The Impact of Water Conservation and Efficiency on Water Treatment and Green Building at UT Austin
Main Campus Statistics

- ± 70 thousand students, faculty, and staff
- ± 150 buildings totaling ± 16,500,000 assignable square feet of space
- ± 400 acres
- I know... it’s big!
Characteristics of Central Plant

- Natural Gas-fired combined heating and power cogeneration plant
- 132MW design capacity (enough to power 100,000 homes)
- 48,000 tons cooling capacity at 4 central cooling plants for building air conditioning (enough to cool 20,000 homes)
- 2 large cooling towers for turbines and other power generation equipment.
- ’07-’08 consumed 395M gallons for cooling.
Water Conservation Programs and Projects

• Water Recovery- Direct non-potable reuse from internal sources – not “wastewater”
• DSEMC- Demand-Side Energy Management and Conservation
• WRI- Water Reclamation Initiative- Direct non-potable reuse from City of Austin sources- highly treated wastewater
• Chilled Water Conservation
• Biology Ponds Water Conservation
Water Recovery

- Program initiated in 1980
- Contributing sources: once-through cooling in research labs, groundwater, air conditioning condensate, rainfall harvesting
- Water is pumped through 6 miles of pressurized piping in steam tunnels
- Recycles between 35-50 million gallons/year for cooling tower makeup
• Initiated fall 2007, program included $1.7 M for water efficiency improvements in non-auxiliary buildings- Replaced +/- 6,000 fixtures

• Replacement of old 3.5 and 5.0 gpf toilets with 1.6 gpf units and 1.0 urinals

• Replacement of lavatory fixtures with water efficient units and aerators

• Next Phase: Replacement of old irrigation controllers with ET/soil moisture or weather-based units?

• Expected savings = 40-60M gals/year, ~$600,000/yr., ~ 124 tons CO2e
Water Reclamation Initiative (Reuse- or Reclaimed Water)

- Arriving at UT campus fall 2010
- Will become primary make-up water source to cooling towers, behind Recovered Water
- Expect to use about 350 million gallons per year for cooling towers
- Cost expected to be about 20% of city water, not including increased treatment
Chilled Water Conservation

- Implemented in 1997, has cut chilled water makeup rate from ± 75 to ± 35 gpm, saving 21M GPY.
- Stop leaks from old-style packing gland pumps by replacing with new mechanical seal pumps
- Stop uncontrolled losses by replacing corroded carbon steel pipe nipples with stainless steel nipples
- Add strategically located valves to better isolate sections, reducing loss during routine maintenance
- Treatment chemical is phosphate-based compound
Biology Ponds Water Conservation Project

- Popular campus water feature
- 3-10,000 gallon ponds
- Conversion of once-thru flow to re-circulating system
- Corrected NPDES issues
- Evaporative loss makeup with rainfall harvesting
- 5.3M gallons/year, worth about $60K/year saved
- Biological filter/wetland system removes NH$_3$, NO$_2$, NO$_3$, and adds O$_2$ for water quality
Impact of Conservation on Water Treatment

- Recovered Water
  - ± 1/8 city water (once-through cooling)
  - 1/2 groundwater from french drains
  - 1/4 air conditioning condensate
  - 1/8 rainfall harvesting

Net effect... it’s a push because ultra-clean ac condensate offsets the increased conductivity and hardness of groundwater

In fact, some evidence that “fin water” (ac condensate) actually increases cycles of concentration at towers close to large sources.
Impact of Conservation on Water Treatment (cont.)

- **Reclaimed Water**
  - Increased phosphates will require increased sulfuric acid to control pH
  - Increased use of calcium phosphate dispersants to prevent scale
  - Close control of phosphates to prevent increased corrosiveness of chlorides and sulfates
  - Higher TOCs, potential for bio-film fouling
  - Switching to chlorine dioxide for better bio control
  - Reduced cycles of concentration due to chemical balancing act means more chemicals needed
Impact of Conservation on Water Treatment (cont.)

- Chilled Water Conservation
  - Reduced water loss lessens added $O_2$, a major cause of corrosion in recirculating closed systems
  - Side-stream sand filter removes bulk of solids and circulating bio-films
  - Add chemical dispersants, polymers and azoles for scale and corrosion control, with nitrate/molybdate tracers and oxygen scavengers
  - Less makeup means less chemical treatment
Water Conservation: Impact on LEED Certification

- 10 possible credit points for water efficiency in LEED 2009 (Twice as many as LEED 2.2)
  - WEp1-Prerequisite: (No credit) Design for 20% less use than baseline for fixture units meeting 1992 Energy Policy Act
    - Water closets: 1.6 gpf
    - Urinals: 1.0 gpf
    - Showerheads: 2.5 gpm
    - Private Lavatory Faucet: 2.2 gpm
    - Public Lavatory Faucet: .5 gpm
    - Public Lavatory Faucet (metering): .25 g/cycle
    - Sink Faucet: 2.2 gpm
Water Conservation: Impact on LEED Certification (cont.)

- WEc1-Water Efficient Landscaping
  - 2 credits for 50% potable reduction via:
    - Xeriscaping
    - Irrigation efficiency (E-T controllers)
    - Use of collected rainwater
    - Use of recycled water (Water Recovery, treated wastewater)
    - Use of reclaimed water
Water Conservation: Impact on LEED Certification (cont.)

- **WEc1.2** No Potable Water Use or No Irrigation: Achieve WEc1.1 *and*
  - Option 1: Use only non-potable water for irrigation, or
  - Option 2: Do not install a permanent underground automatic irrigation system
  - Temporary automation irrigation systems must be removed within 1 year of installation
Water Conservation: Impact on LEED Certification (cont.)

- WEc2-Innovative Wastewater Technologies
  - 2 credit points for:
    - Option 1: 50% reduction of potable use by low/no-flow fixtures or use of auxiliary water sources, or
    - Option 2: treat 50% of wastewater on site; treated wastewater must be used on site
Water Conservation: Impact on LEED Certification (cont.)

- **WEC3.1** 2 Credit Points - Design for 30% less use than baseline for fixture units meeting 1992 Energy Policy Act
- **WEC3.2** 1 Credit Point - Design for 35% less use than baseline for fixture units meeting 1992 Energy Policy Act
- **WEC3.3** 1 Credit Point - Design for 40% less use than baseline for fixture units meeting 1992 Energy Policy Act
Water Conservation: Impact on LEED Certification (summary)

- 20% Water Use Reduction: prerequisite
  - Cannot certify without achieving this
- 30% Water Use Reduction: 2 Additional Credits, 35%+1, 40%+1
- Aggregate strategies which achieve reductions after meeting 1992 Energy Policy Act fixture performance standards
- Cannot include irrigation savings
There are Design Considerations:

- Auxiliary Water Use Requires Careful Selection and Use of Materials
  - Purple Pipe
  - Pipe Markers to Distinguish from Potable Waters
- Cross-Connection Prevention is Regulated
  - Annual Inspection and Testing (RPZs)
  - Shut-in Testing of Potable and Non-Potable Systems
  - Maintenance of Continuous Monitoring Systems
Design Considerations (cont.)

- Separation Requirements for Reuse Water
  - 9 Feet Horizontal Separation From Parallel Potable Water if Possible, 4 Feet Minimum
  - 3 Feet Vertical Separation From Potable With Reuse Lower
  - Minimum 3 Feet Horizontal Separation From Parallel Wastewater
  - Reuse at or Below Elevation of Wastewater
Fail-Safe Overflow Design
- Auxiliary Water Supplies Within Buildings Must Not Cause Damage!
  - Pressure or Gravity Flows Must Enter Gravity Drains

City Ordinances: No Storm Water in Sanitary Drains, No Sanitary Water in Storm Drains
- Rainfall, Fin H₂O, and Groundwater = Storm Water; Thus, Overflow to Storm Sewer
State Regulation: No Reuse Water in Surface Waters of the State

- Thus, Reuse Water Must Overflow to Sanitary Sewers
- Implication: Irrigation with Reuse Water Must be Controlled with “Smart Controllers” to prevent runoff
  - UT TPDES Permit Should be Modified to Exempt Equipment Failure as a Permit Violation
Think About the Future!

“Best and Highest Use Doctrine”...Different Auxiliary Water Types Have Different Quality and Availability Characteristics

- Rainwater is high in N₂, a limiting plant nutrient- thus, best use is for irrigation
- AC Condensate (Fin H₂O) is very low in conductivity, and naturally cold- thus, highest use is cooling tower makeup
- Reuse Water is wastewater- thus, best and highest use is flushing toilets and urinals; but it’s abundant- can be used for all non-potable needs
Think About the Future!

“Lowest Quality for the Need” Doctrine

- Use Potable Water for Potable Needs Only!
  - Drinking
  - Cooking
  - Bathing

- Use Non-Potable Wherever Possible!
  - Cooling
  - Irrigation
  - Toilet Flushing
  - Parts Washing
  - Dust Control
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