Commercial Water Saving Opportunities

David Broustis, Seattle Parks and Recreation

PUGET SOUND ENERGY

What We'll Cover Today

RCM Training Series

- **…Water**
- **Metering and Billing**
- **Overview of Commercial Water Use**
  - *Indoor and Outdoor Uses*
- **Factors Impacting Water Use**
  - *Cost, Facility Type, Seasonal Uses*
- **Savings Opportunities**
  - *Pinpointing leaks*
  - *Operation and Maintenance*
  - *Water Using Fixtures and Equipment*
- **Fixture Replacement Case Studies and Exercises**
- **Pay attention…we are playing a game later**

Before we get started…

RCM Training Series

- **Carkeek Environmental Learning Center**
  - *LEED Gold (41 points)*

Broadview Green Grid

RCM Training Series

- **Natural drainage system**
  - *Improve drainage and water quality…attractively*

Why Conserve Water?

The Utility Perspective

RCM Training Series

- **Low-cost supply**
- **Climate change/uncertain future**
- **Delay/postponement of new supply**
- **Environmental preservation**
- **Drought response**
- **Customer service**
- **Other:**
  - *Legislative mandates*
  - *Collaborate with energy/wastewater utilities*
  - *Accelerate market transformation*
  - *Tribal agreements*

Why Conserve Water?

The Customer Perspective

RCM Training Series

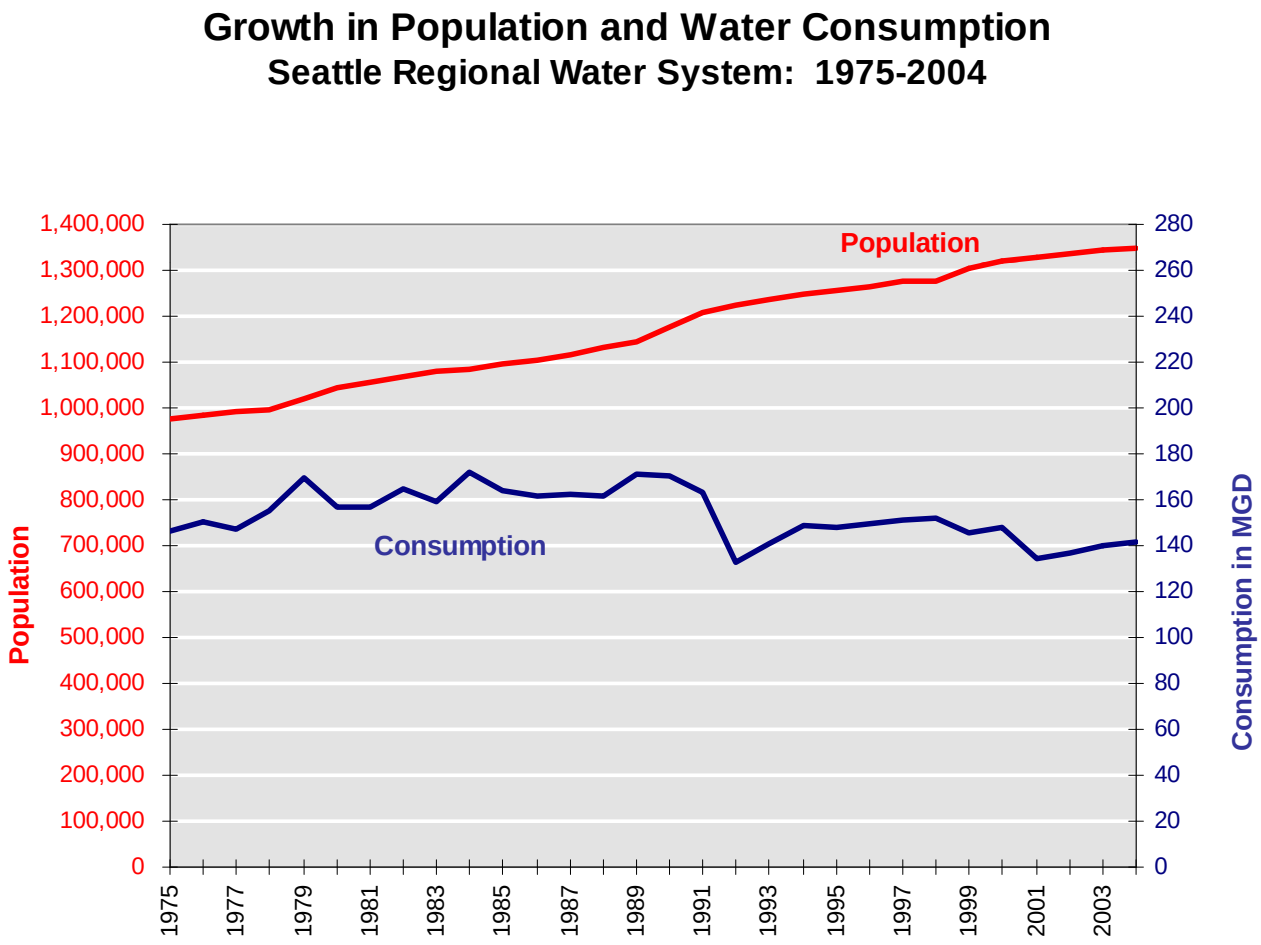
- **Water can be expensive**
  - *Increasing rates – Seattle up an average of 8% over 8 years*
- **Wastewater charges –** *2x water cost in Seattle*
- **Frequent energy/water benefit**
  - *Hot water*
  - *6.5% of all electricity use in California is for pumping water*
- **Attractive efficiency paybacks**
  - *Typically better than energy investments*
- **Environmental preservation**
  - *It's about "Ecological Footprinting" not just Carbon Footprinting*

…it's finally getting on people's radar as a resource, like energy

Water drainage (surface water) fees also becoming important

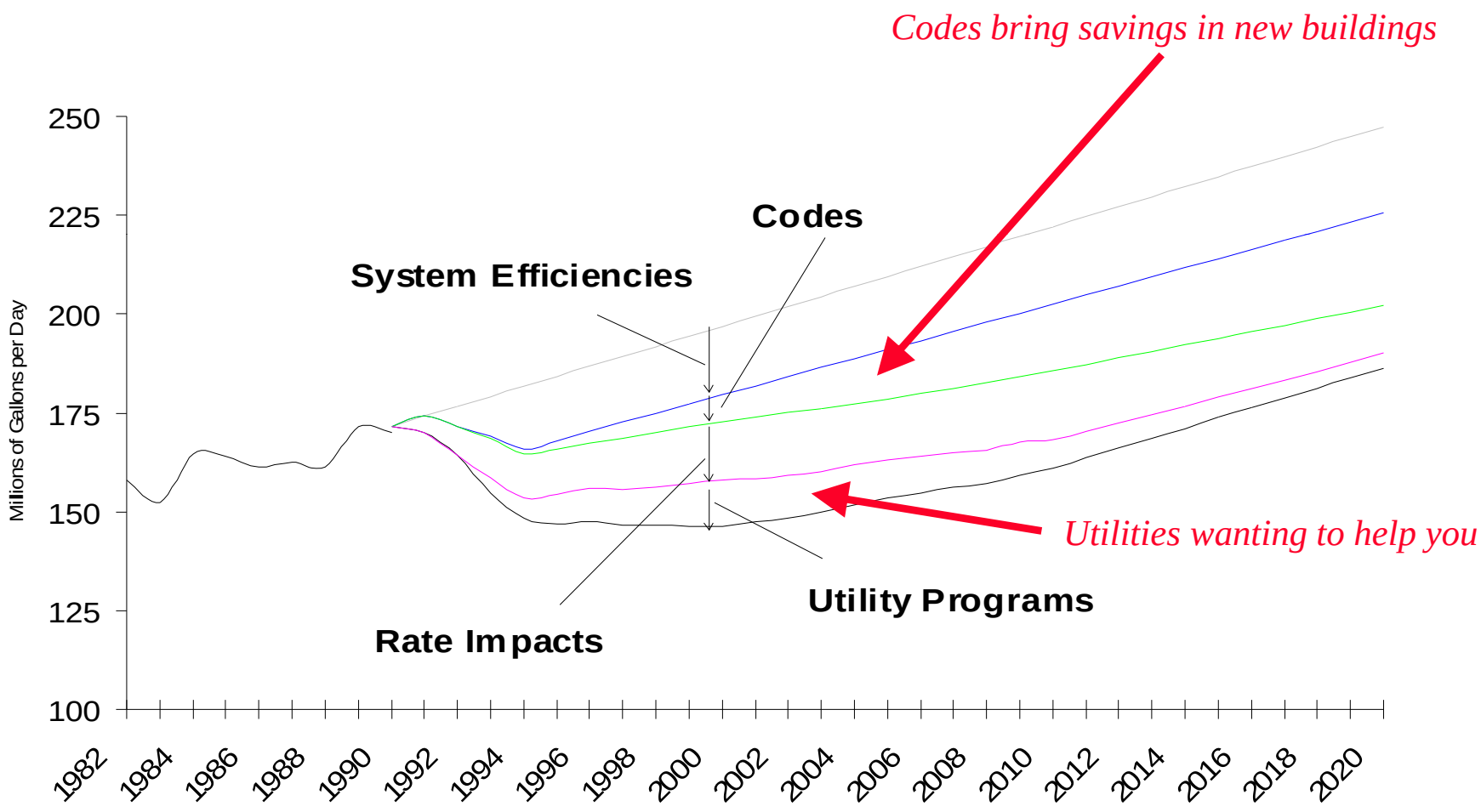
The Big Picture
Success of Conservation

RCM Training Series



The Big Picture
Reduction Breakdown

RCM Training Series



Water Supply Sources

RCM Training Series

- **Distribution is largely de-centralized**
  - *Limited by:*
    - *Capacity of supply source(s), storage and transport system*
- **Local sources**
  - *Surface water*
    - *Watersheds: Cedar River, Green River, Sultan basin, Whatcom Reservoir…*
      - Held in reservoirs, before treatment and transport
    - *Rivers: Skagit*
    - *Future? Lake Tapps…*
  - *Groundwater*
  - *Reuse (minimal)*
- **Issues are local**
  - *Conservation*
  - *Rates*

Wastewater Treatment

RCM Training Series

- **Generally transported to a central facility**
  - *Pumping costs can restrict long transport…or make it expensive*
- **Issues are local**
  - *Treated before release into bodies of water*
    - *Secondary treatment is typical locally-- removes up to 90% of "solids"*
    - *Tertiary treatment can remove up to 99% of contaminants*
  - *Conservation drivers are determined locally*
    - *Historically "easier" to build new treatment than support conservation*
    - *Combined sewers: Sewage and stormwater go into the same pipe*
      - ~50% of Seattle has combined sewers
      - Inflow/infiltration are a <u>large</u> percentage of treated water

Water vs. Energy

RCM Training Series

Some similarities…some differences

Similarities/overlap

- **Water is frequently heated**
  - *Homes: ~ 30% of water use is hot water*
  - *Commercial Buildings: Generally lower % - but varies widely*
- **O & M has a huge impact** on consumption
- **Cost increases** raise importance of conservation
- **Seasonal peaking rates in NW** (some utilities)
  - **Opposite times of year**
- **Metering of uses is essential** for controlling costs
- **Some big users are silent users**

Water vs. Energy: Differences

RCM Training Series

Water

- **Bills can have <u>huge</u> fluctuations**
  - *Problems can increase monthly bill by 2x, 3x, 5x, 20x…100x*
  - *Large fluctuations can be difficult to pinpoint source of problem*
- **Multiple potential problem points** can require sleuthing
  - *Single piece of (malfunctioning) equipment can dwarf other bldg uses*
- **Fixture specs/ratings are usually not accurate**
- **Data are limited**
  - *Regional/national benchmarks are hard to come by*
  - *Installed fixture and equipment consumption is often unknown*
- **Square footage not always a good indicator of consumption**
- **Efficiency projects can result in big reductions (up to 60%+)**
- **Possible significant swings in seasonal rates**
  - *Can penalize uncontrollable consumption*

Water Metering

RCM Training Series

- **Meter size determined by peak flow rate**
  - *Common sizes: 3/4”, 1”, 1 1/2”, 2”, 3”, 4”, 6”, 8”*
    - *Residential: 3/4”*
    - *Small commercial (schools): 1” to 4”*
    - *Large commercial: 4” to 8” +*
    - *Fire meters: 6” to 8”+*
- **Number of registers**
  - *Less than 3” meter: single “register” dial*
  - *3” to 4”: one or two registers*
    - *Low flow, High flow*
  - *6”+: Two register meters*
- **Fire Meters**
  - *Often inaccurately metered with small “flow detection” meter*

Meter Size	Max Flow (gpm)
3/4"	30
1"	50
1 1/2"	100
2"	160
3"	450
4"	1000
6"	2000

Meter Reading Tools

RCM Training Series

- Past meter readings/billing history
- Spray bottle
- Flashlight
- Pole with rag on end
- Magnifying glasses?

Spray water on scratched glass for better reading(s)

Finding a Water Meter…

RCM Training Series

- **Meter # on meter cap**
- **Small meters are near surface**
- **Large meters are up to 10’ below surface**
  - *May need flashlight and towel wrapped on pole…or stick…or ??? to clean dial and read*

Reading a Water Meter

RCM Training Series

- **Measured in Gallons or CCF**
  - *CCF = 100 cubic feet = 748 gallons*

Accurate within +/- 2%. If inaccurate…tend to run slow

Meters Billed by…

RCM Training Series

- **Domestic consumption**
- **Irrigation only**
- **Deduct meters**
  - *Avoid paying sewer charges for water not entering the sewer*
  - *Irrigation branched from domestic (potable) water line*
  - *Cooling towers/evaporation*
  - *Other water not going into sewer system*
- **Chargeable meters**
  - *Dedicated irrigation meter with charges for water going to sewer*
    - *Drinking fountains, restrooms, etc.*

Meter Fees

RCM Training Series

- **Installation fee**
  - *Goes up significantly for 3"+*
    - *2" installation & connection: ~ $11,700*
    - *3" installation & connection: ~ $30,800*
- **Monthly fee**
  - *Determined by meter size*
- **Commodity charge**
  - *Seasonal rates are typical (wastewater is same year-round)*
    - *Summer water peak charges to discourage irrigation*

Meter Size	Monthly Charge
3/4"	$12.56
1"	$13.00
1 1/2"	$19.95
2"	$25.57
3"	$81.88
4"	$117.36
6"	$144.36

These fees vary widely by water provider

Savings Opportunities
Metering

RCM Training Series

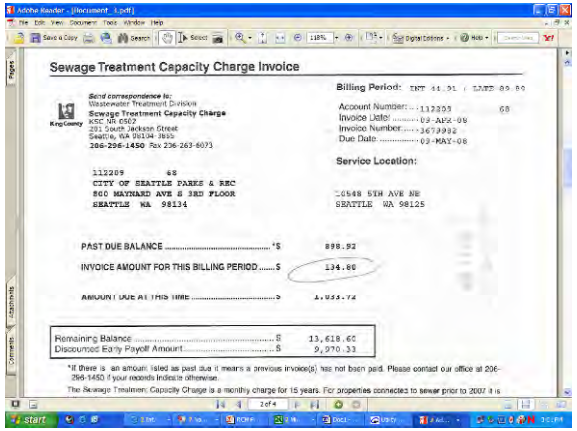
- **Minimize meter size for new construction**
- **Downsize existing meters**
  - *If smaller meter can supply adequate volume*
    - *6” meter for drinking fountain???*
    - *Be aware that oversized meters can run slow*
- **Install irrigation-only or deduct meters**
- **Retire old unused accounts**
- **Don’t pay accounts that aren’t yours**

Possible zero consumption accounts				
Site	Account #	Meter #	Monthly ~ $	Notes:
Delridge	2-510651-488913	PCN-T0239247-1	$ 56	
Loyal Heights CC	2-526723-481864	PCN-65090847-1	$ 22	one ccf every year or so
Green Lake	2-527822-482611	NAT-00632925-1	$ 42	
Green Lake	2-527826-482126	PCN-S0350904-1	$ 22	
Discovery Park	2-536795-461032	PCN-U0463055-1	$ 22	One CCF since 2004 (in 2006)
	2-42560-477503	PCN-Q0129579-1	$ 17	
	2-482171-485364	PCN-R0101651-1	$ 43	
McGilvra median	2-482172-466664	PCN-R0101684-1	$ 44	5 CCF in 12/07. No other consumption for years.
	2-486902-462474	PCN-R0129519-1	$ 16	
	2-486904-485261	PMM-60688395-1	$ 42	
	2-489465-484416	PCN-R0129547-1	$ 16	55 CCF in 1/06. No other consumption.
	2-491631-462531	PCN-Q0129357-1	$ 16	17 CCF in 7/06. Almost always zero.
	2-504465-467018	PCN-M0018475-1	$ 16	
	2-505198-457769	OTH-99902020-1	$ 16	A couple CCF in 2004.
	2-520459-467015	PCN-Q0129100-1	$ 16	1CCF in mid 2006. No other.
	2-524256-467283	PMM-58799977-1	$ 16	
	2-527818-467382	OTH-99901969-1	$ 16	1CCF in 2003.
	2-527819-461226	PCN-Q0129578-1	$ 8	
	2-535805-472274	PCN-S0328905-1	$ 22	
	2-537800-473377	PCN-X0330073-1	$ 8	
Woodland Park	2-527821-482618	NEP-31949574-2		Not zero consumption but 6" irrigation could likely be do
Lakewood Playfield	2-520464-489291	NEP-31955294-2	$ 50	Large meter for drinking fountain. Uses 1CCF every yea
213 W Highland Dr	2-531958-485077	PCN-R0101641-1		~1CCF every 18 months. 5 CCF since 2000.
Pratt Park	2-520371-487790	PCN-U0463120-1	$ 30	

Water and Wastewater Rates

RCM Training Series

- **Water**
  - *Historically low rates: some utilities still don't meter*
  - *Steadily increasing over past decade or more*
  - *Rates typically between $1 to $5 per ccf*
  - *Summer increases often 50% or more*
    - *Peak consumption charges reflect need for storage*
- **Wastewater**
  - *Costs can be up to 3x water costs*
  - *Rate structures:*
    - *Variable: based on water use volume*
    - *Flat: based on flat fee per use type*
    - *Hybrid: combination of flat fee and volume charge*
    - *Ensure wastewater charges are billed according to actual consumption*
  - *New construction impact fees can be hefty*
- **Fire meters**
  - *Consumption on fire meters can be very expensive*
    - *$20/ccf in Seattle*


Sewage Treatment Capacity Charge Invoice

Billing Period:

Account Number:

Invoice Date:

Invoice Number:

Due Date:

Service Location:

PAST DUE BALANCE

INVOICE AMOUNT FOR THIS BILLING PERIOD

Remaining Balance

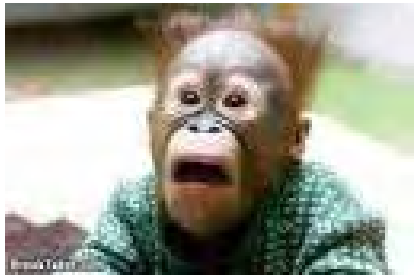
Discounted Early Payoff Amount

Seattle Water/Wastewater Rates

Similar rates for Seattle wholesale customers --- 1.3 million population in Puget Sound

RCM Training Series

- **Water: up 45% since 2007**
- **Wastewater: up 33% since 2006**



2009 Seattle Commercial Water Rates	**$ per CCF**
Winter (8 months)	$ 3.50
Summer (4 months)	$ 4.49
Annual average	$ 3.83
Wastewater	$ 8.98
Combined (annual average)	**$ 12.81**

yet…water/wastewater less than 1.75 cents/gallon

Billing Cycles

RCM Training Series

- **Monthly**
  - *Larger commercial Accounts*
  - *Most schools and larger buildings should fall into this category*
- **Bi-monthly**
  - *Smaller accounts*
  - *Irrigation-only accounts*
  - *Issues*
    - *Problems take longer to discover*
      - Wasted water and wasted costs
    - *Some utilities may bill all customers bi-monthly*

Sample Bill

RCM Training Series

Adobe Acrobat - [Report29]

File Edit Document Tools View Window Help

CITY OF SEATTLE

Seattle Public Utilities Bill

C00064
DAAU
22M
CD-6

Questions? Call 206-684-3000 or 1-800-862-1181 (out of area calls only)
Write us? 700 5th Avenue, Suite 2777, PO Box 34027, Seattle, WA 98124-4027

Account number:
2-537)68

MS-23-365
POB 34165

SEATTLE, WA 98124-1165

Property owner:

Service address:
1418 H ST

Summary of charges as of June 02, 2004
Payments received after June 02, 2004 are not reflected.

Previous balance:		2,117.97
Payments applied -	**THANK YOU:**	2,117.97 CR
Balance:		0.00
Total adjustments:		0.00
Current billing:		3,950.45
TOTAL AMOUNT DUE ON June 23, 2004		**$3,950.45**

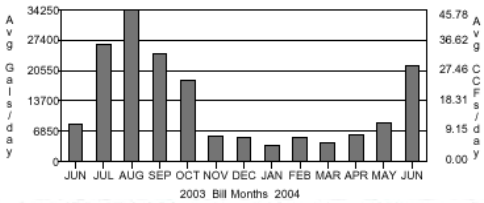
SUMMER WATER RATES ARE IN EFFECT FROM MAY 16 THROUGH SEPTEMBER 15.

Moving? *Call us on the day you move if you are reading your own meter. To have us read your meter for a fee, call us at least 3 days in advance of your move.*

Remember: Account openings and account closings cannot be backdated to a day before you contact us.

Customers are responsible for all charges until an account closes.

Compare Your Water Usage



	This Period	Same Period Last Year
	No. of days: 30	No. of days: 30
	Consumption in CCF: 871	Consumption in CCF: 341
	Avg consumption/day: 29.03 CCF	Avg consumption/day: 11.36 CCF
	Consumption in gals: 651508	Consumption in gals: 255068
	Avg consumption/day: 21716.93 gals	Avg consumption/day: 8502.26 gals

1 CCF = 748 gallons

Please tear off remittance stub below and mail it with your payment in the enclosed return envelope.

Start 18 No... 2 Micr... 5 Micr... 4 Inte... Adobe ... Water ... 2 Micr... 4:16 PM

Sample Bill

RCM Training Series

Adobe Acrobat - [Report29]

File Edit Document Tools View Window Help

CITY OF SEATTLE

Account number:
2-53 068

MS-23-365
POB 34165

SEATTLE, WA 98124-1165

Property owner:

Service address:
1418 1 ST

C00064
DAAU
22M
CD-6

Seattle Public Utilities Bill

Statement date: June 02, 2004 Page 2

DETAILED BILLING INFORMATION

Water Service

Service From	Service Through	CCF Usage	Previous Reading	Current Reading
Apr 26,2004	May 26,2004	671.00	16561.00	17232.00
Meter Number: NEP-70032474-2		Service Category: WTR1		
Apr 26,2004	May 26,2004	200.00	1408.00	1608.00
Meter Number: NEP-70032474-2		Service Category: WTR2		
Winter Commercial		551.63 CCF @ $2.000 per CCF		1,103.27
Base service charge				127.93
Summer Commercial		319.37 CCF @ $3.350 per CCF		1,069.88
Base service charge				74.07

Water revenue pays the following costs:
38% for water quality and supply
28% for infrastructure and maintenance
12% for services, billing and emergency response
11% for taxes
5% for administration
4% for environmental investments
2% for revenue stabilization fund

Current Water Service: 2,375.15

Sewer Service

Service From	Service Through	CCF Usage	Previous Reading	Current Reading
Apr 26,2004	May 26,2004	604.00	22085.00	22689.00
Meter Number: NEP-60131783-1		Service Category: SW1		
Apr 26,2004	May 26,2004	267.00	0.00	0.00
Commercial Inside City		267.00 CCF @ $5.900 per CCF		1,575.30

63% of sewer revenue is paid to King County Metro for sewage treatment.

Current Sewer Service: 1,575.30

CURRENT BILLING: 3,950.45

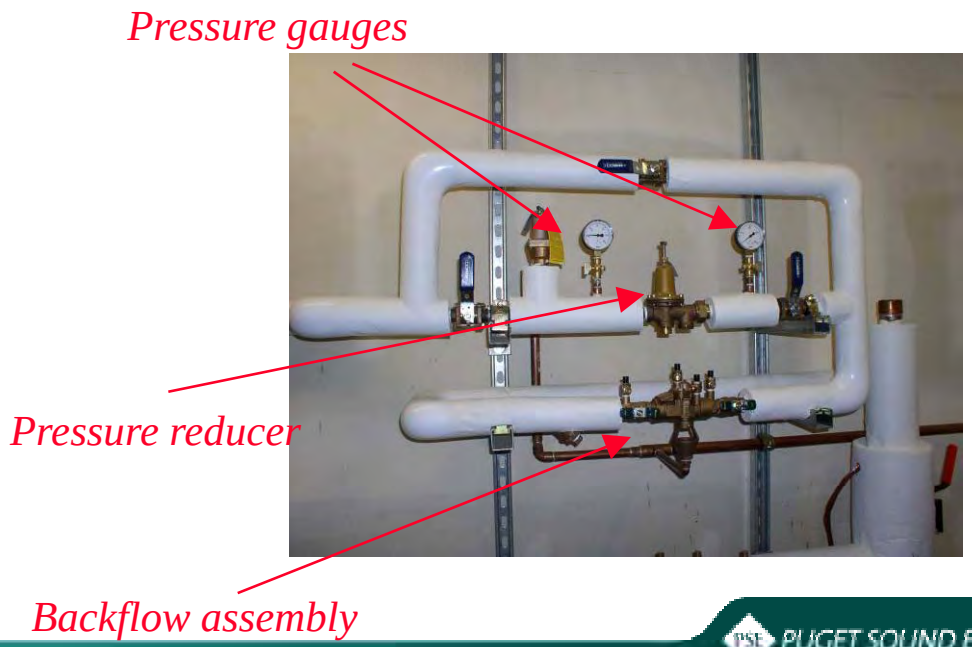
Moving on to buildings…

RCM Training Series

Building Water Supply

RCM Training Series

- **Water typically enters in mechanical room**
- **Reducing building pressure may be a savings opportunity**
  - *60 p.s.i. "static" pressure should be sufficient*
  - *Need to consider fixture performance at lower pressures*
  - *Newer showerheads/aerators are already pressure-compensating*



Building Water Use Drivers

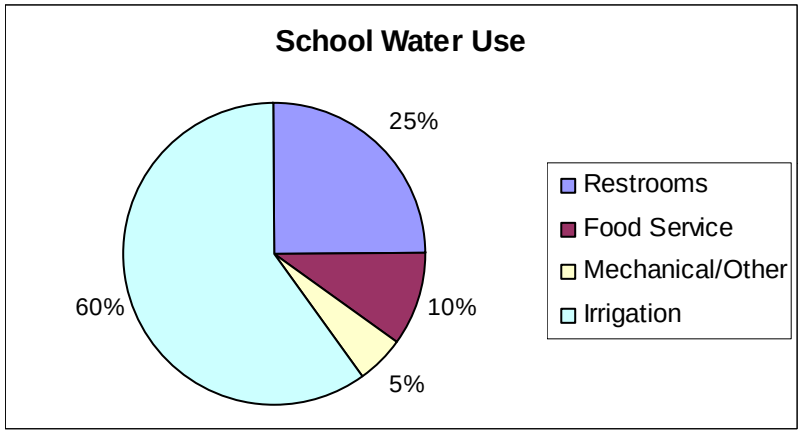
RCM Training Series

- **Human occupancy**
  - *People drive water use, not square footage*
- **Age of building**
  - *Much more efficient since ~ 1994*
- **Commercial uses**
  - *Schools*
    - *Central food service or on-site?*
    - *Irrigation?*
    - *Urinal flushing mechanisms*
  - *Office*
    - *Restroom driven*
    - *Tenants (restaurants, health clubs, etc.)*
  - *Industrial*
    - *Laundry? Manufacturing?...*

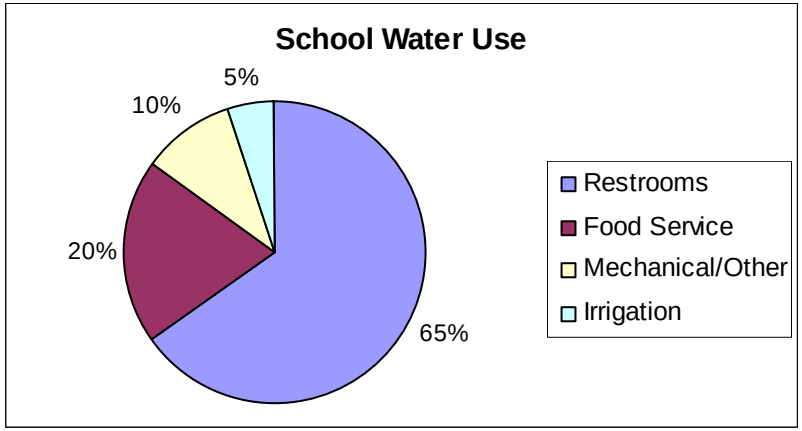
School Water Use Breakdown…

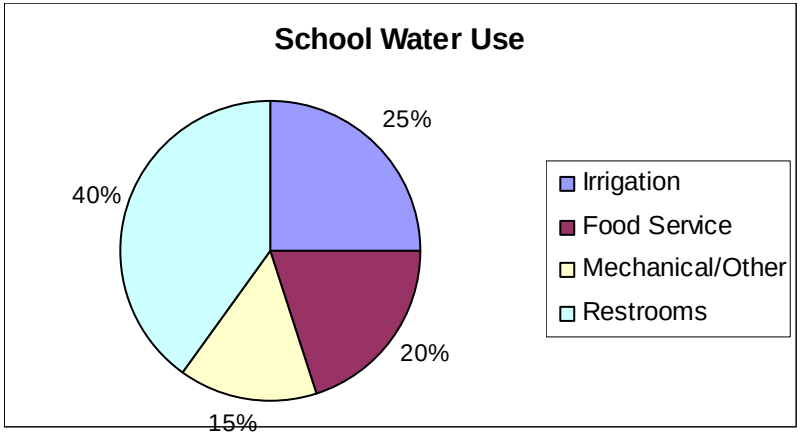
RCM Training Series

- Commercial buildings ~ 20% of national water use *EPA



Or this…





Or maybe this…

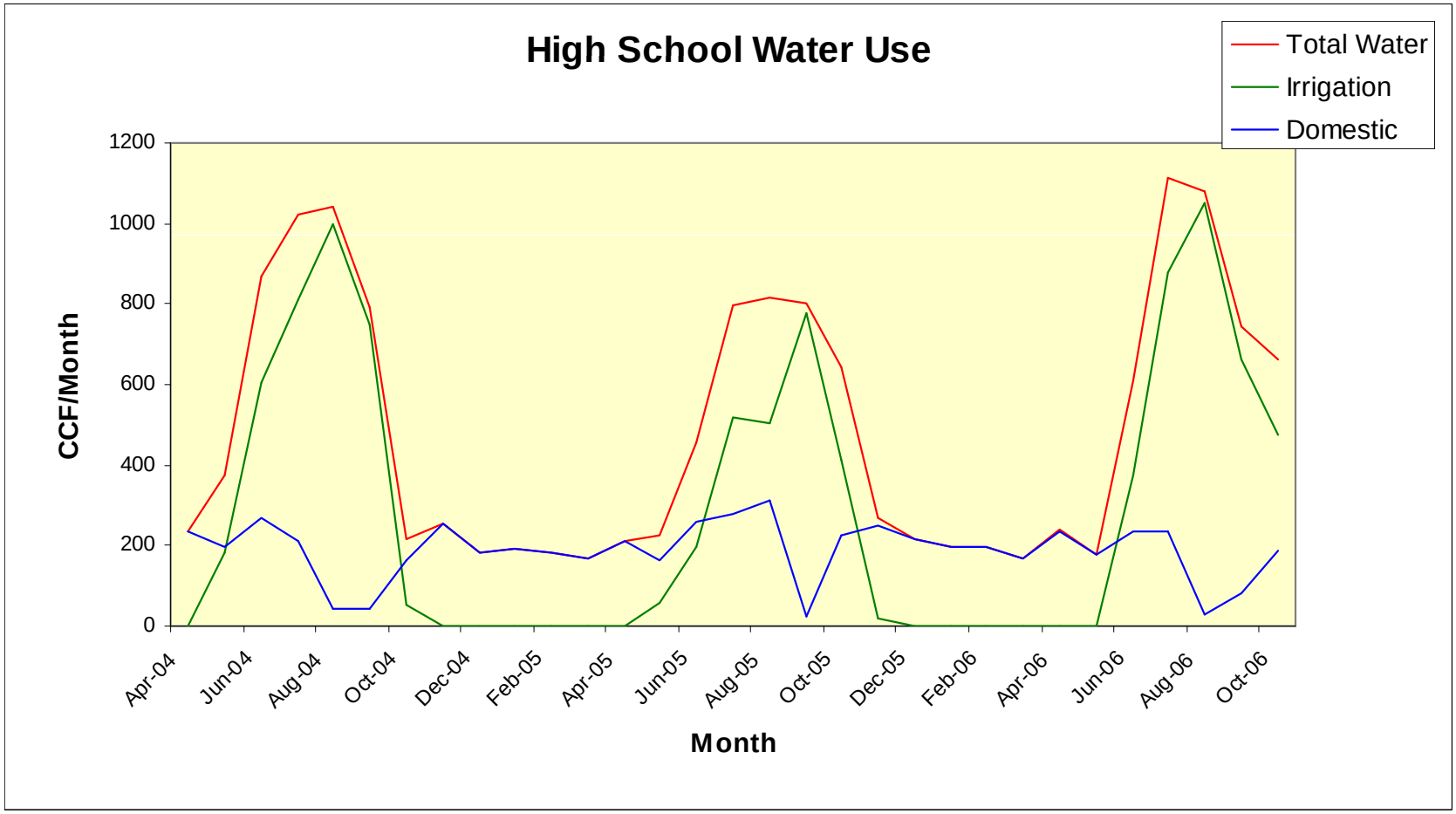
School Water Use

RCM Training Series

- **Per occupant use varies**
  - *Range of 3 – 10 gpd*
    - *.75 – 2.5 ccf/school year*
  - *4 – 6 gpd is typical*
  - *Use seems to go up a bit with each "level"*
    - *Elementary: little cooking, no showers*
    - *Middle: Additional cooking, possible showering*
    - *High: Cooking, showers (sports), mechanical equipment*
      - ~ 5 gallons/school day/occupant
- **Heavy use for 9 months of year**
  - *Other use:*
    - *Irrigation/summer school consumption*
    - *Consumption during break periods*

Billing Analysis

RCM Training Series



Commercial Indoor Water Uses

RCM Training Series

- Kitchens/food service
- Restrooms
- Mechanical
- Process/Other
- Outdoor

Kitchen Water Uses

RCM Training Series

- **General Cooking**
  - *Minimal water used as an actual ingredient*
- **Cleaning**
  - *Pre-rinse*
  - *Food waste disposal*
  - *Dishwashing*
    - *Three sink*
    - *Automatic*
  - *Floor/surface washing*

Kitchen Water Uses (cont.)

RCM Training Series

- **Water-cooled refrigeration**
  - *Refrigerator/freezer condensers*
  - *Ice machines*
- **Dipper wells**
- **Steamers**
- ***Laundry***
- ***Combination ovens***
- ***Pasta cookers/Wok ranges***
- ***Water wash hoods***
- ***Drain water tempering***

Kitchen Cleaning

RCM Training Series

- **Pre-rinsing**
  - *Removes debris before dishwashing*
  - *Keeps wash water clean/more effective cleaning*
  - *~ 1.6 to 4.5 gpm nozzles (some even lower)*
  - *Going from 3.2 gpm to 1.6 gpm (1.5 hrs/day)*
    - *~50,000 gallons savings*
    - *Energy savings: 432 therms*
  - *But how long does washing take?*
- **Food waste disposals**
  - *Sometimes used as scrape-off alternative*
  - *Often run for many hours*
  - *Up to 4 gpm*

1.6 gpm 2.6 gpm 4.5 gpm

Kitchen Dishwashing

RCM Training Series

- **Three basin sink**
  - *Minimal flexibility with consumption*
    - *Keep wash/rinse water clean*
- **Automatic**
  - *Can use ~ 0.4 – 3+ Gallons per "rack"*
    - *0.4 gallons per rack is optimal*
    - *Consumption information sometimes difficult to find*
  - *Types*
    - *Under Counter*
    - *Door*
    - *Conveyor*

Ivars:
2001 3.8 g/rack
2005: 1.8 gal/rack
2010: 0.4 gal/rack

Kitchens: Water Cooled Compressors

RCM Training Series

Compressor to cool down fridges/freezers/ice machines

- *Water cooled: flow of cold water to absorb heat*
  - *One unit uses ~ 230,000 gallons/year**
  - *Should flow water when compressor is running*
  - *Flow rate should be sufficient but not excessive*
  - *Flow should be off when unit is off*
  - *Can potentially be run off non-potable water sources*
    - Looped into cooling tower system
    - Sea water – limited applications
- *Air cooled: uses airflow to absorb heat*
  - *Space must receive adequate ventilation to outdoors*
    - Otherwise room heats up too much

Restricts use in some applications

* 6 hrs/day, 1.75 gpm, 365 days/yr.

Kitchens: Ice machines

RCM Training Series

Water uses

- **Water for ice**
- **Purge water for clarity**
  - *Used to keep cubes clear*
  - *Primarily an issue with cubes*
    - *Less of a problem for flake machines*
  - *Should be minimal purge, settings are adjustable*
    - *May be factory set to maximum*
  - *Possibly as much water used as for making ice. Data being collected*
- **If water cooled condenser…**
  - *Undoubtedly largest opportunity for savings*

Kitchens: Other Equipment

RCM Training Series

- **Dipper wells**
  - *Used for keeping utensils clean*
  - *Constant flow of water*
  - *Can be health department driven*

- **Steamers**
  - *Traditional: 30 – 40 gallons/hr*
  - *Connectionless: 1 – 2 gallons/hr*

- **Cookers, Steam kettles, Ranges, Hoods**
  - *Identify water use*
- **Laundry**
  - *Look for front loaders*

Kitchens: O & M Savings Opportunities

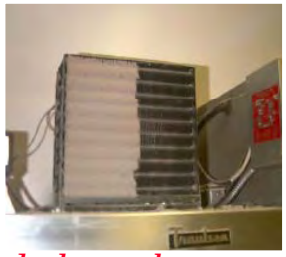
RCM Training Series

- **Don't defrost in sinks**
- **Scrape scraps from plates**
- **Install efficient pre-rinse valves…but not too efficient**
- **Minimize water for food disposal run time**
- **Ensure dishwasher is operating at specified settings**
  - *Turn off conveyor dishwashers when racks aren't running through*
  - *Check valves and solenoids for leaks*
- **Dipper wells**
  - *Ascertain the need*
  - *Adjust flow rate*
  - *Set to operate according to actual need*
- **Cleaning**
  - *Use mop instead of daily hosedown of floor*

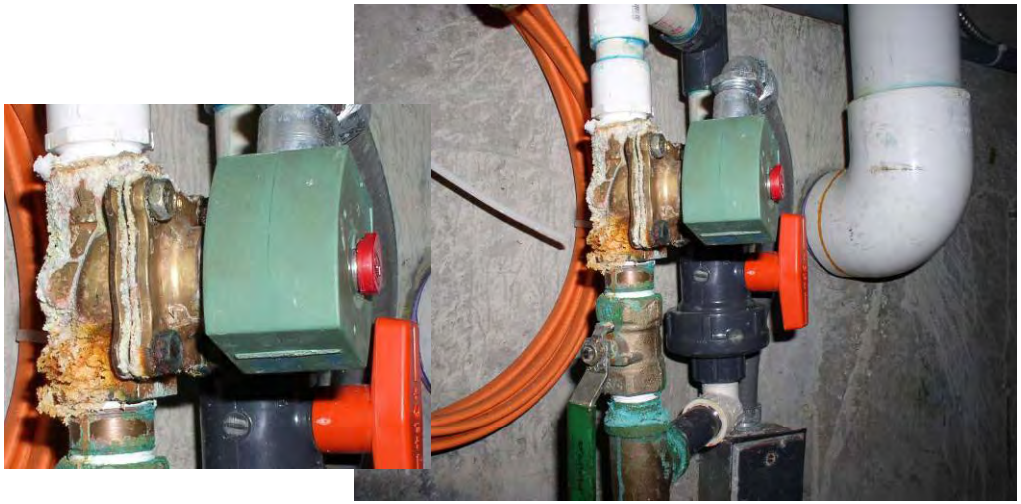
Kitchens: O & M Savings Opportunities

RCM Training Series

- **Ensure water cooled equipment is operating properly**
  - *Solenoid (valve) not stuck open*
  - *Thermostatic control to adjust flow to cooling load*
  - *Turn off units during summer breaks*
  - *Consider replacement with air cooled units*



And clean those coils!



Water Cooled Equipment Retrofit

RCM Training Series

- **Water cooled to air cooled**
  - *Often a simple equipment changeout*
- **Need to Identify compressor/condenser location with adequate ventilation**
  - *Could require relocating compressor*
  - *May require wall penetration with ventilation fan*
- **Could result in energy penalty (additional kWh use)**
  - *New equipment offers opportunity for better efficiency*
  - *Water/sewer savings should still result in acceptable payback.*

Conservation Project:

Water Cooled to Air Cooled Compressor

RCM Training Series

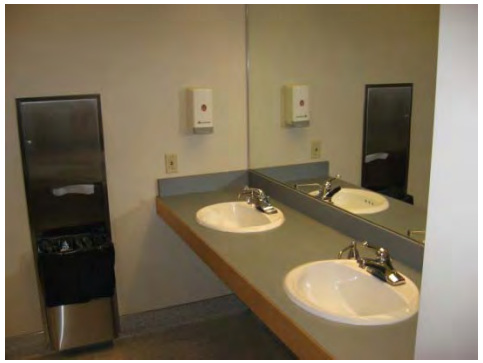
- **Replace a water cooled compressor with air cooled**
  - *New unit draws 1/3 hp: 6 hrs day, 365 days/year ($.06/kwh), plus same for supplemental exhaust fan*

Water savings/year	229,950	Gallons
Annual water/wastewater savings	$3,938	
Parts Cost	$2,400	
Labor Cost	$2,940	
New energy use	1095	kWh
New energy cost	$69	
Total Cost	$5,340	
Total Annual Savings	$3,869	
Simple Payback	**1.4**	**Years**
Payback cut in half with potential 50% rebate		

Restrooms

RCM Training Series

- Toilets
- Urinals
- Sinks



Toilets 201: Advanced Water Closet Analysis

RCM Training Series

- Standard Tank Toilets
- Pressure assist tank toilets
- Flush Valve (Commercial) Toilets

ALL toilets will eventually leak…

Toilets: water consumption

RCM Training Series

- **Code maximum consumption**
  - *Pre-1980:* ***5+ gallons per flush (gpf)***
    - *Many 5 gallon toilets have been adjusted to flush at less than 4 gpf*
  - *1980 - ~1994:* ***3.5 gpf***
  - *1994 to current:* ***1.6 gpf***
- **Current 3.5 gpf exemption for "blowout" fixtures**
  - *Loophole in the law for stadiums, etc.*
  - *3 bolt configuration*
- **<u>H</u>igh <u>E</u>fficiency <u>T</u>oilet<u>s</u> (HETs)**
  - *20% better than code*
    - *< 1.28 gpf*
    - *Dual flush*
  - *Up to 74% savings*
  - *Some are washdown design (Poor bowl cleaning)*

Dating Your Toilet

RCM Training Series

- **Tank Toilets:**
  - Manufacturing date is located on inside of lid or inside back of tank
    - Sometimes looks like a string of numbers
  - Flush volume often indicated
- **Flush valve Toilets**
  - *"Rated" volume listed under the flush valve*
    - *May not reflect what's in it*

Toilet Fixture Use

RCM Training Series

- **General rule is 5 uses per person per day**
  - *Can vary widely*
    - *Women use toilets more (some male uses are urinals)*
    - *Some people have 5 uses/day at work*
    - *Some people/kids have no uses per day*
    - *Many people appear to pre-flush*
- **Cleaning uses need to be considered**
  - *Can vary from one to three flushes per fixture/day*

Toilets: Tank-type Water Shutoffs

RCM Training Series

- **Handle type**
  - *Handles often feel like they will break when shutting off*
  - *Chlorine products break down rubber seals*
  - *Often leak through*

- **Water key**
  - *Semi-reliable, still prone to leak-through*

- **Quarter-turn**
  - *Ball style*
  - *More reliable*

Good rule of thumb…open shutoff fully, then back about ½ turn (so it doesn't stick open) – except ¼ turn valves

Toilets: Tank-type mounting

RCM Training Series

- **Floor mounted**
  - *Most popular*
  - *Floor bolts are at center of drain*
  - *Old bowls sometimes have extra floor bolts*
  - *Old tanks sometimes bolted to wall*
- **Four-Bolt Wall Mount**
  - *Rare*

Toilets: Rough-in

RCM Training Series

- **Distance from wall to center of drain/bolts**
  - *10" sometimes in tight installations*
  - *12" is standard*
  - *14" sometimes in older restrooms*
    - *12" can fit in 14" installations (with room behind tank)*

Rough in

Toilets: Fill valves

RCM Training Series

Tank toilets fill at up to 3 gpm

- **Float ("ballcock")**
  - *Notorious for leaking*
    - *Water levels creeps up over time*
    - *Bending arm typically a temporary fix.*
- **Pilot valves**
  - *Pedestal style*
    - *Becoming industry standard*
    - *Often easy to clean out debris*

Fill valves

Float (ballcock) Pilot valves

Toilets: Flapper Assembly

- **Water level should be ~ 1” below top of overflow**
- **Standard flappers**
  - *2”Standard for many years*
    - *Floats on chain often used to maintain 1.6 flush*
  - *3”Developed by Toto*
    - *Now being copied by most manufacturers*
    - *Rapid, effective flush*
- **Proprietary flush valves**

Dual flush

Flush valves

Typical Pedestal type Plunger

Flappermania

Assortment of 2” flappers

Toilets: Tank Toilet Leaks

RCM Training Series

- **Use dye tabs or food coloring to check**
  - *Put in TANK*
  - *Don't flush, wait ten minutes*
  - *Look in bowl*
    - *If color appears, there is a leak*
- **Leaking flappers**
  - *Need to find exact replacement part to maintain volume*
  - *Avoid black rubber flappers*
- **Malfunctioning fill valve**
  - *Won't shut of completely – water enters through overflow tube*

Toilets: Commercial Toilet Bowls

RCM Training Series

- **Floor mount**
  - *10” rough is typical*
- **Wall mount**
  - *Simplify floor cleaning*
  - *Attach to a wall “carrier”*
  - *4 bolt*
    - *Popular style*
  - *3 bolt*
    - *“Blowout” fixtures*
    - *send waste down a bigger outlet*

Toilets: Commercial Valve Shutoffs: Control Stops

RCM Training Series

- **Ground Joint**
  - *Older threaded style connection*
  - *Requires precise installation*
- **Slip joint**
  - *All new installations*
  - *Enables left/right adjustment during installation*

Control stops

- Designed for shutting off water supply
- Minor adjustments can sometimes change flush volume
- A control stop leaking through necessitates freezing the pipe or turning off the whole building

Toilets: Commercial Flushometers (Flush Valves)

RCM Training Series

- **Diaphragm**
  - *Used for many decades*
  - *Easily clogged by debris*
    - *Newer styles attempt to bypass debris*

- **Piston**
  - *Less susceptible to debris-related clogging*

Peak flow ~ 25 gpm

Flush cycle is ~ 5 to 9 seconds

- **Marine style**
  - *For poor water applications*
    - *Highly adjustable: can use dozens of gallons per flush*

Toilets: Commercial Valve Configurations

RCM Training Series

- **"Concealed" valves:**
  - *behind wall with button near toilet*
- **Auto-sensor valves**
  - *Available for both diaphragm and piston valves*
    - *More about these later…*

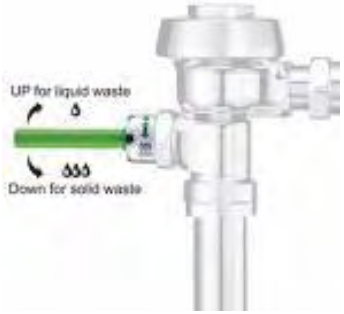
Toilets: Commercial Dual-Flush Handles

RCM Training Series

- Can be easily retrofitted onto existing flushvalves
- Vendor indicates 0.5 gpf savings

Questionable savings?

- Half flush may not be effective at flushing toilet paper
- Men typically already have urinals for liquid waste



Toilets: Flushometer Issues

RCM Training Series

- **Flush volumes are rarely as rated**
  - *Typically flush more water…more on this soon.*
- **Same model can have wide range of volumes**
- **Internal parts/volumes are interchangeable**
- **Static & running pressure can impact flush and volume**
  - *Building pressure below 30 psi is a cause for performance concerns*
- **Dual flush handles may not provide much savings**

Toilet *Maximum Performance* (MaP) Testing

RCM Training Series

- **Quantifiable and repeatable**
- **No serious previous flushing requirements existed**
- **Sets recommended minimum for performance**
  - *250 grams*
- **Started with Tank toilets.**
  - *Now flushometer toilets, too*
- ***Drawbacks***
  - *Doesn't address bowl cleaning*
  - *Doesn't deal with non-flush issues*
    - *Inferior flushing mechanisms*
  - *Results not always field-replicated*
  - *Manufacturers sometimes design to the test*

Test rig (top left), bulk & extruded media (top right), packaged media (bottom left), dropping media (bottom right).

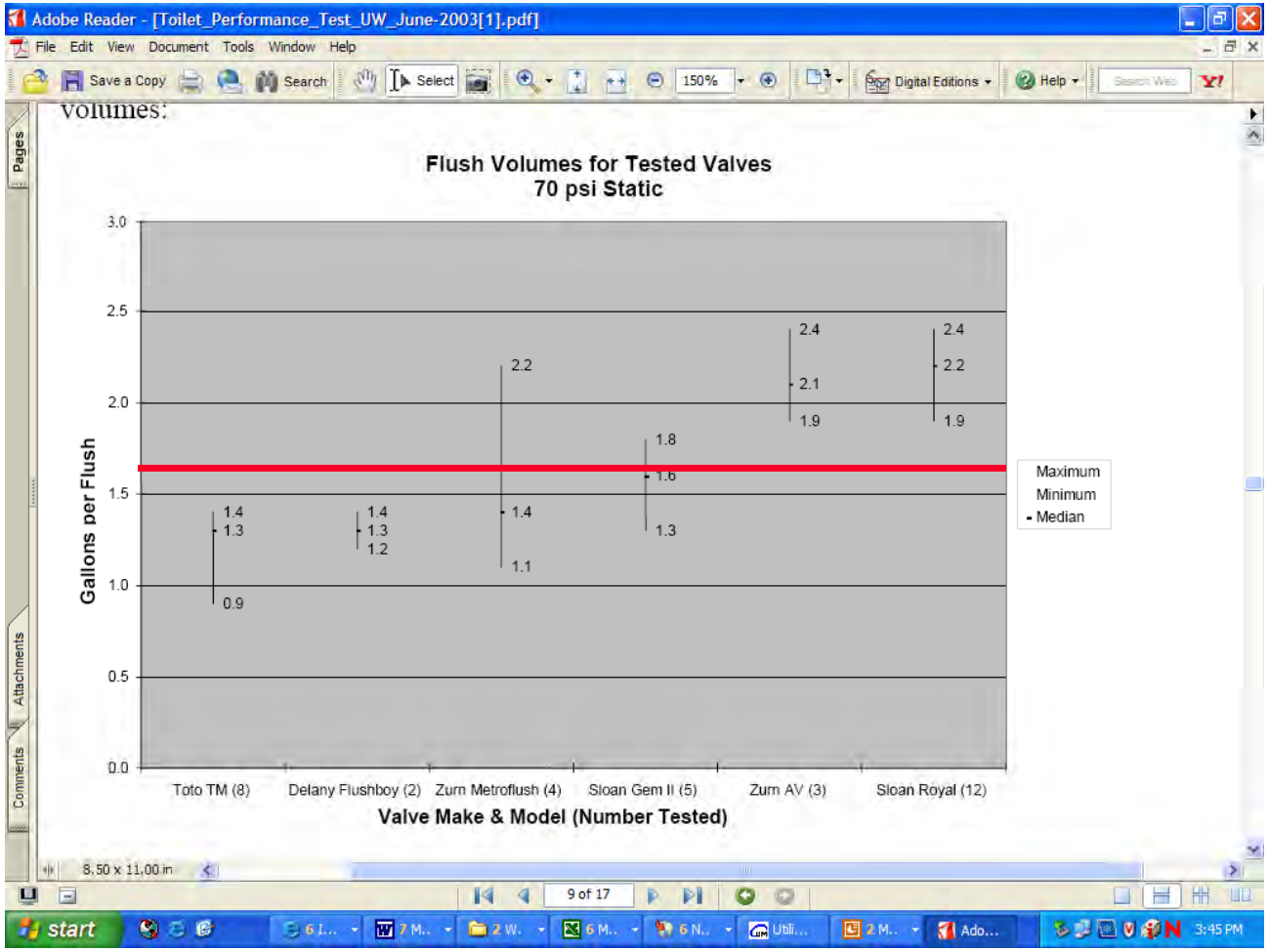
Flushometer Toilet Testing

RCM Training Series

- **Volume testing is difficult for the individual to perform**
- **Don't believe the specs**
  - *Flushometers flush with a wide range of volumes*
- **Volume can vary from flush to flush**
  - *Pressure variations*
  - *How fixture is flushed*
  - *Manufacturing: casting/flush inserts*
- **Currently, virtually all flushvalves can be manipulated to flush more water than rated**

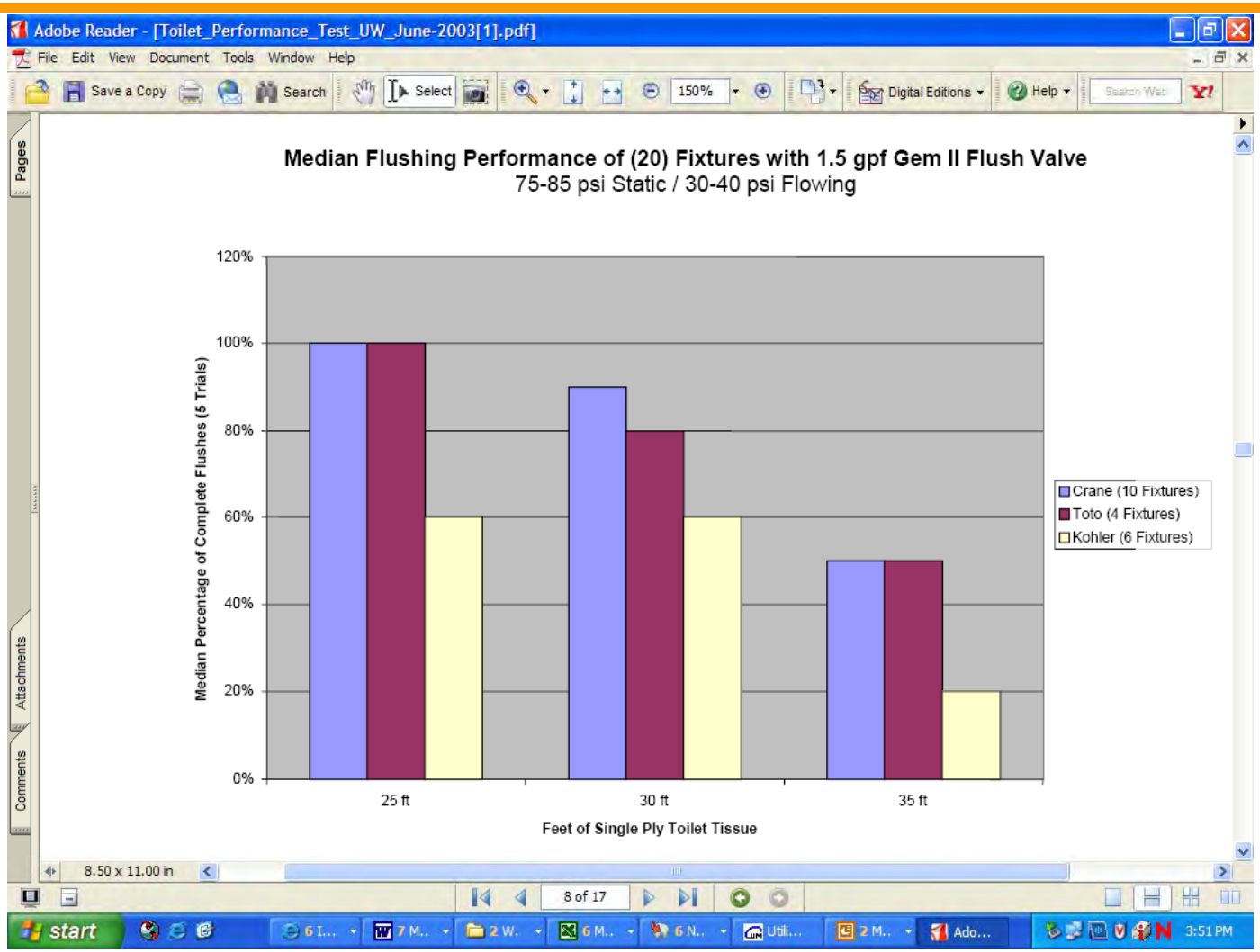
Flushometer Toilet Testing

RCM Training Series



Flushometer Toilet Testing

RCM Training Series



1.6 gpf Flushometer toilet testing

RCM Training Series

General conclusions…

- Floor and wall mount Toto toilets and bowls tend to perform well and provide consistent and reliable water savings
- Piston flushvalves work well
- Crane and American Standard wall mount toilets work well
- American Standard floor mount toilets work well
- Crane makes the only 1.6 gpf blowout (3 bolt) toilet. It performs satisfactorily
- Newer HET commercial toilets are beginning to hit the market

High Efficiency Toilets (HETs)

RCM Training Series

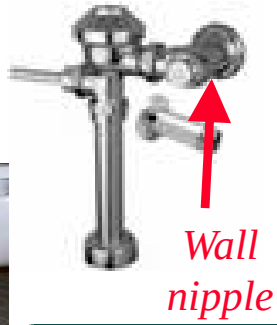
- **Tank Type**
  - *Hundreds of models now on the market*
    - *Dual flush = ~1.28 gpf on average*
    - *Some products now available at 1.0 gpf (pressure assist)*
  - *Be concerned about proprietary parts*
- **Flushometer**
  - *Products less than two years old*
  - *Many now on the market*
  - *Drain line carry and solids removal are key*

Toilet Retrofit Measurements

RCM Training Series

- **Tank toilets**
  - *Rough in*
  - *Height: Top of bowl*
    - *Handicap ~17" off floor*
      - Raised seats are available
    - *Standard ~14" off floor*
    - *Child ~ 10"*

- **Commercial floor mount**
  - *Rough-in*
  - *Distance from existing "spud" to center of bolts*
    - *If different on new toilets, may need to install new wall nipple*
- **4 Bolt Wall Mount**
    - *Thickness of porcelain against the wall*
      - May need new threaded rod for new toilets
    - *Distance from bottom of bolts to floor*



Toilet Retrofit Measurements

RCM Training Series

- **3 Bolt Wall Mount Toilets**
  - *Distance from bottom bolt to floor*
  - *Limited 1.6 gpf retrofit product options available*
- **Flush Valves**
  - *Concealed or exposed?*
  - *Type of control stop (seek to replace with slip-joint)*
  - *Type/condition of valve*
    - *Valve body may be reusable with new diaphragm/insert*

Commercial Toilet Retrofit Costs

RCM Training Series

- **Toilets**
  - *$300 - $600 installed (new toilet and flushometer)*
    - *$125 to $250 parts cost (3 bolt are more)*
    - *May be able to reuse flushometer and replace inserts*
    - *Installation: 1 – 3 hrs/toilet*
- **Urinal**
  - *$400 - $700 installed (new urinal/flushometer)*
    - *$200 - $400 parts cost*
    - *Installation: 2 – 4 hrs/toilet*

A toilet or urinal retrofit could cut building water use by 20-50%, if use is restroom driven

First try lower volume diaphragms/inserts and turning down control stop

Conservation Project:

Toilet Replacement

RCM Training Series

- **Replace a 3.5 gpf toilet with a 1.6 gpf model**
  - *Toilet is flushed 15 times per day, 5 days/week including custodial cleaning*

3.5 gpf baseline annual water use	13,650	gallons
Baseline annual water/wastewater cost	$234	
1.6 gpf annual water use	6,240	
1.6 gpf annual water /wastewater cost	$107	
Total water savings	7,410	gallons
Total dollar savings	$127	
Total parts cost	$225	
Total labor cost	$125	
Total Cost	$350	
Simple Payback	**2.75**	**Years**
Payback cut in half with potential 50% rebate		

Conservation Project:

Toilet Replacement

RCM Training Series

- **Replace a 3.5 gpf toilet with a 1.28 gpf model**
  - *Toilet is flushed 15 times per day, 5 days/week including custodial cleaning*

3.5 gpf baseline annual water use	13,650	gallons
Baseline annual water/wastewater cost	$234	
1.28 gpf annual water use	4,992	
1.28 gpf annual water /wastewater cost	$85.50	
Total water savings	8,658	gallons
Total dollar savings	$148.25	
Total parts cost	$275	
Total labor cost	$125	
Total Cost	$400	
Simple Payback	**2.70**	**Years**
Payback cut in half with potential 50% rebate		

Urinals: Water Consumption

RCM Training Series

- **Code maximum**
  - *Pre-1980: 3 gpf was common…no clear code*
  - *1980 - ~1994:* ***1.5 gpf***
  - *1994 to current:* ***1.0 gpf***
- **Newer technologies**
  - *High Efficiency Urinals (HEUs)*
    - *Waterless*
    - *0.5 gpf or less*
      - 0.125 gpf (one pint)

Urinals: Designs

RCM Training Series

- **Washdown**
- **Siphon jet**
- **Blowout**
- **Retrofit situations**
  - *Numerous bolt patterns*
  - *Various waste outlet heights*

Urinals: Flush methods

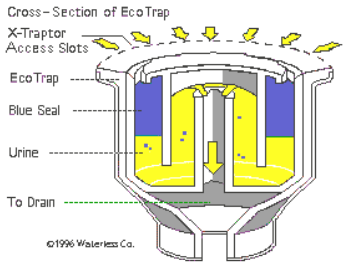
RCM Training Series

- **Continuous flush**
- **Triggered flush**
  - *Occupancy sensor*
  - *Timeclock*
- **Flushometer**
- **Push button**
- **Autosensor**
- **No flush**

Waterless Urinals

RCM Training Series

- **Fluid-filled trapway**
  - *Allows urine to flow through*
  - *Must be refilled or replaced based on uses/time*
- **Type of construction**
  - *First models were fiberglass or plastic*
  - *Porcelain models now on market*
- **Number of manufacturers making products has increased significantly in recent years**



Waterless Urinal Issues

RCM Training Series

- **Retrofits can be difficult**
  - *Waste outlet is lower than most urinals*
    - *Large distance between outlet and lip of urinal*
      - Can result in urinal lip being high off ground

- **High O & M costs**
  - *Replacement fluid and cartridges are expensive*
  - *Salts can build-up in drainline*
  - *Cleaning is different: water down drain is undesirable*
- **Customer/Custodian/Plumber satisfaction**
  - *Ventilation/Odors*
    - *Can be perceived or real issue – reason to complain*
  - *Clogged cartridge can cause slow draining*
  - *Slope of drainline?*

High Efficiency Urinals (water-using)

RCM Training Series

- Response to waterless urinal issues
- Most cost effective, considering all costs
- Better received by plumbers
- Fixtures are showing good performance
- Likely to capture a large future marketshare

Conservation Project:

Urinal Replacement

RCM Training Series

- **Replace a 3.0 gpf urinal with a 0.125 gpf model**
  - *Urinal is flushed 15 times per day, 5 days/week including custodial cleaning*

3.0 gpf baseline annual water use	11,700	gallons
Baseline annual water/wastewater cost	$200	
0.125 gpf annual water use	488	
0.125 gpf annual water /wastewater cost	$8	
Total water savings	11,213	gallons
Total dollar savings	$192	
Total parts cost	$425	
Total labor cost	$150	
Total Cost	$575	
Simple Payback	**3**	**Years**
Payback cut in half with potential 50% rebate		

Other Urinals

RCM Training Series

Toilet and Urinal O & M Opps

RCM Training Series

Listen for quiet leaks…

- **Make sure tank toilets aren't leaking**
  - *Check flapper valves at least once/year*
  - *Check water level/overflow tube*
  - *Remove lid, flush each toilet to see that flapper & chain don't hang up*
- **Flushometers**
  - *Turning off the main water supply to the building?*
    - *Turn back on slowly – debris/air will cause flushometers to stick*
    - *Plumbers need to come in to take valve apart to remove debris*
  - *Use internal parts with lowest required volume for fixture*
  - *Use chlorine-resistant inserts*
  - *Urinal control stops can be turned down to reduce volume -- <u>not</u> toilets*
  - *Replace old diaphragms: with age, will clog and flush more water*
- **Minimize urinal use**
  - *Shut off continuous fill tanks/timers during unoccupied times*
- **Shut off fixtures in unused (rest)rooms**

Showerheads

RCM Training Series

- **Code since ~1994 mandates 2.5 gpm or less**
- **Institutional and residential models**
- **Many good 1.5 gpm – 2.0 gpm models on market**
  - *Wide variety in performance*
- **Avoid "needles and pins heads"**
  - *Go for solid stream patterns*
  - *Dispersed/wide spray pattern can require increased temperature/energy use*

Showerheads

RCM Training Series

- **Factors impacting consumption:**
  - *Kids take few showers in schools*
    - *Pools and after-school sports may be exceptions*
  - *If timer valves, make sure they don't run too long*
    - *Adjust for no more than 30 seconds*
    - *Often can't be adjusted properly*
  - *Multi-head systems becoming popular for homes*
    - *Extremely wasteful*

Faucets/Aerators

RCM Training Series

- **Aerators**

  - *Code: 2.5 gpm*
    - *Code is 0.5/cycle for commercial – rarely followed*
  - *0.5 gpm offers good flow for commercial buildings*
  - *3 common thread patterns…*
    - *+ some proprietary models (Chicago Faucets)*
- **Faucets/Sinks**

  - *Handles*
  - *Push button*
  - *Foot pedal*
  - *Ceramic disk faucets*
    - *Newer style: very reliable for not leaking*
  - *Make sure push button valves run for no more than ten seconds*
  - *Stains in fixtures are often sign of a faucet that doesn't always shut off*

WaterSense Products

RCM Training Series

Toilets

- **1.28 gpf or less**
  - *Tank toilets*
    - *Many products have hit the market in the past few years*
  - *Flushometer toilets*
    - *Products are newer but showing better/good results*
- **Sinks/Faucet Aerators**
  - *1.5 gpm max, 0.8 gpm min.*
- **Urinals**
  - *0.5 gpf ma*
- **Showerheads**
  - *2.0 gpm*

Also landscape professionals and homes

Autosensor Equipment

RCM Training Series

Technology has improved significantly over past few years...still very expensive

- **Toilet flushometers: bad**
  - *Will almost certainly increase water use*
    - *Multiple flushes with single use: phantom flushing*
    - *Courtesy flushing*
    - *Periodic flushing*
  - *Can be calibrated:*
    - *Time in front*
    - *Distance*
  - *Can be retrofitted onto existing flushometers*
- **Urinal flushometers: generally good**
- **Sinks: good…if they work**
  - *Tend to minimize faucet run-time*

Mechanical Equipment and Sub-Metering

RCM Training Series

- Boilers
- Domestic Hot Water
- Cooling Towers
- Trap primers

Boilers

RCM Training Series

- **Water fill**
  - *Should be minimal (closed loop system)*
- **Blowdown**
  - *Done to remove contaminants*
- **Other Losses**
  - *Line leaks*
- **Steam traps**
  - *Will blow through steam if trap is malfunctioning, requiring makeup water*
- **Condensate return pump (Steam only)**
  - *Returns condensate to boiler*
  - *Can cause overflow to drain if it malfunctions*

Model AWVR

Domestic Hot Water

RCM Training Series

- **Central hot water**
  - *Boiler or hot water tank with circulation system*
    - *Possibly through heat exchanger*
- **Distributed heating**
  - *Hot water tanks near each use*
  - *On-demand heating near use*

Make sure hot water can arrive at all locations without waiting…

- **Circulation pump**
  - *Turn off at night (they rarely are turned off)*
    - *Running pump makes line act like a radiator*
- **Check Pressure/Temperature valves for leaks**
  - *Especially ones piped directly to drains*

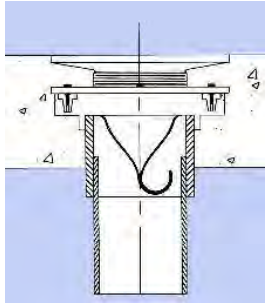
Cooling Towers

RCM Training Series

- **Water Losses**
  - *Evaporation: to dissipate heat*
  - *Drift: blowing away in the wind*
  - *Blowdown: to eliminate dissolved solids*
  - *…and leaks (pan, fill valve)*
- **Cycles of concentration**
  - *Mineral buildup with water recirculation*
    - *Minerals precipitate on coils, etc.*
  - *Higher "cycles" reduces required blowdown*
    - *3-7 cycles is normal*
    - *Conductivity controller*
      - Electronic or automatic
    - *Timer or pulse meter*
    - *Water treatment is key to reducing cycles and water waste*

Trap Primers

RCM Training Series



- **Used to prevent sewer gases from entering building**
- **Should be set for very little water consumption**
  - *Waterless trap primers also available*
- **Are often in hidden/unknown locations**
  - *May need to look at plumbing plans to identify*

Usually okay…but look out if they malfunction. One leaking one can waste tens of thousands of gallons per month.

Liquid Ring Compressors

RCM Training Series

- **Water swirls around to form a cavity**
  - Big water wasters
  - Tend to be maintenance free…but at the cost of water

Sub-metering of uses

RCM Training Series

Sub-metering of uses can pinpoint water consumption for specific areas or equipment, over time

- **Temporary or permanent**
  - *Boiler make-up water*
  - *Cooling towers*
  - *Kitchen equipment/dishwashers*
  - *Water-cooled refrigeration*
  - *Laundry (large uses)*
  - *Leak identification*
  - *Energy management system interaction*
    - *Time of use metering on main meter, or submeters*

Install meters horizontally for better accuracy

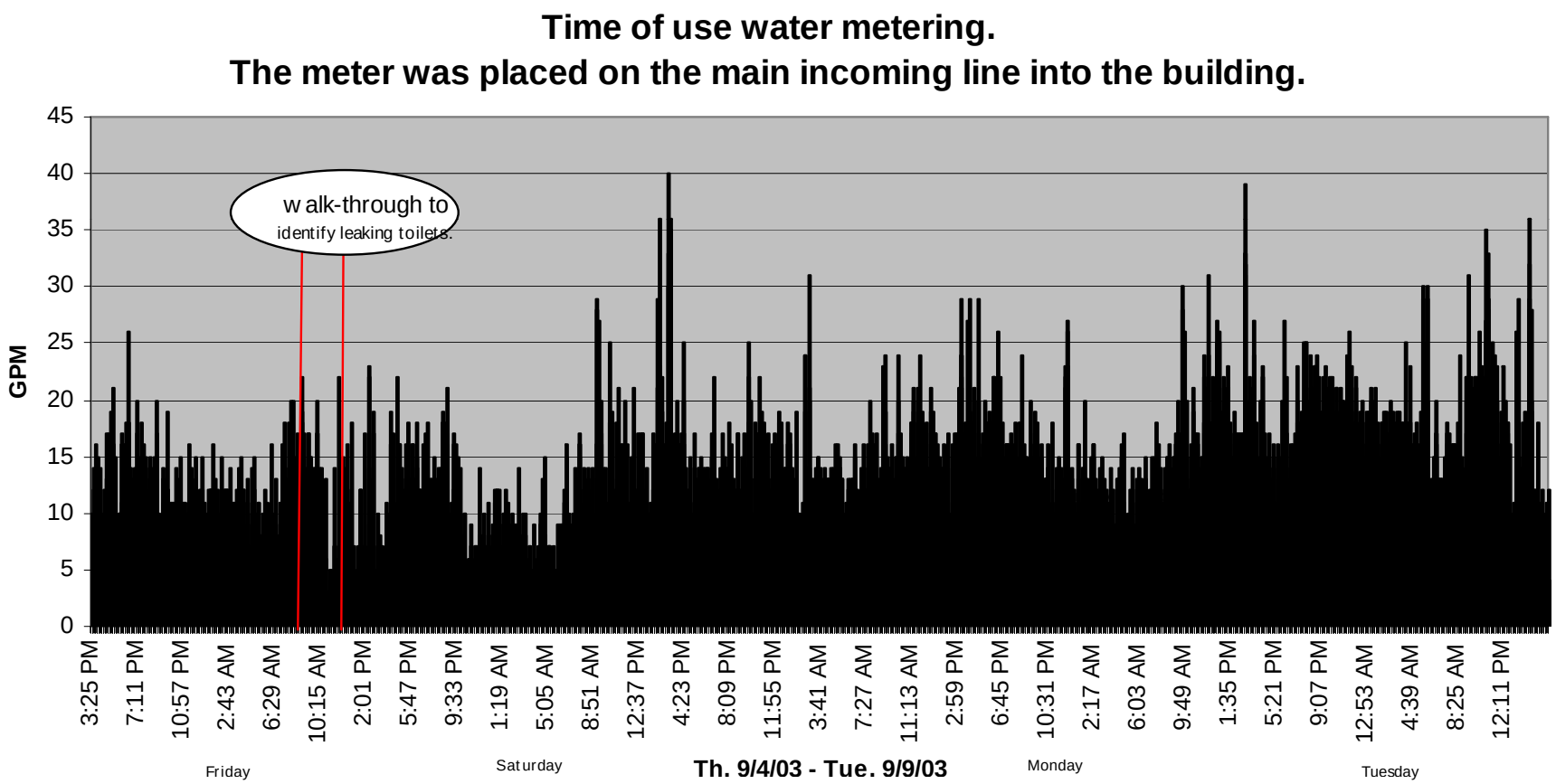
Time of Use Metering

RCM Training Series

- **Strap-on ultrasonic meter**
  - *Can be used on main line or branch lines*
  - *Provides insight into daily/weekly use trends*
  - *Downside: expensive -- $6,000+*
    - *Worthwhile with dozens of facilities or odd/industrial uses*

Time of Use Metering

RCM Training Series



Mechanical Equipment O & M Opps

RCM Training Series

- **Boiler**
  - *Repair line leaks*
  - *Minimize blowdown*
    - *Set to remove contaminants, but no more*
      - Consider blowing down according to total dissolved solid levels
    - *Blowdown wastes of water, energy, and chemicals*
  - *Ensure vacuum pump is properly returning water to boiler (steam)*
- **Cooling towers**
  - *Maximize cycles of concentration*
  - *Some chemicals/systems can allow for increased cycles*
- **Steam traps**
  - *Check and repair annually*
    - *Make sure they aren't running through*
  - *Main header is most important*

Other Building Water Uses

RCM Training Series

- **Pools**
  - *Lower pool level to minimize splashout*
  - *Make sure system gutters (overflow) is recirculating*
  - *Covers to minimize evaporation at night*
  - *Minimize filter backflush: can use 5,000 to 10,000 gallons/flush*
  - *Need to be refilled ~ every 18 months? (salt level buildup)*
- **Laundry**
  - *Residential/small commercial: WashWise efficient machines*
  - *If central laundry, consider rinse cycle reuse for the next wash*
- **Water**
  - *Reverse osmosis (RO)*
  - *Deionized water (DI)*
- **Processes**

Leaks!!!

RCM Training Series

By the end of this section…

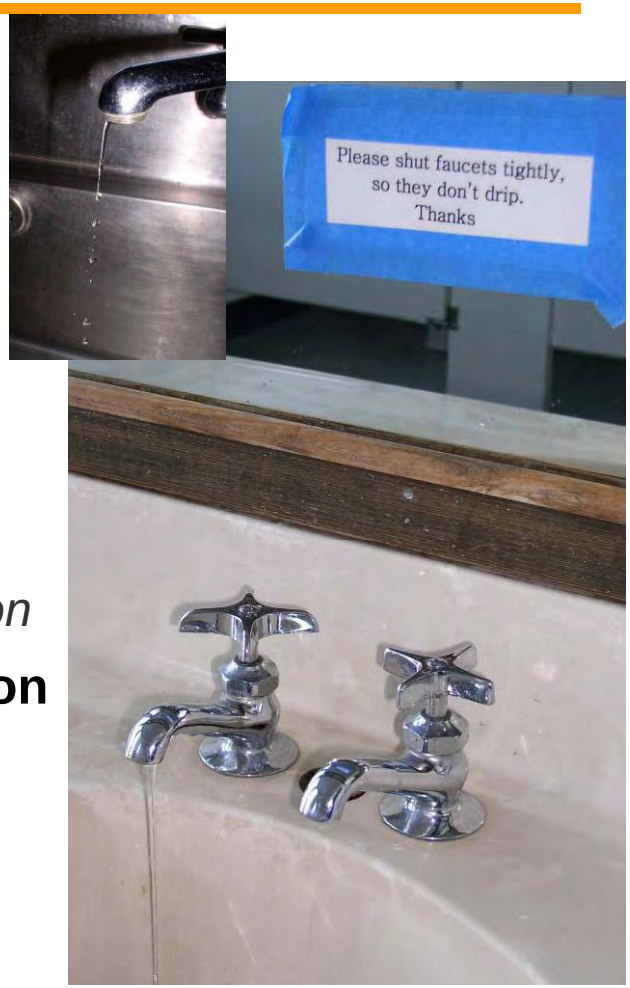
You'll be able to find the leak in this photo!

Leaks: Your biggest O&M Water Savings Opportunity

RCM Training Series

There's no such thing as a "normal" leak

- **Wide range of water waste**
  - *1 gpm = 43,200 gallons/month = $719*
  - *25 gpm (flushometer) = $600 per day*
- **Know what is important**
  - *Drip every ten seconds is minimal*
  - *Faucet: Need to determine how it is used*
  - *Even small steady stream necessitates action*
- **But remember…a leak will never go away on its own…well, usually not**



Quick locating: monthly High Bill Analysis

RCM Training Series

METER_ID	From date	To date	Rate code	Usage CCF	Base cost	Usage cost	Location	Address
HER-07219085-1	1/28/2009	2/27/2009	WIM1	2064	$23	$6,089	Seattle Aquarium	1501 ALASKAN WAY
	2/13/2009	3/13/2009	SIM1	593	$0	$5,272	Queen Anne Community Center & Pool	1920 1ST AVE W
PMM-65090816-1	2/13/2009	3/13/2009	WIM1	593	$21	$1,749	Queen Anne Community Center & Pool	1920 1ST AVE W
PRE-P0029298-1	1/3/2009	2/27/2009	WIM1	478	$31	$1,410	Waterfront Park	1415 ALASKAN WAY
HER-05029731-3	1/20/2009	2/21/2009	WIM1	453	$130	$1,336	Seward Park	5900 LAKE WASHINGTON BLVD S
PRE-L0064108-1	1/14/2009	3/11/2009	WIM1	423	$42	$1,248	Interlaken Park	1256 18TH AVE E
ROC-01241763-1	2/3/2009	3/4/2009	WIM1	329	$96	$971	Green Lake Park	6701 E GREEN LAKE WAY N
HER-05029731-3	2/21/2009	3/18/2009	WIM1	324	$102	$956	Seward Park	5900 LAKE WASHINGTON BLVD S
SEN-01628532-1	2/3/2009	3/4/2009	SIM1	318	$0	$2,827	Green Lake Park	6701 E GREEN LAKE WAY N
PMM-63222046-1	2/4/2009	3/4/2009	WIM1	268	$16	$791	Bobby Morris Playground	1700 NAGLE PL
PCN-F0887752-1	1/7/2009	3/4/2009	WIM1	228	$42	$673	Leschi Park	101 LAKESIDE AVE S
	2/2/2009	3/3/2009	SIM1	219	$0	$1,947	Meadowbrook Playfield	10515 35TH AVE NE
OTH-99901855-2	2/2/2009	3/3/2009	WIM1	219	$67	$646	Meadowbrook Playfield	10515 35TH AVE NE
SEN-66108999-1	1/27/2009	2/25/2009	WIM1	207	$96	$611		
SEN-66108999-1	1/27/2009	2/25/2009	WIM1	207	$96	$611	Lincoln Park	8053 FAUNTLEROY WAY SW
	1/25/2009	2/24/2009	SIM1	205	$0	$1,822	Ballard Pool	1439 NW 67TH ST
NEP-70032081-2	1/25/2009	2/24/2009	WIM1	205	$99	$605	Ballard Pool	1439 NW 67TH ST
	1/24/2009	2/25/2009	SIC1	181	$0	$1,609		
NEP-70048048-2	1/24/2009	2/25/2009	WIC1	181	$106	$534		
	1/28/2009	2/27/2009	SIM1	174	$0	$1,547	Helene Madison Pool	13325 MERIDIAN AVE N
OTH-99901853-2	1/28/2009	2/27/2009	WIM1	174	$69	$513	Helene Madison Pool	13325 MERIDIAN AVE N
SEN-60479423-1	2/3/2009	3/4/2009	WIM1	149	$96	$440	Washington Park Arboretum South Service	816 LAKE WASHINGTON BLVD E
PMM-62985835-1	1/13/2009	3/10/2009	WIM1	147	$32	$434	Colonnade Park	1825 LAKEVIEW BLVD E

Leak Identification and Repair Tool Kit

RCM Training Series

- Billing history
- Flashlight
- Spray bottle
- Camera
- Recent meter reading
- An inquiring mind
- Tenacity
- A wrench doesn't hurt
- but most importantly…

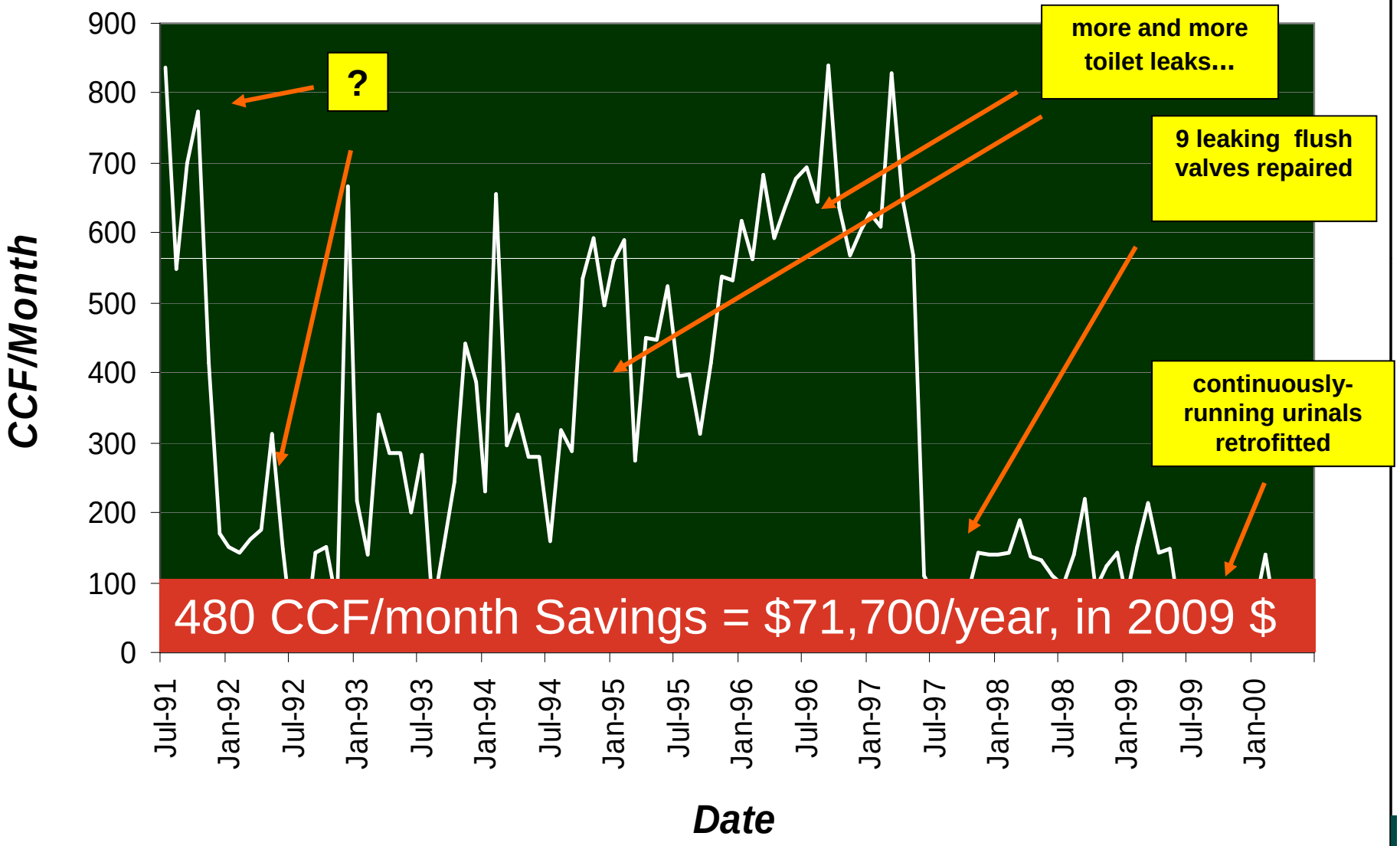
your plumber

How bad is the leak?

RCM Training Series

- **Can vary from gallons/day to gallons/minute**
  - *Tank toilet: up to 1-3 gpm*
    - *Up to 129,000 gallons/$2,150 per month*
  - *2" water line: 120 gpm*
- **Is the leak new or on-going?**
- **High bill? Check meter readings**
  - *Take reading from last bill*
  - *Take new reading and calculate use/day*
  - *Use back to normal? Good luck finding the culprit*
  - *Use still high? Grab the Divining Rods!*

Elementary Water Consumption



Leak Detection Process

RCM Training Series

- **Gather data**
- **Identify/quantify the scope of the problem**
  - *Recent jump*
  - *High use compared to similar facilities*
  - *Steadily increasing water use*
- **Confirm the problem (or maybe you have already)**
  - *Read meter at end of day, after everyone leaves*
  - *Read again at beginning of next day, before anyone arrives*
  - *Time of use metering, if available*
- **Talk with staff/plumbers about the concern**
  - *Changes in use*
  - *Strange issues*
- **Investigate the potential sources**
- **Find the culprit**

Case Study: Green Lake Pool

RCM Training Series

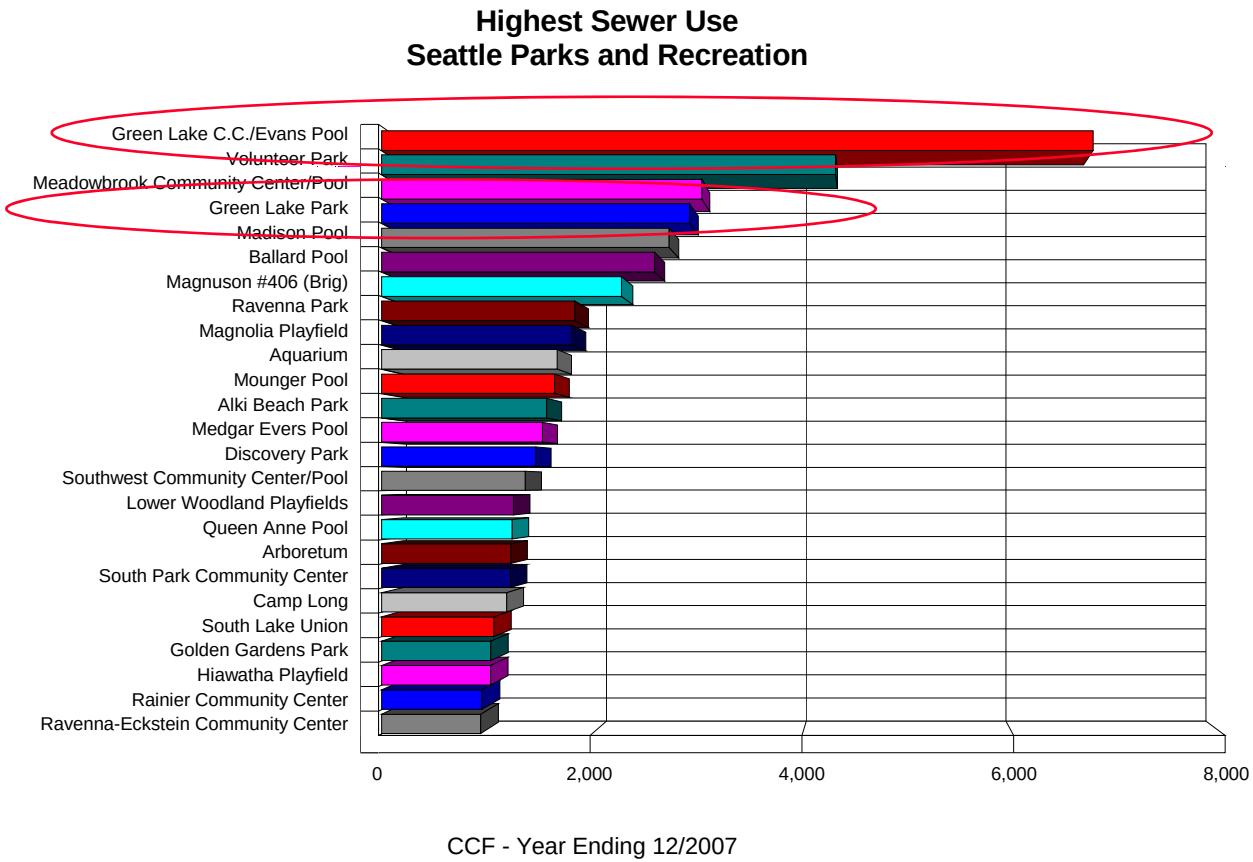
1.) Gather data

From	Thru	Bill Period (days)	Bill Total ($)	Water Usage (CCF)	Water Cost ($)	Sewer Usage (CCF)	Sewer Cost ($)
1/7/2008	2/6/2008	30	$5,341.93	504	$1,412.68	507	$3,929.25
12/6/2007	1/7/2008	32	$5,948.95	566	$1,425.74	602	$4,523.21
11/5/2007	12/5/2007	30	$5,364.43	522	$1,274.38	549	$4,090.05
10/5/2007	11/5/2007	31	$7,868.17	931	$2,213.62	759	$5,654.55
9/8/2007	10/5/2007	28	$3,217.35	655	$1,772.05	194	$1,445.30
8/6/2007	9/7/2007	32	$7,782.77	1,175	$4,020.52	505	$3,762.25
7/5/2007	8/6/2007	32	$11,686.52	1,791	$6,084.12	752	$5,602.40
6/6/2007	7/5/2007	29	$9,223.37	1,385	$4,716.12	605	$4,507.25
5/8/2007	6/6/2007	30	$9,550.98	1,502	$4,686.13	653	$4,864.85
4/3/2007	5/7/2007	34	$7,058.76	727	$1,754.36	712	$5,304.40
3/6/2007	4/3/2007	28	$5,084.67	516	$1,255.37	514	$3,829.30
2/5/2007	3/6/2007	29	$4,788.85	467	$1,145.80	489	$3,643.05
1/8/2007	2/5/2007	28	$4,381.13	430	$1,058.43	446	$3,322.70
12/7/2006	1/8/2007	32	$4,130.06	424	$1,065.89	442	$3,064.17
11/4/2006	12/7/2006	33	$4,308.67	454	$1,138.23	469	$3,170.44
10/3/2006	11/4/2006	32	$5,356.78	725	$1,767.22	531	$3,589.56
9/6/2006	10/3/2006	28	$5,421.04	810	$2,250.60	469	$3,170.44

Case Study: Green Lake Pool

RCM Training Series

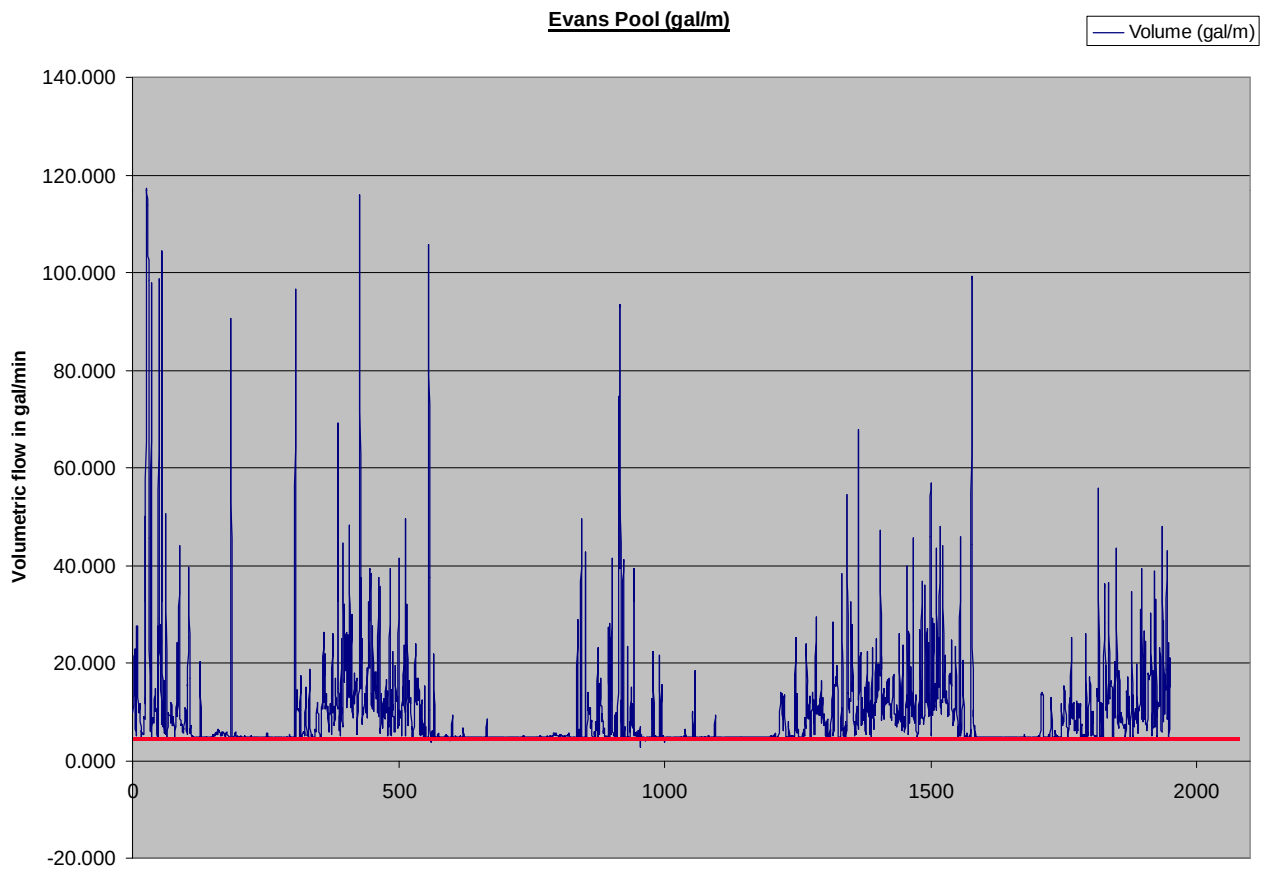
2.) Identify/quantify the scope of the problem



Case Study: Green Lake Pool

RCM Training Series

3.) Confirm the problem

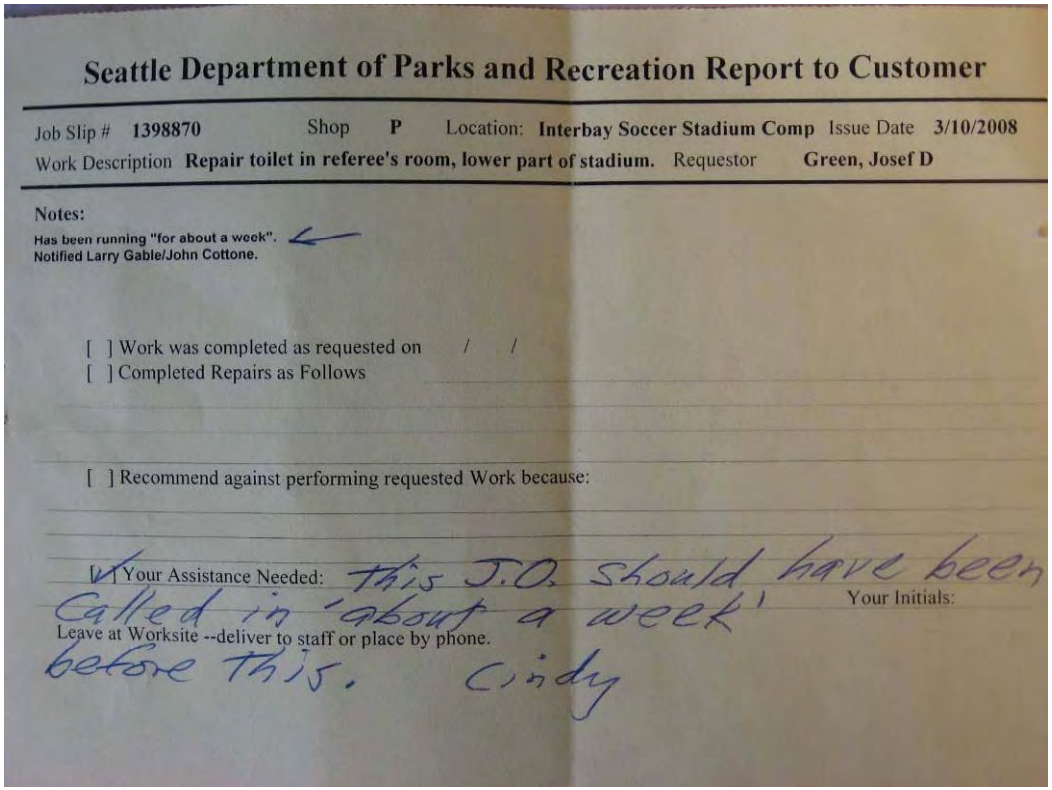


Case Study: Green Lake Pool

RCM Training Series

4.) Talk with staff/plumbers about the concern

- *Find out previous or recent problems*
- *Check past work orders (or uncompleted ones)*



Seattle Department of Parks and Recreation Report to Customer

Job Slip # **1398870** Shop **P** Location: **Interbay Soccer Stadium Comp** Issue Date **3/10/2008**

Work Description **Repair toilet in referee's room, lower part of stadium.** Requestor **Green, Josef D**

Notes:

Has been running "for about a week".
Notified Larry Gable/John Cottone.

[ ] Work was completed as requested on / /
[ ] Completed Repairs as Follows

[ ] Recommend against performing requested Work because:

[✓] Your Assistance Needed: this J.O. should have been called in 'about a week' before this. Cindy

Your Initials:

Leave at Worksite --deliver to staff or place by phone.

Case Study: Green Lake Pool

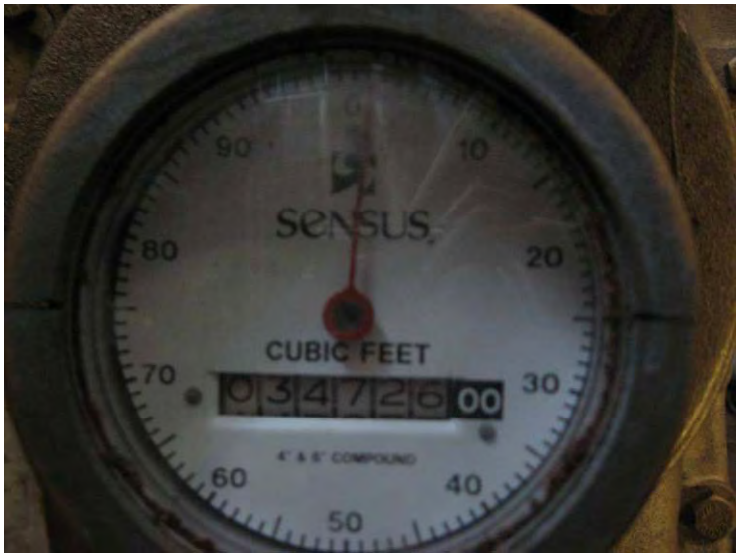
RCM Training Series

5.) **Investigate the potential sources of the problem**

Case Study: Green Lake Pool

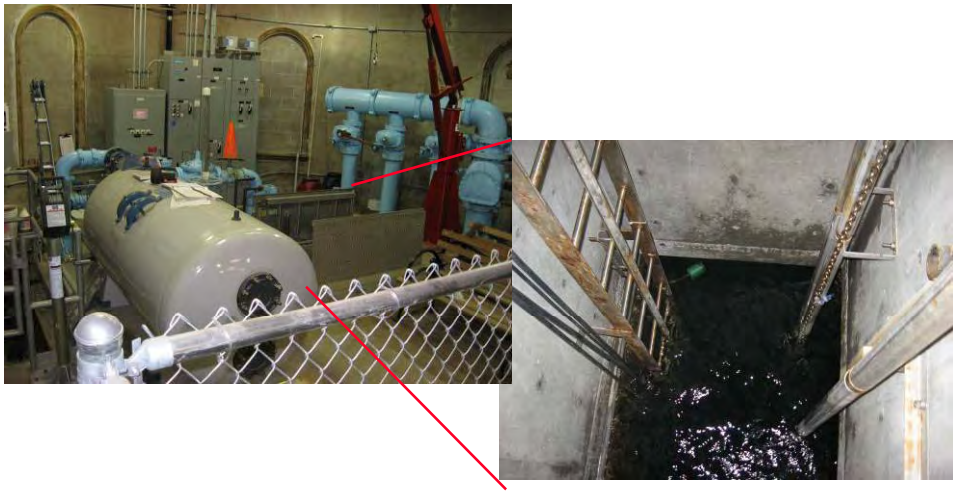
RCM Training Series

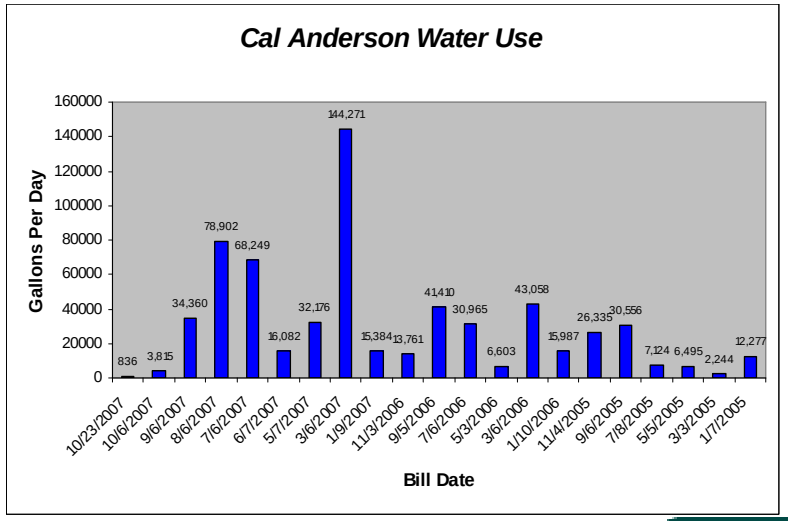
6.) **Confirm the solution**



Cal Anderson Park

RCM Training Series





Lincoln Park

RCM Training Series

- **Leak?**
  - *No! Bad billing!*

Seattle Parks:
known underground leaks in the past year

RCM Training Series

??? Indicates not yet found

- Arboretum
- Cal Anderson Park ???
- Cowen Park ???
- City Hall Park
- Myrtle Edwards/Olympic Sculpture Park ???
- Lower Woodland
- Camp Long
- Magnuson Hanger 27
- Rainier Beach CC
- Discovery Park
- Leschi Park ???
- Lincoln Park
- 100 Dexter ???
- Georgetown Playfield
- Gasworks
- Miller Playfield
- Interbay Stadium
- Lincoln Park ??? – maybe found it.
- Seward Park ??? $17K/year
- West Seattle Golf Course ???
- Don Armeni Boat Ramp ???

Mystery Leaks?

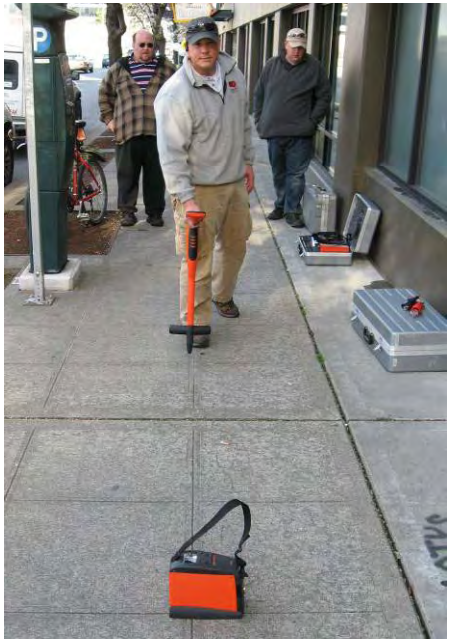
RCM Training Series

- **Check the meter at odd hours**
- **Likely culprits**
  - *Toilets! Toilets! Toilets! urinals*
  - *Trap primers, dishwashers, water cooled equipment*
  - *Odd occupants*
    - *Water quality nut*
    - *Sports fanatic*
  - *Then check the toilets*
- **Still no luck?**
  - *Try isolating building from the meter*
    - *To identify underground leaks*
    - *If this is the likely culprit, leak detection companies can pinpoint leak easily*

Leak Detection Companies

RCM Training Series

- **Can identify leaks with special equipment**
  - *Line locator to locate underground pipe*
  - *Pump CO_2 into line, line with ultrasonic equipment*



Outdoor Consumption

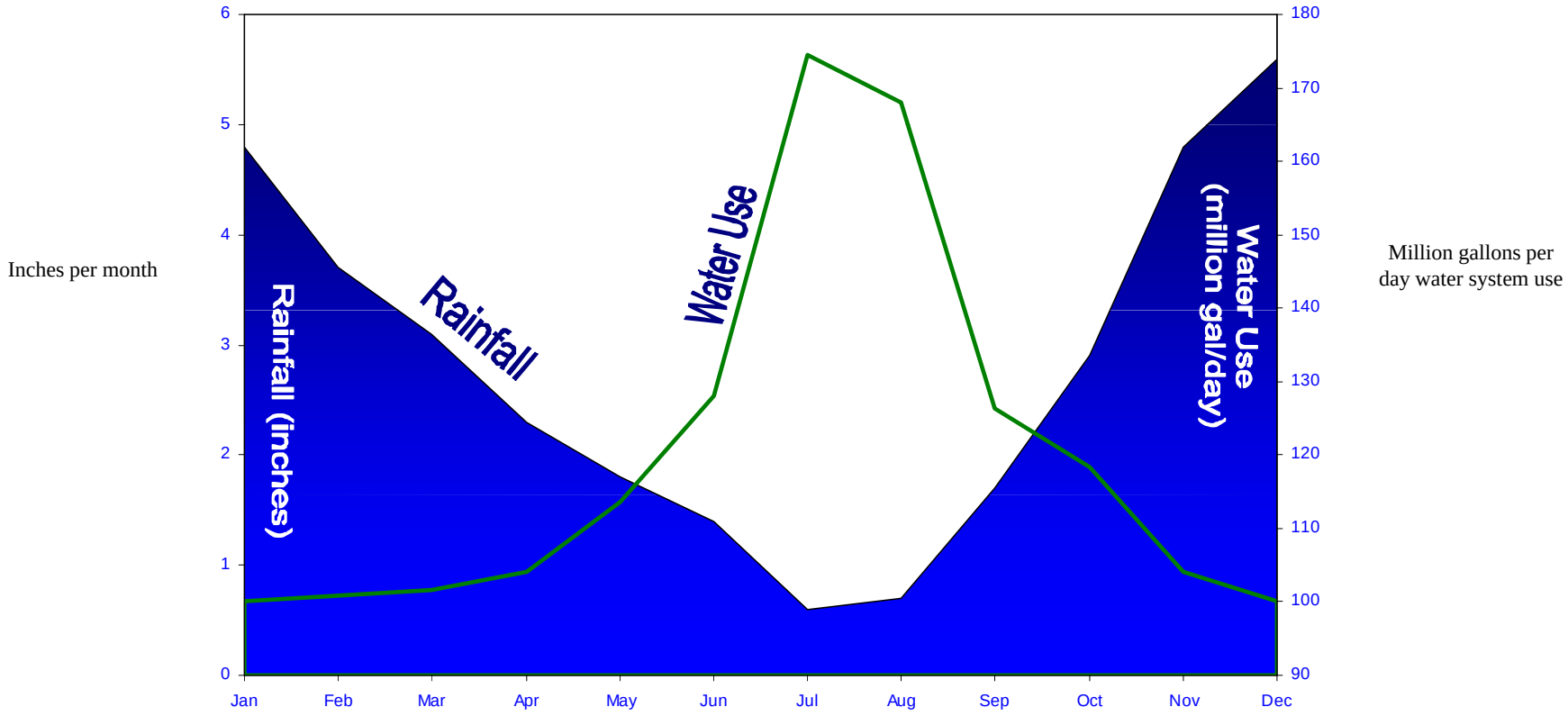
RCM Training Series

- Irrigation
- Restrooms
- Pools and Water Features
- Cleaning

Our dry summers…

RCM Training Series

Summer Crunch



Irrigation

RCM Training Series

Large automatic system

- **Usually a dedicated meter**
- **Or…"deducted" sewer charges from main meter**

Smaller System

- **Hose bibs and hand watering from main building**
- **Often no deduction for sewer charges**

5 – 10 ccf/season justifies installation of a deduct meter

Automatic Irrigation System

RCM Training Series

Components

- **Meter**
- **Backflow preventer**
- **Pump (possible)**
  - *Depends on pressure*
- **Main controller**
- **Irrigation boxes and zones**

Irrigation Equipment

RCM Training Series

Irrigation zone box with solenoid (on/off control)

Pump

Old backflow preventer

Irrigation Controllers

RCM Training Series

- **Standard clocks**
  - *Typically programmable*
    - *Pins for on/off hours*
    - *Manual adjustments*
  - *Bad*
- **Weather-based control**
  - *ET based clocks (WeatherTrack)*
    - *Set according to historical local data*
    - *Or daily data upload with limited programming*
    - *Weather-based watering without high costs*
  - *Maxicom*
    - *High end system*

Maxicom

RCM Training Series

- **Planting/soil condition control**
  - *Variety of soil type and landscape type inputs*
- **Weather based control and scheduling**
  - *Calls in to weather station each day to determine watering need*
  - *Adjusts watering according to ET and planting parameters*
- **Flow sensor/master valve can automatically shut it down if a leak is found**
  - *Senses leaks/broken heads when flowing above set parameters*

Downsides

- *Requires significant education to use to full capability*
- *Expen-sive*
- *At the end of the day…may not save water over status quo*

Rain/moisture Sensors

RCM Training Series

- **Rain sensors**
  - *Simple technology*
    - *Will shut off irrigation system if sensor is wet*
    - *Inexpensive to install*
    - *Install where rain won't be blocked*
  - *Can reduce watering by about 13%*

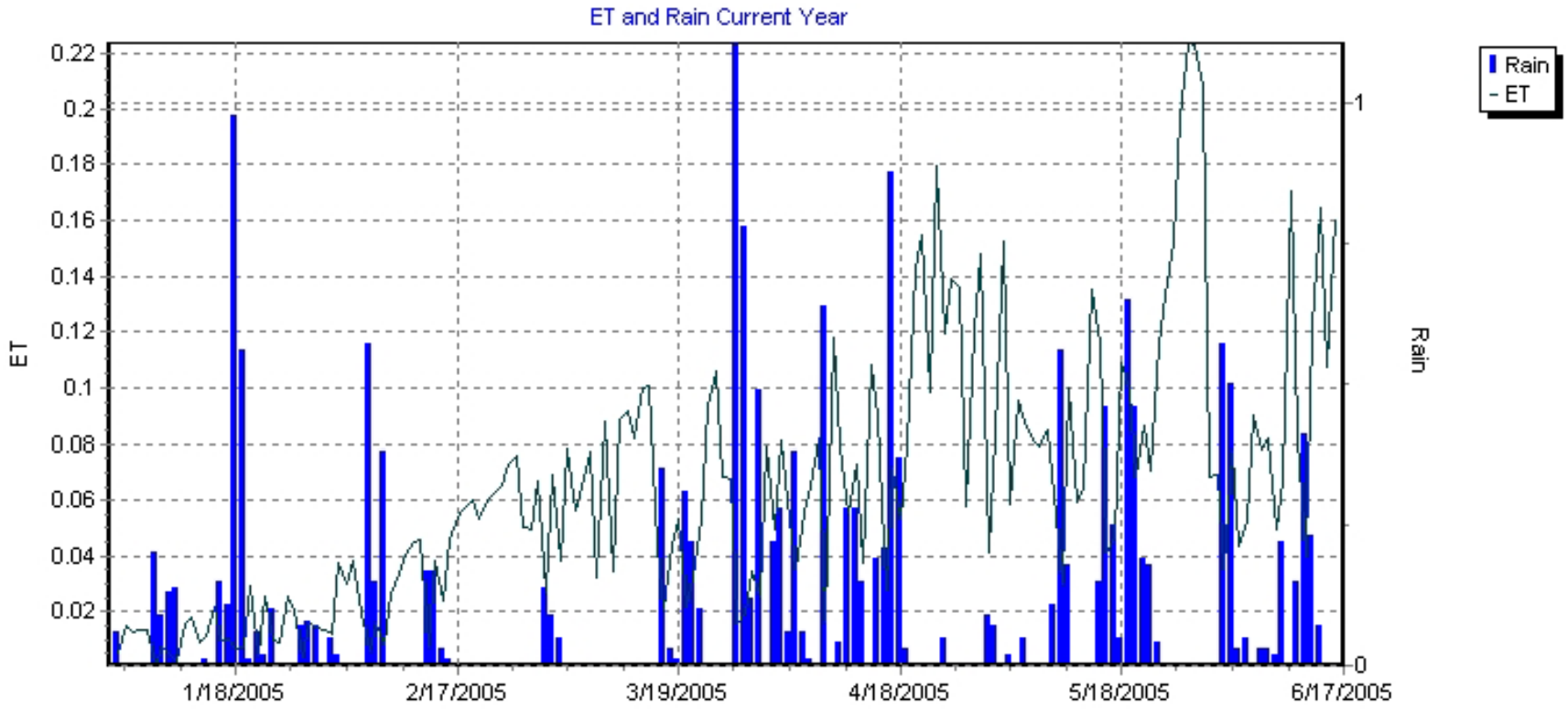
- **Moisture sensors**
  - *Mixed effectiveness*
    - *Set in soil to assess if adequate moisture*
    - *Whole system operated by one point or limited data*

Evapotranspiration (ET) & Rain

RCM Training Series

Evapotranspiration

generally a measure, in inches/day, of plant water need based on solar radiation, wind, temperature and humidity.



Irrigation Savings Potential…

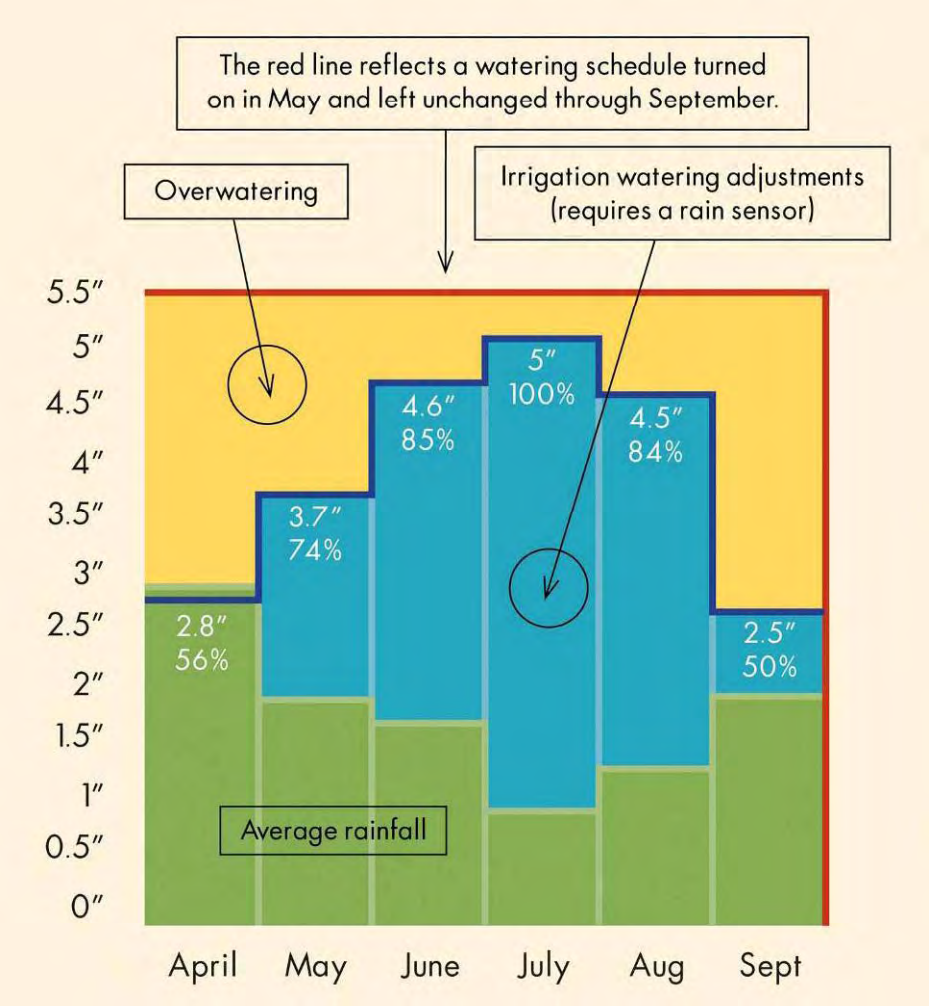
RCM Training Series

Don't set it and forget it!

Set an irrigation budget

Calculation based on plant type, soil conditions, "effective" rainfall (what can soak in), and average weather

- *Ideally, annual irrigation will be the difference between the need (ET) and the actual rainfall during the irrigation season*



General irrigation use and control

RCM Training Series

- **System/zones can use…**
  - *25, 50..75 gpm*
  - *Broken zones use much more water – whatever pipe can supply*
- **Fields: head to head coverage is desirable**
- **Clocks often turned on/off with little seasonal adjustment**
- **Weather-based controllers**
  - *Work with existing system*
  - *Can be cost-effective via shoulder season savings*
- **Professional irrigation audit approach**
  - *Comprehensive look at field coverage, etc.*
  - *Can uncover good opportunities, but at a cost…*
  - *Follow-up often limited by required investment*
    - *Pipe replacement*
    - *Head relocation*

Irrigation Issues: Scheduling

RCM Training Series

Goal: *Just enough water to keep plants healthy and unstressed under expected sun*

- **Systems usually run at 2 A.M. when no one is around!**
  - *Difficult to identify*
    - *Broken heads*
    - *Line leaks*
    - *Causes of bad coverage*
- **Don't water during the day**
  - *But hose dragging often uses less than some automatic systems…*
- **Less frequent, deep soakings to me more effective**
  - *Cycle/soak*

Irrigation Issues: Bad Heads

RCM Training Series

Irrigation: Bad Coverage

RCM Training Series

Irrigation: Bad heads and Coverage

RCM Training Series

Does this look good?

RCM Training Series

How about this?

RCM Training Series

Drip Irrigation

RCM Training Series

- **Reduces evaporation**
- **Measured in gallons per hour**
- **Tubing or emitters**
  - *Tubing: easier to install, more wasteful*
  - *Emitters: target water to specific plant*

Important not to run zones too long

Irrigation Savings Opportunities

RCM Training Series

- **Determine the need/drivers to water**
- **Look for heads that don't shut off**
- **Check head height**
  - *At turf or ¼" below*
  - *Too high: potential for breaking*
  - *Too low: difficulty throwing water designed proper distance*
  - *"Top dressing" will lower heads over time*
- **Monthly**
  - *Run through all zones to identify problems*
    - *Look for zones that can be shut off*
  - *Adjust manual clocks*
- **Weather-based system?**
  - *Tweak schedules back until noticeable brown areas appear*
- **New landscapes?**
  - *Consider drought tolerant plantings*
    - *Only need to run system for 2 – 4 year establishment period*

Indoor Pools

RCM Training Series

- **Pool covers can reduce evaporation**
  - *Estimate of 53,000 gallon annual savings (75' x 40' pool)*

Outdoor Pools and Water Features

RCM Training Series

- **Pools**
  - *Cover nightly to reduce evaporation*
- **Wading Pools**
  - *Decrease fill level*
  - *Consider recirculation*

Water Features

RCM Training Series

- **Fountains**
  - *Is the fountain recirculating?*
    - *Does the fountain have a leak?*
  - *Sub-meter makeup water*
  - *Often malfunction*
- **Water Features**
  - *May have backflushed filters for water quality*

Site	Average Annual CCF
Ballard Commons	1,707
Cal Anderson	2,091
John C Little	631
Judkins	739
MLK Fountain	183
Pigott Corridor	2,603
Pratt	1,559
Waterfront fountain	953
Westlake	1,602

Spray Features

RCM Training Series

~ 5 gpm

~ 175 gpm

Water Recirculation

RCM Training Series

- **Filtration system to reduce potable water use**
  - *Sand filters plus ozone or ultraviolet treatment*
  - *Water quality needs to be monitored*

Other Outdoor Uses

RCM Training Series

- **Restrooms**
  - *Toilets usually are not 1.6 gpf*
    - *New 1.28 gpf model just hit the market (metcraft)*
  - *High uses/fixture*
  - *Check for heat tape!*
- **Drinking Fountains**
  - *Check for leaks*

Other Outdoor Uses

RCM Training Series

- **Spigots**
- **Look in Valve boxes**
  - *Leaking Valves*
  - *Leaking ressure reducers*

Other Outdoor Uses

RCM Training Series

- **Cleaning**
  - *Use a water broom*
  - *Or sweep*

General Water Auditing

RCM Training Series

- **Obtain 1 – 3 years of historical Data**
- **Interview on-site staff or plumber to identify areas of concern**
- **Tools, primarily…**
  - *Flow bag*
  - *Ears!*
  - *Notepad*
- **Visit areas to identify fixture/equipment types and potential for retrofit savings**
  - *Kitchen – visit during cooking and cleanup*
  - *Boiler room – during operational hours*
  - *Restrooms*

Resources

RCM Training Series

- http://www.forester.net/we_subscribe.asp. **Free subscription to Water Efficiency Magazine**
- www.savingwater.org Saving Water Partnership(Seattle Public Utilities and Partnering Water Utilities): technical assistance. A report on Water Closet Performance Testing of approximately (50) different tank type toilet models is available here.
- www.resourceventure.org Business and Industry Resource Venture: technical assistance.
- www.waterwiser.org American Water Works Association: online conferences, drip calculator, reference materials.
- www.cuwcc.org California Urban Water Conservation Council: online newsletter "Waterlogue" (listed under "Product News"), plumbing industry links, reference materials, and the Los Angeles Supplementary Purchase Specification. This specification is currently the most stringent toilet testing standard in the nation for tank style toilets. The listing of toilets that have passed the test can be found at this site by clicking "Product News", then "Technical Information."
- www.p2pays.org North Carolina Dept. of Environment and Natural Resources: Water Efficiency Manual for Commercial, Industrial, and Institutional Facilities, 1998, available for free download at under "Technical Resources."
- www.sbcc.wa.gov Washington State Building Code Council: building and plumbing codes online.
- www.eren.doe.gov/femp/techassist/best_practices.html Federal Energy Management Program (FEMP): Best management practices and other useful info.

RCM Training Series

Thank You!

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