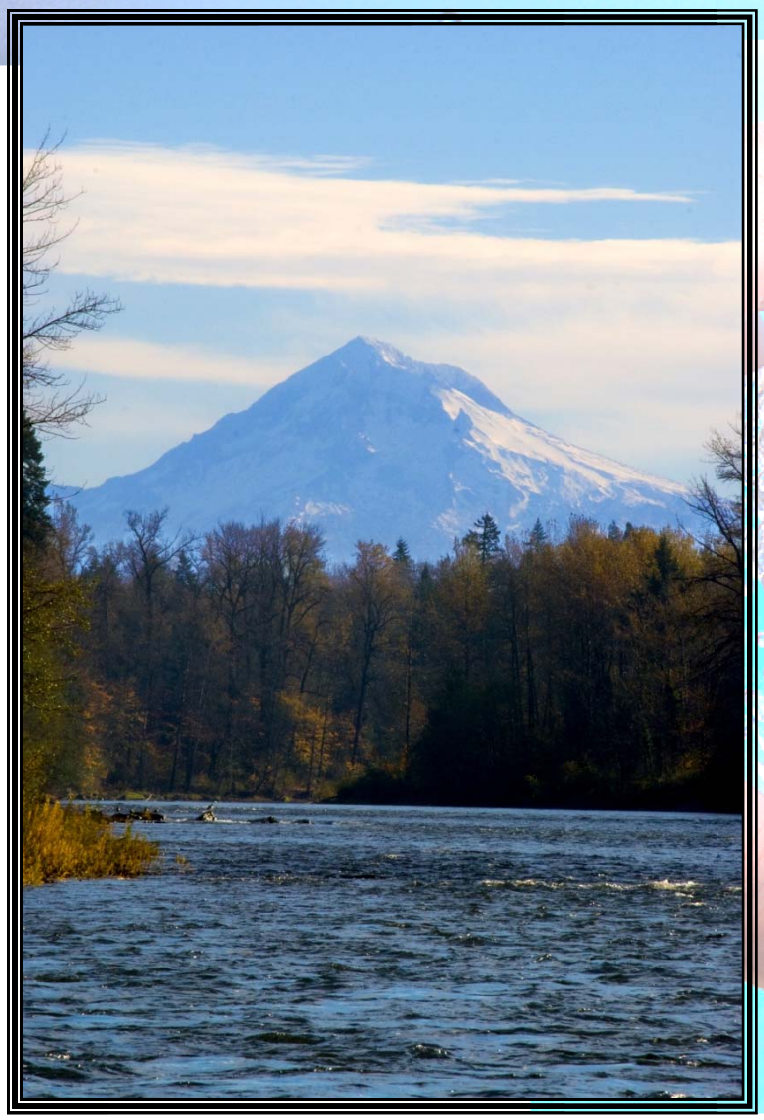
Water Management and Conservation Plan

Clackamas River Water

December 2011



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SECTION 1

Introduction

This section satisfies the requirements of OAR 690-086-0125.

Overview

Clackamas River Water (CRW) was formed in 1995 through the consolidation of the Clackamas Water District and the Clairmont Water District. CRW obtains surface water from the Clackamas River, and groundwater from a well known as Well No. 1, located near Abernathy Creek along Redland Road. Well No. 1 was modified as part of the development of an Aquifer Storage Recovery (ASR) system, and currently serves as a supplemental water supply and an emergency back-up.

CRW's total service population is estimated at 43,400. CRW serves approximately 28,600 people in Service Area 1, north of the Clackamas River, with water from the CRW water treatment plant (WTP), and approximately 14,800 people in Service Areas 2 and 3, south of the Clackamas River, with water purchased from the South Fork Water Board (SFWB). SFWB treats water from the Clackamas River at its WTP located on Hunter Avenue in Oregon City. CRW has been assigned two state and federal Public Water System Identification Numbers: 4100187 for the area north of the Clackamas River, and 4100594 for the areas south of the Clackamas River. CRW also provides water from its WTP to the Sunrise Water Authority (SWA) on a wholesale basis.

Plan Organization

This Water Management and Conservation Plan (WMCP) fulfills the requirements of the Oregon Administrative Rules adopted by the Water Resources Commission in November 2002 (OAR Chapter 690, Division 86). It describes water management, water conservation and curtailment programs to guide the wise use and stewardship of CRW's water supply.

The plan is organized into the following sections, each addressing specific sections of OAR chapter 690, Division 86:

Section	Requirement
Section 1 – Introduction	OAR 690-086-0125
Section 2 - Water Supplier Description	OAR 690-086-0140
Section 3 - Water Conservation	OAR 690-086-0150
Section 4 – Curtailment Plan	OAR 690-086-0160
Section 5 - Water Supply	OAR 690-086-0170

Affected Local Governments

This plan may affect the following local governmental agencies:

- Clackamas County
- City of Damascus
- City of Gladstone
- City of Happy Valley
- City of Milwaukie
- City of Oregon City
- City of Portland
- City of West Linn
- Johnson City
- Oak Lodge Water District (OLWD)
- METRO
- North Clackamas County Water Commission (NCCWC)
- South Fork Water Board (SFWB)
- Sunrise Water Authority (SWA)

Thirty days prior to submitting this WMCP to the Oregon Water Resources Department (OWRD), the draft plan was made available for review by each affected local government listed above along with a request for comments relating to consistency with the local government's comprehensive land use plan. A sample of the letters requesting this input, and any responses received are provided in **Appendix A**.

Plan Update Schedule

CRW anticipates submitting an update of this plan within 10 years of plan approval. As required by OAR Chapter 690, Division 86, a progress report will be submitted by 2016, within five years from the approval of this plan.

SECTION 2

Water Supplier Description

This section satisfies the requirements of OAR 690-086-0140.

Overview

Clackamas River Water (CRW) was formed in 1995 when the Clackamas Water District and the Clairmont Water District consolidated. CRW's history dates from 1926 when the Clackamas Water District was formed, and includes multiple mergers with other districts through the years. As shown in **Exhibit 2-1**, CRW's service area is located in Clackamas County, south of Portland and east of the Willamette River, in primarily unincorporated areas both inside and outside of the urban growth boundaries of the Portland Metropolitan Area and Oregon City. CRW's service area is divided into three sub-areas, one to the north of the Clackamas River and two to the south of the river. These sub-areas receive water from different sources as described below.

Service Area Description

690-086-0140(2)

CRW's overall system provides water to approximately 12,000 service connections. These connections serve residential areas, commercial establishments, industrial facilities, public facilities such as schools and churches, irrigators, and wholesale customers. CRW serves an area of approximately 41.6 square miles. **Exhibit 2-2** is a schematic showing the three sub-areas of CRW's service area, and the water sources for each sub-area.

Area 1, which is an area of approximately 11 square miles, is located north of the river near the I-205/Milwaukie Expressway Interchange. Most of this unincorporated area is located within the Portland Metropolitan Area urban growth boundary, and has an estimated population of 28,600 (2009) based on residential account data and a typical household size of 2.62 people per dwelling.[1]

Areas 2 and 3 are located south of the river, and are rural and more sparsely populated than Area 1. Portions of Areas 2 and 3 are located within Oregon City's urban growth boundary. Area 2 is approximately 27.6 square miles, and Area 3 is approximately 3 square miles. Based on residential account data and typical household size, Areas 2 and 3 have a combined service population of approximately 14,800 (2009).

[1] The dwelling multiplier was obtained from the *Metroscope Gen 2.3 – Year 2030 TAZ Allocation Report.*

EXHIBIT 2-1
Clackamas River Water Service Area Map

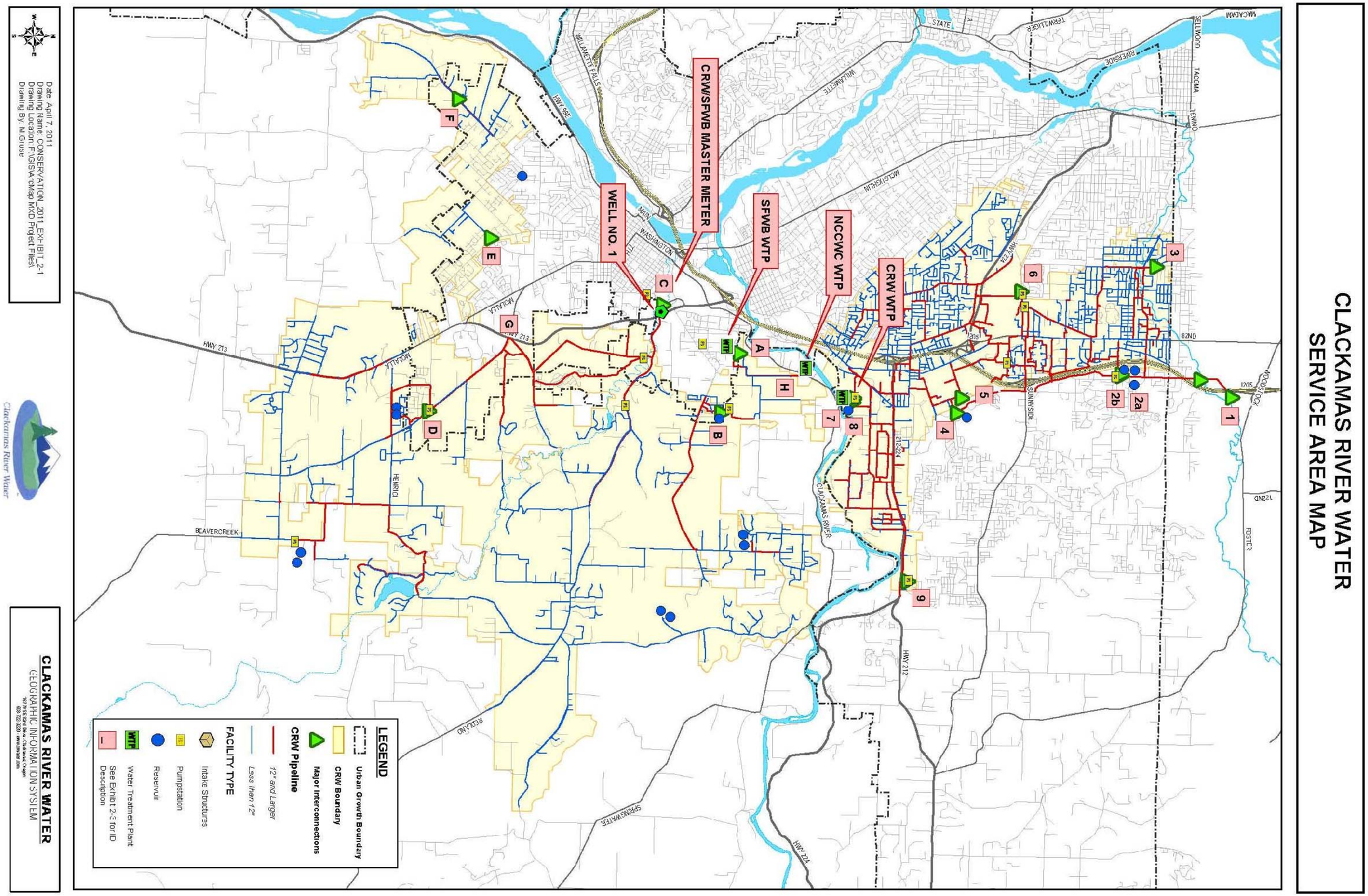
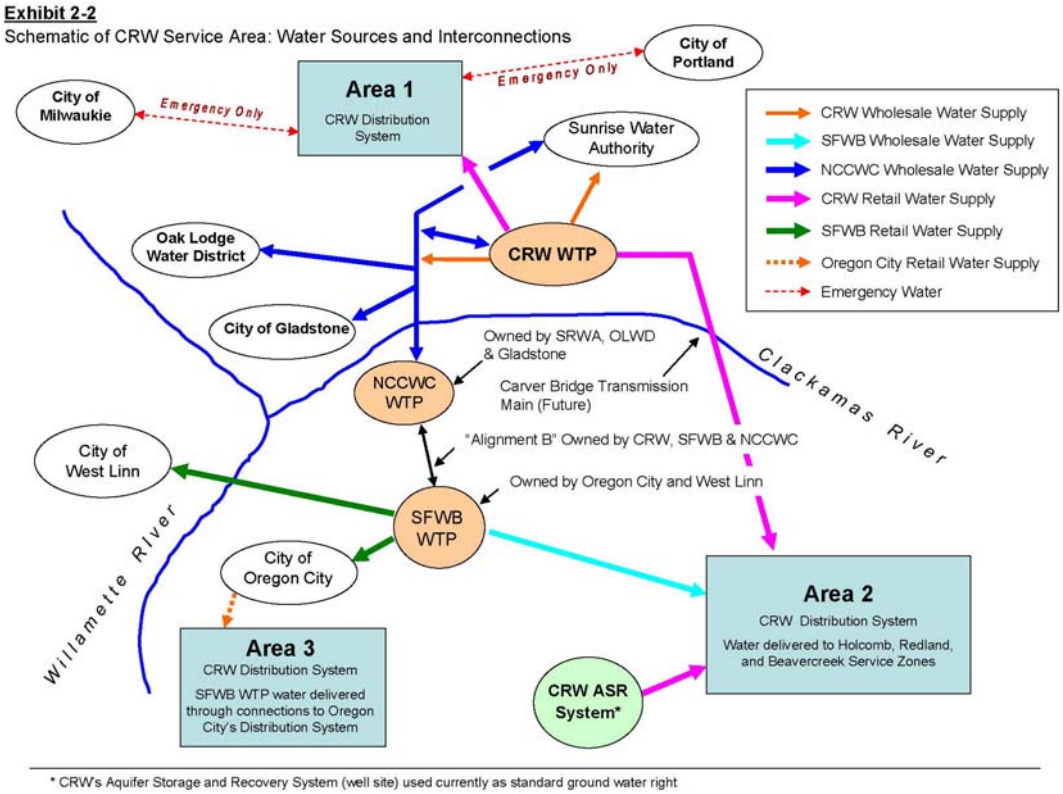


EXHIBIT 2-2
Schematic of CRW Service Area: Water Sources and Interconnections



Source

690-086-0140(1)

As shown on Exhibit 2-2, CRW obtains surface water from two locations on the Clackamas River, and groundwater from a well (Well No. 1), located along Redland Road, near Oregon City. The Clackamas River Basin includes an area of approximately 940 square miles. The upper reaches of the basin are in the Mt. Hood National Forest.

CRW serves the area north of the Clackamas River (Area 1) with water produced at its 30-million gallons per day (mgd) filtration water treatment plant (WTP) located along Mangan Drive, north of the Clackamas River. Raw water for the plant is provided through two screened intakes maintained by CRW, and located at river mile 2.7.

CRW serves the area south of the Clackamas River (Areas 2 and 3) with water purchased from the SFWB, and produced at the SFWB WTP located south of the Clackamas River. The 25-mgd SFWB WTP is jointly owned by the Cities of Oregon City and West Linn. Raw water for the SFWB WTP is obtained through a screened intake maintained by SFWB, and located at river mile 1.5.

In addition, Area 2 does receive approximately 1.2 MGD water from Well No. 1 which was approved for an Aquifer Storage and Recovery (ASR) system in 2003 (ASR LL-03). Well No. 1 it is currently used as a supplemental water supply and an emergency back-up.

Interconnections with Other Systems

690-086-0140(7)

CRW's drinking water system is interconnected with several other systems through wholesale water sales and purchases, and interties. CRW benefits from interconnections with surrounding water systems which allow the exchange of water between systems during emergency or shortage events. CRW's interconnections are summarized in **Exhibit 2-3,** and indicated on Exhibit 2-1.

EXHIBIT 2-3
CRW Interconnections

North Service Area				
ID[1]	**Location**	**Water Supply**	**Customer**	**Description**
1	SE 97th & Glenwood	Portland/CRW	Portland/CRW	Master Meter (emergency use)
2a	Otty Rd Reservoirs Property	CRW	SWA	Pump Station at Otty Rd Reservoirs (owned by SWA)
2b	Otty Rd Reservoirs Property	CRW	Portland	Pump Station at Otty Rd Reservoirs for emergency use (owned by Portland)
3	Flavel Dr. & Alberta	Portland	Oak Lodge Water District/CRW	Shared 24-inch waterline connected to 16-inch from Portland
4	Mather Reservoir @ 97th & Mather Rd.	CRW	SWA	Pump Station (owned by SWA)
5	Lawnfield Rd (Base of Hill)	CRW	SWA	Closed Valve
6	Harmony Rd West of 71st SE	CRW / Milwaukie	CRW / Milwaukie	Bi Directional Pump Station (emergency use)
7	Clackamas River Water - Treatment Plant	CRW	Gladstone	Master Meter (normally closed)
8	Clackamas River Water - Treatment Plant	CRW	NCCWC	NCCWC / OLWD Pump Station (owned by Oak Lodge Water District)
9	Morning Way @ 14801 SE	CRW	SWA	Pump Station (owned by SWA)

EXHIBIT 2-3
CRW Interconnections

South Service Area				
ID[1]	**Location**	**Water Supply**	**Customer**	**Description**
A	Forthsythe	Oregon City	CRW	4-inch Master Meter
B	Barlow Crest Pump Station	Oregon City	CRW	8-inch Master Meter
C	Anchor Way & Redland Road	SFWB	CRW	8-inch Master Meter
D	Glen Oak Pump Station	Oregon City/CRW	CRW	Normally Closed Valve
E	Meyer/Leland	Oregon City	CRW	Master Meter
F	Impala/Southend Rd	Oregon City	CRW	Master Meter
G	Maple Lane Court/Beavercreek Rd	Oregon City/CRW	CRW	Normally Closed Valve
H	Alignment B	CRW/SFWB/NCCWC	CRW	24-inch Transmission Main Between the NCCWC and SFWB Water Treatment Plants (Metered @ SFWB WTP)

[1] ID corresponds to the CRW Service Area Map, Exhibit 2-1.

Currently, CRW sells wholesale water to the SWA. In the past, CRW has supplied wholesale water to the Cities of Milwaukie and Gladstone, and Oak Lodge Water District (OLWD). City of Gladstone and Oak Lodge Water District receive water from the North Clackamas County Water Commission (NCCWC), but CRW remains an emergency back-up supply for these communities. Likewise, CRW maintains a finished water interconnection with the NCCWC WTP. CRW also has an interconnection with the Portland Water Bureau and is pursuing an emergency interconnection agreement.

As noted, CRW supplies its service areas south of the Clackamas River with wholesale water purchased from the SFWB, with water from Well No. 1.

Intergovernmental Agreements

690-086-0140(1)

Exhibit 2-4 provides a summary of CRW's intergovernmental agreements. These agreements include water supply agreements (both sales and purchase), emergency water supply and collaborative agreements. Additional detail about CRW's intergovernmental agreements is contained in **Appendix B**. CRW provides water on a wholesale basis to the SWA and is a wholesale customer of SFWB. CRW is currently operating under the terms and conditions of an expired SFWB agreement to purchase water to supply thesouth service areas while negotiations are underway.

CRW is a member of the Clackamas River Water Providers, a consortium of water utilities that supply water from the Clackamas River. Other members include Lake Oswego, SFWB,

SWA, City of Estacada, and NCCWC. The purpose of the consortium is to coordinate and fund water resource planning, management and conservation outreach programs.

System Description

690-086-0140(8)

Water from the CRW WTP is supplied to the service area north of the river, through CRW's distribution system. CRW also supplies water on a wholesale basis from its WTP to the SWA.

At the two CRW intake structures, raw water is pumped to the CRW WTP through a 30-inch and a 36–inch diameter pipeline buried beneath the Clackamas River. The plant, located along Mangan Drive north of the river, was constructed in 1964 with an initial capacity of 10 mgd. The WTP capacity was expanded to 20 mgd in 1972, and to its current capacity of 30 mgd in 1991. Treatment includes addition of chemical agents to promote coagulation, filtration, and disinfection. The CRW WTP achieves high water use efficiency, producing finished water at a rate of 96 to 97% of pumped raw water. The finished water high service pump station has a firm capacity of approximately 22 mgd.

The CRW distribution system has approximately 257 miles of pipeline, 14 reservoirs[2], and 11 pump stations.

Wholesale water purchased from the SFWB WTP is supplied to CRW's service area south of the Clackamas River through connections with the SFWB and Oregon City distribution systems. CRW also uses water from CRW's ASR Well No. 1.

SFWB WTP, located in Oregon City, and owned by the Cities of Oregon City and West Linn, has a total capacity of 25 mgd, with a delivery capacity of 22-23mgd because of restricted transmission line capacity. Raw water is screened at the raw water intake structure and pumped through a 27-inch diameter pipeline approximately 1,850 ft to the water treatment plant. The SFWB WTP is a conventional plant with treatment processes including flocculation, sedimentation, filtration and chlorination.

[2] CRW owns 15% of the Barlow Crest Reservoir.

EXHIBIT 2-4
Summary of CRW's Intergovernmental Agreements

Contract Supplier	Supply Source	Contract Purchaser	Contract Dates	Duration	Termination Provisions		Terms	Current Cost
Clackamas River Water	Clackamas River	City of Milwaukie	07/01/98 – 6/30/17	20 years	Notification to renew not later than 12 months prior to expiration	Sales/ Emergency Supply	City deemed to have satisfied obligation to consume and pay for minimum quantity of water (24 million cubic feet per year) thru 12/31/07; CRW furnishes surplus water from 7/01/98 through 6/30/17; City purchases water for emergency or non-emergency or backup basis; discuss terms/conditions each calendar year	Fixed dollar amount/yr; Billed for draws above minimum
Clackamas River Water	Clackamas River	SWA/ NCCWC	3/8/2001-3/1/2021	20 years	08/03/2004 SWA assigned rights and obligation of NCCWC; notify of intent to extend no later than 2 yrs prior to termination	Sales	NCCWC to purchase minimum of 122 million cubic feet each calendar year beginning March 1, 2001. Section 1, "Supply of Water" amended by SWA agreement above.	Mather Road/152nd: $0.42769/ccf ($0.572 per 1,000 gallons); Otty Road: $0.53767/ccf $0.719 per 1,000 gallons)
SFWB	Clackamas River	CRW	Water Supply Agreement -- 2/15/1983-7/1/1998; Rates agreement – 5/13/2010 - 6/30/2011		Agreement termination by written notice given by either party to the other no later than 18 months prior to the termination of agreement	Purchase	SFWB subject to the prior and superior rights of Oregon City and West Linn, furnishes surplus water to CRW as needs of the cities permit. CRW & SFWB to negotiate future rates according to the process established in Sect 4.	Rates agreement – 9/1/2008-3/31/2010 $0.7400/ccf; 4/1/2010-6/30/2011 $0.7400/ccf
Oregon City Meyers/Leland Roads Master Meter	Clackamas River	CRW	(to be negotiated)			Purchase	Wholesale water agreement to serve South Leland Road	

EXHIBIT 2-4
Summary of CRW's Intergovernmental Agreements

Contract Supplier	Supply Source	Contract Purchaser	Contract Dates	Duration	Termination Provisions		Terms	Current Cost
Oregon City South End/ Impala	Clackamas River	CRW	2/8/2000-2/8/2020	20 years		Purch ase	"The parties agree that the following water lines shall be jointly funded, connected, and used by the parties pursuant to the terms of this section and this agreement."	
Oregon City/ CRW HOPP Service Area	Clackamas River	CRW	4/22/98-4/28/2028	30 years	Terminated by mutual agreement. Sect 15	Purch ase	"Wheeling Agreement. CRW and the City agree that the City shall wheel water through the newly constructed system to deliver water to CRW's system. The cost of wheeling the water will be based upon the pro rata share of operating, maintaining, repair and replacement of the jointly-constructed and owned facilities, and is to be accomplished by a separate agreement.	
Oregon Water/Wastewater Agency Response Network			6/20/2007	5 years – with automatic renewal	60 day written notice	Collab oration	Mutual aid and assistance agreement for the provision of emergency services related to water and wastewater utilities	See Article VI – Cost Reimbursement
Regional Water Providers Consortium		Consortium Members	1/13/2005	Perpetual – Unless otherwise notified	30 day written notice	Collab oration	"The parties shall make available to each other vehicles, equipment, machinery, related items and services…" according to the terms of the agreement.	

EXHIBIT 2-4
Summary of CRW's Intergovernmental Agreements

Contract Supplier	Supply Source	Contract Purchaser	Contract Dates	Duration	Termination Provisions		Terms	Current Cost
Clackamas River Water Providers		CRW, Lake Oswego, SFWB, SWA, Estacada, NCCW	5/10/2007	Perpetual – Unless otherwise notified	written notice	Collaboration	The purposes of CRWP: 1. Coordinate efforts regarding water resource planning, management, conservation and development of the waters of the Clackamas River on a sustainable basis. 3. Water resource activities that may include watershed assessments, water quality monitoring and analyses and water supply planning.	
CRW/NCCWC/SFWB	CRW/NCCWC/SFWB	CRW/NCCWC/SFWB	7/1/2001	Perpetual	General Managers to meet annually to revise.	Collaboration	This Joint Operating Plan states how NCCWC, SFWB and CRW will share water and resources.	
City of Oregon City	Interies between water systems	CRW	(To Be Negotiated)			Emergency Water Serv.	Provide emergency water as needed and as available to South Service Area	
Portland Water Bureau	18" intertie at Otty Road Reservior	CRW	(To Be Negotiated)			Emergency Water Serv.	Provide emergency water as needed and as available to North Service Area	

Exhibit 2-5 is a summary of pipeline length by material and diameter. Approximately nine percent of the system consists of pipes with diameters of four inches or less, and 59% of the system is six or eight inches in diameter. Approximately 11% of the system is constructed with steel or galvanized steel pipe. CRW has targeted areas with these materials for leak detection and pipe replacement because of a history of pin-hole leaks.

EXHIBIT 2-5
Summary of CRW Distribution System Pipe Length in Feet by Diameter and Material, 2008

	Pipe Diameter (inch)								
Material	**<=4**	**6-8**	**10-14**	**16-18**	**20-24**	**30-36**	**Total (ft)**	**Total (mi)**	**Percent**
Copper	1,181	-	-	-	-	-	1,181	0	0%
Galvanized Steel	9,383	-	-	-	-	-	9,383	2	1%
PVC	2,565	6,404	-	-	-	-	8,969	2	1%
Asbestos Cement	7,544	8,755	-	-	-	-	16,298	3	1%
Cast Iron	77,636	317,866	43,251	-	-	-	438,754	83	32%
Ductile Iron	6,744	366,631	212,437	62,949	29,806	13,685	692,253	131	51%
OD Steel	23,628	74,964	24,319	9,292	-	752	132,956	25	10%
Concrete Cylinder	-	-	-	21,489	8,017	9,009	38,514	7	3%
Hydrant	-	20,100	-	-	-	-	20,100	4	1%
Total (ft)	128,681	794,720	280,007	93,730	37,823	23,446	1,358,408	257	100%
Total (mi)	24	151	53	18	7	4	257		
Percent	9%	59%	21%	7%	3%	2%	100%		

Exhibits 2-6 and 2-7 provides a summary of the system reservoirs and pump stations, respectively. CRW identified leaks at Henrici Reservoir No. 2 and Beaver Creek Reservoir No. 1., and repairs were completed as part of the FEMA seismic structural upgrade project in fiscal year 2009-2010. The magnitude of leakage was considered minimal at both reservoirs and was not included in past water accounting. The estimated construction costs were $153,000 for Henrici Reservoir No. 2 and $140,000 for Beavercreek Reservoir No. 1.

EXHIBIT 2-6
Summary of CRW Pump Stations

Pump Station Name	No. of Pumps	Pump Size (hp)	Flow Rate per Pump (gpm)[1]	Firm Capacity (MGD)[2]	Total Capacity (MGD)[3]
CRW WTP High Service	2	200	2,800	22	35
	2	350	5,000		
	1	600	9,000		
90th Street	2	75	2,100	5.8	11.5
	1	150	4,000		
Harmony Road	2	100	2,500	3.5	4.8
Kirkwood	1	7.5	100	-	0.1
Barlow Crest	2	60	500	0.7	1.0
Redland	3	100	600		1.5
Hunter Heights	1	5	100	0.2	0.6
	1	7.5	210		
	1	7.5	120		
	1	60	700		
Holly Lane	2	75	540	2.9	3.0
	2	150	1,200		
Glen Oaks	2	50	600	2.9	3.0
	2	100	1,100		
Beaver Creek	1	40	700	-	1.8
Well Site No. 1	1	60	650	0.9	1.3
	1	40	400		
	1	20	200		

Information based on data from the May 2005 CRW *Water System Master Plan Update*; Table 3-4.
[1] Pump flow based on design flow characteristics
[2] Actual capacity with largest pump out of service.
[3] Actual capacity with all pumps operating.

EXHIBIT 2-7
Summary of CRW's Reservoirs

Facility Name	Volume (MG)	Overflow Elevation (ft)	Bottom Elevation (ft)	Year Constructed
Mather Reservoir	10.0	292	252	1977
Otty Reservoir 1	2.1	383	349.5	1962
Otty Reservoir 2	2.6	383	349.5	1985
Otty Reservoir 3 [1]	2.0	383	355	1993
Barlow Crest Reservoir [2]	1.75	548	518	1999
Redland Reservoir 1	0.3	729	697	1967
Redland Reservoir 2	0.75	729	697	1983
Hunter Heights Reservoir 1	0.2	797	765	1975
Hunter Heights Reservoir 2	1.0	797	749	1997
Henrici Reservoir 1	0.3	590.2	555	1964
Henrici Reservoir 2	1.25	590.2	555	1973
Beaver Creek Reservoir 1	1.0	666	634	1974
Beaver Creek Reservoir 2	1.0	744	644	1988
Well No. 1	0.1	107	83	1973
Total	**24.35**			

[1] 2.0 MG volume accounts for usable storage only
[2] CRW owns 15 percent of this reservoir. Oregon City owns the remaining 85%.

Records of Water Use

690-086-0140(4) and (9)

Terminology

Production refers to the quantity of water delivered to the distribution system from the CRW and SFWB WTPs, and CRW's Well No. 1. To date, CRW has not used Well No. 1 to inject water for storage. By definition, production equals system demand, which includes water supplied to an ASR system, metered consumption (residential, municipal, commercial, industrial, irrigation, and wholesale), public uses (fire fighting, hydrant flushing, other), and water lost to leakage and reservoir overflow.

Consumption is equal to the metered water use. Production minus consumption equals unaccounted for water. Unaccounted for water is equal to the sum of real losses, which are physical losses from the distribution system caused by leakage, evaporation, or reservoir overflows, and apparent losses which are nonphysical losses that occur because of inaccuracies of measurement at the production or customer meters, utility accounting and

billing errors, or unauthorized and unmetered uses. Authorized, unmetered water uses, such as for hydrant flushing, also contribute to unaccounted for water.

Generally, demands and consumption in municipal systems are expressed in units of mgd. They also may be expressed in cubic feet per second (cfs) or gallons per minute (gpm). One mgd is equivalent to 1.55 cfs or 694 gpm. For annual or monthly values, it is typical to refer to the total quantity of water in million gallons (MG). Water use per person (per capita use) is expressed in gallons per person per day (gpcd).

The following terms are used to describe specific values of system demands:

- Average day demand (ADD) equals the total annual production from all sources divided by 365 days.
- Maximum day demand (MDD) equals the highest system demand that occurs on any single day during a calendar year. It is also called the one-day MDD. Because CRW's south areas are served from the SFWB WTP, maximum demand must be estimated from monthly reading of transmission system meters, rather than daily production records.
- WTP maximum day demand equals the highest demand produced at the CRW WTP in a single day.
- The three-day maximum day demand (3-d MDD) equals the average of the daily demands that occurred on the day before, the day of, and the day after the MDD.
- Maximum monthly demand (MMD) equals the highest monthly demand in one of the 12 months of a calendar year.
- Peaking factors are the ratios of one demand value to another. The most common and important peaking factor is the ratio of the MDD to the ADD.

Historical Water Demands

Northern service area and wholesale customer demands from production records from CRW's WTP, historical demands from the southern service areas, and overall system demands are shown in **Exhibit 2-8.** WTP production records include annual and maximum day production for the period 2000 through 2009 and 3-day demand for the period 2003 to 2009. The SFWB WTP component of CRW system demand averaged 15% for the period, and was 19.5% in 2009. **Exhibit 2-9** graphically displays overall water system ADD, and the contribution to ADD by the north and south service areas. Similarly, **Exhibit 2-10** shows water system MDD by area.

EXHBIT 2-8
Summary of CRW's Average and Maximum Day Demands by Area and Overall

	North Service Area Demands (Area 1)[1]				South Service Area Demands (Areas 2 & 3)					Overall System Demand		
Year	**Finished Water (MG)[1]**	**ADD (mgd)**	**MDD (mgd)**	**3-d MDD (mgd)**	**Purchased from SFWB (MG)**	**Well No.1 (MG)**	**Total Sources in South**	**ADD (mgd)**	**MDD (mgd)[2]**	**Total Production (MG)**	**Overall System ADD (mgd)**	**Overall System MDD (mgd)[3]**
2000	3,862	10.6	20.6	-	-	-	-	-	-	-	-	-
2001	3,590	9.8	14.6	-	-	-	-	-	-	-	-	-
2002	3,472	9.5	16.9	-	-	-	-	-	-	-	-	-
2003	3,551	9.7	17.8	15.4	586	0	586	1.6	4.5	4,185	11.5	22.3
2004	3,504	9.6	16.5	15.3	529	0	529	1.5	4.1	4,079	11.2	20.6
2005	3,231	8.9	15.5	14.3	512	0	512	1.4	3.9	3,786	10.4	19.4
2006	2,980	8.2	16.2	14.7	587	0	587	1.6	4.5	3,611	9.9	20.7
2007	2,705	7.4	13.7	11.3	599	58	657	1.8	5.0	3,399	9.3	18.7
2008	2,619	7.2	13.6	11.5	469	118	587	1.6	4.5	3,206	8.8	18.2
2009	2,521	6.9	14.8	10.5	482	114	596	1.6	4.6	3,117	8.5	19.5
Average '08-'09	**2,570**	**7.1**	**14.2**	**11.0**	**476**	**116**	**592**	**1.6**	**4.6**	**3,162**	**8.7**	**18.9**

[1] Based on CRW WTP data.
[2] Calculated using a MDD to ADD peaking factor of 2.8 from the May 2005 CRW *Water Master Plan Update*.
[3] Calculated as the sum of the MDDs of the north and south regions.

As shown in Exhibits 2-9 and 2-10, since 2003, the ADD and MDD in Area 1 have declined steadily because of reorganization of regional water providers, changes in wholesale customers, and annexation of portions of CRW's service areas into other jurisdictions. CRW's WTP ADD ranged from 9.7 mgd in 2003 to 6.9 mgd in 2009, and the MDD ranged from 17.8 mgd in 2003 to 14.8 mgd in 2009. The average CRW WTP ADD for the 2008-2009 period was 7.1 mgd, and the average MDD for the same period was 14.2 mgd. The southern region ADD has remained relatively constant, ranging from 1.4 mgd in 2005 to 1.6 mgd in 2009, and averaging 1.6 mgd for the years 2008-2009. The estimated southern region MDD has ranged from 3.9 to 5.0 mgd, and averaged 4.6 mgd for the 2008-2009 period.

EXHIBIT 2-9
CRW Average Day Demands by Service Area and Overall

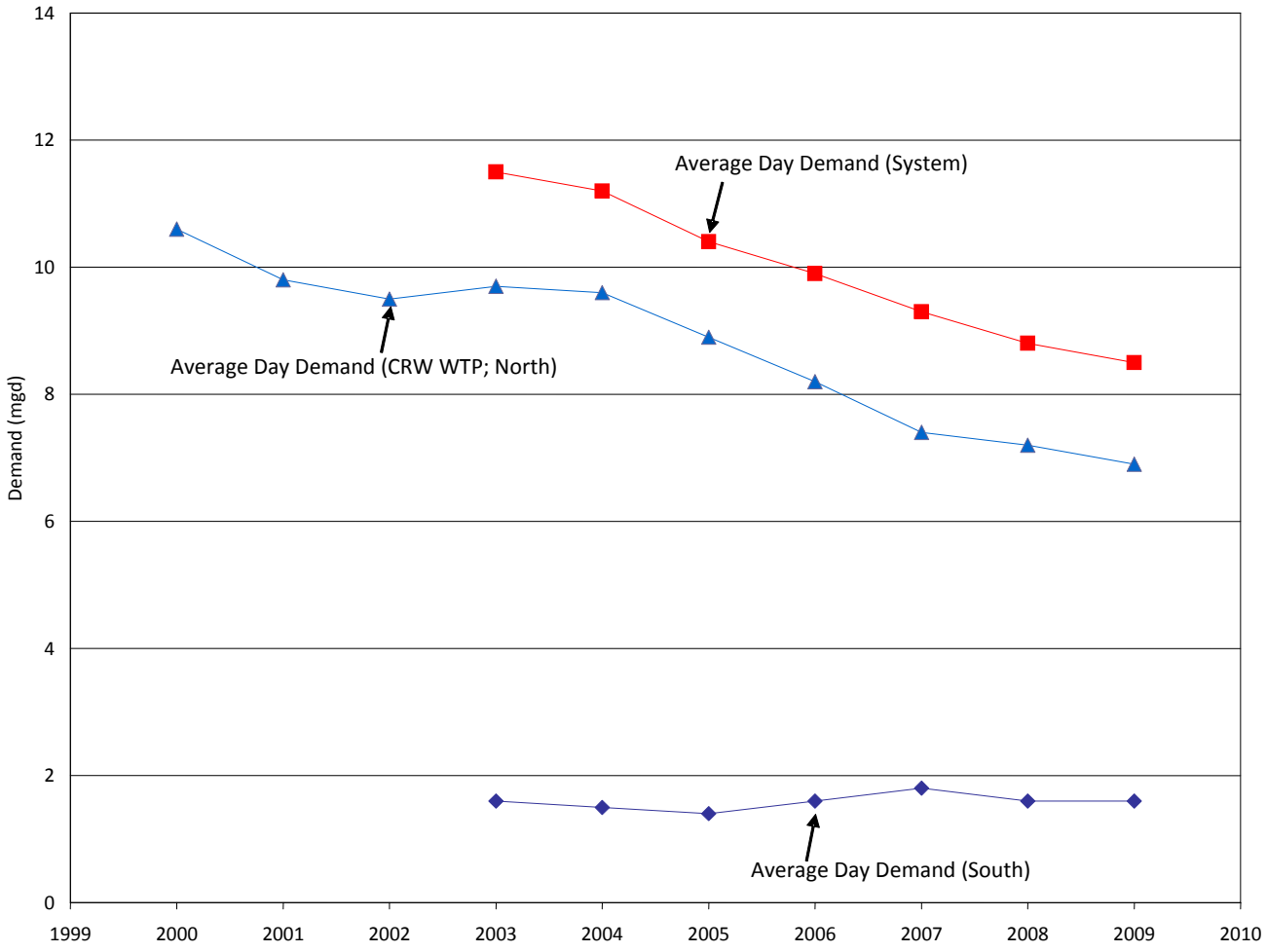
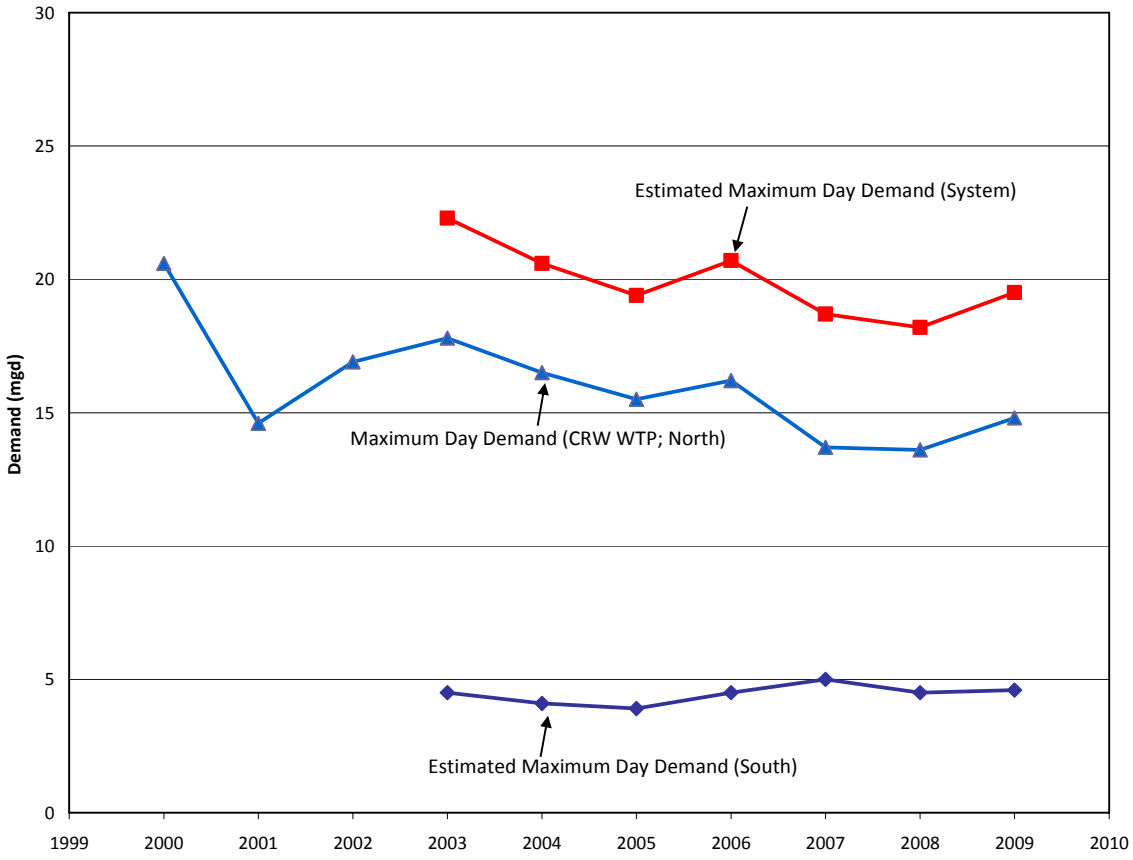


EXHIBIT 2-10
CRW maximum Day Demands by Service Area and Overall



MDDs are generally more variable from year to year than are ADDs because MDDs are sensitive to weather patterns. Unusually hot weather or the combination of hot and dry weather results in more outdoor irrigation, which increases the MDD.

When demand approaches production capacity for a short period (single day) water systems generally can rely on storage to meet demand. However, if high demand persists for an extended period, water shortages may result. The 3-day WTP MDD gives an indication of the duration of periods of maximum demand. The 3-day MDD ranged from 15.4 mgd in 2003 to 10.5 mgd in 2009, and averaged approximately 90% of WTP MDD. This means that if the MDD equals 14 mgd, CRW WTP will experience three consecutive days averaging a demand of 12.6 mgd each day.

Per Capita Demand

Based on demand data averaged for the two-year period of 2006-2007, and estimates of the service populations north and south of the Clackamas River, the per capita water demand rates were estimated as follows:

- Area 1
  - Average day demand (ADD): 91 gallons per capita per day
  - Maximum day demand (MDD): 175 gallons per capita per day

  - MDD to ADD Peaking Factor = 1.9 from CRW WTP production data

- Areas 2 and 3
  - Average day demand (ADD): 120 gallons per capita per day
  - Maximum day demand (MDD): 340 gallons per capita per day
  - MDD to ADD Peaking Factor = 2.8 from the 2005 *Water Master Plan Update*

The larger per capita demand value and lower MDD to ADD peaking factor for Area1 versus Areas 2 and 3 are consistent with the larger proportion of commercial and industrial customers located in Area 1. Many industries have relatively uniform water needs throughout the year, and correspondingly lower peaking factors.

Consumption and Unaccounted For Water

Consumption is equal to the metered water use within the system. The CRW system is fully metered, including water used in parks, playgrounds and irrigation for landscaping. Unaccounted for water or water loss is the difference between produced or purchased water and metered consumption. Unaccounted for water consists of real physical loss and apparent nonphysical loss. Real physical losses in the distribution system result from leakage, evaporation, or reservoir overflows. Apparent nonphysical losses occur because of inaccuracies of measurement at the production or customer meters, utility accounting and billing errors, or unauthorized and unmetered uses.

Authorized, unmetered water uses, such as for hydrant flushing, also contribute to unaccounted for water. Water usage is not recorded when hydrants are flushed as part of routine hydrant maintenance or when needed after service interruptions. CRW does maintain a database that tracks the volume of water used during routine water quality flushing in the distribution system. This data has not been included in historical water loss calculations. A permit is required for all private water use from fire hydrants. District-issued hydrant meters are used to account for usage. If hydrant meters are unavailable then CRW allows contractors to use tanker load counts to account for water use.

CRW calibrates reservoir water-level set points quarterly to ensure the accuracy of water elevations. High-level floats installed one foot below the overflow elevations shut off operating pumps to avoid overflow conditions.

The CRW district wide 5 year average water loss is 4.89%. CRW monitors unaccounted for water loss in the north and south service areas. The north system 5-year average was 3.78%and the South system was 10.32% for the same period. There is an on-going leak detection program that is described more fully in Section 3. It is anticipated that leakage rates will decline due to pipe replacement in leakage-prone areas and continued leak detection activities.

Exhibit 2-11 lists annual total production and metered consumption, and unaccounted for water for 2005-2009. When the difference between production and metered consumption is divided by the production value the result is unaccounted for water. That value is expressed as a percentage of total demand. The Oregon Water Resources Department's (OWRD) goal for municipalities is to reduce the percentage of unaccounted for water to 10% or less.

EXHIBIT 2-11
CRW System Unaccounted for Water, 2005-2009

Year	Total Production (MG)	Metered Consumption (MG)	Unaccounted for Water (MG)	Unaccounted for Water (Percent)
2005	3,791	3,712	79	2.08%
2006	3,559	3,430	128	3.61%
2007	3,307	3,116	191	5.79%
2008	3,207	2,962	245	7.63%
2009	3,118	2,952	166	5.32%

Customer Characteristics and Water Use Patterns

Exhibits 2-12 through 2-15 present the annual meter count and annual metered consumption by customer category for the years 2005 through 2009. Annual metered consumption declined over the five year period from approximately 3,800 million gallons (MG) in 2005 to 3,100 MG in 2009. Reduction in water use occurred across all categories. However, **Exhibit 2-15** shows that the single family residential use normalized by the number of single family accounts has remained relatively constant from 2005 through 2009.

Exhibit 2-12
Summary of Annual Meter Count by Customer Category, 2005-2009

Year	Single-Family	Multi-Family[1]	Commercial & Industrial[2]	Wholesale	Irrigation	Other[3]	Total
2005	10,153	228	802	7	91	378	11,658
2006	10,516	230	816	6	90	377	12,034
2007	10,835	222	806	5	102	365	12,334
2008	10,569	208	755	5	93	319	11,947
2009	10,584	206	756	3	93	384	12,026

[1] Includes Trailer Parks accounts
[2] Includes Medical accounts
[3] Includes Government, Churches, School District, District, and Fire Service accounts

Exhibit 2-13
Summary of Annual Consumption by Customer Category, MG, 2005-2009

Year	Single-Family	Multi-Family[1]	Commercial & Industrial[2]	Wholesale	Irrigation	Other[3]	Total
2005	924	501	717	1,563	51	54	3,809
2006	1,044	525	714	1,135	50	64	3,532
2007	976	450	600	1,047	51	48	3,172
2008	928	440	588	985	45	48	3,034
2009	1,046	447	565	940	50	53	3,102
Average Percentage '08-'09	32.2%	14.5%	18.8%	31.4%	1.5%	1.6%	100.0%
Percent Reduction '05-'09	13.2%	-10.8%	-21.1%	-39.8%	-2.2%	-2.1%	-18.6%

[1] Includes Trailer Parks accounts
[2] Includes Medical accounts
[3] Includes Government, Churches, School District, District, and Fire Service accounts

EXHIBIT 2-14
CRW Annual Metered Consumption by Customer Category (Volume)

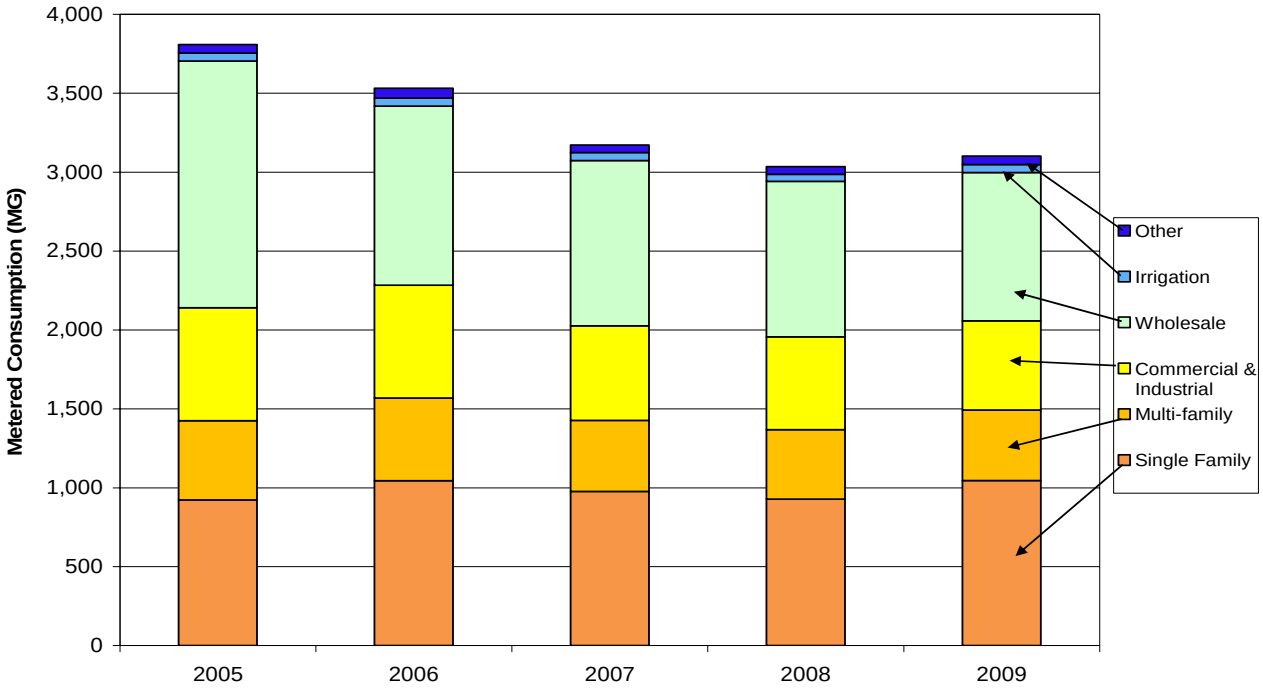


EXHIBIT 2-15
CRW System Annual Metered Consumption by Customer Category (Percent)

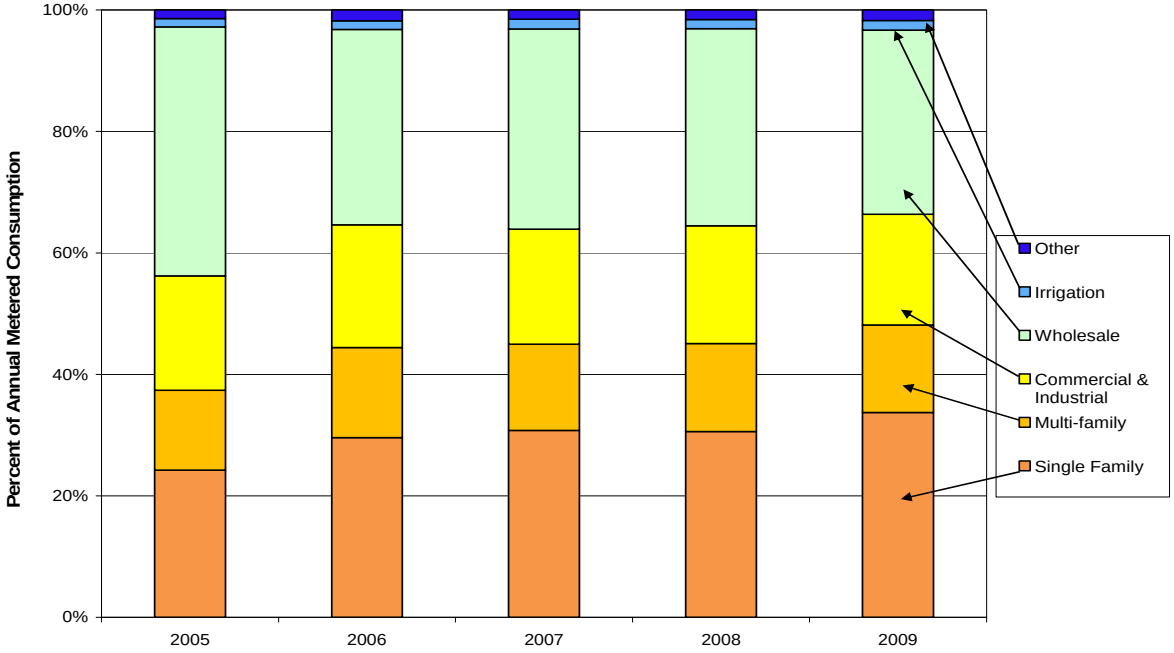
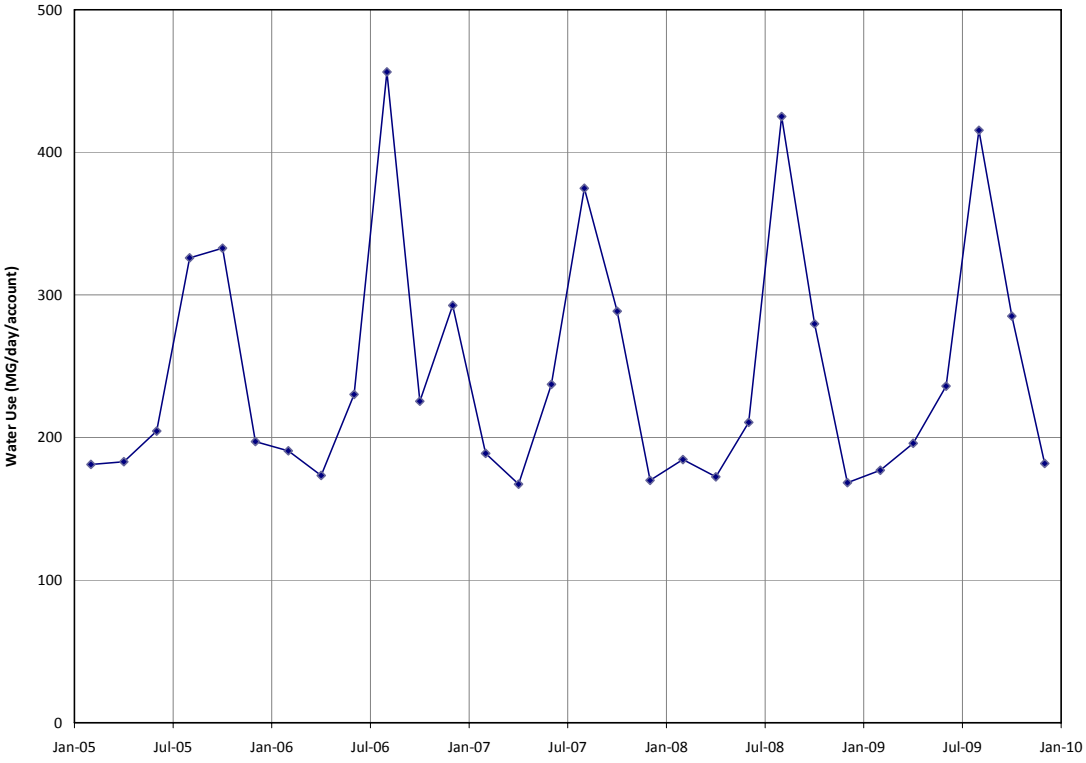


EXHIBIT 2-16
Historical Metered Consumption per Single Family Residential Account 2003-2007



In 2008 and 2009, residential water use represented 46% of metered production (31% for single family accounts and 15% for multi-family accounts). For these two years, commercial and industrial use averaged 19%, and wholesale consumption averaged 32% of annual metered consumption.

CRW's top eleven commercial and industrial water consumers for the period August 31, 2008 through September 30, 2009 are listed in **Exhibit 2-17.** These 11 customers were responsible for approximately 7% of metered consumption. Customers who use large amounts of water may benefit from water audits that identify customer-specific conservation measures. Between 1999 and 2001, CRW participated in a pilot program that provided water audits for three commercial and industrial customers.

Exhibit 2-17

Water Use for the Eleven Largest Commercial and Industrial Accounts, 2009

Facility Type	Volume (MG)
Manufacturing	90.4
Food processing	34.6
Grocery	22.7
Retail	20.9
Food processing	14.1
Food processing	13.6
Food processing	13.0
Hotel	11.4
Grocery	10.8
Retail	9.7
Retail	9.3
Total	**250.5**

CRW reads all meters on a bi-monthly schedule. **Exhibit 2-18** presents the monthly billed consumption by customer category for 2009. Consumption increased for all customer categories in the peak billing months of July/August through September/October. The summer season was defined as the four month period of July through October. The winter season is defined as the six month period of November through April **Exhibit 2-19** shows that the average overall monthly consumption for the summer season averaged approximately 328 MG per month (10.6 mgd), with 175 MG per month (5.6 mgd) from residential customers and 60 MG per month (1.9 mgd) from commercial and industrial customers.

The winter season average was 205 MG per month (6.6 mgd) with 91 MG per month (2.9 mgd) from residential customers and 38 MG per month (1.2 mgd) from commercial and industrial customers.

The estimated average monthly consumption by season and customer category average was 258 MG per month (8.3 mgd).

EXHIBIT 2-18
CRW Monthly Water Consumption for 2009

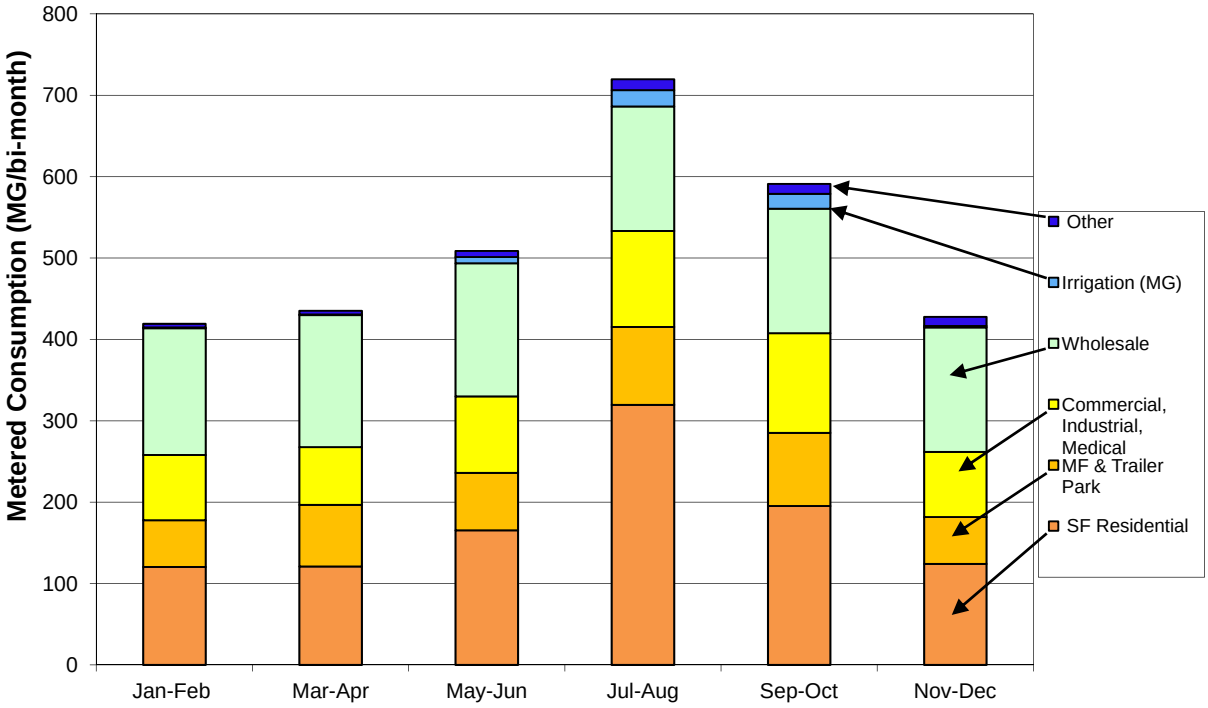


EXHIBIT 2-19
Estimated Average Monthly Consumption by Season and Customer Category, 2008/09

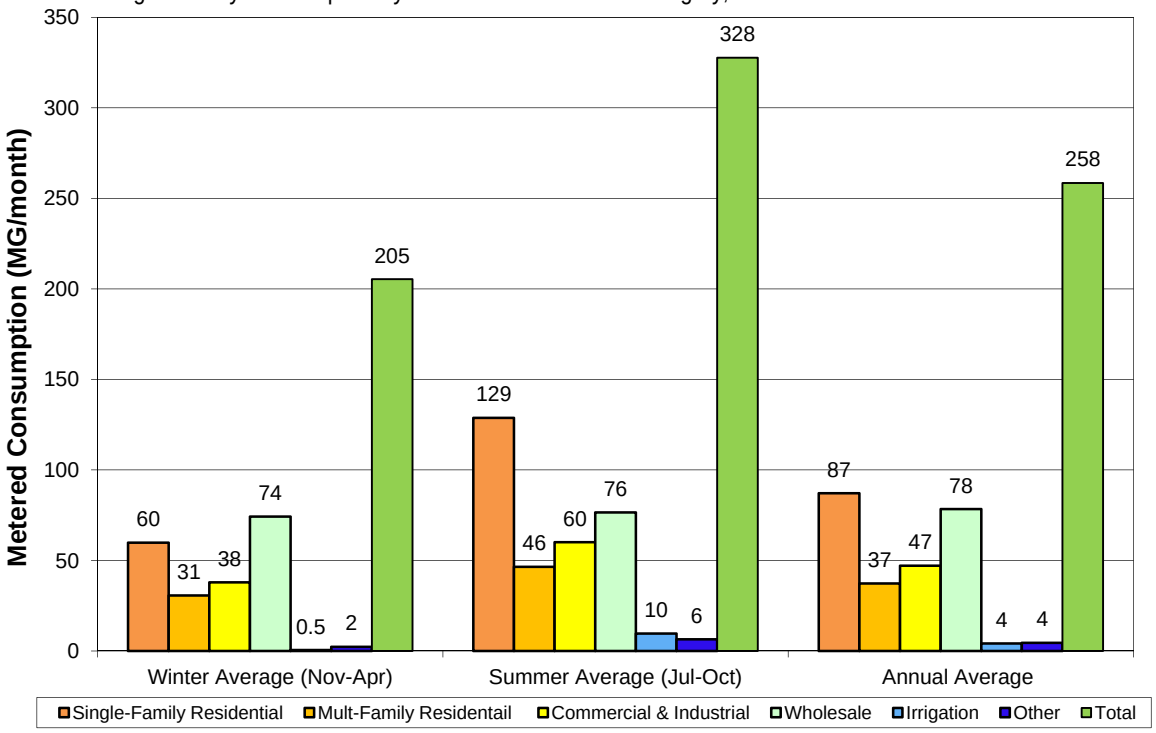
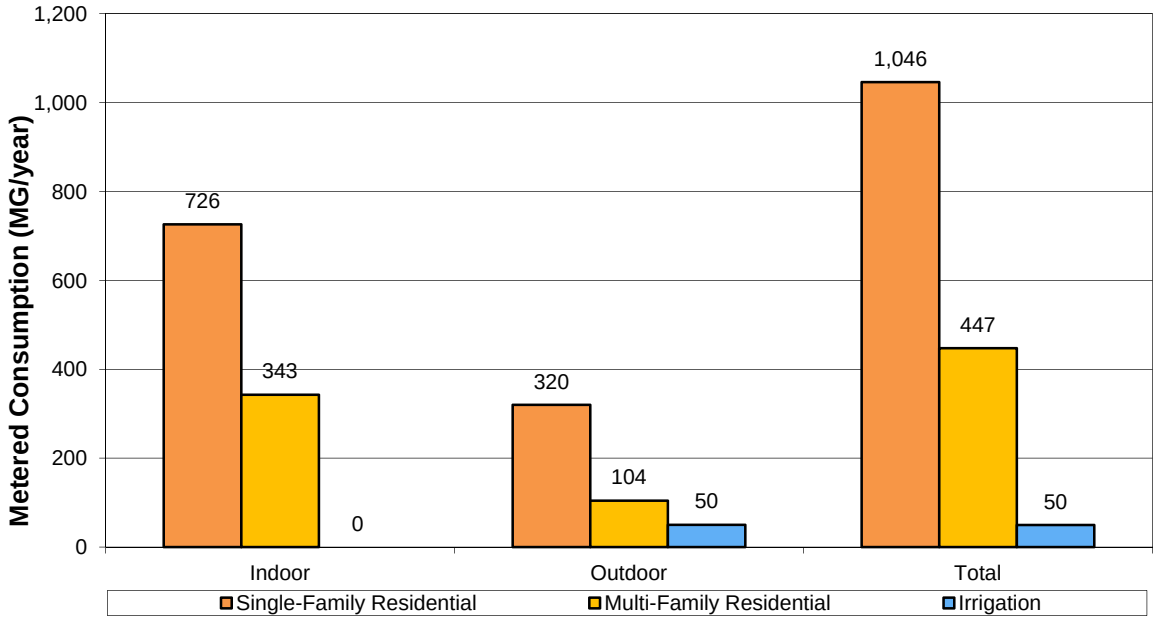


Exhibit 2-20shows estimated indoor and outdoor water consumption for single-family residential and irrigation accounts. With an estimated single-family population of 27,600, the single-family per capita indoor water use for 2009 was approximately 66 gpcd. This value is on the low end of the typical indoor water use range of 60 to 80 gpcd[3]. Outdoor use represented approximately 31 % of single-family residential consumption, and the single-family per capita outdoor use over a four month irrigation season was approximately 48 gpcd. The typical range is between 10 and 80 gpcd.

[3] AWWA. Manual of Water Supply Practices M52. *Water Conservation Programs—A Planning Manual, First Edition*, page 41.

EXHIBIT 2-20
Clackamas River Water Estimated Annual Indoor and Outdoor Use, 2009



Wholesale Water Sales

In the past, CRW provided wholesale water to several other cities and water districts. From 1995 to 2000, OLWD purchased approximately 16% (approximately 630 MG out of 4,050 MG) of the water produced by the CRW WTP. In 2001, OLWD stopped purchasing water from CRW and began taking water from the NCCWC, of which it is a member. This resulted in more than a 13%reduction in CRW WTP demand for 1995 to 2003 compared to the previous six years (1995 to 2000). As shown in Exhibit 2-12 wholesale sales have declined approximately 39.8% between 2005 and 2009.

Water Rights

Introduction

Under Oregon water law, with few exceptions, the use of public water (both ground and surface water) requires a water right permit from the Oregon Water Resources Department (OWRD). The administration of water rights by OWRD is based on the doctrine of prior appropriation. Under this doctrine, the first person to have obtained a water right permit (the senior appropriator) is the last to be limited in low water conditions. The date of application for the water right permit usually establishes the "priority date" or place in line of an appropriator. In times of shortage, the senior appropriator can demand the full amount of their water right regardless of the needs of junior appropriators. If there is surplus beyond the needs of the senior appropriator, the next most senior appropriator can take as much as needed to satisfy their right and so on down the line until there is no surplus. A state officer (an OWRD Watermaster) oversees which junior appropriators must stop using water so that senior users' needs can be satisfied.

The right to use water is typically first granted in the form of a water use permit. The permit describes the priority date, the amount of water that can be used, the location and type of water use and often a number of water use conditions. The permit allows the water user to develop the infrastructure needed to put the water to full beneficial use – a requirement of Oregon water law. When the report of beneficial use, called a Claim of Beneficial Use (COBU), is approved by OWRD, a water right certificate is issued confirming the status of the right. Obtaining a water right certificate is the best way to ensure the protection of the use, particularly since municipal water use certificates are not subject to cancellation due to non-use.

Water use permits typically have timelines for making full beneficial use of the water. If more time is needed than provided in the permit, the permit holder may request an "extension of time" from OWRD. In the past, extensions of time were routinely granted by OWRD. Under current law, an extension of time may involve an analysis of what would happen to state and federally listed fish species if the "undeveloped portion of the permit" were to be used.

There are two different application processes that allow modification of a water right. When a water right is in the permit phase (still being developed), the permit holder may modify the water use by changing the location of use and the point where water is appropriated through an application for a permit amendment. For a water right certificate, the water right holder can modify the location of use, the point where water is diverted and the type of use made under the water right through an application for a water right transfer.

Water Rights Held by Clackamas River Water

Exhibit 2-21 provides a summary of CRW's surface water and ground water rights. CRW holds three surface water right certificates authorizing the total use of up to 46.5 cfs (30.1 mgd) from the Clackamas River for municipal use. These certificates are numbered 37794, 79899, and 84072, and have priority dates of 1962, 1968, and 1969, respectively). The authorized point of diversion for all surface water rights held by CRW is the CRW WTP intake structure on the Clackamas River at approximately RM 2.7.

In June 1995, CRW submitted two additional applications for municipal water use from the Clackamas River (applications S-80438 for 77.4 cfs and S-80465, for 71.5 cfs). These two applications are still pending at OWRD.

By virtue of consolidation with Clairmont Water District, CRW also owns one municipal groundwater permit (G-6728) for 8.9 cfs (5.8 mgd) for a well (Clairmont Well No. 1; now referred to as ASR Well No. 1) located near Abernathy Creek in the vicinity of Oregon City. The well was drilled in 1973 to a depth of 560 feet, and the potential yield was estimated at 3,150 gallons per minute (4.5 mgd). Current use of the well is limited to approximately 920 gpm (1.3 mgd). CRW has a permit extension that will expire October 1, 2029 to allow for further development of this water right. The Well No. 1 is also associated with Aquifer Storage and Recovery Limited License 003. Under this limited license, CRW is authorized to store up to 200 million gallons of surface water in the basalt aquifer using 6 injection wells (including Well No. 1). The limited license, which has a number of conditions for monitoring and reporting, expires in 2011.

Aquatic Resource Concerns

Resource concerns are summarized in **Exhibit 2-21**. As shown in **Exhibit 2-22**, the Clackamas River supports a number of streamflow dependent species listed by the state or federal governments as sensitive, threatened or endangered.

Four salmonid species are listed: Chinook salmon (both fall and spring runs are federally listed as threatened); winter steelhead (federally listed as threatened); coho salmon (state listed as endangered); and coastal cutthroat (federally listed as a Species of Concern). Spring Chinook enter the river in the spring, and both fall and spring Chinook spawn in late summer through early fall—typically the lowest-flow season. Juveniles of all the salmon species are present in the mainstem Clackamas River year-round. In addition, the Pacific lamprey is found in the Clackamas and is federally listed as a Species of Concern.

Water Quality Limited Status

In 1998 the Clackamas River from RM 0 to RM 22.9 was placed on Oregon Department of Environmental Quality's (ODEQ) 303(d)-list as water quality limited streams due to summer water temperatures because it exceeds the salmonid rearing temperature standard of 64 degrees F. In 2002, ODEQ also listed RM 0 to RM 15 as water quality limited for violating water contact recreation standards for *E. Coli* from June 1st – September 30th.

ODEQ is responsible for ensuring that bodies of water in Oregon comply with the criteria designated in the federal Clean Water Act. DEQ's responsibilities are to determine whether water quality standards are being violated and whether the beneficial uses of the waters are impaired.

ODEQ's *Oregon's 2004/2006 Integrated Report* identifies the following water quality parameters in the vicinity of the diversion structure (a complete list of the Clackamas River water quality parameters can be found on ODEQ's web page at http://www.deq.state.or.us/wq/assessment/rpt0406/search.asp):

- Alkalinity
- Ammonia
- Arsenic
- Bis (2Ethylhexyl) phthalate
- Chlorophyll a
- Chromium hex
- Copper
- Dissolved Oxygen
- Fluoranthene
- Iron
- Manganese
- Mercury
- Nickel
- PCB
- pH
- Phosphate phosphorus
- Pyrene
- Sedimentation

EXHIBIT 2-21

Water Rights Held by CRW

Source	Priority Date	Application, Permit, and Certificate Numbers	Quantity	Type of Use	Max. Rate of Withdrawal to Date	2007 Withdrawal	Five-Year Avg. Withdrawal	Authorized Date for Completion	CRW Maximum Annual Quality of Water Diverted
Clackamas River	4/25/1962	App: S-37245 Permit: S-27925 Cert: 37794	15.0 cfs [9.7 mgd]	Municipal	15.0 cfs [9.7 mgd]	2,733 MG/yr 231 MG/mo 7.5 mgd	3,318 MG/yr 277 MG/mo 9.1 mgd	n/a	Year -1999 4,511 MG
Clackamas River	5/20/1968	App: S-44939 Permit: S-33586 Cert: 79899	25.0 cfs [16.2 mgd]	Municipal	25.0 cfs [16.2 mgd]			n/a	
Clackamas River	5/23/1969	App: S-46072 Permit: S-34426 Cert: 84072	6.5 cfs [4.2 mgd]	Municipal	6.5 cfs [4.2 mgd]			n/a	
Clackamas River	6/13/1995	App: S-80438	77.4 cfs	Municipal	0	n/a	n/a	n/a	
Clackamas River	6/1511995	App: S-80465	71.5 cfs [46.2 mgd]	Municipal	0	n/a	n/a	n/a	
Well near Abernathy Cr., tributary to the Willamette R.	7/13/1973	App: G-6228 Permit: G-6728 Permit: G-6728	8.9 cfs [5.8 mgd]	Municipal	3.3 cfs [2.1 mgd]	58 MG/yr 4.8 MG/mo 0.16 mgd	12.3 MG/yr 1.0MG/mo 0.03 mgd	Oct. 1, 2029	Year - '08/'09 123.5MG

EXHIBIT 2-22
Streamflow-Dependent species Listed as Sensitive, Threatened, or Endangered in the Clackamas River

Species	State Status	Federal Status
Fall Chinook salmon	Sensitive Critical	Threatened
Spring Chinook salmon	Sensitive Critical	Threatened
Coho salmon	Endangered	Threatened
Winter steelhead	Sensitive Critical	Threatened
Coastal Cutthroat	Sensitive Critical	Species of Concern
Pacific Lamprey	Sensitive Vulnerable	Species of Concern
Chum Salmon	Sensitive Critical	Threatened
Coastal Cutthroat Trout	Sensitive Vulnerable	Species of Concern

Critical Groundwater Areas

There are no critical groundwater areas in the vicinity.

Evaluation of Water Rights/Supply

690-086-0140(3)

CRW holds 46.5 cfs (30.1 mgd) of certificated water rights from the Clackamas River. The degree to which CRW's water rights are secure and satisfied depends on stream flows in the Clackamas River and how many senior water rights holders there are downstream who get first call on water during times of shortage.

There is significant flow in the Clackamas River, even during the driest months of the year. According to long-term stream flow records at the Estacada stream gauge (USGS gauge # 14210000—about 20 miles upstream from CRW's point of diversion), Clackamas River flows range from 1,500 to 2,300 cfs (2,300 to 3,600 mgd) during high-flow months, and from 880 to 2,180 cfs (569 to 1,409 mgd) during low-flow months. Flows increase substantially in the 20 miles down to CRW's point of diversion because of the contributions of many tributaries, including Eagle Creek, Deep Creek, Richardson Creek, Clear Creek, and Rock Creek.

There are many water rights on the Clackamas River, including those that authorize diversion for irrigation, industrial use, and municipal use—as well as those that make use of water in-stream, such as for power production and fish protection. While far from having the most senior rights on the Clackamas, CRW's intake location just three miles from the mouth bestows an important advantage—there is abundant streamflow and there are not many senior downstream users. There are three municipal entities that divert sizeable water quantities downstream of CRW: the SFWB; the NCCWC; and the City of Lake Oswego. Both SFWB and City of Lake Oswego hold water rights that are senior to CRW. One of the most significant downstream senior rights is an instream water right held by the State of Oregon (Certificate 59491). This water right has a priority date of August 26, 1968, and protects flows for aquatic life in the Clackamas River from Three Lynx (at river mile 48) to the

mouth. It authorizes protection of 400 cfs (259 mgd) from July 1 through September 15, and 640 cfs (414 mgd) from September 16 through June 30.

Based on priority date and abundant stream flow, CRW's water right certificate 37794 (priority date April 25, 1962) for 15 cfs (9.7 mgd) is highly reliable. While this right is junior to SFWB's 60 cfs permit S-22581 on the Clackamas River, it is senior to the rights held by the NCCWC and Lake Oswego and to the instream water right.

Certificate 79899 for 25 cfs (16.2 mgd) also appears reliable, given its priority date of May 20, 1968. While this right is junior to SFWB's permit S-22581 and Lake Oswego's 50 cfs permit S-32410, it is senior to the instream water right.

CRW's certificate 84072 (priority date May 23, 1969) is junior to downstream water rights held by SFWB and Lake Oswego, and to the instream water right. This water right also represents a much smaller diversion than CRW's other rights, and historically, stream flows have not dropped below those specified in the instream water right often. Nevertheless, daily records for the stream flow gauge at Estacada (USGS gauge 14210000 at river mile 23.1) indicate that between 1975 and 2000, there were 11 years where daily flows fell below those specified in the instream right. These instances occurred during the late summer and fall of dry years, especially 1977, 1978, 1979, 1987, 1992, and 1994. Therefore, use under this permit may be restricted in some years to satisfy this senior instream water right. Even if CRW's permit is regulated to protect use under the instream water right, it could still be used to provide water for domestic purposes, as the instream right is conditioned to not have priority over such use. ("Domestic purposes" is defined by OWRD as the use of water for human consumption, household purposes, and domestic animal consumption related to residential use of the property.)

Overall, CRW appears to have reliable surface water rights and an ample water supply. In addition, CRW's future use of permit G-6228 could add to its existing supply capacity and increase system reliability, as the use of water under this permit is not likely to be regulated in favor of other uses, nor will it impact listed species or water quality.

CRW currently purchases water to supply its south service areas under the terms and conditions of the expired SFWB supply agreement until a new agreement is established. CRW also augments its SFWB supply with water from CRW Well No. 1. CRW will continue to explore the possibilities of increasing the percentage of supply from Well No.1as well as the potential for establishing a direct supply from its north service area.

SECTION 3

Water Conservation

This section satisfies the requirements of OAR 690-086-0150.

Current Conservation Measures

690-086-0150 (1) and (3)

CRW has implemented a number of conservation measures in recent years. Even though, CRW has not previously had an approved Water Management and Conservation Plan (WMCP).

Public education. CRW maintains a Web site, www.crwater.com, which offers indoor and outdoor water conservation and leak detection information as well providing links to other water conservation web sites. In addition, CRW is a member of the Regional Water Providers Consortium (RWPC) and relies on the RWPC for help in meeting the public education portion of CRW's conservation program. CRW makes a broad range of water conservation printed education material available to customers in the public entry lobby of its Administration Building at 16770 SE 82nd Ave. Clackamas, OR 97015.

CRW paid dues of $21,666 to RWPC for Fiscal Year 2008-2009. RWPC programs include a variety of public outreach efforts including the following:

- A Web site, www.conserveh2o.org that has indoor and outdoor water conservation information and suggestions.
- A metro wide summer media campaign that includes TV and radio advertisements with regular news interviews on local stations.
- Workshops for developers and landscapers that focus on water–efficient landscape design and installation and using water-efficient irrigation equipment.
- Conservation displays available to consortium members for use at local events.
- Brochures containing conservation information.
- Outreach at large regional events such as the Yard, Garden and Patio Show and the Salmon Festival.

Conservation Kits. Indoor water conservation kits provided by the RWPC are given to CRW customers who contact CRW with leak or water cost concerns. The kits contain a low-flow faucet aerator, low-flow showerhead, shower timer, leak detection dye tablets and water conservation literature.

Rates. CRW has a four-tiered, increasing block rate structure that is based on the quantity of water metered. The rate structure encourages conservation, because customers pay higher rates when certain volume thresholds are exceeded. The volume of water consumed is measured in units of hundred cubic feet (ccf). One ccf is equal to 748 gallons. The volume

thresholds, or tiers, are 0-4 ccf, 5-8 ccf, 9-24 ccf, and greater than 25 ccf. CRW provides graphical 12-month water use histories on customer bills so that customers can compare current with past water use.

Water audit. CRW has not previously had a central water audit procedure. However, water use statistics are maintained by Operations and Finance staff and are reported in CRW's *Comprehensive Annual Financial Report (CAFR)*. To date, water used for distribution system flushing, hydrant flushing, fire department use, reservoir leakage, and repaired leaks have been monitored by staff, but have not been included in water use statistics.

Leak detection. CRW invested approximately $60,000 in acoustic leak detection equipment in 1998. In 2006, CRW invested another $40,000 in a new laptop-based leak correlator, 30 acoustic loggers, and additional staff training.

An acoustic leak survey of the 260 miles of pipe within the CRW system is performed once a year. An additional 31.5 miles of leakage prone pipe is surveyed a second time during the year. Leakage prone pipe include OD steel, PVC, Galvanized Steel, and AC/Transite. Problem areas are monitored during the summer and checked as part of routine maintenance at other times during the year.

CRW billing staff monitors customer billing data and notifies them if abnormal water consumption is indicated, possibly indicating the presence of a leak in the customer system.

Leak Repair. Operations staff have located and repaired an average of 37 leaks per year since 1998. The location, pipe material, type of leak, and estimated leakage rate are recorded for each repaired leak. Leakage rate data is not currently included in water loss analyses. The majority of the identified leaks have been pinhole leaks in OD steel pipe. Pinholes range in size from the diameter of a pencil lead to a nickel. All leaks are characterized during repair and recorded in a database for use in identification of future CIP projects.

CRW identified leaks at two of its concrete reservoirs: Henrici Reservoir No. 2 and Beaver Creek Reservoir No. 1. Repairs were performed as part of CRW's FEMA seismic structural upgrade project completed in September 2009. The magnitude of leakage was considered minimal at both reservoirs and was not included in past water accounting. The repair construction costs were $153,000 for Henrici Reservoir No. 2 , and $140,000 for Beavercreek Reservoir No. 1.

Pipe replacements. CRW has replaced approximately 7.1 miles of pipe (2.5 percent of system) at a cost of $3.7 million between FY 2000 and December 2010. Pipelines with recurring leaks have been targeted for replacement and included in an on-going capital improvements plan.

System-Wide Metering. The CRW system is fully metered, and provides water to approximately 12,000 service connections.

Meter Testing and Maintenance. Master meters are tested annually and repaired as needed. All retail meters are monitored for abnormal usage by billing staff. If a meter is found to be malfunctioning it is repaired or replaced. All meters 3-inches and larger are tested annually and repaired as needed. In 2007, a random sample of meters less than 3 inches was tested. Results indicated that routine replacement of these smaller meters is not required.

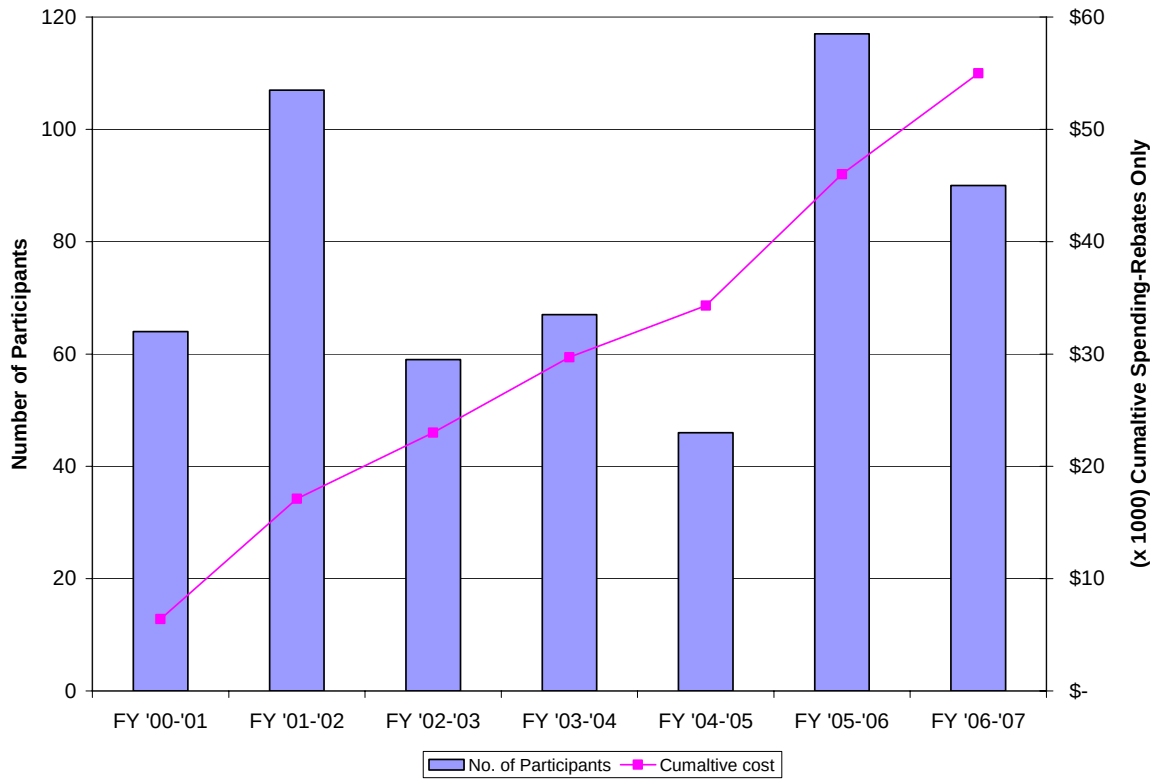
Prevention of Reservoir Overflows. Pressure sensors and transducers, installed in reservoirs turn off pumps when the water surface reaches one foot below the overflow level. Water-level detector set points are calibrated quarterly to ensure the accuracy of water elevations. A back-up float provides overflow feedback and turns off pumps if a transducer fails.

Past Conservation Measures

CRW has a history of supporting water conservation measures to maximize the benefits of their water resources. The responsibilities for previous conservation efforts were shared among several personnel from different areas of the CRW organization. As a result, evaluation of conservation programs was not centralized and systematic. A Conservation Coordinator position was created in December 2007 as part of reorganization. The responsibilities of this position include implementing and evaluating current and future conservation measures. These consist of conducting both the Required Conservation Programs and the Five Year Benchmarks for Additional Conservation Measures.

CRW has had programs that provided rebates to homeowners for installation of water-conserving clothes washers ($100) and dishwashers ($25). All CRW customers were eligible for rebates regardless of whether the low-flow fixtures were purchased to replace existing high-flow fixtures or for new installations. With 550 participants representing approximately 5 percent of single family residential accounts, CRW staff estimate a cumulative water savings of approximately 19 MG over the seven year life of the program. These water savings will continue to accrue over the lifetime of the installed clothes washers. **Exhibit 3-1** shows the annual participation and cumulative cost of rebates for the clothes washer program. Costs associated with advertising the program and processing the rebates are not included. The dishwasher rebate program had twelve participants during the two year period from FY'05-'06 to FY'06-'07, for a total rebate cost to CRW of $300. Both clothes washer and dishwasher rebate programs were terminated for the time being in CRW's 2007 budget process. CRW is not currently offering rebates to CRW ratepayers.

EXHIBIT 3-1
Number of Annual Participants and Cumulative Rebate Cost for CRW's Clothes Washer Rebate Program, FY00-01 to FY06-07



Between 1999 and 2000, CRW participated in a pilot program that provided water audits for three commercial and industrial customers. As noted in CRW's 2005 Water Master Plan Update, as of 2004, none of the measures recommended in the audits were implemented. The water audit reports generated from this project are contained in Appendix C: Comprehensive Water Audit Summary by Black & Veach dated September 21, 2000 of this document.

Use and Reporting Program

690-086-0150(2)

CRW has a water use measurement and reporting program that complies with the measurement standards in OAR Chapter 690, division 85. CRW's water use records can be found through the OWRD webpage.[1]

[1] http://www.wrd.state.or.us/OWRD/WR/water_use_report.shtml

Required Conservation Programs

690-086-0150(4)

The Oregon Administrative Rules for Water Management and Conservation Plans require that all water suppliers establish five-year benchmarks for implementing the following required conservation measures:

- Public education
- System-wide metering
- Meter testing and maintenance
- Unit-based billing program
- Annual water audit
- Leak detection and repair (if system leakage exceeds 10%)
- Main repair and replacement (if system leakage exceeds 15%)

CRW has implemented the above measures. CRW maintains water loss statistics, is fully metered, has a meter testing and maintenance program, and uses a 4-tiered, inclining block rate structure. CRW conducts public outreach via printed and electronic media through membership in the RWPC. The RWCP conduct educational activities such as metro area roadside billboard water conservation messages, TV and radio water conservation messages, community media forum discussion events and classroom education presentations. CRW has an on-going leak detection and repair program, and has identified pipes prone to leakage for replacement in its capital improvements program.

Five Year Benchmarks for Required Existing or Expanded Conservation Measures

Public Education. CRW continues public education activities through participation in and financial support of the RWPC. CRW will be placing increased emphasis on youth water conservation education by directly employing companies to conduct public school class and assembly presentations. CRW will additionally be conducting an annual outdoor water conservation customer billing insert. In 2009, CRW added household leak detection to the CRW website (currently under Frequently Asked Questions). CRW also, provides a list of resources available to CRW customers on the CRW conservation web page.

Conservation Kits. CRW continues to make indoor conservation kits available to CRW rate payers.

System Metering. All customers served by CRW are metered. CRW will continue to require meters for all new customers. CRW will continue to require metering of hydrant water used by contractors.

Meter Testing and Maintenance. CRW will continue annual testing and repair of production meters and all meters 3-inches and larger.

Rates. CRW's inclining block rate structure is designed to encourage conservation because customers pay higher rates if they exceed set thresholds. CRW will consider conservation as it evaluates future rate changes. CRW will continue to provide graphical 12-month water use histories on customer bills so that customers can compare current with past water use.

Annual Water Audit. CRW currently collects data regarding water consumption that are not formally incorporated in its water statistics database. These include water used during routine flushing of the distribution system, estimates of water lost through identified leaks, and water use by the Fire Department. By 2012, CRW will establish procedures that integrate the water data currently being captured into a water audit process. That data will reflect the multiple District Metered Zones (DMA) already established within CRW boundaries. Guidelines established in the American Water Works Association (AWWA) manual titled *Water Audits and Leak Detection* (M-36, AWWA 1990), along with the AWWA Research Foundation, Leakage Management Technologies manual will be utilized to establish Water Management and Conservation data.

Leak Detection and Waterline Repair/Replacement. As currently tracked the water statistics indicate that the annual system wide leakage rate is below the 10% action level for leak detection and waterline repair or replacement. The 5-year average loss for the overall system between 2006 and 2010 was under 6%. Nevertheless, CRW will continue its commitment to annual leak detection. The entire system will be surveyed once annually with acoustic leak detection equipment and problem areas will continue to receive additional attention.

Identified leaks will continue to be repaired promptly, and pipeline replacements for areas with historic leakage are identified in CRW's capital improvement plan (CIP). In 2009, 6,100 feet (1.2 miles) of 6-inch diameter steel pipe was replaced at a cost of $611,500. Since then three additional projects have been completed on Beavercreek Road, Alderplace, and Cliffwiew. The pipe length replaced is approximately 2600 feet at a cost of $420,000. The replacement of 3500 feet of transmission main is planed for the summer of 2011. Additional projects totaling approximately 4.7 miles have been identified for future replacement. An updated 5-year CIP and General Maintenance Plan is currently under development.

Reservoir Leak Repair. CRW repaired leaks in the two reservoirs with identified leaks in 2009.

Expanded Use under Extended Permit G-6728

690-086-0150(5) & (6)

CRW was granted an extension in 2009 to develop a water source associated with permit G-6728. CRW is conducting research to evaluate related aquifer water capacity and quality to determine the potential water volume capacity of this permit. Because CRW serves a population greater than 7,500, several additional conservation measures must be considered by either establishing 5-year benchmarks to implement additional conservation measures, or document that the measures are neither feasible nor appropriate.

CRW currently meets the requirement for having system-wide leakage (estimated real losses) of less than 15%. CRW has an on-going, annual leak detection program and anticipates that leakage rates will continue to decline as leak-prone piping is replaced.

Analysis of Potential New Conservation Measures

As previously noted CRW has a history of fostering water conservation and is dedicated to maximizing the benefits of their water resources. In deciding which additional measures to

implement, CRW has identified conservation measures that are expected to provide significant water savings compared to their implementation costs. This section explains the analysis of potential additional measures.

As described in Section 2, residential customers account for 67% (45% for single-family and 22% for multi-family) of CRWs retail water sales. Approximately 68% of water used by CRW's single-family residential customers is used for indoor purposes. The remaining 32% is used for outdoor purposes, primarily landscape irrigation.

A water audit pilot program from 1999 to 2000 identified water savings opportunities at three commercial and industrial facilities. Commercial and industrial customers account for 20% of CRWs retail water sales. Future programs targeting this sector may prove beneficial.

These use statistics suggest that CRW should consider conservation programs that target following areas:

- Indoor use
- Irrigation
- Commercial/industrial use by customers using large amounts of water

Conservation programs that target reductions in indoor use will realize reductions in both the average annual and maximum day demands. Programs that target irrigation will help to reduce the maximum day demand. Programs that target customers using large amounts of water will address significant amounts of the overall water demand in the system, both for average and maximum day.

In addition to these targeted areas, supply-side programs such as leak detection and repair will contribute to reductions in both average and maximum day demands.

Reductions in indoor use can be accomplished by programs such as customer and youth education and promoting low use fixture / appliance replacement. Outdoor irrigation savings can be achieved through programs such as promoting the use of weather-based irrigation devices and xeriscaping. Water audits may be an effective means to help customers that use large amounts of water to find efficiencies in their operations. A public information program will contribute to savings in all three areas.

Exhibit 3-2 provides a summary of new or expanded conservation measures that were given detailed consideration in the development of this plan. The table lists potential programs, the assumed participation during a five year implementation period, the anticipated lifespan of each measure, costs to implement, and potential water savings in the fifth year. The unit value of each program is calculated as the cost of implementing a program over five years divided by the water savings (in thousands if gallons) that might be achieved over the lifespan of the conservation measure. Using this approach, the lowest values (the lowest cost per 1,000 gallons of water savings) represent the most beneficial programs.

Conservation program costs include labor performed by district staff, direct expenses, and contract costs. Actual costs and water savings will vary depending on the level of participation by customers, and the actual level of staff effort required to implement and to evaluate the conservation programs.

Of the programs listed in **Exhibit 3-2**, the most cost-effective is CRW's on-going Leak Detection and Waterline Repair/Replacement program. While this program requires a significant investment of approximately $1,200,000 from 2005 - 2009, the large water savings achieved over the life of the conservation measure makes the unit cost of this program equal to approximately $0.20 per 1000 gallons. This savings helps offset the cost of providing water to CRW customers in both the north and south service areas. Savings are especially realized on the south side, since CRW purchases water at a wholesale rate of $0.74 per ccf from SFWB to serve the southern service area, in addition to CRW's transmission costs to deliver water to its customers. Given the immediate and long-term benefits of leak detection and waterline repair/replacement, CRW is committed to continue this program.

The next two most cost-effective programs are the toilet and clothes washer fixture replacement programs. The success of fixture replacement measures largely depends on the level of public participation. Past participation in CRW's clothes washer rebate program demonstrated an effective marketing strategy. Both programs required a significant financial investment by CRW to initiate, maintain, and evaluate the programs over their lifetimes. In 2007 the CRW rebate program was ended by board resolution in response to concerns of overall cost and budgetary impact. In the future, an approach of promoting low water use fixture and appliances while directing and helping facilitate customer access to existing State and Federal Energy Rebate Incentives will be a more fiscally sustainable approach than direct financial contributions to customer purchases as has been done in the past. The program's focus will be on communicating the value to the customer of replacing worn out fixtures and appliances with low-flow models.

Residential indoor use accounts for approximately 34 percent of the total annual metered consumption in the CRW system. As illustrated in **Exhibit 3-3** (based on *Residential End Uses of Water*, American Water Works Association Research Foundation, 2000), toilets and clothes washing machines account for 48% of this indoor residential use in a typical home. Therefore, for an annual average retail demand of 6.8 mgd, 1.1 million gallons is used on average each day for these two fixtures. Annually, this totals 400 million gallons. Implementation of the toilet and clothes washer rebate programs targets this volume of water use. The replacement of older toilets and clothes washing machines with water-efficient models provides high water savings per each unit. The limitation to each program is obtaining significant participation by customers.

Technical assistance in the form of onsite water use audits had the next most favorable unit value. However, CRW's past experience with water audits of commercial customers illustrates the difficulties associated with motivating adoption of conservation measures: none of the measures suggested in a water audit pilot program in 2000 had been adopted four years later. Rather than participating in formal water audits of commercial and industrial water users, upon request, CRW's Conservation Coordinator will assist customers in examining water use patterns, and identifying possible water conservation opportunities.

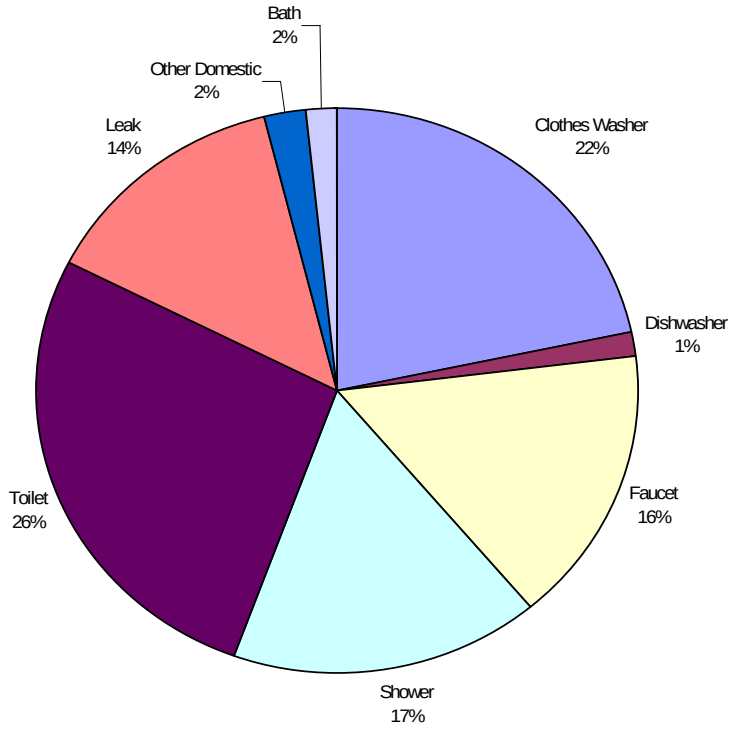
The rebate programs for weather-based irrigation measurement and control devices and for dishwashers had less favorable unit values. The weather-based irrigation system rebate program is a relatively new program in Oregon. Participation rates and data on water savings are less certain than for other measures. Conservative estimates for these parameters led to the high calculated unit cost.

EXHIBIT 3-2
Analysis of Conservation Measures

Program	Estimated Total Number of Participants after 5 years	Estimated Lifespan of Improvement (years)	Rebate Value	Cost over 5 years	Total Savings, 5th Year (gpd)	Annual Volume Saved, 5th Year (MG)	Water Savings During Peak Season [1] (MG)	Water Savings During Non-Peak Season (MG)	Unit Cost of Water Savings[2] ($ per 1,000 gal)
Leak detection and repair	190	50	NA	$1,160,000	330,000	120	40	80	$0.20
Toilet rebate	380	25	$75	$64,000	6,800	2.5	0.8	1.7	$1.00
Clothes washer rebate	400	25	$100	$77,000	7,600	2.8	0.9	1.8	$1.10
Dishwasher rebate	30	20	$25	$14,000	200	0.1	0.03	0.06	$8.00
Weather-based irrigation device rebate	5	10	$150	$15,000	1,200[1]	0.1	0.1	0.04	$10.30
Commercial and industrial water audits	20	30	NA	$33,000	1,200	0.4	0.1	0.3	$2.50
Total				**$1,363,000**	**347,000**	**126**	**42**	**84**	

[1] Peak summer irrigation season is June – September. The gallons-per-day savings for the weather-based irrigation system measure is calculated for the irrigation season.
[2] Calculated based on the water savings accumulated over the typical lifespan of the measure.

EXHIBIT 3-3
Typical Indoor Residential Use



Note: Based on *Residential End Uses of Water*, American Water Works Association Research Foundation, 2000

The relatively low participation rate in CRW's dishwasher rebate program, and the relatively small fraction of indoor water use attributed to dishwashers (1%, shown in Exhibit 3-3) indicate that CRW would achieve greater value by investing in other rebate programs.

Even though public education was not evaluated as a separate program in Exhibit 3-2, it is the foundation for successful implementation of every conservation program, and must be an essential component of CRW's conservation efforts.

Five-Year Benchmarks for Additional Conservation Measures

The following conservation measures are feasible and appropriate for CRW to implement over the next five years:

- Within available resources, strive to reduce the leakage rate to 10% or less in all three service areas by 2015. Continue the annual leak detection program. Continue documentation of repaired leaks including location, pipe material, type of leak, and estimated leakage rate for each repaired leak. By 2012, use procedures outlined in the American Water Works Association (AWWA) manual titled *Water Audits and Leak Detection* (M-36, AWWA 1990) to help estimate real versus apparent losses.
- CRW will be reaching out to school age children with its water conservation message by contracting professional school class presentation companies to provide classroom and assembly water conservation presentations. CRW will be including an outdoor watering conservation advice insert in customer billings in June of each year.

- Upon request, CRW's Conservation Coordinator will provide technical assistance regarding implementation of water conservation measures to both its Industrial / Commercial and Residential customers. CRW will be promoting to its customers, the value of low flow toilet fixtures, wash machines and dishwashers while directing and helping facilitate customer access to existing State and Federal Energy Rebate Incentives.
- CRW will establish procedures that integrate the water data currently being captured into a water audit process. That data will reflect the multiple District Metered Zones (DMA) already established within CRW boundaries. Guidelines established in the American Water Works Association (AWWA) manual titled *Water Audits and Leak Detection* (M-36, AWWA 1990), along with the AWWA Research Foundation, Leakage Management Technologies manual will be utilized to establish Water Management and Conservation data.
- CRW functions only as a water provider and does not have access to reclaimed water for non-potable water use opportunities. CRW manages water from the Water Treatment Plant filter backwash and basin cleaning process; however, it is currently neither feasible nor appropriate to reuse the water. Filter backwash and basin cleaning water is currently managed through dechlorination, settling and decanting the clear water from 4 designated waste settling ponds, followed by release to a natural pond. The water from the natural pond is released to the Clackamas River as authorized by a National Pollutant Discharge Elimination System (NPDES) Permit.

  Studies have shown that the recycling of filter backwash water can concentrate the Protozoan Cysts of Giardia and Cryptosporidium through stratification, by way of their specific gravity and the particles these cysts are attached to. Giardia tends to be a slightly lighter particle than Cryptosporidium, so two possible zones are possible. Drawing from strata rich in either of these cysts poses a risk of compromising efficient filtration.

  Due to the possibility of Giardia and Cryptosporidium in the waste stream accumulating in the settling ponds, and without additional filtration per Oregon Health Authority requirements it is not in CRW's best interest to use recycle filter wash water in areas where human contact is possible, such as landscapes, public parks and golf courses.

SECTION 4

Curtailment Plan

This section satisfies the requirements of OAR 690-086-0160

Introduction

Clackamas River Water has prepared this water curtailment plan to deal with water shortages when consumption exceeds production capabilities. Water shortages could occur because of drought conditions that deplete source water supplies, flooding or other natural disasters that overwhelm the treatment plant, or a facility failure (mechanical or electrical) that limits potable water production. This plan is designed to conserve and extend CRW's water supply through conservation, waste reduction, and equitable usage. Protecting supplies for public health, fire protection and domestic use is the top priority of this plan.

History of System Curtailment Episodes

690-086-0160 (1)

CRW has not experienced a water shortage within the last ten years.

Curtailment Stages

690-086-0160 (2)

CRW has four curtailment stages:

Stage 1 "Water Shortage Alert" is the least severe of the four stages, and is characterized by the on-set of conditions that, if unabated, will lead to Stage 2, Serious Water Shortage. All associated curtailment actions are advisory or voluntary.

Stage 2 "Serious Water Shortage" is the stage in which an actual water shortage is identified. Most associated curtailment actions are mandatory.

Stage 3 "Severe Water Shortage" is characterized by an acute water shortage. All associated curtailment actions are mandatory.

Stage 4 "Emergency Water Shortage" is the most severe of the four stages, and is characterized by widespread water supply disruption, loss of source supply, or a condition that poses an immediate risk to public health and safety.

Curtailment Event Triggers

690-086-0160 (3)

CRW's curtailment stages are triggered by one or more of the events as shown in **Exhibit 4-1**.

EXHIBIT 4-1
CRW Curtailment Stages and Triggers

Curtailment Stage	Initiating Condition
Stage 1 Water Shortage Alert	Forecasts of below-normal summer stream flows; Mechanical or electrical malfunction causing the loss of pumping capacity at intake facility; or Minor damage to raw or treated water transmission mains (e.g., leaking joint requiring repair.)
Stage 2 Serious Water Shortage	Declaration of drought by Governor pursuant to ORS 536.720; Continuation of hot dry weather predicted; Declining river levels; or Mechanical or electrical malfunction causing the loss of the largest pump at intake; Extensive repairs needed on raw or treated water transmission mains.
Stage 3 Severe Water Shortage	Continuation of hot dry weather predicted; Clackamas River stream flows below 510 cubic feet per second (cfs) between July 1 and September 15 or below 750 cfs between September 16 and June 30[1]; Significant reduction in pump capacity at water treatment plant; Serious mechanical or electrical malfunction within the system; Multiple failures in the joints of the raw or treated water transmission mains.
Stage 4 Emergency Water Shortage	Clackamas River stream flows below 510 cfs between July 1 and September 15 or below 730 cfs between September 16 and June 30 impacting instream water rights[2]; Severe drought conditions; Prolonged loss of utility electrical service at water treatment plant or intake; Major mechanical or electrical malfunctions causing loss of multiple pumps at intake or water treatment plant; Extensive damage to transmission, pumping or treatment processes for example caused by a natural disaster, Contamination of source of supply; Imminent terrorist threat against supply system; or Intentional acts or fire, contamination of source or any other event resulting in an immediate, sustained deprivation of water supply

[1] The approximate total of estimated current peak day withdrawals for the Clackamas River Water Users (107 cfs) and minimum in-stream flows between July 1 through September 15 (400 cfs) and between September 16 and June 30 (640 cfs), measured at U.S. Geological Survey gauging station 14211010 at the South Fork Water Board's intake.

[2] Same as footnote 1, but reflects a fifteen percent reduction in current peak day demands spread across all municipal water providers.

Authority

The CRW General Manager is responsible for execution of the plan provisions once an emergency has been declared. Actions under Stages 2 through 4 of this plan may be initiated only after a declaration of emergency by the CRW General Manager, or designee with notification to the Board of Commissioners.

Plan provisions will remain in effect until the emergency is declared to have ended by the initiating party. The Board may rescind an emergency declaration issued by the General Manager upon a finding that demonstrates the emergency no longer exists, or that the original declaration was made in error.

Actions may be applied to the entire system, or only to those water use sectors, or in those geographic areas that are directly impacted by a water supply shortage.

Stage 1: Water Shortage Alert

Under the Water Shortage Alert stage, CRW's General Manager will activate a program to inform customers of the potential for drought or the need for temporary reductions in consumption due to reasons other than drought. The manager shall issue a general request for voluntary reductions in water use by all water users. The request will include a summary of the current water situation, the reasons for the requested reductions, and a warning that mandatory cutbacks will be required if voluntary measures do not sufficiently reduce water usage. Stage 1 public information program elements would include the following:

1. Contacting local media outlets to notify the public about the potential for summer water shortages or temporary interruptions to normal service delivery.
2. Posting a public service announcement and link to conservation tips on CRW's home webpage.
3. Providing notice on water bills or through utility bill inserts.
4. Activating a CRW water conservation hotline. Include a pre-recorded message providing conservation tips. Update recording weekly to maintain current status of event trigger.
5. Initiating contact with senior operations staff of communities inter-tied with CRW to investigate possibility of activating inter-system connections.
6. Contacting wholesale customers notifying them of the existence or potential for water shortages. In certain circumstances it may be necessary to "lock-out" interties with wholesale customers as a means of offloading demand on CRW's system.

Stage 2: Serious Water Shortage

The Serious Water Shortage stage is similar to Stage 1 except that certain water uses will be prohibited. This stage has more emphasis on the reduction of nonessential water use. A demand reduction target of 10% of MDD will be communicated to the general public. Additional Stage 2 voluntary program elements would include:

1. CRW General Manager will declare a state of emergency.
2. Providing handouts to field personnel with direction to remind customers of voluntary measures and shortage status.
3. Encouraging, through public service announcements, voluntary restrictions on outdoor irrigation. Customers will be asked to irrigate only between the hours of 8 pm and 10 am.

4. Encouraging customers to refrain from washing cars except at commercial establishments that recycle or reuse water in their cleaning process.

5. Prohibiting nonessential uses of water including recreation, remodeling, reconstruction and cleaning uses. Nonessential uses of water may be prohibited unless such uses were contracted for prior to implementation of this curtailment action or unless there is a demonstrable need to do so in order to meet public health or safety requirements including but not limited to abatement of fire or sanitation hazards or to meet air quality standards mandated by the Oregon Department of Environmental Quality.

Stage 3: Severe Water Shortage

In addition to the actions included in Stage 1 and 2, Stage 3 assumes Stages 1-2 have been considered and that a state of emergency has been declared. Stage 3 also will impose an expanded suite of mandatory prohibitions on non-essential water use with the goal of achieving reductions of 20 percent of MDD. Under Stage 3, CRW would introduce the following mandatory water reduction measures:

1. Restricting outdoor irrigation to only 3 days per every 7-day period and only between the hours of 8 pm and 10 am. This restriction and prohibition applies to all outdoor irrigation unless:

    a. grass, turf or landscaping is less than 1-year old, or;

    b. grass or turf is part of a commercial sod farm, or;

    c. grass or turf areas are within a high use athletic field used for organized play, or;

    d. grass or turf areas are used for golf tees or greens, or;

    e. grass or turf areas are part of a park or recreation area deemed by the General Manager to be of particular significance and value to the community.

Notwithstanding the exceptions to the outdoor irrigation restrictions and prohibitions noted above, outdoor watering shall be limited to only that necessary to maintain plant health. There shall be no unnecessary watering.

2. Prohibiting all water waste:

    a. No unfixed leaks

    b. No hosing of paved surfaces

    c. No fountains except those using re-circulated water

    d. No water running onto streets, sidewalks, or into gutters

    e. No washing of vehicles other than in establishments that recycle water

    f. No washing of roofs, decks or home siding unless such uses are solely to abate a potential fire hazard.

3. Activating intersystem connections with inter-tied communities. This measure would only be undertaken if the severe water shortage was due to an event not related to a shortage in the source of supply which also serves neighboring communities.
4. Working with local industrial and large commercial water users to minimize their water use.

Stage 4: Emergency Water Shortage

Conditions causing Stage 4 curtailment measures are severe enough in terms of extent and duration that substantial reductions in water use must be achieved as quickly as possible. Stage 4 assumes Stages 1-3 have been considered and that a state of emergency has been declared. State 4 also responds to events causing an immediate and sustained loss of the source of supply or major damage to critical treatment, transmission and pumping systems. Examples include failure of a main transmission line, failure of the intake or water treatment plant, a chemical spill into the Clackamas River upstream of the intake, or a malevolent attack on the system that introduces a contaminant at some point in the system.

Stage 4 builds on measures enacted through the previous stages. Depending on the emergency, all water use of any kind may be prohibited by order of the General Manager, except that necessary for human consumption and sanitation needs. However, in any case, all outside watering is prohibited and any exceptions noted above for outdoor water uses are rescinded unless such uses are solely to abate public health or fire hazards. Aside from emergency prohibition on all water use, Stage 4 measures attempt to achieve reductions in residential and commercial demands of up to 50% of MDD.

Under Stage 4 it will be expressly prohibited to engage in the following activities:

1. Water, sprinkle or irrigate lawns, grass, landscaping or turf.
2. Wash, wet down, or sweep sidewalks, walkways, driveways, parking lots, open ground or other hard-surfaced areas with water.
3. Wash vehicles, unless the General Manager finds that the public health, safety, and welfare is contingent upon frequent vehicle cleaning such as cleaning of solid waste transfer vehicles, vehicles that transfer food and other perishables, or as otherwise required by law.
4. Flush water mains, except for water quality concerns or emergency purposes.

CRW will continue to investigate and develop specific back-up plans for a Stage 4 emergency. These plans may include purchasing water from other providers, coordinating water distribution points through the use of water tank trucks or by supplying bottled water.

Curtailment Plan Implementation and Enforcement

690-086-0160 (4)

Enforcement of Restrictions

If any customer of CRW fails to comply with the mandatory water use restrictions of this Curtailment Plan, the user shall be given a written notice of such violation. The notice will be delivered by first class mail to the premises at which the unlawful use is occurring. The user will be assessed a penalty in addition to the amounts due for service in accordance with CRW policy:

- First violation - Written notice of violation.
- Second violation - A fine will be added to the user's water bill.
- Third violation - the user's water service will be terminated unless a variance is applied for under the provisions of this Curtailment Plan, and restored only after the Water Shortage has been declared to be over as provided herein.

Variances

Users, who in their belief, are unable to comply with CRW's mandatory water use restrictions, may petition for a variance from restrictions by filing a petition with CRW within ten (10) working days after the issuance of the Proclamation requiring water use restrictions or within five (5) calendar days following notice of violation. All petitions for variance shall complete the appropriate documentation as requested by CRW staff.

In order for the variance to be granted, the petitioner must demonstrate clearly that compliance with the Ordinance would result in significant economic or physical damage. The General Manager is authorized to grant variances. In addition, CRW is authorized to grant temporary variances for existing water uses otherwise prohibited under the Ordinance if it is determined that failure to grant such variances could cause an emergency condition adversely affecting health, sanitation, or fire protection for the public. No such variance shall be retroactive or otherwise justify any violation of this Ordinance occurring prior to the issuance of the variance. During the period from the date of filing the variance until decision by the General Manager, the user may continue to use water in an amount not to exceed the user's average daily winter usage.

SECTION 5

Water Supply

This section satisfies the requirements of OAR 690-086-0170.

Delineation of Service Area

OAR 690-086-0170 (1)

Exhibit 5-1 shows CRW's current service area. A description of the service area is supplied in Section 2. Historically, neighboring city and water district boundaries have changed relatively frequently as a result of consolidation or annexation. This state of flux in service area boundaries is difficult to predict. CRW does anticipate the possibility of significant expansion or contraction of its service area over the 20-year planning period. Therefore, population and demand estimates were projected for the existing service area.

Population and Water Use Projections

OAR 690-086-0170 (1)

Two sources were used to develop population projections: 1) account and GIS data maintained by CRW, and 2) GIS data from Portland Metro's *Metroscope Gen 2.3 - Year 2030 Transportation Analysis Zone (TAZ) Allocation Report*. TAZ data include area-specific population estimates for 2005 and 2030. GIS analysis of the intersection of CRW's service area with TAZ data was used to determine CRW's portion of the TAZ population projections. (The TAZ population estimate for a given zone was multiplied by the percentage of the CRW service area within the zone.) **Exhibit 5-2** shows CRW's service area with the TAZ overlay. Because of differences in land use development north and south of the Clackamas River, separate projections were made for the north (Area 1) and south (Areas 2 and 3) service areas. The CRW service area population estimate for 2007 based on TAZ data was approximately 40% higher than the service population estimate based on the number of customer accounts. Therefore, TAZ projections were used to determine average annual population growth rates for the two areas, but 2007 service area populations were based on the lower, account-based estimates.

The following assumptions were used to develop water use projections:

1. The total 2009 service area population was estimated to be approximately 43,400, with 28,600 people located north of the Clackamas River and 14,800 people located south of the river.

2. Based on demand data averaged for the two-year period of 2006-2007, per capita water demand rates were set as follows:

   - Area 1

     – Average day demand (ADD): 91 gallons per capita per day
     – Maximum day demand (MDD): 175 gallons per capita per day

  - MDD to ADD Peaking Factor = 1.9 from CRW WTP production data

- Areas 2 and 3
  - Average day demand (ADD): 120 gallons per capita per day
  - Maximum day demand (MDD): 340 gallons per capita per day
  - MDD to ADD Peaking Factor = 2.8 from the 2005 Water Master Plan Update

3. CRW's wholesale water sales accounted for approximately 1,000 MG annually from 2005 through 2009, which represented approximately 32% of total metered consumption. CRW has supplied larger volumes of water to wholesale customers in the past. For the purposes of this plan, CRW's wholesale supply was assumed to remain constant at 2007 levels for the planning period.

4. CRW approved the Carver Bridge transmission Main project which constructs a transmission main to establish a direct supply to its south service area from its north service area. Construction of the main is schedule to start in the winter 2013 and is anticipated to be completed in 2015.

5. Surrounding cities and water districts have permitted water rights (not currently being utilized) on the Clackamas River that has not been "Certificated". Due to limited available surface water it is anticipated that obtaining future "Certificated" water rights from the Clackamas River will be limited.

6. Outlined in the districts and city water master plans and water resource studies indicates additional source water will be required to meet future demands. Based on forecasted growth of SWA, City of Happy Valley and the City of Damascus, these government entities could enter into Intergovernmental Agreements (IGA) for wholesale water from CRW through available water treatment capacity utilizing "certificated" water rights.TAZ projections through 2030 were used to estimate an average annual population growth rate of 0.7% per year for Area 1 and 3.8% per year for Areas 2 and 3.

7. Per capita demands were held constant for the entire planning period. Therefore, changes in the proportion of residential to industrial use are not accounted for. Per capita demands and the demand projections in this plan will require periodic evaluation and adjustment.

EXHIBIT 5-1
Clackamas River Water Service Area Map

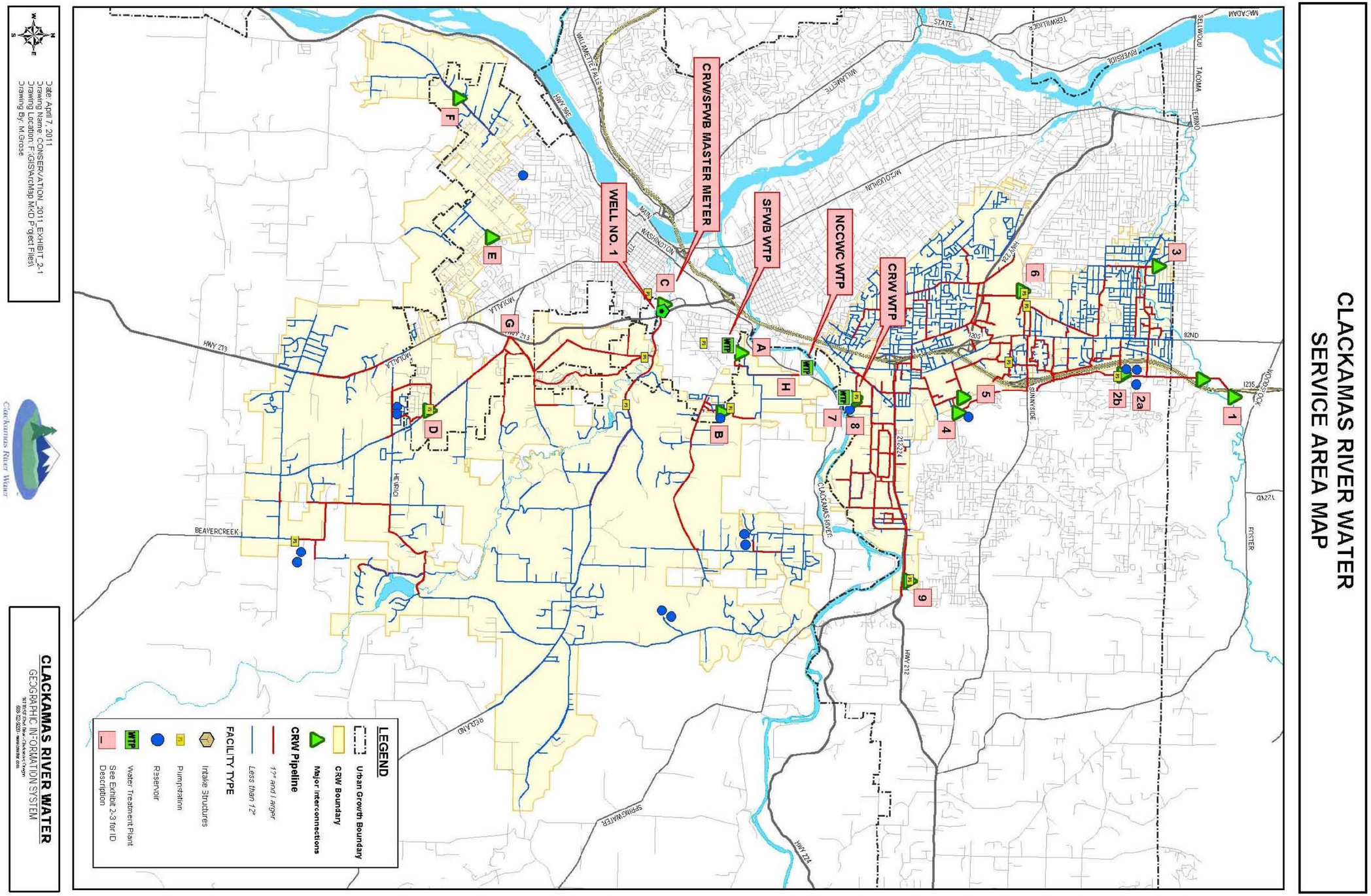


EXHIBIT 5-2
Schematic of CRW Service Area and Overlapping TAZ Zones

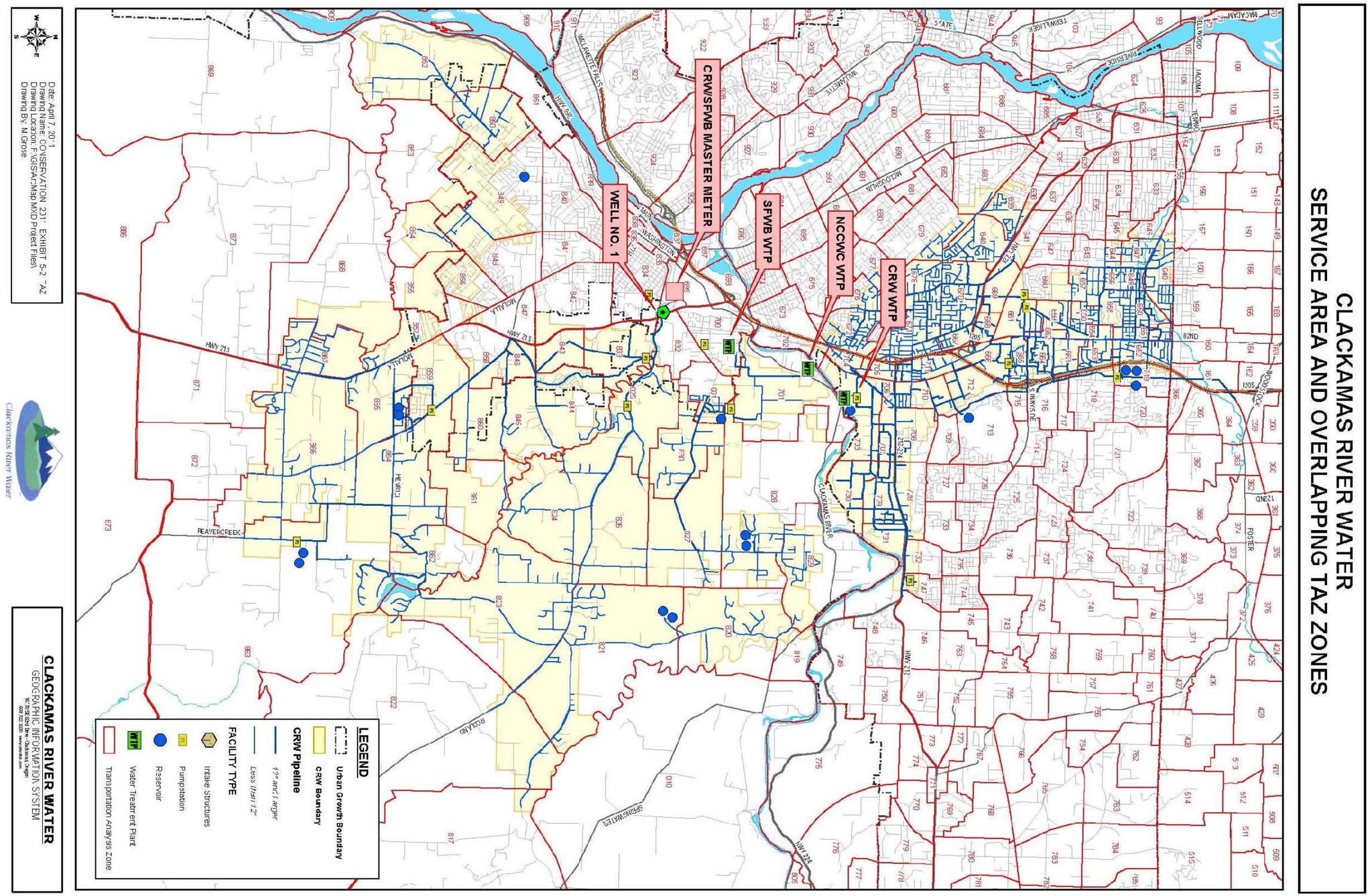


Exhibit 5-3 presents population projections for the north and south service areas, and total service population through 2030.

EXHIBIT 5-3
Summary of CRW's Service Area Population Projections: North and South of the Clackamas River and Total

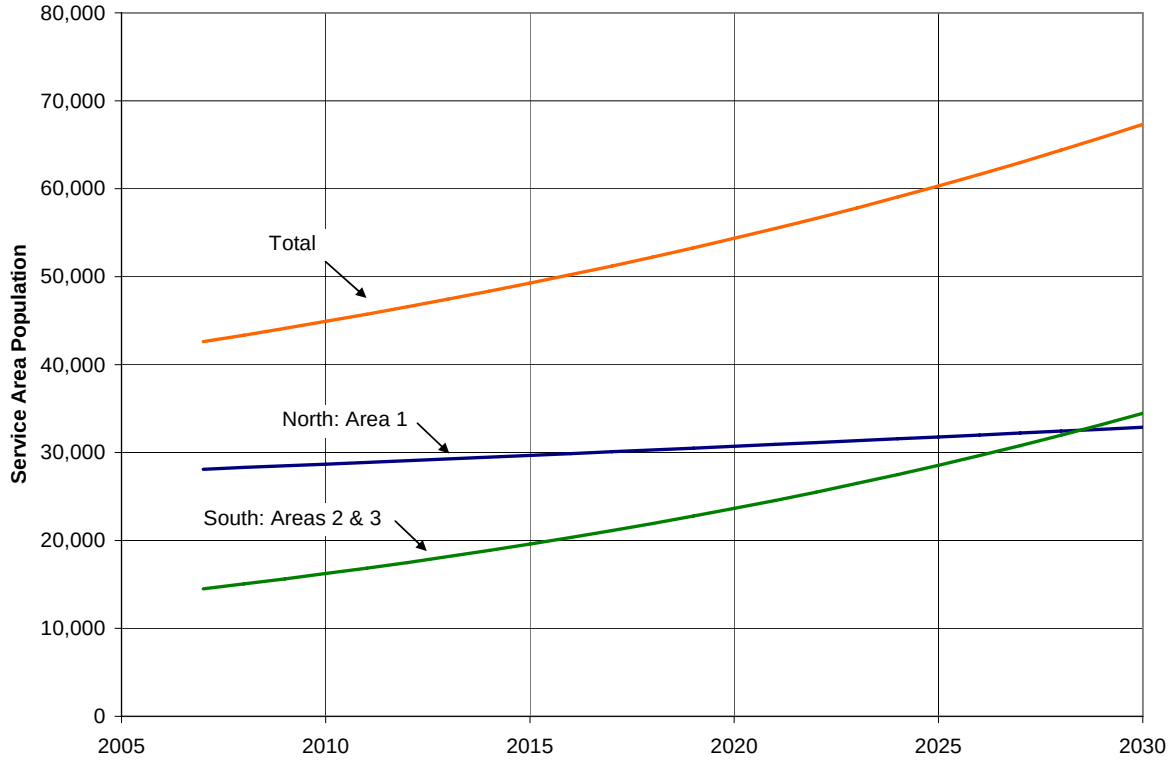


Exhibit 5-4 presents 10- and 20-year demand projections. The overall system demand is equal to the sum of the projection in the north and south service areas and a constant wholesale water demand. According to these projections, within the 20-year planning horizon the CRW water system will need to provide an average day demand of 12.6 mgd and a single day maximum demand of 26.1 mgd. These values are 30% greater than the demands experienced in 2007.

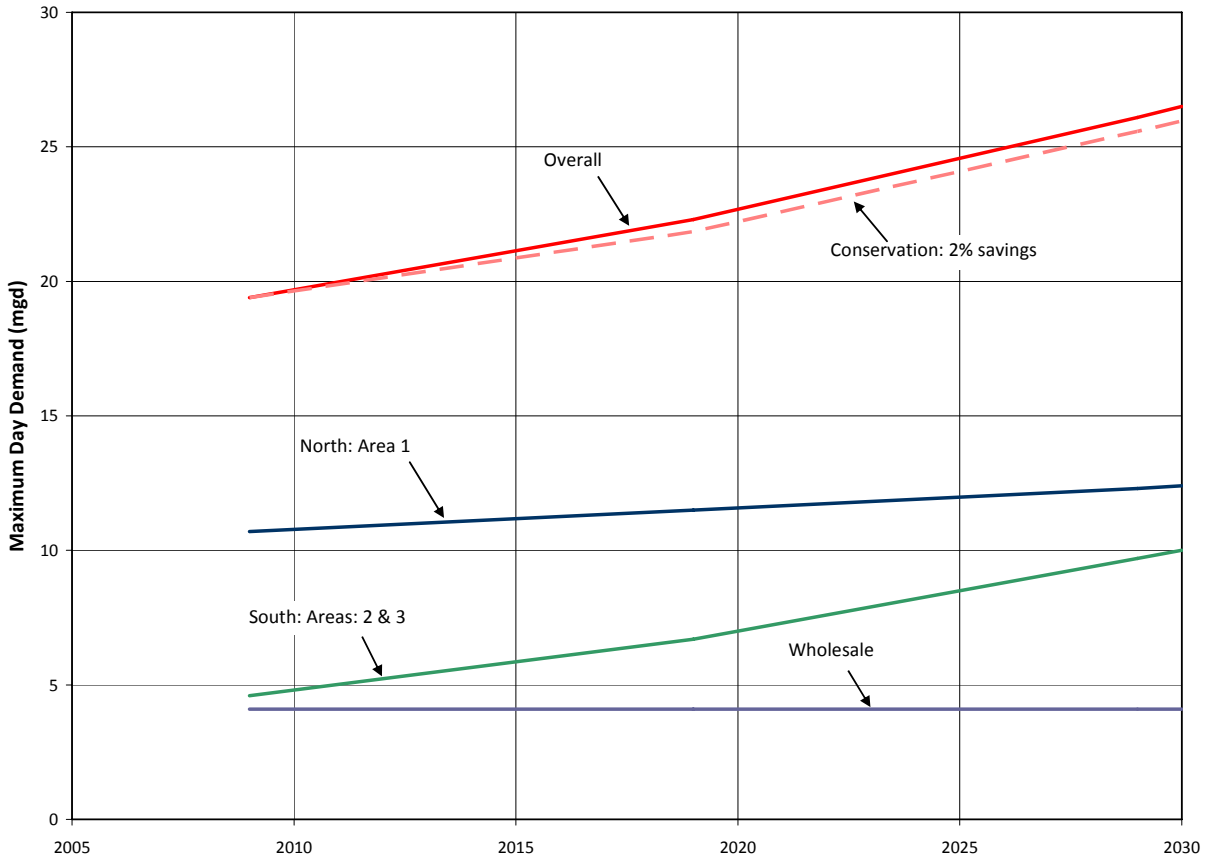
EXHIBIT 5-4
CRW Demand Projections, mgd

	North		South		Wholesale		Total	
	ADD	MDD	ADD	MDD	ADD	MDD	ADD	MDD
2009	4.2	10.7	1.6	4.6	2.7	4.1	8.5	19.4
2019	4.5	11.5	2.4	6.7	2.7	4.1	9.6	22.3
2029	4.8	12.3	3.5	9.7	2.7	4.1	11.0	26.1

Exhibit 5-5 presents the MDD projections presented in Exhibit 5-4, and projections adjusted to reflect 2% maximum day demand water savings through conservation measures adopted

by retail customers over the next five years. The analysis of conservation measures in Section 3 suggest an MDD conservation savings of approximately 2% assuming all programs analyzed in Table 3-2 were to be implemented.

EXHIBIT 5-5
Summary of CRW's Maximum Day Demand Projections by Service Area and Overall



Schedule to Exercise Permits and Comparison of Projected Need to Available Sources

OAR 690-086-0170 (2) and (4)

CRW holds three surface water right certificates authorizing the total use of up to 46.5 cfs (30.1 mgd) from the Clackamas River for municipal use. CRW also holds one municipal groundwater permit (G-6728) for 8.9 cfs (5.8 mgd) for Well No. 1 located near Abernathy Creek in the vicinity of Oregon City. The well has a current production capacity of approximately 920 gpm (1.3 mgd). CRW has received an extension to 2029 to allow further development of this water right permit.

CRW is currently working with Clackamas County to install a water main in the future Carver Bridge replacement. CRW is also a party to a Joint Operating Plan between NCCWC, CRW and SFWB. In this Joint Operating Plan the parties agree to deliver water

and otherwise cooperate to serve the public. Currently CRW provides water for Service Areas 2 and 3 by purchasing water from SFWB or drawing it from Well No. 1. Therefore, Well No. 1 is a critical emergency and supplemental supply for the south service area. As shown in **Exhibit 5-6**, current demands in the southern service areas already exceed current well production capacity. In addition, projected MDD will exceed the maximum rate authorized under permit G-6728 in approximately 2012. CRW intends to continue to explore increasing the percentage supply to its south service area from water authorized under permit G-6728 from use of existing Well No. 1 and from future additional wells. Consistent with CRW's recently approved extension of time for permit G-6728, CRW intends to complete construction and fully beneficially use the water authorized under permit G-6278 prior to October 1, 2029.

CRW has approved a project to construct a transmission main to establish a direct supply to its south service area from its north service area. The Carver Bridge transmission main is anticipated to be completed in 2016.

EXHIBIT 5-6
CRW's South Service Area Demand versus Ground Water Right

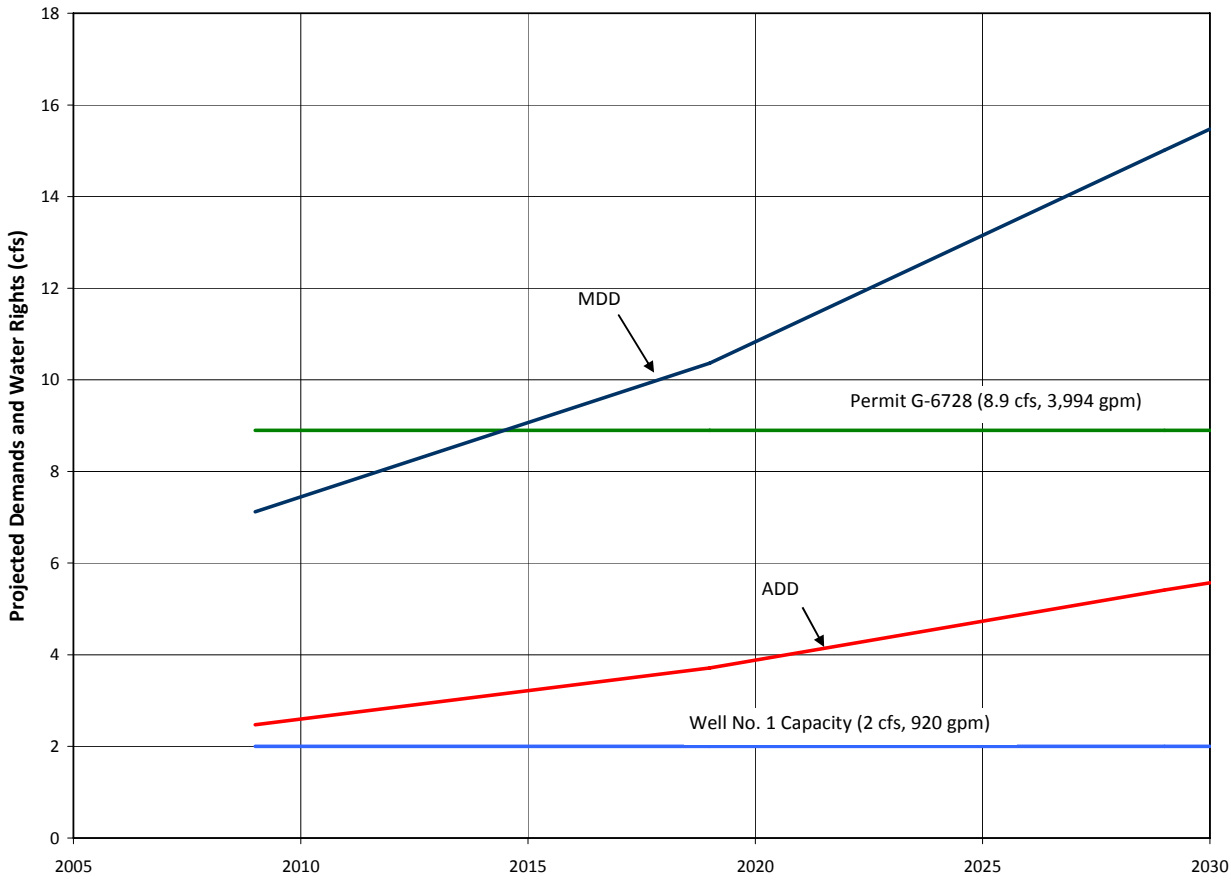
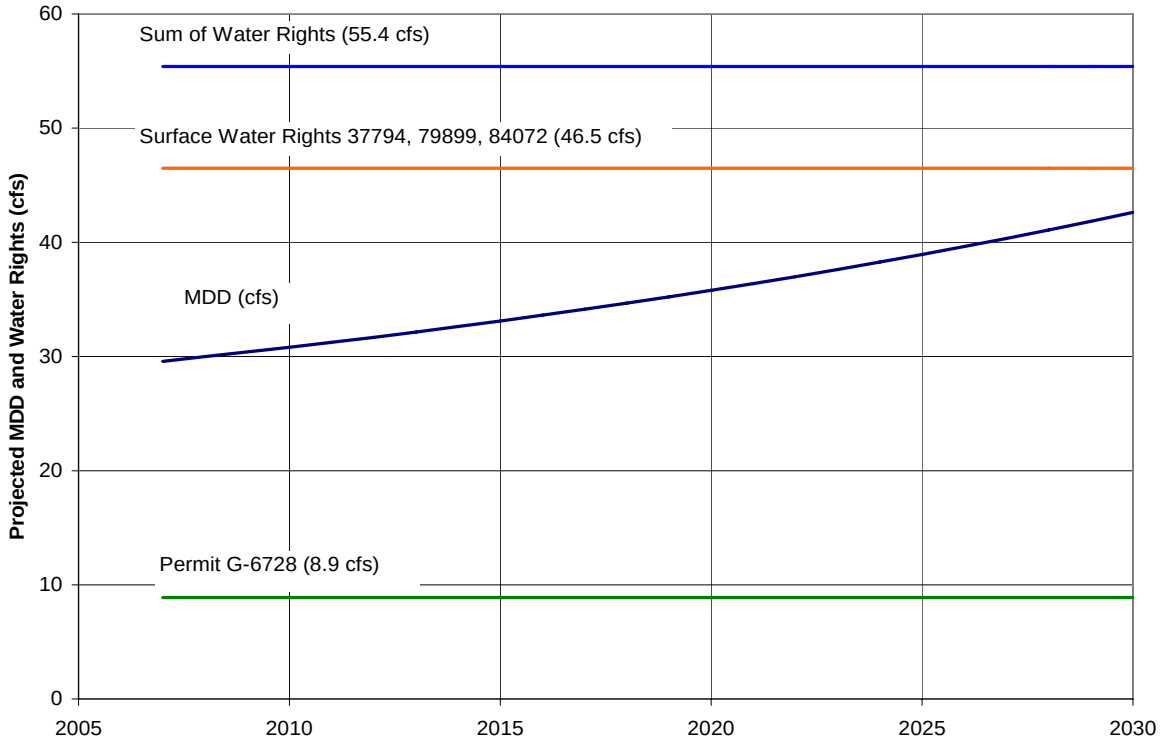


Exhibit 5-7 shows a comparison of total projected MDD with CRW's total surface and ground water rights.

EXHIBIT 5-7
CRW's Total Water Rights versus Overall MDD



Alternative Sources

OAR 690-086-0170 (5)

CRW is currently working with Clackamas County to install a water main in the future Carver Bridge replacement. CRW is also a party to a Joint Operating Plan between NCCWC, CRW and SFWB. In this Joint Operating Plan the parties agree to deliver water and otherwise cooperate to serve the public. Currently CRW provides water for Service Areas 2 and 3 by purchasing water from SFWB or drawing it from Well No. 1. CRW intends to expand the use of its groundwater right permit G-6728 to help meet its projected water demands in the south service area. While CRW has an interconnection with SFWB to serve this area, CRW needs to be prepared for a circumstance, in which SFWB water may not be available (catastrophic loss of system, drought, regulatory action associated with surface water rights, loss of water service agreement, etc).

The alternative means for providing water to the south service area under permit G-6728 are water conservation and use of surface water. CRW recognizes that implementation of conservation measures will slow the growth of annual peak day demand but will not preclude the need for additional water supply in the south service area. Surface water under existing water rights (CRW's and SFWB's) is an alternative. At present providing CRW surface water to this area is not feasible.

CRW has invested $758, 000 since 2001 to modify Well No. 1, and to investigate the feasibility of its ASR system under Limited License 003. Geological studies indicate that CRW could use its ASR system to store surface water in winter for use during the summer. CRW is continuing to explore this option.

CRW's use of groundwater to serve the south service area provides a reliable redundant or primary source that can potentially reduce environmental impacts on the Clackamas River.

Quantification of Maximum Rate and Monthly Volume

OAR 690-086-0170(6)

OAR 690-086-0170(6) requires a quantification of the maximum rate of withdrawal and maximum monthly use if initial diversion of water allocated under an existing permit is necessary to meet demands in the 20-year planning horizon.

This rule does not apply to CRW's surface water rights on the Clackamas River because all three rights are certificated.

CRW has already made initial diversion under its permits for withdrawal from Well No. 1, Permit G 6728. Maximum month withdrawal to date was 32.9 MG (1 mgd) for both July and August 2002. The maximum instantaneous rate of withdrawal for Well No. 1 to date has been 920 gpm (1.3 mgd).

CRW needs permit G-6728 as a redundant or primary source of supply in the south service area. Use of permit G-6728 may also reduce wholesale purchase from SFWB during the peak summer demand season. Over the 20-year planning horizon of this WMCP, CRW intends to fully develop the 8.9 cfs authorized under permit G-6728. Future maximum monthly volume under this permit could be upward of 210 million gallons (8.9 cfs for 12 hours per day for the month of July).

Mitigation Actions under State and Federal Law

OAR 690-086-0170(7)

Under OAR 690-086-0170(7), for expanded or initial diversion of water under an existing permit, the water supplier is to describe mitigation actions it is taking to comply with legal requirements of the Endangered Species Act (ESA), Clean Water Act, and other applicable state or federal environmental regulations. CRW's only ground water right permit is G-6728. CRW currently is not required to take mitigation actions for use of its groundwater.

New Water Rights

OAR 690-086-0170(8)

CRW has two pending water right applications that have been protested. The outcome and ultimate disposition of the application process is unknown.

APPENDIX A

Sample Letter to Affected Local Governments

Example Letter

February 16, 2009

Planning Director
Clackamas River Water
16770SE 82nd Drive
Clackamas, OR 97015

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear XXX:

We have attached a copy of Clackamas River Water's Draft Water Management and Conservation Plan for your review and comment relating to consistency with your comprehensive land use plan.

CRW has prepared this plan to fulfill the requirements of OAR Chapter 690, Division 86 of the Oregon Water Resources Department. Please provide comments to me within 30 days of the date of this letter. If the plan appears acceptable to you as written, a comment to that effect would be appreciated. You may either send your comments to me via e-mail at vvoyles@crwater.com, or by letter to:

Attention: Vance Voyles
Conservation Coordinator
Clackamas River Water
P.O. Box 2439
Clackamas, OR 97015

You are also welcome to call me at 503-722-9244 if you have questions about this plan. Thank you for your interest.

Sincerely,

Vance Voyles
Conservation Coordinator

APPENDIX B

IGA Details

Item 2 a.
Provide a list and brief description of all current intergovernmental agreements for wholesale water delivery

WATER SUPPLY AGREEMENTS
For Wholesale Water Delivery

City of Milwaukie Term: 20 years; 07/01/1998 – 06/30/2018

Supply of Surplus Water and Term of Agreement.

- CRW will furnish to Milwaukie a supply of potable, surplus water for an initial twenty (20) year period beginning July 1, 1998, through June 30, 2018.

- Milwaukie agrees to purchase a minimum of 24 million cubic feet of water each fiscal year during the life of the agreement. During the period May through September the volume of water is to be delivered into the Milwaukie system on the uniform basis of 500,000 gallons per day, at the rate of approximately 350 gallons per minute. For October through April and other times as approved by CRW the volume of water delivered to Milwaukie on a uniform basis shall be 500,000 gallons per day, but the flow rate (in gpm) may vary during the day, provided the flow rate does not cause undue or extraordinary demands on the CRW system (for example, not more than 3.0 times the average flow rate). In either circumstance, the total volume per day shall be subject to a 5% variance, allowing an additional 25,000 gallons per day to be taken without invoking higher rates to compensate for use of additional facilities.

- On or before January 1 of every calendar year and on or before January 1 of every fifth calendar year thereafter, Milwaukie may give written notice to CRW declaring its election to amend the agreement by revising its water supply requirements. Such modification could include, *but not be limited to, purchase of a greater amount of water each day on a uniform basis throughout the year.* Upon receipt of notice, the parties shall negotiate the terms and conditions of the amendment to the agreement, including adjustment of rates pursuant to cost of service principles. Shall be approved by the governing bodies of the parties and effective commencing on July 1 following conclusion of negotiations, unless the parties mutually agree to another effective date. Subsequent to an initial modification Milwaukie may revise its water supply requirement no more than once every five years. [2003, 2008, 2013]

- Contract Demand. *Each year* Milwaukie will notify CRW of the peak days' demand projected and average annual amount of water needed from CRW for the current year and the next 10 years. CRW will conduct a study every 4 years [2002, 2006, 2010, 2014, 2018] in conjunction with a rate study to forecast demand by all users on a regional basis. This will be in addition to the annual forecast of demand by Milwaukie and other users. The amount of annual or quadrennial forecast demand will establish Milwaukie's demand.

- Emergency/Curtailment. If a general emergency or water shortage requires restrictions on the delivery of water, then general restrictions placed upon deliveries to Milwaukie shall be determined by a similar method to that used for restricting deliveries to CRW's own inhabitants and other direct service customers; employing a pro-rata reduction. If localized emergency problems occur, temporary service interruptions may result.

Item 2 a.
Provide a list and brief description of all current intergovernmental agreements for wholesale water delivery

WATER SUPPLY AGREEMENTS, continued
For Wholesale Water Delivery

City of Milwaukie Term: 20 years; 07/01/1998 – 06/30/2018, cont.

Emergency/Curtailment. It is recognized by both parties that emergency curtailment measures may have to be implemented by CRW on an area-wide basis in order to meet an emergency condition. Milwaukie shall assist and support such emergency curtailment measures. Milwaukie shall be included in discussions leading to the decision to implement the measures.

CRW will provide oral notice to Milwaukie and any other purchaser if CRW determines that such interruption or reduction is necessary or reasonable for system emergencies or to install equipment, make repairs, replacements, investigations and inspections or perform other maintenance work on CRW's system or those parts of the system supplying Milwaukie. Except in cases of emergency and in order that Milwaukie's operations will not be unreasonably interfered with, CRW also shall give Milwaukie ten (10) days written notice of any such interruption or reduction, the reason, and the probable duration. CRW agrees to exercise reasonable diligence and foresight to repair, replace and maintain its treatment plant and other facilities so as to provide a normal volume and pressure of water to the point of Milwaukie's connection.

Sunrise Water Authority 11/10/2005

- Water Sales. SWA and CRW agree that nothing in this agreement shall effect prior existing agreements between CRW and SWA for water service except pursuant to Section 1 of the Water Supply Agreement dated March 8, 2001, between CRW and the North Clackamas County Water Commission (NCCWC), as amended August 3, 2004, to assign to SWA the rights and obligations of NCCWC, *SWA will purchase a minimum of 122 million cubic feet of water each calendar year (2.5 mgd) for the next 10 years beginning March 1, 2006. [03/01/2016]*

SWA - North Clackamas County Water Commission (NCCWC) Term: 20 years; 03/08/01 - 03/01/2021
(Section 1 Superseded 11/10/05): Supply of Water. CRW agrees to provide the Commission 122 million cubic feet of water each calendar year during the life of this Agreement, and the Commission agrees to purchase this amount, unless modified by other provisions of this Agreement, for an initial twenty-year period beginning March 1, 2001, through December 31, 2021, subject to renewal, extension or termination on the terms and conditions as set forth in this Agreement.

- Every five years [2006, 2011, 2016] the parties will jointly review the quantity of water purchased and, if a change in purchase is anticipated, the parties will negotiate the terms of a change. The Commission will notify CRW six months before the end of each fifth year that it desires to change the amount of water purchased.

Item 2 a.
Provide a list and brief description of all current intergovernmental agreements for wholesale water delivery

WATER SUPPLY AGREEMENTS, continued
For Wholesale Water Delivery

SWA - North Clackamas County Water Commission (NCCWC) Term: 20 years; 03/08/01-03/01/2021, cont.

- Status of Prior Supply Agreements. At the time of creation of the Commission, Water Supply Agreements existed between the Oak Lodge Water District (Oak Lodge) and CRW dated February 1, 1996, and between the Mt. Scott Water District (Mt. Scott) and CRW dated May 1, 1995. *All water purchase responsibility for Oak Lodge and Mt. Scott has been assumed by the Commission.* The Parties acknowledge that there are no outstanding claims or disputes of any kind remaining between them, including the Commission's predecessors in interests, Oak Lodge and Mt. Scott, concerning the aforedescribed Water Purchase Agreements and that *this Water Supply Agreement supersedes and replaces all previous Water Supply Agreements between the parties.* [The Gladstone City Council on May 10, 2005 elected to become a member of the North Clackamas County Water Commission.]

- Service Reduction in Case of Emergency. If a general emergency or water shortage requires restrictions on the delivery of water, then general restrictions placed upon deliveries to the Commission shall be determined by a similar method to that used for restricting deliveries to Clackamas' own inhabitants and other direct service customers, employing a pro rata reduction.

- Connections and Meters. The Commission will provide and maintain meters, valves and controls, including backflow prevention assemblies as necessary, as approved by CRW, in proper order for water transmission line connections at the following locations:
    - Mather Road Level: Near the Mather reservoir at SE 92nd and Mather Road; Near SE Mangan Way and Water Ave
    - 152nd: At SE Pinegrove Loop near SE 152nd Ave and the CRW reservoir site north of HWY 212
    - (Emergency Only) Otty Road: Near SE 92nd Ave and Otty Rd, near the reservoir owned by CRW; on SE Mt. Scott Blvd. near SE 92nd Ave

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Item 2 a.
Provide a list and brief description of all current intergovernmental agreements for wholesale water delivery

WATER SUPPLY AGREEMENTS, continued
CRW's Purchase of Wholesale

- South Fork Water Board
  - Effective 09/01/05, the wholesale water rate to CRW will $0.704 per ccf for all usage
- Oregon City
  - Master Meters at Leland/Meyer and Impala/South End Roads; pumping charge is $0.4031

Oregon City South End / Meyers Roads Term: 20 years; 05/16/90 - 05/16/2010
Period review: "each other anniversary of date of agreement"; wheeling water to CRW south service area at Leland and Meyers Roads intertie.

Supply of Surplus Water and Term of Agreement.

- City and CRW desire to provide water service within the UGMB in an orderly, efficient, non-duplicative manner as provided for within the City's public facility plan.
- CRW is a wholesale water customer of the South Fork Water Board. The primary interconnection between the CRW system and the South Fork system is located at the juncture of the main South Fork transmission line at Anchorway and Redland Road. Water is supplied directly from the South Fork transmission line to the CRW's transmission distribution system through this intertie. The "South End" area of CRW receives water through the South End Road master meter located on South End Road in the vicinity of South End Court. Water flowing through that intertie to CRW is wheeled through certain Oregon City facilities before it reaches the intertie. The parties are desirous of constructing an additional intertie and installing another master meter at the intersection of Clairmont Way, Meyers Road and Leland Road.
- Supply of Water. During the term of this agreement and pursuant to its terms and conditions, City agrees to wheel to and provide through the South End Road intertie and the Clairmont Way intertie a supply of potable water to patrons of CRW located in the South End area.
- Limitation o£ Supply. CRW understands and agrees that the City anticipates the supply of water sufficient to furnish CRW with water as provided for in this agreement. For purposes of this agreement, water provided to CRW by City is considered to be available from the high level system consisting of pumping at the Mountain View Pumping Station and storage at the City's Boyton Reservoir or other future reservoirs in this system. In the event an inability on the part of City to furnish a sufficient supply of water to CRW should arise during the term of this agreement, City shall give the best notice possible to CRW, and it is agreed that City shall not be held liable on account of any such inability. CRW may at its discretion obtain and use water from wells maintained by CRW or from other sources at any time during the term of this agreement.
- Construction of Clairmont Way Intertie. CRW shall by construct at its own expense an intertie and install a master meter in the vicinity of the intersection of Clairmont Way, Meyers Road, and Leland Road. CRW will maintain ownership and responsibility for this interconnection and master meter and also for the existent interconnection and master meter located on South End Road.
- Responsibilities Concerning Connection and Meters. CRW agrees that, except as provided herein, the meters of the South End and Clairmont Way interties shall at all time measure accurately the water supplied by City to CRW.

Item 2 a.
Provide a list and brief description of all current intergovernmental agreements for wholesale water delivery

WATER SUPPLY AGREEMENTS, continued
CRW's Purchase of Wholesale

Oregon City South End / Meyers Roads Term: 20 years; 05/16/90 - 05/16/2010, cont.

- Pumping and Wheeling Charges. CRW agrees to pay City pumping and wheeling charges for water received by CRW through the South End and Clairmont Way interties. This charge shall include operation and maintenance expenses (including general administrative expenses); return on investment (based upon the depreciated value of assets); and depreciation (based upon the established life and value of those facilities necessary to supply CRW with water). The methodology for determining the pumping and wheeling charges are contained in Exhibit 2. The parties agree that an appropriate charge during the first year of this agreement is twenty-four cents ($0.24) per hundred cubic feet of water supplied. The methodology will be updated every fifth year [1995, 2000, 2005, 2010, 2015] to take into account variances the number of customers within CRW served by the interties described in this agreement, meter usage, and variations of continuing costs and bonded indebtedness. *Each year the volume rate shall be increased by 5 %. CRW shall continue to pay the wholesale rate charge to the South Fork Water Board for water purchased from South Fork and wheeled through the City System.*
- Maintenance. City shall own, operate, maintain, repair and replace all water system facilities necessary to furnish water to the inlet side of the master meters at the Clairmont Way and South End Road interties used for measuring the quantity of water delivered to CRW.
-

Oregon City South End / Impala Term: 20 years; 02/08/00 - 02/08/2020

Period review: every 5 yrs [2005, 2010, 2015]. South End Rd from master meter near McLoughlin School to Impala Ln; wheeling water to CRW south service area at South End/Impala Roads.

Establishment of Volume Rate. The volume rate consists of a wheeling rate portion and the South Fork wholesale rate portion.

- CRW shall pay to the City a wheeling rate of $0.8932 per hundred cubic feet for water used by the properties connected to the water lines identified in Section 2 of the agreement until these properties are annexed to City. The rate will be effective until a jointly funded economic study is completed to determine an appropriate rate. If the study is not completed within one year of the effective date of this agreement, the parties will update the rate set.
- Where jurisdiction operation and maintenance responsibility has been transferred to City. CRW shall pay to the City a wheeling rate of $1.0667 per hundred cubic feet of water used by properties connected to the water lines identified in Section 2 of the agreement when jurisdiction over the line serving the property has been transferred to the City under Section 5 of the agreement. The rate will be effective until a jointly funded economic study is completed to determine an appropriate rate. If the study is not completed within one year of the effective date of this agreement, the parties will update the rate set.
- Volume Rate and Updates. The two parties shall update the two wheeling rates every fifth year [2005, 2010, 2015]. This update is intended to account for variances in the number of customers within CRW served by the respective lines, metered usage, and variations of continuing costs and bonded indebtedness. *Both parties agree to jointly fund an economic study update* every five years.

Item 2 a.
Provide a list and brief description of all current intergovernmental agreements for wholesale water delivery

WATER SUPPLY AGREEMENTS, continued
CRW's Purchase of Wholesale

Oregon City South End /Impala Term: 20 years; 02/08/00 - 02/08/2020, cont.

Between study updates, each year the wheeling rate portion of the volume rate shall be increased by 75% of the Portland, Oregon Consumer Price Index based on the previous December 31 index. The South Fork wholesale portion of the volume rate will be adjusted annually to reflect the City's then current South Fork wholesale rate. CRW shall pay the City a volume water rate that includes the City's South Fork Water Board wholesale rate. City will then remit that portion of the volume rate directly to the South Fork Water Board.

Oregon City - CRW HOPP Service Area Term: 30 years; 04/22/98 - 04/22/2028

Period review: every 5 yrs [2003, 2008, 2013, 2018, 2023]; Service area: Holcomb-Outlook-Park Place (HOPP) and MOU; 30-year intergovernmental agreement to provide water in the HOPP area above the 200 foot elevation; inside the existing city limits, as well as future water service to land outside the city limits and within the urban growth boundary, and in the urban reserves.

- The service area includes the northerly area of the City along Holcomb Road within Oregon City's UGB above the elevation of 200 feet, in addition to two Urban Reserve areas (one northerly and one easterly of Park Place) and certain northerly area within CRW 's service boundary. City and CRW boundaries; Areas A1 through A6.
- Area A-1 shall immediately become part of the city service territory upon construction of the Basic Facilities. CRW shall provide water service to territories within the Service Area until their annexation into the City. CRW shall continue to provide service to lands within its boundary that adjoin the corporate limits of the City. CRW currently has service responsibility for water service in the areas designated as A-2 and A-3, CRW shall continue to be the immediate water service provider within Areas A-2 and A-3 and the City agrees to wheel water through its system for these areas; provided however, that at any time during the period of this Agreement, when the City has annexed not less than 75% of the territory of Area A-2, then the City shall operate and maintain water facilities to serve all properties within Area A-2, and operate and maintain Area A-3 under separate agreement.
- The City agrees to wheel water through the Basic Facilities to allow CRW to provide service to Areas A-4, A-5 and A-6, up to the design rate of the Basic Facilities (900 gpm). The parties agree to negotiate an equitable arrangement for water demand beyond this rate.

Area 1: Oregon City UGB, 200 feet elevation to 450 feet
Area 2: Northerly Urban Reserve Area
Area 3: Clackamas River Water district area, 200 ft elevation to 450 ft, excluding Urban Reserve area
Area 4: Oregon City UGB, above 450 feet elevation
Area 5: Easterly Urban Reserve Area (lies entirely above 450 feet elevation)
Area 6: Clackamas River Water district area, easterly to Hunters Heights

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Item 2 a.
Provide a list and brief description of all current intergovernmental agreements for wholesale water delivery

WATER SUPPLY AGREEMENTS, continued

CLACKMAS RIVER WATER PROVIDERS

Term: Perpetual from date last participant signs IGA in June 2007. For coordinating and funding water resource planning, management, conservation, outreach programs, and use of Stored Water from Timothy Lake Concerning the 2006 PGE Stored Water Agreement.

Participants: CRW, Lake Oswego, SFWB, SWA, NCCWC

NCCWC as fiscal agent: provides work plan and budget by Feb 1 each year; participants adopt by July 1 in any year; participants pay quarterly in advance determined annually based on finished water exchange;

The Participants own and operate structures on the Clackamas River the purpose of which are to divert the waters of the Clackamas River for beneficial uses without waste.

The general purposes of the Clackamas River Water Providers are as follows:

- To coordinate efforts regarding water resource planning, management, conservation and development of the waters of the Clackamas River on a sustained and sustainable basis.
- To fund and manage water conservation and public outreach and education programs.
- To fund and manage other water resource activities that may include watershed assessments, water quality monitoring and analyses, and water supply planning.
- To fund administrative staff to implement the activities and programs of the Clackamas River Water Providers as they may be identified, approved and funded on an annual basis.

- The parties agree that the North Clackamas County Water Commission (Commission) will provide administrative staff support services to the Clackamas River Water Providers and the Clackamas River Water Providers will compensate the Commission for those services.

- Compensation for staffing and other costs shall be set at a level sufficient to cover the Commissions actual costs of providing these services including salaries and fringe benefits, overhead expenses and other costs specifically related to providing agreed upon services to the Clackamas River Water Providers in support of its approved Work Plan.

Work Plan and Budgeting

- By February 1 of each year the Clackamas River Water Providers shall prepare an annual Work Plan for the upcoming fiscal year beginning on July 1.
- Concurrently, the Clackamas River Water Providers shall prepare a budget sufficient to implement and complete the annual Work Plan. The budget shall also include a calculation of the dues owed by each Participant.
- Each Participant will, by and through separate action of their respective elected board, commission or council, adopt the Work Plan and Budget prior to July 1 in any year.

Item 2 a.
Provide a list and brief description of all current intergovernmental agreements for wholesale water delivery

WATER SUPPLY AGREEMENTS, continued

CLACKMAS RIVER WATER PROVIDERS, cont.

- The Commission will serve as the Fiscal Agent and is authorized by the Clackamas River Water Providers to sign contracts approved by the Clackamas River Water Providers.

- Each Participant of the Clackamas River Water Providers shall pay costs quarterly in advance of expenses incurred by the Commission to provide staffing services and implement the approved Work Plan. The dues for each Participant will be determined annually based on the finished water exchange grid and invoiced to each Participant by the Fiscal Agent.

- The Agreement shall remain in effect, subject to the following: (1) any Participant may withdraw at the end of any fiscal year as provided in this Agreement by delivering written notice to the Clackamas River Water Providers not less than 90-days prior to June 30 of any year; (2) the Agreement may be ended and the Clackamas River Water Providers dissolved by majority

- Water Resource Plans: Work with Clackamas Watershed Management Group members on implementation of their Water Management and Conservation Plans, and Water Curtailment Plans. Other future projects could include developing Source Water Protection Plans, and joint Emergency Response Plans.

- Regional Water Providers Consortium Conservation Program: Represents Clackamas River Water Providers members in regional conservation efforts by attending and participating in Consortium Conservation Committee (CCC).

PGE & CLACKAMAS RIVER WATER PROVIDERS Effective: 10/19/06
Clackamas River Water Providers: CRW, Lake Oswego, SFWB, SWA, NCCWC
For Coordinating Use of Stored Water from Timothy Lake
Concerning the 2006 PGE Stored Water Agreement; Operational Advisory Committee (OAC); Clackamas Watershed Management Group; subject to terms of the PGE FERC license of the Clackamas River Hydroelectric project (project 2195)

- The parties agree to coordinate water supply planning for the beneficial use of the stored water from Timothy Lake under the Stored Water Agreement with PGE.

Regarding the PGE Agreement and its use for public water supply purposes:

- Covenant of Water Providers. The Water Providers have existing water withdrawal permits on the Clackamas River. Low flows in the Clackamas River may be supplemented by releases of water from Timothy Lake pursuant to the PGE Agreement to the extent such releases are necessary to satisfy public water supply purposes during low flow conditions and subject to the terms of the FERC License of the Clackamas River Hydroelectric Project (Project 2195).

Item 2 a.
Provide a list and brief description of all current intergovernmental agreements for wholesale water delivery

WATER SUPPLY AGREEMENTS, continued

PGE & CLACKAMAS RIVER WATER PROVIDERS Effective: 10/19/06, cont.

- Operational Advisory Committee. The Water Providers agree to form an operational Advisory Committee (OAC) that will convene once a month beginning after May 31St through September lst of each year or as needed. The OAC will consist of one member selected by each party. The OAC will review projected peak summer seasonal demands provided by each party prior to May 31 of each year, projected weather conditions, and in-stream flows.

The decision to call for the release of water from Timothy Lake will be made to satisfy two purposes:

- Preserve minimum in-stream flows - a decision to release reserved water for this purpose would be made based on the arithmetic difference between current flows measured at the USGS flow gage at the Oregon City site (Station Number 14211010) and the minimum in-stream flow in effect at the time of decision relative to water demands forecasted by the OAC members for the peak summer season. The decision to release reserved water for this purpose will be made by majority vote of the OAC.

- Enhance in-stream flows - a decision to release reserved water for this purpose would be made upon request by any OAC member subject to approval by a majority of the OAC. Any OAC member that decides not to be a party to this type of release will not be charged for the costs incurred.

Management and Release of Water

The fiscal agent and single point of contact for PGE for the extension of the current CRW/PGE Storage Agreement will be Clackamas River Water. The fiscal agent for the Clackamas Watershed Management Group (Exhibit 2) shall serve as the single point of contact and fiscal agent for the Clackamas River Water Providers' coordinated use of the new Storage Capacity Agreement effective *upon issuance of a new license for PGE's Hydroelectric Project.* The fiscal agent will be responsible for contacting PGE before January 1 of each year to reserve stored water. The fiscal agent will be responsible for making payments to PGE required by the PGE Agreement. **The fiscal agent will also serve as the single point of contact with PGE for the release of the stored water as authorized by the OAC.** The fiscal agent will be responsible for invoicing the reservation costs to each party as presented in Section 1.5, and for invoicing each party(s) that calls for the release of the water as presented in the PGE Agreement. *The costs, content, and distribution of public news releases regarding the release of Timothy Lake stored water will be approved by the OAC.* The fiscal agent will invoice the parties for public news release costs based on the distribution of the reservation cost for that calendar year.

Shared Shortages

The parties agree that in times when demands exceed water supplies in the Clackamas River, all Water Providers will coordinate reductions in demand requirements from the Clackamas River subject to the Clackamas River Water Providers individual Water Curtailment Plans. If approved by all parties, the Joint Water Curtailment Plan will govern in such situations.

Item 2 a.
Provide a list and brief description of all current intergovernmental agreements for wholesale water delivery

WATER SUPPLY AGREEMENTS, continued

PGE & CLACKAMAS RIVER WATER
Storage Capacity Agreement; Portland General Electric and Clackamas River Water

- Amendment and Extension of Storage Capacity Agreement, executed 11/02/2006
- The term of this agreement should be for a term concurrent with that of the PGE FERC License No. 135, which expires on August 31, 2006, until a new PGE FERC license is issued for the Project. Upon issuance of the new license PGE and the Clackamas River Water Providers will enter into a new storage capacity agreement concurrent with the term of that license period.

###

Item 2 b. Emergency Water Service

EMERGENCY WATER SERVICE

RWPC-CRW SHARING EQUIPMENT AND SERVICES; 01/13/05

The Five-Year Strategic Plan approved by the Consortium Board to provide a forum for regional equipment and resource sharing among water providers. To accomplish this goal, The Emergency Planning Committee of the Regional Water Providers Consortium and the Consortium Technical Subcommittee recommend that all Consortium members join the Intergovernmental Agreement for Equipment and Services.

CRW Membership to ORWARN; 06/20/07

Oregon Water/Wastewater Agency Response Network (ORWARN)
Mutual Aid and Assistance Agreement for the provision of emergency services related to water and wastewater utilities.

PORTLAND WATER BUREAU

In 2007, CRW and Portland Water Bureau are negotiating an EMERGENCY RECIPROCAL WATER SALES AGREEMENT. Subject to the terms and conditions, the parties agree to provide each other an emergency supply of potable water on as needed and as available basis.

###

[Provide: map that shows emergency interties and intersections maps.]

Item 2 c. Has the intertie to Rockwood PUD been completed?

There is no transmission line connection between CRW and Rockwood PUD; the intertie was not completed.

May 4, 2005 Rockwood notified CRW of Rockwood's election to terminate and withdraw from the IGA. The Rockwood Water PUD had developed a substantial groundwater supply, approximately 7.5 mgd and capacity was no longer needed as a secondary supply for their district.

CRW and Rockwood entered into an intergovernmental agreement in 2000. Under the terms of that agreement, Rockwood acquired capacity of 1 mgd from CRW and the right and obligation to acquire an additional 5 mgd by August 1, 2005. Rockwood has not purchased anything beyond the original 1 mgd. The Board of Directors of Rockwood Water PUD elected to terminate their contractual rights to purchase an additional 5 mgd capacity and to sell their ownership in the Clackamas River Water filter plant.

June 10, 2005 CRW notified Rockwood of CRW's desire to purchase Rockwoods's interests under the IGA. On August 1, 2005 Rockwood received a check from CRW.

###

Wednesday, November 14, 2007 1:57:18 PM

Database entries | System fields

CRW CODE	AD-01-01
Document Series	AGREEMENTS INTERGOVERNMENTAL:IGA
Filename	OREGON CITY SOUTH END-NAVAHO-IMPALA
Unique Identifier	
Year	2000
RetentionStipulation	PERMANENT
Disposal Date	
Storage Date	09/24/2003
Last Used by	MGEORGE
Last Date Used	11/14/2007
Section Number	
Entity/Company/Firm	CLACKAMAS RIVER WATER (CRW)
Document Type	CONTRACT
Key Search Word	
	CONTRACT
Description	Expiration Date: 02/08/2020, term: 20 yrs, Date executed 02/08/00, Period review: every 5 yrs South End Rd from master meter near McLoughlin School to Navaho/Impala Ln. Wheeling water to CRW south service area CRW Project No. 99-0194

intergovernmental cooperative agreement pursuant to ORS 190.003 to 190.030; and

WHEREAS, the parties represent that the persons signing this agreement on each party's behalf are duly authorized to bind it to the terms of this agreement.

NOW, THEREFORE, IT IS AGREED by and between the parties hereto as follows:

1. Effective Date. This agreement shall be effective when the last party enters into the same and shall be effective for a period of twenty years from that date. The parties shall review the terms of this agreement every five years and, unless one of the parties requests amendment or termination of this agreement 90 days prior to the expiration of that five year period, the agreement shall remain in full force and effect for an additional five year period, but, in the aggregate, no more than twenty years. If a party requests amendment or termination, the parties shall use the dispute resolution process provided by section 9 herein to resolve any disputes, including those related to division of assets or territory, provided that the non-requesting party shall be deemed the party charged with the default under Step Three of section 9. Any action by Metro or other authority with jurisdiction over matters affecting this Agreement shall trigger a review of the Agreement by the parties. No such actions, however, shall affect this Agreement unless it is so amended by mutual written consent of the parties.

2. **Identification of Joint Usage Lines**. The parties agree that the following water lines shall be jointly funded, connected, and used by the parties pursuant to the terms of this section and this agreement.

a. **South End Road**: Approximately 4,000-foot ductile iron water transmission line in South End Road as further described in Section 3. Includes appropriate 8-inch tees and gate valves at connecting streets and individual service reconnects by both parties on existing 12-inch line and new line. The amount of work to be completed for this line under this agreement may be decreased based on future development requirements to loop water lines in South End Road. Development would only be responsible for a basic 8-inch water line. As a minimum, the parties to this agreement must fund for oversizing the water line and the cross street connections and reconnections.

b. **Salmonberry Drive**: Appropriate connection at the east end of street as described in Section 3.

c. **Maywood Street**: Appropriate connection at the north end of street as described in Section 3.

d. **Finnigan's Way**: City shall connect new development off Parrish Road to CRW water line in Finnigan's Way and CRW shall approve connection details and activate the connection at the appropriate time.

e. **Longstanding Court**: CRW shall install a new 8-inch connection in the existing City 12-inch line in South End Road and connect this service subject to City connection detail approval.

f. **Rose Road**: CRW shall install a new 8-inch connection in the existing

City 12-inch line in South End Road and connect this service subject to City connection detail approval.

g. **Beutel Road**: CRW shall install and connect 8-inch tee in new South End Road transmission line subject to City connection detail approval.

h. **Parrish Road**: CRW shall install 8-inch tee in new South End Road transmission line. CRW shall make connection to 8-inch line in Parrish Road if City has provided for said line by way of development. Alternatively, the parties may agree in writing to other types of connection details when the Parrish Road line is developed to South End Road.

i. **Parkland Court**: CRW shall install and connect 8-inch tee in new South End Road transmission line subject to City connection detail approval.

j. **South End Court**: CRW shall install and connect 8-inch tee in new South End Road transmission line subject to City connection detail approval.

k. **Forest Ridge Lane**: CRW shall install and connect 8-inch tee in new South End Road transmission line subject to City connection detail approval.

l. **Proposed Merchant Meadows Subdivision Development Loop Line**: City shall provide for connection to Forest Ridge Lane subject to CRW approval of connection details in the event of future development of 3-1 E 12BA, Tax Lot 1800. CRW shall activate the connection if the future development of Tax Lot 1800 is completed. CRW shall activate the connection promptly in that event.

m. **Impala Lane**: CRW shall install and connect 8-inch tee in new South End Road transmission line subject to City connection detail approval.

n. **Navaho Way**: CRW shall install and connect 8-inch tee in new South End Road transmission line subject to City connection detail approval.

o. The following lines are also joint usage lines and do not require any connections:

1) Columbine Court

2) Elizabeth Court

3) Sunnyridge Court

4) Allen Court

5) Shamrock Lane

6) Turquoise Way

7) Deer Lane

The City, at its own cost, may extend and interconnect from the aforesaid water

Wednesday, November 14, 2007 2:04:15 PM

Database entries | System fields

CRW CODE	AD-01-01
Document Series	AGREEMENTS INTERGOVERNMENTAL:IGA
Filename	OREGON CITY SOUTH END & CLAIRMONT WAY
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RetentionStipulation	PERMANENT
Disposal Date	
Storage Date	09/24/2003
Last Used by	MGEORGE
Last Date Used	11/14/2007
Section Number	
Entity/Company/Firm	CLACKAMAS RIVER WATER (CRW)
Document Type	CONTRACT
Key Search Word	>>
	CONTRACT
Description	Expiration Date: 05/16/2010, term: 20 yrs, Date executed 05/16/90, Period review: "each other anniversary of date of agreement" pg 6 South End Rd and Clairmont Way (Meyer/Leland Rd) interties. Wheeling water to CRW south service area

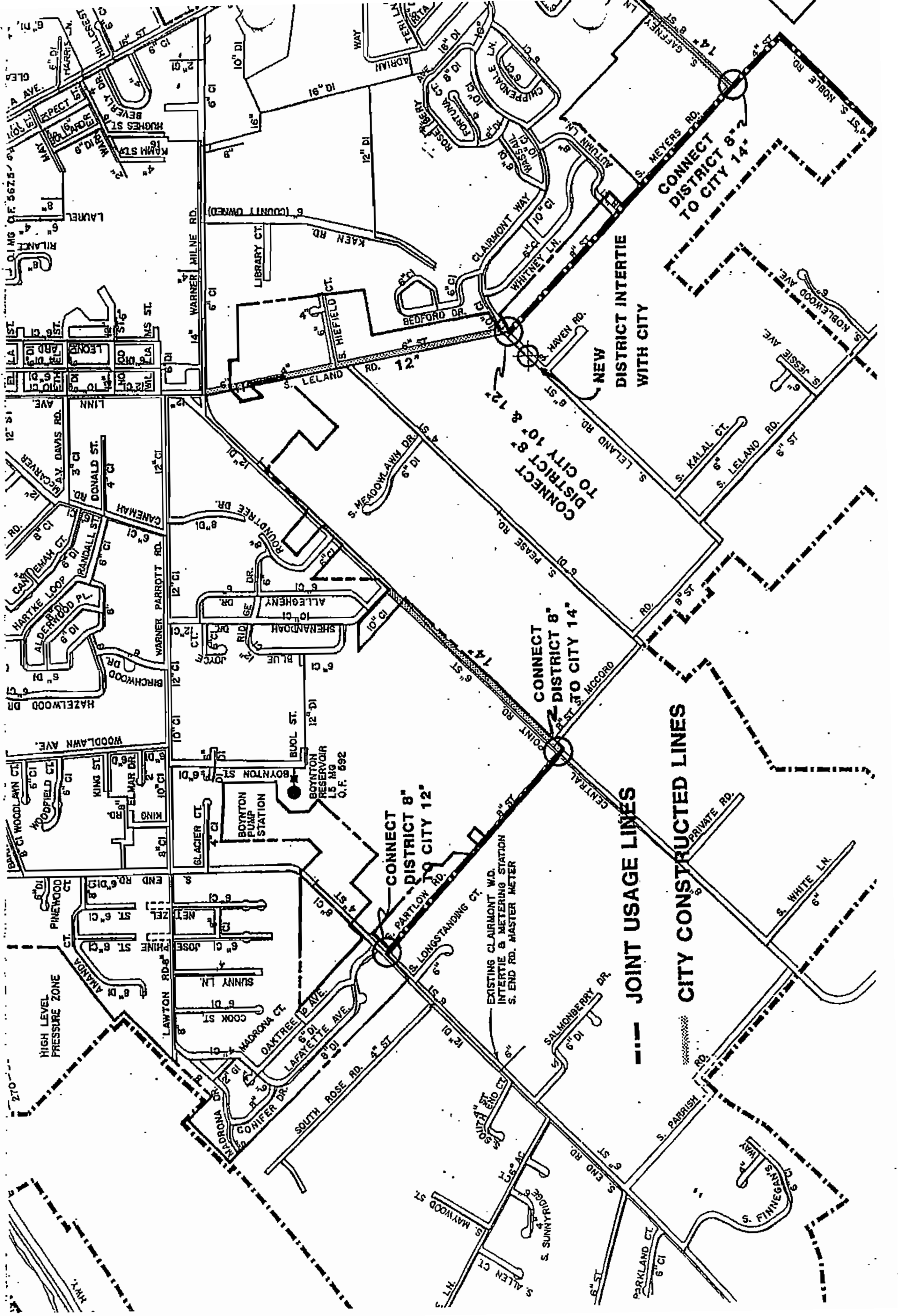
CONNECT DISTRICT 8" TO CITY 14"
NEW DISTRICT INTERTIE WITH CITY
CONNECT DISTRICT 8" TO CITY 10" & 12"
CONNECT DISTRICT 8" TO CITY 14"
CONNECT DISTRICT 8" TO CITY 12"
EXISTING CLAIRMONT W.D. INTERTIE & METERING STATION S. END RD. MASTER METER
BOYNTON PUMP STATION
BOYNTON RESERVOIR 1.5 MG O.F. 592
HIGH LEVEL PRESSURE ZONE
JOINT USAGE LINES
CITY CONSTRUCTED LINES
S. LELAND RD.
S. MEYERS RD.
S. GAFFNEY LN.
S. NOBLE RD.
S. NOBLEWOOD AVE.
S. JESSIE AVE.
S. KALAL CT.
S. LELAND RD.
S. PEASE RD.
S. MEADOWLAWN DR.
S. MCCORD
CENTRAL POINT RD.
PRIVATE RD.
S. WHITE LN.
S. PARRISH RD.
S. FINNEGAN'S WAY
S. END RD.
S. PARTLOW RD.
S. LONGSTANDING CT.
SALMONBERRY DR.
SOUTH ROSE RD.
LAFAYETTE AVE.
OAKTREE AVE.
MADRONA CT.
CONIFER DR.
MADRONA DR.
AMANDA CT.
LAWTON RD.
SUNNY LN.
COOK ST.
JOSEPHINE ST.
NETZEL ST.
PINEWOOD CT.
GLACIER CT.
BOYNTON ST.
BUOL ST.
KING RD.
KING ST.
ELMAR DR.
WOODFIELD CT.
WOODLAWN CT.
WOODLAWN AVE.
HAZELWOOD DR.
BIRCHWOOD DR.
WARNER PARROTT RD.
BLUE RIDGE DR.
JOYCE CT.
SHENANDOAH
ALLEGHENY DR.
ROUNDTREE DR.
ALDERWOOD PL.
HARTKE LOOP
CANEMAH CT.
RANDALL ST.
CANEMAH RD.
DONALD ST.
DAVIS RD.
MCCARVER AVE.
LINN AVE.
WARNER MILNE RD.
LIBRARY CT.
KAEN RD.
6" (COUNTY OWNED)
S. HIEFIELD CT.
BEDFORD DR.
CLAIRMONT WAY
WHITNEY LN.
HAVEN RD.
AUTUMN LN.
WASSAIL CT.
CHIPPENDALE LN.
FORTUNA CT.
ROSEMARY AVE.
ADRIAN WAY
LAUREL
RILANCE
KAMM ST.
HUGHES ST.
BEVERLY DR.
PROSPECT ST.
HILLCREST
S. ALLEN CT.
S. MAYWOOD ST.
S. SUNNYRIDGE
S. SOUTH END CT.
PARKLAND CT.
HWY.
O.F. 567.5
1.0 MG
270

Exhibit 2

TABLE 3
SOUTH END ROAD ANALYSIS
CALCULATION OF WHOLESALE WATER RATE FROM OREGON CITY
THROUGH SOUTH END ROAD METER

O.C. Operation and Maintenance Allocable CWD (a)		
Plus 5% Inflation	$8,385	
1990 O&M	1.05	
	$8,804	
Water Consumption Through Hilltop Meter (HCF)	148,574	
O&M Volume Rate Per HCF		$0.0593
South Fork Rate		$0.3162
Capital Cost (Table 2)		
Volume Through South End Meter	$19,939	
Capital Volume Rate	112,269	$0.1776
Total Volume Rate (includes South Fork charge)		$0.5531
Net Pumping and Wheeling Charges		$0.24

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a. From Hilltop Wholesale Rate Analysis.

SOUTH FORK WATER BOARD
CLACKAMAS COUNTY, OREGON
INVOICE FOR WATER SUPPLIED DURING THE MONTH OF: NOVEMBER 2007

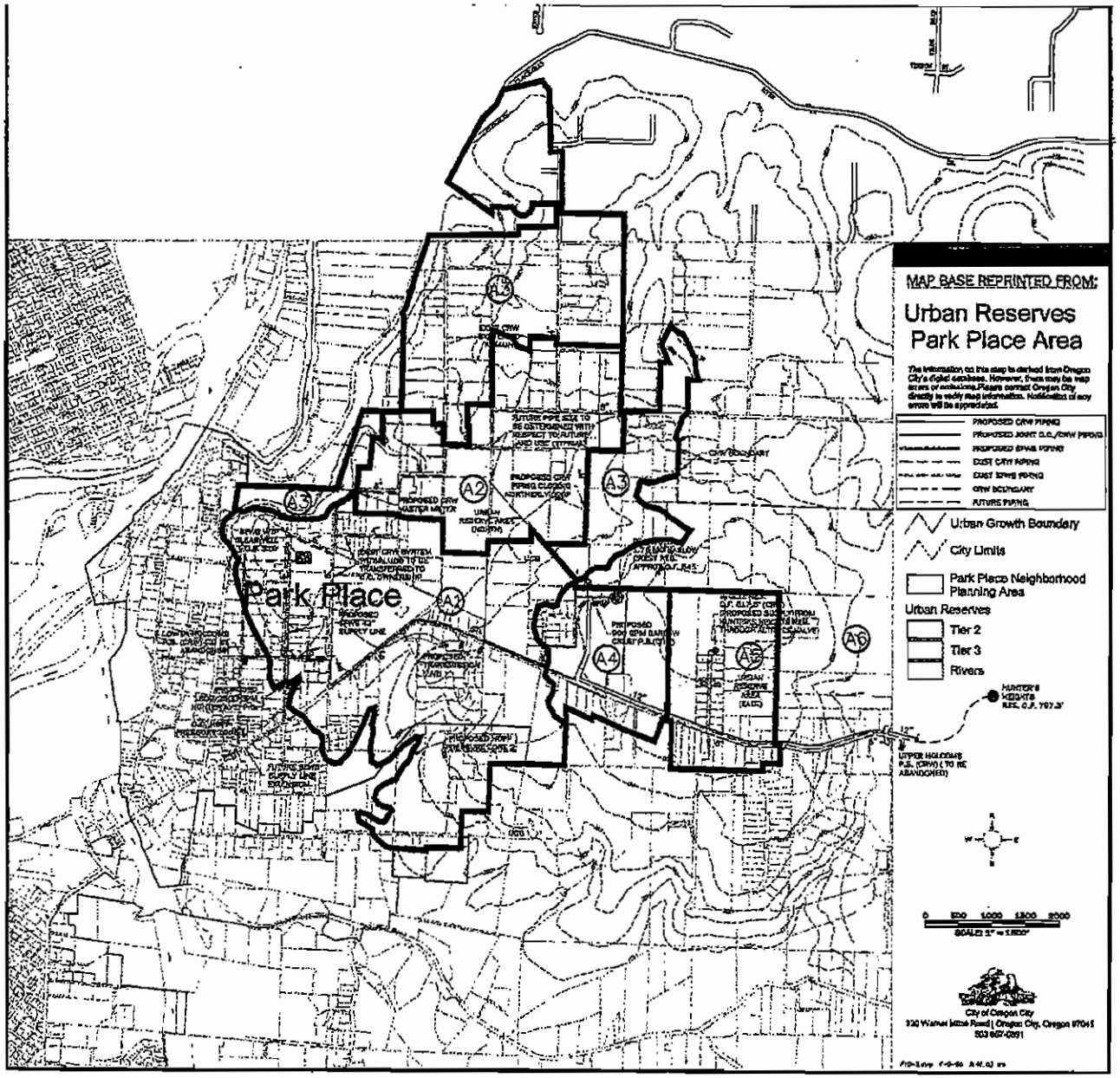
The SFWB supplies water principally to the cities of West Linn and Oregon City. Surplus water is supplied to the CLACKAMAS Water District and thru an intertie, to the City of Lake Oswego. Each of these has a different rate per 100 cubic feet of water based on the cost to supply, negotiated terms and the amount invested in the processing plant.

This invoice shows the readings of the meters to determine usage, adjustments to a full month if necessary, total usage and the billing by extension of the usage times the rate. The usage is combined to compare chargeable production to the intake of the plant.

IDENTIFY METER	Meter ID	Meter Number	Unit of Measure	Date Read	CURRENT READING	PRIOR READING	USAGE FOR BILLING	Conversion Factor	CONVERSION TO 100 CUBIC FEET	CENTS PER 100 RATE	AMOUNT DUE
CITY OF WEST LINN	3		Gallons	11/30/07	6,608,730,000	6,548,660,000	60,070,000	/748	80,307	0.5910	$47,461.72
								% OF SFWB	33.05%		
CITY OF OREGON CITY								% CITIES	41.89%		
Cleveland & Hiram Roads	1	3614309	100 cf	11/30/07	697,350	687,490	9,860	None Reqd.	9,860		
16th & Division	4	5263181	1 cf	11/30/07	999,900	999,900	0	/100	0		
Mt. View Pump Station 3	6	851834	1000 Gal.	11/30/07	1,661,208	1,661,208	0	x1000/748	0	REMOVED 8/07	
Mt. View Pump Sta. 1, 2 & 4	5	11898	10000 cf	11/30/07	67,499	67,499	0	x100	0	REMOVED 8/07	
Mt. View Pump Sta. 1, 2 & 4	5		100 cf	11/30/07	443,711	366,943	76,768	None Reqd.	76,768	NEW 8/07	
Mt. View Street	7	1638536	1000 cf	11/30/07	222,489	219,955	2,534	x 10	25,340		
Hunter Ave Pump Station	10	1570243	100 cf	11/30/07	1,448,443	1,438,739	9,704	None Reqd.	9,704		
Less Water Tower Recycle	ET	1534058	100 cf	11/30/07	17,820	17,820	0	None Reqd.	0		
Less CLACKAMAS Usage									(10,289)		
TOTALS									111,383	0.6020	$67,052.57
								% OF SFWB	45.84%		
								% CITIES	58.11%		
CLACKAMAS RIVER WATER DISTRICT											
Redland Rd & Anchor Way	2	88811	100 cf	11/30/07	4,461,610	4,430,301	31,309	None Reqd.	31,309		
Redland Rd & Anchor Way	2	3746687	100 cf	11/30/07	996,317	992,405	3,912	None Reqd.	3,912		
Redland Rd & Anchor Way	2	5424502	100 cf	11/30/07	11,333	10,605	728	None Reqd.	728		
Leland and Meyers Roads	8	5572530	100 cf	11/30/07	23,254	22,818	436	None Reqd.	436		
Leland and Meyers Roads	8	5572530	100 cf	11/30/07	167,828	165,358	2,470	None Reqd.	2,470		
Leland and Meyers Roads	8	5572530	100 cf	11/30/07	21,755	21,755	0	None Reqd.	0		
S. End & Impala Roads	9	57404835	100 cf	11/30/07	99,700	98,955	745	None Reqd.	745		
S. End & Impala Roads	9	1620846	100 cf	11/30/07	6,205	6,205	0	None Reqd.	0		
Barlow Crest Pump St. (1)	11	M016162399	10 Gal.	11/30/07	4,335,866	4,335,866	0	/7.48	0		
Barlow Crest Pump St. (1)	11	67134913	100 cf	11/30/07	129,456	123,322	6,134	None Reqd.	6,134		
Barlow Crest Reservoir	12	1569585	100 cf	11/30/07	75	75	0	None Reqd.	0		
Barlow Crest Reservoir	12	53559697	100 cf	11/30/07	14,158	13,947	211	None Reqd.	211		
Swan Ave. & Forsythe Rd.	13	5355693	100 cf	11/30/07	47,008	46,715	293	None Reqd.	293		
Swan Ave. & Forsythe Rd.	13	1569614	100 cf	11/30/07	60	60	0	None Reqd.	0		
TOTALS									46,238	0.7040	$32,551.55
(1) Meter was registering about 40% loss so it was replaced on 10/30/06								% OF SFWB	19.03%		
CITY OF LAKE OSWEGO			Gallons	11/30/07	0	0	0	/748	0	0.4000	$0.00
NCCWC (Pipeline B)			Gallons	11/30/07	273,154,530	273,154,530	0	/748	0	0.7040	$0.00
TOTAL PAID CONSUMPTION									237,928		$147,065.84
								% OF SFWB	97.93%		
SFWB PLANT INTAKE									242,956		
							VARIANCE IN PRODUCTION		(5,028)		
								% OF SFWB	-2.07%		

Database entries | System fields |

CRW CODE	AD-01-01
Document Series	AGREEMENTS INTERGOVERNMENTAL:IGA
Filename	OREGON CITY - CRW HOPP SERVICE AREA
Unique Identifier	
Year	1998
RetentionStipulation	PERMANENT
Disposal Date	
Storage Date	09/24/2003
Last Used by	MGEORGE
Last Date Used	11/06/2007
Section Number	
Entity/Company/Firm	CLACKAMAS RIVER WATER (CRW)
Document Type	CONTRACT
Key Search Word	
	CONTRACT
Description	Expiration Date: 04/22/2028, term: 30 yrs, Date executed 04/22/98, Period review: every 5 yrs Service area: Holcomb-Outlook-Park Place (HOPP) MOU as Exhibit 1



LEGEND

- (A1) Oregon City UGB, 200 feet elevation to 450 feet
- (A2) Northerly Urban Reserve Area
- (A3) Clackamas River Water District area, 200 feet elevation to 450 feet, excluding Urban Reserve area
- (A4) Oregon City UGB, above 450 feet elevation
- (A5) Easterly Urban Reserve Area (Lies entirely above 450 feet elevation)
- (A6) Clackamas River Water District area, easterly to Hunter's Heights

HOPP AREA
WATER SERVICE PLAN
Oregon City (O.C.)/
Clackamas River Water (CRW)
(Attachment to Memorandum of Understanding")
Service Area Descriptions

MSA

FEBRUARY 1998

FIGURE 2

PAYMENT OF PGE STORAGE FEE
TOTAL ADJUSTED FINISHED WATER PRODUCTION
FOR CLACKAMAS RIVER WATER PROVIDERS
IN MG FOR CALENDAR YEAR 2006

Water Providers	Finished Water MG	% Total MG	Total Due
South Fork	3305.00	28%	$2,081.25
CRW	3104.59	26%	$1,955.04
Lake Oswego	2703.77	23%	$1,702.64
NCCWC	2639.70	22%	$1,662.29
Sunrise Water	[redacted]	0%	$0.00
Total	11753.06	100%	$7,401.22

APPENDIX C

PR-01 Comprehensive Water Audit Report

BLACK & VEATCH

MEMORANDUM **Black & Veatch Corporation**

To: Duane Karstens with Clackamas River Water (CRW)

Prepared By: Anthony Dunams, P.E.

Reviewed By: Randall Krueger, P.E.

Date: September 21, 2000

RE: Comprehensive Water Audit Summary

Water audits were performed on three CRW industrial/commercial customers. This memorandum summarizes the findings, general expectations (potential reductions and payback periods), and predicts potential results from implementing water conservation measures with respect to all CRW industrial/commercial customers.

The water audits of the three following industries revealed the following respective water reduction possibilities (in percent reductions):

- Consolidated Metco, Inc. (33.1 percent);
- Kaiser Foundation/ Mt. Scott Medical Clinic (39.2 percent); and
- Columbia Rubber Mills (70.1 percent).

The nearly 40-percent reduction rate determined for Mt. Scott Medical Clinic is high for a hospital, and is due to the excessive irrigation and the amount of area to be irrigated. The 70-percent reduction rate determined for Columbia Rubber Mills is also high, and is due to the large amounts of single-pass cooling water that is used.

These water audit reports were performed in an effort by CRW to identify water conservation actions that are cost-effective (a low payback period, typically less than a few years) for industrial and commercial customers and that preserve domestic water resources. Participation by the audited organizations as well as implementation of recommended water conservation actions are voluntary. Although this is a limited

sample, the analysis indicates that short payback periods for water conservation opportunities can be found that provide significant savings and that the water savings can be significant.

The purpose of these audits was to provide site-specific suggestions for water conservation activities for each participant. We were able to make a rough estimate of savings that can be achieved if the actions are implemented. Treated water production requirements can be reduced if the commercial and industrial sectors engaged in some form of water conserving practices.

As a daily average, Clackamas River Water treats and distributes approximately 11.7 mgd to wholesale Districts/Cities, commercial, industrial, institutional and domestic uses. Because some of its production is sold at the wholesale level, CRW is not able to precisely calculate the percentage of daily production that is delivered to non-residential end users. Industry standard indicates that approximately 25 to 30 percent of municipal water use in the United States is for industrial (non-domestic) water uses. Based on conversations with CRW staff, this percentage is estimated to be closer to 20 percent for the CRW service area. Based on that assumption, non-domestic users consume nearly a daily average of 2.3 mgd (= 11.7 mgd x 0.20) of the treated finished water that Clackamas River Water produces.

As listed earlier, percent reductions were determined for each of the three audited industries. This reduction percentage is based on how much each organization can reasonably expect to reduce its respective water use resulting in coarse average water savings of approximately 47.5 percent. It must be noted that the three industries audited were among CRW's largest water consumers and are not necessarily representative of the overall industrial/commercial/institutional (ICI) customer base. Due to their size and their widespread use of single-pass cooling water and excessive irrigation, these facilities have the highest potential for water conservation potential, as evidenced by the high percentage reductions discovered. Not all the industries will implement water conservation measures and some will not implement to the full degree. We recommend CRW realistically assume that only a 13-percent water saving will be realized with a

voluntary non-domestic water conservation program. This value is in accordance with reduction values (10.7 to 13.6 percent) determined by Black & Veatch and the Portland Bureau of Water Works in the 1998 BIG (Business, Industry and Government) Program Water Demand Reduction Potential from Conservation, Direct Use, Alternate Source, and Reclaimed Wastewater Opportunities report prepared for the Portland Bureau of Water Works. This results in average daily savings of approximately 0.3 mgd (= 2.3 mgd x 0.13) and reduces the average daily demand placed on Clackamas River Water to approximately 11.4 mgd, an approximate overall reduction of three percent.

The key benefits associated with water conservation measures include decreasing water usage and the decreased cost of discharging of water by industrial users. Moreover, such a program fosters a working relationship between the industrial and commercial users and Clackamas River Water.

Pertaining to future water audit issues and requirements, it is recommended that CRW should:

- continue to work with the Regional Water Providers Consortium to educate water users to the benefits of water conservation;
- recommend new developments be equipped with water conserving devices (other than the plumbing fixtures required by law) and protocols;
- provide assistance to industrial customers to reduce outdoor water use among those customers who are doing significant amounts of irrigation;
- work with vendors to advocate water conservation products;
- work with individual customers with large single-pass cooling loads to encourage cost-effective opportunities to convert to closed loop systems; and
- develop a water conservation program, where industries apply to and work with CRW staff on developing water conservation protocols and measures jointly.

In conclusion, the table below specifically provides information on what percent water reductions could be encountered and the payback period for the audited industry to recover initial capital costs.

Industry Name	Annual Water Reductions, gallons (%)	Total Implementation Costs [2]	Total Payback Period, months
Consolidated Metco, Inc. [1]	1,229,450 (33.1)	$205,810	38
Kaiser Foundation/ Mt. Scott Medical Clinic	1,297,400 (39.2)	$3,310	4
Columbia Rubber Mills	3,897,800 (70.1)	$6,775	6

1. Information shown includes Option 1 – Vacuum Distillation Evaporator, which is currently planned, as a conservation method for reducing cooling tower makeup water.
2. Operations and Maintenance Costs have not been included.

It is evident from this table that with minor manageable water conservation solutions (solutions to target the "low hanging fruit"), two of the industries can receive an economic benefit within one year. For industries that already have implemented significant water conservation measures (i.e. Consolidated Metco), additional water conservation savings can occur but require additional efforts and investment that still result in a manageable payback period of approximately three years, this payback period may be pushing the limit on being "cost-effective."

Based on the results of these initial water audits, Black & Veatch believes that these commercial/industrial audits demonstrate that there is significant cost-effective water savings potential. This potential exists for both individual participants and for Clackamas River Water through a CRW Comprehensive Water Audits Program that espouses industrial and commercial water conservation measures.

Table 4 – Conservation Economics							
Water Use Type	**Metered Water Usage (gallons)**	**Percent of Total (%)**	**Annual Water Savings (gallons)**	**Percent Water Reduction (%)**	**Annual Cost Savings**	**Implementation Costs**	**Payback Period (months)**
Domestic Uses	255,650	4.6	165,000	64.5	$660	$525	10
Process Heating	1,222,680	22.0	72,000	5.9	$260	$1,250	58
Single-Pass Cooling	3,790,310	68.2	3,660,800	95.0	$13,310	$5,000	5
Process Water	83,370	1.5	0	0.0	$0	$0	0
Landscape Irrigation	205,630	3.7	0	0.0	$0	$0	0
Total	**5,557,640**	**100.0%**	**3,897,800**	**70.1%**	**$14,230**	**$6,775**	**6**

BLACK & VEATCH

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Black & Veatch Corporation

Clackamas River Water
Commercial Water Audits

B&V Project 98505.100
B&V File E
September 12, 2000

Duane Karstens
Clackamas River Water
9100 SE Mangan Drive
Clackamas, OR 97015

Subject: Completed Water Audits

Dear Mr. Karstens:

Black & Veatch is pleased to provide you with eight bound copies and one unbound copy of the three water audits performed for the following industries:

- Consolidated Metco, Inc.;
- Kaiser Foundation/ Mt. Scott Medical Clinic; and
- Columbia Rubber Mills.

These water audit reports were performed in an effort by Clackamas River Water (CRW) to identify water conservation actions that are cost-effective for industrial and commercial customers and will preserve domestic water resources. Participation by the audited organizations as well as implementation of recommended water conservation actions are voluntary. However, the general thrust of the analysis indicates that reasonable payback periods can be encountered that provide significant savings.

Please do not hesitate to contact us or inquire about a presentation to the CRW Board and Citizen's Advisory Committee regarding work and findings contained in these audits. Also later this week, under separate cover, we will submit a short technical memorandum that will make recommendations for CRW's consideration in conducting future water audits and a gross estimate of expected water savings from the District's overall commercial customers.

Sincerely,

BLACK & VEATCH

Randall Krueger

Randall Krueger
Project Manager

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Enclosure

CONSOLIDATED METCO, INC.
CLACKAMAS RIVER WATER
COMPREHENSIVE COMMERCIAL WATER AUDITS

Prepared by

BLACK & VEATCH
Corporation

4004 Kruse Way Place, Suite 200
Lake Oswego, OR 97035

September 12, 2000

Introduction

This report presents the results of a water audit at Consolidated Metco, Inc. (Con Met) located on Highway 212 in Clackamas, Oregon. The audit was performed in conjunction with the Clackamas River Water (CRW) Preliminary Commercial Water Audits Program. The purpose of this audit is to characterize existing uses of CRW water and to preliminarily identify cost-effective water conservation measures for this facility. These measures can provide benefits to both the specific industry and CRW.

The scope of the study included review of water consumption data; an on-site study of water uses focusing on makeup water, die spray water and domestic uses; identification of water conservation measures recommended for implementation; and preparation of this report.

The following people participated in the site visit on June 21, 2000:

Larry Burnett, Facilities Manager – Consolidated Metco, Inc.
Duane Karstens, System Operations Coordinator – Clackamas River Water
Randall Krueger, Project Manager – Black & Veatch Corporation
Anthony Dunams, Project Engineer - Black & Veatch Corporation

Facility Profile

The facility consists of an office building and a process building. Approximately 145 employees work in the process building, 24 hours a day, five to six days a week. Approximately 35 employees work in the office building, eight to ten hours a day, five days a week.

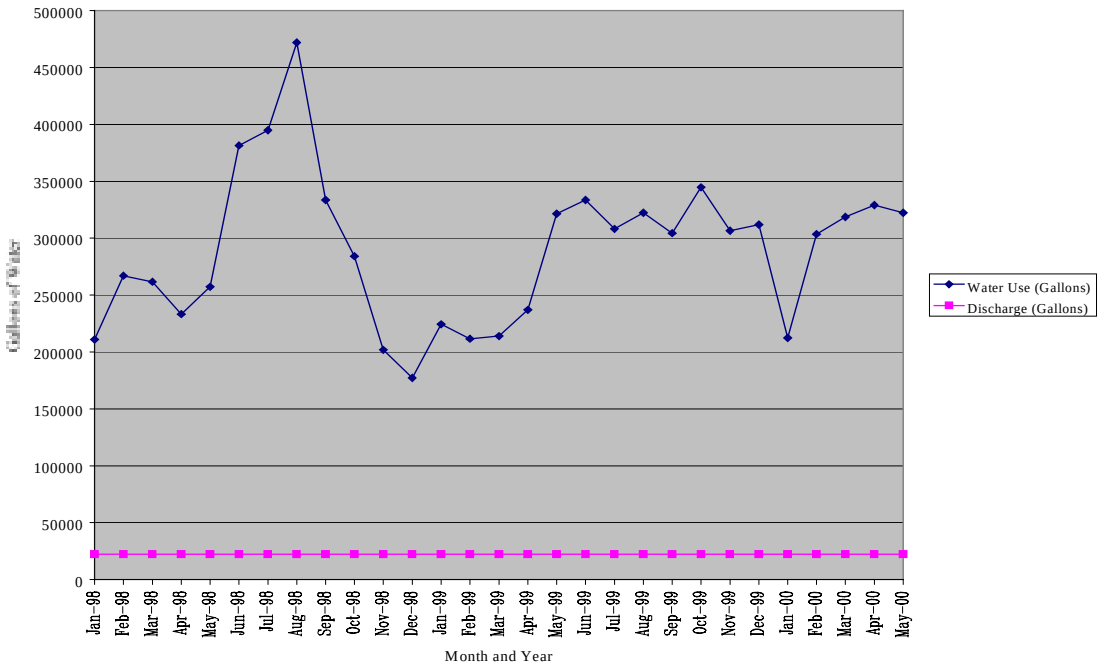
The entire process building footprint is approximately 62,000 square feet. This building was originally constructed in 1979 with an addition added in 1998/1999.

Con Met produces air brake canisters for trucks, air diaphragm pump casings and the lower and upper arm links for Freightliner's "Ezy-Rider" seats. This plant was originally built by Freightliner and is still tied heavily into the heavy trucking industry.

Water Consumption

All of the water used at this facility is purchased from Clackamas River Water. Total water consumption from the facility for the last 12 months, ending May 31, 2000, was 3,718,300 gallons. This corresponds to a daily consumption of approximately 13,100 gallons per workday (gpd) over a six-day workweek. The following figure, Figure 1, presents total water usage at the facility from January 1998 to May 2000.

Figure 1 - Recorded Monthly Consumption



Clackamas County Water Environment Services (WES), the wastewater provider, does not meter wastewater amounts and sets a standard sewer charge of three EDU's a month or 3,000 cubic feet (22,440 gallons a month). Based on this flat rate, this facility is charged annually for sewer uses amounting to 269,280 gallons or approximately 940 gpd.

This facility only discharges domestic waste to the sewer system, all process water is evaporated during the process, or collected and sent to the oil-water separator and then to an evaporator, or collected and transported off-site.

From this separation and evaporation process, side-stream products are created that cannot be discharged to sewer or reused and must be collected and hauled off-site. These components consist of waste solids (i.e. scaling from the evaporation process), waste oil, and excess evaporator capacity wastewater. The amounts removed are as follows:

- Approximately 2,000 gallons a year of waste solids are trucked off-site annually at a cost of $2.50 per gallon (at a yearly cost of $5,000);
- Approximately 1,500 gallons a year of waste oil is trucked off-site annually also at a cost of $2.50 per gallon (at a yearly cost of $3,750); and
- Approximately 160,800 gallons of excess wastewater is trucked off-site annually by Spencer Environmental (at a yearly cost of $80,040).

All of the above costs are borne from process water use that cannot be discharged to the sewer and is not evaporated by the on-site treatment system and is a cost that can be minimized by a reduction of water use.

Clackamas River Water and Clackamas County Water Environment Service rates are summarized as follows:

Table 1 – Water/Wastewater Rates

	Cost per ccf	**Cost per 1,000 gallons**
Water	$1.22	$1.63
Wastewater	$2.15	$2.86
Total	$3.37	$4.49

Applying the annualized average rate to Con Met's consumption, the total cost per year for water and wastewater is approximately $6,830 ($6,060 for water and $770 for wastewater). For the remainder of the report, cost calculations are based on an assumption that the combined water/sewer rate is $4.49 per 1000 gallons of water purchased. Charges per type of water use (in Table 3 and Table 4) are based on the value of what should have been paid based on actual flows.

Existing Water Conservation Efforts

This facility, unlike most, is very aware of water uses and how to minimize water uses. Since the process wastewater produced is laden with phenols and cannot be discharged to sewer, Con Met, over time, has reduced water consumption as a means of minimizing wastewater discharged. Hence, they have been promoting pollution prevention over pollution control as a means to deal with their wastewater problems.

Some elements of their pollution prevention mindset is the collection and recirculation of process wastewater, metering of most of the various process units, and separating process wastewater from the domestic sewer stream.

Water Balance/Water Use

The water uses identified at Consolidated Metco's facility include domestic, cooling tower and mold release compound makeup water, process use and wash water. Estimates of the water consumption for each type of use are formulated and discussed in the following paragraphs.

Domestic Uses

Domestic uses of water were identified for employee use. Rest rooms, six total, are located in the front office building and the plant process building. The rest rooms contain approximately 12 toilets, 5 urinals, 16 sinks, and 4 showers. The following table, Table 2, provides water consumption values.

Table 2 – Domestic Water Consumption					
Building	**No. of People**	**Toilets and Urinals**	**Lavatory Faucets (Sinks)**	**Showers**	**Total (gpd)**
Office	35	(3 flushes/day) x (4 gallons/flush) = 12 gpcd	(4 uses/day) x (15 secs/use) x (2.5 gpm) = 2.5 gpcd	(no showers) 0 gpcd	35 x 14.5 gpcd = 507.5 gpd
Plant Process Building	145	(3 flushes/day) x (5 gallons/flush) = 15 gpcd	(5 uses/day) x (15 secs/use) x (4 gpm) = 5 gpcd	(12 min/use) x (6 gpm) x (2 people) = 144 gpd	145 x 20 gpcd + 144 gpd = 3,044 gpd
Total					***3,551.5 gpd (say 3,550 gpd)***

The total annual domestic water consumption at the facility is approximately 1,011,750 gallons (3550 gpd). The cost per year for domestic uses is approximately $1,650 for water consumption. Since Con Met only pays for sanitary treatment of domestic waste, the wastewater charge is currently set at 3 EDU's (22,440 gallons a month or 269,280 gallons a year). Unless WES assumes that 25-percent of water used for domestic uses is discharged to sewer (note that about 60 to 85 percent of the per capita consumption of water becomes wastewater per Tchobanoglous, *Wastewater Engineering*, 3rd Edition); WES is not accurately billing Con Met. Based on the above consumption numbers and assuming 75 percent of the domestic water becomes wastewater, Con Met's monthly wastewater charge should be set at 8 EDU's, minimum, for a monthly sewer charge of $171.60 (annual charge of $2,060).

For the remainder of this report, we will note that all wastewater charges stem from domestic uses and will base costs and savings using actual calculated wastewater rates, which are based on domestic water usage rates.

Makeup Water

The primary uses of water for the facility is used for providing makeup cooling water for the evaporating cooling tower and mold release compound (die spray) makeup water.

Based on conversations with the client and a review of their metered data, makeup water to the cooling tower accounts for approximately 5,700 gpd of the daily water use. The existing evaporative cooling system provides a 10-degree cooling effect of process water running as high as 100 degrees Fahrenheit. The cooling reservoir downstream pumps are pumping a high volume of water (two pumps each capable of 415 gpm) throughout the various process machines and up to the cooling tower. Therefore, this cooling tower is providing a high volume of cooling, a high volume of evaporation, and thus requiring a large volume of makeup water.

Photo 1:
Die Casting Equipment with the Die Spray Process Occurring

Another process that uses a significant amount of makeup water is the die spray system (Photo 1). In this process, a lubricant is mixed with domestic water to act as a die-casting cooling and release compound to ensure the integrity of the die molds. Based on conversations with the client and a review of their metered data, the amount of water used for the die release compound is approximately 4,000 gpd. This sprayed compound is collected via trays and pumps under the die cast machines and returned to the process.

Water usage by these two process amounts to approximately 2,764,500 gallons annually or 9,700 gpd. The cost of water usage pertaining to makeup water uses amounts to approximately $4,510 annually. There are no WES sewer charges associated with this water use but there are disposal and transportation charges associated with the production of waste oils, waste solids, and the excess capacity wastewater that results from various process waters (see above). The total annual cost associated with die spray water and cooling tower makeup water amounts to approximately $82,500.

Process Water

Additional water is used for a few minor elements such as vibratory finish water and tool coolant water. Water in the vibratory finisher is used for polishing and removing the rough edges from the casted aluminum products. Tool coolant water is self-explanatory.

These uses combined amount to water uses of 550 gpd (156,750 gallons a year). The annual cost for this consumption of water is $260. The prorated, associated cost of trucking excessive wastewater, waste solids, and waste oil is $4,920.

Pressure Wash Water

For cleaning down equipment and process tools, an outside pressure wash water unit is used. The client, up to year 2000, has collected metered data on the use of pressure wash water, which amounts to 200 gpd (57,000 gallons a year). The annual cost for this consumption of water is $90. The prorated, associated cost of trucking excessive wastewater, waste solids, and waste oil is $1,730.

Summary

Tables 3 and 4 summarize the water-balance estimates for the facility and makes a comparison to actual metered water use at the site over the last year ending May 31, 2000. The water use allocation estimates are based on information provided by Larry

Burnett with Consolidated Metco, meter data furnished by CRW and Con Met, information gathered during the site visit, and product specific characteristics discovered by subsequent contact with manufacturers.

Table 3 – Estimated Annual Water Balance					
Water Use Type	**Estimated Water Use, Gallons**	**CRW Water and WES Wastewater Costs**	**Waste Oil, Waste Solids and Excess Wastewater Costs**	**Total Costs**	**CRW Metered Water Usage, Gallons**
Domestic Uses	1,011,750	$3,710[1]	$0	$3,710	**3,718,300 (7.3% difference from estimated water balance)**
Cooling Tower Makeup Water	1,624,500	$2,650	$52,030	$54,680	
Die Spray Water	1,140,000	$1,860	$36,490	$38,350	
Process Water	156,750	$260	$5,280	$5,540	
Pressure Wash Water	57,000	$90	$1,860	$1,950	
Total	**3,990,000**	**$8,570**	**$95,660**	**$104,230**	

1. Includes all WES wastewater charges at 8 EDU's a month.

The water use difference from estimated to actual amounted to 271,700 gallons a year. This discrepancy is attributable to the subjective estimates made during the analysis of water usage rates and reflects the use of assumptions in evaluating each water use category. For the remainder of this report, cost savings will be compared to actual water usages for the 12-month period ending May 31, 2000, see Table 4 below. Therefore, Table 4 water usage and costs are the baseline for measuring water conservation savings.

Table 4 – Annual Metered Water Balance						
Water Use Type	**Estimated Water Use, Gallons**	**Percent of Total, %**	**CRW Metered Water Usage, Gallons**	**Metered Water Usage per Type of Use, Gallons[1]**	**CRW Water and WES Wastewater Costs**	**Waste Oil, Waste Solids and Excess Wastewater Costs**
Domestic Uses	1,011,750	25.4	**3,718,300 (7.3% difference from estimated water balance)**	944,450	$3,600	$0
Cooling Tower Makeup Water	1,624,500	40.7		1,513,350	$2,470	$48,490
Die Spray Water	1,140,000	28.6		1,063,430	$1,730	$34,010
Process Water	156,750	3.9		145,010	$240	$4,920
Pressure Wash Water	57,000	1.4		52,060	$80	$1,730
Total	**3,990,000**	**100.0**		**3,718,300**	**$8,120**	**$89,150**

1. (Metered water usage = 3,718,300) x (percent of total) = Metered water usage per type of use

Therefore, the total cost of consuming water and discharging of wastewater, waste solids and waste oils is $97,270, not including energy or chemical costs.

Water Conservation Opportunities

A review of the water consumption information provided by Consolidated Metco aided in the identification of additional water conservation opportunities. Opportunities for water conservation have been identified in the following water use categories: domestic uses, makeup water, and other ancillary improvements.

Domestic Use Savings

Significant savings can be realized by modifying domestic water consumption at the facility. With 180 employees and 25-percent of the water consumed going to domestic uses, a significant reduction in water use can be realized by retrofitting existing fixtures.

Three water conservation measures can be implemented to reduce domestic water consumption. These measures include retrofitting toilets and urinals with ultra low flush components or models for flushometer type fixtures, which can reduce toilet flows from five gallons a flush to approximately 1.6 gallons and reduce flow through urinals to below one gallon a flush. A second conservation measure can reduce lavatory faucet flows to approximately one gpm or less with the addition of aerators. A third conservation measure is to modify the showerheads in the double men's bathroom with aerators. These units can reduce flow through the showerheads down to approximately 2.5 gpm or less and will also save energy by reducing hot water consumption. Note that showers are used by less than 2-percent of the employees that work in the process area, hence a minor savings will be realized with the installation of low-flow showerheads.

The addition of these water conservation methods can reduce domestic water usage by approximately 58-percent to a daily use of less than 1,400 gallons. This amounts to an annual saving of 545,450 gallons of water (409,090 gallons of created wastewater) or

approximately $1,920 a year savings based on reduced water and wastewater volumes. An additional savings due to reduced energy consumption for heating domestic water adds an additional $180 a year savings. Energy savings for reduced gas usage amounts to $0.33 per 1,000 gallons.

The cost of implementation per each conservation measure is estimated as follows:

- At a minimum to upgrade the 12 toilets and five urinals, improvements can be made with retrofit kits. Toilets and urinals equipped with flush valves can be retrofitted with orifice inserts or valve replacement kits to reduce the volume of water used per flush. The cost per fixture retrofit kit is approximately $30 leading to an installed cost (20% of the cost of material) of $610.

- The facility has four showers of which only two see limited use and the others are not used at all. At a minimum, two showers in the mixing building should be retrofitted with new water-conserving hardware or aerators. Cost of retrofitting each showerhead is $20. This improvement to restrict flow through showerheads by installing water-conserving hardware costs $50 installed ($100 for retrofitting all four showerheads).

- Installation of faucet aerators or flow reducing inserts can reduce the flow to nearly 1 gpm and are quite less costly than completely replacing a faucet. The cost to retrofit an existing faucet is approximately $5 per faucet and the total cost of retrofitting all 16 sinks is approximately $100 installed.

The overall cost to retrofit the domestic uses at Con Met is $810. Implementation of the retrofit conservation measures would save approximately 545,450 gallons of water and $2,100 in water, energy and wastewater charges each year. Therefore, the combined simple-payback period for these retrofits would be approximately five months.

Makeup Water Savings

Con Met requires makeup water to replenish the cooling water that is evaporated during the heat exchange process of the cooling tower evaporator (see Photo 2, which shows the elevated cooling tower reservoir). This facility is already practicing water conservation activities by recirculating and cooling water for machine cooling purposes. Without recirculating cooling water, Con Met would require over one mgd of water from CRW instead of the less than 6,000 gpd that facility currently uses and recirculates.

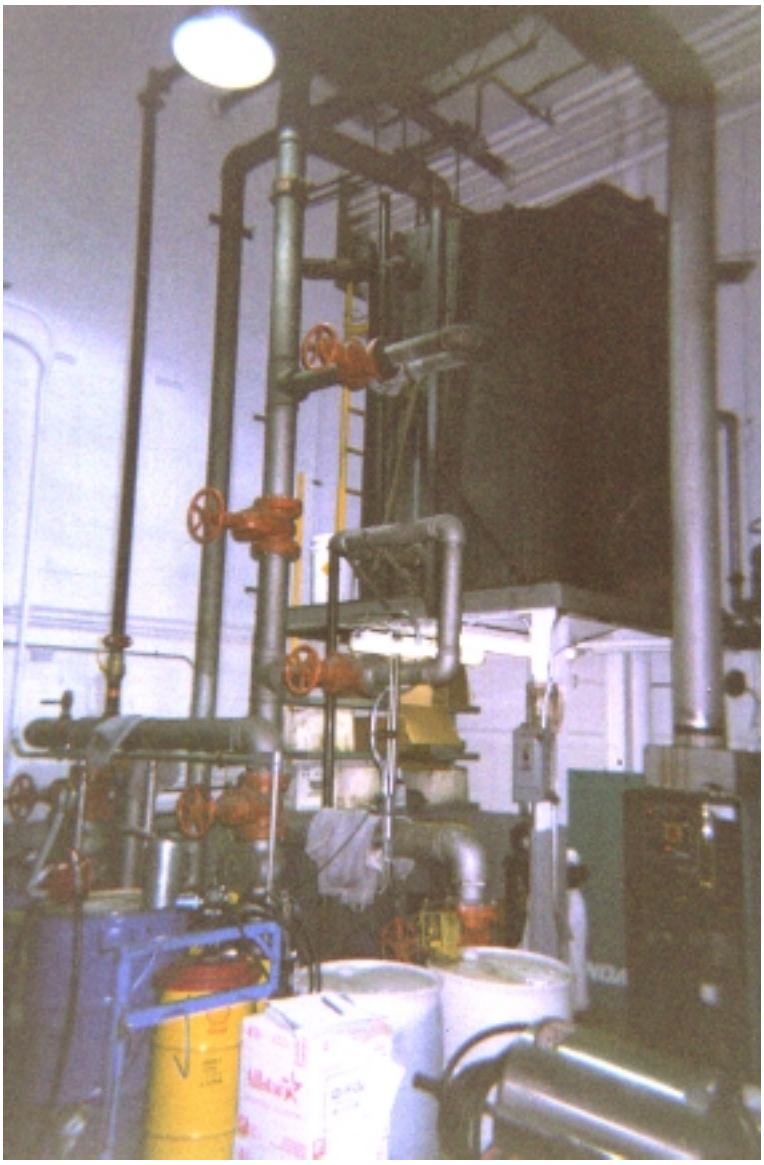


Photo 2: Cooling Tower Reservoir

An evaluation of the cooling tower indicates that minimal improvements (i.e. minimizing evaporation) can be made to provide water consumption reductions. Typically, increasing the concentration ratio and/or reducing the amount of bleed-off can provide significant water consumption reductions. As of June 2000, the cooling tower concentration ratio was found to be approximately 10.3, hence only a small additional amount of water can be conserved by increasing the concentration ratio to 15 (less than four-percent which amounts to 210 gpd or 59,850 gallons a year). Cost-wise this amounts to water savings of $100 a year. Pertaining to bleed-off amounts, Larry Burnett indicated that bleed-off is negligible thereby providing no recourse for water conservation via reducing the amount of bleed-off. This option of regulating the cooling tower concentration ratio will require the addition of a new make-up water valve with a conductivity controller; the payback on this option would be approximately 30 years. This option is not recommended.

Photo 3:
Photo 3: Con-Met's Oil-Water Separator, Storage Tanks, and Evaporator

The next option is to reduce the makeup water volume required from CRW. Con Met is currently procuring a vacuum distillation evaporator to replace the existing evaporator (Photo 3) and to recover water for return to the cooling tower. Process water collected from the process building drain system is pumped to the oil-water separator (OWS), the holding tanks and subsequently to the existing evaporator (this evaporator should not be confused with the cooling tower evaporator). Currently 3,000 gpd of 10,500 gpd of process water is collected and routed to the OWS and holding tanks; the remainder of the daily process water is evaporated in the cooling tower or at the equipment being cooled. This vacuum distillation evaporator can recovery approximately 80-percent of the 3,000 gpd, per information from client. Hence, 2,400 gpd can be recovered and routed to the cooling tower reservoir thus reducing the daily demand for makeup water from 5,310 gpd to 2,910 gpd. This amounts to a yearly reduction of CRW by 684,000 gallons or approximately $1,110 in annual water costs (Option 1). This technology will also reduce the amount of excess wastewater hauled off-site by a minimum of 80-percent (most likely

all excess wastewater will be disposed of on-site). Therefore, this excess wastewater volume will be reduced to 31,200 gallons; a reduction of 124,800 gallons and a yearly cost savings of $62,400.

The cost for pumping and conveying the recovered makeup water will not exceed $5,000 and the cost for the installed vacuum distillation evaporator will be approximately $200,000. The payback period for this water conservation effort is a little over three years (39 months). This process is promising but would also have to consider energy and chemical usage and problems associated with scaling and solids carryover.

Ancillary Improvements

The two following ancillary improvements may also provide some means of reducing water consumption and wastewater production.

The outside pressure wash system drains to the OWS and the evaporation holding tanks. This outside drain also collects an undetermined amount of parking lot stormwater runoff. Unless this is Con Met's approach to handling stormwater discharge volumes; this additional volume goes through the evaporation process or may be subsequently trucked off as excess wastewater. Black & Veatch would recommend that this pressure wash drain be bermed off to minimize surface water inflow.

Another additional source of makeup water is the volume of rainwater that is collected from the roof of the 62,000 square foot process building. This volume of rainwater, assuming one foot of rainfall a year and taking into account evaporation, could be as high as 465,000 gallons a year (Option 2). This would reduce the required CRW water for makeup water by approximately 30-percent and provide savings of $760 a year. The cost to modify rain gutters and to provide gravity piping to the cooling water reservoir is approximately $2,500 resulting in a payback period of 40 months (20 months assuming two feet of rainfall collected a year).

Summary

The following table, Table 5, compares the potential savings of the identified water-conservation opportunities to the total allocated water balance. Implementation of the water saving measures could reduce the annual water use at Consolidated Metco significantly, anywhere from 1,010,450 to 1,229,450 gallons which equates to a cost savings ranging from $2,860 to $65,610 a year depending on what option selected by Con Met. At this point, with the procurement of the vacuum distillation evaporator, Con Met can experience cost savings of $65,610 a year in water and wastewater charges with a payback period a little over three years. Table 5 lists the potential cost savings and payback periods for the conservation measures identified within each water-use category.

Table 5 – Conservation Economics

Water Use Type	Metered Water Usage (gallons)	Percent of Total (%)	Annual Water Savings (gallons)	Percent Water Reduction (%)	Annual Cost Savings	Implementation Costs	Payback Period (months)
Domestic Uses	944,450	25.4	545,450	57.8	$2,100	$810	5
Cooling Tower Makeup Water	1,513,350	40.7	684,000 Option 1	45.2	$63,510	$205,000	39
	1,513,350	40.7	465,000 Option 2	30.7	$760	$2,500	40
Die Spray Water	1,063,430	28.6	0	0.0	$0	$0	0
Process Water	145,010	3.9	0	0.0	$0	$0	0
Pressure Wash Water	52,060	1.4	0	0.0	$0	$0	0
Total	**3,718,300**	**100.0%**	**1,010,450 (min) and 1,229,450 (max)**	**27.2% (min) and 33.1% (max)**	**$2,860 (min) and $65,610 (max)**	**$3,310 (min) and $205,810 (max)**	**14 (min) and 38 (max)**

Option 1 – The Vacuum Distillation Evaporator
Option 2 – Rainfall Collection (assuming one foot of rainfall collected)

KAISER FOUNDATION / MT. SCOTT MEDICAL CLINIC
CLACKAMAS RIVER WATER
COMPREHENSIVE COMMERCIAL WATER AUDITS

Prepared by

BLACK & VEATCH
Corporation

4004 Kruse Way Place, Suite 200
Lake Oswego, OR 97035

September 12, 2000

Introduction

This report presents the results of a water audit at the Kaiser Foundation/Mt. Scott Medical Clinic (Kaiser/Mt. Scott) located on Sunnyside Drive in Clackamas, Oregon. The audit was performed in conjunction with the Clackamas River Water (CRW) Preliminary Commercial Water Audits Program. The purpose of this audit is to characterize existing uses of CRW water and to preliminarily identify cost-effective water conservation measures for this facility. These measures can provide benefits to both the specific industry and CRW.

The scope of the study included review of water consumption data, an on-site study of water uses focusing on irrigation and domestic uses, identification of water conservation measures recommended for implementation, and preparation of this report.

The following people participated in the site visit on June 22, 2000:

Tony Opzeeland, Facilities Engineer – Kaiser Foundation/Mt. Scott
Duane Karstens, System Operations Coordinator – Clackamas River Water
Anthony Dunams, Project Engineer - Black & Veatch Corporation

Facility Profile

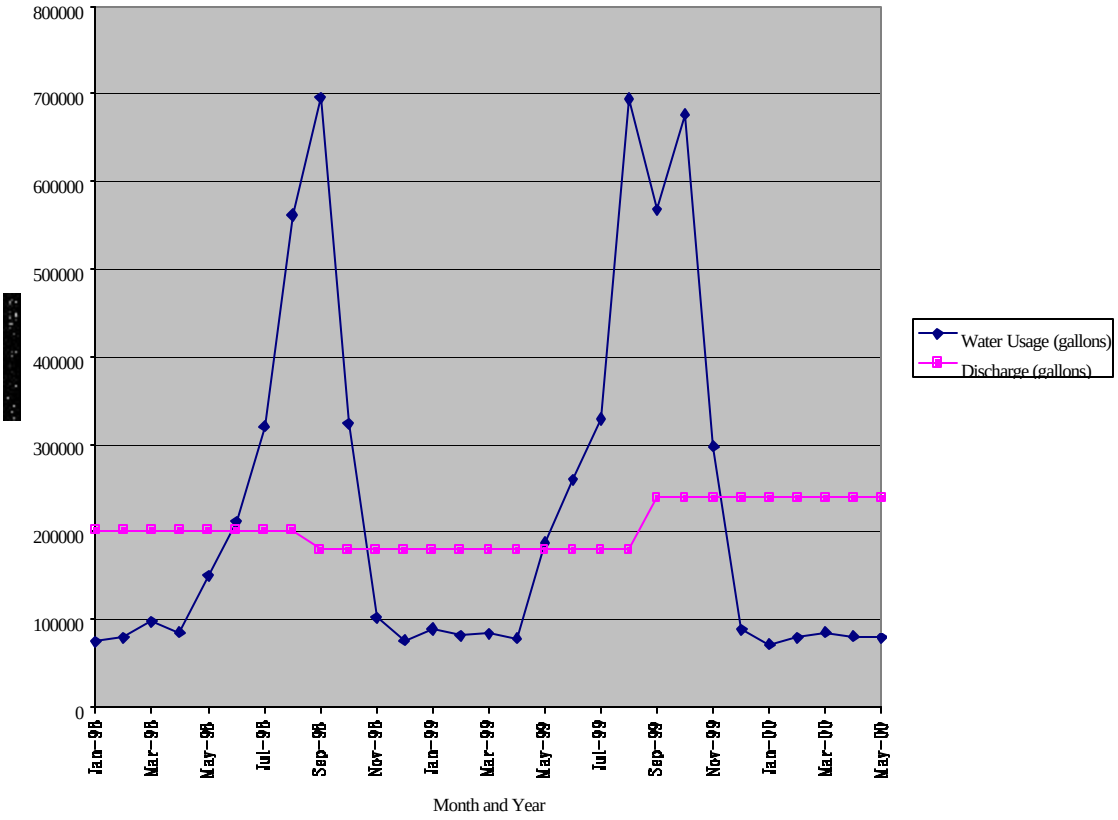
This facility consists of a medical office for patient visits and surrounded by irrigated turf. The office is approximately 56,500 square feet in area and the entire parcel is approximate 4.5 acres.

Approximately 200 employees work in the office and the average daily patient count is 650. This office is open five days a week and ten hours per day. This facility is used for routine evaluation and testing of patients.

Water Consumption

All of the water used at this facility is purchased from Clackamas River Water. Total water consumption for the facility over the last 12 months, ending May 31, 2000, was 3,307,700 gallons. This corresponds to a daily consumption of 12,720 gallons per workday (gpd). The following figure, Figure 1, presents total water usage and wastewater discharges at the facility from January 1998 to May 2000. The two water usage peaks correspond to summer irrigation of the surrounding landscaped areas.

Figure 1 - Recorded Monthly Consumption



Clackamas County Water Environment Services (the wastewater provider) does not meter wastewater amounts and sets an annual sewer charge every September based on the previous average monthly flows from July to June. As noted in Figure 1, during the winter months it appears that more wastewater is being discharged than water consumed.

This is not occurring since the wastewater discharges are just an average allotted per month. One element of this wastewater estimating is the inclusion of the peaks in the figure, these peaks are due to turf irrigation which subsequently percolates into the ground or is collected on the pavement and routed to the detention pond. Therefore, Kaiser/Mt. Scott is paying for wastewater that is not being generated.

Clackamas River Water and Clackamas County Water Environment Service rates are summarized as follows:

Table 1 – Water/Wastewater Rates

	Cost per ccf	**Cost per 1,000 gallons**
Water	$1.22	$1.63
Wastewater	$2.15	$2.86
Total	$3.37	$4.49

Applying the annualized average rate to Kaiser/Mt. Scott's consumption, the total cost per year for water and wastewater is approximately $14,900 ($5,400 for water and $9,500 for wastewater). The cost for wastewater includes costs pertaining to water used for irrigation, this will not be carried through for the rest of the report since water used for irrigation does not enter the wastewater stream. Also for the remainder of the report, cost calculations are based on an assumption that the combined water/sewer rate is $4.49 per 1000 gallons of water purchased. Charges per type of water use (in Table 3) are based on the value of what should have been paid based on actual flows and the wastewater credit.

Existing Water Conservation Efforts

The facility currently implements a few water conservation efforts. The two showers in the facility are equipped with low flow devices and the entire HVAC system is air cooled, not water-cooled. The latter does provide significant water consumption savings.

Water Balance/Water Use

The water uses identified at the Kaiser/Mt. Scott facility include domestic, x-ray processing and landscape irrigation. Estimates of the water consumption for each type of use are formulated and discussed in the following paragraphs.

Domestic Uses

Domestic uses of water were identified for employee use, patient use and laboratory use. This facility is equipped with two low flow showers, 21 toilets, two urinals, 125 sinks, 20 lab sinks, three janitorial sinks, three water fountains and two small ice machines. The following table, Table 2, provides water consumption values:

Table 2 – Domestic Water Consumption

	No. of People	**Toilets and Urinals**	**Sinks**	**Showers**	**Total (gpd)**
Patients	650	(0.5 flushes/day) x (4 gallons/ flush) = 2 gpcd	(1 use/day) x (15 secs/use) x (4 gpm) = 1 gpcd	0 gpcd (no showers)	650 x 3 gpcd = 1950 gpd
Employees	200	(3 flushes/day) x (4 gallons/ flush) = 12 gpcd	(4 use/day) x (15 secs/use) x (5 gpm) = 5 gpcd	(12 min/use) x (2 gpm) x (5% use) = 1.2 gpcd	200 x 18.2 gpcd x 60% = 2,184 gpd
Total					***4,134 gpd***

To account for a large portion of the office staff working only six hours at the facility (per conversation with Kaiser/Mt. Scott representative), the 60-percent factor was applied to the employee consumption number. The total annual domestic water consumption at the facility is approximately 1,074,800 gallons (4,134 gpd). The cost per year for domestic uses is approximately $4,830 (water and wastewater charges).

X-ray Processing

There is one x-ray processor that is used at this facility. This system is operational for about ten hours a day and processes approximately 40 x-rays a day. No actual flows could be measured in the field. The unit uses an average flowrate of 1.5 gpm during a 90-second process cycle according to information from the equipment manufacturer. This unit is equipped with an internal process valve to ensure that the flow stays set at 1.5 gpm. Total x-ray processor water consumption is therefore estimated to be 23,400 gallons (90 gpd). The cost per year for x-ray processing is approximately $110.

Landscape Irrigation

Approximately 137,640 square feet of landscaping around the office building is irrigated with CRW water. Most of the irrigated area is covered with turf with some shrubs. During the warm weather months, the turf areas are watered every other night for thirty minutes. There is no meter to determine the amount of water used for irrigation. Based on information from a 1997 Portland area water audit performed by Black & Veatch, an irrigation specialist with Portland Bureau of Water Works recommends that the application rate for turf be 16 inches per year. Therefore the amount of water used for irrigation per year should amount to 1,372,700 gallons or 5,280 gpd if watered every other day during the whole year, which is not done. Typically landscaped area are watered anywhere from four to six months of the year, amounting to 21,120 gpd for the former watering period and 10,560 for the latter.

However, based on Figure 1, it is readily apparent which months the lawns are irrigated and the volume of water that is used to irrigate. During the summer of 1998, nearly 1,700,000 gallons were used for irrigation. During the summer of 1999, nearly 2,400,000 gallons of water were used for irrigation. Based on historical data, it appears that the facility over-irrigates the landscape by anywhere from four-inches to 12-inches. Assuming that 2,000,000 gallons (7,690 gpd) are used annually, the cost per year for

irrigation water is $3,260. No wastewater cost is associated with this since this water does not enter the wastewater stream.

Summary

Table 3 summarizes the water-balance estimates for the facility and makes a comparison to actual metered water use at the site over the last year ending May 31, 2000. The water use allocation estimates are based on information provided by Tony Opzeeland with Kaiser Foundation/Mt. Scott Medical Clinic, meter data furnished by CRW, information gathered during the site visit, and product specific characteristics discovered by subsequent contact with the x-ray manufacturer (Kodak).

Table 3 – Estimated Annual Water Balance

Water Use Type	Estimated Water Use (gallons)	Water/ Wastewater Costs (Based on Estimated Use)	Water Use Percent of Total (%)	Metered Water Usage from CRW (gallons)	Metered Water Usage per Type of Use (gallons)[1]	Water/ Wastewater Costs (Based on Metered Use)
Domestic Uses	1,074,800	$4,830	34.7	**3,307,700 (6% difference from estimated water balance)**	1,147,800	$5,150
X-ray Process	23,400	$110	0.8		26,400	$120
Landscape Irrigation	2,000,000	$3,260	64.5		2,133,500	$3,480 ($6,100)[2]
Total	**3,098,200**	**$8,200**	**100.0**		**3,307,700**	**$8,750**

1. (Water usage = 3,307,700) x (percentage, column 4) = Metered water usage for type.
2. Since this facility is currently being charged wastewater rates for all water consumed, the $6,100 rate is a real cost to Kaiser/Mt. Scott and will be a water conservation charge reduction once a irrigation meter is installed.

Water use difference amounted to 209,500 gallons. This discrepancy is attributable to the subjective estimates made during the analysis of water usage rates and reflects the use of assumptions in evaluating each water use category. For the remainder of this report, cost savings will be compared to actual water usages for a 12-month period ending May 31, 2000. Hence the last two columns of Table 3 is the baseline for measuring cost savings. In addition, note that the total water and wastewater cost is less than $9,000 compared to the $14,900 indicated based on all water, even irrigation water, going to sewer. This discrepancy can be easily resolved with an irrigation meter, see water conservation

opportunities section, and will immediately provide a reduced utility cost to Kaiser/Mt. Scott but is not a water conservation savings per se.

Water Conservation Opportunities

A review of the water consumption information provided by Kaiser Foundation aided in the identification of additional water conservation opportunities. Opportunities for water conservation have been identified in the following water use categories: domestic uses and landscape irrigation.

Domestic Use Savings

Significant savings can be realized by modifying domestic water consumption at the facility. With 200 employees, 650 patients daily, and 35-percent of the water consumed going to domestic uses, a significant reduction in water use can be realized by retrofitting existing fixtures.

Two water conservation measures can be implemented to reduce domestic water consumption. These measures include retrofitting toilets and urinals with ultra low flush components or models for flushometer type fixtures, which can reduce toilet flows from four or five gallons a flush to approximately 1.6 gallons and reduce flow through urinals to below one gallon a flush. The second conservation measure for sinks can reduce flows to approximately one gpm or less with the addition of aerators.

The addition of these water conservation methods can reduce domestic water usage by approximately 54-percent to a daily use of approximately 2,030 gallons (down from approximately 4,415 gpd). This amounts to an annual saving of 620,100 gallons of water or approximately $2,780 a year savings based on reduced water and wastewater volumes. An additional savings due to reduced energy consumption for heating less domestic water adds an additional $200 a year savings. Energy savings for reduced gas usage amounts to $0.33 per 1000 gallons.

The cost of implementation per each conservation measure is estimated as follows:

- At a minimum to upgrade the 21 toilets and two urinals, improvements can be made with retrofit kits. Toilets and urinals equipped with flush valves can be retrofitted with orifice inserts or valve replacement kits to reduce the volume of water used per flush. The cost per fixture retrofit kit is approximately $30 leading to an installed cost (labor is 20% of the cost of material) of $830.

- Installation of faucet aerators or flow reducing inserts can reduce the flow to nearly 1 gpm and are quite less costly than completely replacing a faucet. The cost to retrofit an existing faucet is approximately $10 per faucet, installed, and the total cost of retrofitting all 148 sinks is approximately $1480 installed.

The overall cost to retrofit the domestic uses at Kaiser/Mt. Scott is $2,310. Implementation of the retrofit conservation measures would save approximately 620,100 gallons of water and $3,030 in water, energy and wastewater charges each year. Therefore, the combined simple-payback period for these retrofits would be approximately ten months.

Landscape Irrigation Savings

Assumptions about water usage seem to indicate that the application rate for the Kaiser/Mt. Scott facility is higher than what is required, approximately four to 12-inches higher. Based on our assumptions, this facility can save anywhere from 327,300 to 1,027,300 gallons a year by not over irrigating the lawns. This amounts to annual water savings of $530 to $1,670, on average we will say a yearly savings of $1,100 or 677,300 gallons. Black & Veatch recommends that the irrigation system be audited by a specialist to determine the correct irrigation rates for this facility based on soil type, slope and type of grasses planted.

Aside from overwatering the turf, this facility is also being charged for metered water that does not enter the wastewater stream, i.e. irrigation water, which enters the stormwater stream, is included in current wastewater charges. Hence, a savings will be realized but not a direct water conservation savings, but a savings nevertheless. This savings is approximately $6,100 a year (see Table 3).

To remedy excess irrigation and over-inflated wastewater bills, Black & Veatch recommends the installation of an irrigation meter ($1,000 approximate installed cost) and an evaluation of the existing sprinklers and sprinkler system. The latter may lead to a new programmable controller.

The overall minimum cost to retrofit the irrigation system at the Kaiser/Mt. Scott is approximately $1,000. Implementation of the retrofit conservation measures would save approximately $7,200 in water and wastewater charges each year. Therefore, the combined simple-payback period for this retrofit would be approximately two months.

Summary

The following table, Table 4, compares the potential savings of the identified water-conservation opportunities to the total allocated water balance. Implementation of the water saving measures could reduce the annual water use at Kaiser/Mt. Scott significantly, approximately 1,297,400 gallons which equates to a cost savings of a little over $10,000 a year. Most of these savings are attributed to metering irrigation water which will indicate what is not entering the wastewater collection system subsequently resulting in reduced wastewater charges. Table 4 lists the potential cost savings and payback periods for the conservation measures identified within each water-use category.

Table 4 – Conservation Economics

Water Use Type	Metered Water Usage (gallons)	Percent of Total (%)	Annual Water Savings (gallons)	Percent Water Reduction (%)	Annual Cost Savings	Implementation Costs	Payback Period (months)
Domestic Uses	1,147,800	34.7	620,100	54.0	$3,030	$2,310	10
X-ray Process	26,400	0.8	0	0.0	$0	$0	0
Landscape Irrigation	2,133,500	64.5	677,300	31.7	$7,200	$1,000	2
Total	**3,307,700**	**100.0%**	**1,297,400**	**39.2%**	**$10,230**	**$3,310**	**4**

COLUMBIA RUBBER MILLS
CLACKAMAS RIVER WATER
COMPREHENSIVE COMMERCIAL WATER AUDITS

Prepared by

BLACK & VEATCH
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September 12, 2000

Introduction

This report presents the results of a water audit at Columbia Rubber Mills (CR Mills) located on 82nd Drive in Clackamas, Oregon. The audit was performed in conjunction with the Clackamas River Water (CRW) Preliminary Commercial Water Audits Program. The purpose of this audit is to characterize existing uses of CRW water and to preliminarily identify cost-effective water conservation measures for this facility. These measures can provide benefits to both the specific industry and CRW.

The scope of the study included review of water consumption data, an on-site study of water uses focusing on cooling water and boiler operations, identification of water conservation measures recommended for implementation, and preparation of this report.

The following people participated in the site visit on June 27, 2000:

Bruce Weaver, Plant Manager – Columbia Rubber Mills
Duane Karstens, System Operations Coordinator – Clackamas River Water
Randall Krueger, Project Manager – Black & Veatch Corporation
Anthony Dunams, Project Engineer - Black & Veatch Corporation

Facility Profile

The facility consists of three buildings with varying procedures occurring in each:

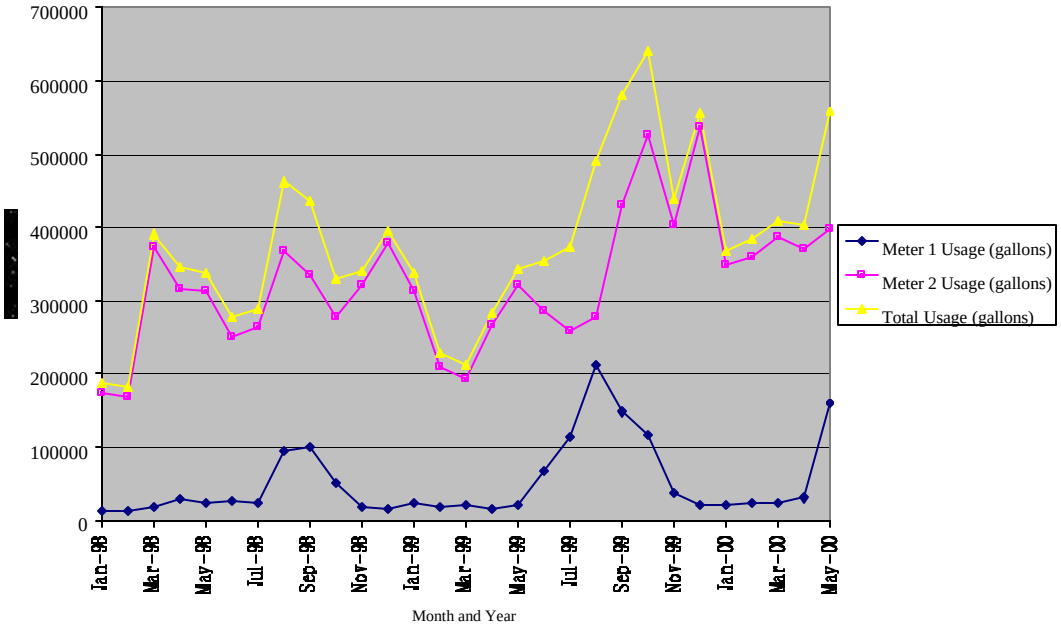
- The office and roll building, built in the mid 1990's;
- The press building, built in the late 1970's/early 1980's; and
- The mixing building, which was also built in the late 1970's/early 1980's.

The roll building footprint is approximately 30,000 square feet. The total footprint for all three buildings is approximately 100,000 square feet. The facility is sited on seven acres of land.

Approximately 32 people work in the three buildings, five days per week (260 days a year). The facility operates 8 to 10 hours a day. Columbia River Mills produces all types of rubber rollers and specialty rubber molded products.

Water uses by the office and roll building, as well as for facility irrigation purposes, is metered as account number 15683-6 (Meter 1). Water use by the press and mixing building is metered separately towards account number 15684-4 (Meter 2). There is also a fire usage meter and an abandoned meter. The following figure, Figure 1, presents total water usage at the facility from January 1998 to May 2000.

Figure 1 - Recorded Monthly Consumption



Water Consumption

All of the water used at this facility is purchased from Clackamas River Water. Total water consumption from the facility for the last 12 months, ending May 31, 2000, was 5,557,640 gallons. This corresponds to a daily consumption of 21,400 gallons per workday (gpd). Of this amount, the office, roll building and facility irrigation (accounted for by Meter 1) amounts to approximately 3,800 gpd and the other two buildings, which

utilize most of the facility water (accounted for by Meter 2), amounts to approximately 17,600 gpd.

Clackamas County Water Environment Services (the wastewater provider) does not meter wastewater amounts and determines the sewer charge based on water usage and credits CR Mills 20,000 cubic feet per month. Based on this credit, this facility is charged annually for sewer uses amounting to 3,762,440 gallons or approximately 14,500 gpd. CR Mills also disposes to the storm sewer non-contaminated, process water and irrigation water.

Clackamas River Water and Clackamas County Water Environment Service rates are summarized as follows:

Table 1 – Water/Wastewater Rates

	Cost per ccf	**Cost per 1,000 gallons**
Water (Meter 1)	$1.52	$2.03
Water (Meter 2)	$1.22	$1.63
Water Average *	$1.27	$1.70
Wastewater	$2.15	$2.86
Total	$3.42	$4.56

* Weighted proportionately based on average flows through each meter.

Applying the annualized average rate to CR Mills's consumption, the total cost per year for water and wastewater is approximately $20,200 ($9,400 for water and $10,800 for wastewater). For the remainder of the report, cost calculations are based on an assumption that the combined water/sewer rate is $4.56 per 1000 gallons of water purchased. Charges per type of water use (in Table 3) are based on the value of what should have been paid based on actual flows and the sewer credit.

Existing Water Conservation Efforts

The facility currently does not implement many water conservation efforts. Some showers are equipped with low-flow showerheads and the Kewanee boiler is arranged to return condensate, amount unknown, from the press machines to the boiler. Most of the

other domestic uses do not utilize low flow or low flush devices, and an outmoded single-pass cooling system is used for cooling the rubber mills and for cooling the autoclave cooling fan.

Water Balance/Water Use

The water uses identified at the Columbia Rubber Mills facility include domestic, single-pass machinery cooling, process use, steam production via boilers and landscape irrigation. Estimates of the water consumption for each type of use are formulated and discussed in the following paragraphs.

Domestic Uses

Domestic uses of water were identified for employee use. Rest rooms, eight total, are located throughout the three buildings and office area. The rest rooms contain approximately 9 toilets, 4 urinals, 11 sinks, 7 showers and a janitorial sink.

Table 2 – Domestic Water Consumption

Building	No. of People	Toilets and Urinals	Lavatory Faucets (Sinks)	Showers	Total (gpd)
Office	6	(3 flushes/day) x (5 gallons/flush) = 15 gpcd	(5 uses/day) x (30 secs/use) x (2 gpm) = 5 gpcd	Low-flow shower used infrequently = 0 gpcd	6 x 20 gpcd = 120 gpd
Roll Building	13	15 gpcd	5 gpcd	Low-flow shower used infrequently = 0 gpcd	13 x 20 gpcd = 260 gpd
Mixing Building	3	15 gpcd	(4 uses/day) x (30 secs/use) x (10 gpm) = 20 gpcd	(12 minutes/use) x (5 gpm) = 60 gpcd	3 x 95 gpcd = 285 gpd
Press (Molding) Building	10	15 gpcd	(4 uses/day) x (30 secs/use) x (10 gpm) = 20 gpcd	No Showers	10 x 35 gpcd = 350 gpd
Total					***1,015 gpd***

The total annual domestic water consumption at the facility is approximately 263,900 gallons (1,015 gpd). The cost per year for domestic uses is approximately $970 (water and wastewater charges).

Process Heating

Two boilers utilize CRW water to produce steam for sterilization (autoclaves) and process use at the facility. A 50 horsepower Parker boiler, with a steam capacity rating of 1,725 pounds per hour (207.1 gallons/hour), provides steam for four autoclaves. Three of the autoclaves are direct injection steam autoclaves and the fourth is a heat exchange type autoclave. A 60 horsepower Kewanee boiler, with a steam capacity rating of 2,070 pounds per hour (248.5 gallons/hour), provides steam and pressure for the press and mold machines. The Kewanee boiler operates approximately 12 hours a day while the Parker boiler operates approximately 9 hours a day. Makeup water and chemicals are continuously added to both boilers (about 2 gpw of Chemtreat BL-8631 and, for the Kewanee boiler only, BL-151 Steamline Treatment). The Kewanee boiler has a mechanism in place to collect some condensate from the press machines.

Water usage to these boilers based on steam capacity and hours of usage amounts to approximately 1,259,700 gallons annually or 4,845 gpd. The cost of water usage and subsequent wastewater charges for facility heating amounts to approximately $4,610 (water and wastewater charges).

Single-pass Cooling

There are a few elements of the facility that use water for cooling purposes. A major application that uses a large amount of single-pass cooling water is the rubber mill cooling system. Another item using single-pass cooling is the fan motor in the heat exchange autoclave.

Cooling water for the rubber mills is submetered and the water usage averages around 14,800 gpd. Each rubber mill is used approximately two to three hours a day, off and on, with a flowrate of 15 to 20 gpm. Cooling water for the autoclave fan motor amounts to about 200 gpd. Both elements can be recirculated since the cooling water never becomes contaminated during the cooling process.

Annual water consumption for cooling the rubber mills amounts to 3,848,000 gallons and cooling water for the autoclave fan motor amounts to 52,000 gallons. The cost of cooling water for the facility is $14,280 (water and wastewater charges) for 3,900,000 gallons a year.

Process Water

Additional water is used for a few minor elements such as soak tank water and grinder makeup water. The grinders use approximately 25 gpd and the soak tanks use approximately 315 gpd when combined amounts to 340 gpd or 88,400 gallons a year. The cost for this consumption and disposal of water is $330 (water and wastewater charges).

Landscape Irrigation

Approximately 28,000 square feet of landscaping around the plant buildings is irrigated with CRW water. Most of the irrigated area is covered with an equal combination of turf and shrubs (assuming 50-percent of the area is turf). During the warm weather months, the turf areas are watered every other day for ten minutes a day and shrubs are watered every other day for five minutes. There is no meter to determine the amount of water used for irrigation. Based on information from a 1997 Portland area water audit performed by Black & Veatch, an irrigation specialist with Portland Bureau of Water Works recommends that the application rate for turf be 16 inches per year (assuming 8 inches per year for shrubs). Therefore the amount of water used for irrigation per year should amount to 209,400 gallons or 1,150 gpd if watered every other day during the whole year, which is not done. Typically landscaped area are watered anywhere from

four to six months of the year, amounting to 3440 gpd for the former watering period and 2300 for the latter. Photo 1, below, shows most of the landscaped area for the facility.

Photo 1:
Landscaped Street View of Facility.

Summary

Table 3 summarizes the water-balance estimates for the facility and makes a comparison to actual metered water use at the site over the last year ending May 31, 2000. The water use allocation estimates are based on information provided by Bruce Weaver with Columbia Rubber Mills, meter data was furnished by CRW, information gathered during the site visit, and product specific characteristics discovered by subsequent contact with manufacturers (Melco Steel and Taylor Boiler).

Table 3 – Estimated Annual Water Balance						
Water Use Type	**Determined Water Use (gallons)**	**Water/ Wastewater Costs**	**Percent of Total (%)**	**Metered Water Usage from CRW (gallons)**	**Meter Water Usage per Type of Use (gallons)[1]**	**Water/ Wastewater Costs**
Domestic Uses	263,900	$970	4.6	**5,557,640 (3% difference from water balance)**	255,650	$930
Process Heating	1,259,700	$4,610	22.0		1,222,680	$4,450
Single-Pass Cooling	3,900,000	$14,280	68.2		3,790,310	$13,780
Process Water	88,400	$330	1.5		83,370	$300
Landscape Irrigation	209,400	$760	3.7		205,630	$740
Total	**5,721,400**	**$20,950**	**100.0**		**5,557,640**	**$20,200**

1. (Water usage = 5,557,640) x (percentage, column 4) = Metered water usage for type.

Water use difference amounted to 163,760 gallons. This discrepancy is attributable to the subjective estimates made during the analysis of water usage rates and reflects the use of assumptions in evaluating each water use category. For the remainder of this report, cost savings will be compared to actual water usages for a 12-month period ending May 31, 2000. Hence the last two columns of Table 3 is the baseline for measuring cost savings.

Water Conservation Opportunities

A review of the water consumption information provided by Columbia Rubber Mills aided in the identification of additional water conservation opportunities. Opportunities for water conservation have been identified in the following water use categories: domestic uses, process heating, single-pass cooling, process water, and landscape irrigation.

Domestic Use Savings

Minor savings can be realized by modifying domestic water consumption at the facility. Savings are considered minor because less than five-percent of the water used is expended for domestic uses (see Table 3).

Three water conservation measures can be implemented to reduce domestic water consumption. These measures include retrofitting toilets and urinals with ultra low flush components or models, which can reduce toilet flows from five gallons a flush to approximately 1.6 gallons and reduce flow through urinals to below one gallon a flush. A second conservation measure can reduce lavatory faucet flows to approximately one gpm or less with the addition of aerators. Most of the sinks in the two older buildings, the press building and the mixing building, have flowrates of 10 gpm flowing from the sinks. A third conservation measure is to modify the showerheads in the mixing building with water-conserving hardware or aerators. These units can reduce flow through the showerheads down to approximately three gpm or less and will also save energy by reducing hot water consumption.

The addition of these water conservation methods can reduce domestic water usage by approximately 65-percent to a daily use of less than 350 gallons. This amounts to an annual saving of 165,000 gallons or approximately $600 a year savings based on reduced water and wastewater volumes. An additional savings due to reduced energy consumption for heating domestic water adds an additional $60 a year savings. Energy savings for reduced gas usage amounts to $0.33 per 1000 gallons.

The cost of implementation per each conservation measure is estimated as follows:

- To upgrade the nine toilets, the tank-type toilets should be converted to either ultra low-flush toilets ($500 capital cost per each toilet) or retrofit tank-type toilets with dams or water-filled plastic containers as displacement devices and check for leaks with dye tablets ($25 per tank toilet retrofit kit). To upgrade the four urinals, the urinal flush valve can be retrofitted with orifice plates or valve replacement kits ($25 per urinal) or the entire urinal fixture could be replaced ($400 per urinal). At a minimum, improvements can be made to upgrade existing toilets and urinals with retrofit kits for a cost, including construction (added 20% to the cost of material), of $400. At a maximum, improvements can be made to replace existing high-flush toilets and urinals with low-flush units at a cost, including construction, of $7,300.

- The facility has seven showers of which only two see heavy use and the others see very low usage so low that they were not included in the water balance. At a minimum, the two showers in the mixing building would be retrofitted with new water-conserving hardware or aerators. Cost of retrofitting each

showerhead is $20. An improvement to restrict flow through showerheads by installing water-conserving hardware costs $50 installed.

- Installation of faucet aerators or flow reducing inserts can reduce the flow to nearly 1 gpm and are quite less costly than completely replacing a faucet. The cost to retrofit an existing faucet is approximately $5 per faucet and the total cost of retrofitting all twelve sinks is approximately $75 installed.

The overall cost to retrofit the domestic uses at CR Mills is $525. Since less than 5-percent of the water consumed is use for domestic uses, Black & Veatch would not recommend replacing existing toilets, urinals, or faucets with new low-flow alternatives. Installation of low-flow toilets and urinals would increase the installed capital cost to $7,425, correlating to a payback period of over eleven years.

Implementation of the retrofit conservation measures would save approximately 165,000 gallons of water and $660 in water, energy and wastewater charges each year. The total cost to retrofit existing devices only with flow-reducing devices is approximately $525 and the combined simple-payback period for these programs would be approximately ten months.

Landscape Irrigation Savings

Assumptions about water usage seems to indicate that the application rate may be appropriate for CR Mills, facility personnel indicated that the irrigation pattern, frequency and duration seem correct. Based on our assumptions, a limited amount of water is used for irrigation, less than 5-percent, and not much savings will probably be gained from exploring modifications to the irrigation rate. However, we recommend that the irrigation system be audited by a specialist to determine the correct irrigation rates for the different areas.

Single-pass Cooling Savings

Currently the rubber mills are cooled by single-pass water and use 14,580 gpd (see Photo 2 which shows the injection point for the single-pass cooling water). Significant water

volume can be conserved if this system was modified to a recirculated system with a cooling tower. The only daily volume of water to be added would be needed to replace water that is evaporated and water that is bled-off. Assuming that the temperature needs to be reduced by 10 degrees Fahrenheit (note that CR Mills's staff measured the temperature increase across the mill to be approximately 4 degrees Fahrenheit), the water evaporated and bleed-off amounts to less than 500 gpd. This results in daily water savings of 14,080 gpd or yearly savings of 3,660,800 gallons. This reduces the cost of water and wastewater services by approximately $13,310 per year.

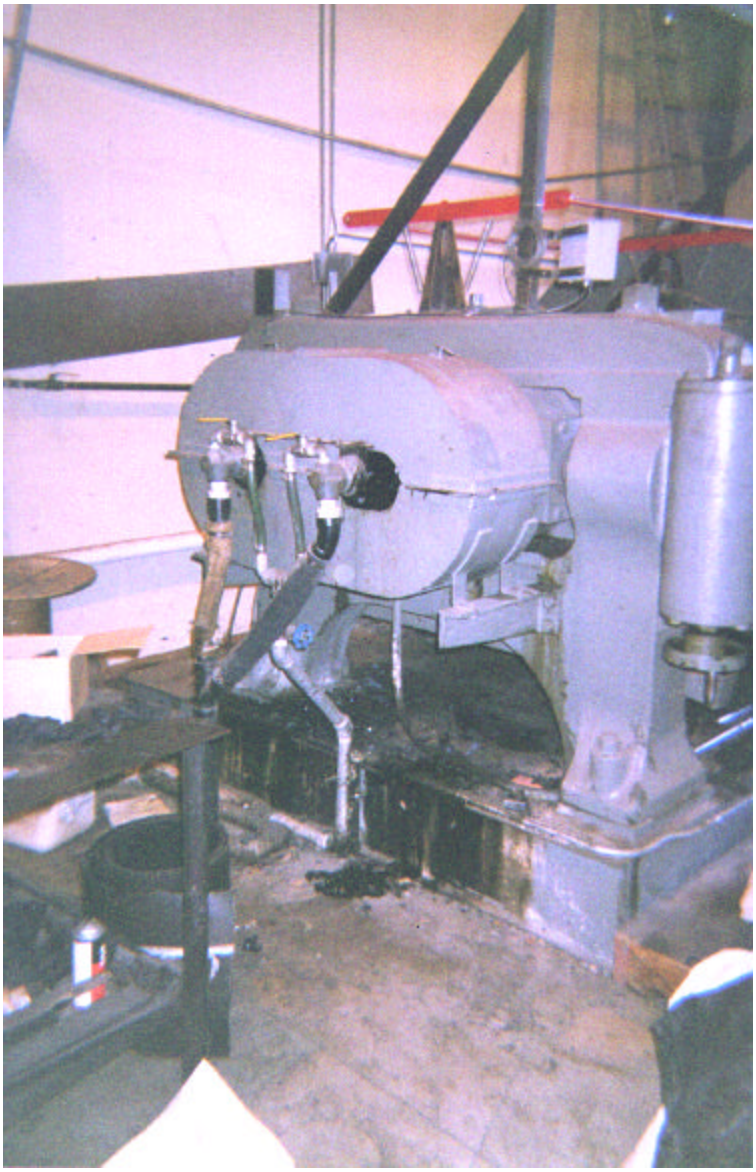


Photo 2:
Water Supply Connection to Rubber Mill

The nominal cost to provide and install a sump, new piping, a sump pump and a cooling tower is approximately $5,000. Based on the savings expected and the cost to install the cooling tower, the simple-payback period for this improvement would be five months.

Process Heating Savings

There are minimal opportunities to minimize or reuse water that is used for process heating via the two boilers. The Kewanee boiler in the molding room is already equipped with a return condensate line. CR Mills's staff needs to ensure that the steam trap and line is not leaking for this condensate recovery system. The other boiler in the roll

building is used to provide pressurized steam for the four autoclaves. Three of these autoclaves are of the steam injection type and the fourth autoclave is of the heat exchange type. Contamination of steam occurs in the steam injection type thus making condensation collection and return not feasible. The heat exchange autoclave is a candidate for condensation recovery. This autoclave is typically only used 10 hours per week and utilizes approximately 120,000 gallons a year, which is 10-percent of the entire process heating usage. Steam condensate recovery systems typically capture 50- to 70-percent of the steam for reuse. Assuming 60-percent of the steam is recaptured for reuse, approximately 72,000 gallons of water a year can be saved by condensate recovery. This amounts to an annual saving slightly less than $260.

The cost for implementing this system is on the expensive side since the autoclaves are located on the other side of the building away from the boiler. The distance is approximately 100 feet of insulated and pressure rated pipe at a cost of $10 a lineal foot. The cost of the piping and steam trap (approximately $250) amounts to $1250. This improvement has a simple-payback of nearly five years (58 months).

Process Water Savings

Minimal savings, if any. Metered usage for this type of use is low.

Summary

Table 4, compares the potential savings of the identified water-conservation opportunities to the total allocated water balance. Implementation of the water saving measures could reduce the annual water use at Columbia Rubber Mills significantly, approximately 3,839,600 gallons which equates to a cost savings of a little over $14,000 a year. Most of these savings are attributed to recirculation of cooling water – the use of cooling water amounts to over two-thirds of the water use and can be reduced by 95-percent with a closed loop system and a cooling tower. Table 4 lists the potential cost savings and payback periods for the conservation measures identified within each water-use category.