

Appendix C
Demand Management

Pierce County Public Works and Utilities – Sewer Utility
Unified Sewer Plan Update



DEMAND MANAGEMENT

Introduction

Demand management is a program of activities which result in a cost-effective reduction in the amount of and strength of wastewater generated, delaying the need for additional wastewater treatment and transmission capacity. Demand management is an aspect of the Unified Sewer Plan service area and treatment process and applies regardless of where flows are treated.

The Unified Sewer Plan includes a basic assumption that demand management is an aspect of each service area and treatment option. The approach builds on work performed by the Lacey, Olympia, Tumwater, and Thurston County (LOTT) Partnership.

This paper: (1) identifies how demand management can be integrated and (2) summarizes possible components of a demand management program. Details of new or expanded program components will be worked out following adoption of the Unified Sewer Plan.

Cost and rate estimates shown are intended to enable comparison among the demand management measures discussed below. They do not represent actual costs which cannot be accurately estimated until the program design stage.

What is Demand Management

While demand management can mean different things to different people, in the context of the Unified Sewer Plan the phrase “demand management” means programs and projects which reduce the amount or strength of residential, commercial, and industrial wastewater entering the Pierce County sewer system. Other efforts, such as reuse of treated effluent, which reduce surface water discharge but which do not affect the amount of water entering the sewer systems tributary to Pierce County facilities are not considered demand management programs.

Benefits of Demand Management

Demand management reduces flow and loading, reducing the need for larger wastewater conveyance and treatment facilities. Loading means the total amount of material entering a system and is typically measured in pounds per day biological oxygen demand (BOD) and total suspended solids (TSS). Reducing present wastewater flows to existing treatment facilities frees treatment plant capacity that could be allotted to planned residential and commercial growth. In addition, if the flow or loading can be reduced, the size, and therefore the cost, of new facilities can be reduced.

Demand Management Techniques

The following demand management techniques are available for the potential reduction of wastewater flow and loading to existing Pierce County wastewater facilities:

Flow Reduction

- Water Conservation
- Wastewater Reduction through Education
- Infiltration and Inflow Reduction
- Demand-Based User Charges

Loading Reduction

- Wastewater Reduction through Education
- Industrial Pretreatment
- Demand-Based User Charges

Demand Management Summary

Demand Management Techniques	Estimated Gallons of Water Saved (gpcpd)	Estimated Pierce Co. Sewer Utility Cost to Construct 1 Gallon of Daily Capacity	Authority	Findings	Conclusions and Recommendations
WATER CONSERVATION					
PLUMBING CODE ^a	19-23	\$0 ^b	RCW 43.20	<p>Applies from 1993 into future for new construction and remodels requiring a plumbing permit.</p> <p>Potential reduction in the incremental increase in new wastewater flows depends upon the number of new residential units constructed or remodeled under the updated Plumbing Code requirements, compared to the existing customer base flow.</p>	<p><i>Urge retention of Plumbing Code requirements for low-flow fixtures.</i></p> <p><i>Factor potential reduction in the incremental increase in new wastewater flows into flow projections.</i></p>
RESIDENTIAL PLUMBING FIXTURE RETROFITS ^c	15-21	\$17 ^d	No authority for mandatory retrofits	<p>The current estimated cost of 1 gallon of treatment capacity is \$8^e.</p> <p>Tacoma Public Utilities, Water Division, has an extensive water conservation program.</p> <p>U.S. EPA and the Washington State Department of Ecology fund educational programs.</p>	<p>High cost of mandatory retrofits is twice that of \$8^e estimated cost to provide 1 gallon of new treatment capacity.</p> <p>More efficient for Pierce County to cooperate with and build on existing conservation programs of other agencies before embarking on new programs.</p> <p><i>Support cost-effective incentive programs for low-flow plumbing fixture and appliance</i></p>

^a Effect of 1.6 gal/flush ultra low-flow toilets and 2.5-gpm low-flow showerheads required in 1993 Washington Plumbing Code for new construction compared to conventional 5.5 gal/flush toilets and 4.5-gpm showerheads.

^b Costs borne by manufacturers/property owners; Pierce County costs would be in supporting enforcement of codes.

^c Replacement of > 5.5 gal/flush and 3.5 gal/flush toilets with 1.6 gal/flush ultra low-flow model.

^d Assumes \$500 per home total cost for 2 bathroom retrofits with ultra low-flow toilets, including installation and disposal of old fixtures.

^e Estimated cost of new treatment capacity based upon King County Wastewater 2020 studies.

Demand Management Techniques	Estimated Gallons of Water Saved (gpcpd)	Estimated Pierce Co. Sewer Utility Cost to Construct 1 Gallon of Daily Capacity	Authority	Findings	Conclusions and Recommendations
WASTEWATER REDUCTION THROUGH EDUCATION	0.5 - 1.5	Variable, based on Program ^f	RCW 36.94	<p>Can be effective for short periods of time and specific conditions, long-term results can fluctuate.</p> <p>Public information/education activities are essential parts of any demand management retrofit programs directly affecting the customer.</p>	<p><i>replacement in service areas.</i></p> <p>Public education should be included as part of any direct flow reduction programs pursued by Pierce County in the future.</p> <p><i>Participate in public information & education programs in service areas.</i></p>
I/I REDUCTION	Pierce Co. has areas of significant I/I. Reductions require area-specific studies. ^g	Existing program is part of operating budget ^h	NPDES Permit	<p>Existing Pierce County I/I reduction program exists.</p> <p>Contracts call for I/I reduction within 10 years, with submittal of annual reports or a cap on peak flows.</p> <p>A program of telemonitoring sewer lines for breaks are also included in the I/I program.</p> <p>Program could be expanded to include standards for contract (city) service areas and programs to further identify and correct areas of excessive I/I.</p> <p>A new program for I/I has been</p>	<p><i>Continue aggressive I/I reduction programs of Pierce County and contract customers to locate and correct I/I sources.</i></p> <p><i>Other I/I recommendations are expected to result from the Unified Sewer Plan and subsequent analyses when future service areas are established.</i></p>

^f Public education program costs for conservation/demand management are expected to be similar to those associated with the Pierce County solid waste education program. The solid waste program spent \$64,000 in staff labor for its education programs for wastewater in 1997 (\$55,000 1998 Budget).

^g The County is experiencing growth and therefore increasing connections to the collection system on an annual basis. With the addition of the older systems such as Steilacoom to the service area, I/I is expected to increase.

^h I/I reduction program costs already included in annual Pierce County Utilities Department budget (\$275,000 for 1998). For comparison, LOTT I/I reduction cost estimates indicate a unit cost of \$20 per gallon for flow reduction up to 1.5MGD and > \$30 per gallon for reduction of 3MGD.

Demand Management Techniques	Estimated Gallons of Water Saved (gpcpd)	Estimated Pierce Co. Sewer Utility Cost to Construct 1 Gallon of Daily Capacity	Authority	Findings	Conclusions and Recommendations
INDUSTRIAL PRETREATMENT	Primarily affects wastewater loads (strength), not quantity of wastewater.	Existing program is part of operating budget. ⁱ	RCW 90.48	<p>added to the Sewer Utility budget.</p> <p>Applies to all Pierce County service areas flowing to the Chambers Creek WWTP and in unincorporated Pierce County.</p> <p>Monitoring indicates that the existing program effectively controls industrial discharges.</p>	<p><i>Continue existing program to ensure industrial impacts are minimized.</i></p> <p><i>Continue to counsel commercial and industrial businesses on how to keep substances harmful to the treatment process out of their wastewater.</i></p>
DEMAND-BASED USER CHARGES ^j	Not available	Not available	RCW 36.94	<p>Residential rate equity issues may be raised.</p> <p>May not be effective on long-term basis, as people tend to cut back on water use initially, but gradually return to old habits.</p> <p>Pierce County business, government office, and industrial customers are already billed based on wastewater volume and strength.</p>	<p>Application of demand based charges for residential customers depends upon the availability of water use data for billing purposes from multiple water utilities and financial planning and rate study considerations related to user charge equity.</p> <p><i>Examine long-term cost-effectiveness of basing residential rates on the volume of wastewater discharged in next rate study.</i></p> <p><i>Continue industrial and commercial demand-based user charges.</i></p>

ⁱ Industrial Pretreatment Program costs already included in annual Pierce County Utilities Department budget (\$234,280 for 1998).

^j If implemented, such incentives usually involve establishment of sewer rates based on wet weather water use.

Demand Management Techniques	Estimated Gallons of Water Saved (gpcpd)	Estimated Pierce Co. Sewer Utility Cost to Construct 1 Gallon of Daily Capacity	Authority	Findings	Conclusions and Recommendations
ON-SITE SYSTEMS	220 gpd per RE	\$21	None	<p>Not a permanent solution in urban areas per <i>Pierce County County-Wide Planning Policies</i>.</p> <p>Potential for long-term environmental impacts on ground and surface water resources and public health.</p> <p>If not properly installed and maintained many areas may not be suitable at urban densities.</p> <p>Pierce County has history of ground water pollution associated with on-site systems.</p>	<p>Urban area use conflicts with county-wide growth management planning policies.</p> <p><i>Do not include in programmatic feature.</i></p>
GREY WATER REUSE	25 - 40 gpcpd	\$53	No authority to implement in RCW 36.94	<p>Water savings during summer irrigation season only. Required design capacity of WWTP is not reduced.</p> <p>Subject to same soil/site conditions and regulatory constraints as on-site systems. Many areas not suitable at urban densities.</p>	<p>Not considered a substitute means of wastewater treatment and disposal.</p> <p>High cost compared to ^{\$8} estimated cost to provide 1 gal of new treatment capacity.</p> <p><i>Do not include in programmatic feature.</i></p>

DESCRIPTION OF TECHNIQUES

Water Conservation

Effect of Water Conservation on Wastewater Planning

For wastewater management, the internal water uses such as plumbing fixtures or commercial and industrial processes determine wastewater flows. A long-term sustained reduction of water use from fixtures which drain to the wastewater collection system will result in a corresponding reduction of flow to the treatment plant in two ways:

- Continuous reduction of year-round base flows.
- Reduction of peak water use and peak wastewater flows.

Water conservation has the potential to reduce wastewater flows, but flow reduction alone may not decrease loadings to treatment facilities and, therefore, may not always reduce required WWTP treatment capacities.

Typical Components of a Water Conservation Program

Over 80 percent of indoor water use is directly related to fixtures that can be changed to reduced flow devices. Toilets, shower heads, and faucets account for over 60 percent of the total; clothes washing machines add over 20 percent more. Interior water use for a non-conserving home can specifically be divided as shown in Table 1.

Table 1 Typical Residential indoor Water Use

Item	Percent ^a	Gallons per Capita per Day ^a	Uniform Plumbing Code gpcpd
Toilets	28.5%	22.0	6.2 to 10.1 ^b
Washing Machines	21.3%	16.5	16.5
Showers	21.1%	16.3	9.1 ^c
Faucets	11.6%	9.0	9.0
Baths	9.1%	7.0	7.0
Toilet Leakage	5.3%	4.1	4.1
Dishwashers	3.1%	2.4	2.4
Totals	100%	77.3^d	54.3 to 58.2^e

^a Source: Gambrell Urban, 1987.

^b Based on ultra low flush toilets with 1.6 gal/flush compared to 3.5 gal/flush (1990-1993) and 5.7 gal/flush (pre-1990).

^c Based on 2.5 gpm showerheads compared to 4.5 gpm.

^d Total average Pierce County residential wastewater flow is 95 gpcpd, including infiltration and inflow.

^e Plumbing code results in an estimated 25% to 30% reduction in residential flows for new construction.

Pierce County wastewater flow generation compares with indoor water use as follows:

- Average Pierce County wastewater generated per residential equivalent (RE) =220 gallons per day (gpd).
- Per capita per day (gpcpd) = 95 gpcpd (77 gpcpd from residential use + 18 gpcpd from infiltration and inflow).

Potential water conservation measures include the use of low flow toilets, showerheads, faucet aerators, and front-loading washing machines. These measures can be implemented through:

- Building (plumbing) codes for new construction and major remodels which require low flow plumbing fixtures.
- Encouraged as retrofits for existing homes and businesses.

Plumbing Code

Since July 1, 1993, the Washington State Plumbing Code has required the use of ultra-low flush toilets (1.6 gallons/flush) and showerheads limited to 2.5 gallons per minute. New residential construction, or homes remodeled under the new Plumbing Code have fixtures which consume 25 to 30 percent less water as shown in Table 1.

No other Plumbing Code amendments are likely. In fact, there has been a concerted effort since 1990 to have the 1.6-gallon State requirement repealed. A nation-wide negative campaign to have the water conservation portion of the Plumbing Code repealed is also on-going.

Potential reduction in the incremental increase in new wastewater flows will depend upon the number of new residential units constructed or remodeled under the updated Plumbing Code requirements, compared to the existing customer base flow. Pierce County has the following approximate number of residences in the Chambers Creek basin currently flowing to the Chambers Creek Regional WWTP:

Table 2 Residential Construction

Single Family (SF) residences	Multi-Family (MF) residences	Single Family (SF) residences	Multi-Family (MF) residences	Total
Built Prior to 2001	Built Prior to 2001	Built After 2001	Built After 2001	
55,550	27,930			83,480
		19,925	5,400	25,326

Retrofit Approach

Approaches to fixture replacement or retrofits for single-family and multi-family residences and businesses with low flow plumbing fixtures can include:

Table 3 Retrofit Approaches

Approach	Voluntary	Mandatory
Residential - Focus on older <ul style="list-style-type: none"> Pre-1990 emphasis 1990-1993 secondary 	<ul style="list-style-type: none"> Public education Give away, voucher, or rebate programs (incentives) 	Replacement Required: <ul style="list-style-type: none"> When converting to sanitary sewer or new connections As homes are sold
Industrial	<ul style="list-style-type: none"> Audits with advice on how to reduce 	<ul style="list-style-type: none"> No way to police/enforce

These programs could be cost-shared with the Tacoma Public Utilities Water Division and other water purveyors.

Potential issues associated with mandatory retrofit programs include:

- Previous capacity purchases of 220 gals per RE—capacity refunds might need to be given.
- Grandfathering statutes that are set out in the State Building Code - per RCW 43.20, local governments are not allowed to deviate from the State Building Code without demonstrating to the satisfaction of the Building Code Council that special health and safety conditions exist which warrant extra protection or a unique approach. Mandatory retrofits might be legal given these statutes.

Low flow plumbing fixture retrofit programs elsewhere have targeted 1 percent, 5 percent and 10 percent wastewater flow reductions. Table 2 illustrates the potential wastewater flow reduction, number of residences required for retrofit, and the potential investment required to meet these targets. In 2009, Chambers Creek Regional WWTP flows averaged 18.6MGD, including contract flows from Tacoma and Steilacoom. Based on flows of 18.6MGD, and a residential equivalent (RE) flow of 220 gpd per RE (approximately 84,500 equivalent REs), the 10 percent flow reduction target would require 51,900 residential retrofits. This approaches the total 2009 RE base of approximately 83,480 units.

Table 4 Low Flow Plumbing Fixture Refit to Accomplish Targeted Flow Reductions

Target Flow Reduction		Estimated Number of Retrofit Residences ^b	Estimated Cost of Retrofit, dollars ^c
Percent	Flow, MGD ^a		
1%	0.155	6,200	\$3,100,000
5%	0.778	31,000	\$15,500,000
10%	1.556	62,000	\$31,000,000

^a Based upon 2009 Chambers Creek Regional WWTP average flow of 18.6MGD.

^b Based upon 30 gallon per residential unit wastewater reduction from toilet replacement. Assumes retrofit of existing residential homes with ultra low flush toilets (1.6 gal/flush), with 2.5 residents per home, 2 toilets per home, and 4 flushes per day per person. Assumes 50% of toilets replaced are 5.7 gallons per flush (pre-1990) and 50% are 3.5 gallons per flush (1990 to 1993).

^c Assumes cost of new toilets are \$150 each, with 2 toilets per residence and installation costs and disposal of old fixtures of \$100 each for a total cost of \$500 per residence (unit cost of approximately \$20/gallon of reduction).

Large Water Users

Commercial, industrial, and governmental conservation programs and potential benefits need to be defined and evaluated on a case-by-case basis. These programs usually require direct work with specific, individual large use customers. Wastewater demand management programs are in place in Pierce County for industrial and commercial dischargers:

- Industrial Pretreatment Program monitoring and controlling discharge
- Demand-Based User Charges linking rates with wastewater flows and strength
- Water conservation programs through water utilities such as Tacoma Public Utilities, Water Division; Lakewood Water District; Spanaway Water; etc.

The most effective programs have been undertaken by businesses themselves as they explore ways to cut costs, ensure water supplies, and remain competitive in the marketplace. Consideration of both flow volume and waste strength concentration must be given when developing demand-based rate structures so that customers are not penalized if flow conservation measures result in increased discharge concentrations (see “Potential Negative Effects of Demand-Based Sewer Rates” in the report section, Demand-Based User Charges).

Cost Considerations

As shown in Table 3, the total program cost for residential low flow plumbing fixture retrofits is estimated to be \$20 per gallon of water reduction. Water conservation programs would have to be funded by the residential user, local water utilities, and/or Pierce County rate payers or capital construction funds for treatment plant capacity.

This usually involves administration, staffing, and related expenses, as well as the costs of purchasing conservation material and of providing incentives. Throughout the nation such programs have varied from individual staff working part-time on the program to a full division of a utility devoted exclusively to promoting water conservation. In Pierce County, there are 20 major water utility companies serving the CUGA area with which to coordinate and potentially share program costs, administration, etc.

Findings and Recommendations

Findings

1. While water conservation has the potential to reduce wastewater flows, it does not change service area nor alter the best location for wastewater treatment.
2. Flow reduction alone may not decrease loadings to treatment facilities and, therefore, may not always reduce required WWTP treatment capacities.

3. Over 80 percent of indoor water use is directly related to fixtures that can be changed to reduced flow services. Toilets, showerheads, and faucets account for over 60 percent of the total; clothes washing machines add over 20 percent more.
4. A reduction of water use from indoor fixtures which drain to the wastewater collection system results in a corresponding reduction of year-round base wastewater flows while also reducing peak water use and peak wastewater flows.
5. Building (plumbing) codes for new conservation and major remodels require low flow plumbing fixtures, and such fixtures can be encouraged as retrofits for existing homes and businesses. Washington State adopted new water conserving fixture standards in 1990. The standards called for interim reductions between 1990 and 1993 and additional reductions after 1993.
6. Typical indoor water use by a non-conserving home averages 77 gallons per capita per day (gpcpd). Pierce County average wastewater flow per residential equivalent is 220 gpd or approximately 95 gpcpd. If 77 gpcpd is attributed to residential indoor water use, then 18 gpcpd originates from other sources such as inflow and infiltration.
7. New residential construction or homes remodeled under the Washington State plumbing code consume approximately 25 to 30 percent less water, with a corresponding wastewater flow reduction of 19 to 23 gpcpd compared to homes built before 1990.
8. Potential reduction in the incremental increase in new wastewater flows will depend upon the number of new residential units constructed or remodeled under the updated plumbing code requirements, compared to the existing customer base flow.
9. Based on current average Chambers Creek Regional WWTP flows of approximately 18.6MGD, the number of toilet retrofit residences required to accomplish example target flow reductions of 1, 5, and 10 percent is 6,200, 31,000, and 62,000 residences, respectively. Pierce County has 83,476 single family and multi-family residences in the Chambers Creek basin currently flowing to the WWTP.
10. The estimated unit cost of residential plumbing fixture retrofits is \$20 per daily gallon reduced; the current estimated cost of 1 gallon of treatment capacity is \$5.60 (based upon 220 gpd). At the present time, residential plumbing fixture retrofits are not cost-effective.
11. Commercial, industrial, and governmental conservation programs and potential benefits need to be defined and evaluated on a case-by-case basis.
12. The following wastewater demand management programs are in place in Pierce County for industrial and commercial dischargers: Demand-Based User Chargers, and Water Conservation Programs principally through the Tacoma Public Utilities Water Division.
13. It is more efficient for Pierce County to cooperate with and build on existing conservation programs of other agencies before embarking on new programs.

Recommendations

1. Pierce County should urge the State to continue to require water conserving fixtures in the State Plumbing Code.
2. The potential reduction in the incremental increase in new wastewater flows should be factored into flow projections based upon the number of new residential units constructed or remodeled under the updated plumbing code requirements, compared to the existing customer base flow in 1990.
3. Cost-effective incentive programs for low-flow plumbing fixture and appliance replacement in service areas should be supported.

Wastewater Reduction through Education

Description

Public information and education programs inform the public about their role in the operation of the sewer utility. Customers are more likely to participate in conservation programs if they understand about where wastewater comes from and the challenges to treatment with a growing population base.

Education Program Elements

The Solid Waste Division of the Department of Public Works and Utilities provides classes that both directly and indirectly related to wastewater as part of a comprehensive program to educate youth about ways they can minimize polluting water, air, and land. Basic components of the program include staff to manage and implement the program, and effective materials to convey the program message.

In 2009, the Department presented its wastewater-focused “Water In, Water Out” curriculum to 32 classrooms. Environmental Educators’ labor and overhead totaled \$8,085. In addition, the same educators’ classes covering an array of water quality issues an additional 374 classrooms and incurred \$94,492 in expense. For 2010, the program expects to offer “Water In, Water Out” to at least 42 classrooms and other water quality classes to 450 classrooms. The 2010 program budget is \$110,000.

In addition the Utility has produced informational literature for inclusion in Sewer Billing such as “*Fats, Oils, and Grease*” and “*Wipes Clog Pipes*.” Other planned informational billing inserts are “*Reclaimed Water*”, “*Pharmaceuticals in Wastewater*”, “*Rehabilitation and Replacement*”, “*Side Sewer Connections*”, and “*Sustainable Practices*”.

Education programs can encompass several items which work to distribute information and engage the community. Programs range in complexity from simple bill inserts to full media and public awareness campaigns and school programs.

To encourage conservation and reduce wastewater flow, education programs should:

- Inform the public on sources of wastewater.
- Inform homeowners/businesses on methods of flow and loading reduction and consequences for them if they are not reduced.
- Inform contractors as to proper methods of construction to reduce inflow and infiltration.

Flow and Loading Reduction through Education

The Tacoma Public Utilities Water Division has an extensive public information and education program for water conservation. Although intended for City of Tacoma customers (including University Place and Fife), the program reaches a much larger audience.

Experience in California and other areas which have practiced construction and education programs aimed at changing basic public water use habits have not always been very successful. Public involvement and education can be very effective for short periods of time and to address specific conditions. However, people tend to return to old habits over time without continuous programs.

Specialized public information and education programs have been found to be essential components of successful programs which directly affect the customer; i.e., plumbing fixture and appliance retrofits. Studies by the U.S. Environmental Protection Agency have shown that public education contributes from 0.5 gpcpd to 1.5 gpcpd of increased flow savings in retrofit programs.

As such, public information and education programs that focus on voluntary behavior changes will not meet the County’s objective of long-term conservation, but such programs are a critical part of other direct flow reduction programs.

Cost Considerations

Education programs can vary significantly. Basic components of the program include staff to manage and implement the program, and effective materials to convey the program message. The solid waste program for Pierce County did not fund staff labor for education programs for wastewater in 2009.

Findings and Recommendations

Findings

1. Pierce County does not have an independent education program for the wastewater utility, but has used the solid waste section for education efforts related to wastewater, water conservation, and the water cycle. The solid waste program for Pierce County did not fund staff labor for education programs for wastewater in 2009.
2. The Tacoma Public Utilities Water Division has an extensive public information and education program for water conservation. Although intended for City of Tacoma customers (including University Place and Fife), the program reaches a much larger audience.
3. Experience in California and other areas has shown that, while public education can be very effective for short periods of the time and to address specific conditions, people tend to return to old habits over time without continuous programs.
4. Specialized public information and education programs have been found to be essential components of successful programs which directly affect the customer; i.e., plumbing fixture and appliance retrofits.
5. Studies have shown that public education contributes from 0.5 to 1.5 gpcpd of increased flow savings in retrofit programs.
6. While public information/education programs that focus on voluntary behavior changes will not meet the County's objective of long-term conservation, such programs are a critical part of other direct flow reduction programs. Wastewater use reduction through education should be included as part of any direct flow reduction programs pursued by Pierce County in the future.

Recommendations

Pierce County Sewer Utility will continue to participate in, if not fund, public information and education programs of the service areas.

Infiltration and Inflow Reduction

Infiltration is the unintentional entry of ground water into the wastewater collection system from surrounding soil. Common points of entry typically include broken pipe and defective joints, as well as cracked manholes. Inflow primarily consists of rain water which enters the collection system through roof drains, foundation drains, catch-basin connections, and manhole lids in flooded streets. An example is breaks by other utilities during construction projects.

Infiltration and inflow (I/I) bear on demand management because they consume useable capacity in the conveyance system and treatment facilities. Excessive levels may also dilute wastewater and cause treatment plant performance to deteriorate.

Existing Pierce County Infiltration & Inflow Control Program

Pierce County has an I/I reduction program in effect. An I/I evaluation is conducted annually as required by the Chambers Creek Regional WWTP National Pollutant Discharge Elimination System (NPDES) permit. I/I is currently moderate due to the age of the core of the ULID 73-1 collection system and use of PVC pipe, although there are areas with significant I/I that have been added since.

Flow monitoring and plant monitoring records are currently used to measure infiltration and inflow. Field crews visually inspect suspected problem areas using closed circuit television. Defects are repaired by sealing interceptors and repairing side sewer connections. Repairs are monitored to gauge how much flows have been reduced.

Pierce County is presently in the process of increasing staff to further devote more efforts into this important collection system program.

While I/I in many of the newer developments are minimal, the addition of older collection systems to the Pierce County system has increased I/I. Existing service areas with high I/I include Steilacoom, Tacoma Western Slopes, and the Hylebos area (the Hylebos area is not currently connected to the Chambers Creek system).

The summary of flows to the Chambers Creek Regional WWTP presented in Table 4 indicates the degree to which the County system is influenced by I/I.

Table 5 2009 Chambers Creek Regional WWTP Flow Summary^{a, b}

Flow Type	Million Gallons per Day (MGD)
Average Annual Flow	18.6
Peak Month (February)	23.15
Peak Month I/I	7.66
Peak Day (February)	41.32
Peak Day I/I	25.83

^a The Chambers Creek Regional WWTP has a nominal design capacity label of 28.7MGD Average Daily Flow and a peak flow hydraulic capacity of 45MGD.

^b The peak hourly flow in January of 2009 was approximately 42MGD (Peak Hourly Flow to Average Annual Flow Ratio = 2.98).

While a peak flow factor of 2.4 times average annual flow does not indicate excessive infiltration, it does indicate the presence of I/I. This I/I is believed to originate from older collection systems and from contract customer (city) systems, as well as from some newer systems that experience direct inflow.

Components of an I/I Program

A comprehensive I/I program focuses on three fronts:

- Ensuring the integrity of new infrastructure by:
 - Maintaining construction standards for new sewers.
 - Providing inspection of all new systems.
- Maintaining the integrity of installed infrastructure by:
 - Providing regular flow monitoring of system components.
 - Conducting regular visual inspection of the installed collection system.
- Correcting I/I from leaking or degraded systems by:
 - Maintaining a program to identify leaking systems, locate inflow, and make repairs.
 - Developing agreements with contract customers which require I/I control, such as the current Steilacoom contract provisions.

Anticipated Reductions in Wastewater Flows

The results of I/I reduction programs vary considerably between utilities. Historically, as systems age, I/I increase. For newer systems, an I/I program may not decrease flow but will work to minimize increases in I/I as the system ages.

As specific areas of I/I are identified, such as Steilacoom, Western Slopes, and Hylebos, a system specific reduction plan can be developed. The following areas may be subject to surface runoff or flooding entering manhole lids or other extraneous flow entering the sewer system due to older sewer age, varying construction materials, or other direct inflow sources:

- East Pacific Avenue within Parkland (inflow—new system).
- Frederickson area (inflow—new system).
- Western Slopes and other Tacoma service areas tributary to the Chambers Creek Regional WWTP.
- Former Westside Sewer District service area within University Place.
- Fircrest (currently served by Tacoma).
- Fort Lewis (not currently connected to the Chambers Creek system; service may be linked to decisions on the Tatsolo plant).
- City of Milton (served by Pierce County; currently tributary to the Tacoma Central WWTP).

Cost of Program

The cost of the current I/I reduction program is incorporated into the operation and maintenance budget for the Sewer Utility.

Findings and Recommendations

Findings

1. Pierce County has an I/I reduction program in effect. The cost of the program is incorporated into the operation and maintenance budget of the Sewer Utility.
2. While peak flows at the Chambers Creek Regional WWTP do not indicate infiltration, they do indicate the presence of I/I. I/I primarily originates from older collection systems and from contract customer (city) systems. Some newer systems experience direct inflow. As a result, I/I reductions require area-specific studies.

Recommendations

1. Pierce County and contract customers should continue aggressive I/I reduction programs to locate and correct I/I sources.
2. Other I/I recommendations are expected to result from the Unified Sewer Plan and subsequent analyses when future service areas are established.

Industrial Pretreatment

A pretreatment program works to control what enters the sewer system at commercial and industrial sources so that the wastewater is treatable and does not contain substances that are harmful or toxic. Businesses often use solvents, acids, chemicals, or other materials. Occasionally, they discharge varying amounts of these materials to the sewers which can destroy sewer lines, produce hazardous gases, or interfere with the operations of the wastewater treatment plant.

Components of Program

Pierce County has a full Industrial Pretreatment Program, including staff regulation of approximately 1,800 business discharges to the sewer system, issuance of industrial discharge permits, compliance inspections, monitoring, and other enforcement activities, and annual reporting. The requirements for a pretreatment program are mandated by Clean Water Act Section 307. The specific regulations are found in 40 CFR Parts 403-471. The primary objectives of the pretreatment program are to:

- Protect sewer system damage due to accidental or deliberate discharge of pollutants.
- Provide safe working environment for sewer utility workers.
- Prevent the introduction of pollutants into the sewer system which would interfere with the treatment process or pass through the plant to Puget Sound.
- Improve the opportunity to recycle and reclaim municipal wastewater biosolids.
- Comply with federal and state laws.

Industrial dischargers are required to obtain a permit and comply with pretreatment standards prior to discharging to the County's system. Each permit contains conditions and requirements such as:

- Acceptable discharge limits, including volume and wastewater characteristics.
- Sampling and monitoring requirements.
- Reporting requirements.
- Other special conditions deemed necessary.

Results of Pretreatment Program

Sampling at the Chambers Creek Regional WWTP indicates relatively low levels of pollutant concentrations. The evaluations indicate that current limitations on industrial dischargers are adequate, and that industrial dischargers are not causing water quality violations, process inhibition, or unacceptable limitations on biosolids reuse/disposal.

The County's pretreatment inspection program will be continued to ensure industrial impacts are minimized.

Cost of Program

The cost of the Industrial Pretreatment Program is incorporated into the operation and maintenance budget for the Sewer Utility. Chambers Creek Regional WWTP personnel conduct the majority of the required pretreatment program activities. The cost of the pretreatment program is recovered through industrial user fees. Industrial users are assessed a fee based on their water usage. The program ensures that industrial users are not subsidized by residential customers.

The program is mandated by the Clean Water Act and must be maintained. The program pays for itself through the reduction of industrial loads on the plant and by maintaining the operating integrity of the plant.

Findings and Recommendations

Findings

1. Pierce County presently has a full Industrial Pretreatment Program, including issuance of industrial discharge permits, compliance inspections and other enforcement activities, and annual reporting.
2. Reports from the Chambers Creek Regional WWTP indicate that, under the current program, industrial dischargers are not causing water quality violations, process inhibition, or unacceptable limitations on biosolids reuse/disposal.
3. The cost of the Industrial Pretreatment Program is incorporated into the operation and maintenance budget for the Sewer Utility.

Recommendations

1. The Pierce County industrial pretreatment program should be continued to all areas contributing flows to Pierce County treatment facilities to minimize industrial waste impacts.
2. Pierce County should continue to counsel commercial and industrial businesses on how to keep substances harmful to the treatment process out of their wastewater.

Demand Based User Charges

Demand-based user charges can be used two ways. First, volume-based rates for sewer and/or water which increase as volumes increase can encourage wastewater flow reduction. Businesses, government offices, and industries are already billed for sewer flows based on volume discharged into the sewer system. Changing rate structures for sewer to charge higher amounts on a volume of sewage produced basis is one strategy that can apply to residential and commercial/ governmental/industrial customers. Secondly, loading-based rates can differ based on wastewater strength.

Current Pierce County Sewer Rates

Pierce County's current rate structure for residential and multi-family customers is a flat rate per month charge. Current 2011 monthly rates are:

- Single Family Residential, \$/unit/month \$34.19
- Multi-Family Residential, \$/unit/month \$30.10

Commercial customers are charged a fixed minimum usage fee of \$8.94/month along with a variable charge for all flow in excess of the minimum ranging from \$2.49 to \$5.03 per thousand cubic feet (CCF).

Commercial customers are categorized according to Standard Industrial Code to reflect wastewater strength and charged accordingly in the County's pretreatment program.

Conditions for Implementation

Volume based billing is typically performed by either: metering at individual connections, or using water usage records as a basis for establishing each residential sewer bill. The extrapolation method assumes that the time period when water use is recorded does not include outdoor water usage, such as yard irrigation, which does not enter the sewer system. Water use data for winter months are used as a measure of water use which enters the sewer system. Data are available for residential customers on public water systems. However, in the case of Pierce County, this would require collecting data from more than twenty water purveyors which exist in the County's service area.

For customers not on public water systems or for non-metered systems, a uniform rate typical of residential users is generally applied. Direct metering of wastewater flows is generally not cost-effective except for large industrial and commercial water users, when the cost of domestic water is extremely high, or a new sewerage system is constructed. None of these conditions exist for the Pierce County Sewer Utility.

Potential Negative Effects of Demand-Based Sewer Rates

Demand-based sewer rates for commercial customers have potential to create negative effects if flow volumes and concentrations are not both considered. For example, if rates based on waste strength (concentration) are applied without being coupled with volume-based rates, unintentional encouragement of inflow or other means of diluting discharges may occur.

Similarly, if volume-based rates are applied without accounting for waste concentrations in the rate structure, desired reduction in loading (pounds per day of BOD and TSS) may not occur.

The current demand-based rate structure used by Pierce County for commercial customers includes consideration of both flow volumes and concentrations so that these potential negative effects are avoided.

Anticipated Reduction in Wastewater Flow

The reduction of water usage quoted by water utilities does not correlate directly to reduced sewer flows. Volume-based user charges have primarily been used by water utilities. Volume-based theory asserts that price increases will reduce water usage. However, from a water utility perspective, price increases typically have the largest impact on non-essential water usage such as yard irrigation which does not enter the sewer system.

Few studies exist which correlate volume-based sewer charges to reduced water usage. Studies conducted for LOTT suggest that, as a conservation measure, the strategy is not effective on a long-term basis (*Review of Alternative Wastewater Billing Options for LOTT*, Economic and Engineering Services, Inc., May 1993). People tend to cut back on water use initially, but gradually return to old habits.

Demand based user charges for commercial/governmental/industrial customers should be maintained with the basis of charges including components for both flow and wastewater strength.

Application of volume-based charges for residential customers depends on the availability of water use data for billing purposes from multiple water utilities and financial planning and rate study considerations related to user charge equity. For these reasons, Pierce County should not pursue demand-based user charges for residential customers as a component of a demand management program.

Findings and Recommendations

Findings

1. Pierce County's current rate structure for residential and multi-family customers is a flat rate per month charge. Businesses, government offices, and industries are already billed for sewer flows based on volume and wastewater strength.
2. Direct metering of waste flows is generally not cost-effective except for large industrial and commercial customers or new systems. It is expensive and includes cost of meter, installation, new billing system, and meter reading.
3. Non-metered volume-based rates for residential customers would require establishing a program for collection of extensive water use data from over 20 water purveyors which exist in the County's service area.
4. The practice of demand-based user charges has primarily been used by water utilities. Price increases typically have the largest impact on non-essential water usage such as yard irrigation. In that these flows do not enter the sewer system, the reduction of water usage quoted by water utilities does not correlate to reduced sewer flows.
5. Studies on the relationship of demand-based sewer charges to reduced water usage suggest that the strategy is not effective in the long term. People tend to cut back on water use initially, but generally return to old habits.

Recommendations

1. Demand-based user charges for commercial/governmental/industrial customers should be continued with the basis of charges including both flow and wastewater strength.
2. Demand-based charges for residential customers depends upon the availability of water use data for billing purposes from multiple water utilities and financial planning and rate study considerations related to user charge equity. For these reasons, it is recommended that the cost-effectiveness of residential demand-based user charges be examined in the next rate study.

On-Site Systems

Description

An alternative to sanitary sewers is use of on-site sewer systems. This wastewater reduction (diversion) measure involves increasing the interim and/or permanent use of on-site sewage systems (septic tanks with soil absorption systems) prior to full density development within the urban growth boundary outside of incorporated areas. It is an option that only applies where: (1) levels of service standards in adopted growth management plans endorse its use, and (2) where soils and groundwater can support on-site sewer systems or (3) cost-effective package treatment facilities exist.

In Pierce County, an estimated 70,000 households and businesses rely on on-site systems to dispose of their wastewater. Although primarily concentrated in rural areas of the County and in areas where lots are large enough for drain fields, on-site systems are also used in urban and suburban areas, such as Tillicum and Edgewood. The Lakewood/Parkland area was the largest urban area in the country to be served by on-site systems until ground water pollution problems led to the construction of the County's Chambers Creek Regional WWTP in 1984.

Today, permanent septic systems cannot be built in urban areas under the *Pierce County Comprehensive Plan* and *County-Wide Planning Policies*. However, interim on-site sewage systems can be built and on-site systems may continue to operate until they fail.

Conditions for Successful Implementation

On-site systems present potential for long-term environmental effects to ground water resources and public health if not properly designed, installed, or maintained. To be environmentally acceptable, on-site wastewater disposal considerations should minimize the disposal of wastewater effluent to ground water. Many areas within the urban growth area are not suitable for conventional on-site systems (or grey water systems) at urban densities due to soil adsorption capability and leach field area required.

For these reasons, the *Pierce County County-Wide Planning Policies* do not consider on-site systems to be a permanent solution in urban areas. Similarly, issues specific to Pierce County cited in the *Pierce County Comprehensive Plan* include provision of permanent sewer services to those areas of the Chambers Creek-Clover Creek Basin still on on-site systems.

Cost Considerations

Estimated capital costs for permanent residential on-site systems are \$8,000 – \$12,000 per RE, and that the unit cost was \$23 - \$27 per gallon of daily capacity gained.

Findings and Recommendations

Findings

1. The *Pierce County-Wide Planning Policies* call for “the elimination of all new permanent on-site and community septic systems within the urban areas. . .” (CWPP, Urban Growth Areas, 3.4.3) due to the pollution history associated with on-site systems in Pierce County.
2. On-site systems present potential for long-term environmental effects to ground water resources and public health if not properly designed, installed, and maintained.
3. Many areas within the urban growth areas of the County are not suitable for on-site systems at urban densities due to required soil adsorption capacity, leach field area, and other regulatory requirements.
4. The estimated unit cost to provide permanent residential on-site systems is \$23- \$27 per gallon of daily capacity gained (exclusive of maintenance program costs).

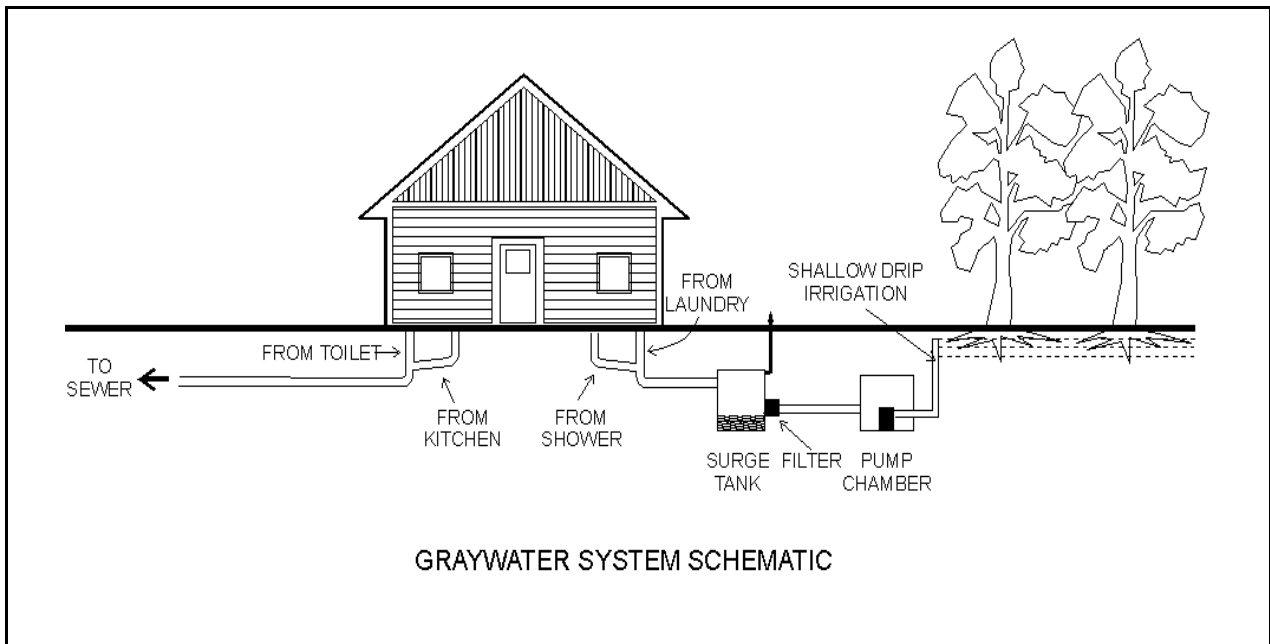
Recommendations

On-site wastewater systems should not be pursued as a component of a Pierce County demand management program because of pollution history and conflicts with State and local growth management policies.

Grey Water Reuse

A method of reducing flows to wastewater treatment facilities is to allow recycling of wastewater within the household. Requirements for commercial establishments to implement grey water recycling programs are covered under industrial water conservation. Grey water is untreated wastewater of domestic strength and consistency that has not come in contact with toilet or urinal waste (referred to as brown water). Grey water includes wastewater from bathtubs, showers; bathrooms wash basins, clothes washing machines, and laundry tubs. Grey water systems vary in complexity. A typical residential system is shown in Figure 1.

Figure 1 Grey Water Reuse System



(Source: LOTT)

Washington’s standards emphasize that such a system is *not* a substitute means of wastewater treatment and disposal. Local health jurisdictions are the lead for the permits and other more stringent local on-site wastewater requirements (setbacks, vertical separation, trench depths, etc.) may apply.

The primary purpose of the Washington grey water standards is to protect public health while reducing potable water demand for irrigation during the peak summer months. The incentive to install a grey water reuse system is a reduced water bill. Specific regulations do not exist for on-site reuse of grey water for non-potable, non-irrigation purposes such as toilet flushing. (WAC 246-274) Internal building use requires Class A reclaimed water.

Anticipated Reduction in Wastewater Flow

Residential sewage is composed of grey water and brown water. Representative flow data for grey and brown water from residential fixtures are as shown in Table 4. Of the total wastewater flow, approximately 50%-80% is grey water and 20%-50% is brown water.

TABLE 6 Grey and Brown Water Generation Rates and Usage^(a)

Fixture Type	Range of Flow (gallons) ^(b)	Water Type	Household Usage (%)
Automatic Washing Machine	35-50/use	Grey	18-25 (Laundry)
Automatic Dishwasher	4-8/use	Grey	
Kitchen Sink	3-6/use	Grey	25 (Bath)
Shower Head	20-30/use	Grey	
Bathtub	20-30/use	Grey	
Wash Basin	1-2/use	Grey	
Toilet	2-7/use	Brown	21-48

^(a) Source: LOTT Inflow and Infiltration Study and Capital Improvement Plan, May 1994.

^(b) Values do not take into consideration water conservation fixtures.

Grey water systems must be constructed exclusively for the purpose of landscape subsurface irrigation of residences served by either an approved on-site or public sewer system. Any anticipated reduction in wastewater flow due to grey water reuse would be realized only during the irrigation season when grey water systems would be in use.

Cost Considerations

Various water treatment packaged systems exist to treat grey water. These systems range from simple designs employing a collection tank (55-gallon drum) and cloth filters (stockings) to complex systems utilizing available water treatment technology. The application of the package systems range from treating grey water for outside irrigation (single family residences) to treating grey water to drinking water quality standards (commercial establishment). Cost of the treatment systems range from \$800 for the simplified system to provide irrigation water to \$4,000-\$5,000 for systems producing a secondary effluent for commercial/residential toilet/urinal flushing, to \$350,000 to produce 8,500 gpd of drinking water for commercial establishments.

Based on residential population projections for Lacey, Olympia, and Tumwater, a cost analysis conducted for LOTT (*Final Programmatic Environmental Impact Statement*, December 1996) estimated that the capital cost for residential grey water systems was \$6,000 each, and that the unit cost to provide grey water reuse was \$53 per gallon of daily capacity gained.

Findings and Recommendations

Findings

1. Washington State's standards emphasize that grey water reuse systems are not substitute means of wastewater treatment and disposal. Grey water systems must be constructed exclusively for the purpose of landscape subsurface irrigation of residences that are served by either an approved on-site or public sewer system.
2. The efficiency of grey water system use in urban areas has not been established. Many areas within the urban growth areas of the County are not suitable for these systems at urban densities due to soil adsorption capacity and leach field area required.
3. Any anticipated reduction in wastewater flow due to grey water reuse would be realized only during the irrigation season when grey water systems would be in use. Therefore, the required design capacity of the WWTP is not reduced.
4. The estimated unit cost to provide grey water reuse is \$53 per gallon of daily capacity gained.

Recommendations

Grey water reuse should not be pursued as a component of a Pierce County demand management program due to lack of authority, high cost, and low return.

After studying options and what other utilities are doing, the project team concluded that Pierce County will be most efficient by cooperating with and building on the existing conservation programs of other agencies before embarking on our own.

Other Demand Management Techniques

The Utility continues to review several methods to reducing the quantity and strength of wastewater:

- Promotion of the use of on-site sewer systems instead of sanitary sewers in urban areas.
This approach conflicts with county-wide growth management planning policies and the Pierce County Comprehensive Plan. The extent of the sanitary sewer system is largely a result of urban development and water quality problems that the County was asked to correct.
- Use of grey water systems at urban densities.
This has yet to be authorized by the State of Washington. Pilot projects exist, but the facts are not in about either their effectiveness or potential impacts to surface and ground water. Grey water systems will not be a substitute for wastewater disposal systems.
- Mandatory replacement of toilets and faucets throughout the County.
Very costly, at this time it appears to be twice as expensive as building new facilities.
- Setting sewer rates on the basis of actual flow volumes.
A cost-benefit investigation is beyond the scope of the Unified Sewer Plan. Metering of wastewater flows from an individual residence is technically difficult because intermittent flows are almost impossible to measure accurately.