolled. No major housing issues exist in this 1971 constructed facility.

SCHOOL FACILITY PLANNING

The School District is preparing to undertake a detailed facility development plan. The most immediate need for the District is to expand housing of elementary age school children (K-5). During the Fall of the 1990-91 school year, the District completed the purchase of a new elementary school site located within the City limits of Sherwood. The District also owns a school site (purchased in 1971) in the proximity of the Tualatin portion of the school district.

The intent of the District is to seek voter approval of a bond measure to address short and long-term housing needs. The measure is planned to be submitted in the Fall of 1991 or the Spring of 1992 in order to construct an additional elementary school.

I. PUBLIC SAFETY

POLICE PROTECTION

The City of Sherwood, Washington County and the State Police co-ordinate police protection within the Planning Area. In 1989 the Sherwood Police Force consisted of five officers. In order to meet future demand it is anticipated that the department will need additional patrolmen proportional to the projected increase in population. The State formula for City police protection is one officer per 500 people. The police force should expand accordingly.

FIRE PROTECTION

The Planning Area is wholly contained within the Tualatin Valley Consolidated Fire and Rescue District. One engine house is located within the City. The District feels that present physical facilities will be adequate to serve the projected year 2000 growth in the area with some increase in manpower and equipment. The District currently employs a 5-year capital improvement planning

process which is updated annually. The City will co-ordinate its planning with the district to assure the adequacy of fire protection capability in the Planning Area.

J. GENERAL GOVERNMENTAL SERVICES

As a general purpose governmental unit, the City of Sherwood intends to fulfill its responsibilities in the principal areas of general administration, planning, public works, and library services. With expected growth in Sherwood, additional manpower and facilities will be required.

1. Manpower Needs

   In 1989 there are currently seventeen (17) City staff in general governmental services. A review of cities which have reached Sherwood's projected five and twenty year growth levels indicate that new staffing will be needed proportional to population increases in most departments. Using this assumption a full-time staff of 15-20 persons will be required by 1985 and a staff of 20-40 will be needed by the year 2000. Most critical immediate needs are in the area of clerical staff to support existing departmental work loads.

2. Space Needs

   The City offices, water department, police department, planning department and public works, are currently housed in a remodeled turn-of-the-century house. Although the structure is significant historically and should be saved, it may not meet the long term functional or space needs of a City Hall.

   In 1982 the Senior and Community Center was built and provides meeting space for the City Council and Planning Commissions.

K. HEALTH FACILITIES

The local health system is linked to a number of organizations and institutions that can and do affect how it will develop. The latest planning legislation P.L. 93-641 and its recent amendments has placed Health care delivery systems planning are under the auspices of the State Certificate of Need laws and the Federal Health System Agency (HSA) planning regulations. Sherwood is located in the six county Northwest Oregon Health Systems Agency (NOHS) which is charged with reviewing new service proposals, expenditures involving public funds and the development of a health system plan for the area. The first HSA plan was adopted in 1978. State agencies administer HSA regulations. NOHS established subdistricts within the six county service area. Sherwood is located in the south-rural sub-district (see Figure VII-8). The only hospital located in the sub-district is Meridian Park Hospital in Tualatin.

Sherwood is served by various Metropolitan area hospitals depending on local physician affiliations. The City currently has only one doctor with offices in the Planning Area. St. Vincent's Hospital in Beaverton has expressed interest in establishing a satellite clinic in Sherwood.

The City will encourage the decentralization of Metropolitan health care delivery to assure that a broad range of inpatient, outpatient and emergency medical services are available to Sherwood residents. To that end the City will support the location of a St. Vincent's Satellite Center in Sherwood and encourage the appropriate expansion of Meridian Park facilities to meet the growing needs of the Planning Area.

L. SOCIAL FACILITIES AND SERVICES

A broad range of social services will be needed in the Planning Area to serve a growing urban population. Sherwood will continue to depend on metropolitan area services for which the demand does not justify a decentralized center. Multi-purpose social and health services and referral are offered by the Washington County Satellite Center in Tigard. The City will encourage the continued availability of such services.

Sherwood is located in Region 8 of the State Department of Human Resources Service Area and benefits from that agency's services. State services are administered through the County's Washington County office located in Hillsboro. In addition to public social service programs, many private organizations serve the Sherwood area.

The City is particularly interested in locating a multi-purpose social and health service referral agency in Sherwood so that residents of Sherwood would be able to get timely information on the available services. The City also supports the development of a Comprehensive Social and health services delivery plan for the Planning Area to identify gaps in needed services and develop an ongoing strategy for their provision. Of particular concern are day care and senior citizens services.

Day Care

A growing need exists for day care. State standards for the establishment of day care centers are supplemented by City standards. Currently day care has been carried on by churches and small home operations. The City recognizes and supports the proper siting and housing of day care services.

Senior Citizens Services

With an increasing proportion of the Planning Areas population reaching the age of 60, Sherwood will require additional specialized services and facilities for senior citizens. The City was awarded a grant from HUD for a Senior Citizen Community Center was completed in 1982. Community Center functions will be carried out under the authority of the City. It is the intent of the City that the Center be the focus for the Community activities requiring meeting and multi-purpose areas with particular emphasis on Senior Citizens programs and activities.

Exhibit C

City of Sherwood
16527 SW Willamette St
Sherwood, OR 97140
Tel 503-625-5722
Fax 503-625-0629
www.sherwoodoregon.gov

March 11, 2015

Mr. Brad Kilby and
City of Sherwood Planning Commission
22560 SW Pine Street
Sherwood, OR 97140

Re: Sherwood Water System Master Plan Update (WSMPU)

Brad and Members of the Planning Commission:

The following questions are paraphrased from discussion at the Sherwood Planning Commission work session regarding the Water System Master Plan Update. The answers given herein are intended to provide clarification for the commissioners in advance of a Planning Commission Public Hearing anticipated on March 24, 2015.

Questions

1. What is a Water System Master Plan Update and what is the process for water master planning in Sherwood?

The City of Sherwood (City) is required to maintain a current water system master plan as a drinking water provider in the State of Oregon with more than 300 customers. The City's water master plan must comply with Oregon Administrative Rule (OAR) 333-061-0060(5). This OAR stipulates certain elements that must be part of the plan, including, an evaluation of the water system for at least a 20 year period and an estimate of projected growth in the water system during that time.

The completed plan must be reviewed and approved by the Oregon Health Authority's Drinking Water Services for compliance with the OAR. Prior plan adoption by the governing body of the water system, such as a city council, is not expressly required by the OAR for State approval. However, most if not all water providers, including the City of Sherwood, will seek water master plan adoption by their governing body before submitting the plan to the Oregon Health Authority.

Funding for the capital improvement program (CIP) recommended in the Sherwood Water System Master Plan Update (WSMPU) is being assessed through a water rate and system development charge (SDC) analysis independent of the Master Plan Update document. This rate and SDC analysis will be presented to the budget committee, City Council for review, public hearing, and adoption, in coordination with the Water System Master Plan Update, consistent with Sherwood policies.

2. *What is being approved if the Water System Master Plan Update is recommended for adoption by the Planning Commission?*

   The Water System Master Plan Update will serve as an amendment to the Public Facilities Chapter of the Sherwood Comprehensive Plan (Part 2). Any addendum to Sherwood's comprehensive plan must be reviewed and approved by the Oregon State Department of Land Conservation and Development (DLCD) and recommended by Sherwood's Planning Commission for adoption by the City Council.

   Water rates, SDCs and water utility funding are independent of the Water System Master Plan Update document and will be presented to the budget committee, City Council for review, public hearing and adoption consistent with Sherwood policies.

3. *Why are we planning for so much growth?*

   Public water system master plans are required to evaluate water system needs for a minimum of 20 years. The Sherwood WSMPU considers 4 growth areas; the existing city limits, Tonquin Employment Area (TEA), Brookman Annexation Area and Sherwood West Urban Reserve. The Sherwood city limits, TEA and Brookman fall within the existing Metro Urban Growth Boundary (UGB) which is drawn to accommodate anticipated Portland metro area growth within 20 years. Thus, any of these areas may be expected to experience growth within 20 years.

   Sherwood West was identified by City Planning staff as the next likely area to develop after TEA and Brookman. Although this area remains outside of the Metro UGB, it is prudent for the City to consider the long range water system needs to serve potential customers in Sherwood West. With a basic water infrastructure plan in place for Sherwood West, the City can ensure that appropriately-sized water facilities are built when and if development occurs.

   Any project in the water system CIP designated 100% for growth would only be constructed if development occurred in the area served by that project. Projects in the CIP may be re- prioritized or delayed based on

where or if growth is occurring in the Sherwood water system but additional projects would not be added to the CIP without updating the Water System Master Plan. Review and re-prioritization of projects will occur annually as part of the budgeting process, in addition to longer-range prioritization of projects by the Engineering and Public Works Departments.

4. *What is the total CIP cost to existing Sherwood water customers?*

Of the $36.2 million total estimated cost for recommended capital improvement projects, only $2.2 million is anticipated to be paid by existing customers through saturation development. The remaining projects in the CIP are for water system expansion to serve growth, as development occurs. These improvements will be funded through the collection of System Development Charges (SDCs).

Note:

A typo was identified in the CIP summary table presented in the Draft Water System Master Plan Update. Water main projects M-3, 4 & 5 which replace existing 8-inch mains in order to provide adequate fire flow for future development in Brookman Annexation should be 100% allocated to growth. An updated CIP summary table showing this 100% allocation is attached. The attached table replaces Table ES-3 on page 7 of the draft Executive Summary and Table 5-3 on page 13 of Section 5.

A second version of the CIP summary table showing the total estimated CIP cost to existing customers is also attached with the M-3, 4 & 5 allocation correction. The uncorrected table was displayed as a poster at the WSMPU public open house February 25, 2015, and a specific question related to this typo was asked by a Sherwood citizen during the open house.

Sincerely,

Craig Sheldon
Public Works Director

Table ES-3
CIP Summary

DRAFT

Project Category	Project ID	Project Description	CIP Schedule and Project Cost Summary								% Allocated to Growth
			FY1 (2016)	FY2 (2017)	FY3 (2018)	FY4 (2019)	FY5 (2020)	10-Year (2024)	20-Year (2034)	Beyond 20 years	
Supply	S-1	Existing WRWTP upgrades to achieve max 15 mgd capacity				$ 250,000	$ 250,000	$ 500,000			21%
	S-2	WRWTP purchase 5 mgd intake capacity			$ 100,000	$ 150,000	$ 150,000	$ 1,600,000			100%
	S-3	WRWTP treatment expansion - Sherwood 5 mgd share			$ 440,000	$ 550,000	$ 550,000	$ 6,160,000			100%
	S-4	Install hydrants at Wells 3 and 5	$ 25,000								0%
	S-5	Abandon Well 4 and transfer water rights	$ 25,000								0%
		Subtotal	***$ 50,000***	***$ -***	***$ 540,000***	***$ 950,000***	***$ 950,000***	***$ 8,260,000***	***$ -***	***$ -***	
Pump Station	P-1	Proposed 1,600 gpm Ladd Hill Pump Station to serve future 400 Brookman Zone customers							$ 477,000		100%
	P-2	Proposed 2,400 gpm Kruger Pump Station to serve future 630 Zone customers								$ 2,547,000	100%
	P-3	Proposed 1,600 gpm Edy Road Pump Station to serve future 475 Zone customers								$ 1,505,000	100%
		Subtotal	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ 477,000***	***$ 4,052,000***	
Water Main	M-1	Fire flow capacity -Sherwood Senior Center		$ 36,000							0%
	M-2	Fire flow capacity - Norton Ave			$ 92,000						0%
	M-60	Fire flow capacity - June Court				$ 43,000					0%
	M-7	Expansion to Brookman - Loop from prop SW Sherwood PRV to Hwy 99		$ 68,000							100%
	M-8				$ 204,000						100%
	M-9				$ 239,000						100%
	M-29	Expansion to TEA - Loop with existing Oregon Street mains			$ 154,000						100%
	M-30					$ 264,000					100%
	M-31					$ 438,000					100%
	M-32						$ 267,000				100%
	M-33						$ 162,000				100%
	M-34						$ 178,000				100%
	M-3, 4 & 5	10-Year (2024) - upgrade existing mains						$ 300,000			100%
	M-6, 10 to 19B, 35 to 37, 40 to 42	10-Year (2024)						$ 5,275,000			100%
	M-20 to 28, 43 to 45	20-Year (2034)							$ 3,295,000		100%
	M-38, 39, 46 to 59	Beyond 20 years								$ 7,183,000	100%
		Routine Pipe Replacement Program	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 250,000	$ 500,000	$50K annually	57%
		Subtotal	***$ 50,000***	***$ 154,000***	***$ 739,000***	***$ 795,000***	***$ 657,000***	***$ 5,825,000***	***$ 3,795,000***	***$ 7,183,000***	
PRV	V-1	SW Sherwood PRV			$ 150,000						100%
	V-2	Handley PRV						$ 150,000			100%
	V-3	Haide PRV								$ 150,000	100%
	V-4	195th PRV								$ 150,000	100%
		Subtotal	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ 300,000***	
Other		Upgrade SCADA System		$ 75,000							35%
		Subtotal	***$ -***	***$ 75,000***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	
Planning		Update Water Master Plan						$ 150,000	$ 150,000		35%
		Update Water Management and Conservation Plan			$ 150,000				$ 150,000		35%
		Update Vulnerability Assessment						$ 60,000	$ 60,000		35%
		Resiliency Plan	$ 150,000						$ 150,000		35%
		Subtotal	***$ 150,000***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 210,000***	***$ 510,000***	***$ -***	
Capital Improvement Program (CIP) Total			**$ 250,000**	**$ 229,000**	**$ 1,579,000**	**$ 1,745,000**	**$ 1,607,000**	**$ 14,445,000**	**$ 4,782,000**	**$ 11,535,000**	**$ 36,172,000**

Annual Average CIP Cost		
$1,082,000 over 5 years	$1,985,500 over 10 years	$1,231,850 over 20 years

DRAFT

Water System Master Plan Update

Proposed Capital Improvement Program (CIP) Summary

Project Category	Project ID	Project Description	CIP Schedule and Project Cost Summary								% Allocated to Future Growth
			FY1 (2016)	FY2 (2017)	FY3 (2018)	FY4 (2019)	FY5 (2020)	10-Year (2024)	20-Year (2034)	Beyond 20 years	
Supply	S-1	Existing WRWTP upgrades to achieve max 15 mgd capacity				$ 250,000	$ 250,000	$ 500,000			21%
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	S-4	Install hydrants at Wells 3 and 5	$ 25,000								0%
	S-5	Abandon Well 4 and transfer water rights	$ 25,000								0%
		Subtotal	***$ 50,000***	***$ -***	***$ 540,000***	***$ 950,000***	***$ 950,000***	***$ 8,260,000***	***$ -***	***$ -***	
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		Subtotal	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ 477,000***	***$ 4,052,000***	
Water Main	M-1	Fire flow capacity - Sherwood Senior Center		$ 36,000							0%
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	M-60	Fire flow capacity - June Court				$ 43,000					0%
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	M-38, 39, 46 to 59	Beyond 20 years								$ 7,183,000	100%
		Routine Pipe Replacement Program	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 250,000	$ 500,000	$50K annually	57%
		Subtotal	***$ 50,000***	***$ 154,000***	***$ 739,000***	***$ 795,000***	***$ 657,000***	***$ 5,825,000***	***$ 3,795,000***	***$ 7,183,000***	
PRV	V-1	SW Sherwood PRV			$ 150,000						100%
	V-2	Handley PRV						$ 150,000			100%
	V-3	Haide PRV								$ 150,000	100%
	V-4	195th PRV								$ 150,000	100%
		Subtotal	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ 300,000***	
Other		Upgrade SCADA System		$ 75,000							35%
		Subtotal	***$ -***	***$ 75,000***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	
Planning		Update Water Master Plan						$ 150,000	$ 150,000		35%
		Update Water Management and Conservation Plan			$ 150,000				$ 150,000		35%
		Update Vulnerability Assessment						$ 60,000	$ 60,000		35%
		Resiliency Plan	$ 150,000						$ 150,000		35%
		Subtotal	***$ 150,000***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 210,000***	***$ 510,000***	***$ -***	
Capital Improvement Program (CIP) Total			**$ 250,000**	**$ 229,000**	**$ 1,579,000**	**$ 1,745,000**	**$ 1,607,000**	**$ 14,445,000**	**$ 4,782,000**	**$ 11,535,000**	

Overall CIP Total	**$ 36,172,000**
Total Allocated to Future Growth	**$ 34,020,000**
Total Allocated to Current Customers	**$ 2,152,000**

Exhibit D

MSA
MURRAY, SMITH & ASSOCIATES, INC.
ENGINEERS | PLANNERS

City of Sherwood Oregon

CITY OF SHERWOOD

WATER SYSTEM MASTER PLAN UPDATE

DRAFT

FEBRUARY 2015

WATER SYSTEM MASTER PLAN UPDATE

FOR

CITY OF SHERWOOD

FEBRUARY 2015

DRAFT

MURRAY, SMITH & ASSOCIATES, INC.
121 SW Salmon, Suite 900
Portland, OR 97204
503.225.9010

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EXECUTIVE SUMMARY

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5. RECOMMENDATIONS AND CAPITAL IMPROVEMENT PROGRAM (CIP)

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EXECUTIVE SUMMARY

Introduction

The purpose of this Water System Master Plan Update is to perform an analysis of the City of Sherwood's (City's) water system and:

- Document water system upgrades, including significant changes in water supply completed since the 2005 Master Plan
- Estimate future water requirements including potential water system expansion areas
- Identify deficiencies and recommend water facility improvements that correct deficiencies and provide for growth
- Update the City's capital improvement program (CIP)
- Evaluate the City's existing water rates and system development charges (SDCs)

This plan complies with water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61.

Study Area

The study area of this planning effort includes the current city limits, the Tonquin Employment Area (TEA), Brookman Annexation area, the West Urban Reserve and a portion of the Tonquin Urban Reserve, which generally includes all area within the City's existing Urban Growth Boundary (UGB).

Planning Period

The planning period for this Water Master Plan Update is 20 years, through the year 2034. Some planning and facility sizing efforts within this plan will use estimates of water demands at saturation development. Saturation development occurs when all the vacant, developable land within the planning area has been developed to the maximum zoning density with some practical allowance for in-fill of existing developed properties.

Water System Background

The City owns and operates a public water system that supplies potable water to all residents, businesses and public institutions within the city limits.

Supply Facilities

The City draws the majority of its water supply from the Willamette River Water Treatment Plant (WRWTP) in the City of Wilsonville, approximately 6 miles southeast of Sherwood. The City owns 5 mgd of production capacity in the existing WRWTP facilities. Sherwood also maintains four groundwater wells within the city limits for back-up supply. Prior to

2011, the City also purchased water from the Portland Water Bureau (PWB) through the City of Tualatin's water system and maintains an emergency connection and transmission piping associated with this supply source.

Pressure Zones

The City's existing distribution system is divided into three major pressure zones. Pressure zone boundaries are defined by ground topography in order to maintain service pressures within an acceptable range for all customers in the zone. The hydraulic grade line (HGL) of a zone is designated by overflow elevations of water storage facilities or outlet settings of pressure reducing valves (PRVs) serving the zone.

The majority of Sherwood customers are served from the 380 Pressure Zone which is supplied by gravity from the City's Sunset Reservoirs. The 535 Pressure Zone, serving the area around the Sunset Reservoirs, is supplied constant pressure by the Sunset Pump Station, and the 455 Pressure Zone serves higher elevation customers on the western edge of the City by gravity from the Kruger Reservoir.

Storage Reservoirs

Sherwood's water system has three reservoirs with a total combined storage capacity of approximately 9.0 million gallons (MG). Two reservoirs, Sunset Nos. 1 and 2, provide 6.0 million gallons (mg) of gravity supply to the 380 Pressure Zone. The other reservoir, Kruger Road, provides 3.0 mg of gravity supply to the 455 Pressure Zone.

Pump Stations

Sherwood's water system includes two booster pump stations, the Sunset Pump Station and the Wyndham Ridge Pump Station.

The Sunset Pump Station is located in Snyder Park adjacent to the Sunset Reservoir complex and has an approximate total capacity of 3,770 gallons per minute (gpm). This station provides constant pressure service and fire flow to the 535 Pressure Zone.

The Wyndham Ridge Pump Station is located on SW Handley Street west of Highway 99W. Two 40-hp pumps supply a total capacity of approximately 1,200 gpm from 380 Zone distribution piping to the Kruger Road Reservoir.

Distribution System

The City's distribution system is composed of various pipe materials in sizes up to 24 inches in diameter. The total length of piping in the service area is approximately 77.4 miles. Pipe materials include cast iron, ductile iron, PVC and copper. The majority of the piping in the system is ductile iron.

Water Demand Projections

Water demand refers to all water required by the system including residential, commercial, industrial and institutional uses. Demands are described using two water use metrics, average daily demand (ADD) and maximum day demand (MDD), in gallons per unit of time such as gallons per day (gpd) or million gallons per day (mgd).

Current Water Demand

For the purposes of this Plan, water production data is used to calculate total water demand in order to account for unmetered water uses. Table ES-1 summarizes the City's current system-wide water demand based on water production data.

Table ES-1
Current Water Demand Summary

Year	ADD (mgd)	MDD (mgd)	Ratio MDD:ADD
2012	1.85	3.85	2.1
2013	1.87	3.83	2.0
Average	1.86	3.84	2.1

Future Water Demand Projections

The City's future water service area is comprised of five different planning areas:

1. Sherwood city limits
2. Tonquin Employment Area (TEA)
3. Brookman Annexation Area
4. West Urban Reserve
5. Tonquin Urban Reserve

Each of these areas has their own land use characteristics, approximate development timelines and existing planning information. Estimates of future growth and related water demand are developed using the best available information for each area including Sherwood buildable lands geographic information system (GIS) data, population growth projections, development area concept plans and current water demand data.

Water demand growth is projected at 10 years, 20 years and at saturation development. Estimated water demands at saturation development are used to size recommended transmission and distribution improvements. Future MDD is projected from estimated future ADD based on the current average ratio of MDD:ADD, also referred to as a peaking factor.

Future demand projections by planning area and pressure zone are summarized in Tables ES-2.

Table ES-2
Future Water Demand Summary

	Current			10-Year (2024)			20-Year (2034)			Saturation Development		
Pressure Zone	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**
City Limits	***8,779***	***1.87***	***3.93***	***9,536***	***2.03***	***4.26***	***9,536***	***2.03***	***4.26***	***9,536***	***2.03***	***4.26***
380	6,857	1.47	3.09	7,447	1.59	3.34	7,447	1.59	3.34	7,447	1.59	3.34
400	149	0.03	0.06	162	0.03	0.06	162	0.03	0.06	162	0.03	0.06
455	816	0.17	0.36	887	0.19	0.40	887	0.19	0.40	887	0.19	0.40
535	957	0.20	0.42	1,039	0.22	0.46	1,039	0.22	0.46	1,039	0.22	0.46
Tonquin Employment Area (TEA)				***238***	***0.05***	***0.11***	***484***	***0.11***	***0.23***	***744***	***0.16***	***0.34***
380	-	-	-	238	0.05	0.11	484	0.11	0.23	744	0.16	0.34
Brookman Annexation				***752***	***0.16***	***0.34***	***1,330***	***0.28***	***0.59***	***1,330***	***0.28***	***0.59***
380	-	-	-	752	0.16	0.34	1,275	0.27	0.57	1,275	0.27	0.57
400 Brookman	-	-	-	-	-	-	55	0.01	0.02	55	0.01	0.02
West Urban Reserve				***235***	***0.05***	***0.11***	***2,066***	***0.43***	***0.90***	***7,974***	***1.70***	***3.57***
380	-	-	-	235	0.05	0.11	1,138	0.24	0.50	4,391	0.94	1.97
455	-	-	-	-	-	-	432	0.09	0.19	1,670	0.36	0.76
475 West	-	-	-	-	-	-	52	0.01	0.02	202	0.04	0.08
630 West	-	-	-	-	-	-	444	0.09	0.19	1,711	0.36	0.76
Tonquin Urban Reserve										***591***	***0.13***	***0.27***
380	-	-	-	-	-	-	-	-	-	591	0.13	0.27
GRAND TOTAL	**8,779**	**1.9**	**3.9**	**10,761**	**2.3**	**4.8**	**13,416**	**2.9**	**6.0**	**20,175**	**4.3**	**9.0**

Planning and Analysis Criteria

Criteria are established for evaluating water supply, distribution system piping, service pressures, storage and pumping capacity and fire flow availability. These criteria are used in conjunction with the water demand forecasts to complete the water system analysis.

The water distribution system should be capable of operating within certain performance limits under varying customer demand and operational conditions. The recommendations of this plan are based on performance criteria developed through a review of State requirements, American Water Works Association (AWWA) acceptable practice guidelines, *Ten States Standards* and the *Washington Water System Design Manual*.

Water System Analysis

Water Supply

Sherwood's supply from the WRWTP is sufficient to meet MDD through the 10-year planning horizon with an additional 1 mgd of capacity required at 20 years and an additional 4 mgd needed at build-out. Existing City groundwater wells provide an effective emergency supply to complement emergency storage in the City's reservoirs.

Pumping and Storage

The City's distribution system has adequate storage and pumping capacity to meet existing service area demands through 2034. Due to significant uncertainty related to long-term growth and system expansion, minor storage and pumping deficiencies at build-out should be re-evaluated with the next Water Master Plan Update or as development warrants. Additional pump stations are recommended to serve proposed high-elevation closed pressure zones in the water service expansion areas: Brookman Annexation and West Urban Reserve.

Distribution Piping

Sherwood's distribution piping is sufficiently looped to provide adequate fire flow capacity to commercial, industrial and residential customers. Few piping improvement projects are needed to meet fire flow criteria. Extensive large diameter mains will be needed to expand the City's water service area to supply the Brookman Annexation, TEA and West Urban Reserve as development occurs.

Recommendations and Capital Improvement Program

Recommended improvements for the City's water system are based on the analysis and findings presented above. These improvements include proposed supply, pump station and water line projects.

Cost Estimating Data

An estimated project cost has been developed for each improvement project recommended. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The cost estimates presented here have an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs.

Capital Improvement Program

A summary of all recommended improvement projects and estimated project costs is presented in Table ES-3. This CIP table provides for project sequencing by showing fiscal year-by-year project priorities for the first five fiscal years, then prioritized projects in 5-year blocks for the 10-year, 20-year and Beyond 20 year timeframes. The total estimated cost of these projects is approximately $24.6 million through FY 2034. Approximately $19.9 million of the total estimated cost is for projects needed within the 10-year timeframe and $5.4 million of these improvements are required in the next 5 years.

Table ES-3
CIP Summary

DRAFT

Project Category	Project ID	Project Description	CIP Schedule and Project Cost Summary								% Allocated to Growth
			FY1 (2016)	FY2 (2017)	FY3 (2018)	FY4 (2019)	FY5 (2020)	10-Year (2024)	20-Year (2034)	Beyond 20 years	
Supply	S-1	Existing WRWTP upgrades to achieve max 15 mgd capacity				$ 250,000	$ 250,000	$ 500,000			20%
	S-2	WRWTP purchase 5 mgd intake capacity			$ 100,000	$ 150,000	$ 150,000	$ 1,600,000			100%
	S-3	WRWTP treatment expansion - Sherwood 5 mgd share			$ 440,000	$ 550,000	$ 550,000	$ 6,160,000			100%
	S-4	Install hydrants at Wells 3 and 5	$ 25,000								0%
	S-5	Abandon Well 4 and transfer water rights	$ 25,000								0%
		Subtotal	***$ 50,000***	***$ -***	***$ 540,000***	***$ 950,000***	***$ 950,000***	***$ 8,260,000***	***$ -***	***$ -***	
Pump Station	P-1	Proposed 1,600 gpm Ladd Hill Pump Station to serve future 400 Brookman Zone customers							$ 477,000		100%
	P-2	Proposed 2,400 gpm Kruger Pump Station to serve future 630 Zone customers								$ 2,547,000	100%
	P-3	Proposed 1,600 gpm Edy Road Pump Station to serve future 475 Zone customers								$ 1,505,000	100%
		Subtotal	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ 477,000***	***$ 4,052,000***	
Water Main	M-1	Fire flow capacity -Sherwood Senior Center		$ 36,000							0%
	M-2	Fire flow capacity - Norton Ave			$ 92,000						0%
	M-60	Fire flow capacity - June Court				$ 43,000					0%
	M-7	Expansion to Brookman - Loop from prop SW Sherwood PRV to Hwy 99		$ 68,000							100%
	M-8				$ 204,000						100%
	M-9				$ 239,000						100%
	M-29	Expansion to TEA - Loop with existing Oregon Street mains			$ 154,000						100%
	M-30					$ 264,000					100%
	M-31					$ 438,000					100%
	M-32						$ 267,000				100%
	M-33						$ 162,000				100%
	M-34						$ 178,000				100%
	M-3, 4 & 5	10-Year (2024) - upgrade existing mains						$ 300,000			56%
	M-6, 10 to 19B, 35 to 37, 40 to 42	10-Year (2024)						$ 5,275,000			100%
	M-20 to 28, 43 to 45	20-Year (2034)							$ 3,295,000		100%
	M-38, 39, 46 to 59	Beyond 20 years								$ 7,183,000	100%
		Routine Pipe Replacement Program	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 250,000	$ 500,000	$50K annually	57%
		Subtotal	***$ 50,000***	***$ 154,000***	***$ 739,000***	***$ 795,000***	***$ 657,000***	***$ 5,825,000***	***$ 3,795,000***	***$ 7,183,000***	
PRV	V-1	SW Sherwood PRV			$ 150,000						100%
	V-2	Handley PRV						$ 150,000			100%
	V-3	Haide PRV								$ 150,000	100%
	V-4	195th PRV								$ 150,000	100%
		Subtotal	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ 300,000***	
Other		Upgrade SCADA System		$ 75,000							35%
		Subtotal	***$ -***	***$ 75,000***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	
Planning		Update Water Master Plan						$ 150,000	$ 150,000		35%
		Update Water Management and Conservation Plan			$ 150,000				$ 150,000		35%
		Update Vulnerability Assessment						$ 60,000	$ 60,000		35%
		Resiliency Plan	$ 150,000						$ 150,000		35%
		Subtotal	***$ 150,000***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 210,000***	***$ 510,000***	***$ -***	
Capital Improvement Program (CIP) Total			**$ 250,000**	**$ 229,000**	**$ 1,579,000**	**$ 1,745,000**	**$ 1,607,000**	**$ 14,445,000**	**$ 4,782,000**	**$ 11,535,000**	**$ 36,172,000**

Annual Average CIP Cost		
$1,082,000 over 5 years	**$1,985,500 over 10 years**	**$1,231,850 over 20 years**

SECTION 1
INTRODUCTION AND EXISTING WATER SYSTEM

Introduction

The purpose of this Water System Master Plan Update is to perform an analysis of the City of Sherwood's (City's) water system and:

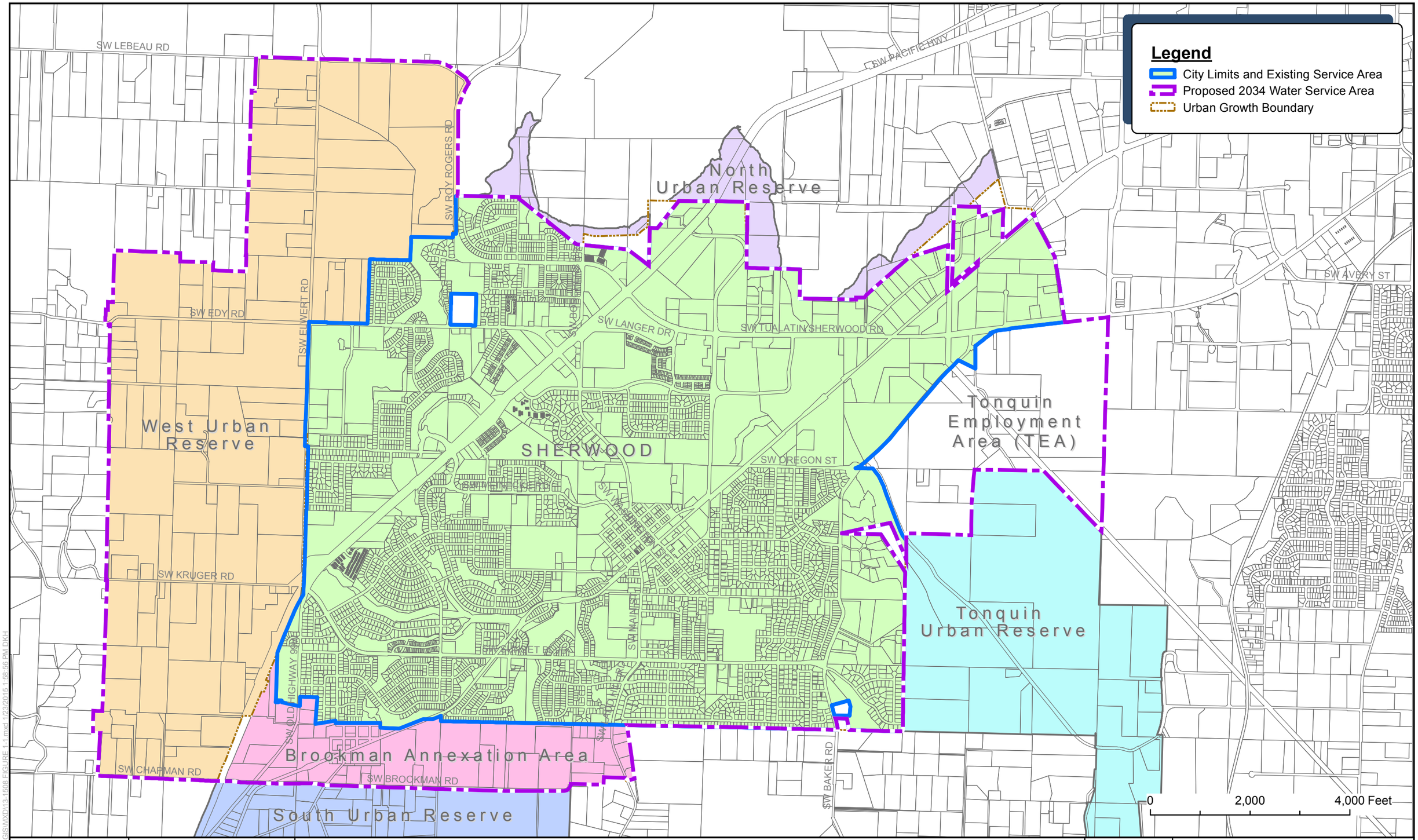
- Document water system upgrades, including significant changes in water supply completed since the 2005 Master Plan
- Estimate future water requirements including potential water system expansion areas
- Identify deficiencies and recommend water facility improvements that correct deficiencies and provide for growth
- Update the City's capital improvement program (CIP)
- Evaluate the City's existing water rates and system development charges (SDCs)

In order to identify system deficiencies, existing water infrastructure inventoried in this section will be assessed based on estimated existing and future water needs developed in Section 2 and water system performance criteria described in Section 3. The results of this analysis are presented in Section 4. Section 5 identifies improvement projects to mitigate existing and projected future deficiencies and provide for system expansion including a prioritized CIP. Section 6 presents the water system financial analysis including an assessment of the City's current water rates and SDCs. The planning and analysis efforts presented in this Master Plan Update are intended to provide the City with the information needed to inform long-term water infrastructure decisions.

This plan complies with water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61.

Study Area

The City's current water service area includes all areas within the current city limits. The study area of this planning effort includes the current city limits, the Tonquin Employment Area (TEA), Brookman Annexation area, the West Urban Reserve and a portion of the Tonquin Urban Reserve. The TEA and Brookman Annexation are within the City's existing Urban Growth Boundary (UGB). Some development in the West and Tonquin Urban Reserves is considered in the future water system analysis in order to provide for anticipated long-term growth. Future jurisdiction of the Tonquin Urban Reserve area is divided between the City of Sherwood and the City of Tualatin with Sherwood serving customers west of SW 124th Avenue. The study area is illustrated in Figure 1-1.



Sherwood Water System Master Plan Update

Figure 1-1
Study Area

Water System Background

The City owns and operates a public water system that supplies potable water to all residents, businesses and public institutions within the city limits. This section describes the water service area and inventories the City's water system facilities including existing supply sources, pressure zones, finished-water storage reservoirs, pump stations and distribution system piping.

Plate 1 in Appendix A illustrates the City's water system service area limits, water system facilities and distribution system piping. The water system schematic in Figure 1-2 at the end of this section shows the existing configuration of water system facilities and pressure zones.

Supply Facilities

The City draws the majority of its water supply from the Willamette River Water Treatment Plant (WRWTP) in the City of Wilsonville, approximately 6 miles southeast of Sherwood. Sherwood maintains four wells within the city limits for back-up supply. Prior to 2011, the City also purchased water from the Portland Water Bureau (PWB) through the City of Tualatin's water system.

Willamette River Water Treatment Plant

The Willamette River Water Treatment Plant (WRWTP) in the City of Wilsonville began operating in 2002 using conventional filtration to treat up to 15 million gallons per day (mgd) of Willamette River water for municipal consumption. The facility was developed and funded by Wilsonville and the Tualatin Valley Water District (TVWD). In December 2006, Sherwood purchased 5 mgd of the WRWTP's capacity from TVWD. The plant is currently operated and maintained under contract by Veolia Water, a private contractor.

WRWTP Transmission to Sherwood

Water is supplied from the WRWTP to Sherwood's Sunset Reservoirs through approximately 6.3 miles of 63-inch and 48-inch diameter welded steel pipe. Some segments of the transmission main currently serve both Sherwood and Wilsonville customers with pipe oversizing to accommodate future WTP expansion. Intergovernmental agreements (IGAs) between Sherwood, Wilsonville and TVWD define the capacity in each shared pipe segment that is available to each water provider. Transmission main segment descriptions, lengths, sizes and capacities are summarized in Table 1-1.

Table 1-1
WRWTP-Sherwood Transmission Main

Pipe Segment	From	To	Length (LF)	Dia (in)	Capacity	
					IGA Total (mgd)	Sherwood Share
1	Willamette River WTP	Kinsman Road at Wilsonville Road	4,300	63	70	5 mgd
2	Kinsman Road at Wilsonville Road	Kinsman Road at Barber Road	2,537	48	40	1/2
3A	Kinsman Road at Barber Road	180 feet north of Segment 2	180	48	40	1/2
3B	Segment 3A	Boeckman Road at Kinsman Road	2,400	48	40	1/2
4	Boeckman Road at Kinsman Road	Tooze Road at 110th Avenue	4,185	48	30	2/3
5A	Tooze Road at 110th Avenue	400 feet west of Tooze Road & Grahams Ferry Road	1,461	48	30	2/3
5B	Segment 5A	Revenue Meter Vault (Tooze Road)	198	48	40	1/2
6 thru 9	Revenue Meter Vault (Tooze Road)	Sherwood Sunset Reservoirs	18,000	48		All

Groundwater Wells

Sherwood operates four groundwater wells for back-up supply within the City's water service area. Well Nos. 3, 4, 5 and 6 have a combined production capacity of approximately 3.3 mgd. Liquid sodium hypochlorite is added at each well for disinfection.

Although the wells are currently used for back-up supply only, they are exercised regularly and supplied approximately 6 percent of the City's annual demand in 2013 while Segment 3B of the WRWTP transmission main was completed. City wells are summarized in Table 1-2.

Table 1-2
Groundwater Well Summary

Well No.	Location	Pump Type	Hp	Year Constructed	Production Capacity (gpm)	Approx. Depth (feet)	Casing Dia. (inches)
3	Intersection of Pine and Willamette Street	Vertical Line Shaft Turbine	75	1946	890	319	12
4	17191 Smith Road	Vertical Line Shaft Turbine	60	1969	250	458	14
5	16491 Sunset Boulevard	Vertical Line Shaft Turbine	150	1984	600	800	16
6	1830 Roy Street	Vertical Line Shaft Turbine	75	1997	550 [1]	889	16
Total Production Capacity (gpm): **(mgd):**					**2,290** **3.3**		

[1] *Production capacity is limited to 550 gpm by available water rights.*

Tualatin Emergency Intertie

Sherwood maintains an emergency connection with the City of Tualatin through an approximately 4-mile long, 24-inch diameter Sherwood-owned transmission main. This transmission main begins at the Tualatin Community Park where the Tualatin-Portland supply main connects to the City of Tualatin's distribution system. A pressure reducing valve (PRV) at this connection reduces the hydraulic grade to approximately 385 feet of head for the City of Sherwood.

Prior to 2011 when Sherwood began drawing water from the WRWTP, Sherwood purchased water from the Portland Water Bureau, under an agreement with the City of Tualatin and TVWD, through this 24-inch main. Currently, the City receives a small amount of supply from Tualatin through this main under normal operating conditions to maintain water quality in the main for use in a water emergency.

Pressure Zones

The City's existing distribution system is divided into three major pressure zones. Pressure zone boundaries are defined by ground topography in order to maintain service pressures within an acceptable range for all customers in the zone. The hydraulic grade line (HGL) of a zone is designated by overflow elevations of water storage facilities, discharge pressure of pump stations, or outlet settings of pressure reducing valves (PRVs) serving the zone. Existing pressure zone HGLs, approximate service elevation ranges and related facilities are summarized in Table 1-3. Water system facilities serving each pressure zone are illustrated on Figure 1-2 at the end of this section.

The majority of Sherwood customers are served from the 380 Pressure Zone which is supplied by gravity from the City's Sunset Reservoirs. The 380 Zone can also be served by gravity from the WRWTP, the City's groundwater wells and the Tualatin emergency supply connection. The 535 Pressure Zone, serving the area around the Sunset Reservoirs, is supplied constant pressure by the Sunset Pump Station. The Murdock sub-zone, with an HGL of 400 feet, is served through a PRV from the 535 Zone. The 455 Pressure Zone serves higher elevation customers on the western edge of the City. This zone is served by gravity from the Kruger Reservoir which is filled by pumping out of the 380 Zone at the Wyndham Ridge Pump Station.

Storage Reservoirs

Sherwood's water system has three reservoirs with a total combined storage capacity of approximately 9.0 million gallons (MG). Table 1-3 presents a summary of the City's existing storage reservoirs.

Table 1-3
Reservoir Summary

Reservoir	Location	Capacity (MG)	Overflow Elevation (ft)	Pressure Zone Served
Sunset No. 1	Snyder Park	2.0	380	380
Sunset No. 2	Snyder Park	4.0	383.5	380
Kruger Road	SW Kruger Road west of Highway 99W	3.0	455	455

Sunset Reservoirs

Sherwood's Sunset Reservoirs provide gravity service to the City's largest pressure zone, 380. Both Reservoirs are located at the north end of Snyder Park near the intersection of SW Division and Pine Streets. The 2.0 MG Sunset Reservoir No. 1 is a 105-foot diameter circular, partially buried, cast in place, prestressed concrete reservoir constructed in 1972. Reservoir No. 1 was seismically upgraded in 2005 with more extensive seismic structural improvements, drainage improvements and re-coating completed in 2012. The 4.0 MG Sunset Reservoir No. 2 was constructed in 2009 adjacent to Sunset Reservoir No. 1. Sunset No. 2 is a 155-foot diameter circular, partially buried, cast in place, prestressed concrete reservoir.

Both reservoirs are supplied from the WRWTP through the Sherwood transmission main which terminates at the reservoir site. The reservoirs provide suction supply to the Sunset Pump Station which provides constant pressure service to the 535 Zone. Site piping at

Snyder Park is configured such that either or both reservoirs may be taken out of service for maintenance.

Kruger Road Reservoir

The 3.0 MG Kruger Road Reservoir was constructed in 2002 and is located approximately one-half mile west of Highway 99W, outside of the UGB on the west side of Sherwood. Kruger Road Reservoir is a 130-foot diameter circular, partially buried, cast in place, prestressed concrete reservoir. The reservoir is supplied water from the Wyndham Ridge Pump Station and serves the 455 Pressure Zone by gravity.

Pump Stations

Sherwood's water system includes two booster pump stations, the Sunset Pump Station and the Wyndham Ridge Pump Station. Table 1-4 summarizes the City's existing pump stations.

Table 1-4
Pump Station Summary

Pump Station	Pump No.	Horsepower (Hp)	Capacity (gpm)	Serves
Sunset	1	7.5	120	Constant Pressure to 535 Zone and Murdock Sub-Zone
	2	20	325	
	3	20	325	
	4	100	1500	
	5	100	1500	
Wyndham Ridge	1	40	600	Kruger Road Reservoir and 455 Zone
	2	40	600	
	3	10	N/A[1]	
	4	10	N/A[1]	

[1] *Pumps are not used to supply the Kruger Road Reservoir under normal operating conditions.*

Sunset Pump Station

The Sunset Pump Station is located in Snyder Park adjacent to the Sunset Reservoir complex and houses five vertical turbine pumps with an approximate total capacity of 3,770 gallons per minute (gpm). This station provides constant pressure service and fire flow to the 535 Pressure Zone and the PRV controlled Murdock sub-zone. Site piping at Snyder Park is configured such that suction supply to the station can be provided from either the Sunset Reservoirs or the 380 Zone distribution piping. Sunset Pump Station is equipped with variable frequency drives (VFDs) to meet instantaneous demands and improve operating

efficiency. Back-up power and redundant high capacity pumps capable of supplying adequate fire flow provide resilient operation for this continuously operating station.

Wyndham Ridge Pump Station

The Wyndham Ridge Pump Station is located on SW Handley Street west of Highway 99W and houses four close-coupled, end suction centrifugal pumps. Two 40-hp pumps supply water from 380 Zone distribution piping to the Kruger Road Reservoir. Each of these pumps has a capacity of approximately 600 gpm. Prior to the completion of the Kruger Road Reservoir in 2002, the Wyndham Ridge Pump Station provided constant pressure service to the 455 Zone at a lower HGL using a 5-hp and two 10-hp pumps. The required pumping head to deliver water to the Kruger Road Reservoir and the 455 Pressure Zone exceeds the operating range of these original pumps which are not currently used. The 5-hp pump was removed and the piping and valving reconfigured to allow supply from the 455 Zone to the 380 Zone.

In the event that the Kruger Road Reservoir is taken out of service, the pump station is capable of providing constant pressure service to the 455 Zone. The two 40-hp pumps are equipped with VFDs which will operate to maintain pressure and meet demands in the zone. The pump station is equipped with a 125 kilowatt generator for emergency back-up power.

Distribution System

The City's distribution system is composed of various pipe materials in sizes up to 24 inches in diameter. The total length of piping in the service area is approximately 77.4 miles. Pipe materials include cast iron, ductile iron, PVC and copper. The majority of the piping in the system is ductile iron. Table 1-5 presents a summary of pipe lengths by diameter.

Table 1-5
Distribution System Pipe Summary

Pipe Diameter	Approximate Length (miles)
4-inch or Less	0.7
6-inch	5.0
8-inch	37.2
10-inch	6.9
12-inch	14.0
14-inch	0.9
16-inch	1.8
18-inch	0.8
24-inch	4.3
Total Length	**77.4**

SCADA System

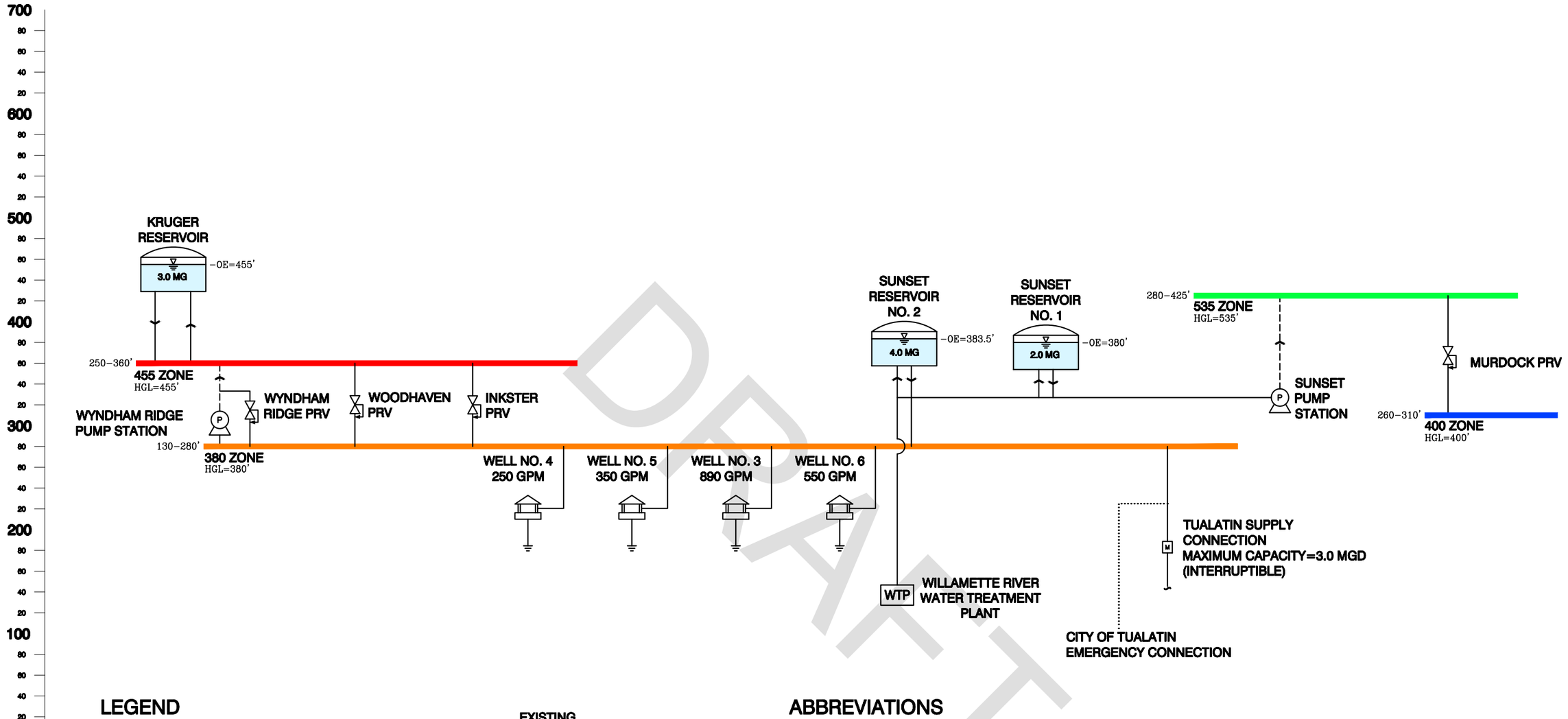
Sherwood's supervisory control and data acquisition (SCADA) system monitors all storage reservoirs, pump stations and wells within the City's water distribution system and provides for manual or automatic control of certain facilities and operations. The SCADA system also collects and stores system status and performance data.

All facilities are equipped with remote telemetry units (RTUs) that monitor reservoir water surface elevations, pump station on/off status and pump station flow rates. In addition, some sites are equipped with intrusion, overflow warning and fire alarms which alert staff to unauthorized access, flooding or fire.

All signals from the RTUs are collected and transmitted to the local operations center and to a Human-Machine Interface (HMI) located at the Public Works complex which enables City staff to view the status of the water system. The system is also capable of automatically dialing City officials 24 hours a day in the event that one of the alarms is triggered at any of the sites. Many of the City's telemetry system facilities have recently been upgraded.

Summary

This section presents a summary of the City of Sherwood's existing water system, including the transmission and supply system, emergency interties, pressure zones, storage and pumping facilities and distribution system piping.



LEGEND

	EXISTING
PUMP DISCHARGE WATER MAIN	
WATER MAIN	
RESERVOIR (CAPACITY IN MG, OVERFLOW ELEVATION IN FEET)	1.0 MG, OE=410'
GROUNDWATER WELL (PRODUCTION CAPACITY IN GPM)	
PRESSURE REDUCING VALVE	
PUMP STATION	P
MASTER METER	M
WATER TREATMENT PLANT	WTP
DISTRIBUTION SYSTEM EMERGENCY INTERTIES	

ABBREVIATIONS

GPM	GALLONS PER MINUTE
HGL	HYDRAULIC GRADE LINE
MG	MILLION GALLONS
MGD	MILLION GALLONS PER DAY
OE	OVERFLOW ELEVATION
PRV	PRESSURE REDUCING VALVE

FIGURE 1-2

City of Sherwood Oregon

Water System Master Plan Update

WATER SYSTEM SCHEMATIC

FEBRUARY 2015

MSA

13-1508

SECTION 2
LAND USE AND WATER REQUIREMENTS

This section presents existing and projected future water demands for the City of Sherwood's (City's) water service area. Demand forecasts are developed from current land use, buildable lands data and historical water consumption and production records.

Service Area

The existing water service area is the entire area within the existing city limits. The City's future water system planning area includes the current city limits, the Tonquin Employment Area (TEA), Brookman Annexation Area, West Urban Reserve and a portion of the Tonquin Urban Reserve. The TEA and Brookman Annexation Area are within the City's existing Urban Growth Boundary (UGB). Some development in the West and Tonquin Urban Reserves is considered in the future water system analysis in order to provide for anticipated long term growth. Future jurisdiction of the Tonquin Urban Reserve area is divided between the City of Sherwood and the City of Tualatin with Sherwood serving customers west of SW 124th Avenue.

Future water service expansion areas are divided between existing and proposed future pressure zones based on ground elevations and a service pressure range of 40 to 80 pounds per square inch (psi). Sherwood's existing and future service areas and pressure zones are illustrated on Figure 2-1 at the end of this section.

Planning Period

The planning period for this Water Master Plan Update is 20 years, through the year 2034. Some planning and facility sizing efforts within this plan will use estimates of water demands at saturation development. Saturation development occurs when all the vacant, developable land within the planning area has been developed to the maximum zoning density with some practical allowance for in-fill of existing developed properties. Typically, if substantial water system improvements are required beyond the 20-year planning period in order to accommodate water demands at saturation development, staging is recommended for facilities where incremental expansion is feasible and practical. Unless otherwise noted, recommended improvements identified in this plan are sized for saturation development.

Current Water Demand

Water demand refers to all water required by the system including residential, commercial, industrial and institutional uses. Demands are described using two water use metrics, average daily demand (ADD) and maximum day demand (MDD), in gallons per unit of time such as gallons per day (gpd) or million gallons per day (mgd). ADD is the total annual water volume used in the system divided by 365 days per year. MDD is the largest 24-hour

water volume for a given year. In western Oregon, MDD usually occurs each year between July 1st and September 30th. This timeframe is referred to as the peak season.

Water demand can be calculated using either water consumption or water production data. Water consumption data is taken from the City's customer billing records which do not include unmetered water use such as system flushing and water loss. Water production is the total of all water entering the Sherwood water system including water purchased from the Willamette River Water Treatment Plant (WRWTP), water wheeled through Tualatin from the Portland Water Bureau and water produced at the City's wells.

For the purposes of this Plan, water production data is used to calculate total water demand in order to account for unmetered water uses. Customer consumption and billing records are used to distribute demands throughout the Sherwood water system hydraulic model discussed in Section 4 and to estimate water demand distribution among the City's pressure zones. The historical ratio of MDD:ADD is used to estimate future maximum day demands. Table 2-1 summarizes the City's current system-wide water demand based on water production data.

Table 2-1
Current Water Demand Summary

Year	ADD (mgd)	MDD (mgd)	Ratio MDD:ADD
2012	1.85	3.85	2.1
2013	1.87	3.83	2.0
Average	1.86	3.84	2.1

Water Demand by Pressure Zone

As described in Section 1, water systems are divided into pressure zones in order to provide adequate service pressure to customers at different elevations. Each pressure zone is served by specific facilities, such as, reservoirs or pump stations and related piping which supply pressure to customers. In order to assess the sufficiency of these facilities, it is necessary to estimate demand in each pressure zone. Current water demand based on water production data, as shown in Table 2-1 is distributed between the City's pressure zones based on metered water consumption from utility billing records. Current water demand by pressure zone is summarized in Table 2-2.

Table 2-2
Current Water Demand by Pressure Zone

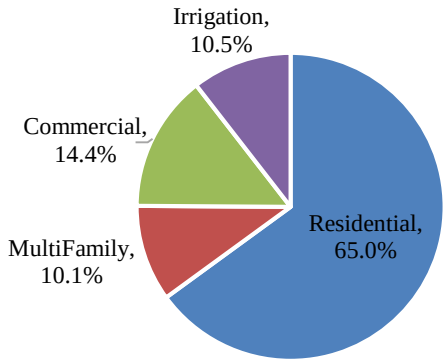
Pressure Zone	ADD (mgd)	MDD (mgd)
380	1.45	2.97
400	0.04	0.07
455	0.18	0.38
535	0.19	0.42
Total	1.86	3.84

Water Consumption by Customer Class

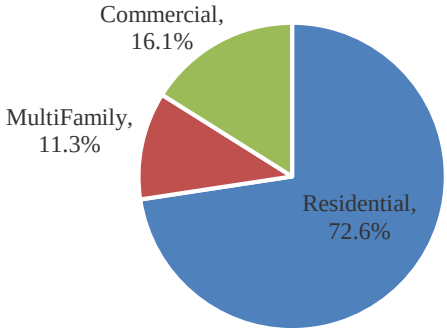
Current water consumption by service type or customer class from the City's billing records is used to correlate water demand to land use type for future demand projections. The City's water utility billing records maintain five service types, Residential, MultiFamily, Commercial, Irrigation and Fireline. Fireline meters are used only in an emergency and are not included in this consumption analysis.

Sherwood's irrigation consumption serves both residential and non-residential properties. It is important to include irrigation use in estimates of future water consumption for properties that are not yet developed. In order to estimate the water need for each customer class including irrigation use, the current annual irrigation demand is distributed to the other three customer classes, Residential, MultiFamily and Commercial, proportional to their share of total annual metered consumption. Current water consumption by customer class is based on a 2-year average of City water billing data from 2012 and 2013. Current water consumption by customer class, including irrigation use, is illustrated in Figure 2-2.

Figure 2-2
Current Annual Water Consumption by Customer Class



with Irrigation independent



with Irrigation included

Commercial Water Demand per Acre

Commercial demand per acre is used to estimate long term future water demands in areas without detailed planning information, such as, the Tonquin and West Urban Reserves and for infill development within the city limits. Current average daily commercial water demand per acre is estimated by associating commercial water consumption to developed commercial and light industrial acreage within the city limits and TEA. Developed commercial acreage is estimated using the City's buildable lands geographic information systems (GIS) data general zoning categories. Estimated commercial average daily water demand is 437 gpd per acre.

Water Demand per Residential Unit

Growth projections developed for the City through previous planning efforts identify the number of future residential units (RUs) anticipated within an area to be developed. In order to forecast future water demands using these estimated future RUs, an average daily water demand (ADD) per RU is established from current water billing data.

ADD per residential unit is calculated as the total annual consumption by single-family residential customers divided by the total number of single-family residential service connections. As previously discussed, the City has a significant number of irrigation meters. Consumption from irrigation meters is distributed to all other customer classes proportional to their annual water use as illustrated in Figure 2-2. Current ADD per RU including irrigation use is approximately 213 gallons per day (gpd/RU) as summarized in Table 2-3. For the purposes of this analysis, ADD per residential unit is anticipated to remain constant in the future.

Table 2-3
ADD per Residential Unit

Annual Water Consumption (gallons)	Residential	370,287,850
	Residential Portion (72.6%) of Irrigation Consumption	43,465,166
	Residential Total	413,753,016
Residential Consumption ADD		1,133,570
No. of Residential Services		5,322
ADD per RU (gpd/RU)		**213**

Future Water Demand Projections

Approach

The City's future water service area, illustrated on Figure 2-1, is comprised of five different planning areas:

1. Sherwood city limits
2. Tonquin Employment Area (TEA)
3. Brookman Annexation Area
4. West Urban Reserve
5. Tonquin Urban Reserve

Each of these areas has their own land use characteristics, approximate development timelines and existing planning information. Estimates of future growth and related water demand are developed using the best available information for each area including Sherwood buildable lands geographic information system (GIS) data, population growth projections, development area concept plans and current water demand data. The buildable lands GIS includes a calculated number of new units for each residentially zoned property and a net acreage for each non-residential property. Each of these values take into account the property's current zoning and development restrictions such as floodplain overlays.

Water demand growth is projected at 10 years, 20 years and at saturation development. Estimated water demands at saturation development are used to size recommended transmission and distribution improvements. Future MDD is projected from estimated future ADD based on the current average ratio of MDD:ADD, also referred to as a peaking factor. From current water demand data shown in Table 2-1, the MDD:ADD peaking factor for the Sherwood system is approximately 2.1.

Forecasted demands are allocated to existing and proposed future pressure zones based on the ground elevations in water service expansion areas and a service pressure range of 40 to 80 pounds per square inch (psi). Existing and proposed pressure zone boundaries for the study area are illustrated on Figure 2-1 and Plate 1 in Appendix A. Future demand projections by pressure zone are summarized in Tables 2-7 and 2-8 at the end of this section.

Sherwood City Limits

Residential services account for the majority of water demand in the City of Sherwood, thus, an estimated annual average population growth rate is used as an indicator of growth in water demand within the current city limits. The regional government Metro projects saturation development will occur within the existing Sherwood city limits in the next 10 years. According to annual population estimates developed for all Oregon cities by the Portland State University Population Research Center (PRC), recent population growth within the Sherwood city limits has occurred at an average rate of less than 0.3 percent annually.

Based on proposed subdivisions and planned unit developments (PUDs) approved by the City in 2012 and 2013, it is assumed that residential growth within the city limits will be slightly accelerated for the next 3 to 5 years as these housing developments are completed. For this analysis, future population growth within the city limits is estimated based on an annual average growth rate of approximately 1.25 percent through 2019 and 0.15 percent after 2019 to saturation development in approximately 2024.

Tonquin Employment Area (TEA)

Growth in the TEA is estimated based on the September 2010 *Tonquin Employment Area Preferred Concept Plan Report* Table IV-1: TEA 20-Year Employment Forecast. This table develops estimates of job density per acre for four sub-areas within the TEA. For the Water Master Plan analysis, it is assumed the TEA will begin developing in sub-areas A and B1 within 5 years and in sub-areas B2 and B3 within 10 years. Development in the TEA is assumed to follow a linear growth pattern based on 20-year development percentages established in Table IV-1 of the *TEA Concept Plan.* For example, the 96.8 acres of light industrial buildable land in sub-area A is anticipated to be 70 percent developed in 20 years. Using a linear growth pattern, light industrial land in sub-area A will be 35 percent developed in 10 years and approximately 17 percent developed within 5 years. Total jobs within the TEA at saturation development (buildout) are also established in Table IV-1.

Future water demand projections in the TEA are based on water use per employee of 45 gallons per day (gpd) for mixed use commercial, office and light industrial development as presented in the *TEA Concept Plan*. This water demand estimate assumes there will be no process water uses in future TEA developments. Growth projections and future water demand estimates for the TEA are summarized in Table 2-4.

Table 2-4
TEA Projected Growth and Future Water Demand

Growth Projection	TEA Sub Area	Total Developed Acres	Total Jobs	ADD (mgd)
5-Year (2019)	A, B1	31.0	490	0.03
10-Year (2024)	All	74.9	1,160	0.05
20-Year (2034)	All	147.0	2,290	0.11
Saturation Development	All	235.2	3,520	0.16

Brookman Annexation Area

Growth projections in the Brookman Annexation Area are developed based on the *2009 Brookman Addition Concept Plan Final Report* and the City's buildable lands GIS data. The concept plan identifies areas for residential, commercial, office and light industrial development within the Brookman Annexation Area. Table 1 Land Use Metrics from the *Brookman Concept Plan* presents an estimated density and total number of jobs within the Brookman Annexation Area at saturation development. The City's buildable lands GIS data for the Brookman area includes an estimated number of residential units at saturation development. Due to the small amount of developable residential land within the existing city limits and the exclusively non-residential, primarily industrial development anticipated within the TEA, it is assumed that the Brookman Annexation Area will reach saturation development within the 20-year planning horizon.

It is assumed that the Brookman Annexation Area will begin developing in five years with an initial 80 households and 300 jobs. The initial number of households is based on existing housing unit counts in the area from the 2010 Census and two new residential developments of 30 to 40 homes. Approximately eight acres of non-residential development would yield 300 jobs based on the density of 35.83 jobs/acre presented in the *Brookman Concept Plan* Table 1. Growth projections at 10 years are based on a linear growth pattern from initial development at five years to saturation at 20 years.

Average daily water demands for future residential development are estimated based an ADD/RU of 213 gpd/RU. Commercial, office and light industrial average daily water demands within the Brookman Annexation Area are based on an average water use per employee of 45 gpd consistent with the *TEA Concept Plan* for these same land uses. All Brookman Annexation Area growth through 2024 is assumed to occur only in the 380 Pressure Zone. Growth projections and future water demand estimates for the Brookman Annexation Area are summarized in Table 2-5.

Table 2-5
Brookman Projected Growth and Future Water Demand

Growth Projection	Non-Residential Developed Acres	Total Jobs	Residential Units	ADD (mgd)
5-Year (2019)	8.4	300	80	0.04
10-Year (2024)	18.6	665	596	0.16
20-Year (2034)	28.7	1,029	1,112	0.28
Saturation Development	28.7	1,029	1,112	0.28

West Urban Reserve

For the purposes of this analysis, future land use within the West Urban Reserve is assumed to mirror the proportion of land use types among developed properties within the current city limits. The proposed 630 West Zone within the West Urban Reserve, as shown on Figure 2-1, is not anticipated to have any industrial development. Percentages of future land use by type have been adjusted to exclude industrial development in this area. 20 percent of land within the West Urban Reserve is assumed to be dedicated to right-of-way, parks and open space with no future water demand.

Due to the small amount of developable residential land within the existing city limits, the exclusively non-residential development anticipated within the TEA, and the assumed build-out of the Brookman Annexation Area, it is assumed that the West Urban Reserve will be approximately one-quarter developed within the 20-year planning horizon. It is assumed that the West Urban Reserve will begin developing in 10 years with an initial 20 acres of non-residential development and 100 residential units. Long term residential development in the West Urban Reserve is anticipated to occur at approximately 10 units per acre based on discussion with City planning staff.

Future water demand in the West Urban Reserve is based on 213 gpd/RU and 437 gpd/acre for non-residential land as developed previously in this section. The West Urban Reserve will be served from the existing 380 and 455 Pressure Zones and proposed 475 West and 630 West Pressure Zones. Initial growth in the West Urban Reserve is assumed to occur only in the 380 Pressure Zone north of SW Handley Street. Growth projections and future water demand estimates for the West Urban Reserve are summarized in Table 2-6.

Table 2-6
West Urban Reserve Projected Growth and Future Water Demand

Growth Projection	Total Residential Units	Developed Non-Residential Acres	ADD (mgd)
10-Year (2024)	150	20	0.05
20-Year (2034)	1,849	93.8	0.44
Saturation Development	7,395	281.5	1.70

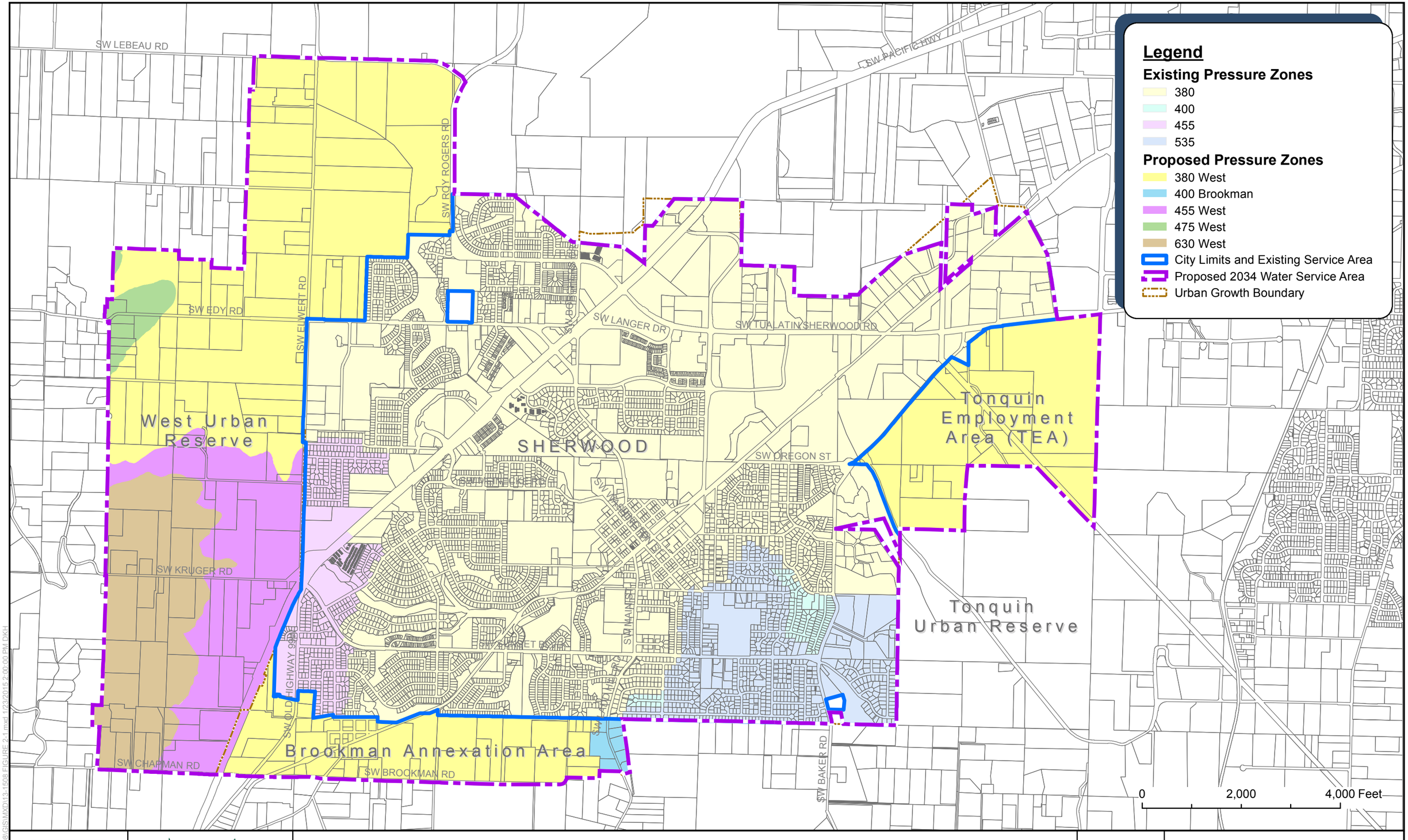
Tonquin Urban Reserve

The Tonquin Urban Reserve is not anticipated to begin development until the end of the 20-year planning horizon. Future land use within the Tonquin Urban Reserve is anticipated to be entirely industrial and commercial, based on conversations with City planning staff. Future water demands are forecast based on 437 gpd/acre as previously presented. The Tonquin Urban Reserve will be served from the existing 380 Pressure Zone.

Equivalent Residential Units (ERUs)

Sherwood's water system serves single-family residential customers as well as commercial customers and multifamily housing developments. Single-family residential water services generally have a consistent daily and seasonal pattern of water use or demand. Water demands for multifamily residences, commercial and industrial users may vary from service to service depending on the number of multifamily units per service or the type of commercial enterprise. In order to establish a common measure of water demand growth for all service types, the water needs of non-residential and multi-family residential customers are represented by comparing their water use volume to the average single-family residential unit. The number of single-family residential units that could be served by the water demand of these other types of customers is referred to as a number of "equivalent residential units" (ERUs).

ERUs differ from actual metered service connections in that they relate all water services to an equivalent number of representative single-family residential services based on typical annual consumption. ERUs calculated here are specific to estimating future water demand and are not the same as dwelling units used in housing studies or comprehensive planning to forecast future population. Demand per ERU in the Sherwood system is 213 gpd/ERU. ERUs are used in the water system financial analysis to distribute anticipated project costs between existing customers and water system growth.



MSA Murraysmith & Associates, Inc.

Sherwood Oregon

Sherwood Water System Master Plan Update

Figure 2-1
Existing and Future Pressure Zones

Table 2-7
Future Water Demand Summary

	Current			10-Year (2024)			20-Year (2034)			Saturation Development		
Pressure Zone	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**
City Limits	***8,779***	***1.87***	***3.93***	***9,536***	***2.03***	***4.26***	***9,536***	***2.03***	***4.26***	***9,536***	***2.03***	***4.26***
380	6,857	1.47	3.09	7,447	1.59	3.34	7,447	1.59	3.34	7,447	1.59	3.34
400	149	0.03	0.06	162	0.03	0.06	162	0.03	0.06	162	0.03	0.06
455	816	0.17	0.36	887	0.19	0.40	887	0.19	0.40	887	0.19	0.40
535	957	0.20	0.42	1,039	0.22	0.46	1,039	0.22	0.46	1,039	0.22	0.46
Tonquin Employment Area (TEA)				***238***	***0.05***	***0.11***	***484***	***0.11***	***0.23***	***744***	***0.16***	***0.34***
380	-	-	-	238	0.05	0.11	484	0.11	0.23	744	0.16	0.34
Brookman Annexation				***752***	***0.16***	***0.34***	***1,330***	***0.28***	***0.59***	***1,330***	***0.28***	***0.59***
380	-	-	-	752	0.16	0.34	1,275	0.27	0.57	1,275	0.27	0.57
400 Brookman	-	-	-	-	-	-	55	0.01	0.02	55	0.01	0.02
West Urban Reserve				***235***	***0.05***	***0.11***	***2,066***	***0.43***	***0.90***	***7,974***	***1.70***	***3.57***
380	-	-	-	235	0.05	0.11	1,138	0.24	0.50	4,391	0.94	1.97
455	-	-	-	-	-	-	432	0.09	0.19	1,670	0.36	0.76
475 West	-	-	-	-	-	-	52	0.01	0.02	202	0.04	0.08
630 West	-	-	-	-	-	-	444	0.09	0.19	1,711	0.36	0.76
Tonquin Urban Reserve										***591***	***0.13***	***0.27***
380	-	-	-	-	-	-	-	-	-	591	0.13	0.27
GRAND TOTAL	**8,779**	**1.9**	**3.9**	**10,761**	**2.3**	**4.8**	**13,416**	**2.9**	**6.0**	**20,175**	**4.3**	**9.0**

Table 2-8
Future Water Demand Summary by Pressure Zone

	10-Year (2024)			20-Year (2034)			Saturation Development		
Pressure Zone	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**
380	8,672	1.85	3.90	10,344	2.21	4.64	14,448	3.09	6.49
400	162	0.03	0.06	162	0.03	0.06	162	0.03	0.06
455	887	0.19	0.40	1,319	0.28	0.59	2,557	0.55	1.16
475 West	-	-	-	52	0.01	0.02	202	0.04	0.08
535	1,039	0.22	0.46	1,039	0.22	0.46	1,039	0.22	0.46
400 Brookman	-	-	-	55	0.01	0.02	55	0.01	0.02
630 West	-	-	-	444	0.09	0.19	1,711	0.36	0.76

SECTION 3
PLANNING AND ANALYSIS CRITERIA

This section documents the performance criteria used for water system analysis presented in Section 4 of this Water System Master Plan. Criteria are established for evaluating water supply, distribution system piping, service pressures, storage and pumping capacity and fire flow availability. These criteria are used in conjunction with the water demand forecasts presented in Section 2 to complete the water system analysis.

Performance Criteria

The water distribution system should be capable of operating within certain performance limits under varying customer demand and operational conditions. The recommendations of this plan are based on the performance criteria summarized in Table 3-3. These criteria have been developed through a review of State requirements, American Water Works Association (AWWA) acceptable practice guidelines, *Ten States Standards* and the *Washington Water System Design Manual*.

Water Supply

As described in Section 1, the City of Sherwood (City) draws the majority of its water supply from the Willamette River Water Treatment Plant (WRWTP) in Wilsonville. Supplemental water supply can be provided from Sherwood Well Nos. 3, 4, 5 and 6. The City also has an emergency connection to the Portland Water Bureau's Washington County Supply Line through the City of Tualatin.

Based on current water system operations, the City should plan for adequate supply capacity to provide maximum day demand (MDD) from the WRWTP alone. As discussed later in this section, storage capacity in the City reservoirs and supplemental supply from City wells should provide adequate water in the event of a WRWTP supply or transmission emergency lasting less than 48 hours under average demand conditions.

Service Pressure

Water distribution systems are separated by ground elevation into pressure zones in order to provide service pressures within an acceptable range to all customers. 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 each individual service connection. When it is not feasible or practical to have a separate reservoir for each pressure zone, pump stations or pressure reducing valves (PRVs) are used to serve customers in different pressure zones from a single reservoir.

The maximum service pressure limit is 80 pounds per square inch (psi) as required by the *Oregon Plumbing Specialty Code*. The desired service pressure range under normal operating conditions is 40 to 70 psi. Conformance to this pressure range may not always be

possible or practical due to topographical relief, existing system configurations and economic considerations. Where mainline pressures exceed 100 psi, services must be equipped with individual PRVs to maintain their static pressures at no more than 80 psi. During a fire flow event or emergency, the minimum service pressure is 20 psi as required by Oregon Health Authority, Drinking Water Program (OHA) regulations. Recommended service pressure criteria are summarized in Table 3-1.

Distribution System Evaluation

The distribution system should also be capable of providing the required fire flow to a given location while, at the same time, supplying MDD and maintaining a minimum residual service pressure at any meter in the system of 20 psi as required by OHA regulations. The system should meet this criterion with all equalization storage depleted, booster pump stations operating at firm capacity and flow velocity in the distribution system of less than 10 feet per second (fps).

The distribution system should be capable of supplying peak hourly demands (PHD) while maintaining service pressures within approximately 85 percent of service pressures under average day demand (ADD) conditions but not less than the minimum 40 psi service pressure as shown in Table 3-1. The system should meet this criterion with booster pump stations operating at firm capacity and flow velocity in the distribution system of less than 10 fps.

Table 3-1
Recommended Service Pressure Criteria

Service Pressure Criterion	Pressure (psi)
Normal Range under ADD conditions	40-70
Maximum	80
Minimum under MDD conditions + Fire Flow	20
Minimum under PHD conditions	85% of normal, not less than 40 psi

Main Size

Typically, new water distribution mains should be at least 8 inches in diameter in order to supply minimum fire flows. According to the 2010 *Sherwood Engineering Design Manual*, a minimum 6-inch diameter main is required except 4-inch diameter mains are acceptable on runs less than 300 feet, if no fire hydrant connection is required, there are no more than 8 services on the main and future extension of the main is not anticipated. A 4-inch or 6-inch diameter main may be sufficient under these specific conditions; however, it is recommended that proposed or new water mains be at least 8 inches in diameter to supply adequate fire flows.

Storage Capacity

Sherwood water storage reservoirs should provide capacity for four purposes: operational storage, equalization storage, fire storage, and standby or emergency storage. A brief discussion of each storage element, as defined in the *Washington Water System Design Manual,* is provided below.

Adequate storage capacity must be provided for each pressure zone. Storage volume for pressure zones served through PRVs or by constant pressure pump stations is provided in the upstream pressure zone supplying the PRV or pump station. For instance, Sherwood's Sunset Reservoirs serve customers in the 380 Zone and provide suction supply to the constant pressure 535-Zone Sunset Pump Station which in turn supplies the 400 Zone through the Murdock PRV. Thus, the Sunset Reservoirs must have adequate storage volume to meet the storage criteria for the 380, 535 and 400 Zones.

Operational Storage

Operational storage is the volume of water dedicated to supplying customers while the pumps used to fill the reservoir are "off". Operational storage in the 455 Zone is defined by Kruger Reservoir level set points which signal the Wyndham Ridge pumps to turn on and off. The set points are discussed further in Section 4.

The 380 Zone reservoirs are continuously supplied from the WRWTP making operational storage irrelevant under normal operating conditions. For this analysis, required operational storage for the 380 Zone is assumed to be zero.

Equalization Storage

Equalization storage is required to meet water system demands in excess of delivery capacity from the water supply source to reservoirs serving each pressure zone. Equalization storage volume should be sufficient to supply demand fluctuations throughout the day resulting from typical customer water use patterns and is generally considered as the difference between PHD and MDD on a 24-hour basis.

For pressure zones with a continuously available supply like the 380 Zone's supply from the WRWTP, equalization storage of approximately 25 percent of MDD is sufficient for analysis and planning purposes.

In the 455 Zone, supply to the Kruger Reservoir is provided from only one source, the Wyndham Ridge Pump Station. For pressure zones with a single source of supply to the reservoir, equalization storage is calculated as PHD minus the source capacity operating for 150 minutes.

Fire Storage

Water stored for fire suppression is typically provided to meet the single most severe fire flow demand within each pressure zone. Required fire flow rates and durations based on the 2014 *Oregon Fire Code* (OFC) are discussed later in this section and summarized in Table 3-2. The recommended fire storage volume is determined by multiplying the fire flow rate by the duration of that flow.

Emergency (Standby) Storage

Emergency storage is provided to supply water from storage during emergencies such as pipeline failures, equipment failures, power outages or natural disasters. The amount of emergency storage provided can be highly variable depending upon an assessment of risk and the desired degree of system reliability.

According to standby storage guidelines from the *Washington Water System Design Manual*, water systems with multiple sources, like Sherwood's 380 Zone, should have sufficient storage to supply ADD for 48 hours with the largest source, the WRWTP, out of service. Standby storage for the 380 pressure zone is calculated as two times ADD minus the maximum operational capacity of the City wells operating for 24 hours but not less than 200 gallons per ERU. Standby storage for zones with a single source, like Sherwood's 455 Zone, is calculated as 2 times ADD but not less than 200 gallons per ERU.

Pump Stations

Capacity and Number of Pumps

Pumping capacity requirements vary depending on the water demand, volume of available storage and the number of pumping facilities serving a particular pressure zone. When pumping to storage reservoirs, also referred to as an "open zone", a firm pumping capacity equal to the pressure zone's MDD is recommended. Firm pumping capacity is defined as a station's pumping capacity with the largest pump out of service. A minimum of three pumps at each pump station are recommended for redundancy.

Constant Pressure Pump Stations

Although it is desirable to serve water system customers by gravity from storage, constructing and maintaining a reservoir for a small group of customers may be prohibitively expensive and lead to water quality issues associated with slow reservoir turnover. Constant pressure pump stations supply a pressure zone without the benefit of storage, also referred to as a closed zone. These stations are only recommended for residential developments with a small number of services, preferably in an area that will not be looped back into adjacent pressure zones in the future. Constant pressure stations are commonly used to serve customers at the highest elevations in a water service area where only an elevated reservoir would be capable of providing the necessary head to achieve adequate service pressures by gravity.

Pump stations supplying constant pressure service to closed zones should have firm pumping capacity to meet PHD while simultaneously supplying the largest fire flow demand in the zone.

Backup Power

It is recommended that pump stations supplying gravity storage reservoirs include manual transfer switches and connections for a portable back-up generator. The emergency storage volume in each reservoir will provide short term water service reliability in case of a power outage at the pump station. Back-up power generators with automatic transfer switches are recommended for all constant pressure pump stations serving closed zones without the benefit of gravity storage.

Required Fire Flow

While the water distribution system provides water for domestic uses, it is also expected to provide water for fire suppression. The amount of water required for fire suppression purposes is associated with the local building size and type or land use of a specific location within the distribution system. Fire flow requirements are typically much greater in magnitude than the MDD in any local area. Adequate hydraulic capacity must be provided for these potentially large fire flow demands. Emergency response in the City of Sherwood is provided by Tualatin Valley Fire and Rescue (TVFR). TVFR establishes fire flow requirements for each building within the City. General TVFR fire flow guidelines are described in the TVFR *Fire Code Applications Guideline* consistent with the 2014 OFC. Fire flow requirements by land use type based on these guidelines are summarized in Table 3-2.

Single-Family and Duplex Residential

The OFC and TVFR guidelines specify a minimum fire flow of 1,000 gpm for single-family and two-family dwellings with a square footage less than 3,600 square feet. For residential structures larger than 3,600 square feet, the minimum fire flow requirement is 1,500 gpm. Among currently developed single-family residential properties in the City, approximately 2 percent of homes are 3,600 square feet and larger, based on information available from the regional government Metro. For the purposes of this Plan, residential fire flow capacity will be tested in the water system hydraulic model with a minimum requirement of 1,500 gpm to accommodate the range of potential future residential development in the City.

Medium Density Residential, Office and Neighborhood Commercial

Existing medium density residential development, such as, the Cherry Woods Condominiums have an average building size of approximately 6,900 square feet with four dwellings per building. For the purposes of this Plan, it is assumed that future medium density residential development would involve buildings of similar size. Based on the 2014 OFC requirements adopted by TVFR, a required fire flow of 2,500 gpm is recommended for

medium density residential properties. Properties zoned for neighborhood commercial or office development are anticipated to require similar flows for fire suppression.

High Density Residential, Commercial, Industrial and Institutional

A 3,000 gpm fire flow is recommended for high density residential, commercial and industrial development in Sherwood consistent with TVFR maximum fire flow guidelines. This maximum fire flow requirement is also appropriate for institutional and public facilities, such as, schools or community centers. Fire flow requirements by land use type are summarized in Table 3-2.

Table 3-2
Required Fire Flow Summary

Land Use Type	Applicable Zoning	Required Fire Flow (gpm)	Required Duration (hours)
Single-Family and Duplex Residential	VLDR, LDR	1,500	2
Medium Density Residential, Office and Neighborhood Commercial	MDRL, MDRH, NC, OC	2,500	2
High Density Residential, Commercial, Industrial and Institutional	HDR, RC, GC, EI, LI, GI, IP	3,000	3

Summary

Table 3-3 provides a summary listing of the criteria presented in this Section.

Table 3-3
Water System Performance Criteria

Water System Facility	Evaluation Criterion	Value	Design Standard/Guideline
Water Supply	Supply Capacity	MDD[2]	Ten States Standards and Washington Water System Design Manual
Service Pressure	Normal Range (ADD[1] Conditions)	40-70 psi	AWWA M32
	Maximum	80 psi	AWWA M32, Oregon Plumbing Specialty Code, Section 608.2
	Minimum, during MDD[2] with Fire Flow	20 psi	AWWA M32, OAR 333-061
	Minimum, during PHD[3]	85% of normal, not less than 40 psi	MSA recommended, AWWA M32
Distribution Piping	Velocity during PHD[3] or Fire Flow	Not to exceed 10 fps	AWWA M32
	Minimum Pipe Diameter	8-inch recommended for fire flow, current City standard is 6-inch, except 4-inch for short mains without fire service	MSA recommended, Sherwood Engineering Design Manual
Storage	Total Storage Capacity	Sum of operational, equalization, fire suppression and emergency (standby) storage volumes	Washington Water System Design Manual
	Operational Storage	Kruger Res level set point for 455 Zone, none in 380 or closed[5] zones	
	Equalization Storage	25% of MDD[2]	
	Fire Storage	Required fire flow x flow duration	
	Emergency (Standby) Storage	2 x [ADD[1] – (all but largest supply to the zone x 24 hours)], not less than 200 gallons per ERU	
Pump Stations	Minimum No. of Pumps at Firm Capacity	2	Ten States Standards
	Open Zone Capacity[4]	MDD[2]	Washington Water System Design Manual
	Closed Zone Capacity[5]	PHD[3] + Fire Flow	Washington Water System Design Manual
	Backup Power	At least two independent sources	Ten States Standards
Required Fire Flow and Duration	Single Family and Duplex Residential	1,500 gpm for 2 hours	2014 Oregon Fire Code, Tualatin Valley Fire & Rescue Fire Code Applications Guide
	Medium Density Residential, Office and Neighborhood Commercial	2,500 gpm for 2 hours	
	High Density Residential, Commercial, Industrial and Institutional	3,000 gpm for 3 hours	

[1] *ADD: Average daily demand, defined as the average volume of water delivered to the system during a 24-hour period = total annual demand/365 days per year.*
[2] *MDD: Maximum day demand, defined as the maximum volume of water delivered to the system during any single day.*
[3] *PHD: Peak hour demand, defined as the maximum volume of water delivered to the system during any single hour of the maximum demand day.*
[4] *Open zone is defined as a pressure zone supplied by gravity from a storage reservoir.*
[5] *Closed zone is defined as a pressure zone supplied constant pressure from a booster pump station without the benefit of storage.*

SECTION 4
WATER SYSTEM ANALYSIS

This section presents an analysis of the City of Sherwood's (City's) water distribution system based on criteria outlined in Section 3. The water demand forecasts summarized in Section 2 are used in conjunction with analysis criteria to assess water system characteristics including supply capacity, service pressures, storage and pumping capacity and emergency fire flow availability. This section provides the basis for recommended distribution system improvements presented in Section 5.

Water Supply Analysis

In 2011 Sherwood transitioned their primary water source from the City's groundwater wells to the Willamette River Water Treatment Plant (WRWTP). The City is also able to draw Portland Water Bureau (PWB) supply through a 4-mile long, 24-inch diameter City-owned transmission main from the City of Tualatin's system. An agreement with Tualatin Valley Water District (TVWD) and the City of Tualatin allows Sherwood to purchase up to 3 million gallons per day (mgd) of TVWD's excess capacity in PWB's Washington County Supply Line (WCSL) system and wheel it through the City of Tualatin's transmission to the Tualatin Supply Connection. These agreements expire in 2015.

The City continues to maintain Wells 3, 4, 5 and 6 and the Tualatin Supply Connection. Currently, the City takes a small amount of PWB supply through the Tualatin Supply Connection to maintain drinking water quality in the pipeline for use in a water emergency.

WRWTP Capacity

It is recommended that Sherwood develop adequate source capacity to supply maximum day demand (MDD) from the WRWTP alone. Sherwood's 5 million gallons per day (mgd) share of the WRWTP's existing 15 mgd capacity is adequate to meet forecasted MDD, including projected service area expansion, through the 10-year (2024) planning horizon. It is recommended that the City purchase additional intake capacity and pursue WRWTP expansion within the 20-year planning horizon through existing cooperative agreements with TVWD and the City of Wilsonville. Based on projected MDD and service area expansion presented in Section 2, Sherwood will require a total capacity of approximately 9 mgd from the WRWTP at build out. Future expansion of the WRWTP capacity will likely be through construction of a parallel 15 mgd treatment train. Based on the strong potential for continued growth in Sherwood and anticipated long-term water system expansion into urban reserve areas it is recommended that the City pursue an additional 5 mgd of capacity from the WRWTP. The WRWTP capacity analysis is summarized in Table 4-1.

Table 4-1
WRWTP Supply Capacity Analysis

Timeframe	Capacity (mgd)		
	Recommended Supply Capacity (MDD)	Sherwood's Existing WRWTP Share	Surplus / (Deficit)
Current	3.9	5.0	1.1
10-Year (2024)	4.8	5.0	0.2
20-Year (2034)	6.0	5.0	(1.0)
Build-Out	9.0	5.0	(4.0)

Emergency Supply

In the event of a WRWTP supply or transmission emergency, it is recommended that the City's groundwater wells and storage reservoirs be used to provide adequate emergency water supply to meet average day demands (ADD) for 48 hours.

City Wells

Wells 3, 5 and 6 have an existing combined operational capacity of approximately 1,790 gallons per minute (gpm) (2.6 mgd). Well 5 production capacity is limited to approximately 350 gpm due to foaming in the well caused by air entrainment at higher pumping rates. All of Sherwood's wells are currently inactive. The City does not have a regular schedule for exercising the wells and monthly water quality samples are not currently required. In order to ensure that wells are available as an on-demand emergency source, water operations staff will begin exercising the wells and performing regular water quality testing. To accomplish this, the City must have a means of isolating the well discharge from the distribution system. There is an existing fire hydrant and isolation valve at Well 6 which allows the City to pump Well 6 to atmosphere. It is recommended that a new hydrant and isolation valve be installed at Wells 3 and 5 for this purpose.

The City has expressed interest in abandoning the low-producing Well 4 which would reduce well maintenance costs and potentially allow water rights to be transferred to other City wells which may have additional production capacity. Sherwood could attain additional value by allowing development of the Well 4 property after the well is abandoned. The well site is located in an established residential area along Smith Avenue and, as presented in Section 2, the City has limited developable land available within the existing city limits. For the purposes of this analysis, Well 4 capacity is not considered as an emergency source. Existing well capacities are summarized in Table 4-2.

Table 4-2
Well Capacity Summary

Well	Water Rights Capacity (gpm)	Production Capacity (gpm)
3	900	890
5	673	350
6	550	550
Total	**2,123**	**1,790**

It is not recommended that the City develop additional groundwater wells to meet the emergency supply goal of ADD for 48 hours. This emergency capacity should be provided from emergency storage in the City's reservoirs and from the existing wells. Emergency supply goals and well capacity are summarized in Table 4-3.

Table 4-3
Emergency Supply from City Wells

Timeframe	Emergency Supply Goal: 2 * ADD (mgd)	City Well Production Capacity (mgd)	Deficit to be Supplied from Emergency Storage (mgd)[1]
Current	3.8	2.6	(1.2)
10-Year (2024)	4.6	2.6	(2.0)
20-Year (2034)	5.8	2.6	(3.2)
Build-Out	8.6	2.6	(6.0)

[1] *See Table 4-4 Storage Analysis*

Tualatin Supply Connection

Under the City's supply agreement with TVWD and Tualatin, excess capacity from the PWB wheeled through the WCSL system is interruptible, meaning capacity is only available to Sherwood under certain contractual conditions where surplus supply is available from PWB. Because of this contingent capacity the Tualatin Supply Connection is a less reliable on-demand emergency source than the City's wells. It is not recommended that the City maintain the Tualatin Supply Connection solely as an on-demand emergency source. However, the 24-inch diameter main is a vital link to long-term regional supply and Sherwood may benefit from maintaining a portion of the 24-inch diameter supply line capacity for emergency supply. The remaining capacity could be sold to Tualatin as part of a future WRWTP supply agreement or to provide large diameter looping within Tualatin's distribution system.

Potential Future Supply to Tualatin

The City of Tualatin, which currently receives all of its source water from the WCSL system, is in the process of evaluating their long-term source options and needs. If Tualatin opts to pursue source water from the WRWTP, they may negotiate purchase of plant capacity or wholesale water from Sherwood. The Sherwood-owned 24-inch diameter transmission main would be a key facility to allow supply of WRWTP water through Sherwood to Tualatin's distribution system. It is recommended that Sherwood does not abandon the Tualatin Supply Connection to allow for future supply of WRWTP water to Tualatin. However, the City of Tualatin's current supply agreement with PWB does not expire until 2026 so Tualatin may not make a final decision regarding their long-term water source for several years. It is recommended that Sherwood discontinue taking water through the Tualatin Supply Connection and close valves to isolate the transmission main. The transmission main would need to be disinfected before bringing it back on-line to serve the City of Tualatin if a long-term WRWTP supply agreement is established between the two cities in the future.

The 24-inch diameter Tualatin supply main may also be useful to the City of Tualatin as part of their distribution system regardless of Tualatin's long-term source decisions. Sherwood staff have engaged with Tualatin to determine the potential for mutual benefit of selling or transferring portions of the main.

Pressure Zone Analysis

Sherwood's four existing pressure zones provide adequate service pressures between 40 and 80 pounds per square inch (psi) to all water system customers. The existing 380 and 455 Pressure Zones are open zones, served by gravity from storage facilities. The 535 Zone serves the southeast corner of the City by constant pressure from the Sunset Pump Station. Zones served by constant pressure are also referred to as closed zones. Customers in the 400 Zone are supplied from the 535 Zone through the Murdock pressure reducing valve (PRV). The City's existing and proposed future pressure zones are illustrated on Figure 2-1.

Future 535 Zone Reservoir

The 535 and 400 Zones have approximately 810 existing services. For pressure zones of this size, it is preferable to supply customers by gravity from a storage reservoir rather than through a constant pressure pump station. Supplying customers from storage reduces the risk of a water outage due to mechanical or electrical failure at the pump station and reduces maintenance and power costs associated with pumping.

The City's 2005 Master Plan recommended construction of a storage reservoir to serve the 535 Zone by gravity. However, the nearest site which would meet the elevation requirements for a ground level reservoir is almost a mile south of existing 535 Zone distribution mains along Ladd Hill Road. With the approximately mile-long waterline required to fill the proposed reservoir and the relatively low customer demands in this residential zone, it is likely that water quality issues would develop in the waterline and

reservoir due to minimal water circulation and slow reservoir turnover. Due to potential water quality issues associated with a 535 Zone reservoir and the high cost of constructing a transmission main to serve the proposed reservoir, it is recommended that the 535 Zone continue to be served as a closed zone from the Sunset Pump Station.

Future Service Area Expansion

Brookman Annexation and TEA

As the City's water service area expands to include the Brookman Annexation and Tonquin Employment Area (TEA), it is anticipated that the majority of customers in these areas will be served from the 380 Zone by extending existing distribution mains. A small area along Ladd Hill Road in the southeast corner of the Brookman Annexation is too high in elevation to receive adequate service pressure from the 380 Zone. For master planning purposes, this area is referred to as the 400 Brookman Zone.

400 Brookman Zone

As development occurs, it is recommended that the City evaluate the benefits and risks of serving the 400 Brookman Zone through one of the following methods:

1. A PRV which reduces pressure from existing 535-Zone mains on Highpoint Drive east of Ladd Hill Road

2. A booster pump station which provides constant pressure to the zone and draws suction supply from existing 12-inch diameter 380-Zone distribution mains on Ladd Hill Road at Brookman Road

Although option 1, the PRV from the 535 Zone, seems to be the simplest solution there are additional factors which should be considered. Existing 535-Zone distribution mains on Highpoint Drive dead-end approximately 375 feet west of Ladd Hill Road. In order to provide service to the proposed 400 Brookman Zone, the existing 535-Zone mains would need to be extended or existing 380-Zone mains which already extend west to Ladd Hill Road along Highpoint Drive would need to be re-configured to be part of the 535-Zone.

Extending 535-Zone mains west to Ladd Hill Road may add substantial cost to the PRV solution. In addition, the existing Highpoint Drive right-of-way (R-O-W) does not connect with the Ladd Hill Road R-O-W. Thus, any new 535-Zone mains would need to be constructed within an existing 15-foot wide City of Sherwood easement parallel to existing 8-inch diameter 380-Zone mains. Existing 380-Zone mains provide service to 32 existing homes between 225 and 300-feet elevation along Bowmen Lane and Highpoint Drive. Re-configuring these mains to be part of the 535-Zone would cause significant pressure increases for these existing 32 customers and would likely require individual PRVs at each service. Both of these considerations may increase the project cost of option 1 significantly.

A constant pressure pump station, as described in option 2, requires more maintenance and has a higher operating cost than a PRV. However, capital costs for constructing the pump station may be comparable to option 1 because distribution mains upstream of the proposed pump station would not need to be constructed new or re-configured as described above for the PRV.

For the purposes of this Master Plan, an estimated cost for the booster pump station described in option 2 is included in the CIP presented in Section 5.

West Urban Reserve

Initial anticipated growth in the West Urban Reserve will be served by extending existing 380- and 455-Zone distribution mains. Future customers along the ridge north and south of the existing Kruger Reservoir will be served by constant pressure from the proposed Kruger Pump Station at the existing reservoir site. This proposed closed zone is referred to as the 630 West Zone. Some future customers in the West Urban Reserve at the interface between the 630 West and 455 Zones may need to be served through a PRV-controlled sub-zone or through individual PRVs on each service in order to maintain required service pressures. This area is referred to as the 630 West PRV Zone.

A small area on the western edge of the West Urban Reserve along Edy Road near Eastview Road is too high in elevation to receive adequate service pressure from the adjacent 380 Zone. This area will be served as part of the closed 475 West Zone by constant pressure from the proposed Edy Road Pump Station.

Storage Capacity Analysis

Existing storage reservoirs serve customers in the 380 and 455 Pressure Zones by gravity. All of the City's other existing and proposed pressure zones are supplied either through constant pressure pump stations or PRVs. There must be adequate reservoir volume to meet customer demands in the zone served directly from the reservoir, as well as any smaller zones served through constant pressure pumping or PRVs from the zones with storage. For instance, Sherwood's Sunset Reservoirs serve customers in the 380 Zone and provide suction supply to the constant pressure 535-Zone Sunset Pump Station which in turn supplies the 400 Zone through the Murdock PRV. Thus, the Sunset Reservoirs must have adequate storage volume to meet the storage criteria for the 380, 535 and 400 Zones.

Ideally, the 535 Zone, which supplies a relatively large geographic area, would have dedicated gravity storage. As previously described, due to the City's topography, sites with adequate elevation for a future 535-Zone reservoir are too far away from existing 535 Zone customers to be practical or cost effective.

Storage facilities are provided for four purposes: operational storage, equalization storage, fire storage and emergency or standby storage. As presented in Section 3, the total storage required is the sum of these four elements. Storage volumes are calculated according to the following criteria:

- *Operational Storage*
  - 455 Zone - volume of average Kruger Reservoir level drop between "off" and "on" operation of Wyndham Ridge Pump Station
  - 380 Zone and closed zones - none

- *Equalization Storage* - 25 percent of maximum day demand (MDD)

- *Fire Storage* - largest fire flow demand for each pressure zone multiplied by the duration of that flow

- *Emergency Storage* - 2 times average day demand (ADD) minus the approximate volume of water supplied in 24 hours by all but the largest capacity supply to the zone

Operational Storage

Operational storage is the volume of water dedicated to supplying customers while the pumps used to fill the reservoir are "off". In the 455 Zone, operational storage is managed by City water staff using Kruger Reservoir level set points. These set points signal the Wyndham Ridge pumps to turn on and refill the reservoir when the water level drops to the specified point. Reservoir level set points are adjusted seasonally to mitigate potential water quality issues associated with slow reservoir turnover during periods of low water demand in the fall and winter. For the purpose of this analysis, operational storage in the 455 Zone will be estimated based on a year-round average drop in the Kruger Reservoir level of six feet, approximately 0.6 million gallons (MG).

The 380 Zone's Sunset Reservoirs are continuously supplied from the WRWTP making operational storage irrelevant under normal operating conditions. For this analysis, required operational storage for all zones served by the Sunset Reservoirs is assumed to be zero.

Emergency Storage

The 380 Zone is supplied by both the WRWTP and the City's wells. The WRWTP is the largest supply to the 380 Zone. Thus, emergency storage for the 380 Zone is calculated as 2 times ADD minus the volume of water supplied by City Wells 3, 5 and 6 pumping for 24 hours. The only supply to the 455 Zone is the Wyndham Ridge Pump Station. Although the pump station contains multiple pumps there are emergency situations, such as a break in the suction supply line to the pump station, which would take the entire station out of service.

Thus, for the purpose of calculating required emergency storage volume in the 455 Zone, it is assumed that the entire pump station is out of service.

Storage Analysis Findings

Both the Kruger and Sunset Reservoirs have adequate capacity to meet storage criteria through the 20-year planning horizon. An approximately 0.3 MG storage deficit in 455 Zone at build-out may be mitigated by modifying the Kruger Reservoir average water level drop from 6 feet to 3 feet to reduce the operational storage need. No significant operational challenges are anticipated with this change as increased future demands will reduce the need for this operational strategy to maintain water quality. Under existing conditions the Kruger Reservoir water level is set lower to allow the City to store water at Kruger that has been delivered from the WRWTP but is not immediately needed in the 380 Zone and to mitigate potential water quality issues associated with slow reservoir turnover at Kruger. Increasing water demands due to future growth in both the 380 and 455 Zone will lessen the need to drop the Kruger Reservoir to this lower existing set point.

Despite a 0.61 MG storage deficit at build-out, additional storage is not recommended for the 380 Zone due to the uncertainty of long-term future development over a large area to be served from this zone. Storage capacity in the 380 Zone should be re-evaluated with the next Master Plan update to determine if additional capacity will be needed and to identify the optimal sites for additional storage, if needed. The storage analysis is summarized in Table 4-4.

Table 4-4
Storage Analysis

Storage Component (MG)	Sunset Reservoirs			Kruger Reservoir		
	380, 535, 400, Future 400 Brookman & Future 475 West Pressure Zones			455 & Future 630 West Pressure Zones		
	Existing	2034	Build-Out	Existing	2034	Build-Out
Operational	-	-	-	0.60	0.60	0.60
Equalization	0.87	1.30	1.78	-	0.05	0.25
Fire Suppression	0.63	0.63	0.63	0.63	0.63	0.63
Emergency	1.58	2.38	4.20	0.36	0.74	1.82
TOTAL Required	3.07	4.31	6.61	1.59	2.01	3.30
Existing Storage	6.00	6.00	6.00	3.00	3.00	3.00
Surplus/(Deficit)	**2.93**	**1.69**	**(0.61)**	**1.41**	**0.99**	**(0.30)**

Pump Station Analysis

Closed Zones

The existing Sunset Pump Station and proposed Ladd Hill, Kruger and Edy Road Pump Stations supply constant pressure to customers in existing and future pressure zones without water storage facilities, also referred to as closed zones. Pump stations serving these closed zones are the only means of supplying domestic water demands and fire flow to the zone. Pump stations serving closed zones should have sufficient firm capacity to supply PHD and the highest required fire flow in the primary zone and any PRV-controlled sub-zones. Firm capacity is defined as the nominal pump station capacity with the largest pump out of service.

Open Zones (Supplied by Gravity Storage)

The Wyndham Ridge Pump Station supplies the Kruger Reservoir which serves customers in the 455 Zone by gravity. Pressure zones with the benefit of gravity storage are also referred to as open zones. Operational and fire storage provided by open zone reservoirs such as the Kruger Reservoir make it unnecessary to plan for fire flow or peak hour capacity from pump stations assuming adequate storage is available. Open zone pump stations such as the Wyndham Ridge Pump Station must have sufficient firm capacity to meet the MDD for all customers in the zone and any higher level zones supplied from the primary zone.

Back-Up Power

At least two independent power sources are recommended for the City's pump stations. Back-up power is particularly critical for facilities that serve closed zones through constant pressure pumping. It is recommended that pump stations supplying gravity storage reservoirs include, at a minimum, manual transfer switches and connections for a portable back-up generator. The emergency storage volume in each reservoir will provide short term water service reliability in case of a power outage at the pump station. On-site standby power generators with automatic transfer switches are recommended for all constant pressure pump stations serving closed zones without the benefit of gravity storage. Both of Sherwood's existing pump stations have on-site, diesel powered, backup generators with automatic transfer switches.

Pump Station Analysis Findings

Table 4-5 summarizes the City's existing and future pumping requirements. Existing pump stations have adequate firm capacity to supply customer demands through the 20-year planning period. There is a small firm capacity deficit in the 455 Zone at build-out which may be addressed by replacing one of the existing Wyndham Ridge pumps as development warrants.

Due to the uncertainty of long-term future development, it is recommended that 455 Zone pumping capacity needs beyond 2034 be re-evaluated with the next Master Plan Update. Additional constant pressure pump stations are recommended to supply future proposed pressure zones as development warrants.

Table 4-5
Pump Station Analysis

Pressure Zone	Pumping Criteria	Existing Pump Stations		Firm Pumping Capcity (gpm)					
				Existing		2034		Build-out	
		Name	Firm Capacity (gpm)	Required	Surplus / (Deficit)	Required	Surplus / (Deficit)	Required	Surplus / (Deficit)
535 & 400	PHD + FF	Sunset	2,270	2,078	-	2,114	-	2,114	-
455	MDD	Wyndham Ridge	600	264	-	410	-	806	**206**
Future 400 Brookman	PHD + FF					1,524	**1,524**	1,524	**1,524**
Future 630 West	PHD + FF					1,724	**1,724**	2,397	**2,397**
Future 475 West	PHD + FF					1,524	**1,524**	1,594	**1,594**

Distribution System Analysis

A steady-state hydraulic network analysis model was used to evaluate the performance of the City's existing distribution system and identify proposed piping improvements based on performance criteria described in Section 3. The purpose of the model is to determine pressure and flow relationships throughout the distribution system for average and peak water demands under existing and projected future conditions. Modeled pipes are shown as "links" between "nodes" which represent pipeline junctions or pipe size changes. Diameter, length and head loss coefficients are specified for each pipe and an approximate ground elevation is specified for each node.

The hydraulic model was developed prior to the Water System Master Plan using the InfoWater modeling software platform and geographic information system (GIS) base mapping. Building on the facilities identified in the prior model and updated facility and operations data provided by the City, analysis scenarios were created to evaluate existing and projected 20-year demand conditions.

Modeled Demands

Existing and projected future demands are summarized in Table 2-7. Within the existing city limits, demands are assigned to the model based on customer billing records and meter locations provided by the City. Future demands in water service expansion areas such as the Brookman Annexation, TEA and West Urban Reserve are assigned uniformly over each proposed pressure zone area shown in Figure 2-1.

Fire Flow Analysis

Fire flow scenarios test the distribution system's ability to provide required fire flows at a given location while simultaneously supplying MDD and maintaining a minimum residual service pressure of 20 psi at all services. Required fire flows are assigned based on the zoning surrounding each node as summarized in Table 3-2.

Since the 2005 Master Plan, the City has invested in large diameter loops through developing commercial areas and small projects to provide additional looping for fire flow in residential areas. As a result, very few fire flow deficiencies were identified under existing and projected future MDD conditions.

Peak Hour Demand Analysis

Distribution system pressures were evaluated under peak hour demand conditions to confirm identified piping improvements. Peak hour demands (PHD) were estimated as 1.7 times the maximum day demand. No additional deficiencies were identified under these conditions.

Summary

Section 4 presents an analysis of Sherwood's water supply capacity and distribution system performance. Criteria outlined in Section 3 and water demand forecasts summarized in Section 2 are used to assess water system characteristics including service pressures, storage and pumping capacity and emergency fire flow availability. Proposed facilities to mitigate deficiencies are discussed in Section 5 and illustrated on Plate 1 Water System Map in Appendix A.

Sherwood's supply from the WRWTP is sufficient to meet MDD through the 10-year planning horizon with an additional 1 mgd of capacity required at 20 years and an additional 4 mgd needed at build-out. Existing City groundwater wells provide an effective emergency supply to complement emergency storage in the City's reservoirs.

The City's distribution system has adequate storage and pumping capacity to meet existing service area demands through 2034. Due to significant uncertainty related to long-term growth and system expansion, minor storage and pumping deficiencies at build-out should be re-evaluated with the next Water Master Plan Update or as development warrants. Additional pump stations are recommended to serve proposed high-elevation closed pressure zones in the water service expansion areas Brookman Annexation and West Urban Reserve.

Sherwood's distribution piping is sufficiently looped to provide adequate fire flow capacity to commercial, industrial and residential customers. Few piping improvement projects are needed to meet fire flow criteria. Extensive large diameter mains will be needed to expand the City's water service area to supply the Brookman Annexation, TEA and West Urban Reserve as development occurs.

SECTION 5
RECOMMENDATIONS AND CAPITAL IMPROVEMENT PROGRAM (CIP)

This section presents recommended improvements for the City of Sherwood's (City's) water system based on the analysis and findings presented in Section 4. These improvements include proposed supply, pump station and water line projects. The capital improvement program (CIP) presented in Table 5-3 later in this section summarizes recommended improvements and provides an approximate schedule for project completion. Proposed distribution system improvements are illustrated on Plate 1 Water System Map in Appendix A and on Figure 5-1, Proposed Water System Schematic at the end of this section.

Cost Estimating Data

An estimated project cost has been developed for each improvement project recommended in this section. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The Association for the Advancement of Cost Engineering International (AACE) classifies cost estimates depending on project definition, end usage and other factors. The cost estimates presented here are considered Class 4 with an end use being a study or feasibility evaluation and an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed.

Estimated project costs are based upon recent experience with construction costs for similar work in Oregon and southwest Washington and assume improvements will be accomplished by private contractors. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs. Estimates do not include the cost of property acquisition. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News-Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For purposes of future cost estimate updating; the current ENR CCI for Seattle, Washington is 10162 (August 2014).

Water System Capital Improvement Program

A summary of all recommended improvement projects and estimated project costs is presented in Table 5-3. This CIP table provides for project sequencing by showing fiscal year-by-year project priorities for the first five fiscal years, then prioritized projects in 5-year blocks for the 10-year, 20-year and Beyond 20 year timeframes.

The City's fiscal year begins July 1st and ends June 30th. Fiscal years are designated by the year in which they end. For example, fiscal year (FY) 2016 includes the period from July 1, 2015 through June 30, 2016. The 10-year project timeframe includes projects recommended for completion between 6 and 10 years (FY 2021 through FY 2024). The 20-year timeframe

includes projects recommended for completion between 11 and 20 years (FY 2025 through FY 2034).

CIP Cost Allocation to Growth

Water system improvement projects are recommended to mitigate existing system deficiencies and to provide capacity to accommodate growth and service area expansion. Projects that benefit future water system customers by providing capacity for growth may be funded through system development charges (SDCs). SDCs are sources of funding generated through development and water system growth and are typically used by utilities to support capital funding needs. SDCs are determined as part of a financial evaluation and are based in part on a utility's current CIP. To facilitate the Financial Analysis presented in Section 6, a percentage of the cost of each project which benefits future water system growth is allocated in the CIP table. Percentages allocated to growth are described later in this section for each type of recommended facility and summarized in the CIP Table 5-3.

Water Supply Projects

WRWTP

S-1 Existing Plant Upgrades

The City currently owns 5 million gallons per day (mgd) of the WRWTP's current 15 mgd capacity. As part of previous WRWTP studies, Sherwood and Wilsonville have determined that two improvement projects related to surge mitigation and disinfectant contact time (CT) are needed at the plant in order to deliver the current 15 mgd capacity. Sherwood's share of these improvements is approximately $500,000 for each project. The surge mitigation project needs to be completed in order to achieve 12 mgd plant capacity. Estimated costs for this project are included in the CIP distributed over fiscal years 2019 and 2020. CT improvements are needed to achieve 15 mgd plant capacity. The CT project is included in the CIP in the 10-year timeframe. Costs for both projects are allocated 80 percent to existing customers based on Sherwood's existing maximum day demand (MDD) of 4 mgd of the total 5 mgd Sherwood capacity from the WRWTP. The remaining 20 percent of project cost is allocated to system growth.

S-2 and S-3 Plant Expansion

To meet long-term supply needs, it is recommended that the City pursue purchase of 5 mgd of additional capacity in the WRWTP's oversized intake facilities (S-2). The estimated $2 million purchase cost for an additional 5 mgd of intake capacity is based on individual treatment plant component costs from the City's 2006 contract with TVWD for the purchase of an initial 5 mgd of capacity at the WRWTP.

It is further recommended that Sherwood pursue expansion of the WRWTP treatment facilities (S-3) to secure a total capacity of 10 mgd from the plant. The cost of plant

expansion is estimated based on the 2005 WRWTP Master Plan which identified improvements required to expand plant capacity by 50 mgd at an estimated 2005 cost of approximately $900,000 per mgd without contingency. Project cost for Sherwood's proposed 5 mgd share of plant expansion is estimated at $7.7 million including a 45 percent allowance for administration, engineering and contingency adjusted to 2014 dollars using the ENR CCI for Seattle described previously. An update of the 2005 WRWTP Master Plan is currently being completed and will include an update and refinement of these cost estimates. It is recommended that the City update plant expansion costs in the Sherwood CIP when that study is complete.

It is recommended that the City pursue both projects within the 20-year planning horizon in order to mitigate an estimated 1 mgd supply deficit in 2034. Based on the City's discussions with their WRWTP partner City of Wilsonville, expansion of treatment facilities will need to be completed within the 10-year timeframe in order to meet Wilsonville's forecasted demands. It is anticipated that design and engineering of the WRWTP expansion will begin within fiscal year 2018 with the majority of construction occurring within the 10-year timeframe. 20 percent of estimated costs for treatment plant expansion and future intake capacity purchase are distributed over the 2018, 2019 and 2020 fiscal years with the remaining 80 percent assigned to the 10-year timeframe. Project costs for this supply expansion are allocated 100 percent to growth.

City Wells

S-4 Hydrants at Wells 3 and 5

In order to maintain the City's groundwater wells as an on-demand emergency source, the City must have a means of isolating well water from the distribution system for exercising the well pumps and taking water quality samples. There is an existing fire hydrant and isolation valve at Well 6 which allows the City to pump Well 6 to atmosphere. It is recommended that a new hydrant and isolation valve be installed at Wells 3 and 5 for this purpose within fiscal year 2016. Emergency capacity from all of the City's wells is only sufficient to benefit existing customers, thus the estimated cost of this project is allocated entirely to existing customers.

S-5 Well 4 Abandonment and Water Rights Transfer

It is recommended that the City abandon the low-producing Well 4. Well 4 water rights may be eligible for transfer to one of Sherwood's other existing wells. Approximately $25,000 is allocated in the CIP to abandon Well 4 and apply for a water rights transfer to other City wells. For the purposes of this analysis it is assumed that the City's total well capacity for emergency supply will be from Wells 3, 5 and 6 not including any capacity from Well 4 or water rights transferred from Well 4. The Well 4 project is recommended for completion in fiscal year 2016. Emergency capacity from all of the City's wells is only sufficient to benefit existing customers, thus the estimated cost of this project is allocated entirely to existing customers.

Pump Station Projects

Sherwood's existing pumping facilities are adequate to meet customer demands in the 455 and 535 Pressure Zones through the 20-year planning horizon. Due to significant uncertainty regarding the nature of future development in the West Urban Reserve, a deficiency in the 455 Zone at build-out is recommended to be re-evaluated with the next Master Plan update or as development warrants. No pump station projects are currently recommended to mitigate this 455 Zone deficiency. Additional pumping facilities are recommended to serve proposed future constant pressure (closed) zones outside of the City's existing service area.

Estimated project costs for proposed pump stations are allocated 100 percent to growth as all of the proposed stations are intended to serve future development outside of the existing Sherwood water service area.

P-1 Ladd Hill Pump Station

The 1,600 gpm Ladd Hill Pump Station is proposed to serve future customers along Ladd Hill Road in the proposed 400 Brookman Zone. The proposed pump station, illustrated on Plate 1 in Appendix A, will boost water from existing 380 Zone distribution mains on Ladd Hill Road at Brookman Road to provide customers with constant pressure service at an hydraulic grade line (HGL) of approximately 400 feet. The pump station is proposed for construction within the 20-year timeframe.

P-2 Kruger Pump Station

The 2,400 gpm Kruger Pump Station is proposed to serve future high-elevation customers west of Kruger Reservoir in the proposed 630 West Zone. The proposed pump station, located on the same site as the existing Kruger Reservoir, will boost water from the reservoir to provide customers with constant pressure service at an HGL of approximately 630 feet. The pump station is proposed for construction beyond 20 years as development warrants.

P-3 Edy Road Pump Station

The 1,600 gpm Edy Road Pump Station is proposed to serve future high-elevation customers along Edy Road near the western boundary of the West Urban Reserve in the proposed 475 West Zone. The proposed pump station, illustrated on Plate 1 in Appendix A, will boost water from proposed 380 Zone distribution mains (M-54 and -55) on Edy Road west of Chicken Creek to provide customers with constant pressure domestic and fire flow service at an HGL of approximately 475 feet. The pump station is proposed for construction beyond 20 years as development warrants.

During the pump station pre-design process, it is recommended that the City evaluate providing fire flow to future 475 West Zone customers from the nearby 380 Zone proposed distribution mains. Providing fire flow from the 380 Zone would allow a significant

reduction in the proposed Edy Road Pump Station capacity thereby reducing construction and long-term maintenance costs for this station.

Distribution Main Improvement Projects

Table 5-2 presents prioritized water distribution main project recommendations for fire flow capacity and system expansion including estimated project costs and cost allocations to future growth. All recommended water main projects are illustrated on Plate 1 in Appendix A. Water main project costs are estimated based on unit costs by diameter shown in Table 5-1.

Table 5-1
Unit Cost for Water Main Projects

Pipe Diameter	Cost per Linear Foot
6-inch	$160
8-inch	$180
10-inch	$210
12-inch	$250

Assumptions:

1. Ductile iron pipe with an allowance for fittings, valves and services
2. Surface restoration is assumed to be asphalt paving
3. No rock excavation
4. No dewatering
5. No property or easement acquisitions
6. No specialty construction included

Projects for Fire Flow

As presented in Section 4, analysis using the City's water system hydraulic model revealed that minimal piping improvements are needed to provide sufficient fire flow capacity within the existing water service area under existing and projected future demand conditions. Some water main projects identified in the 2005 Sherwood Water System Master Plan were eliminated from the CIP based on the 2014 analysis. This was primarily due to the availability of more refined data in 2014 and completion of major piping improvement projects since 2005. Water main projects recommended for fire flow capacity serve only existing developed areas, thus estimated project costs are allocated 100 percent to existing customers.

Projects for Future System Expansion

Large diameter distribution main loops are needed to serve the currently undeveloped Brookman Annexation, TEA and West Urban Reserve. Proposed water main projects to serve future development in Brookman and TEA are adapted from their respective concept

plans and prioritized according to the projected development timelines provided in the concept plans. Proposed water main projects to serve potential growth in the West Urban Reserve are aligned with existing roadways where possible and highest priority is given to areas with adjacent existing development which will be served from the existing 380 and 455 Pressure Zones.

Cost Allocation to Growth for System Expansion Projects

Estimated costs for projects which are recommended to replace existing pipes in order to serve system expansion areas are allocated to growth based on the ratio of existing and proposed future replacement pipe diameter. The flow area of the existing pipe size is considered to be serving existing system demands and benefiting existing customers. Any capacity beyond the existing pipe size is allocated to growth based on flow area. This cost allocation applies to recommended water main replacement projects M-3, M-4 and M-5.

Costs for all other water main projects recommended to facilitate water system expansion to the Brookman Annexation, TEA and West Urban Reserve are 100 percent allocated to growth.

Routine Pipe Replacement Program

In addition to distribution main projects to address capacity deficiencies, the City should plan for replacement of pipes based on a 100-year life cycle. It is recommended that routine pipe replacement be prioritized as follows:

1. Known pipe capacity and condition issues
2. Pipe material – based on City record of pipe material and era of manufacture
    - Highest priorities are galvanized pipe and post-1950 cast iron
3. Pipe age – coordinate replacement of pipes 50 years or older with other City utilities and transportation (City, County or State) projects

Sherwood has experienced substantial growth and city boundary expansion over the last few decades, as a result much of the City's water system is less than 30 years old. Based on a 100-year replacement cycle, none of this infrastructure would need to be replaced for 70 years, well beyond the planning horizon of this Master Plan Update. However, it is recommended that the City allocate funds for a long term pipe replacement program.

Based on the lengths and diameters of the City's oldest existing pipe, those mains within the 1960 city limit boundary, and input from City staff it is recommended that Sherwood allocate approximately $50,000 annually for routine pipe replacement. Estimated costs for the pipe replacement program are allocated to future growth based on the ratio of existing to projected build-out demands.

PRV Projects

Two new pressure reducing valves are recommended, as development warrants, to provide an emergency connection between the existing 455 Zone distribution mains and future 380 Zone mains on Elwert Road at Handley Street and on Old Highway 99W at the Brookman Annexation boundary. Two additional PRVs are recommended, as development warrants, to provide an emergency connection between the future 630 West Pressure Zone and 455 Zone future expansion in the West Urban Reserve. Project costs for all four PRVs are allocated 100 percent to growth.

SCADA System Upgrade

A Supervisory Control and Data Acquisition (SCADA) system is a computer and communication system which provides critical real-time information and data recording to inform both immediate and long-term water system operations decisions. The SCADA system monitors water facility performance with measures, such as, system pressure, reservoir water level and pump on/off status as well as entry alarms for security at drinking water reservoirs and pump stations. Based on experience with similar water providers in the region, equipment becomes more difficult to maintain and repair 10 to 15 years after installation as SCADA technology advances leading to increasing maintenance effort and cost. The City's current SCADA system is over 10 years old. It is recommended that the City upgrade their existing SCADA system in fiscal year 2017. Estimated costs for the proposed upgrade are allocated to future growth based on the ratio of existing to 20-year projected demands. It is assumed that the SCADA system would likely need to be upgraded again at the end of the 20-year planning horizon.

Planning Projects

It is recommended that the City update this Water System Master Plan within the next 6 to 10 years and again at 20 years. An update may be needed sooner if there are significant changes to the City's water service area, supply or distribution system which are not currently anticipated.

To comply with Oregon Water Resources Department (OWRD) requirements for groundwater permit holders Sherwood is required to complete an update of their Water Management and Conservation Plan (WMCP) every 10 years. The next update of the City's WMCP is expected to begin in fiscal year 2018.

The City intends to update the existing Water System Vulnerability Assessment within the next 10 years to identify any additional security measures or operations procedures which may be needed to protect water facilities. It is assumed that this assessment update will be repeated at 20 years.

Sherwood staff have identified the need for a local water system resilience plan to achieve the seismic response and recovery goals for Willamette Valley water utilities presented in the

Oregon Resilience Plan. It is recommended that the City begin developing this plan in the next year.

Estimated costs for future water system planning projects are allocated to future growth based on the ratio of existing to 20-year projected demands.

Summary

This section presented recommendations for improvement and expansion projects in the City's supply system, pump stations and distribution mains. As presented in Table 5-3, the total estimated cost of these projects is approximately $24.6 million through FY 2034. Approximately $19.9 million of the total estimated cost is for projects needed within the 10-year timeframe and $5.4 million of these improvements are required in the next 5 years.

Table 5-2
Water Main Projects

DRAFT

CIP ID	Project Description	Project Purpose	Diameter (in)	Total Project Length (ft)	Timeframe	Estimated Project Cost	% Allocated to Growth
M-1	Upgrade 6-inch fire line to Sherwood Senior Center (21907 Sherwood Boulevard) from Sherwood Boulevard	Commercial Fire Flow	8	196	FY2 (2017)	$ 36,000	0%
M-2	Upgrade 6-inch main along Norton Street from Willamette Street south to fire hydrant at Forest Avenue	Residential Fire Flow	8	507	FY3 (2018)	$ 92,000	0%
M-3	Upgrade 8-inch main along Sanders Terrace from Inkster Drive to Maidenfern Lane	Fire flow to Brookman Expansion	12	487	10-Year (2024)	$ 122,000	56%
M-4	Upgrade 8-inch main along Maidenfern Lane from Sanders Terrace to Middleton Road, open NCV at 18191 Maidenfern to transfer services from 455 to 380 Zone		12	381	10-Year (2024)	$ 96,000	56%
M-5	Upgrade 8-inch main along Middleton Road from Maidenfern Lane to city limits, close valve at Middleton & Maidenfern to transfer services from 455 to 380 Zone		12	325	10-Year (2024)	$ 82,000	56%
M-6	Install new main along Middleton Road from city limits south to 24312 Middleton Road	Brookman Expansion - 380 Zone	12	884	10-Year (2024)	$ 221,000	100%
M-7	Install new main along Old Hwy 99W from existing dead end south of Crooked River Lane to proposed Southwest Sherwood PRV (V-1)		12	268	FY3 (2018)	$ 68,000	100%
M-8	Install new main along Old Hwy 99W from proposed Southwest Sherwood PRV (V-1) across Goose Creek		12	813	FY4 (2019)	$ 204,000	100%
M-9	Install new main along proposed Goose Creek arterial from Old Hwy 99W northwest to Hwy 99W		8	1,325	FY4 (2019)	$ 239,000	100%
M-10	Install new main along proposed Goose Creek arterial from Old Hwy 99W southeast to Brookman Road		12	1,246	10-Year (2024)	$ 312,000	100%
M-11	Install new main along Middleton Road from Brookman Road north to 24312 Middleton Road		12	517	10-Year (2024)	$ 130,000	100%
M-12	Install new main along Brookman Road from Middleton Road east to 16655 Brookman Road		12	1,223	10-Year (2024)	$ 306,000	100%
M-13			12	1,233	10-Year (2024)	$ 309,000	100%
M-14			12	2,414	10-Year (2024)	$ 604,000	100%
M-15	Install new main from 16655 Brookman Road northeast to 24100 Ladd Hill Road		12	1,382	10-Year (2024)	$ 346,000	100%
M-16	Install new main along Ladd Hill Road from 24100 Ladd Hill Road north to Brookman Road		12	255	10-Year (2024)	$ 64,000	100%

Table 5-2
Water Main Projects

DRAFT

CIP ID	Project Description	Project Purpose	Diameter (in)	Total Project Length (ft)	Timeframe	Estimated Project Cost	% Allocated to Growth
M-17	Install new main along proposed roadway running north-south at 17433 Brookman Road	Brookman Expansion - 380 Zone	12	1,726	10-Year (2024)	$ 432,000	100%
M-18	Install new main from proposed roadway through 17433 Brookman Road, across Cedar Creek to Redfern Drive		12	1,537	10-Year (2024)	$ 385,000	100%
M-19A	Install new main from Redfern Drive east to Brookman Road	Brookman Expansion - 380 Zone	8	565	10-Year (2024)	$ 102,000	100%
M-19B	Install new main along Brookman Road to Ladd Hill Road		8	995	10-Year (2024)	$ 180,000	100%
M-20	Install new main along Old Hwy 99W from proposed Goose Creek arterial southwest to Brookman Road		8	878	20-Year (2034)	$ 159,000	100%
M-21	Install new main along Brookman Road from Old Hwy 99W west to Hwy 99W		8	627	20-Year (2034)	$ 113,000	100%
M-22	Install new main along Hwy 99W from Brookman Road north to proposed Goose Creek arterial		8	1,678	20-Year (2034)	$ 303,000	100%
M-23	Install new mains along proposed roadways for system looping in the Brookman Annexation area		8	860	20-Year (2034)	$ 155,000	100%
M-24			8	2,254	20-Year (2034)	$ 406,000	100%
M-25			8	412	20-Year (2034)	$ 75,000	100%
M-26	Install new mains along Ladd Hill Road from proposed Ladd Hill Pump Station (P-1) south of Brookman Road	Brookman Expansion - 400 Zone	12	288	20-Year (2034)	$ 73,000	100%
M-27			12	498	20-Year (2034)	$ 125,000	100%
M-28	Extend proposed Ladd Hill main (M-27) south to southern boundary of Brookman Annexation		12	453	20-Year (2034)	$ 114,000	100%
M-29	Extend Cipole Road main south from Tualatin Sherwood Road to proposed TEA water main backbone	TEA Expansion - 380 Zone	10	731	FY3 (2018)	$ 154,000	100%
M-30	Install new mains to form TEA water main backbone running northeast to southwest across TEA parallel to Oregon Street		10	1,256	FY4 (2019)	$ 264,000	100%
M-31			12	1,750	FY4 (2019)	$ 438,000	100%
M-32	Install new main across 21600 Oregon Street property to TEA water main backbone		10	1,267	FY5 (2020)	$ 267,000	100%
M-33	Extend proposed Cipole Road main (M-29) southeast to proposed 124th Avenue roadway extension south of Tualatin Sherwood Road		10	768	FY5 (2020)	$ 162,000	100%

Table 5-2
Water Main Projects

DRAFT

CIP ID	Project Description	Project Purpose	Diameter (in)	Total Project Length (ft)	Timeframe	Estimated Project Cost	% Allocated to Growth
M-34	Install new main along proposed 124th Avenue roadway extension south of Tualatin Sherwood Road contiuing south to proposed collector road running west to east across TEA	TEA Expansion - 380 Zone	10	843	FY5 (2020)	$ 178,000	100%
M-35	Install new main from intersection of Dahlke Lane & Oregon Street southeast to TEA water main backbone		10	1,530	10-Year (2024)	$ 322,000	100%
M-36	Install new main from TEA water main backbone east to 124th Avenue roadway extension at proposed collector road		12	1,695	10-Year (2024)	$ 424,000	100%
M-37	Extend proposed TEA water main backbone (M-31) south to serve TEA concept plan area B(2)		12	1,161	10-Year (2024)	$ 291,000	100%
M-38	Install new main parallel to the south side of the Bonneville Power Easement from Oregon Street to the TEA water main backbone at Dahlke Lane	TEA Expansion - 380 Zone	12	1,347	Beyond 20 years	$ 337,000	100%
M-39	Install new main from Tualatin Sherwood Road west of Cipole Road south to TEA water main backbone		10	942	Beyond 20 years	$ 198,000	100%
M-40	Extend Edy Road 12-inch 380 Zone main west to Elwert Road		12	870	10-Year (2024)	$ 218,000	100%
M-41	Install new main along Elwert Road from Edy Road south to 21615 Elwert Road	West Expansion - 380 Zone	12	1,323	10-Year (2024)	$ 331,000	100%
M-42	Install new main along Elwert Road from 21615 Elwert Road to connect with existing 455 Zone piping through proposed Handley PRV (V-2)		12	1,191	10-Year (2024)	$ 298,000	100%
M-43	Extend existing 12-inch 455 Zone main along Hwy 99W from the intersection of Hwy 99W & Kruger Road southwest across Goose Creek to 23975 Hwy 99W	West Expansion - 455 Zone	12	2,908	20-Year (2034)	$ 727,000	100%
M-44	Install new main from 23975 Hwy 99W west to proposed 195th PRV (V-4)		12	1,533	20-Year (2034)	$ 384,000	100%
M-45	Install new main from existing 18-inch 455 Zone Kruger Road main south to connect with 455 distribution extension (M-44) near proposed 195th PRV (V-4)		12	2,642	20-Year (2034)	$ 661,000	100%
M-46	Extend existing 10-inch 380 Zone main along Roy Rogers Road north across Chicken Creek bridge to Scholls Sherwood Road	West Expansion - 380 Zone	12	3,168	Beyond 20 years	$ 792,000	100%
M-47	Install new main along Scholls Sherwood Road from Roy Rogers Road west to Elwert Road		12	3,088	Beyond 20 years	$ 773,000	100%

Table 5-2
Water Main Projects

DRAFT

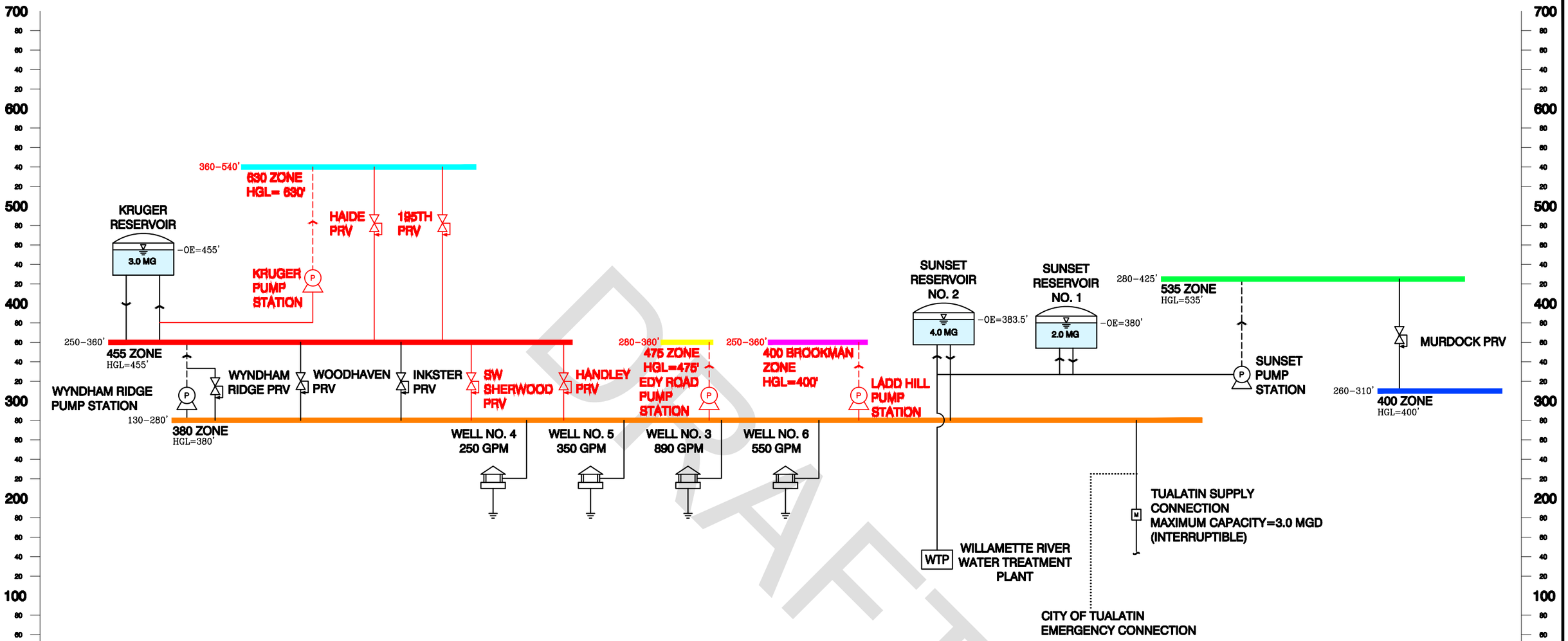
CIP ID	Project Description	Project Purpose	Diameter (in)	Total Project Length (ft)	Timeframe	Estimated Project Cost	% Allocated to Growth
M-48A	Install new main along Elwert Road from Scholls Sherwood Road south to Conzelmann Road	West Expansion - 380 Zone	12	2,640	Beyond 20 years	$ 660,000	100%
M-48B	Install new main along Elwert Road from Conzelmann Road south across Chicken Creek to Edy Road		12	2,640	Beyond 20 years	$ 661,000	100%
M-49	Install new main along Haide Road from Elwert Road west to proposed Haide PRV (V-3)	West Expansion - 455 Zone	12	2,658	Beyond 20 years	$ 665,000	100%
M-50	Install new main from existing 18-inch 455 Zone Kruger Road main north to connect with Haide Road 455 distribution extension (M-49)		12	1,998	Beyond 20 years	$ 500,000	100%
M-51	Install new main along Kruger Road from proposed Kruger Pump Station (P-2) west to serve future West Urban Reserve customers in proposed 630 Zone	West Expansion - 630 Zone	12	750	Beyond 20 years	$ 188,000	100%
M-52	Install new mains from proposed Kruger Road 630 Zone main (M-51) north to loop with proposed 455 Zone mains on Haide Road through proposed Haide PRV (V-3)		12	1,615	Beyond 20 years	$ 404,000	100%
M-53			12	1,230	Beyond 20 years	$ 308,000	100%
M-54	Extend proposed 380 Zone main along Edy Road from Elwert Road west across Chicken Creek to proposed Edy Road Pump Station (P-3)	West Expansion - 380 Zone	12	1,978	Beyond 20 years	$ 495,000	100%
M-55			12	970	Beyond 20 years	$ 243,000	100%
M-56	Install new mains from proposed Kruger Road 630 Zone main (M-51) south to loop with proposed 455 Zone mains through proposed 195th PRV (V-4)	West Expansion - 630 Zone	12	1,387	Beyond 20 years	$ 347,000	100%
M-57			12	1,434	Beyond 20 years	$ 359,000	100%
M-58			12	559	Beyond 20 years	$ 140,000	100%
M-59	Install new main along Edy Road west of proposed Edy Road Pump Station (P-3) to serve future West Urban Reserve customers in proposed 455Booster Zone	West Expansion - 475 Zone	12	452	Beyond 20 years	$ 113,000	100%
M-60	Upgrade existing 2-inch main on June Court from Cochran Avenue to existing dead end, add fire hydrant at end of cul-de-sac	Residential Fire Flow	6	263	FY4 (2019)	$ 43,000	100%
					Total Cost	**$ 18,198,000**	

Table 5-3
CIP Summary

DRAFT

Project Category	Project ID	Project Description	CIP Schedule and Project Cost Summary								% Allocated to Growth
			FY1 (2016)	FY2 (2017)	FY3 (2018)	FY4 (2019)	FY5 (2020)	10-Year (2024)	20-Year (2034)	Beyond 20 years	
Supply	S-1	Existing WRWTP upgrades to achieve max 15 mgd capacity				$ 250,000	$ 250,000	$ 500,000			20%
	S-2	WRWTP purchase 5 mgd intake capacity			$ 100,000	$ 150,000	$ 150,000	$ 1,600,000			100%
	S-3	WRWTP treatment expansion - Sherwood 5 mgd share			$ 440,000	$ 550,000	$ 550,000	$ 6,160,000			100%
	S-4	Install hydrants at Wells 3 and 5	$ 25,000								0%
	S-5	Abandon Well 4 and transfer water rights	$ 25,000								0%
		Subtotal	***$ 50,000***	***$ -***	***$ 540,000***	***$ 950,000***	***$ 950,000***	***$ 8,260,000***	***$ -***	***$ -***	
Pump Station	P-1	Proposed 1,600 gpm Ladd Hill Pump Station to serve future 400 Brookman Zone customers							$ 477,000		100%
	P-2	Proposed 2,400 gpm Kruger Pump Station to serve future 630 Zone customers								$ 2,547,000	100%
	P-3	Proposed 1,600 gpm Edy Road Pump Station to serve future 475 Zone customers								$ 1,505,000	100%
		Subtotal	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ 477,000***	***$ 4,052,000***	
Water Main	M-1	Fire flow capacity -Sherwood Senior Center		$ 36,000							0%
	M-2	Fire flow capacity - Norton Ave			$ 92,000						0%
	M-60	Fire flow capacity - June Court				$ 43,000					0%
	M-7	Expansion to Brookman - Loop from prop SW Sherwood PRV to Hwy 99		$ 68,000							100%
	M-8				$ 204,000						100%
	M-9				$ 239,000						100%
	M-29	Expansion to TEA - Loop with existing Oregon Street mains			$ 154,000						100%
	M-30					$ 264,000					100%
	M-31					$ 438,000					100%
	M-32						$ 267,000				100%
	M-33						$ 162,000				100%
	M-34						$ 178,000				100%
	M-3, 4 & 5	10-Year (2024) - upgrade existing mains						$ 300,000			56%
	M-6, 10 to 19B, 35 to 37, 40 to 42	10-Year (2024)						$ 5,275,000			100%
	M-20 to 28, 43 to 45	20-Year (2034)							$ 3,295,000		100%
	M-38, 39, 46 to 59	Beyond 20 years								$ 7,183,000	100%
		Routine Pipe Replacement Program	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 250,000	$ 500,000	$50K annually	57%
		Subtotal	***$ 50,000***	***$ 154,000***	***$ 739,000***	***$ 795,000***	***$ 657,000***	***$ 5,825,000***	***$ 3,795,000***	***$ 7,183,000***	
PRV	V-1	SW Sherwood PRV			$ 150,000						100%
	V-2	Handley PRV						$ 150,000			100%
	V-3	Haide PRV								$ 150,000	100%
	V-4	195th PRV								$ 150,000	100%
		Subtotal	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ 300,000***	
Other		Upgrade SCADA System		$ 75,000							35%
		Subtotal	***$ -***	***$ 75,000***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	
Planning		Update Water Master Plan						$ 150,000	$ 150,000		35%
		Update Water Management and Conservation Plan			$ 150,000				$ 150,000		35%
		Update Vulnerability Assessment						$ 60,000	$ 60,000		35%
		Resiliency Plan	$ 150,000						$ 150,000		35%
		Subtotal	***$ 150,000***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 210,000***	***$ 510,000***	***$ -***	
Capital Improvement Program (CIP) Total			**$ 250,000**	**$ 229,000**	**$ 1,579,000**	**$ 1,745,000**	**$ 1,607,000**	**$ 14,445,000**	**$ 4,782,000**	**$ 11,535,000**	**$ 36,172,000**

Annual Average CIP Cost		
$1,082,000 over 5 years	**$1,985,500 over 10 years**	**$1,231,850 over 20 years**



LEGEND

	EXISTING
PUMP DISCHARGE WATER MAIN	-------
WATER MAIN	———
RESERVOIR (CAPACITY IN MG, OVERFLOW ELEVATION IN FEET)	1.0 MG, OE=410'
GROUNDWATER WELL (PRODUCTION CAPACITY IN GPM)	
PRESSURE REDUCING VALVE	
PUMP STATION	P
MASTER METER	M
WATER TREATMENT PLANT	WTP
DISTRIBUTION SYSTEM EMERGENCY INTERTIES	.....

ABBREVIATIONS

GPM	GALLONS PER MINUTE
HGL	HYDRAULIC GRADE LINE
MG	MILLION GALLONS
MGD	MILLION GALLONS PER DAY
OE	OVERFLOW ELEVATION
PRV	PRESSURE REDUCING VALVE

NOTES:

1. FACILITIES SHOWN IN RED ARE PROPOSED.

FIGURE 5-1

City of Sherwood Oregon

Water System Master Plan Update

PROPOSED WATER SYSTEM SCHEMATIC

FEBRUARY 2015

MSA

13-1508

PLATE 1

City of Sherwood Oregon

Water System Master Plan Update

Water System Map

MSA Murray, Smith & Associates, Inc. Engineers/Planners

DRAFT

24-inch Tualatin Supply Connection

Future 475 WEST Zone

Future 380 WEST Zone

Future 380 TEA Zone

380 Zone

Proposed Handley PRV

Proposed Haide PRV

Wyndham Ridge Pump Station

455 Zone

Woodhaven PRV

Kruger Reservoir

Future 455 WEST Zone

Inkster PRV

Proposed SW Sherwood PRV

Proposed 195th PRV

Future 630 WEST Zone

Proposed NCV Hatched Area Customers Transfer to 380 Zone

Future 380 BROOKMAN Zone

Future 400 BROOKMAN Zone

Sunset Reservoirs & Pump Station

400 Zone

Murdock PRV

535 Zone

Willamette River Water Treatment Plant 48-inch Transmission Main (to Wilsonville)

West Fork Chicken Creek

Chicken Creek

Rock Creek

Cedar Creek

Goose Creek

Coffee Lake Creek

Legend

- Existing Reservoir
- Existing Well

Pump Station

- Existing
- Proposed

Pressure Reducing Valve

- Existing
- Proposed

Water Main

- Existing
- Proposed
- Existing Transmission
- Railroad
- Stream
- City Limits
- Urban Growth Boundary (UGB)

This map is intended for informational purposes only. The City of Sherwood makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, or surveying purposes. Notification of any errors is appreciated.

Source Data:
Basemapping - Metro/RLIS Nov. 2014
Water System - MSA and City of Sherwood Dec. 2014

800 0 800 Feet

N W E S

MSA

MURRAY, SMITH & ASSOCIATES, INC.
ENGINEERS | PLANNERS

EXHIBIT E

City of Sherwood
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2009 Top Ten Selection

2007 18th Best Place to Live

Sherwood 2006 All-America City Finalist

Date: March 24, 2015

To: Brad Kilby, Planning Manager

From: Craig Sheldon, Public Works Director

Subject: Water Master Plan Open House

On February 25, 2015 the City of Sherwood Public Works Department held an Open House Meeting at the Sherwood Police Department, 20495 SW Borchers Drive, from 5:30 to 7:00 PM to give residents the opportunity to view and ask questions about the Water Master Plan. Rich Sattler and Amy Jollett attended on behalf of the City and Brian Ginter and Heidi Springer attended on behalf of Murray, Smith & Associates (MSA).

The City did a saturation mailing to all addresses in the 97140 zip code. A few of the early questions were from people who do not live in the boundaries of the City and they wanted to know the impact of the plan on them. The answer was that based on where they live the plan did not affect them at this time.

A question on the impacts of the plan to the City was asked. MSA responded that the plan identifies projects for the next 20 years.

A resident asked if we [the City] are in "good shape?" The response was that within the City limits there are not a lot of projects that need to be completed. Brian Ginter referenced the two maps that depicted the projects identified in the 2005 Water Master Plan and the revisions to the current Water Master Plan. He pointed out how many projects have gone away. Rich Sattler added that between the ongoing maintenance being performed, the addition of the new reservoir and water transmission pipeline project and the data we are now able to collect in our system, a lot of the projects have either been resolved or have gone away now that we have accurate data. There are projects that will need to happen as growth occurs.

A resident stated that he spoke with Clean Water Services (CWS) and they informed him that they had not raised the City's rates in years. He stated that the City was increasing CWS rates and using the additional money to fund

projects. He also stated that the City is double dipping in regards to street lights since we charge residents on their utility bill and also collect franchise fees for the street lights. Lastly, the resident stated that if the plant in Wilsonville hits capacity, the City of Sherwood is responsible for 100% of the expenses to upgrade the plant. Rich Sattler interjected that he has reviewed the agreements between the City of Wilsonville and the City of Sherwood and he didn't recall reading that all the responsibility was on Sherwood. The resident responded that he called over to the City of Wilsonville and they laughed when they said that we are 100% responsible.

Several residents expressed concerns about the "water" bill being too high and not wanting to have rate increases. Staff clarified that it is a utility bill and therefore covers water, sewer, stormwater, street fees and other utilities. It was discussed that there may be increases but they will need to be approved by the Budget Committee and City Council.

A question was asked if we have enough water to support the Sherwood West development. It was answered that yes we do have enough water to handle the additional growth that would happen as a result of the Sherwood West project moving forward.

A follow up question was asked if we have adequate supply to meet demand at the plant and would Sherwood be covered if Sherwood West does move forward. It was answered that yes we do. Sherwood has ownership interest in the plant (5 mgd) along with Wilsonville (10 mgd). It was stated that the majority of capital improvement projects are covered by SDCs.

A resident stated that existing customers should not have to pay for new construction (Brookman area) and that the people that will be living there should pay for the new pipeline.

A resident asked about Krueger Reservoir is filled. The answer is that it is fed by an 18" water line that fills it during the night and it is used during the day.

A resident was confused by the charges on their bill and Rich Sattler answered the questions.

A resident expressed concerns about our Water Right on the Willamette River and the impact on fish flow from an article he read in the Sherwood Gazette. Brian Ginter explained that there is little to no risk of us losing our Water Right due to impact on fish flows since the time of year when it is most restrictive on the Willamette is during Sherwood's non-peak use so we never come close to the threshold.

A question was asked if the Parks pay for water or do the enterprise funds pay for water in the parks. Brian Ginter answered that parks are not charged for water.

EXHIBIT E

City of Sherwood
15527 SW Willamette St
Sherwood, OR 97140
Tel 503-625-5722
Fax 503-625-0629
www.sherwoodoregon.gov

2009 Top Ten Selection

2007 18th Best Place to Live

Sherwood 2006 All-America City Finalist

Date: March 24, 2015

To: Brad Kilby, Planning Manager

From: Craig Sheldon, Public Works Director

Subject: Water Master Plan Open House

On February 25, 2015 the City of Sherwood Public Works Department held an Open House Meeting at the Sherwood Police Department, 20495 SW Borchers Drive, from 5:30 to 7:00 PM to give residents the opportunity to view and ask questions about the Water Master Plan. Rich Sattler and Amy Jollett attended on behalf of the City and Brian Ginter and Heidi Springer attended on behalf of Murray, Smith & Associates (MSA).

The City did a saturation mailing to all addresses in the 97140 zip code. A few of the early questions were from people who do not live in the boundaries of the City and they wanted to know the impact of the plan on them. The answer was that based on where they live the plan did not affect them at this time.

A question on the impacts of the plan to the City was asked. MSA responded that the plan identifies projects for the next 20 years.

A resident asked if we [the City] are in "good shape?" The response was that within the City limits there are not a lot of projects that need to be completed. Brian Ginter referenced the two maps that depicted the projects identified in the 2005 Water Master Plan and the revisions to the current Water Master Plan. He pointed out how many projects have gone away. Rich Sattler added that between the ongoing maintenance being performed, the addition of the new reservoir and water transmission pipeline project and the data we are now able to collect in our system, a lot of the projects have either been resolved or have gone away now that we have accurate data. There are projects that will need to happen as growth occurs.

A resident stated that he spoke with Clean Water Services (CWS) and they informed him that they had not raised the City's rates in years. He stated that the City was increasing CWS rates and using the additional money to fund

projects. He also stated that the City is double dipping in regards to street lights since we charge residents on their utility bill and also collect franchise fees for the street lights. Lastly, the resident stated that if the plant in Wilsonville hits capacity, the City of Sherwood is responsible for 100% of the expenses to upgrade the plant. Rich Sattler interjected that he has reviewed the agreements between the City of Wilsonville and the City of Sherwood and he didn't recall reading that all the responsibility was on Sherwood. The resident responded that he called over to the City of Wilsonville and they laughed when they said that we are 100% responsible.

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A resident asked about Krueger Reservoir is filled. The answer is that it is fed by an 18" water line that fills it during the night and it is used during the day.

A resident was confused by the charges on their bill and Rich Sattler answered the questions.

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A question was asked if the Parks pay for water or do the enterprise funds pay for water in the parks. Brian Ginter answered that parks are not charged for water.

City of Sherwood Oregon
Home of the Tualatin River National Wildlife Refuge

ORDINANCE 2015-004

AMENDING CHAPTER 7 OF VOLUME II OF THE SHERWOOD COMPREHENSIVE PLAN AND ADOPTING THE SHERWOOD WATER SYSTEM MASTER PLAN

WHEREAS, the City Comprehensive Plan and Water System Master Plans are long range planning documents intended to be updated as conditions within the City change; and

WHEREAS, the Sherwood Water System Master Plan was updated in 2005; and

WHEREAS, at the time of the last Sherwood Water System Master Plan, the associated information in Volume II of the Sherwood Comprehensive Plan was not updated; and

WHEREAS, the City has determined that amendments to the Sherwood Comprehensive Plan and Water System Master Plan are necessary and must be coordinated and;

WHEREAS, the City contracted with Murray Smith and Associates to update the Sherwood Water System Master Plan; and

WHEREAS, in the course of review of the Sherwood Water System Master Plan, staff identified the need to update Chapter 7 of Volume II of the Sherwood Comprehensive Plan as it relates to water; and

WHEREAS, after an Open House and input from the Planning Commission, staff proceeded with noticing and processing an amendment to: 1) Update certain portions of Chapter 7 of Volume II of the Comprehensive Plan as they relate to the Water System Master Plan, so that the information is current; 2) Identifying the Sherwood Water System Master Plan as an appendix to the Comprehensive Plan; and 3) Adopting the Sherwood Water System Master Plan; and

WHEREAS, the proposed amendments were reviewed for compliance and consistency with the Comprehensive Plan, regional and state regulations and found to be fully compliant; and

WHEREAS, the proposed amendments were subject to full and proper notice and review and a public hearing was held before the Planning Commission on March 24, 2015; and

WHEREAS, the Planning Commission voted to forward a recommendation of approval to the City Council for the proposed Comprehensive Plan amendments and the Sherwood Water System Master Plan; and

WHEREAS, the analysis and findings to support the Planning Commission recommendation are identified in Attachment 1; and

WHEREAS, the City Council held a public hearing on April 21, 2015 and determined that the proposed amendments to the Comprehensive Plan met the applicable Comprehensive Plan criteria and continued to be consistent with regional and state standards; and

WHEREAS, the City Council determined that the Sherwood Water System Master Plan addressed existing conditions, identified capital improvements and associated costs needed to meet the future needs for the Sherwood Water System over the planning horizon.

NOW, THEREFORE, THE CITY OF SHERWOOD ORDAINS AS FOLLOWS:

Section 1. Findings. After full and due consideration of the proposed amendments to the Chapter 7 of Volume II of the Sherwood Comprehensive Plan and the updates to the Sherwood Water System Master Plan, the Planning Commission recommendation, the record, findings, and evidence presented at the public hearing, the Council adopts the findings of fact contained in the Planning Commission Recommendation, finding that Water System Master Plan and Comprehensive Plan shall be amended as documented in the attached Exhibits 1 and 2.

Section 2. Approval. The proposed amendments for Water System Master Plan and Comprehensive Plan (PA 15-01) identified in Exhibits 1 and 2 are hereby **APPROVED**.

Section 3 - Manager Authorized. The Planning Department is hereby directed to take such action as may be necessary to document this amendment, including notice of adoption to DLCD.

Section 4 - Effective Date. This ordinance shall become effective the 30th day after its enactment by the City Council and approval by the Mayor.

Duly passed by the City Council this 5th day of May 2015.

_____
Krisanna Clark, Mayor

Attest:

_____
Sylvia Murphy, MMC, City Recorder

	AYE	NAY
Cooke	____	____
Harris	____	____
Kuiper	____	____
King	____	____
Henderson	____	____
Robinson	____	____
Clark	____	____

COMMUNITY FACILITIES AND SERVICES

A. GENERAL INTRODUCTION

Community facilities and services in the Sherwood Planning Area are provided by Washington County, the City of Sherwood, special service districts, semi-public agencies and the State and Federal government, (see Table VII-1). Public facilities and services include sewer, water, fire and police protection, libraries, drainage, schools, parks and recreation, solid waste and general governmental administrative services. Semi-public facilities and services are those which are privately owned and operated but which have general public benefit. They include health facilities, energy and communication utilities, and day care.

Although a small community, Sherwood has learned well the importance of adequate community facilities and services to orderly urban growth. Lack of sewer treatment capacity curtailed growth in the City in the 1970's. Planning for public facilities and services in response to growth rather than in advance of growth results in gaps in facilities and services. As population growth and density increase in the Sherwood Planning Area, greater facility and service support will be required. In recognition of this basic fact, the Plan stresses the need for provision of necessary facilities and services in advance of, or in conjunction with, urban development.

The Community Facilities and Services element identifies general policy goals and objectives; service areas and providers, problems, and service plans, and potential funding for key public and semi-public facilities and services. Park and recreation facilities are treated in Chapter 5, Environmental Resources. Transportation facilities are treated in Chapter 6, Transportation. This element was updated in 1989 to comply with OAR 197.712(2)(e).

B. POLICY GOAL AND OBJECTIVES

To insure the provision of quality community services and facilities of a type, level and location which is adequate to support existing development and which encourages efficient and orderly growth at the least public cost.

OBJECTIVES

1. Develop and implement policies and plans to provide the following public facilities and services; public safety fire protection, sanitary facilities, water supply, governmental services, health services, energy and communication services, and recreation facilities.

2. Establish service areas and service area policies so as to provide the appropriate kinds and levels of services and facilities to existing and future urban areas.

3. Coordinate public facility and service plans with established growth management policy as a means to achieve orderly growth.

4. Coordinate public facility and service provision with future land use policy as a means to provide an appropriate mix of residential, industrial and commercial uses.

5. Develop and implement a five-year capital improvements and service plan for City services which prioritizes and schedules major new improvements and services and identifies funding sources.

6. The City will comply with the MSD Regional Solid Waste Plan, and has entered into an intergovernmental agreement with Washington County to comply with the County's Solid Waste and Yard Debris Reduction Plan, 1990.

7. Based on Sewer, Water, Stormwater, and Transportation Plan updates, the City shall prepare a prioritized list of capital improvement projects to those systems and determine funding sources to realize the improvements envisioned in those plans.

8. It shall be the policy of the City to seek the provision of a wide range of public facilities and services concurrent with urban growth. The City will make an effort to seek funding mechanisms to achieve concurrency.

C. PUBLIC AND SEMI-PUBLIC UTILITIES

Public utilities including water, sanitary sewer, drainage, and solid waste, as well as semi-public utilities including power, gas and telephone services are of most immediate importance in the support of new urban development. Water, sewer collection, and drainage facilities are the major services for which the City of Sherwood has responsibility. Service plans for these key services are contained in this section. The other utilities referred to above are the principal responsibilities of those agencies listed in Table VII-1. These agencies have been contacted for the purpose of coordinating their service planning and provision with the level and timing of service provision required to properly accommodate growth anticipated by the Plan.

TABLE VII-1
FACILITY AND SERVICE PROVIDERS
IN THE SHERWOOD PLANNING AREA

1. Public Utilities

   a. Public Water Supply
      City of Sherwood

   b. Sanitary Sewer System
      (1) Clean Water Services
      (2) City of Sherwood

   c. Storm Drainage System
      (1) City of Sherwood
      (2) Washington County
      (3) State of Oregon

2. Private/Semi-Public Utilities

   a. Natural Gas
      Northwest Natural Gas Co.

   b. Electric Power
      Portland General Electric

   c. Solid Waste: Pride Disposal Co.

3. Transportation

   a. Paved Streets, Traffic Control, Sidewalks, Curbs, Gutters, Street Lights
      (1) City of Sherwood
      (2) Washington County
      (3) State of Oregon

   b. Bikeways
      (1) City of Sherwood
      (2) Washington County
      (3) State of Oregon

c. Public Transit
Tri-Met

4. Public Health and Safety

a. Police Protection
(1) City of Sherwood
(2) Washington County
(3) State of Oregon

b. Fire Protection
Tualatin Valley Fire and Rescue

c. Animal Control
Washington County

5. Recreation

a. Parks and Recreation
City of Sherwood

b. Library
City of Sherwood

6. Schools
Sherwood School District 88J

D. SEWER SERVICE PLAN

INTRODUCTION

The Sewer Service Plan of the Comprehensive Plan was updated in 1990 and is included as an appendix to the Plan, and is incorporated into this chapter. The following describes the existing sewer system, recommended improvements to the existing system, recommended expansion of the sewer system and estimated costs.

EXISTING SEWER SYSTEM

The City of Sherwood's existing sewer system is as shown on Figure VII-1. The system is located in USA's Durham South Basin which consists of two sub-basins are centered around Cedar Creek and Rock Creek, respectively, and will be referred to as the Cedar Creek basin and the Rock Creek basin throughout the remainder of this section.

The Rock Creek Basin system currently serves a residential area bounded by Lincoln Street to the west, West Sunset Boulevard to the south, Oregon Street to the north and the UGB to the east. Rock Creek Basin also contains approximately 7l.2 acres of land, north of Oregon Street, which is currently zoned and developed for industrial use. The remaining northern portion of the Basin is essentially undeveloped and zoned primarily for industrial use. Flow is by gravity from south to north, eventually connecting to USA's Rock Creek trunk. This trunk then follows Rock Creek until it connects with the Upper Tualatin Interceptor which transports sewage to the Durham treatment plant.

The Cedar Creek Basin system serves the majority of Sherwood. Drainage is again from south to north and the main trunk of the system follows Cedar Creek from Sunset Boulevard under Pacific Highway continuing north until it connects with the Upper Tualatin Interceptor. From this point sewage is transported to the Durham Treatment plant.

insert map

ANALYSIS OF EXISTING SEWER SYSTEM

The population for the City of Sherwood in the year 2008 is estimated to be 7,000 people. The 1979 Sewer Service Plan estimated a population of 10,600 people in the year 2008, and a full-development population within the Sherwood Urban Growth Boundary (UGB) of 18,900 people.

In order to accentuate any deficiencies in the existing sanitary sewer system, peak flowrates were generated based on full development or saturation of the Sherwood UGB. This analysis was used for the following reasons. Maximum design flows for sanitary sewers are far less than peak storm sewer flows. Very often sanitary sewer pipes are sized at a minimum 8-inch diameter for maintenance purposes; consequently the majority of these pipes are flowing at a minimum of their capacity. A full-development demand analysis was the most conservative and efficient way of analyzing the system for all deficiencies.

Wastewater flow criteria for the analysis was taken from USA's 1985 Master Sewer Plan Update and is based on land use designation as listed below:

TABLE VII-2
WASTEWATER FLOW DESIGN CRITERIA
DESIGN UNIT FLOW RATE

LAND USE DESIGNATION	EXISTING	FUTURE
RESIDENTIAL	75 gpcd	75 gpcd
COMMERCIAL	1000 gpad	1000 gpad
INDUSTRIAL	3000 gpad	3000 gpad
INSTITUTIONAL	500 gpad	500 gpad
PEAK ANNUAL	4000 gpad	4000 gpad

The City of Sherwood Zoning Map was used to determine the amount of acreage of each land use designation. This acreage was then applied to tributary basins contributing to their respective sewers and multiplied by the appropriate land use design unit flowrate in order to generate the total design flowrate. An average of residential densities per tributary basin was used to account for the five different residential zoning densities shown on the current City Zoning Map.

The domestic sewage flow allowance for the 1979 Sewer Plan followed the 1969 USA Master Plan value of 90 gallons per capita per day (gpcd). The updated, June 1985 USA Master Plan, has reduced this value to 75 gpcd.

In order to account for periods of maximum use, flowrates are multiplied by factors which result in peak flowrates. The 1979 Sewer Service Plan used peak factors of 3.0 for lateral sewers and 2.7 for trunk sewer lines. The 1985 USA Master Plan Update requires peak factors ranging from 1.5 to 2.0. These lower values are based on actual dry-weather flow monitoring, performed in June and July of 1984, at points throughout the Durham Basin.

The July 1979 Sewer Service Plan used values ranging from 500 gallons per acre per day (gpad) to 700 gpad for inflow and infiltration (I&I), depending on land use designation. These values were concurrent with past EPA design standards and were based on the assumption that rehabilitation measures would remove 60 to 90 percent of excessive I&I. According to USA's 1985 Master Plan these abatement techniques proved to be ineffective. USA's review of the Durham treatment facility led to the design rate of 4000 gpad for the existing peak annual occurrence for infiltration and inflow. This value is not anticipated to decrease for the Durham basin and is therefore also used for the future design flowrates.

Two areas of special concern exist inside the current City of Sherwood UGB. Both areas are recent additions to the UGB and have not yet been assigned a land use. Rather than assume zoning designations for the areas they were both excluded from the model. Both areas can be served by gravity and neither will cause deficiencies in the system. Their service routes are discussed below.

The first area is located in the southwest corner of the UGB in the Cedar Creek Basin, between Pacific Highway and Old Highway 99W. This area can be served by line number 1 in area A (Figure VII-2). The northern half of this area may also be served by connecting to the southern most extension of line number 2 in area B. The second area is located east of Pacific Highway and north of Edy Road, in the Rock Creek Basin. The southern portion should be incorporated in line number 3 extending from Rock Creek west along Edy Road (Figure VII-2). The northern half must be served using a direct lateral to the area from the Rock Creek trunk.

RECOMMENDED IMPROVEMENTS TO EXISTING SEWER SYSTEM

The analysis of the existing system shows no size deficiencies in any of the City maintained pipes. City officials have confirmed that there are areas of surcharge in the system due to pipe under sizing. Surcharge due to blockage of the system has occurred but has since been remedied.

Improvements are recommended to the existing sewer systems main trunk lines. These improvements are required due to very slight slips which occur in the northern sections of the Rock Creek and Cedar Creek main trunk lines.

The Rock Creek trunk requires improvements from manhole number 11663, which is located at the confluence of the Rock Creek and Cedar Creek trunk lines, south to a manhole located near the Southern Pacific crossing of Rock Creek. The existing 18-inch diameter pipe has a length of 6,035 feet and an existing slope of 0.0031 feet/feet. The USA master plan recommends that a 15-inch diameter pipe be placed parallel to the existing 18-inch in order to convey future flows based on 20-year ultimate development peak flowrates. Our analysis is based on total ultimate development of the Sherwood UGB and therefore suggests that an 18-inch diameter pipe parallel the existing 18-inch at the existing slope of 0.0031 feet/feet.

The Cedar Creek Trunk presents similar slope problems along the northern trunk. USA's Master Plan breaks these into three sections but this report will combine them for simplicity. The section of sewer begins at manhole 11663, which is located at the confluence of the Rock Creek and Cedar

Creek trunks, and continues south to manhole number 11752 which is 200 feet south of Edy Road and slightly west of the UGB. (see Fig.1) The entire 12,640 feet of this line is outside of the UGB, and has a slope averaging between 0.0016 feet/feet and 0.0025 feet/feet. Depending on existing slopes a parallel system will be required ranging from 18 to 30-inches in diameter.

insert Figure VII-2

RECOMMENDED SEWER SYSTEM EXPANSION

The City of Sherwood's Urban Growth Boundary includes significant areas that are currently not served by the existing sanitary sewer system. All of these areas are part of either the Rock Creek Basin system or the Cedar Creek Basin system and can be easily served by extending laterals off the respective trunk lines of each basin. These new laterals have no special priority except to serve those who require sewer service. The locations of the recommended sewers are shown on Figure VII-3.

All new sewer lines should have a minimum diameter of 8-inches for ease of serviceability. These new laterals were designed by setting the slope of the sewer pipe invert, equal to the slope of the existing ground along the sewer line path. Individual pipe slopes may be required to be less than natural ground slopes in order to serve isolated areas of low ground elevation.

The sewer expansions are listed below under the basin in which they occur. The costs are listed by pipe diameter and are in 1990 dollars. These costs are typically paid for by the land developments that create the need for the extensions. The costs include design and construction. Land acquisition may be required but those costs are not included in the estimates below.

1.	Sewer Trunk Lines		
	Cedar Creek Parallel (15"-30")	12,640LF	$991,000
	Rock Creek Parallel (18")	6,750 LF	$378,000
2.	Rock Creek Basin Lines (All 8")		
	Tonquin	1400 LF	$ 47,000
	Highland/12th	3000 LF	$100,800
	Tualatin-Sherwood	2300 LF	$ 77,300
	Onion Flats W.	5000 LF	$168,000
	Onion Flats E.	2900 LF	$ 97,500
3.	Cedar Creek Basin Lines (8" except as noted)		
	Steeplechase S. (10")	4100 LF	$160,700
	Steeplechase N. (12")	650 LF	$ 29,100
	Steeplechase N. (10")	4100 LF	$161,000
	E. Sunset	1300 LF	$ 43,700
	W. Sunset	3500 LF	$117,600
	Scholls-Sherwood W.	1200 LF	$ 40,300
	Scholls-Sherwood E.	3100 LF	$104,200
	BPA#	3500 LF	$117,600

insert Figure VII-3

WATER SERVICE PLAN

INTRODUCTION

The City draws the majority of its water supply from the Willamette River Water Treatment Plant (WRWTP) in the City of Wilsonville, approximately 6 miles southeast of Sherwood. The City owns 5 million gallons per day (MGD) of production capacity in the existing WRWTP facilities. Sherwood also maintains four groundwater wells within the city limits for back-up supply. Prior to 2011, the City also purchased water from the Portland Water Bureau (PWB) through the City of Tualatin's water system and maintains an emergency connection and transmission piping associated with this supply source. The Water System Master Plan that provides the supporting documentation to this section is attached as Appendix A to Volume II of the Sherwood Comprehensive Plan.

The City's future water service area is comprised of five different planning areas:
1. Sherwood city limits
2. Tonquin Employment Area (TEA)
3. Brookman Annexation Area
4. West Urban Reserve
5. Tonquin Urban Reserve

Each of these areas has their own land use characteristics, approximate development timelines and existing planning information. Estimates of future growth and related water demand are developed using the best available information for each area including Sherwood buildable lands geographic information system (GIS) data, population growth projections, development area concept plans and current water demand data.

Water demand growth is projected at 10 years, 20 years and at saturation development. Estimated water demands at saturation development are used to size recommended transmission and distribution improvements. .

EXISTING WATER SYSTEM CONDITIONS

Pressure Zones

The City's existing distribution system is divided into three major pressure zones. Pressure zone boundaries are defined by ground topography in order to maintain service pressures within an acceptable range for all customers in the zone. The hydraulic grade line (HGL) of a zone is designated by overflow elevations of water storage facilities or outlet settings of pressure reducing valves (PRVs) serving the zone.

The majority of Sherwood customers are served from the 380 Pressure Zone which is supplied by gravity from the City's Sunset Reservoirs. The 535 Pressure Zone, serving the area around the Sunset Reservoirs, is supplied constant pressure by the Sunset Pump Station, and the 455 Pressure

Zone serves higher elevation customers on the western edge of the City by gravity from the Kruger Reservoir.

Storage Reservoirs

Sherwood's water system has three reservoirs with a total combined storage capacity of approximately 9.0 million gallons (MG). Two reservoirs, Sunset Nos. 1 and 2, provide 6.0 million gallons (MG) of gravity supply to the 380 Pressure Zone. The other reservoir, Kruger Road, provides 3.0 mg of gravity supply to the 455 Pressure Zone.

Pump Stations

Sherwood's water system includes two booster pump stations, the Sunset Pump Station and the Wyndham Ridge Pump Station.

The Sunset Pump Station is located in Snyder Park adjacent to the Sunset Reservoir complex and has an approximate total capacity of 3,770 gallons per minute (gpm). This station provides constant pressure service and fire flow to the 535 Pressure Zone.

The Wyndham Ridge Pump Station is located on SW Handley Street west of Highway 99W. Two 40-hp pumps supply a total capacity of approximately 1,200 gpm from 380 Zone distribution piping to the Kruger Road Reservoir.

Distribution System

The City's distribution system is composed of various pipe materials in sizes up to 24 inches in diameter. The total length of piping in the service area is approximately 77.4 miles. Pipe materials include cast iron, ductile iron, PVC and copper. The majority of the piping in the system is ductile iron.

ANALYSIS OF EXISTING WATER SYSTEM

Water Supply

Sherwood's supply from the WRWTP is sufficient to meet MDD through the 10-year planning horizon with an additional 1 mgd of capacity required at 20 years and an additional 4 mgd needed at build-out. Existing City groundwater wells provide an effective emergency supply to complement emergency storage in the City's reservoirs.

Pumping and Storage

The City's distribution system has adequate storage and pumping capacity to meet existing service area demands through 2034. Due to significant uncertainty related to long-term growth and system expansion, minor storage and pumping deficiencies at build-out should be re-evaluated with the

next Water Master Plan Update or as development warrants. Additional pump stations are recommended to serve proposed high-elevation closed pressure zones in the water service expansion areas: Brookman Annexation and West Urban Reserve.

Distribution Piping

Sherwood's distribution piping is sufficiently looped to provide adequate fire flow capacity to commercial, industrial and residential customers. Few piping improvement projects are needed to meet fire flow criteria. Extensive large diameter mains will be needed to expand the City's water service area to supply the Brookman Annexation, TEA and West Urban Reserve as development occurs.

RECOMMENDED IMPROVEMENTS TO EXISTING WATER SYSTEM

Recommended improvements for the City's water system include proposed supply, pump station and water line projects.

Cost Estimating Data

An estimated project cost has been developed for each improvement project recommended. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The cost estimates presented have an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs.

Capital Improvement Program

A summary of all recommended improvement projects and estimated project costs is presented in Table ES-3 of the 2015 City of Sherwood Water System Master Plan Update. The table provides for project sequencing by showing fiscal year-by-year project priorities for the first five fiscal years, then prioritized projects in 5-year blocks for the 10-year, 20-year and Beyond 20 year timeframes. The total estimated cost of these projects is approximately $24.6 million through FY 2034. Approximately $19.9 million of the total estimated cost is for projects needed within the 10-year timeframe and $5.4 million of these improvements are required in the next 5 years.

F. DRAINAGE PLAN

INTRODUCTION

The Sherwood Planning Area is located within the Willamette River-Tualatin River Basin as identified in the Portland-Vancouver Metropolitan Area Water Resources Study (PMAWRS). The Cedar Creek and Rock Creek sub-basins channel surface runoff to the Tualatin River just north of the Planning Area. Within these sub-basins there exists considerable variation in slope. A highland area known as Washington Hill has some erosion and sedimentation potential. High groundwater and poorly drained soils in portions of the northern half of the Planning Area will require measures to regulate excavation and site drainage.

In March 1989, DEQ issued draft rules for storm water quality control to all jurisdictions in the Tualatin River sub-basin. The City of Sherwood is required to comply with the rules and participate in the development of a Surface Water Drainage Management Plan for the region. When the Plan is completed and adopted this section will be amended accordingly.

Objectives

1. Comply with DEQ Storm water quality control rules until completion of a Drainage Management Plan.

2. Cooperate with United Sewerage Agency, Washington County, and DEQ in the preparation of a Drainage Management Plan.

Findings

1. A storm drainage plan for the City's urban growth area has been developed and is illustrated on Figure VII-7. Major storm sewers are recommended for construction in accordance with the Plan; minor storm sewers are not shown on the proposed storm drainage plan. This Plan will be updated upon completion of the regional Drainage Plan.

2. Cedar Creek, Rock Creek, and Chicken Creek shall continue to be the City's primary conveyance systems for storm runoff.

3. Existing flood areas have been identified and are analyzed and described in Section VII Background Data and Analysis. It is anticipated, all but one of the problem areas will be eliminated by implementation of the Plan. An area of flooding at N.W. 12th Street and Highway 99W remains to be resolved by construction of a minor storm sewer, which is not shown on the Plan.

4. The rational method formula was used to estimate runoff to proposed storm sewers. This method has a tendency to overestimate design flows when applied to large basins. Runoff

coefficients used in the rational method are predicted on the City's Comprehensive Plan. During final design of storm sewers, actual development within the basin should be reviewed to verify previous assumptions in selection of a runoff coefficient.

5. Cost estimates for proposed storm sewer improvements have been prepared, based on 1980 construction costs and increased in 1990 by 1.25%, and on Engineering News Record (ENR) index of 3264. These estimates are presented in Table 2 of the Appendix.

6. Design of relief culverts in Cedar Creek and Rock Creek may significantly alter hydraulic control sections used by the U.S. Army Corps of Engineers to establish water surface elevations and limits of the flood plain as set forth in Flood Insurance Study, City of Sherwood, Oregon, and provided to the City in preliminary draft, dated December 17, 1980. Design of relief culverts should be coordinated with the U.S. Army Corps of Engineers to insure integrity of their flood insurance study.

Implementation

1. The City will endeavor to establish a source of revenue to finance the cost of storm sewer construction, acquisition of lands along creeks, maintenance of storm sewers and waterways, and administration of the storm plan in accordance with the regional Surface Water Drainage Management Plan.

2. Until user fees are in effect, the City should obtain waivers of remonstrance to future storm drainage improvements projects from all property owners wishing to develop their land, and the City should also require all developers to provide adequate storm sewers to serve their property as well as those properties that would naturally drain to the proposed storm sewer.

SOLID WASTE

Solid waste disposal is a regional concern requiring regional solutions. The City of Sherwood recognizes MSD's responsibility and authority to prepare and implement a solid waste management plan and supports the MSD Solid Waste Facilities Model Siting Ordinance and will participate in these procedures as appropriate. There are no landfills in Sherwood.

The Model Siting Ordinance will be incorporated into this Plan when approved by METRO. In addition, the City conducted extensive hearings on solid waste incineration in 1990 and determined incineration is generally not a form of solid waste disposal environmentally compatible in the community except in limited circumstances. Therefore, solid waste incineration is generally prohibited by this Plan.

Electrical Power

The Sherwood Planning Area is well served by major power facilities. Portland General Electric Co. (PGE) runs and operates a major regional sub-station in the northern portion of the Planning

Area and has a network of major transmission lines which cross the Planning Area. Minor sub-station siting and construction, if needed in response to development, will be coordinated with PGE.

Natural Gas

The Sherwood Planning Area is served by Northwest Natural Gas Co. (NNG) lines. The existing system consists of a 6" high pressure line extended to the Planning Area via Tualatin-Sherwood Road, So. Sherwood Blvd. and Wilsonville Road. The distribution system is adequate to serve immediate development. NNG reports that the 6" main will be adequate to serve growth projected by the Plan with new lateral line extensions and attention to proper "looping" of existing lines.

Telephone

General Telephone services the Sherwood Planning Area. Planned improvements should have the capability of handling projected growth demands in the Area.

H. SCHOOLS

INTRODUCTION

The Sherwood Planning Area is wholly contained within Sherwood School District 88J. Although the City of Sherwood is the only currently urbanized area within the district, district boundaries include approximately 44 square miles and parts of Washington, Clackamas, and Yamhill Counties. The District is currently predominately rural but, by the year 2000, the Sherwood Planning Area will contribute most of the total student enrollment.

FUTURE ENROLLMENT/FACILITY NEEDS

The School District completed a School Enrollment Study (Metro Service District Analysis) in the Fall of 1990. Revisions were made in the Spring of 1991. The study data suggests that school enrollments will be increasing sharply in the coming years. The growth assumption is supported by record-setting residential building permit issuance during 1990. Major arterial road improvements between I-5 and 99W will also cause further growth and development.

ELEMENTARY AGE STUDENTS (K-5)

J. Clyde Hopkins Elementary School has a capacity to house 600 students. Currently, 670 students are enrolled in grades K-5. Three double portable classrooms and one single portable classroom are utilized to address the growing elementary age population.

INTERMEDIATE AGE STUDENTS (6-8)

Approximately 300 students are enrolled in grades 6-8. The Intermediate School building capacity is 400 students. This capacity can be accessed by relocating District office services, which occupy a four classroom wing of the building.

HIGH SCHOOL AGE STUDENTS (9-12)

Sherwood High School has a capacity of 500 students. Approximately 420 students are currently enrolled. No major housing issues exist in this 1971 constructed facility.

SCHOOL FACILITY PLANNING

The School District is preparing to undertake a detailed facility development plan. The most immediate need for the District is to expand housing of elementary age school children (K-5). During the Fall of the 1990-91 school year, the District completed the purchase of a new elementary school site located within the City limits of Sherwood. The District also owns a school site (purchased in 1971) in the proximity of the Tualatin portion of the school district.

The intent of the District is to seek voter approval of a bond measure to address short and long-term housing needs. The measure is planned to be submitted in the Fall of 1991 or the Spring of 1992 in order to construct an additional elementary school.

I. PUBLIC SAFETY

POLICE PROTECTION

The City of Sherwood, Washington County and the State Police co-ordinate police protection within the Planning Area. In 1989 the Sherwood Police Force consisted of five officers. In order to meet future demand it is anticipated that the department will need additional patrolmen proportional to the projected increase in population. The State formula for City police protection is one officer per 500 people. The police force should expand accordingly.

FIRE PROTECTION

The Planning Area is wholly contained within the Tualatin Valley Consolidated Fire and Rescue District. One engine house is located within the City. The District feels that present physical facilities will be adequate to serve the projected year 2000 growth in the area with some increase in manpower and equipment. The District currently employs a 5-year capital improvement planning process which is updated annually. The City will co-ordinate its planning with the district to assure the adequacy of fire protection capability in the Planning Area.

J. GENERAL GOVERNMENTAL SERVICES

As a general purpose governmental unit, the City of Sherwood intends to fulfill its responsibilities in the principal areas of general administration, planning, public works, and library services. With expected growth in Sherwood, additional manpower and facilities will be required.

1. Manpower Needs

In 1989 there are currently seventeen (17) City staff in general governmental services. A review of cities which have reached Sherwood's projected five and twenty year growth levels indicate that new staffing will be needed proportional to population increases in most departments. Using this assumption a full-time staff of 15-20 persons will be required by 1985 and a staff of 20-40 will be needed by the year 2000. Most critical immediate needs are in the area of clerical staff to support existing departmental work loads.

2. Space Needs

The City offices, water department, police department, planning department and public works, are currently housed in a remodeled turn-of-the-century house. Although the structure is significant historically and should be saved, it may not meet the long term functional or space needs of a City Hall.

In 1982 the Senior and Community Center was built and provides meeting space for the City Council and Planning Commissions.

K. HEALTH FACILITIES

The local health system is linked to a number of organizations and institutions that can and do affect how it will develop. The latest planning legislation P.L. 93-641 and its recent amendments has placed Health care delivery systems planning are under the auspices of the State Certificate of Need laws and the Federal Health System Agency (HSA) planning regulations. Sherwood is located in the six county Northwest Oregon Health Systems Agency (NOHS) which is charged with reviewing new service proposals, expenditures involving public funds and the development of a health system plan for the area. The first HSA plan was adopted in 1978. State agencies administer HSA regulations. NOHS established subdistricts within the six county service area. Sherwood is located in the south-rural sub-district (see Figure VII-8). The only hospital located in the sub-district is Meridian Park Hospital in Tualatin.

Sherwood is served by various Metropolitan area hospitals depending on local physician affiliations. The City currently has only one doctor with offices in the Planning Area. St. Vincent's Hospital in Beaverton has expressed interest in establishing a satellite clinic in Sherwood.

The City will encourage the decentralization of Metropolitan health care delivery to assure that a broad range of inpatient, outpatient and emergency medical services are available to Sherwood residents. To that end the City will support the location of a St. Vincent's Satellite Center in Sherwood and encourage the appropriate expansion of Meridian Park facilities to meet the growing needs of the Planning Area.

L. SOCIAL FACILITIES AND SERVICES

A broad range of social services will be needed in the Planning Area to serve a growing urban population. Sherwood will continue to depend on metropolitan area services for which the demand does not justify a decentralized center. Multi-purpose social and health services and referral are offered by the Washington County Satellite Center in Tigard. The City will encourage the continued availability of such services.

Sherwood is located in Region 8 of the State Department of Human Resources Service Area and benefits from that agency's services. State services are administered through the County's Washington County office located in Hillsboro. In addition to public social service programs, many private organizations serve the Sherwood area.

The City is particularly interested in locating a multi-purpose social and health service referral agency in Sherwood so that residents of Sherwood would be able to get timely information on the available services. The City also supports the development of a Comprehensive Social and health services delivery plan for the Planning Area to identify gaps in needed services and develop an ongoing strategy for their provision. Of particular concern are day care and senior citizens services.

Day Care

A growing need exists for day care. State standards for the establishment of day care centers are supplemented by City standards. Currently day care has been carried on by churches and small home operations. The City recognizes and supports the proper siting and housing of day care services.

Senior Citizens Services

With an increasing proportion of the Planning Areas population reaching the age of 60, Sherwood will require additional specialized services and facilities for senior citizens. The City was awarded a grant from HUD for a Senior Citizen Community Center was completed in 1982. Community Center functions will be carried out under the authority of the City. It is the intent of the City that the Center be the focus for the Community activities requiring meeting and multi-purpose areas with particular emphasis on Senior Citizens programs and activities.

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Engineers | Planners

City of Sherwood Oregon

CITY OF SHERWOOD

Water System Master Plan Update

DRAFT

FEBRUARY 2015

WATER SYSTEM MASTER PLAN UPDATE

FOR

CITY OF SHERWOOD

FEBRUARY 2015

DRAFT

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EXECUTIVE SUMMARY

Introduction

The purpose of this Water System Master Plan Update is to perform an analysis of the City of Sherwood's (City's) water system and:

- Document water system upgrades, including significant changes in water supply completed since the 2005 Master Plan
- Estimate future water requirements including potential water system expansion areas
- Identify deficiencies and recommend water facility improvements that correct deficiencies and provide for growth
- Update the City's capital improvement program (CIP)
- Evaluate the City's existing water rates and system development charges (SDCs)

This plan complies with water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61.

Study Area

The study area of this planning effort includes the current city limits, the Tonquin Employment Area (TEA), Brookman Annexation area, the West Urban Reserve and a portion of the Tonquin Urban Reserve, which generally includes all area within the City's existing Urban Growth Boundary (UGB).

Planning Period

The planning period for this Water Master Plan Update is 20 years, through the year 2034. Some planning and facility sizing efforts within this plan will use estimates of water demands at saturation development. Saturation development occurs when all the vacant, developable land within the planning area has been developed to the maximum zoning density with some practical allowance for in-fill of existing developed properties.

Water System Background

The City owns and operates a public water system that supplies potable water to all residents, businesses and public institutions within the city limits.

Supply Facilities

The City draws the majority of its water supply from the Willamette River Water Treatment Plant (WRWTP) in the City of Wilsonville, approximately 6 miles southeast of Sherwood. The City owns 5 mgd of production capacity in the existing WRWTP facilities. Sherwood also maintains four groundwater wells within the city limits for back-up supply. Prior to

2011, the City also purchased water from the Portland Water Bureau (PWB) through the City of Tualatin's water system and maintains an emergency connection and transmission piping associated with this supply source.

Pressure Zones

The City's existing distribution system is divided into three major pressure zones. Pressure zone boundaries are defined by ground topography in order to maintain service pressures within an acceptable range for all customers in the zone. The hydraulic grade line (HGL) of a zone is designated by overflow elevations of water storage facilities or outlet settings of pressure reducing valves (PRVs) serving the zone.

The majority of Sherwood customers are served from the 380 Pressure Zone which is supplied by gravity from the City's Sunset Reservoirs. The 535 Pressure Zone, serving the area around the Sunset Reservoirs, is supplied constant pressure by the Sunset Pump Station, and the 455 Pressure Zone serves higher elevation customers on the western edge of the City by gravity from the Kruger Reservoir.

Storage Reservoirs

Sherwood's water system has three reservoirs with a total combined storage capacity of approximately 9.0 million gallons (MG). Two reservoirs, Sunset Nos. 1 and 2, provide 6.0 million gallons (mg) of gravity supply to the 380 Pressure Zone. The other reservoir, Kruger Road, provides 3.0 mg of gravity supply to the 455 Pressure Zone.

Pump Stations

Sherwood's water system includes two booster pump stations, the Sunset Pump Station and the Wyndham Ridge Pump Station.

The Sunset Pump Station is located in Snyder Park adjacent to the Sunset Reservoir complex and has an approximate total capacity of 3,770 gallons per minute (gpm). This station provides constant pressure service and fire flow to the 535 Pressure Zone.

The Wyndham Ridge Pump Station is located on SW Handley Street west of Highway 99W. Two 40-hp pumps supply a total capacity of approximately 1,200 gpm from 380 Zone distribution piping to the Kruger Road Reservoir.

Distribution System

The City's distribution system is composed of various pipe materials in sizes up to 24 inches in diameter. The total length of piping in the service area is approximately 77.4 miles. Pipe materials include cast iron, ductile iron, PVC and copper. The majority of the piping in the system is ductile iron.

Water Demand Projections

Water demand refers to all water required by the system including residential, commercial, industrial and institutional uses. Demands are described using two water use metrics, average daily demand (ADD) and maximum day demand (MDD), in gallons per unit of time such as gallons per day (gpd) or million gallons per day (mgd).

Current Water Demand

For the purposes of this Plan, water production data is used to calculate total water demand in order to account for unmetered water uses. Table ES-1 summarizes the City's current system-wide water demand based on water production data.

Table ES-1
Current Water Demand Summary

Year	ADD (mgd)	MDD (mgd)	Ratio MDD:ADD
2012	1.85	3.85	2.1
2013	1.87	3.83	2.0
Average	1.86	3.84	2.1

Future Water Demand Projections

The City's future water service area is comprised of five different planning areas:

1. Sherwood city limits
2. Tonquin Employment Area (TEA)
3. Brookman Annexation Area
4. West Urban Reserve
5. Tonquin Urban Reserve

Each of these areas has their own land use characteristics, approximate development timelines and existing planning information. Estimates of future growth and related water demand are developed using the best available information for each area including Sherwood buildable lands geographic information system (GIS) data, population growth projections, development area concept plans and current water demand data.

Water demand growth is projected at 10 years, 20 years and at saturation development. Estimated water demands at saturation development are used to size recommended transmission and distribution improvements. Future MDD is projected from estimated future ADD based on the current average ratio of MDD:ADD, also referred to as a peaking factor.

Future demand projections by planning area and pressure zone are summarized in Tables ES-2.

Table ES-2
Future Water Demand Summary

	Current			10-Year (2024)			20-Year (2034)			Saturation Development		
Pressure Zone	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**
City Limits	***8,779***	***1.87***	***3.93***	***9,536***	***2.03***	***4.26***	***9,536***	***2.03***	***4.26***	***9,536***	***2.03***	***4.26***
380	6,857	1.47	3.09	7,447	1.59	3.34	7,447	1.59	3.34	7,447	1.59	3.34
400	149	0.03	0.06	162	0.03	0.06	162	0.03	0.06	162	0.03	0.06
455	816	0.17	0.36	887	0.19	0.40	887	0.19	0.40	887	0.19	0.40
535	957	0.20	0.42	1,039	0.22	0.46	1,039	0.22	0.46	1,039	0.22	0.46
Tonquin Employment Area (TEA)				***238***	***0.05***	***0.11***	***484***	***0.11***	***0.23***	***744***	***0.16***	***0.34***
380	-	-	-	238	0.05	0.11	484	0.11	0.23	744	0.16	0.34
Brookman Annexation				***752***	***0.16***	***0.34***	***1,330***	***0.28***	***0.59***	***1,330***	***0.28***	***0.59***
380	-	-	-	752	0.16	0.34	1,275	0.27	0.57	1,275	0.27	0.57
400 Brookman	-	-	-	-	-	-	55	0.01	0.02	55	0.01	0.02
West Urban Reserve				***235***	***0.05***	***0.11***	***2,066***	***0.43***	***0.90***	***7,974***	***1.70***	***3.57***
380	-	-	-	235	0.05	0.11	1,138	0.24	0.50	4,391	0.94	1.97
455	-	-	-	-	-	-	432	0.09	0.19	1,670	0.36	0.76
475 West	-	-	-	-	-	-	52	0.01	0.02	202	0.04	0.08
630 West	-	-	-	-	-	-	444	0.09	0.19	1,711	0.36	0.76
Tonquin Urban Reserve										***591***	***0.13***	***0.27***
380	-	-	-	-	-	-	-	-	-	591	0.13	0.27
GRAND TOTAL	**8,779**	**1.9**	**3.9**	**10,761**	**2.3**	**4.8**	**13,416**	**2.9**	**6.0**	**20,175**	**4.3**	**9.0**

Planning and Analysis Criteria

Criteria are established for evaluating water supply, distribution system piping, service pressures, storage and pumping capacity and fire flow availability. These criteria are used in conjunction with the water demand forecasts to complete the water system analysis.

The water distribution system should be capable of operating within certain performance limits under varying customer demand and operational conditions. The recommendations of this plan are based on performance criteria developed through a review of State requirements, American Water Works Association (AWWA) acceptable practice guidelines, *Ten States Standards* and the *Washington Water System Design Manual*.

Water System Analysis

Water Supply

Sherwood's supply from the WRWTP is sufficient to meet MDD through the 10-year planning horizon with an additional 1 mgd of capacity required at 20 years and an additional 4 mgd needed at build-out. Existing City groundwater wells provide an effective emergency supply to complement emergency storage in the City's reservoirs.

Pumping and Storage

The City's distribution system has adequate storage and pumping capacity to meet existing service area demands through 2034. Due to significant uncertainty related to long-term growth and system expansion, minor storage and pumping deficiencies at build-out should be re-evaluated with the next Water Master Plan Update or as development warrants. Additional pump stations are recommended to serve proposed high-elevation closed pressure zones in the water service expansion areas: Brookman Annexation and West Urban Reserve.

Distribution Piping

Sherwood's distribution piping is sufficiently looped to provide adequate fire flow capacity to commercial, industrial and residential customers. Few piping improvement projects are needed to meet fire flow criteria. Extensive large diameter mains will be needed to expand the City's water service area to supply the Brookman Annexation, TEA and West Urban Reserve as development occurs.

Recommendations and Capital Improvement Program

Recommended improvements for the City's water system are based on the analysis and findings presented above. These improvements include proposed supply, pump station and water line projects.

Cost Estimating Data

An estimated project cost has been developed for each improvement project recommended. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The cost estimates presented here have an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs.

Capital Improvement Program

A summary of all recommended improvement projects and estimated project costs is presented in Table ES-3. This CIP table provides for project sequencing by showing fiscal year-by-year project priorities for the first five fiscal years, then prioritized projects in 5-year blocks for the 10-year, 20-year and Beyond 20 year timeframes. The total estimated cost of these projects is approximately $24.6 million through FY 2034. Approximately $19.9 million of the total estimated cost is for projects needed within the 10-year timeframe and $5.4 million of these improvements are required in the next 5 years.

Table ES-3
CIP Summary

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Project Category	Project ID	Project Description	CIP Schedule and Project Cost Summary								% Allocated to Growth
			FY1 (2016)	FY2 (2017)	FY3 (2018)	FY4 (2019)	FY5 (2020)	10-Year (2024)	20-Year (2034)	Beyond 20 years	
Supply	S-1	Existing WRWTP upgrades to achieve max 15 mgd capacity				$ 250,000	$ 250,000	$ 500,000			20%
	S-2	WRWTP purchase 5 mgd intake capacity			$ 100,000	$ 150,000	$ 150,000	$ 1,600,000			100%
	S-3	WRWTP treatment expansion - Sherwood 5 mgd share			$ 440,000	$ 550,000	$ 550,000	$ 6,160,000			100%
	S-4	Install hydrants at Wells 3 and 5	$ 25,000								0%
	S-5	Abandon Well 4 and transfer water rights	$ 25,000								0%
		Subtotal	***$ 50,000***	***$ -***	***$ 540,000***	***$ 950,000***	***$ 950,000***	***$ 8,260,000***	***$ -***	***$ -***	
Pump Station	P-1	Proposed 1,600 gpm Ladd Hill Pump Station to serve future 400 Brookman Zone customers							$ 477,000		100%
	P-2	Proposed 2,400 gpm Kruger Pump Station to serve future 630 Zone customers								$ 2,547,000	100%
	P-3	Proposed 1,600 gpm Edy Road Pump Station to serve future 475 Zone customers								$ 1,505,000	100%
		Subtotal	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ 477,000***	***$ 4,052,000***	
Water Main	M-1	Fire flow capacity -Sherwood Senior Center		$ 36,000							0%
	M-2	Fire flow capacity - Norton Ave			$ 92,000						0%
	M-60	Fire flow capacity - June Court				$ 43,000					0%
	M-7	Expansion to Brookman - Loop from prop SW Sherwood PRV to Hwy 99		$ 68,000							100%
	M-8				$ 204,000						100%
	M-9				$ 239,000						100%
	M-29	Expansion to TEA - Loop with existing Oregon Street mains			$ 154,000						100%
	M-30					$ 264,000					100%
	M-31					$ 438,000					100%
	M-32						$ 267,000				100%
	M-33						$ 162,000				100%
	M-34						$ 178,000				100%
	M-3, 4 & 5	10-Year (2024) - upgrade existing mains						$ 300,000			56%
	M-6, 10 to 19B, 35 to 37, 40 to 42	10-Year (2024)						$ 5,275,000			100%
	M-20 to 28, 43 to 45	20-Year (2034)							$ 3,295,000		100%
	M-38, 39, 46 to 59	Beyond 20 years								$ 7,183,000	100%
		Routine Pipe Replacement Program	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 250,000	$ 500,000	$50K annually	57%
		Subtotal	***$ 50,000***	***$ 154,000***	***$ 739,000***	***$ 795,000***	***$ 657,000***	***$ 5,825,000***	***$ 3,795,000***	***$ 7,183,000***	
PRV	V-1	SW Sherwood PRV			$ 150,000						100%
	V-2	Handley PRV						$ 150,000			100%
	V-3	Haide PRV								$ 150,000	100%
	V-4	195th PRV								$ 150,000	100%
		Subtotal	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ 300,000***	
Other		Upgrade SCADA System		$ 75,000							35%
		Subtotal	***$ -***	***$ 75,000***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	
Planning		Update Water Master Plan						$ 150,000	$ 150,000		35%
		Update Water Management and Conservation Plan			$ 150,000				$ 150,000		35%
		Update Vulnerability Assessment						$ 60,000	$ 60,000		35%
		Resiliency Plan	$ 150,000						$ 150,000		35%
		Subtotal	***$ 150,000***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 210,000***	***$ 510,000***	***$ -***	
Capital Improvement Program (CIP) Total			**$ 250,000**	**$ 229,000**	**$ 1,579,000**	**$ 1,745,000**	**$ 1,607,000**	**$ 14,445,000**	**$ 4,782,000**	**$ 11,535,000**	**$ 36,172,000**

Annual Average CIP Cost		
$1,082,000 over 5 years	**$1,985,500 over 10 years**	**$1,231,850 over 20 years**

SECTION 1
INTRODUCTION AND EXISTING WATER SYSTEM

Introduction

The purpose of this Water System Master Plan Update is to perform an analysis of the City of Sherwood's (City's) water system and:

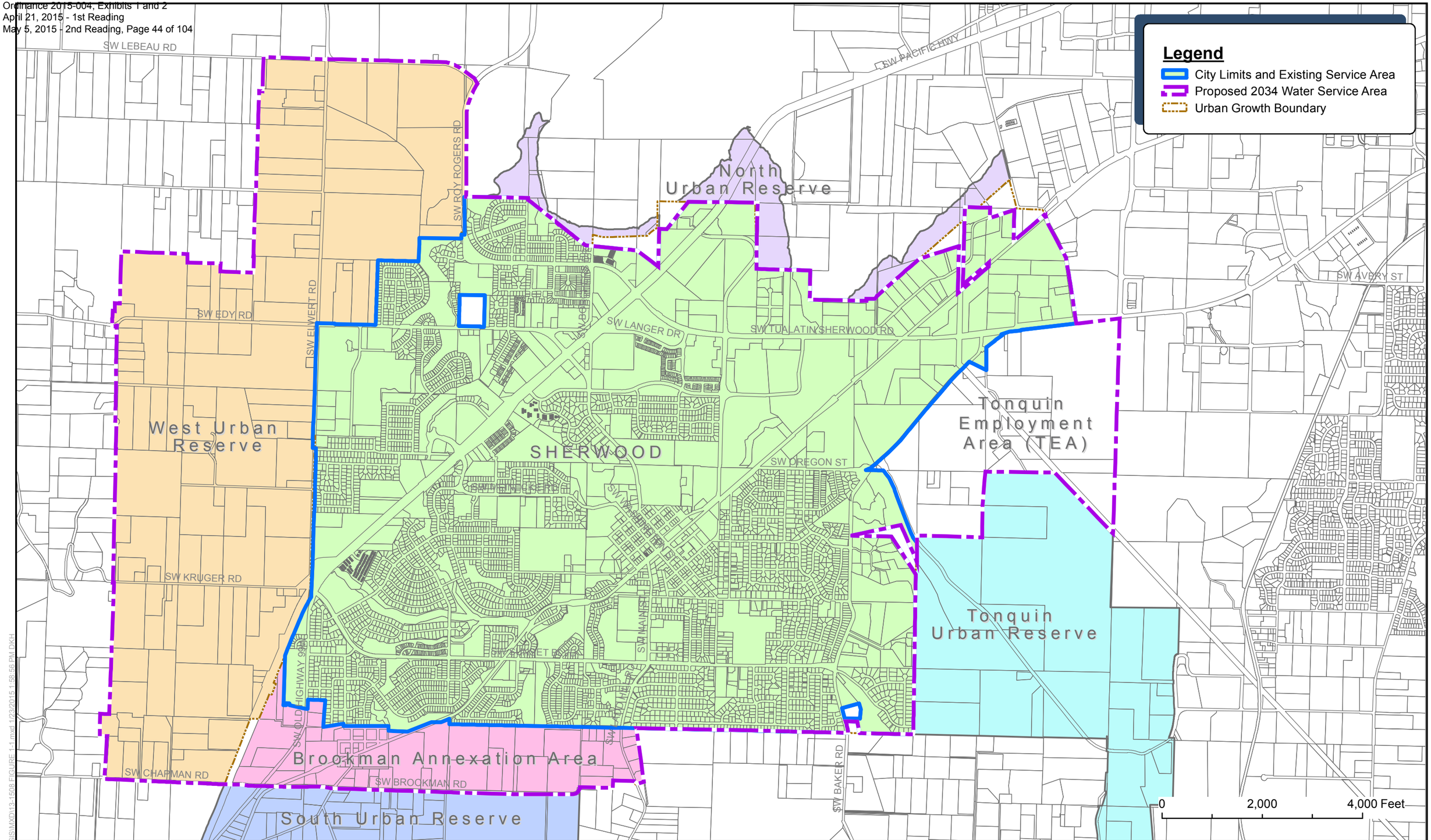
- Document water system upgrades, including significant changes in water supply completed since the 2005 Master Plan
- Estimate future water requirements including potential water system expansion areas
- Identify deficiencies and recommend water facility improvements that correct deficiencies and provide for growth
- Update the City's capital improvement program (CIP)
- Evaluate the City's existing water rates and system development charges (SDCs)

In order to identify system deficiencies, existing water infrastructure inventoried in this section will be assessed based on estimated existing and future water needs developed in Section 2 and water system performance criteria described in Section 3. The results of this analysis are presented in Section 4. Section 5 identifies improvement projects to mitigate existing and projected future deficiencies and provide for system expansion including a prioritized CIP. Section 6 presents the water system financial analysis including an assessment of the City's current water rates and SDCs. The planning and analysis efforts presented in this Master Plan Update are intended to provide the City with the information needed to inform long-term water infrastructure decisions.

This plan complies with water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61.

Study Area

The City's current water service area includes all areas within the current city limits. The study area of this planning effort includes the current city limits, the Tonquin Employment Area (TEA), Brookman Annexation area, the West Urban Reserve and a portion of the Tonquin Urban Reserve. The TEA and Brookman Annexation are within the City's existing Urban Growth Boundary (UGB). Some development in the West and Tonquin Urban Reserves is considered in the future water system analysis in order to provide for anticipated long-term growth. Future jurisdiction of the Tonquin Urban Reserve area is divided between the City of Sherwood and the City of Tualatin with Sherwood serving customers west of SW 124th Avenue. The study area is illustrated in Figure 1-1.



MSA Murray, Smith & Associates, Inc.

City of Sherwood Oregon

Sherwood Water System Master Plan Update

Figure 1-1
Study Area

G:\PDX_Projects\13\1508\GIS\MXD\13-1508 FIGURE 1-1.mxd 1/23/2015 1:58:56 PM DKH

February 2015 13-1508

Water System Background

The City owns and operates a public water system that supplies potable water to all residents, businesses and public institutions within the city limits. This section describes the water service area and inventories the City's water system facilities including existing supply sources, pressure zones, finished-water storage reservoirs, pump stations and distribution system piping.

Plate 1 in Appendix A illustrates the City's water system service area limits, water system facilities and distribution system piping. The water system schematic in Figure 1-2 at the end of this section shows the existing configuration of water system facilities and pressure zones.

Supply Facilities

The City draws the majority of its water supply from the Willamette River Water Treatment Plant (WRWTP) in the City of Wilsonville, approximately 6 miles southeast of Sherwood. Sherwood maintains four wells within the city limits for back-up supply. Prior to 2011, the City also purchased water from the Portland Water Bureau (PWB) through the City of Tualatin's water system.

Willamette River Water Treatment Plant

The Willamette River Water Treatment Plant (WRWTP) in the City of Wilsonville began operating in 2002 using conventional filtration to treat up to 15 million gallons per day (mgd) of Willamette River water for municipal consumption. The facility was developed and funded by Wilsonville and the Tualatin Valley Water District (TVWD). In December 2006, Sherwood purchased 5 mgd of the WRWTP's capacity from TVWD. The plant is currently operated and maintained under contract by Veolia Water, a private contractor.

WRWTP Transmission to Sherwood

Water is supplied from the WRWTP to Sherwood's Sunset Reservoirs through approximately 6.3 miles of 63-inch and 48-inch diameter welded steel pipe. Some segments of the transmission main currently serve both Sherwood and Wilsonville customers with pipe oversizing to accommodate future WTP expansion. Intergovernmental agreements (IGAs) between Sherwood, Wilsonville and TVWD define the capacity in each shared pipe segment that is available to each water provider. Transmission main segment descriptions, lengths, sizes and capacities are summarized in Table 1-1.

Table 1-1
WRWTP-Sherwood Transmission Main

Pipe Segment	From	To	Length (LF)	Dia (in)	Capacity	
					IGA Total (mgd)	Sherwood Share
1	Willamette River WTP	Kinsman Road at Wilsonville Road	4,300	63	70	5 mgd
2	Kinsman Road at Wilsonville Road	Kinsman Road at Barber Road	2,537	48	40	1/2
3A	Kinsman Road at Barber Road	180 feet north of Segment 2	180	48	40	1/2
3B	Segment 3A	Boeckman Road at Kinsman Road	2,400	48	40	1/2
4	Boeckman Road at Kinsman Road	Tooze Road at 110th Avenue	4,185	48	30	2/3
5A	Tooze Road at 110th Avenue	400 feet west of Tooze Road & Grahams Ferry Road	1,461	48	30	2/3
5B	Segment 5A	Revenue Meter Vault (Tooze Road)	198	48	40	1/2
6 thru 9	Revenue Meter Vault (Tooze Road)	Sherwood Sunset Reservoirs	18,000	48		All

Groundwater Wells

Sherwood operates four groundwater wells for back-up supply within the City's water service area. Well Nos. 3, 4, 5 and 6 have a combined production capacity of approximately 3.3 mgd. Liquid sodium hypochlorite is added at each well for disinfection.

Although the wells are currently used for back-up supply only, they are exercised regularly and supplied approximately 6 percent of the City's annual demand in 2013 while Segment 3B of the WRWTP transmission main was completed. City wells are summarized in Table 1-2.

Table 1-2
Groundwater Well Summary

Well No.	Location	Pump Type	Hp	Year Constructed	Production Capacity (gpm)	Approx. Depth (feet)	Casing Dia. (inches)
3	Intersection of Pine and Willamette Street	Vertical Line Shaft Turbine	75	1946	890	319	12
4	17191 Smith Road	Vertical Line Shaft Turbine	60	1969	250	458	14
5	16491 Sunset Boulevard	Vertical Line Shaft Turbine	150	1984	600	800	16
6	1830 Roy Street	Vertical Line Shaft Turbine	75	1997	550 [1]	889	16
				Total Production Capacity (gpm):	**2,290**		
				(mgd):	**3.3**		

[1] *Production capacity is limited to 550 gpm by available water rights.*

Tualatin Emergency Intertie

Sherwood maintains an emergency connection with the City of Tualatin through an approximately 4-mile long, 24-inch diameter Sherwood-owned transmission main. This transmission main begins at the Tualatin Community Park where the Tualatin-Portland supply main connects to the City of Tualatin's distribution system. A pressure reducing valve (PRV) at this connection reduces the hydraulic grade to approximately 385 feet of head for the City of Sherwood.

Prior to 2011 when Sherwood began drawing water from the WRWTP, Sherwood purchased water from the Portland Water Bureau, under an agreement with the City of Tualatin and TVWD, through this 24-inch main. Currently, the City receives a small amount of supply from Tualatin through this main under normal operating conditions to maintain water quality in the main for use in a water emergency.

Pressure Zones

The City's existing distribution system is divided into three major pressure zones. Pressure zone boundaries are defined by ground topography in order to maintain service pressures within an acceptable range for all customers in the zone. The hydraulic grade line (HGL) of a zone is designated by overflow elevations of water storage facilities, discharge pressure of pump stations, or outlet settings of pressure reducing valves (PRVs) serving the zone. Existing pressure zone HGLs, approximate service elevation ranges and related facilities are summarized in Table 1-3. Water system facilities serving each pressure zone are illustrated on Figure 1-2 at the end of this section.

The majority of Sherwood customers are served from the 380 Pressure Zone which is supplied by gravity from the City's Sunset Reservoirs. The 380 Zone can also be served by gravity from the WRWTP, the City's groundwater wells and the Tualatin emergency supply connection. The 535 Pressure Zone, serving the area around the Sunset Reservoirs, is supplied constant pressure by the Sunset Pump Station. The Murdock sub-zone, with an HGL of 400 feet, is served through a PRV from the 535 Zone. The 455 Pressure Zone serves higher elevation customers on the western edge of the City. This zone is served by gravity from the Kruger Reservoir which is filled by pumping out of the 380 Zone at the Wyndham Ridge Pump Station.

Storage Reservoirs

Sherwood's water system has three reservoirs with a total combined storage capacity of approximately 9.0 million gallons (MG). Table 1-3 presents a summary of the City's existing storage reservoirs.

Table 1-3
Reservoir Summary

Reservoir	Location	Capacity (MG)	Overflow Elevation (ft)	Pressure Zone Served
Sunset No. 1	Snyder Park	2.0	380	380
Sunset No. 2	Snyder Park	4.0	383.5	380
Kruger Road	SW Kruger Road west of Highway 99W	3.0	455	455

Sunset Reservoirs

Sherwood's Sunset Reservoirs provide gravity service to the City's largest pressure zone, 380. Both Reservoirs are located at the north end of Snyder Park near the intersection of SW Division and Pine Streets. The 2.0 MG Sunset Reservoir No. 1 is a 105-foot diameter circular, partially buried, cast in place, prestressed concrete reservoir constructed in 1972. Reservoir No. 1 was seismically upgraded in 2005 with more extensive seismic structural improvements, drainage improvements and re-coating completed in 2012. The 4.0 MG Sunset Reservoir No. 2 was constructed in 2009 adjacent to Sunset Reservoir No. 1. Sunset No. 2 is a 155-foot diameter circular, partially buried, cast in place, prestressed concrete reservoir.

Both reservoirs are supplied from the WRWTP through the Sherwood transmission main which terminates at the reservoir site. The reservoirs provide suction supply to the Sunset Pump Station which provides constant pressure service to the 535 Zone. Site piping at

Snyder Park is configured such that either or both reservoirs may be taken out of service for maintenance.

Kruger Road Reservoir

The 3.0 MG Kruger Road Reservoir was constructed in 2002 and is located approximately one-half mile west of Highway 99W, outside of the UGB on the west side of Sherwood. Kruger Road Reservoir is a 130-foot diameter circular, partially buried, cast in place, prestressed concrete reservoir. The reservoir is supplied water from the Wyndham Ridge Pump Station and serves the 455 Pressure Zone by gravity.

Pump Stations

Sherwood's water system includes two booster pump stations, the Sunset Pump Station and the Wyndham Ridge Pump Station. Table 1-4 summarizes the City's existing pump stations.

Table 1-4
Pump Station Summary

Pump Station	Pump No.	Horsepower (Hp)	Capacity (gpm)	Serves
Sunset	1	7.5	120	Constant Pressure to 535 Zone and Murdock Sub-Zone
	2	20	325	
	3	20	325	
	4	100	1500	
	5	100	1500	
Wyndham Ridge	1	40	600	Kruger Road Reservoir and 455 Zone
	2	40	600	
	3	10	N/A[1]	
	4	10	N/A[1]	

[1] *Pumps are not used to supply the Kruger Road Reservoir under normal operating conditions.*

Sunset Pump Station

The Sunset Pump Station is located in Snyder Park adjacent to the Sunset Reservoir complex and houses five vertical turbine pumps with an approximate total capacity of 3,770 gallons per minute (gpm). This station provides constant pressure service and fire flow to the 535 Pressure Zone and the PRV controlled Murdock sub-zone. Site piping at Snyder Park is configured such that suction supply to the station can be provided from either the Sunset Reservoirs or the 380 Zone distribution piping. Sunset Pump Station is equipped with variable frequency drives (VFDs) to meet instantaneous demands and improve operating

efficiency. Back-up power and redundant high capacity pumps capable of supplying adequate fire flow provide resilient operation for this continuously operating station.

Wyndham Ridge Pump Station

The Wyndham Ridge Pump Station is located on SW Handley Street west of Highway 99W and houses four close-coupled, end suction centrifugal pumps. Two 40-hp pumps supply water from 380 Zone distribution piping to the Kruger Road Reservoir. Each of these pumps has a capacity of approximately 600 gpm. Prior to the completion of the Kruger Road Reservoir in 2002, the Wyndham Ridge Pump Station provided constant pressure service to the 455 Zone at a lower HGL using a 5-hp and two 10-hp pumps. The required pumping head to deliver water to the Kruger Road Reservoir and the 455 Pressure Zone exceeds the operating range of these original pumps which are not currently used. The 5-hp pump was removed and the piping and valving reconfigured to allow supply from the 455 Zone to the 380 Zone.

In the event that the Kruger Road Reservoir is taken out of service, the pump station is capable of providing constant pressure service to the 455 Zone. The two 40-hp pumps are equipped with VFDs which will operate to maintain pressure and meet demands in the zone. The pump station is equipped with a 125 kilowatt generator for emergency back-up power.

Distribution System

The City's distribution system is composed of various pipe materials in sizes up to 24 inches in diameter. The total length of piping in the service area is approximately 77.4 miles. Pipe materials include cast iron, ductile iron, PVC and copper. The majority of the piping in the system is ductile iron. Table 1-5 presents a summary of pipe lengths by diameter.

Table 1-5
Distribution System Pipe Summary

Pipe Diameter	Approximate Length (miles)
4-inch or Less	0.7
6-inch	5.0
8-inch	37.2
10-inch	6.9
12-inch	14.0
14-inch	0.9
16-inch	1.8
18-inch	0.8
24-inch	4.3
Total Length	**77.4**

SCADA System

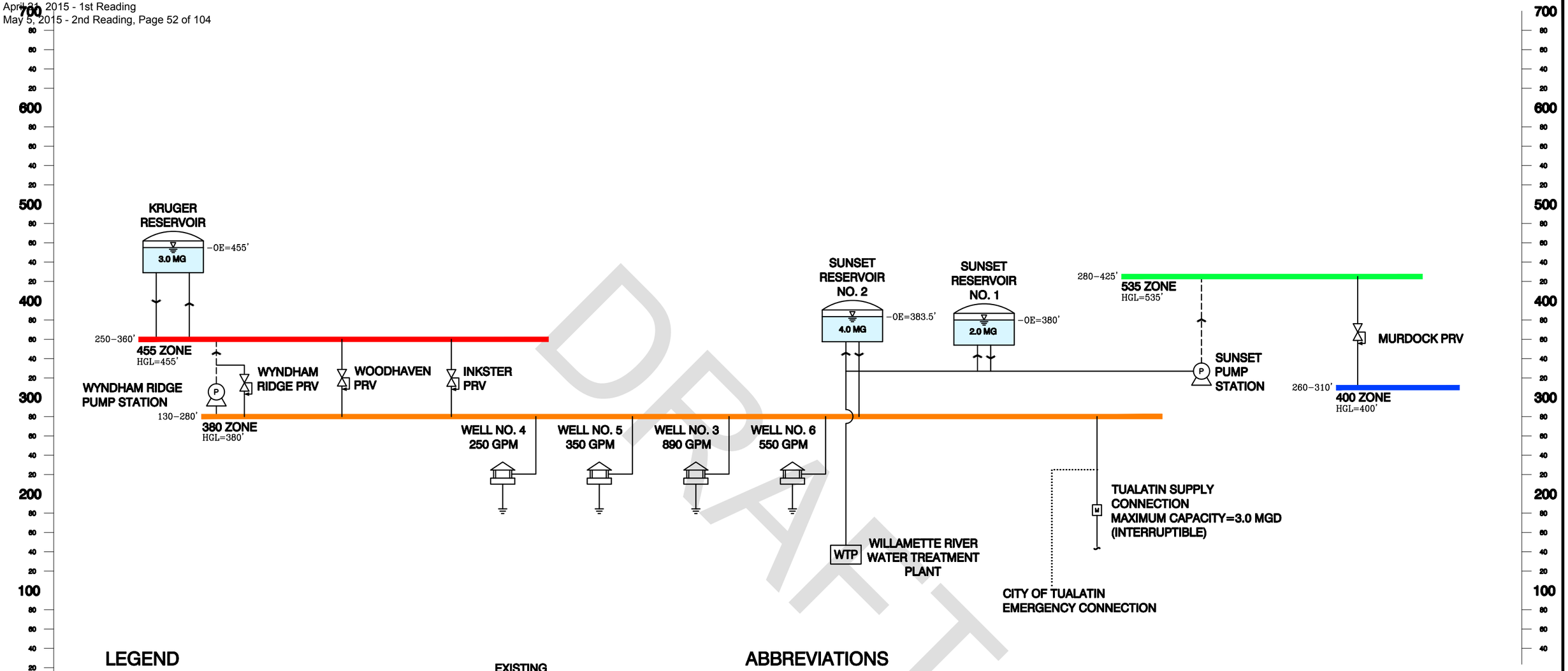
Sherwood's supervisory control and data acquisition (SCADA) system monitors all storage reservoirs, pump stations and wells within the City's water distribution system and provides for manual or automatic control of certain facilities and operations. The SCADA system also collects and stores system status and performance data.

All facilities are equipped with remote telemetry units (RTUs) that monitor reservoir water surface elevations, pump station on/off status and pump station flow rates. In addition, some sites are equipped with intrusion, overflow warning and fire alarms which alert staff to unauthorized access, flooding or fire.

All signals from the RTUs are collected and transmitted to the local operations center and to a Human-Machine Interface (HMI) located at the Public Works complex which enables City staff to view the status of the water system. The system is also capable of automatically dialing City officials 24 hours a day in the event that one of the alarms is triggered at any of the sites. Many of the City's telemetry system facilities have recently been upgraded.

Summary

This section presents a summary of the City of Sherwood's existing water system, including the transmission and supply system, emergency interties, pressure zones, storage and pumping facilities and distribution system piping.



LEGEND

	EXISTING
PUMP DISCHARGE WATER MAIN	-------
WATER MAIN	———
RESERVOIR (CAPACITY IN MG, OVERFLOW ELEVATION IN FEET)	1.0 MG, OE=410'
GROUNDWATER WELL (PRODUCTION CAPACITY IN GPM)	
PRESSURE REDUCING VALVE	
PUMP STATION	P
MASTER METER	M
WATER TREATMENT PLANT	WTP
DISTRIBUTION SYSTEM EMERGENCY INTERTIES	.....

ABBREVIATIONS

GPM	GALLONS PER MINUTE
HGL	HYDRAULIC GRADE LINE
MG	MILLION GALLONS
MGD	MILLION GALLONS PER DAY
OE	OVERFLOW ELEVATION
PRV	PRESSURE REDUCING VALVE

FIGURE 1-2

City of Sherwood Oregon

Water System Master Plan Update

WATER SYSTEM SCHEMATIC

FEBRUARY 2015

MSA

13-1508

SECTION 2
LAND USE AND WATER REQUIREMENTS

This section presents existing and projected future water demands for the City of Sherwood's (City's) water service area. Demand forecasts are developed from current land use, buildable lands data and historical water consumption and production records.

Service Area

The existing water service area is the entire area within the existing city limits. The City's future water system planning area includes the current city limits, the Tonquin Employment Area (TEA), Brookman Annexation Area, West Urban Reserve and a portion of the Tonquin Urban Reserve. The TEA and Brookman Annexation Area are within the City's existing Urban Growth Boundary (UGB). Some development in the West and Tonquin Urban Reserves is considered in the future water system analysis in order to provide for anticipated long term growth. Future jurisdiction of the Tonquin Urban Reserve area is divided between the City of Sherwood and the City of Tualatin with Sherwood serving customers west of SW 124th Avenue.

Future water service expansion areas are divided between existing and proposed future pressure zones based on ground elevations and a service pressure range of 40 to 80 pounds per square inch (psi). Sherwood's existing and future service areas and pressure zones are illustrated on Figure 2-1 at the end of this section.

Planning Period

The planning period for this Water Master Plan Update is 20 years, through the year 2034. Some planning and facility sizing efforts within this plan will use estimates of water demands at saturation development. Saturation development occurs when all the vacant, developable land within the planning area has been developed to the maximum zoning density with some practical allowance for in-fill of existing developed properties. Typically, if substantial water system improvements are required beyond the 20-year planning period in order to accommodate water demands at saturation development, staging is recommended for facilities where incremental expansion is feasible and practical. Unless otherwise noted, recommended improvements identified in this plan are sized for saturation development.

Current Water Demand

Water demand refers to all water required by the system including residential, commercial, industrial and institutional uses. Demands are described using two water use metrics, average daily demand (ADD) and maximum day demand (MDD), in gallons per unit of time such as gallons per day (gpd) or million gallons per day (mgd). ADD is the total annual water volume used in the system divided by 365 days per year. MDD is the largest 24-hour

water volume for a given year. In western Oregon, MDD usually occurs each year between July 1st and September 30th. This timeframe is referred to as the peak season.

Water demand can be calculated using either water consumption or water production data. Water consumption data is taken from the City's customer billing records which do not include unmetered water use such as system flushing and water loss. Water production is the total of all water entering the Sherwood water system including water purchased from the Willamette River Water Treatment Plant (WRWTP), water wheeled through Tualatin from the Portland Water Bureau and water produced at the City's wells.

For the purposes of this Plan, water production data is used to calculate total water demand in order to account for unmetered water uses. Customer consumption and billing records are used to distribute demands throughout the Sherwood water system hydraulic model discussed in Section 4 and to estimate water demand distribution among the City's pressure zones. The historical ratio of MDD:ADD is used to estimate future maximum day demands. Table 2-1 summarizes the City's current system-wide water demand based on water production data.

Table 2-1
Current Water Demand Summary

Year	ADD (mgd)	MDD (mgd)	Ratio MDD:ADD
2012	1.85	3.85	2.1
2013	1.87	3.83	2.0
Average	1.86	3.84	2.1

Water Demand by Pressure Zone

As described in Section 1, water systems are divided into pressure zones in order to provide adequate service pressure to customers at different elevations. Each pressure zone is served by specific facilities, such as, reservoirs or pump stations and related piping which supply pressure to customers. In order to assess the sufficiency of these facilities, it is necessary to estimate demand in each pressure zone. Current water demand based on water production data, as shown in Table 2-1 is distributed between the City's pressure zones based on metered water consumption from utility billing records. Current water demand by pressure zone is summarized in Table 2-2.

Table 2-2
Current Water Demand by Pressure Zone

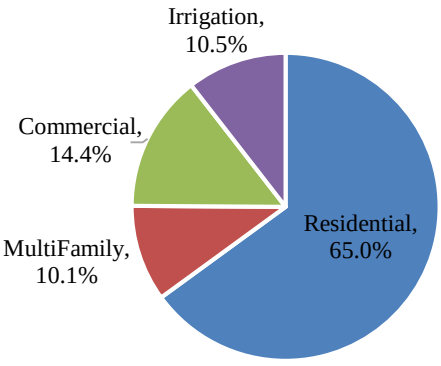
Pressure Zone	ADD (mgd)	MDD (mgd)
380	1.45	2.97
400	0.04	0.07
455	0.18	0.38
535	0.19	0.42
Total	1.86	3.84

Water Consumption by Customer Class

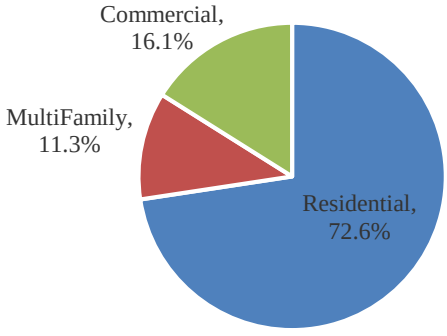
Current water consumption by service type or customer class from the City's billing records is used to correlate water demand to land use type for future demand projections. The City's water utility billing records maintain five service types, Residential, MultiFamily, Commercial, Irrigation and Fireline. Fireline meters are used only in an emergency and are not included in this consumption analysis.

Sherwood's irrigation consumption serves both residential and non-residential properties. It is important to include irrigation use in estimates of future water consumption for properties that are not yet developed. In order to estimate the water need for each customer class including irrigation use, the current annual irrigation demand is distributed to the other three customer classes, Residential, MultiFamily and Commercial, proportional to their share of total annual metered consumption. Current water consumption by customer class is based on a 2-year average of City water billing data from 2012 and 2013. Current water consumption by customer class, including irrigation use, is illustrated in Figure 2-2.

Figure 2-2
Current Annual Water Consumption by Customer Class



with Irrigation independent



with Irrigation included

Commercial Water Demand per Acre

Commercial demand per acre is used to estimate long term future water demands in areas without detailed planning information, such as, the Tonquin and West Urban Reserves and for infill development within the city limits. Current average daily commercial water demand per acre is estimated by associating commercial water consumption to developed commercial and light industrial acreage within the city limits and TEA. Developed commercial acreage is estimated using the City's buildable lands geographic information systems (GIS) data general zoning categories. Estimated commercial average daily water demand is 437 gpd per acre.

Water Demand per Residential Unit

Growth projections developed for the City through previous planning efforts identify the number of future residential units (RUs) anticipated within an area to be developed. In order to forecast future water demands using these estimated future RUs, an average daily water demand (ADD) per RU is established from current water billing data.

ADD per residential unit is calculated as the total annual consumption by single-family residential customers divided by the total number of single-family residential service connections. As previously discussed, the City has a significant number of irrigation meters. Consumption from irrigation meters is distributed to all other customer classes proportional to their annual water use as illustrated in Figure 2-2. Current ADD per RU including irrigation use is approximately 213 gallons per day (gpd/RU) as summarized in Table 2-3. For the purposes of this analysis, ADD per residential unit is anticipated to remain constant in the future.

Table 2-3
ADD per Residential Unit

Annual Water Consumption (gallons)	Residential	370,287,850
	Residential Portion (72.6%) of Irrigation Consumption	43,465,166
	Residential Total	413,753,016
Residential Consumption ADD		1,133,570
No. of Residential Services		5,322
ADD per RU (gpd/RU)		**213**

Future Water Demand Projections

Approach

The City's future water service area, illustrated on Figure 2-1, is comprised of five different planning areas:

1. Sherwood city limits
2. Tonquin Employment Area (TEA)
3. Brookman Annexation Area
4. West Urban Reserve
5. Tonquin Urban Reserve

Each of these areas has their own land use characteristics, approximate development timelines and existing planning information. Estimates of future growth and related water demand are developed using the best available information for each area including Sherwood buildable lands geographic information system (GIS) data, population growth projections, development area concept plans and current water demand data. The buildable lands GIS includes a calculated number of new units for each residentially zoned property and a net acreage for each non-residential property. Each of these values take into account the property's current zoning and development restrictions such as floodplain overlays.

Water demand growth is projected at 10 years, 20 years and at saturation development. Estimated water demands at saturation development are used to size recommended transmission and distribution improvements. Future MDD is projected from estimated future ADD based on the current average ratio of MDD:ADD, also referred to as a peaking factor. From current water demand data shown in Table 2-1, the MDD:ADD peaking factor for the Sherwood system is approximately 2.1.

Forecasted demands are allocated to existing and proposed future pressure zones based on the ground elevations in water service expansion areas and a service pressure range of 40 to 80 pounds per square inch (psi). Existing and proposed pressure zone boundaries for the study area are illustrated on Figure 2-1 and Plate 1 in Appendix A. Future demand projections by pressure zone are summarized in Tables 2-7 and 2-8 at the end of this section.

Sherwood City Limits

Residential services account for the majority of water demand in the City of Sherwood, thus, an estimated annual average population growth rate is used as an indicator of growth in water demand within the current city limits. The regional government Metro projects saturation development will occur within the existing Sherwood city limits in the next 10 years. According to annual population estimates developed for all Oregon cities by the Portland State University Population Research Center (PRC), recent population growth within the Sherwood city limits has occurred at an average rate of less than 0.3 percent annually.

Based on proposed subdivisions and planned unit developments (PUDs) approved by the City in 2012 and 2013, it is assumed that residential growth within the city limits will be slightly accelerated for the next 3 to 5 years as these housing developments are completed. For this analysis, future population growth within the city limits is estimated based on an annual average growth rate of approximately 1.25 percent through 2019 and 0.15 percent after 2019 to saturation development in approximately 2024.

Tonquin Employment Area (TEA)

Growth in the TEA is estimated based on the September 2010 *Tonquin Employment Area Preferred Concept Plan Report* Table IV-1: TEA 20-Year Employment Forecast. This table develops estimates of job density per acre for four sub-areas within the TEA. For the Water Master Plan analysis, it is assumed the TEA will begin developing in sub-areas A and B1 within 5 years and in sub-areas B2 and B3 within 10 years. Development in the TEA is assumed to follow a linear growth pattern based on 20-year development percentages established in Table IV-1 of the *TEA Concept Plan.* For example, the 96.8 acres of light industrial buildable land in sub-area A is anticipated to be 70 percent developed in 20 years. Using a linear growth pattern, light industrial land in sub-area A will be 35 percent developed in 10 years and approximately 17 percent developed within 5 years. Total jobs within the TEA at saturation development (buildout) are also established in Table IV-1.

Future water demand projections in the TEA are based on water use per employee of 45 gallons per day (gpd) for mixed use commercial, office and light industrial development as presented in the *TEA Concept Plan*. This water demand estimate assumes there will be no process water uses in future TEA developments. Growth projections and future water demand estimates for the TEA are summarized in Table 2-4.

Table 2-4
TEA Projected Growth and Future Water Demand

Growth Projection	TEA Sub Area	Total Developed Acres	Total Jobs	ADD (mgd)
5-Year (2019)	A, B1	31.0	490	0.03
10-Year (2024)	All	74.9	1,160	0.05
20-Year (2034)	All	147.0	2,290	0.11
Saturation Development	All	235.2	3,520	0.16

Brookman Annexation Area

Growth projections in the Brookman Annexation Area are developed based on the *2009 Brookman Addition Concept Plan Final Report* and the City's buildable lands GIS data. The concept plan identifies areas for residential, commercial, office and light industrial development within the Brookman Annexation Area. Table 1 Land Use Metrics from the *Brookman Concept Plan* presents an estimated density and total number of jobs within the Brookman Annexation Area at saturation development. The City's buildable lands GIS data for the Brookman area includes an estimated number of residential units at saturation development. Due to the small amount of developable residential land within the existing city limits and the exclusively non-residential, primarily industrial development anticipated within the TEA, it is assumed that the Brookman Annexation Area will reach saturation development within the 20-year planning horizon.

It is assumed that the Brookman Annexation Area will begin developing in five years with an initial 80 households and 300 jobs. The initial number of households is based on existing housing unit counts in the area from the 2010 Census and two new residential developments of 30 to 40 homes. Approximately eight acres of non-residential development would yield 300 jobs based on the density of 35.83 jobs/acre presented in the *Brookman Concept Plan* Table 1. Growth projections at 10 years are based on a linear growth pattern from initial development at five years to saturation at 20 years.

Average daily water demands for future residential development are estimated based an ADD/RU of 213 gpd/RU. Commercial, office and light industrial average daily water demands within the Brookman Annexation Area are based on an average water use per employee of 45 gpd consistent with the *TEA Concept Plan* for these same land uses. All Brookman Annexation Area growth through 2024 is assumed to occur only in the 380 Pressure Zone. Growth projections and future water demand estimates for the Brookman Annexation Area are summarized in Table 2-5.

Table 2-5
Brookman Projected Growth and Future Water Demand

Growth Projection	Non-Residential Developed Acres	Total Jobs	Residential Units	ADD (mgd)
5-Year (2019)	8.4	300	80	0.04
10-Year (2024)	18.6	665	596	0.16
20-Year (2034)	28.7	1,029	1,112	0.28
Saturation Development	28.7	1,029	1,112	0.28

West Urban Reserve

For the purposes of this analysis, future land use within the West Urban Reserve is assumed to mirror the proportion of land use types among developed properties within the current city limits. The proposed 630 West Zone within the West Urban Reserve, as shown on Figure 2-1, is not anticipated to have any industrial development. Percentages of future land use by type have been adjusted to exclude industrial development in this area. 20 percent of land within the West Urban Reserve is assumed to be dedicated to right-of-way, parks and open space with no future water demand.

Due to the small amount of developable residential land within the existing city limits, the exclusively non-residential development anticipated within the TEA, and the assumed build-out of the Brookman Annexation Area, it is assumed that the West Urban Reserve will be approximately one-quarter developed within the 20-year planning horizon. It is assumed that the West Urban Reserve will begin developing in 10 years with an initial 20 acres of non-residential development and 100 residential units. Long term residential development in the West Urban Reserve is anticipated to occur at approximately 10 units per acre based on discussion with City planning staff.

Future water demand in the West Urban Reserve is based on 213 gpd/RU and 437 gpd/acre for non-residential land as developed previously in this section. The West Urban Reserve will be served from the existing 380 and 455 Pressure Zones and proposed 475 West and 630 West Pressure Zones. Initial growth in the West Urban Reserve is assumed to occur only in the 380 Pressure Zone north of SW Handley Street. Growth projections and future water demand estimates for the West Urban Reserve are summarized in Table 2-6.

Table 2-6
West Urban Reserve Projected Growth and Future Water Demand

Growth Projection	Total Residential Units	Developed Non-Residential Acres	ADD (mgd)
10-Year (2024)	150	20	0.05
20-Year (2034)	1,849	93.8	0.44
Saturation Development	7,395	281.5	1.70

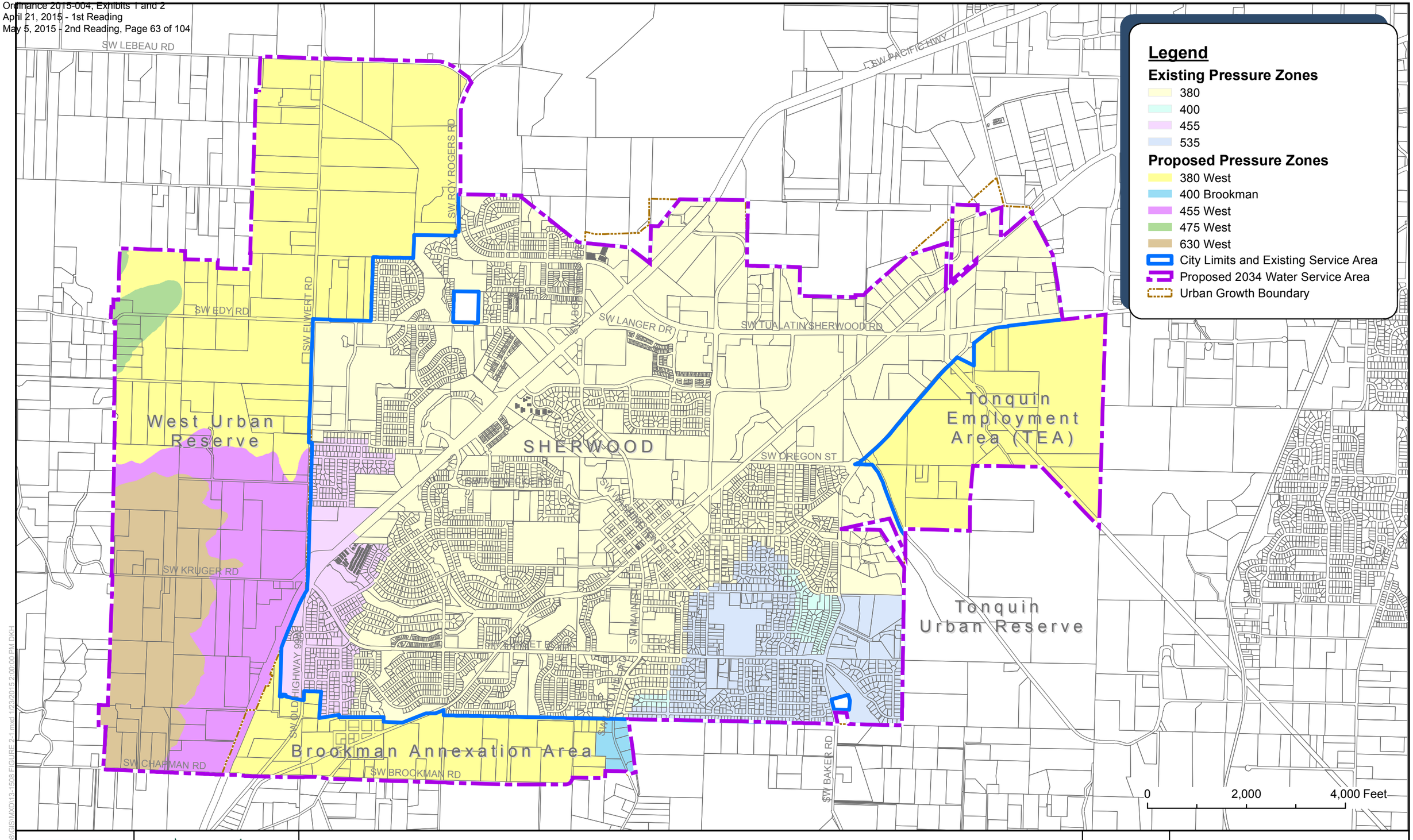
Tonquin Urban Reserve

The Tonquin Urban Reserve is not anticipated to begin development until the end of the 20-year planning horizon. Future land use within the Tonquin Urban Reserve is anticipated to be entirely industrial and commercial, based on conversations with City planning staff. Future water demands are forecast based on 437 gpd/acre as previously presented. The Tonquin Urban Reserve will be served from the existing 380 Pressure Zone.

Equivalent Residential Units (ERUs)

Sherwood's water system serves single-family residential customers as well as commercial customers and multifamily housing developments. Single-family residential water services generally have a consistent daily and seasonal pattern of water use or demand. Water demands for multifamily residences, commercial and industrial users may vary from service to service depending on the number of multifamily units per service or the type of commercial enterprise. In order to establish a common measure of water demand growth for all service types, the water needs of non-residential and multi-family residential customers are represented by comparing their water use volume to the average single-family residential unit. The number of single-family residential units that could be served by the water demand of these other types of customers is referred to as a number of "equivalent residential units" (ERUs).

ERUs differ from actual metered service connections in that they relate all water services to an equivalent number of representative single-family residential services based on typical annual consumption. ERUs calculated here are specific to estimating future water demand and are not the same as dwelling units used in housing studies or comprehensive planning to forecast future population. Demand per ERU in the Sherwood system is 213 gpd/ERU. ERUs are used in the water system financial analysis to distribute anticipated project costs between existing customers and water system growth.



MSA Murray, Smith & Associates, Inc.

City of Sherwood Oregon

Sherwood Water System Master Plan Update

Figure 2-1
Existing and Future Pressure Zones

G:\PDX_Projects\13\1508\GIS\MXD\13-1508 FIGURE 2-1.mxd 1/23/2015 2:00:00 PM DKH

February 2015 13-1508

Table 2-7
Future Water Demand Summary

	Current			10-Year (2024)			20-Year (2034)			Saturation Development		
Pressure Zone	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**
City Limits	***8,779***	***1.87***	***3.93***	***9,536***	***2.03***	***4.26***	***9,536***	***2.03***	***4.26***	***9,536***	***2.03***	***4.26***
380	6,857	1.47	3.09	7,447	1.59	3.34	7,447	1.59	3.34	7,447	1.59	3.34
400	149	0.03	0.06	162	0.03	0.06	162	0.03	0.06	162	0.03	0.06
455	816	0.17	0.36	887	0.19	0.40	887	0.19	0.40	887	0.19	0.40
535	957	0.20	0.42	1,039	0.22	0.46	1,039	0.22	0.46	1,039	0.22	0.46
Tonquin Employment Area (TEA)				***238***	***0.05***	***0.11***	***484***	***0.11***	***0.23***	***744***	***0.16***	***0.34***
380	-	-	-	238	0.05	0.11	484	0.11	0.23	744	0.16	0.34
Brookman Annexation				***752***	***0.16***	***0.34***	***1,330***	***0.28***	***0.59***	***1,330***	***0.28***	***0.59***
380	-	-	-	752	0.16	0.34	1,275	0.27	0.57	1,275	0.27	0.57
400 Brookman	-	-	-	-	-	-	55	0.01	0.02	55	0.01	0.02
West Urban Reserve				***235***	***0.05***	***0.11***	***2,066***	***0.43***	***0.90***	***7,974***	***1.70***	***3.57***
380	-	-	-	235	0.05	0.11	1,138	0.24	0.50	4,391	0.94	1.97
455	-	-	-	-	-	-	432	0.09	0.19	1,670	0.36	0.76
475 West	-	-	-	-	-	-	52	0.01	0.02	202	0.04	0.08
630 West	-	-	-	-	-	-	444	0.09	0.19	1,711	0.36	0.76
Tonquin Urban Reserve										***591***	***0.13***	***0.27***
380	-	-	-	-	-	-	-	-	-	591	0.13	0.27
GRAND TOTAL	**8,779**	**1.9**	**3.9**	**10,761**	**2.3**	**4.8**	**13,416**	**2.9**	**6.0**	**20,175**	**4.3**	**9.0**

Table 2-8
Future Water Demand Summary by Pressure Zone

	10-Year (2024)			20-Year (2034)			Saturation Development		
Pressure Zone	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**	**ERUs**	**ADD (mgd)**	**MDD (mgd)**
380	8,672	1.85	3.90	10,344	2.21	4.64	14,448	3.09	6.49
400	162	0.03	0.06	162	0.03	0.06	162	0.03	0.06
455	887	0.19	0.40	1,319	0.28	0.59	2,557	0.55	1.16
475 West	-	-	-	52	0.01	0.02	202	0.04	0.08
535	1,039	0.22	0.46	1,039	0.22	0.46	1,039	0.22	0.46
400 Brookman	-	-	-	55	0.01	0.02	55	0.01	0.02
630 West	-	-	-	444	0.09	0.19	1,711	0.36	0.76

SECTION 3
PLANNING AND ANALYSIS CRITERIA

This section documents the performance criteria used for water system analysis presented in Section 4 of this Water System Master Plan. Criteria are established for evaluating water supply, distribution system piping, service pressures, storage and pumping capacity and fire flow availability. These criteria are used in conjunction with the water demand forecasts presented in Section 2 to complete the water system analysis.

Performance Criteria

The water distribution system should be capable of operating within certain performance limits under varying customer demand and operational conditions. The recommendations of this plan are based on the performance criteria summarized in Table 3-3. These criteria have been developed through a review of State requirements, American Water Works Association (AWWA) acceptable practice guidelines, *Ten States Standards* and the *Washington Water System Design Manual*.

Water Supply

As described in Section 1, the City of Sherwood (City) draws the majority of its water supply from the Willamette River Water Treatment Plant (WRWTP) in Wilsonville. Supplemental water supply can be provided from Sherwood Well Nos. 3, 4, 5 and 6. The City also has an emergency connection to the Portland Water Bureau's Washington County Supply Line through the City of Tualatin.

Based on current water system operations, the City should plan for adequate supply capacity to provide maximum day demand (MDD) from the WRWTP alone. As discussed later in this section, storage capacity in the City reservoirs and supplemental supply from City wells should provide adequate water in the event of a WRWTP supply or transmission emergency lasting less than 48 hours under average demand conditions.

Service Pressure

Water distribution systems are separated by ground elevation into pressure zones in order to provide service pressures within an acceptable range to all customers. 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 each individual service connection. When it is not feasible or practical to have a separate reservoir for each pressure zone, pump stations or pressure reducing valves (PRVs) are used to serve customers in different pressure zones from a single reservoir.

The maximum service pressure limit is 80 pounds per square inch (psi) as required by the *Oregon Plumbing Specialty Code*. The desired service pressure range under normal operating conditions is 40 to 70 psi. Conformance to this pressure range may not always be

possible or practical due to topographical relief, existing system configurations and economic considerations. Where mainline pressures exceed 100 psi, services must be equipped with individual PRVs to maintain their static pressures at no more than 80 psi. During a fire flow event or emergency, the minimum service pressure is 20 psi as required by Oregon Health Authority, Drinking Water Program (OHA) regulations. Recommended service pressure criteria are summarized in Table 3-1.

Distribution System Evaluation

The distribution system should also be capable of providing the required fire flow to a given location while, at the same time, supplying MDD and maintaining a minimum residual service pressure at any meter in the system of 20 psi as required by OHA regulations. The system should meet this criterion with all equalization storage depleted, booster pump stations operating at firm capacity and flow velocity in the distribution system of less than 10 feet per second (fps).

The distribution system should be capable of supplying peak hourly demands (PHD) while maintaining service pressures within approximately 85 percent of service pressures under average day demand (ADD) conditions but not less than the minimum 40 psi service pressure as shown in Table 3-1. The system should meet this criterion with booster pump stations operating at firm capacity and flow velocity in the distribution system of less than 10 fps.

Table 3-1
Recommended Service Pressure Criteria

Service Pressure Criterion	Pressure (psi)
Normal Range under ADD conditions	40-70
Maximum	80
Minimum under MDD conditions + Fire Flow	20
Minimum under PHD conditions	85% of normal, not less than 40 psi

Main Size

Typically, new water distribution mains should be at least 8 inches in diameter in order to supply minimum fire flows. According to the 2010 *Sherwood Engineering Design Manual*, a minimum 6-inch diameter main is required except 4-inch diameter mains are acceptable on runs less than 300 feet, if no fire hydrant connection is required, there are no more than 8 services on the main and future extension of the main is not anticipated. A 4-inch or 6-inch diameter main may be sufficient under these specific conditions; however, it is recommended that proposed or new water mains be at least 8 inches in diameter to supply adequate fire flows.

Storage Capacity

Sherwood water storage reservoirs should provide capacity for four purposes: operational storage, equalization storage, fire storage, and standby or emergency storage. A brief discussion of each storage element, as defined in the *Washington Water System Design Manual,* is provided below.

Adequate storage capacity must be provided for each pressure zone. Storage volume for pressure zones served through PRVs or by constant pressure pump stations is provided in the upstream pressure zone supplying the PRV or pump station. For instance, Sherwood's Sunset Reservoirs serve customers in the 380 Zone and provide suction supply to the constant pressure 535-Zone Sunset Pump Station which in turn supplies the 400 Zone through the Murdock PRV. Thus, the Sunset Reservoirs must have adequate storage volume to meet the storage criteria for the 380, 535 and 400 Zones.

Operational Storage

Operational storage is the volume of water dedicated to supplying customers while the pumps used to fill the reservoir are "off". Operational storage in the 455 Zone is defined by Kruger Reservoir level set points which signal the Wyndham Ridge pumps to turn on and off. The set points are discussed further in Section 4.

The 380 Zone reservoirs are continuously supplied from the WRWTP making operational storage irrelevant under normal operating conditions. For this analysis, required operational storage for the 380 Zone is assumed to be zero.

Equalization Storage

Equalization storage is required to meet water system demands in excess of delivery capacity from the water supply source to reservoirs serving each pressure zone. Equalization storage volume should be sufficient to supply demand fluctuations throughout the day resulting from typical customer water use patterns and is generally considered as the difference between PHD and MDD on a 24-hour basis.

For pressure zones with a continuously available supply like the 380 Zone's supply from the WRWTP, equalization storage of approximately 25 percent of MDD is sufficient for analysis and planning purposes.

In the 455 Zone, supply to the Kruger Reservoir is provided from only one source, the Wyndham Ridge Pump Station. For pressure zones with a single source of supply to the reservoir, equalization storage is calculated as PHD minus the source capacity operating for 150 minutes.

Fire Storage

Water stored for fire suppression is typically provided to meet the single most severe fire flow demand within each pressure zone. Required fire flow rates and durations based on the 2014 *Oregon Fire Code* (OFC) are discussed later in this section and summarized in Table 3-2. The recommended fire storage volume is determined by multiplying the fire flow rate by the duration of that flow.

Emergency (Standby) Storage

Emergency storage is provided to supply water from storage during emergencies such as pipeline failures, equipment failures, power outages or natural disasters. The amount of emergency storage provided can be highly variable depending upon an assessment of risk and the desired degree of system reliability.

According to standby storage guidelines from the *Washington Water System Design Manual*, water systems with multiple sources, like Sherwood's 380 Zone, should have sufficient storage to supply ADD for 48 hours with the largest source, the WRWTP, out of service. Standby storage for the 380 pressure zone is calculated as two times ADD minus the maximum operational capacity of the City wells operating for 24 hours but not less than 200 gallons per ERU. Standby storage for zones with a single source, like Sherwood's 455 Zone, is calculated as 2 times ADD but not less than 200 gallons per ERU.

Pump Stations

Capacity and Number of Pumps

Pumping capacity requirements vary depending on the water demand, volume of available storage and the number of pumping facilities serving a particular pressure zone. When pumping to storage reservoirs, also referred to as an "open zone", a firm pumping capacity equal to the pressure zone's MDD is recommended. Firm pumping capacity is defined as a station's pumping capacity with the largest pump out of service. A minimum of three pumps at each pump station are recommended for redundancy.

Constant Pressure Pump Stations

Although it is desirable to serve water system customers by gravity from storage, constructing and maintaining a reservoir for a small group of customers may be prohibitively expensive and lead to water quality issues associated with slow reservoir turnover. Constant pressure pump stations supply a pressure zone without the benefit of storage, also referred to as a closed zone. These stations are only recommended for residential developments with a small number of services, preferably in an area that will not be looped back into adjacent pressure zones in the future. Constant pressure stations are commonly used to serve customers at the highest elevations in a water service area where only an elevated reservoir would be capable of providing the necessary head to achieve adequate service pressures by gravity.

Pump stations supplying constant pressure service to closed zones should have firm pumping capacity to meet PHD while simultaneously supplying the largest fire flow demand in the zone.

Backup Power

It is recommended that pump stations supplying gravity storage reservoirs include manual transfer switches and connections for a portable back-up generator. The emergency storage volume in each reservoir will provide short term water service reliability in case of a power outage at the pump station. Back-up power generators with automatic transfer switches are recommended for all constant pressure pump stations serving closed zones without the benefit of gravity storage.

Required Fire Flow

While the water distribution system provides water for domestic uses, it is also expected to provide water for fire suppression. The amount of water required for fire suppression purposes is associated with the local building size and type or land use of a specific location within the distribution system. Fire flow requirements are typically much greater in magnitude than the MDD in any local area. Adequate hydraulic capacity must be provided for these potentially large fire flow demands. Emergency response in the City of Sherwood is provided by Tualatin Valley Fire and Rescue (TVFR). TVFR establishes fire flow requirements for each building within the City. General TVFR fire flow guidelines are described in the TVFR *Fire Code Applications Guideline* consistent with the 2014 OFC. Fire flow requirements by land use type based on these guidelines are summarized in Table 3-2.

Single-Family and Duplex Residential

The OFC and TVFR guidelines specify a minimum fire flow of 1,000 gpm for single-family and two-family dwellings with a square footage less than 3,600 square feet. For residential structures larger than 3,600 square feet, the minimum fire flow requirement is 1,500 gpm. Among currently developed single-family residential properties in the City, approximately 2 percent of homes are 3,600 square feet and larger, based on information available from the regional government Metro. For the purposes of this Plan, residential fire flow capacity will be tested in the water system hydraulic model with a minimum requirement of 1,500 gpm to accommodate the range of potential future residential development in the City.

Medium Density Residential, Office and Neighborhood Commercial

Existing medium density residential development, such as, the Cherry Woods Condominiums have an average building size of approximately 6,900 square feet with four dwellings per building. For the purposes of this Plan, it is assumed that future medium density residential development would involve buildings of similar size. Based on the 2014 OFC requirements adopted by TVFR, a required fire flow of 2,500 gpm is recommended for

medium density residential properties. Properties zoned for neighborhood commercial or office development are anticipated to require similar flows for fire suppression.

High Density Residential, Commercial, Industrial and Institutional

A 3,000 gpm fire flow is recommended for high density residential, commercial and industrial development in Sherwood consistent with TVFR maximum fire flow guidelines. This maximum fire flow requirement is also appropriate for institutional and public facilities, such as, schools or community centers. Fire flow requirements by land use type are summarized in Table 3-2.

Table 3-2
Required Fire Flow Summary

Land Use Type	Applicable Zoning	Required Fire Flow (gpm)	Required Duration (hours)
Single-Family and Duplex Residential	VLDR, LDR	1,500	2
Medium Density Residential, Office and Neighborhood Commercial	MDRL, MDRH, NC, OC	2,500	2
High Density Residential, Commercial, Industrial and Institutional	HDR, RC, GC, EI, LI, GI, IP	3,000	3

Summary

Table 3-3 provides a summary listing of the criteria presented in this Section.

Table 3-3
Water System Performance Criteria

Water System Facility	Evaluation Criterion	Value	Design Standard/Guideline
Water Supply	Supply Capacity	MDD[2]	Ten States Standards and Washington Water System Design Manual
Service Pressure	Normal Range (ADD[1] Conditions)	40-70 psi	AWWA M32
	Maximum	80 psi	AWWA M32, Oregon Plumbing Specialty Code, Section 608.2
	Minimum, during MDD[2] with Fire Flow	20 psi	AWWA M32, OAR 333-061
	Minimum, during PHD[3]	85% of normal, not less than 40 psi	MSA recommended, AWWA M32
Distribution Piping	Velocity during PHD[3] or Fire Flow	Not to exceed 10 fps	AWWA M32
	Minimum Pipe Diameter	8-inch recommended for fire flow, current City standard is 6-inch, except 4-inch for short mains without fire service	MSA recommended, Sherwood Engineering Design Manual
Storage	Total Storage Capacity	Sum of operational, equalization, fire suppression and emergency (standby) storage volumes	Washington Water System Design Manual
	Operational Storage	Kruger Res level set point for 455 Zone, none in 380 or closed[5] zones	
	Equalization Storage	25% of MDD[2]	
	Fire Storage	Required fire flow x flow duration	
	Emergency (Standby) Storage	2 x [ADD[1] – (all but largest supply to the zone x 24 hours)], not less than 200 gallons per ERU	
Pump Stations	Minimum No. of Pumps at Firm Capacity	2	Ten States Standards
	Open Zone Capacity[4]	MDD[2]	Washington Water System Design Manual
	Closed Zone Capacity[5]	PHD[3] + Fire Flow	Washington Water System Design Manual
	Backup Power	At least two independent sources	Ten States Standards
Required Fire Flow and Duration	Single Family and Duplex Residential	1,500 gpm for 2 hours	2014 Oregon Fire Code, Tualatin Valley Fire & Rescue Fire Code Applications Guide
	Medium Density Residential, Office and Neighborhood Commercial	2,500 gpm for 2 hours	
	High Density Residential, Commercial, Industrial and Institutional	3,000 gpm for 3 hours	

[1] *ADD: Average daily demand, defined as the average volume of water delivered to the system during a 24-hour period = total annual demand/365 days per year.*
[2] *MDD: Maximum day demand, defined as the maximum volume of water delivered to the system during any single day.*
[3] *PHD: Peak hour demand, defined as the maximum volume of water delivered to the system during any single hour of the maximum demand day.*
[4] *Open zone is defined as a pressure zone supplied by gravity from a storage reservoir.*
[5] *Closed zone is defined as a pressure zone supplied constant pressure from a booster pump station without the benefit of storage.*

SECTION 4
WATER SYSTEM ANALYSIS

This section presents an analysis of the City of Sherwood's (City's) water distribution system based on criteria outlined in Section 3. The water demand forecasts summarized in Section 2 are used in conjunction with analysis criteria to assess water system characteristics including supply capacity, service pressures, storage and pumping capacity and emergency fire flow availability. This section provides the basis for recommended distribution system improvements presented in Section 5.

Water Supply Analysis

In 2011 Sherwood transitioned their primary water source from the City's groundwater wells to the Willamette River Water Treatment Plant (WRWTP). The City is also able to draw Portland Water Bureau (PWB) supply through a 4-mile long, 24-inch diameter City-owned transmission main from the City of Tualatin's system. An agreement with Tualatin Valley Water District (TVWD) and the City of Tualatin allows Sherwood to purchase up to 3 million gallons per day (mgd) of TVWD's excess capacity in PWB's Washington County Supply Line (WCSL) system and wheel it through the City of Tualatin's transmission to the Tualatin Supply Connection. These agreements expire in 2015.

The City continues to maintain Wells 3, 4, 5 and 6 and the Tualatin Supply Connection. Currently, the City takes a small amount of PWB supply through the Tualatin Supply Connection to maintain drinking water quality in the pipeline for use in a water emergency.

WRWTP Capacity

It is recommended that Sherwood develop adequate source capacity to supply maximum day demand (MDD) from the WRWTP alone. Sherwood's 5 million gallons per day (mgd) share of the WRWTP's existing 15 mgd capacity is adequate to meet forecasted MDD, including projected service area expansion, through the 10-year (2024) planning horizon. It is recommended that the City purchase additional intake capacity and pursue WRWTP expansion within the 20-year planning horizon through existing cooperative agreements with TVWD and the City of Wilsonville. Based on projected MDD and service area expansion presented in Section 2, Sherwood will require a total capacity of approximately 9 mgd from the WRWTP at build out. Future expansion of the WRWTP capacity will likely be through construction of a parallel 15 mgd treatment train. Based on the strong potential for continued growth in Sherwood and anticipated long-term water system expansion into urban reserve areas it is recommended that the City pursue an additional 5 mgd of capacity from the WRWTP. The WRWTP capacity analysis is summarized in Table 4-1.

Table 4-1
WRWTP Supply Capacity Analysis

Timeframe	Capacity (mgd)		
	Recommended Supply Capacity (MDD)	Sherwood's Existing WRWTP Share	Surplus / (Deficit)
Current	3.9	5.0	1.1
10-Year (2024)	4.8	5.0	0.2
20-Year (2034)	6.0	5.0	(1.0)
Build-Out	9.0	5.0	(4.0)

Emergency Supply

In the event of a WRWTP supply or transmission emergency, it is recommended that the City's groundwater wells and storage reservoirs be used to provide adequate emergency water supply to meet average day demands (ADD) for 48 hours.

City Wells

Wells 3, 5 and 6 have an existing combined operational capacity of approximately 1,790 gallons per minute (gpm) (2.6 mgd). Well 5 production capacity is limited to approximately 350 gpm due to foaming in the well caused by air entrainment at higher pumping rates. All of Sherwood's wells are currently inactive. The City does not have a regular schedule for exercising the wells and monthly water quality samples are not currently required. In order to ensure that wells are available as an on-demand emergency source, water operations staff will begin exercising the wells and performing regular water quality testing. To accomplish this, the City must have a means of isolating the well discharge from the distribution system. There is an existing fire hydrant and isolation valve at Well 6 which allows the City to pump Well 6 to atmosphere. It is recommended that a new hydrant and isolation valve be installed at Wells 3 and 5 for this purpose.

The City has expressed interest in abandoning the low-producing Well 4 which would reduce well maintenance costs and potentially allow water rights to be transferred to other City wells which may have additional production capacity. Sherwood could attain additional value by allowing development of the Well 4 property after the well is abandoned. The well site is located in an established residential area along Smith Avenue and, as presented in Section 2, the City has limited developable land available within the existing city limits. For the purposes of this analysis, Well 4 capacity is not considered as an emergency source. Existing well capacities are summarized in Table 4-2.

Table 4-2
Well Capacity Summary

Well	Water Rights Capacity (gpm)	Production Capacity (gpm)
3	900	890
5	673	350
6	550	550
Total	**2,123**	**1,790**

It is not recommended that the City develop additional groundwater wells to meet the emergency supply goal of ADD for 48 hours. This emergency capacity should be provided from emergency storage in the City's reservoirs and from the existing wells. Emergency supply goals and well capacity are summarized in Table 4-3.

Table 4-3
Emergency Supply from City Wells

Timeframe	Emergency Supply Goal: 2 * ADD (mgd)	City Well Production Capacity (mgd)	Deficit to be Supplied from Emergency Storage (mgd)[1]
Current	3.8	2.6	(1.2)
10-Year (2024)	4.6	2.6	(2.0)
20-Year (2034)	5.8	2.6	(3.2)
Build-Out	8.6	2.6	(6.0)

[1] *See Table 4-4 Storage Analysis*

Tualatin Supply Connection

Under the City's supply agreement with TVWD and Tualatin, excess capacity from the PWB wheeled through the WCSL system is interruptible, meaning capacity is only available to Sherwood under certain contractual conditions where surplus supply is available from PWB. Because of this contingent capacity the Tualatin Supply Connection is a less reliable on-demand emergency source than the City's wells. It is not recommended that the City maintain the Tualatin Supply Connection solely as an on-demand emergency source. However, the 24-inch diameter main is a vital link to long-term regional supply and Sherwood may benefit from maintaining a portion of the 24-inch diameter supply line capacity for emergency supply. The remaining capacity could be sold to Tualatin as part of a future WRWTP supply agreement or to provide large diameter looping within Tualatin's distribution system.

Potential Future Supply to Tualatin

The City of Tualatin, which currently receives all of its source water from the WCSL system, is in the process of evaluating their long-term source options and needs. If Tualatin opts to pursue source water from the WRWTP, they may negotiate purchase of plant capacity or wholesale water from Sherwood. The Sherwood-owned 24-inch diameter transmission main would be a key facility to allow supply of WRWTP water through Sherwood to Tualatin's distribution system. It is recommended that Sherwood does not abandon the Tualatin Supply Connection to allow for future supply of WRWTP water to Tualatin. However, the City of Tualatin's current supply agreement with PWB does not expire until 2026 so Tualatin may not make a final decision regarding their long-term water source for several years. It is recommended that Sherwood discontinue taking water through the Tualatin Supply Connection and close valves to isolate the transmission main. The transmission main would need to be disinfected before bringing it back on-line to serve the City of Tualatin if a long-term WRWTP supply agreement is established between the two cities in the future.

The 24-inch diameter Tualatin supply main may also be useful to the City of Tualatin as part of their distribution system regardless of Tualatin's long-term source decisions. Sherwood staff have engaged with Tualatin to determine the potential for mutual benefit of selling or transferring portions of the main.

Pressure Zone Analysis

Sherwood's four existing pressure zones provide adequate service pressures between 40 and 80 pounds per square inch (psi) to all water system customers. The existing 380 and 455 Pressure Zones are open zones, served by gravity from storage facilities. The 535 Zone serves the southeast corner of the City by constant pressure from the Sunset Pump Station. Zones served by constant pressure are also referred to as closed zones. Customers in the 400 Zone are supplied from the 535 Zone through the Murdock pressure reducing valve (PRV). The City's existing and proposed future pressure zones are illustrated on Figure 2-1.

Future 535 Zone Reservoir

The 535 and 400 Zones have approximately 810 existing services. For pressure zones of this size, it is preferable to supply customers by gravity from a storage reservoir rather than through a constant pressure pump station. Supplying customers from storage reduces the risk of a water outage due to mechanical or electrical failure at the pump station and reduces maintenance and power costs associated with pumping.

The City's 2005 Master Plan recommended construction of a storage reservoir to serve the 535 Zone by gravity. However, the nearest site which would meet the elevation requirements for a ground level reservoir is almost a mile south of existing 535 Zone distribution mains along Ladd Hill Road. With the approximately mile-long waterline required to fill the proposed reservoir and the relatively low customer demands in this residential zone, it is likely that water quality issues would develop in the waterline and

reservoir due to minimal water circulation and slow reservoir turnover. Due to potential water quality issues associated with a 535 Zone reservoir and the high cost of constructing a transmission main to serve the proposed reservoir, it is recommended that the 535 Zone continue to be served as a closed zone from the Sunset Pump Station.

Future Service Area Expansion

Brookman Annexation and TEA

As the City's water service area expands to include the Brookman Annexation and Tonquin Employment Area (TEA), it is anticipated that the majority of customers in these areas will be served from the 380 Zone by extending existing distribution mains. A small area along Ladd Hill Road in the southeast corner of the Brookman Annexation is too high in elevation to receive adequate service pressure from the 380 Zone. For master planning purposes, this area is referred to as the 400 Brookman Zone.

400 Brookman Zone

As development occurs, it is recommended that the City evaluate the benefits and risks of serving the 400 Brookman Zone through one of the following methods:

1. A PRV which reduces pressure from existing 535-Zone mains on Highpoint Drive east of Ladd Hill Road

2. A booster pump station which provides constant pressure to the zone and draws suction supply from existing 12-inch diameter 380-Zone distribution mains on Ladd Hill Road at Brookman Road

Although option 1, the PRV from the 535 Zone, seems to be the simplest solution there are additional factors which should be considered. Existing 535-Zone distribution mains on Highpoint Drive dead-end approximately 375 feet west of Ladd Hill Road. In order to provide service to the proposed 400 Brookman Zone, the existing 535-Zone mains would need to be extended or existing 380-Zone mains which already extend west to Ladd Hill Road along Highpoint Drive would need to be re-configured to be part of the 535-Zone.

Extending 535-Zone mains west to Ladd Hill Road may add substantial cost to the PRV solution. In addition, the existing Highpoint Drive right-of-way (R-O-W) does not connect with the Ladd Hill Road R-O-W. Thus, any new 535-Zone mains would need to be constructed within an existing 15-foot wide City of Sherwood easement parallel to existing 8-inch diameter 380-Zone mains. Existing 380-Zone mains provide service to 32 existing homes between 225 and 300-feet elevation along Bowmen Lane and Highpoint Drive. Re-configuring these mains to be part of the 535-Zone would cause significant pressure increases for these existing 32 customers and would likely require individual PRVs at each service. Both of these considerations may increase the project cost of option 1 significantly.

A constant pressure pump station, as described in option 2, requires more maintenance and has a higher operating cost than a PRV. However, capital costs for constructing the pump station may be comparable to option 1 because distribution mains upstream of the proposed pump station would not need to be constructed new or re-configured as described above for the PRV.

For the purposes of this Master Plan, an estimated cost for the booster pump station described in option 2 is included in the CIP presented in Section 5.

West Urban Reserve

Initial anticipated growth in the West Urban Reserve will be served by extending existing 380- and 455-Zone distribution mains. Future customers along the ridge north and south of the existing Kruger Reservoir will be served by constant pressure from the proposed Kruger Pump Station at the existing reservoir site. This proposed closed zone is referred to as the 630 West Zone. Some future customers in the West Urban Reserve at the interface between the 630 West and 455 Zones may need to be served through a PRV-controlled sub-zone or through individual PRVs on each service in order to maintain required service pressures. This area is referred to as the 630 West PRV Zone.

A small area on the western edge of the West Urban Reserve along Edy Road near Eastview Road is too high in elevation to receive adequate service pressure from the adjacent 380 Zone. This area will be served as part of the closed 475 West Zone by constant pressure from the proposed Edy Road Pump Station.

Storage Capacity Analysis

Existing storage reservoirs serve customers in the 380 and 455 Pressure Zones by gravity. All of the City's other existing and proposed pressure zones are supplied either through constant pressure pump stations or PRVs. There must be adequate reservoir volume to meet customer demands in the zone served directly from the reservoir, as well as any smaller zones served through constant pressure pumping or PRVs from the zones with storage. For instance, Sherwood's Sunset Reservoirs serve customers in the 380 Zone and provide suction supply to the constant pressure 535-Zone Sunset Pump Station which in turn supplies the 400 Zone through the Murdock PRV. Thus, the Sunset Reservoirs must have adequate storage volume to meet the storage criteria for the 380, 535 and 400 Zones.

Ideally, the 535 Zone, which supplies a relatively large geographic area, would have dedicated gravity storage. As previously described, due to the City's topography, sites with adequate elevation for a future 535-Zone reservoir are too far away from existing 535 Zone customers to be practical or cost effective.

Storage facilities are provided for four purposes: operational storage, equalization storage, fire storage and emergency or standby storage. As presented in Section 3, the total storage required is the sum of these four elements. Storage volumes are calculated according to the following criteria:

- *Operational Storage*
  - 455 Zone - volume of average Kruger Reservoir level drop between "off" and "on" operation of Wyndham Ridge Pump Station
  - 380 Zone and closed zones - none

- *Equalization Storage* - 25 percent of maximum day demand (MDD)

- *Fire Storage* - largest fire flow demand for each pressure zone multiplied by the duration of that flow

- *Emergency Storage* - 2 times average day demand (ADD) minus the approximate volume of water supplied in 24 hours by all but the largest capacity supply to the zone

Operational Storage

Operational storage is the volume of water dedicated to supplying customers while the pumps used to fill the reservoir are "off". In the 455 Zone, operational storage is managed by City water staff using Kruger Reservoir level set points. These set points signal the Wyndham Ridge pumps to turn on and refill the reservoir when the water level drops to the specified point. Reservoir level set points are adjusted seasonally to mitigate potential water quality issues associated with slow reservoir turnover during periods of low water demand in the fall and winter. For the purpose of this analysis, operational storage in the 455 Zone will be estimated based on a year-round average drop in the Kruger Reservoir level of six feet, approximately 0.6 million gallons (MG).

The 380 Zone's Sunset Reservoirs are continuously supplied from the WRWTP making operational storage irrelevant under normal operating conditions. For this analysis, required operational storage for all zones served by the Sunset Reservoirs is assumed to be zero.

Emergency Storage

The 380 Zone is supplied by both the WRWTP and the City's wells. The WRWTP is the largest supply to the 380 Zone. Thus, emergency storage for the 380 Zone is calculated as 2 times ADD minus the volume of water supplied by City Wells 3, 5 and 6 pumping for 24 hours. The only supply to the 455 Zone is the Wyndham Ridge Pump Station. Although the pump station contains multiple pumps there are emergency situations, such as a break in the suction supply line to the pump station, which would take the entire station out of service.

Thus, for the purpose of calculating required emergency storage volume in the 455 Zone, it is assumed that the entire pump station is out of service.

Storage Analysis Findings

Both the Kruger and Sunset Reservoirs have adequate capacity to meet storage criteria through the 20-year planning horizon. An approximately 0.3 MG storage deficit in 455 Zone at build-out may be mitigated by modifying the Kruger Reservoir average water level drop from 6 feet to 3 feet to reduce the operational storage need. No significant operational challenges are anticipated with this change as increased future demands will reduce the need for this operational strategy to maintain water quality. Under existing conditions the Kruger Reservoir water level is set lower to allow the City to store water at Kruger that has been delivered from the WRWTP but is not immediately needed in the 380 Zone and to mitigate potential water quality issues associated with slow reservoir turnover at Kruger. Increasing water demands due to future growth in both the 380 and 455 Zone will lessen the need to drop the Kruger Reservoir to this lower existing set point.

Despite a 0.61 MG storage deficit at build-out, additional storage is not recommended for the 380 Zone due to the uncertainty of long-term future development over a large area to be served from this zone. Storage capacity in the 380 Zone should be re-evaluated with the next Master Plan update to determine if additional capacity will be needed and to identify the optimal sites for additional storage, if needed. The storage analysis is summarized in Table 4-4.

Table 4-4
Storage Analysis

Storage Component (MG)	Sunset Reservoirs			Kruger Reservoir		
	380, 535, 400, Future 400 Brookman & Future 475 West Pressure Zones			455 & Future 630 West Pressure Zones		
	Existing	2034	Build-Out	Existing	2034	Build-Out
Operational	-	-	-	0.60	0.60	0.60
Equalization	0.87	1.30	1.78	-	0.05	0.25
Fire Suppression	0.63	0.63	0.63	0.63	0.63	0.63
Emergency	1.58	2.38	4.20	0.36	0.74	1.82
TOTAL Required	3.07	4.31	6.61	1.59	2.01	3.30
Existing Storage	6.00	6.00	6.00	3.00	3.00	3.00
Surplus/(Deficit)	**2.93**	**1.69**	**(0.61)**	**1.41**	**0.99**	**(0.30)**

Pump Station Analysis

Closed Zones

The existing Sunset Pump Station and proposed Ladd Hill, Kruger and Edy Road Pump Stations supply constant pressure to customers in existing and future pressure zones without water storage facilities, also referred to as closed zones. Pump stations serving these closed zones are the only means of supplying domestic water demands and fire flow to the zone. Pump stations serving closed zones should have sufficient firm capacity to supply PHD and the highest required fire flow in the primary zone and any PRV-controlled sub-zones. Firm capacity is defined as the nominal pump station capacity with the largest pump out of service.

Open Zones (Supplied by Gravity Storage)

The Wyndham Ridge Pump Station supplies the Kruger Reservoir which serves customers in the 455 Zone by gravity. Pressure zones with the benefit of gravity storage are also referred to as open zones. Operational and fire storage provided by open zone reservoirs such as the Kruger Reservoir make it unnecessary to plan for fire flow or peak hour capacity from pump stations assuming adequate storage is available. Open zone pump stations such as the Wyndham Ridge Pump Station must have sufficient firm capacity to meet the MDD for all customers in the zone and any higher level zones supplied from the primary zone.

Back-Up Power

At least two independent power sources are recommended for the City's pump stations. Back-up power is particularly critical for facilities that serve closed zones through constant pressure pumping. It is recommended that pump stations supplying gravity storage reservoirs include, at a minimum, manual transfer switches and connections for a portable back-up generator. The emergency storage volume in each reservoir will provide short term water service reliability in case of a power outage at the pump station. On-site standby power generators with automatic transfer switches are recommended for all constant pressure pump stations serving closed zones without the benefit of gravity storage. Both of Sherwood's existing pump stations have on-site, diesel powered, backup generators with automatic transfer switches.

Pump Station Analysis Findings

Table 4-5 summarizes the City's existing and future pumping requirements. Existing pump stations have adequate firm capacity to supply customer demands through the 20-year planning period. There is a small firm capacity deficit in the 455 Zone at build-out which may be addressed by replacing one of the existing Wyndham Ridge pumps as development warrants.

Due to the uncertainty of long-term future development, it is recommended that 455 Zone pumping capacity needs beyond 2034 be re-evaluated with the next Master Plan Update. Additional constant pressure pump stations are recommended to supply future proposed pressure zones as development warrants.

Table 4-5
Pump Station Analysis

Pressure Zone	Pumping Criteria	Existing Pump Stations		Firm Pumping Capcity (gpm)					
				Existing		2034		Build-out	
		Name	Firm Capacity (gpm)	Required	Surplus / (Deficit)	Required	Surplus / (Deficit)	Required	Surplus / (Deficit)
535 & 400	PHD + FF	Sunset	2,270	2,078	-	2,114	-	2,114	-
455	MDD	Wyndham Ridge	600	264	-	410	-	806	**206**
Future 400 Brookman	PHD + FF					1,524	**1,524**	1,524	**1,524**
Future 630 West	PHD + FF					1,724	**1,724**	2,397	**2,397**
Future 475 West	PHD + FF					1,524	**1,524**	1,594	**1,594**

Distribution System Analysis

A steady-state hydraulic network analysis model was used to evaluate the performance of the City's existing distribution system and identify proposed piping improvements based on performance criteria described in Section 3. The purpose of the model is to determine pressure and flow relationships throughout the distribution system for average and peak water demands under existing and projected future conditions. Modeled pipes are shown as "links" between "nodes" which represent pipeline junctions or pipe size changes. Diameter, length and head loss coefficients are specified for each pipe and an approximate ground elevation is specified for each node.

The hydraulic model was developed prior to the Water System Master Plan using the InfoWater modeling software platform and geographic information system (GIS) base mapping. Building on the facilities identified in the prior model and updated facility and operations data provided by the City, analysis scenarios were created to evaluate existing and projected 20-year demand conditions.

Modeled Demands

Existing and projected future demands are summarized in Table 2-7. Within the existing city limits, demands are assigned to the model based on customer billing records and meter locations provided by the City. Future demands in water service expansion areas such as the Brookman Annexation, TEA and West Urban Reserve are assigned uniformly over each proposed pressure zone area shown in Figure 2-1.

Fire Flow Analysis

Fire flow scenarios test the distribution system's ability to provide required fire flows at a given location while simultaneously supplying MDD and maintaining a minimum residual service pressure of 20 psi at all services. Required fire flows are assigned based on the zoning surrounding each node as summarized in Table 3-2.

Since the 2005 Master Plan, the City has invested in large diameter loops through developing commercial areas and small projects to provide additional looping for fire flow in residential areas. As a result, very few fire flow deficiencies were identified under existing and projected future MDD conditions.

Peak Hour Demand Analysis

Distribution system pressures were evaluated under peak hour demand conditions to confirm identified piping improvements. Peak hour demands (PHD) were estimated as 1.7 times the maximum day demand. No additional deficiencies were identified under these conditions.

Summary

Section 4 presents an analysis of Sherwood's water supply capacity and distribution system performance. Criteria outlined in Section 3 and water demand forecasts summarized in Section 2 are used to assess water system characteristics including service pressures, storage and pumping capacity and emergency fire flow availability. Proposed facilities to mitigate deficiencies are discussed in Section 5 and illustrated on Plate 1 Water System Map in Appendix A.

Sherwood's supply from the WRWTP is sufficient to meet MDD through the 10-year planning horizon with an additional 1 mgd of capacity required at 20 years and an additional 4 mgd needed at build-out. Existing City groundwater wells provide an effective emergency supply to complement emergency storage in the City's reservoirs.

The City's distribution system has adequate storage and pumping capacity to meet existing service area demands through 2034. Due to significant uncertainty related to long-term growth and system expansion, minor storage and pumping deficiencies at build-out should be re-evaluated with the next Water Master Plan Update or as development warrants. Additional pump stations are recommended to serve proposed high-elevation closed pressure zones in the water service expansion areas Brookman Annexation and West Urban Reserve.

Sherwood's distribution piping is sufficiently looped to provide adequate fire flow capacity to commercial, industrial and residential customers. Few piping improvement projects are needed to meet fire flow criteria. Extensive large diameter mains will be needed to expand the City's water service area to supply the Brookman Annexation, TEA and West Urban Reserve as development occurs.

SECTION 5
RECOMMENDATIONS AND CAPITAL IMPROVEMENT PROGRAM (CIP)

This section presents recommended improvements for the City of Sherwood's (City's) water system based on the analysis and findings presented in Section 4. These improvements include proposed supply, pump station and water line projects. The capital improvement program (CIP) presented in Table 5-3 later in this section summarizes recommended improvements and provides an approximate schedule for project completion. Proposed distribution system improvements are illustrated on Plate 1 Water System Map in Appendix A and on Figure 5-1, Proposed Water System Schematic at the end of this section.

Cost Estimating Data

An estimated project cost has been developed for each improvement project recommended in this section. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The Association for the Advancement of Cost Engineering International (AACE) classifies cost estimates depending on project definition, end usage and other factors. The cost estimates presented here are considered Class 4 with an end use being a study or feasibility evaluation and an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed.

Estimated project costs are based upon recent experience with construction costs for similar work in Oregon and southwest Washington and assume improvements will be accomplished by private contractors. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs. Estimates do not include the cost of property acquisition. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News-Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For purposes of future cost estimate updating; the current ENR CCI for Seattle, Washington is 10162 (August 2014).

Water System Capital Improvement Program

A summary of all recommended improvement projects and estimated project costs is presented in Table 5-3. This CIP table provides for project sequencing by showing fiscal year-by-year project priorities for the first five fiscal years, then prioritized projects in 5-year blocks for the 10-year, 20-year and Beyond 20 year timeframes.

The City's fiscal year begins July 1st and ends June 30th. Fiscal years are designated by the year in which they end. For example, fiscal year (FY) 2016 includes the period from July 1, 2015 through June 30, 2016. The 10-year project timeframe includes projects recommended for completion between 6 and 10 years (FY 2021 through FY 2024). The 20-year timeframe

includes projects recommended for completion between 11 and 20 years (FY 2025 through FY 2034).

CIP Cost Allocation to Growth

Water system improvement projects are recommended to mitigate existing system deficiencies and to provide capacity to accommodate growth and service area expansion. Projects that benefit future water system customers by providing capacity for growth may be funded through system development charges (SDCs). SDCs are sources of funding generated through development and water system growth and are typically used by utilities to support capital funding needs. SDCs are determined as part of a financial evaluation and are based in part on a utility's current CIP. To facilitate the Financial Analysis presented in Section 6, a percentage of the cost of each project which benefits future water system growth is allocated in the CIP table. Percentages allocated to growth are described later in this section for each type of recommended facility and summarized in the CIP Table 5-3.

Water Supply Projects

WRWTP

S-1 Existing Plant Upgrades

The City currently owns 5 million gallons per day (mgd) of the WRWTP's current 15 mgd capacity. As part of previous WRWTP studies, Sherwood and Wilsonville have determined that two improvement projects related to surge mitigation and disinfectant contact time (CT) are needed at the plant in order to deliver the current 15 mgd capacity. Sherwood's share of these improvements is approximately $500,000 for each project. The surge mitigation project needs to be completed in order to achieve 12 mgd plant capacity. Estimated costs for this project are included in the CIP distributed over fiscal years 2019 and 2020. CT improvements are needed to achieve 15 mgd plant capacity. The CT project is included in the CIP in the 10-year timeframe. Costs for both projects are allocated 80 percent to existing customers based on Sherwood's existing maximum day demand (MDD) of 4 mgd of the total 5 mgd Sherwood capacity from the WRWTP. The remaining 20 percent of project cost is allocated to system growth.

S-2 and S-3 Plant Expansion

To meet long-term supply needs, it is recommended that the City pursue purchase of 5 mgd of additional capacity in the WRWTP's oversized intake facilities (S-2). The estimated $2 million purchase cost for an additional 5 mgd of intake capacity is based on individual treatment plant component costs from the City's 2006 contract with TVWD for the purchase of an initial 5 mgd of capacity at the WRWTP.

It is further recommended that Sherwood pursue expansion of the WRWTP treatment facilities (S-3) to secure a total capacity of 10 mgd from the plant. The cost of plant

expansion is estimated based on the 2005 WRWTP Master Plan which identified improvements required to expand plant capacity by 50 mgd at an estimated 2005 cost of approximately $900,000 per mgd without contingency. Project cost for Sherwood's proposed 5 mgd share of plant expansion is estimated at $7.7 million including a 45 percent allowance for administration, engineering and contingency adjusted to 2014 dollars using the ENR CCI for Seattle described previously. An update of the 2005 WRWTP Master Plan is currently being completed and will include an update and refinement of these cost estimates. It is recommended that the City update plant expansion costs in the Sherwood CIP when that study is complete.

It is recommended that the City pursue both projects within the 20-year planning horizon in order to mitigate an estimated 1 mgd supply deficit in 2034. Based on the City's discussions with their WRWTP partner City of Wilsonville, expansion of treatment facilities will need to be completed within the 10-year timeframe in order to meet Wilsonville's forecasted demands. It is anticipated that design and engineering of the WRWTP expansion will begin within fiscal year 2018 with the majority of construction occurring within the 10-year timeframe. 20 percent of estimated costs for treatment plant expansion and future intake capacity purchase are distributed over the 2018, 2019 and 2020 fiscal years with the remaining 80 percent assigned to the 10-year timeframe. Project costs for this supply expansion are allocated 100 percent to growth.

City Wells

S-4 Hydrants at Wells 3 and 5

In order to maintain the City's groundwater wells as an on-demand emergency source, the City must have a means of isolating well water from the distribution system for exercising the well pumps and taking water quality samples. There is an existing fire hydrant and isolation valve at Well 6 which allows the City to pump Well 6 to atmosphere. It is recommended that a new hydrant and isolation valve be installed at Wells 3 and 5 for this purpose within fiscal year 2016. Emergency capacity from all of the City's wells is only sufficient to benefit existing customers, thus the estimated cost of this project is allocated entirely to existing customers.

S-5 Well 4 Abandonment and Water Rights Transfer

It is recommended that the City abandon the low-producing Well 4. Well 4 water rights may be eligible for transfer to one of Sherwood's other existing wells. Approximately $25,000 is allocated in the CIP to abandon Well 4 and apply for a water rights transfer to other City wells. For the purposes of this analysis it is assumed that the City's total well capacity for emergency supply will be from Wells 3, 5 and 6 not including any capacity from Well 4 or water rights transferred from Well 4. The Well 4 project is recommended for completion in fiscal year 2016. Emergency capacity from all of the City's wells is only sufficient to benefit existing customers, thus the estimated cost of this project is allocated entirely to existing customers.

Pump Station Projects

Sherwood's existing pumping facilities are adequate to meet customer demands in the 455 and 535 Pressure Zones through the 20-year planning horizon. Due to significant uncertainty regarding the nature of future development in the West Urban Reserve, a deficiency in the 455 Zone at build-out is recommended to be re-evaluated with the next Master Plan update or as development warrants. No pump station projects are currently recommended to mitigate this 455 Zone deficiency. Additional pumping facilities are recommended to serve proposed future constant pressure (closed) zones outside of the City's existing service area.

Estimated project costs for proposed pump stations are allocated 100 percent to growth as all of the proposed stations are intended to serve future development outside of the existing Sherwood water service area.

P-1 Ladd Hill Pump Station

The 1,600 gpm Ladd Hill Pump Station is proposed to serve future customers along Ladd Hill Road in the proposed 400 Brookman Zone. The proposed pump station, illustrated on Plate 1 in Appendix A, will boost water from existing 380 Zone distribution mains on Ladd Hill Road at Brookman Road to provide customers with constant pressure service at an hydraulic grade line (HGL) of approximately 400 feet. The pump station is proposed for construction within the 20-year timeframe.

P-2 Kruger Pump Station

The 2,400 gpm Kruger Pump Station is proposed to serve future high-elevation customers west of Kruger Reservoir in the proposed 630 West Zone. The proposed pump station, located on the same site as the existing Kruger Reservoir, will boost water from the reservoir to provide customers with constant pressure service at an HGL of approximately 630 feet. The pump station is proposed for construction beyond 20 years as development warrants.

P-3 Edy Road Pump Station

The 1,600 gpm Edy Road Pump Station is proposed to serve future high-elevation customers along Edy Road near the western boundary of the West Urban Reserve in the proposed 475 West Zone. The proposed pump station, illustrated on Plate 1 in Appendix A, will boost water from proposed 380 Zone distribution mains (M-54 and -55) on Edy Road west of Chicken Creek to provide customers with constant pressure domestic and fire flow service at an HGL of approximately 475 feet. The pump station is proposed for construction beyond 20 years as development warrants.

During the pump station pre-design process, it is recommended that the City evaluate providing fire flow to future 475 West Zone customers from the nearby 380 Zone proposed distribution mains. Providing fire flow from the 380 Zone would allow a significant

reduction in the proposed Edy Road Pump Station capacity thereby reducing construction and long-term maintenance costs for this station.

Distribution Main Improvement Projects

Table 5-2 presents prioritized water distribution main project recommendations for fire flow capacity and system expansion including estimated project costs and cost allocations to future growth. All recommended water main projects are illustrated on Plate 1 in Appendix A. Water main project costs are estimated based on unit costs by diameter shown in Table 5-1.

Table 5-1
Unit Cost for Water Main Projects

Pipe Diameter	Cost per Linear Foot
6-inch	$160
8-inch	$180
10-inch	$210
12-inch	$250

Assumptions:

1. Ductile iron pipe with an allowance for fittings, valves and services
2. Surface restoration is assumed to be asphalt paving
3. No rock excavation
4. No dewatering
5. No property or easement acquisitions
6. No specialty construction included

Projects for Fire Flow

As presented in Section 4, analysis using the City's water system hydraulic model revealed that minimal piping improvements are needed to provide sufficient fire flow capacity within the existing water service area under existing and projected future demand conditions. Some water main projects identified in the 2005 Sherwood Water System Master Plan were eliminated from the CIP based on the 2014 analysis. This was primarily due to the availability of more refined data in 2014 and completion of major piping improvement projects since 2005. Water main projects recommended for fire flow capacity serve only existing developed areas, thus estimated project costs are allocated 100 percent to existing customers.

Projects for Future System Expansion

Large diameter distribution main loops are needed to serve the currently undeveloped Brookman Annexation, TEA and West Urban Reserve. Proposed water main projects to serve future development in Brookman and TEA are adapted from their respective concept

plans and prioritized according to the projected development timelines provided in the concept plans. Proposed water main projects to serve potential growth in the West Urban Reserve are aligned with existing roadways where possible and highest priority is given to areas with adjacent existing development which will be served from the existing 380 and 455 Pressure Zones.

Cost Allocation to Growth for System Expansion Projects

Estimated costs for projects which are recommended to replace existing pipes in order to serve system expansion areas are allocated to growth based on the ratio of existing and proposed future replacement pipe diameter. The flow area of the existing pipe size is considered to be serving existing system demands and benefiting existing customers. Any capacity beyond the existing pipe size is allocated to growth based on flow area. This cost allocation applies to recommended water main replacement projects M-3, M-4 and M-5.

Costs for all other water main projects recommended to facilitate water system expansion to the Brookman Annexation, TEA and West Urban Reserve are 100 percent allocated to growth.

Routine Pipe Replacement Program

In addition to distribution main projects to address capacity deficiencies, the City should plan for replacement of pipes based on a 100-year life cycle. It is recommended that routine pipe replacement be prioritized as follows:

1. Known pipe capacity and condition issues
2. Pipe material – based on City record of pipe material and era of manufacture
    - Highest priorities are galvanized pipe and post-1950 cast iron
3. Pipe age – coordinate replacement of pipes 50 years or older with other City utilities and transportation (City, County or State) projects

Sherwood has experienced substantial growth and city boundary expansion over the last few decades, as a result much of the City's water system is less than 30 years old. Based on a 100-year replacement cycle, none of this infrastructure would need to be replaced for 70 years, well beyond the planning horizon of this Master Plan Update. However, it is recommended that the City allocate funds for a long term pipe replacement program.

Based on the lengths and diameters of the City's oldest existing pipe, those mains within the 1960 city limit boundary, and input from City staff it is recommended that Sherwood allocate approximately $50,000 annually for routine pipe replacement. Estimated costs for the pipe replacement program are allocated to future growth based on the ratio of existing to projected build-out demands.

PRV Projects

Two new pressure reducing valves are recommended, as development warrants, to provide an emergency connection between the existing 455 Zone distribution mains and future 380 Zone mains on Elwert Road at Handley Street and on Old Highway 99W at the Brookman Annexation boundary. Two additional PRVs are recommended, as development warrants, to provide an emergency connection between the future 630 West Pressure Zone and 455 Zone future expansion in the West Urban Reserve. Project costs for all four PRVs are allocated 100 percent to growth.

SCADA System Upgrade

A Supervisory Control and Data Acquisition (SCADA) system is a computer and communication system which provides critical real-time information and data recording to inform both immediate and long-term water system operations decisions. The SCADA system monitors water facility performance with measures, such as, system pressure, reservoir water level and pump on/off status as well as entry alarms for security at drinking water reservoirs and pump stations. Based on experience with similar water providers in the region, equipment becomes more difficult to maintain and repair 10 to 15 years after installation as SCADA technology advances leading to increasing maintenance effort and cost. The City's current SCADA system is over 10 years old. It is recommended that the City upgrade their existing SCADA system in fiscal year 2017. Estimated costs for the proposed upgrade are allocated to future growth based on the ratio of existing to 20-year projected demands. It is assumed that the SCADA system would likely need to be upgraded again at the end of the 20-year planning horizon.

Planning Projects

It is recommended that the City update this Water System Master Plan within the next 6 to 10 years and again at 20 years. An update may be needed sooner if there are significant changes to the City's water service area, supply or distribution system which are not currently anticipated.

To comply with Oregon Water Resources Department (OWRD) requirements for groundwater permit holders Sherwood is required to complete an update of their Water Management and Conservation Plan (WMCP) every 10 years. The next update of the City's WMCP is expected to begin in fiscal year 2018.

The City intends to update the existing Water System Vulnerability Assessment within the next 10 years to identify any additional security measures or operations procedures which may be needed to protect water facilities. It is assumed that this assessment update will be repeated at 20 years.

Sherwood staff have identified the need for a local water system resilience plan to achieve the seismic response and recovery goals for Willamette Valley water utilities presented in the

Oregon Resilience Plan. It is recommended that the City begin developing this plan in the next year.

Estimated costs for future water system planning projects are allocated to future growth based on the ratio of existing to 20-year projected demands.

Summary

This section presented recommendations for improvement and expansion projects in the City's supply system, pump stations and distribution mains. As presented in Table 5-3, the total estimated cost of these projects is approximately $24.6 million through FY 2034. Approximately $19.9 million of the total estimated cost is for projects needed within the 10-year timeframe and $5.4 million of these improvements are required in the next 5 years.

Table 5-2
Water Main Projects

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CIP ID	Project Description	Project Purpose	Diameter (in)	Total Project Length (ft)	Timeframe	Estimated Project Cost	% Allocated to Growth
M-1	Upgrade 6-inch fire line to Sherwood Senior Center (21907 Sherwood Boulevard) from Sherwood Boulevard	Commercial Fire Flow	8	196	FY2 (2017)	$ 36,000	0%
M-2	Upgrade 6-inch main along Norton Street from Willamette Street south to fire hydrant at Forest Avenue	Residential Fire Flow	8	507	FY3 (2018)	$ 92,000	0%
M-3	Upgrade 8-inch main along Sanders Terrace from Inkster Drive to Maidenfern Lane	Fire flow to Brookman Expansion	12	487	10-Year (2024)	$ 122,000	56%
M-4	Upgrade 8-inch main along Maidenfern Lane from Sanders Terrace to Middleton Road, open NCV at 18191 Maidenfern to transfer services from 455 to 380 Zone		12	381	10-Year (2024)	$ 96,000	56%
M-5	Upgrade 8-inch main along Middleton Road from Maidenfern Lane to city limits, close valve at Middleton & Maidenfern to transfer services from 455 to 380 Zone		12	325	10-Year (2024)	$ 82,000	56%
M-6	Install new main along Middleton Road from city limits south to 24312 Middleton Road	Brookman Expansion - 380 Zone	12	884	10-Year (2024)	$ 221,000	100%
M-7	Install new main along Old Hwy 99W from existing dead end south of Crooked River Lane to proposed Southwest Sherwood PRV (V-1)		12	268	FY3 (2018)	$ 68,000	100%
M-8	Install new main along Old Hwy 99W from proposed Southwest Sherwood PRV (V-1) across Goose Creek		12	813	FY4 (2019)	$ 204,000	100%
M-9	Install new main along proposed Goose Creek arterial from Old Hwy 99W northwest to Hwy 99W		8	1,325	FY4 (2019)	$ 239,000	100%
M-10	Install new main along proposed Goose Creek arterial from Old Hwy 99W southeast to Brookman Road		12	1,246	10-Year (2024)	$ 312,000	100%
M-11	Install new main along Middleton Road from Brookman Road north to 24312 Middleton Road		12	517	10-Year (2024)	$ 130,000	100%
M-12	Install new main along Brookman Road from Middleton Road east to 16655 Brookman Road		12	1,223	10-Year (2024)	$ 306,000	100%
M-13			12	1,233	10-Year (2024)	$ 309,000	100%
M-14			12	2,414	10-Year (2024)	$ 604,000	100%
M-15	Install new main from 16655 Brookman Road northeast to 24100 Ladd Hill Road		12	1,382	10-Year (2024)	$ 346,000	100%
M-16	Install new main along Ladd Hill Road from 24100 Ladd Hill Road north to Brookman Road		12	255	10-Year (2024)	$ 64,000	100%

Table 5-2
Water Main Projects

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CIP ID	Project Description	Project Purpose	Diameter (in)	Total Project Length (ft)	Timeframe	Estimated Project Cost	% Allocated to Growth
M-17	Install new main along proposed roadway running north-south at 17433 Brookman Road	Brookman Expansion - 380 Zone	12	1,726	10-Year (2024)	$ 432,000	100%
M-18	Install new main from proposed roadway through 17433 Brookman Road, across Cedar Creek to Redfern Drive		12	1,537	10-Year (2024)	$ 385,000	100%
M-19A	Install new main from Redfern Drive east to Brookman Road	Brookman Expansion - 380 Zone	8	565	10-Year (2024)	$ 102,000	100%
M-19B	Install new main along Brookman Road to Ladd Hill Road		8	995	10-Year (2024)	$ 180,000	100%
M-20	Install new main along Old Hwy 99W from proposed Goose Creek arterial southwest to Brookman Road		8	878	20-Year (2034)	$ 159,000	100%
M-21	Install new main along Brookman Road from Old Hwy 99W west to Hwy 99W		8	627	20-Year (2034)	$ 113,000	100%
M-22	Install new main along Hwy 99W from Brookman Road north to proposed Goose Creek arterial		8	1,678	20-Year (2034)	$ 303,000	100%
M-23	Install new mains along proposed roadways for system looping in the Brookman Annexation area		8	860	20-Year (2034)	$ 155,000	100%
M-24			8	2,254	20-Year (2034)	$ 406,000	100%
M-25			8	412	20-Year (2034)	$ 75,000	100%
M-26	Install new mains along Ladd Hill Road from proposed Ladd Hill Pump Station (P-1) south of Brookman Road	Brookman Expansion - 400 Zone	12	288	20-Year (2034)	$ 73,000	100%
M-27			12	498	20-Year (2034)	$ 125,000	100%
M-28	Extend proposed Ladd Hill main (M-27) south to southern boundary of Brookman Annexation		12	453	20-Year (2034)	$ 114,000	100%
M-29	Extend Cipole Road main south from Tualatin Sherwood Road to proposed TEA water main backbone	TEA Expansion - 380 Zone	10	731	FY3 (2018)	$ 154,000	100%
M-30	Install new mains to form TEA water main backbone running northeast to southwest across TEA parallel to Oregon Street		10	1,256	FY4 (2019)	$ 264,000	100%
M-31			12	1,750	FY4 (2019)	$ 438,000	100%
M-32	Install new main across 21600 Oregon Street property to TEA water main backbone		10	1,267	FY5 (2020)	$ 267,000	100%
M-33	Extend proposed Cipole Road main (M-29) southeast to proposed 124th Avenue roadway extension south of Tualatin Sherwood Road		10	768	FY5 (2020)	$ 162,000	100%

Table 5-2
Water Main Projects

DRAFT

CIP ID	Project Description	Project Purpose	Diameter (in)	Total Project Length (ft)	Timeframe	Estimated Project Cost	% Allocated to Growth
M-34	Install new main along proposed 124th Avenue roadway extension south of Tualatin Sherwood Road contiuing south to proposed collector road running west to east across TEA	TEA Expansion - 380 Zone	10	843	FY5 (2020)	$ 178,000	100%
M-35	Install new main from intersection of Dahlke Lane & Oregon Street southeast to TEA water main backbone		10	1,530	10-Year (2024)	$ 322,000	100%
M-36	Install new main from TEA water main backbone east to 124th Avenue roadway extension at proposed collector road		12	1,695	10-Year (2024)	$ 424,000	100%
M-37	Extend proposed TEA water main backbone (M-31) south to serve TEA concept plan area B(2)		12	1,161	10-Year (2024)	$ 291,000	100%
M-38	Install new main parallel to the south side of the Bonneville Power Easement from Oregon Street to the TEA water main backbone at Dahlke Lane	TEA Expansion - 380 Zone	12	1,347	Beyond 20 years	$ 337,000	100%
M-39	Install new main from Tualatin Sherwood Road west of Cipole Road south to TEA water main backbone		10	942	Beyond 20 years	$ 198,000	100%
M-40	Extend Edy Road 12-inch 380 Zone main west to Elwert Road		12	870	10-Year (2024)	$ 218,000	100%
M-41	Install new main along Elwert Road from Edy Road south to 21615 Elwert Road	West Expansion - 380 Zone	12	1,323	10-Year (2024)	$ 331,000	100%
M-42	Install new main along Elwert Road from 21615 Elwert Road to connect with existing 455 Zone piping through proposed Handley PRV (V-2)		12	1,191	10-Year (2024)	$ 298,000	100%
M-43	Extend existing 12-inch 455 Zone main along Hwy 99W from the intersection of Hwy 99W & Kruger Road southwest across Goose Creek to 23975 Hwy 99W	West Expansion - 455 Zone	12	2,908	20-Year (2034)	$ 727,000	100%
M-44	Install new main from 23975 Hwy 99W west to proposed 195th PRV (V-4)		12	1,533	20-Year (2034)	$ 384,000	100%
M-45	Install new main from existing 18-inch 455 Zone Kruger Road main south to connect with 455 distribution extension (M-44) near proposed 195th PRV (V-4)		12	2,642	20-Year (2034)	$ 661,000	100%
M-46	Extend existing 10-inch 380 Zone main along Roy Rogers Road north across Chicken Creek bridge to Scholls Sherwood Road	West Expansion - 380 Zone	12	3,168	Beyond 20 years	$ 792,000	100%
M-47	Install new main along Scholls Sherwood Road from Roy Rogers Road west to Elwert Road		12	3,088	Beyond 20 years	$ 773,000	100%

Table 5-2
Water Main Projects

DRAFT

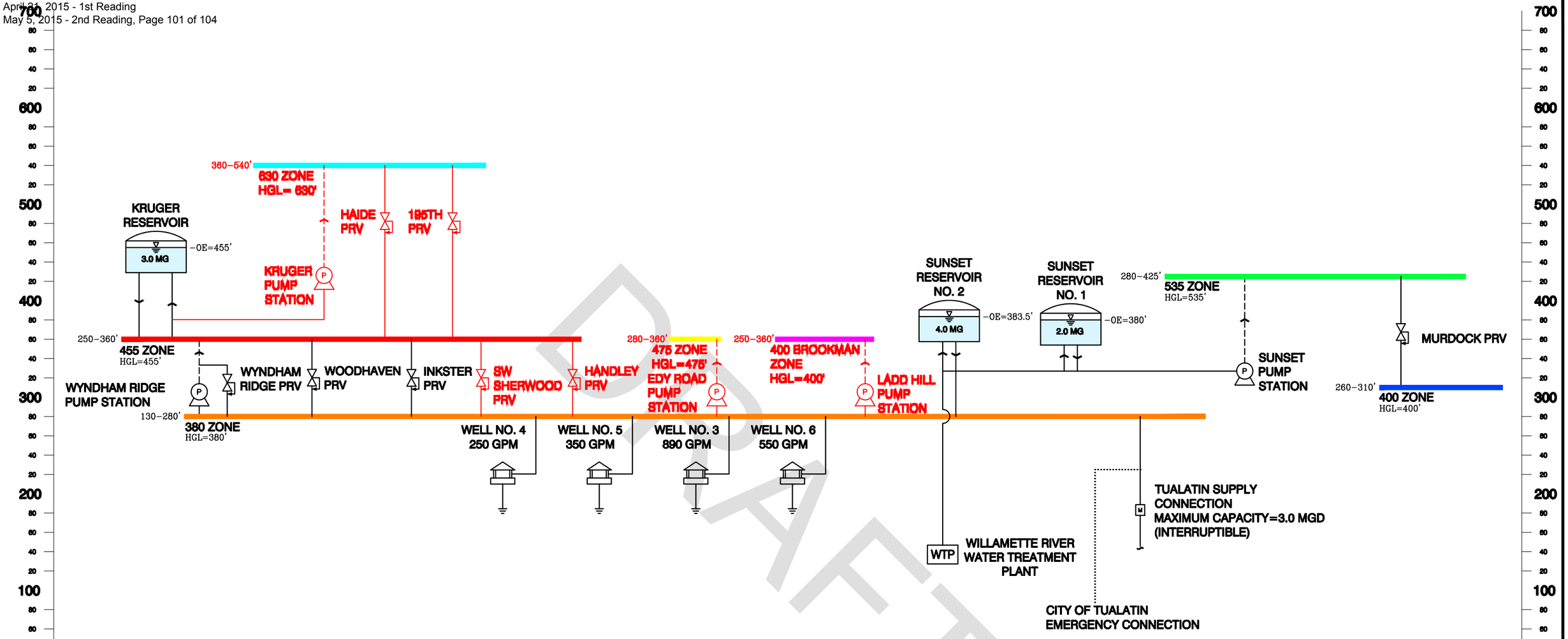
CIP ID	Project Description	Project Purpose	Diameter (in)	Total Project Length (ft)	Timeframe	Estimated Project Cost	% Allocated to Growth
M-48A	Install new main along Elwert Road from Scholls Sherwood Road south to Conzelmann Road	West Expansion - 380 Zone	12	2,640	Beyond 20 years	$ 660,000	100%
M-48B	Install new main along Elwert Road from Conzelmann Road south across Chicken Creek to Edy Road		12	2,640	Beyond 20 years	$ 661,000	100%
M-49	Install new main along Haide Road from Elwert Road west to proposed Haide PRV (V-3)	West Expansion - 455 Zone	12	2,658	Beyond 20 years	$ 665,000	100%
M-50	Install new main from existing 18-inch 455 Zone Kruger Road main north to connect with Haide Road 455 distribution extension (M-49)		12	1,998	Beyond 20 years	$ 500,000	100%
M-51	Install new main along Kruger Road from proposed Kruger Pump Station (P-2) west to serve future West Urban Reserve customers in proposed 630 Zone	West Expansion - 630 Zone	12	750	Beyond 20 years	$ 188,000	100%
M-52	Install new mains from proposed Kruger Road 630 Zone main (M-51) north to loop with proposed 455 Zone mains on Haide Road through proposed Haide PRV (V-3)		12	1,615	Beyond 20 years	$ 404,000	100%
M-53			12	1,230	Beyond 20 years	$ 308,000	100%
M-54	Extend proposed 380 Zone main along Edy Road from Elwert Road west across Chicken Creek to proposed Edy Road Pump Station (P-3)	West Expansion - 380 Zone	12	1,978	Beyond 20 years	$ 495,000	100%
M-55			12	970	Beyond 20 years	$ 243,000	100%
M-56	Install new mains from proposed Kruger Road 630 Zone main (M-51) south to loop with proposed 455 Zone mains through proposed 195th PRV (V-4)	West Expansion - 630 Zone	12	1,387	Beyond 20 years	$ 347,000	100%
M-57			12	1,434	Beyond 20 years	$ 359,000	100%
M-58			12	559	Beyond 20 years	$ 140,000	100%
M-59	Install new main along Edy Road west of proposed Edy Road Pump Station (P-3) to serve future West Urban Reserve customers in proposed 455Booster Zone	West Expansion - 475 Zone	12	452	Beyond 20 years	$ 113,000	100%
M-60	Upgrade existing 2-inch main on June Court from Cochran Avenue to existing dead end, add fire hydrant at end of cul-de-sac	Residential Fire Flow	6	263	FY4 (2019)	$ 43,000	100%
					Total Cost	**$ 18,198,000**	

Table 5-3
CIP Summary

DRAFT

Project Category	Project ID	Project Description	CIP Schedule and Project Cost Summary								% Allocated to Growth
			FY1 (2016)	FY2 (2017)	FY3 (2018)	FY4 (2019)	FY5 (2020)	10-Year (2024)	20-Year (2034)	Beyond 20 years	
Supply	S-1	Existing WRWTP upgrades to achieve max 15 mgd capacity				$ 250,000	$ 250,000	$ 500,000			20%
	S-2	WRWTP purchase 5 mgd intake capacity			$ 100,000	$ 150,000	$ 150,000	$ 1,600,000			100%
	S-3	WRWTP treatment expansion - Sherwood 5 mgd share			$ 440,000	$ 550,000	$ 550,000	$ 6,160,000			100%
	S-4	Install hydrants at Wells 3 and 5	$ 25,000								0%
	S-5	Abandon Well 4 and transfer water rights	$ 25,000								0%
		Subtotal	***$ 50,000***	***$ -***	***$ 540,000***	***$ 950,000***	***$ 950,000***	***$ 8,260,000***	***$ -***	***$ -***	
Pump Station	P-1	Proposed 1,600 gpm Ladd Hill Pump Station to serve future 400 Brookman Zone customers							$ 477,000		100%
	P-2	Proposed 2,400 gpm Kruger Pump Station to serve future 630 Zone customers								$ 2,547,000	100%
	P-3	Proposed 1,600 gpm Edy Road Pump Station to serve future 475 Zone customers								$ 1,505,000	100%
		Subtotal	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ 477,000***	***$ 4,052,000***	
Water Main	M-1	Fire flow capacity -Sherwood Senior Center		$ 36,000							0%
	M-2	Fire flow capacity - Norton Ave			$ 92,000						0%
	M-60	Fire flow capacity - June Court				$ 43,000					0%
	M-7	Expansion to Brookman - Loop from prop SW Sherwood PRV to Hwy 99		$ 68,000							100%
	M-8				$ 204,000						100%
	M-9				$ 239,000						100%
	M-29	Expansion to TEA - Loop with existing Oregon Street mains			$ 154,000						100%
	M-30					$ 264,000					100%
	M-31					$ 438,000					100%
	M-32						$ 267,000				100%
	M-33						$ 162,000				100%
	M-34						$ 178,000				100%
	M-3, 4 & 5	10-Year (2024) - upgrade existing mains						$ 300,000			56%
	M-6, 10 to 19B, 35 to 37, 40 to 42	10-Year (2024)						$ 5,275,000			100%
	M-20 to 28, 43 to 45	20-Year (2034)							$ 3,295,000		100%
	M-38, 39, 46 to 59	Beyond 20 years								$ 7,183,000	100%
		Routine Pipe Replacement Program	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 250,000	$ 500,000	$50K annually	57%
		Subtotal	***$ 50,000***	***$ 154,000***	***$ 739,000***	***$ 795,000***	***$ 657,000***	***$ 5,825,000***	***$ 3,795,000***	***$ 7,183,000***	
PRV	V-1	SW Sherwood PRV			$ 150,000						100%
	V-2	Handley PRV						$ 150,000			100%
	V-3	Haide PRV								$ 150,000	100%
	V-4	195th PRV								$ 150,000	100%
		Subtotal	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 150,000***	***$ -***	***$ 300,000***	
Other		Upgrade SCADA System		$ 75,000							35%
		Subtotal	***$ -***	***$ 75,000***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	***$ -***	
Planning		Update Water Master Plan						$ 150,000	$ 150,000		35%
		Update Water Management and Conservation Plan			$ 150,000				$ 150,000		35%
		Update Vulnerability Assessment						$ 60,000	$ 60,000		35%
		Resiliency Plan	$ 150,000						$ 150,000		35%
		Subtotal	***$ 150,000***	***$ -***	***$ 150,000***	***$ -***	***$ -***	***$ 210,000***	***$ 510,000***	***$ -***	
Capital Improvement Program (CIP) Total			**$ 250,000**	**$ 229,000**	**$ 1,579,000**	**$ 1,745,000**	**$ 1,607,000**	**$ 14,445,000**	**$ 4,782,000**	**$ 11,535,000**	**$ 36,172,000**

Annual Average CIP Cost		
$1,082,000 over 5 years	**$1,985,500 over 10 years**	**$1,231,850 over 20 years**



LEGEND

	EXISTING
PUMP DISCHARGE WATER MAIN	———
WATER MAIN	———
RESERVOIR (CAPACITY IN MG, OVERFLOW ELEVATION IN FEET)	1.0 MG, OE=410'
GROUNDWATER WELL (PRODUCTION CAPACITY IN GPM)	
PRESSURE REDUCING VALVE	
PUMP STATION	P
MASTER METER	M
WATER TREATMENT PLANT	WTP
DISTRIBUTION SYSTEM EMERGENCY INTERTIES	.....

ABBREVIATIONS

GPM	GALLONS PER MINUTE
HGL	HYDRAULIC GRADE LINE
MG	MILLION GALLONS
MGD	MILLION GALLONS PER DAY
OE	OVERFLOW ELEVATION
PRV	PRESSURE REDUCING VALVE

NOTES:

1. FACILITIES SHOWN IN RED ARE PROPOSED.

FIGURE 5-1

City of Sherwood Oregon

Water System Master Plan Update

PROPOSED WATER SYSTEM SCHEMATIC

FEBRUARY 2015

MSA

13-1508

G:\PDX_Projects\13\1508\CAD\13-1508-405-OR-FIG 5-1.dwg FIG 5-1 1/23/15 13:07

PLATE 1

City of Sherwood Oregon

Water System Master Plan Update

Water System Map

MSA Murray, Smith & Associates, Inc. Engineers/Planners

DRAFT

24-inch Tualatin Supply Connection

Future 475 WEST Zone

Future 380 WEST Zone

Future 380 TEA Zone

380 Zone

Proposed Handley PRV

Proposed Haide PRV

Wyndham Ridge Pump Station

455 Zone

Woodhaven PRV

Kruger Reservoir

Future 455 WEST Zone

Inkster PRV

Proposed SW Sherwood PRV

Proposed 195th PRV

Future 630 WEST Zone

Proposed NCV Hatched Area Customers Transfer to 380 Zone

Future 380 BROOKMAN Zone

Future 400 BROOKMAN Zone

Sunset Reservoirs & Pump Station

400 Zone

Murdock PRV

535 Zone

Willamette River Water Treatment Plant 48-inch Transmission Main (to Wilsonville)

West Fork Chicken Creek

Chicken Creek

Rock Creek

Coffee Lake Creek

Goose Creek

Cedar Creek

Legend

- Existing Reservoir
- Existing Well
- Pump Station
  - Existing
  - Proposed
- Pressure Reducing Valve
  - Existing
  - Proposed
- Water Main
  - Existing
  - Proposed
- Existing Transmission
- Railroad
- Stream
- City Limits
- Urban Growth Boundary (UGB)

This map is intended for informational purposes only. The City of Sherwood makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, or surveying purposes. Notification of any errors is appreciated.

Source Data:
Basemapping - Metro/RLIS Nov. 2014
Water System - MSA and City of Sherwood Dec. 2014

800 0 800 Feet

N W E S

City of Sherwood Oregon

MSA

MURRAY, SMITH & ASSOCIATES, INC.
ENGINEERS | PLANNERS

Field house Monthly Report March 2015					
March-15	**Mar-15**		**YTD**		**Feb-14**
Usage		People		People	People
	Count	Served*	Count	Served*	Served*
Leagues	8	611	23	4720	644
Rentals	86	1548	702	10839	1515
Other (Classes)					
[1] Day Use	7	61	68	504	92
Total Usage		**2220**		**16063**	**2251**
Income	**Mar-15**	**YTD**			
Rentals	$6,175	$46,509			
League fees (indoor)	$8,279	$61,485			
Card fees (indoor)	$191	$3,040			
Day Use	$137	$1,532			
Advertising					
Snacks	$780	$4,715			
Classes					
Total	**$15,562**	**$117,281**			
FY 13 14					
Income	**Mar-14**	**YTD**			
Rentals	$5,843	$37,216			
League fees (indoor)	$4,854	$68,635			
Card fees (indoor)	$347	$3,399			
Day Use	$190	$1,427			
Advertising	$1,500	$1,500			
Snacks	$562	$4,216			
Classes					
Total	**$13,295**	**$116,393**			

*Estimated number of people served based on all rentals have a different # of people. Along with each team will carry a different # of people on their roster.

Sports Fields and Gyms

Youth soccer played 8 games at Snyder Park in the month of March.

Youth Lacrosse finished their tryouts and evaluations and are now practicing at Snyder, Middleton and SMS.

Youth softball and baseball are practicing in between rain storms at all the different schools.

I have at least five spring basketball teams in four of the schools and it looks like we will have some spring volleyball also.

Field House

We are still running four adult leagues.

Our last youth session ended at the end of the month.

Sherwood youth soccer will run a spring indoor league in our facility resulting in about 14 hours of rental time per week.

Rentals are slowing with the end of our youth league and the spring outdoor season starting.

Respectfully Submitted

Lance Gilgan

April 1, 2015