

# This presentation premiered at WaterSmart Innovations

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# Overcoming Barriers to Achieve Condensate Collection Return on Investment

WaterSmart Innovations 2010

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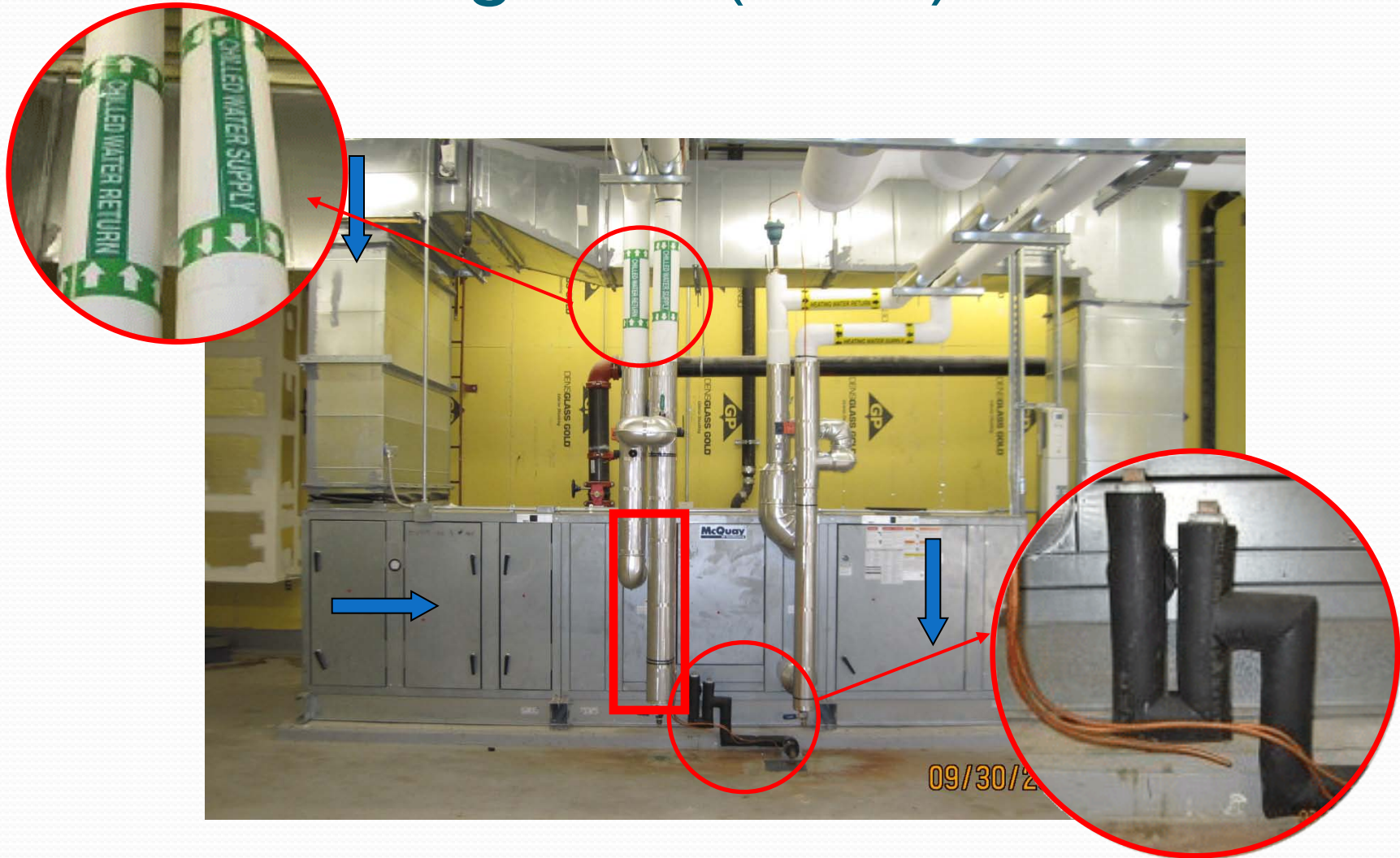
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# Condensate

Water that condenses on a cool surface due to the temperature of the surface being below the point at which moisture in the air forms liquid droplets (i.e. dew point)

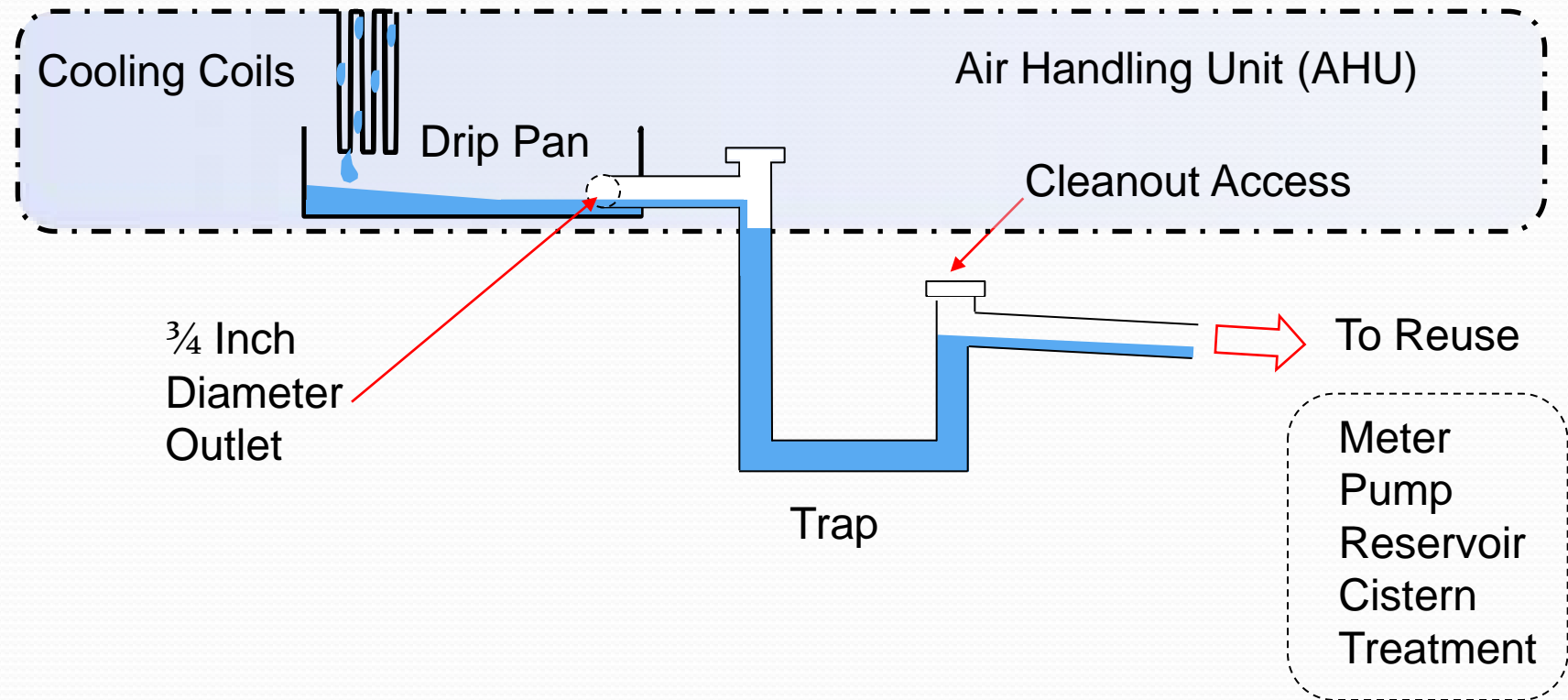


# Air Handling Unit (AHU)



# Condensate System Components

- Depends on location of reuse and condensate rate



# San Antonio Code Sec. 34-274.1

(1) Condensate collection. Newly constructed commercial buildings installing air conditioning systems on and after January 1, 2006, shall have a single and independent condensate wastewater line to collect condensate wastewater to provide for future utilization as:

- a. Process water and cooling tower make-up, and/or
- b. Landscape irrigation water. Condensate wastewater shall not be allowed to drain into a storm sewer, roof drain overflow piping system public way or impervious surface.

(Ord. No. 100322, § 1(Att. A), 1-20-05)

# Administrative Guidance (2008)

- Discharged to sanitary drain if not reused
- Less than 10-tons eligible for exemption
- 1 discharge point, exceptions with approval by PSDS\*
- 1/8-inch minimum slope of condensate lines
- Multi-tenant retail center spaces treated as standalone
- Grandfather clause to repair, replace, relocate existing

\*Planning and Development Services Department  
(Information Bulletin 163, issued 9-17-09)

# Reuse Return on Investment (ROI)

- Economic benefit for building owner
- Reduce burden on central water utility systems
- Water savings, energy savings, CO<sub>2</sub> savings



# Simple ROI Calculation

- ROI in terms of number of years payback
- Does not include water rate increases with time
- Does not include discount rate
- Does not include maintenance costs
- Shared when reuse sources are combined

$$\text{ROI} = \frac{\text{Initial cost} - \text{Avoided cost} - \text{Rebates}}{\text{Annual cost savings}}$$

# Overcoming Barriers to ROI

Anything contributing to reducing costs and increasing benefits

- “Policy”
  - Water rates
  - Codes & standards
  - Incentives
- Education
  - Optimize implementation
  - Operation & maintenance
- Technology advancements
  - Design
  - Equipment

# San Antonio Water System Rebate

- Large-Scale Retrofit Rebate Program
- Commercial, institutional and industrial users
- \$400 per acre-foot water saved over 10 years
- Up to 50% of installed cost
- Install remain in use 10 yrs or life of equipment
- Metered and reported for 5 yrs after install

# Condensate prediction examples

## Instantaneous Calculator<sup>1</sup>

### Condensate Calculator

Outdoor Conditions	Indoor Conditions
70 °F	55 °F
71 % Relative Humidity	40 % Relative Humidity
5.76 gr/ft <sup>3</sup>	1.86 gr/ft <sup>3</sup>
= 3.9 gr/ft <sup>3</sup>	
Tonnage of System	3.5
Outside Air	20 %
Gallons per Minute	0.01
Gallons per Hour	0.49
Gallons per Day	11.79

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## Instantaneous Rule of Thumb (gallons per day)<sup>2</sup>

ton capacity \* load factor \* 4.8

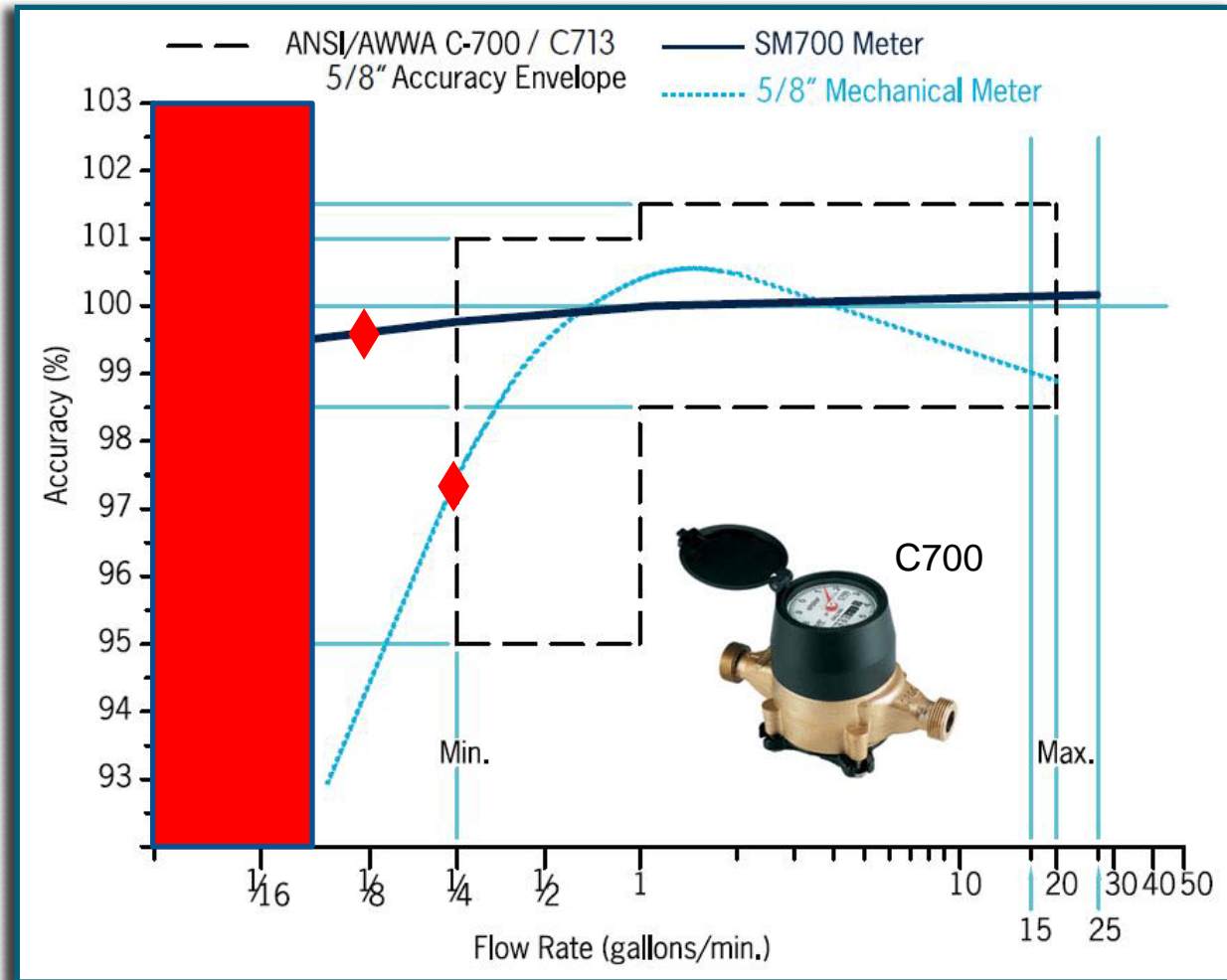
## Monthly Calculator Input<sup>3</sup>

- Ventilation CFM
- Building hours of operation
- % Outside air
- Monthly outdoor conditions

# Oscillating Fluid vs. Mechanical

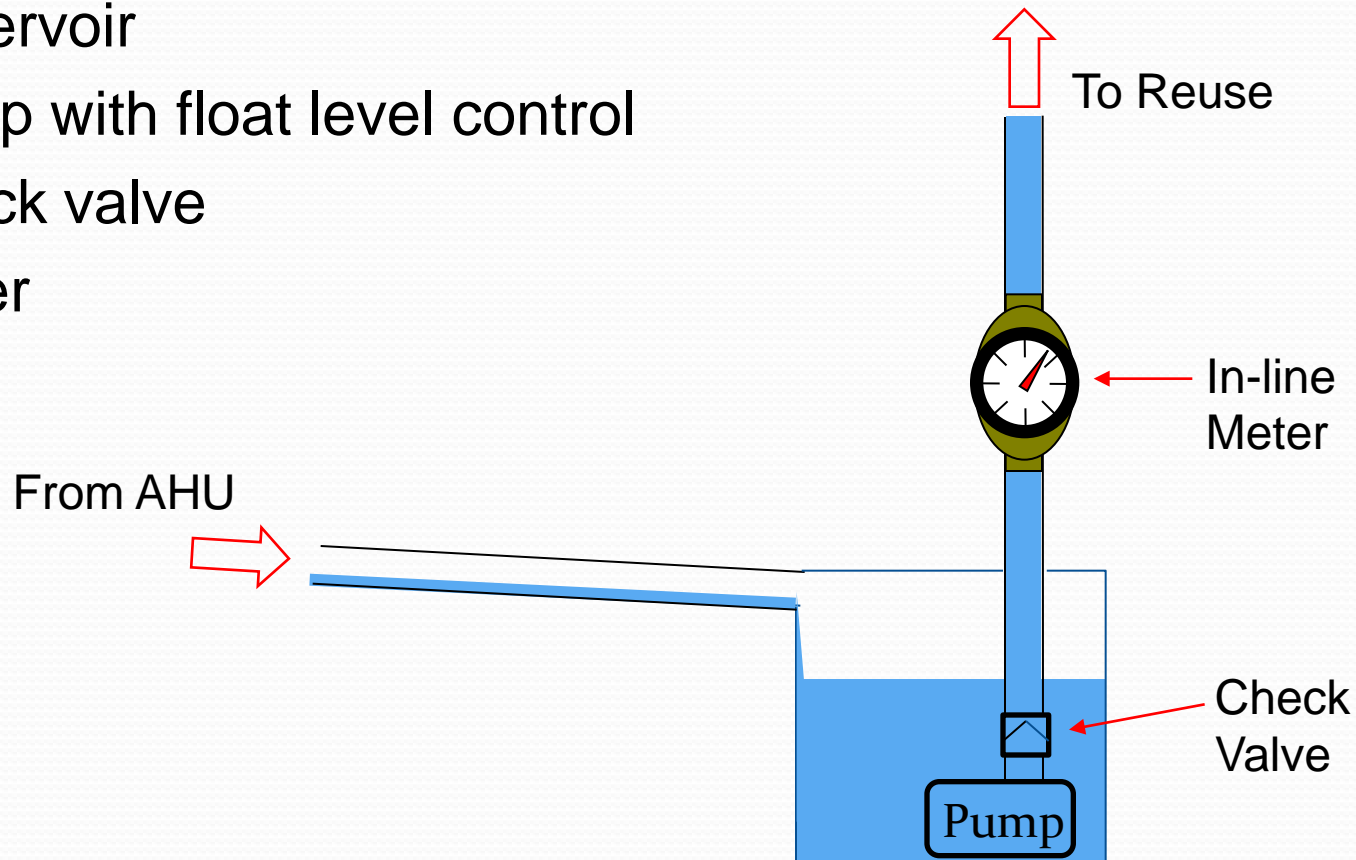


- More accurate
- No moving parts
- Ignores air flow
- Requires 50 microsiemen/cm conductivity
- Electrical noise threshold



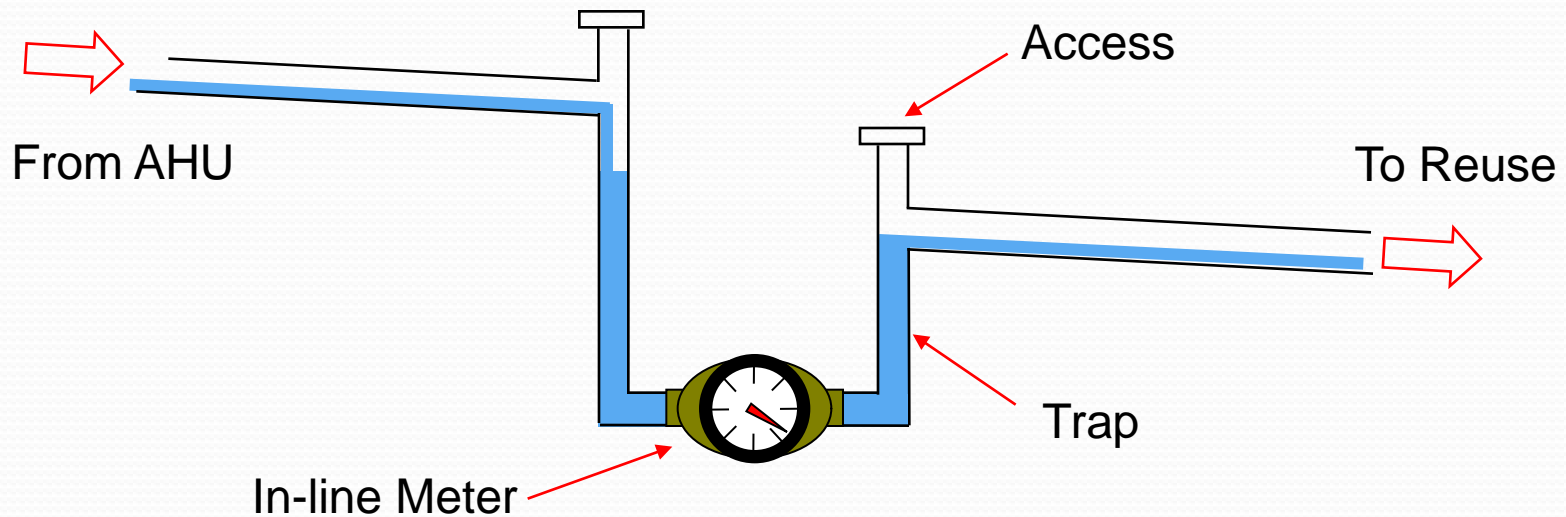
# Low (to high) flow capture

- Reservoir
- Pump with float level control
- Check valve
- Meter



# High flow measurements

- Flow > 1/8 gpm
- Trap design accounts for pressure drop across meter
- Alternative design places meter downstream





# ROI Case Studies



# Drury Plaza Hotel



**Location:** San Antonio, TX

**Building type:** Hotel

**Conditioned space:** 222,157 ft<sup>2</sup>

**Chiller tonnage:** 960 Ton

**Outside air:** it's complicated \*

**Hrs of operation:** 24 hrs -7 days a wk

**Yearly condensate:** 250,000 gallons

**Condensate reuse:** cooling tower

**Retrofit installation:** 2008

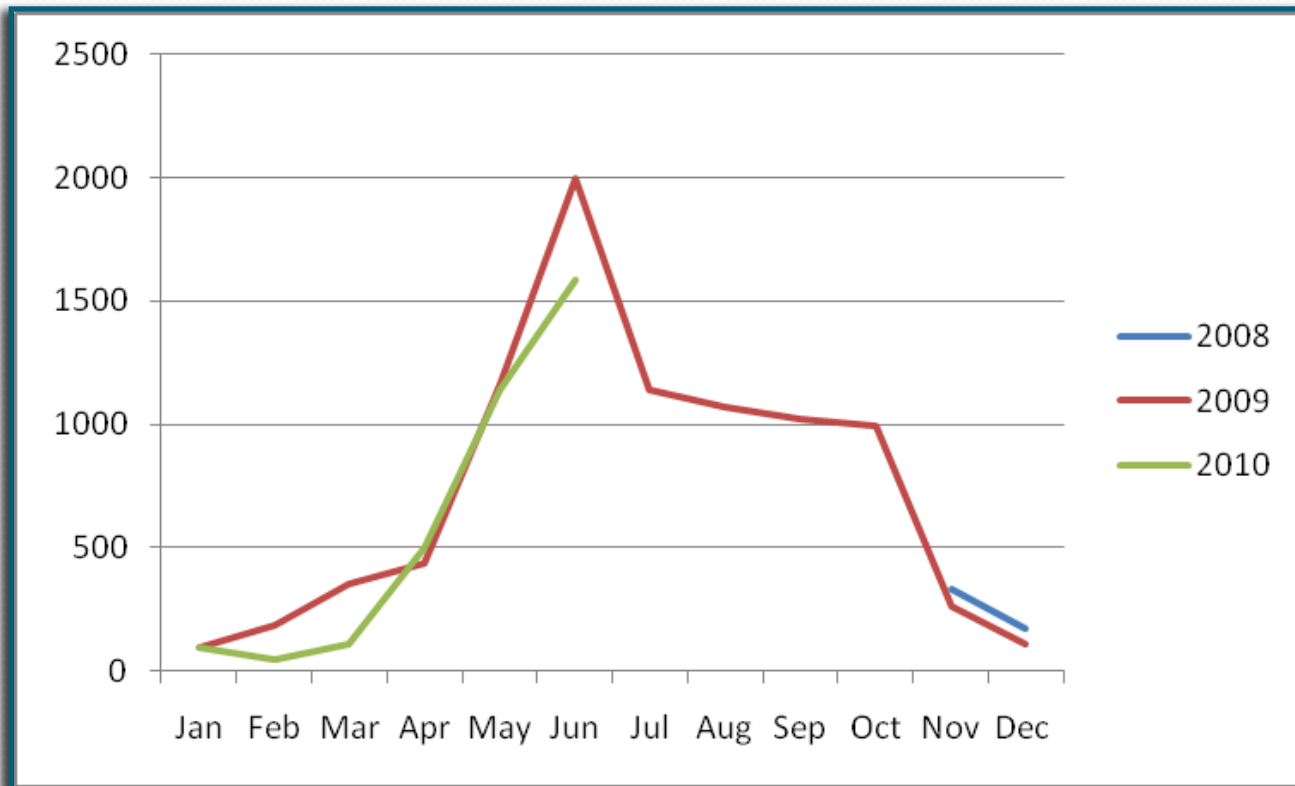
**Condensate champions:**

Greg Mrzlak: Engineer (Drury)

\* Multiple units, some cascading

Cost	Cost Description
\$7.5K	<b>Initial Cost:</b> pipe, pumps, and labor
\$0K	<b>Cost Avoidance:</b> existing building with existing drain line ~\$7.5K
-\$7.5K	<b>SAWS Rebate</b>
\$0K	<b>Net Cost:</b> sum of above
\$1.2K	<b>Annual Water Savings</b>
NA	<b>ROI (6.0 without rebate)</b>
<b>Benefits:</b> Fewer blow-down cycles of cooling tower, reduced chemical requirement	

# Drury Plaza Condensate Data



# Samuel V. Champion HS



**Location:** Boerne, TX

**Building type:** 4A High School

**Conditioned space:** 299,424 ft<sup>2</sup>

**Chiller tonnage:** 773 Gross Tons

**Outside air:** 20-25%

**Hours of operation:** 7am-4pm M-F\*\*\*

**Yearly condensate:** 335,838 gallons

**Condensate reuse:** Irrigate Athletic Fields & Native Landscape Areas

**Storage tank capacity:**

Elevated	13,750 Gallons
The Ranch	15,500 Gallons
Underground	195,000 Gallons
<b>Total</b>	<b>224,250 Gallons</b>

**New Installation:** August 2008

**Condensate Champions:** Jeff Haberstroh (Boerne ISD)

Cost	Cost Description
\$266K	<b>*Initial Cost:</b> Tanks~\$45K; filters, pumps, floats switch gear and labor ~ \$82k; slabs & weir structure~ \$74K; plumbing~ \$65K
\$0K	<b>*Cost Avoidance:</b> existing underground storm sewer, irrigation meter and service, standard gutters ~ \$250K
\$266K	<b>*Net Cost:</b> sum of above
\$55K	<b>*Annual Water Savings:</b> 3.8 million gallons per year rain and condensate**
5 years	<b>*ROI</b>
<b>Benefits:</b> educational opportunity	

\* Includes shared costs with rainwater collection

\*\* Based on National Weather Service normal average rainfall

\*\*\* Does not include after hours events & outside rentals

# Eagle Veterinary Hospital



**Location:** San Antonio, TX

**Building type:** Veterinary Hospital

**Conditioned space:** 10,600 ft<sup>2</sup>

**Chiller tonnage:** 56.5 Tons

**Outside air:** 100%

**Hrs of operation:** M,T,R,F 8-5:30 &  
W,S 8-12

**Yearly condensate:** 49,158 gallons\*

**Condensate reuse:** dog wash, toilets,  
irrigation

**Storage tank capacity:** 9,300 gallons

**New construction:** Nov 2010

**Condensate champion:**

Cesar Garcia: Designer (Mdn)

Cost	Cost Description
\$103K	<b>*Initial Cost:</b> tanks, filters, pumps, floats switch gear and labor ~ \$71k, slab for tanks and overflow plumbing ~ \$32K
-\$58K	<b>*Cost Avoidance:</b> increased service pipes from 1" to 1 ½ ", underground storm sewer, irrigation meter and service, standard gutters
-\$5K	<b>*SAWS Rebate</b>
\$40K	<b>*Net Cost:</b> sum of above
\$810	<b>*Annual Water Savings:</b> 162,299 total reclaimed**
49	<b>*ROI</b>
<b>Benefits:</b> LEED credits, educational	

\*Includes shared costs with rainwater collection

\*\* Based on National Weather Service averages

# Munters



**Location:** Selma, TX

**Conditioned space:** 5,000 ft<sup>2</sup>

**Chiller tonnage:** 30 tons with dehumidification

**Supply air:** 12,000 CFM; 1,000 Outside Air

**Nominal load factor:** 25 Office Staff

**Hours of operation:** 7am-6 pm M-F

**Yearly condensate:** 56,575 gallons\*

**Condensate reuse:** Potable drinking water

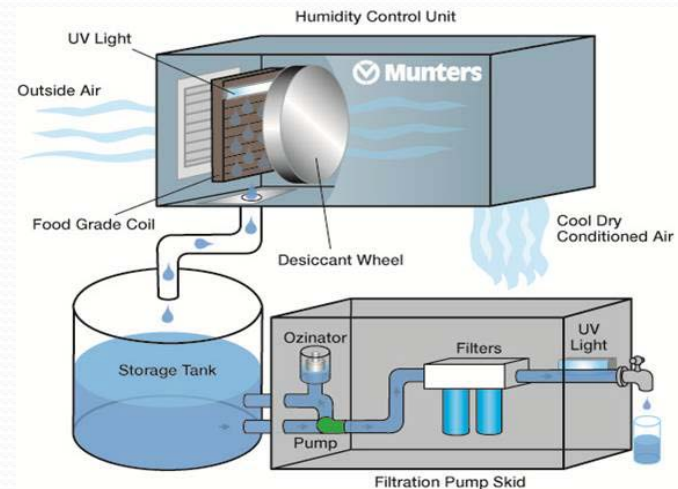
**Storage tank capacity:** 350 gallons

**Retrofit system:** June 2010

**Condensate Champion:** Larry Klekar

\*Based on 85° F & 70% RH 50% of the year

Cost	Cost Description
\$36K	<b>Initial Cost:</b> 30 ton air conditioning unit=\$31k, storage tank= \$1k, filtration pump skid= \$4k
\$5K	<b>Net Cost of Water Making Equipment</b>
\$565	<b>Annual Water Savings</b>
8.8 yrs	<b>ROI:</b> Test unit installed to prove concept
<b>Benefits:</b> Proof of concept. Pure drinking water for employees supplied to water dispensers, coffee pots, and ice machines.	



# Condensate properties

- Distilled (pure) water
- Low conductivity
- Slightly acidic
  - pH 4-6
  - Reacts with metal to suspend metal ions in water
- Exposed to any contaminants along path

# San Antonio Code Sec. 34-18

- Sec. 34-18. - Analyses of drinking water required.
- any water supply in the city
  - domestic purposes to fifty (50) or more people
    - at least one (1) sanitary analysis ,or sample, each week
    - Submit to the city public health department
  - Domestic purposes greater than one thousand (1,000)
    - at least (1) additional analysis each month for each 1000
  - Domestic purposes for populations in excess of (100,000)
    - number of supplies shall be in accordance with the standards adopted in this section.
- (Code 1950, § 62-2; Code 1959, § 41-2)

# Choose optimal applications

- Cooling tower is common #1 choice
  - No storage cistern required
  - No overflow
  - Results in fewer tower blow-down cycles
  - Existing chemical treatment



# Choose optimal applications (cont.)

- Other uses based on balance between trade-offs
  - Size of storage cistern required – cost and space
  - drain pipe length and location – cost and space
  - Predicted overflow (down sanitary drain) – waste
  - Required water treatment(s)
  - Required maintenance
  - E.g., other uses: lavatories, irrigation, process water, fountains

# Effective and Robust Design

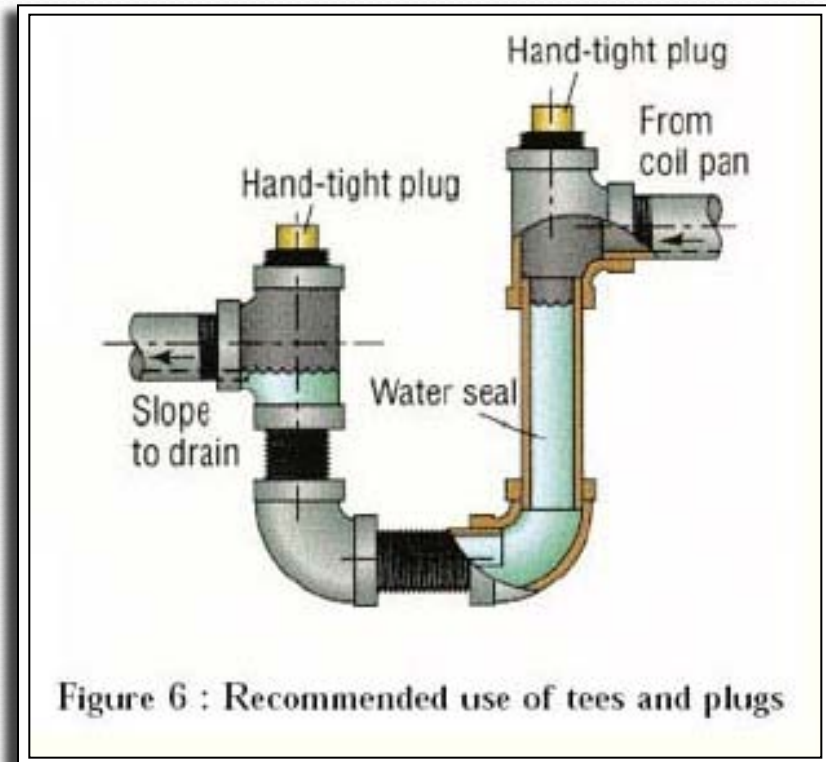
- Proper materials
- Trap
- Proper meter
- Proper slope of condensate lines
- Minimal stagnation points
- Access ports

# Proper Maintenance

- Scheduled inspections
- Add biocide, pH buffer, or alternatives if needed
- Prime traps
- Flush condensate lines
- Check for leaks
- Calibrate meters if needed
- Ensure no water backs up into drip pan

# Traps

- Isolates air handling unit
- Minimizes pipe wet time
- Maintenance access point
- Trap configurations
  - Draw-thru trap
  - Blow-thru trap
- Leverage for meter location
  - Must account for pressure drop across meter



# Future Improved ROI

- Code changes
- Expand applications for reuse
- Leverage “pure” water characteristics of condensate
- Storage cistern innovations
- Advances in water treatment
- Advances in maintenance technology & practices

# Condensate User Manual

- In progress
- Design through maintenance
- In collaboration with San Antonio Water System (SAWS)
- Will be public domain
- Data & best practices contributions welcome
- Send contributions to [dglawe@trinity.edu](mailto:dglawe@trinity.edu)

# Questions

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