This presentation premiered at WaterSmart Innovations

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Overcoming Condensate Collection and Use Challenges

WaterSmart Innovations 2012

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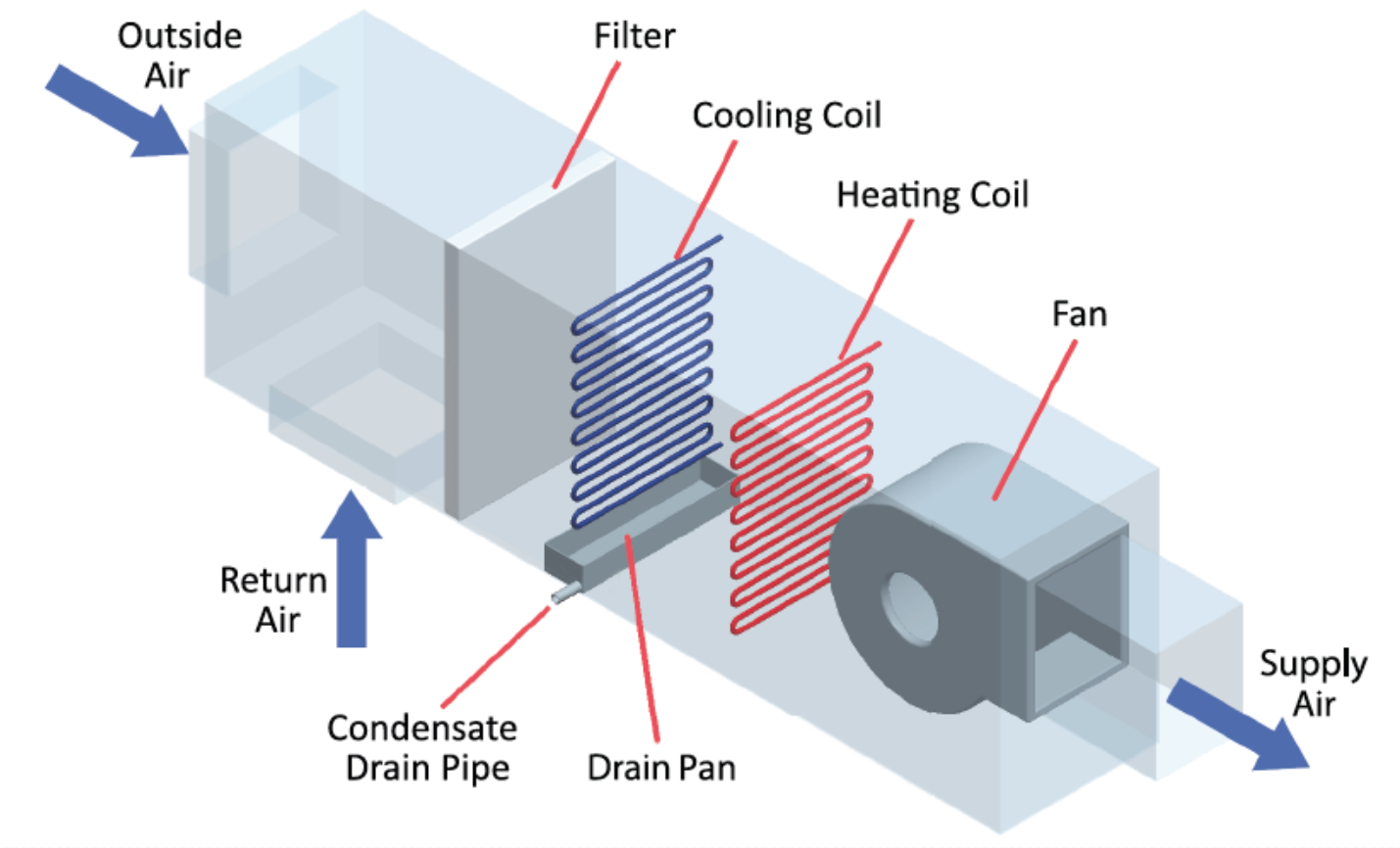
SAN ANTONIO • 1869

Condensate

Water that collects on a cool surface because the temperature of the surface is below the point at which moisture in the air forms liquid droplets (i.e. dew point)

Air Handling Unit (AHU)

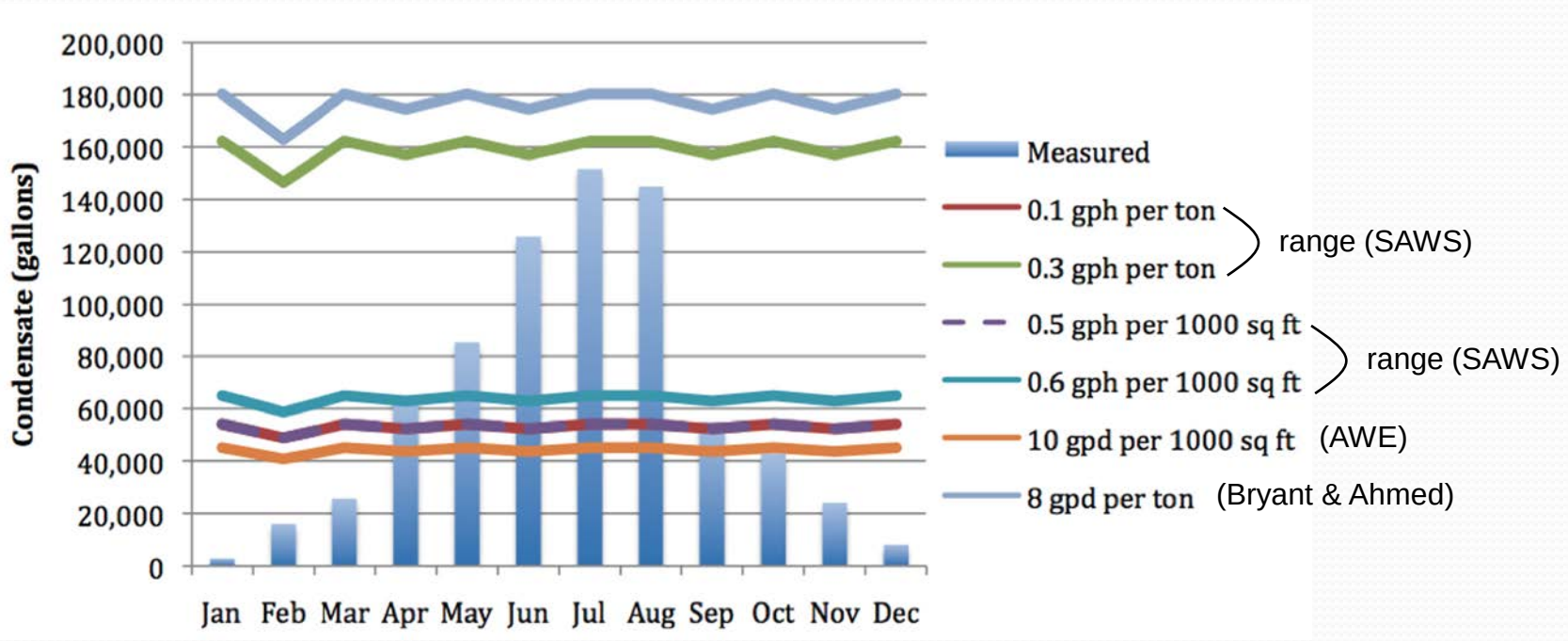


(Source: *San Antonio Condensate Collection and Use Manual for Commercial Buildings. Pending publication*)

How Much Condensate?

How Much Condensate?

Example: 154,440 sq ft (727 ton) applied engineering and technology building measured condensate with predictions (747,290 gallons/yr)



(Source: *San Antonio Condensate Collection and Use Manual for Commercial Buildings. Pending publication*)

Condensate Water Quality?

- Slightly acidic
- Theoretically pure water
- Contaminants
  - Whatever is picked up along the flow path
  - Elements
  - Microbes
  - Particulate

Benefits of Reclaimed Condensate

- Economic benefit for building owner
- Reduce burden on central water utility systems
- Water savings, energy savings, CO_2 savings

Key Challenges of Reclaimed Condensate

- Initial investment/payback period
- Achieving an effective design
- Operations and maintenance

Payback Period Equation

$$Payback\ period = \frac{Incremental\ investment}{Annual\ savings}$$

- Incremental investment = initial cost – mandatory costs – rebates & incentives
- Annual savings
  - Scheduled water rate increases shorten period
  - High discount rate of borrowing capital lengthens payback
  - Green finance programs could reduce financial burden

Payback Period – Application

- Cooling tower make-up water is typically BEST application
  - Low initial cost
  - Easy implementation
  - Cool and pure water a plus
  - Low maintenance

Example: Building producing 224,511 gallons per year. Cost to install retrofit system for cooling tower makeup water was $2,272 materials (pipes and pumps) plus $750 labor. SAWS rebate 50%. Incremental investment $1,511. Payback period 16 months. No water treatment beyond that already existing for cooling tower water. No overflow and no storage requirements. Maintain air seal and pump (if applicable).

(Source: *San Antonio Condensate Collection and Use Manual for Commercial Buildings. Pending publication*)

Payback Period - Applications

- Other applications include
  - Irrigation
  - Water features
  - Toilet flushing
  - Car washing
  - Process water
  - Trap primers
  - Drinking water – ONLY with specialized system and ONLY if permitted in jurisdiction

(Source: *San Antonio Condensate Collection and Use Manual for Commercial Buildings. Pending publication*)

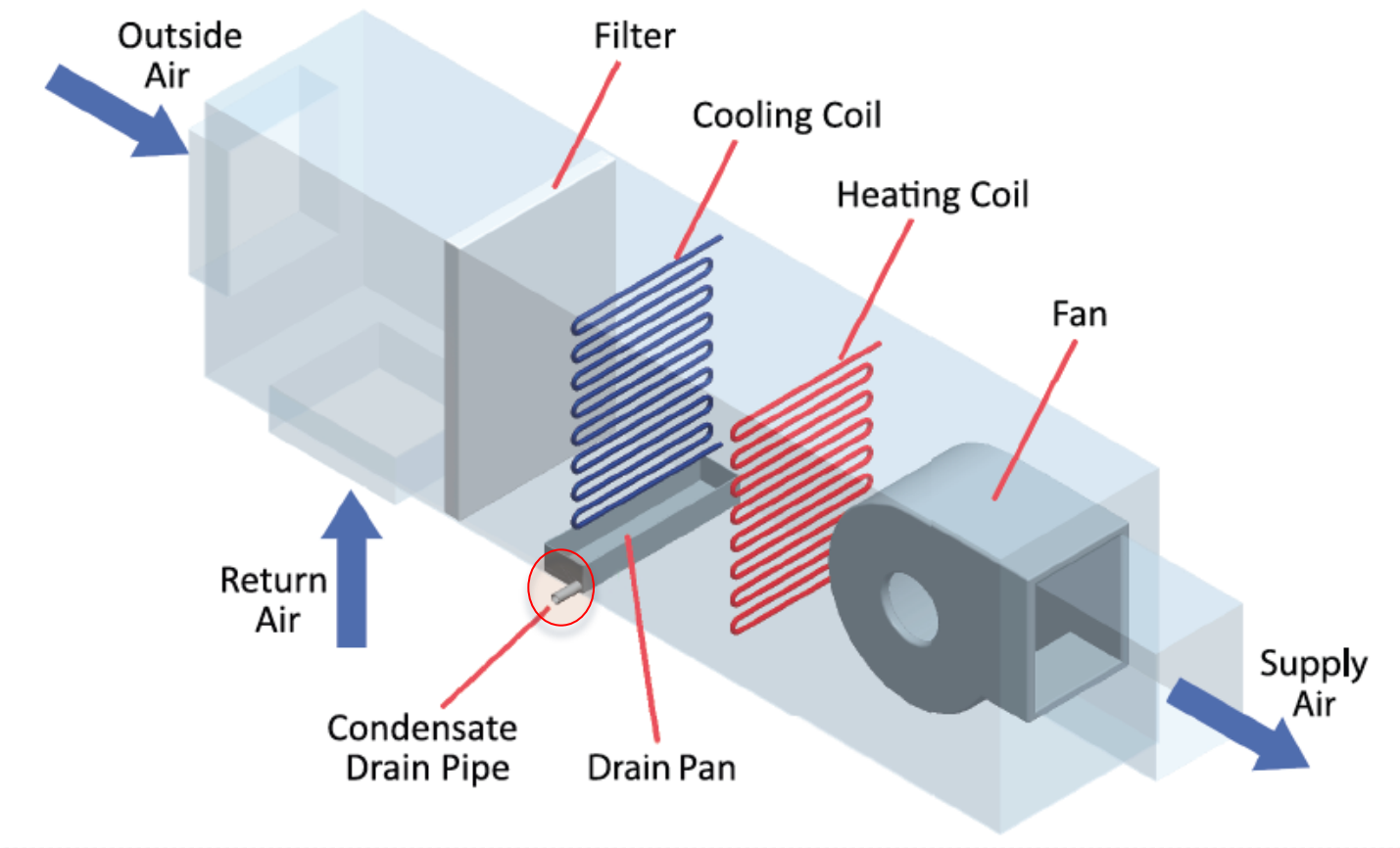
Other Priorities - Applications

- Other priorities and related payback
  - Bypass drought restrictions
  - Environmental stewardship

Example: Based on analysis of energy that City Public Services (CPS) must provide to support San Antonio Water System (SAWS) operation. A building reclaiming one million gallons of water for use on-site saves the City of San Antonio 4141 kWh/yr and reduces carbon emissions by 2.84 metric tons per year.

(Source: *San Antonio Condensate Collection and Use Manual for Commercial Buildings. Pending publication*)

Effective Design – Drain Line Air Seal



(Source: *San Antonio Condensate Collection and Use Manual for Commercial Buildings. Pending publication*)

Air Seals : Standard P-trap

- Isolates air handling unit
- Minimizes pipe wet time
- Maintenance access point
- Trap configurations
  - Draw-thru trap
  - Blow-thru trap
- Standard traps incur
  - High maintenance
  - High failure rate

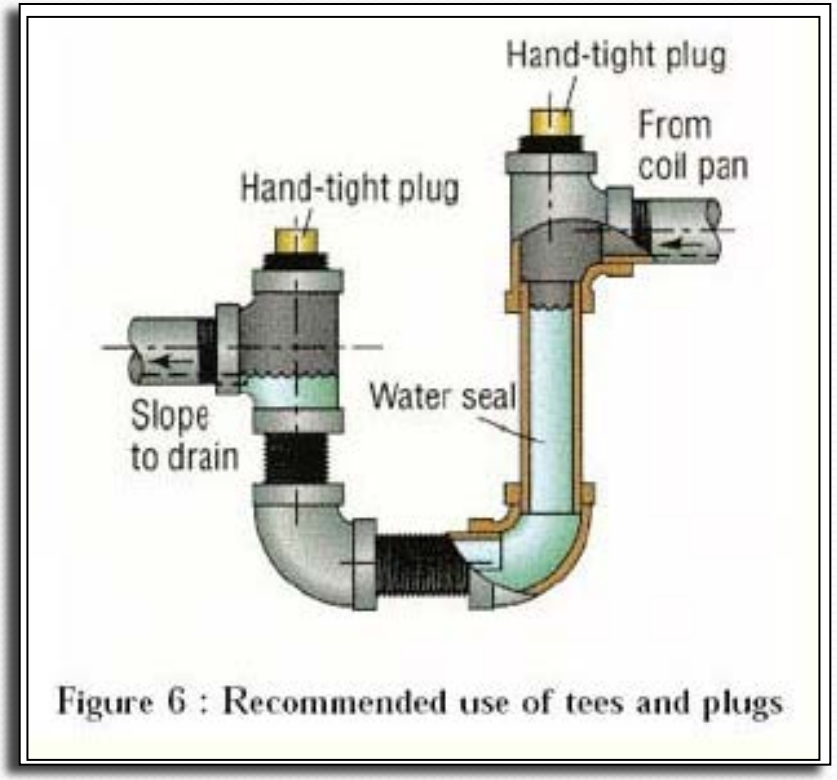
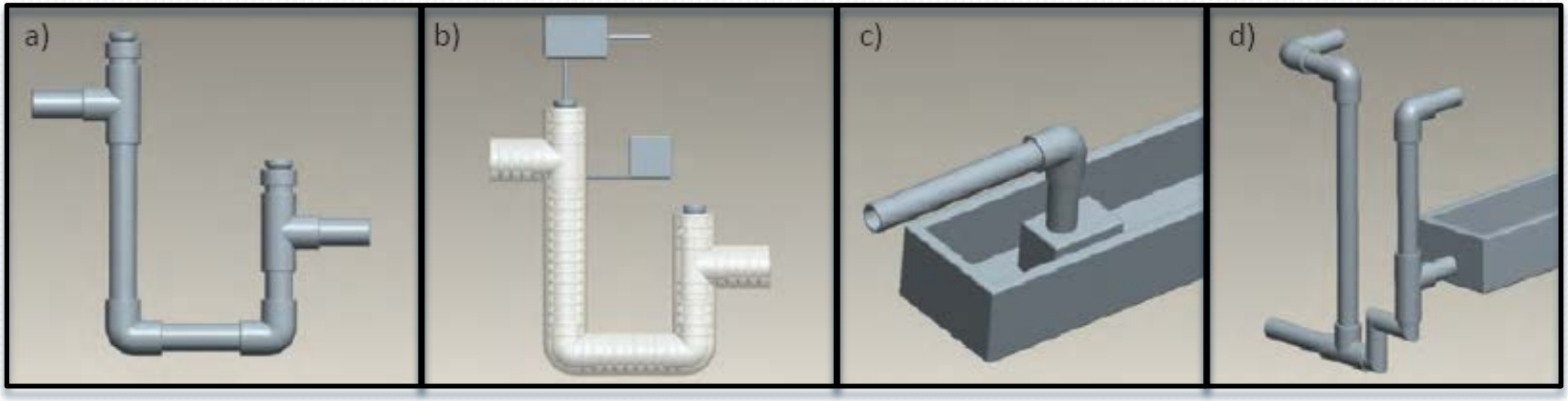


Figure 6 : Recommended use of tees and plugs

(Source: Brusha, Ronald F. “Condensate Traps for Cooling Coils.” HPAC Engineering, Oct 2001)

Alternatives to Standard P-trap

P-trap | P-trap with additions | Condensate pump in drain pan | Pneumatic air seal

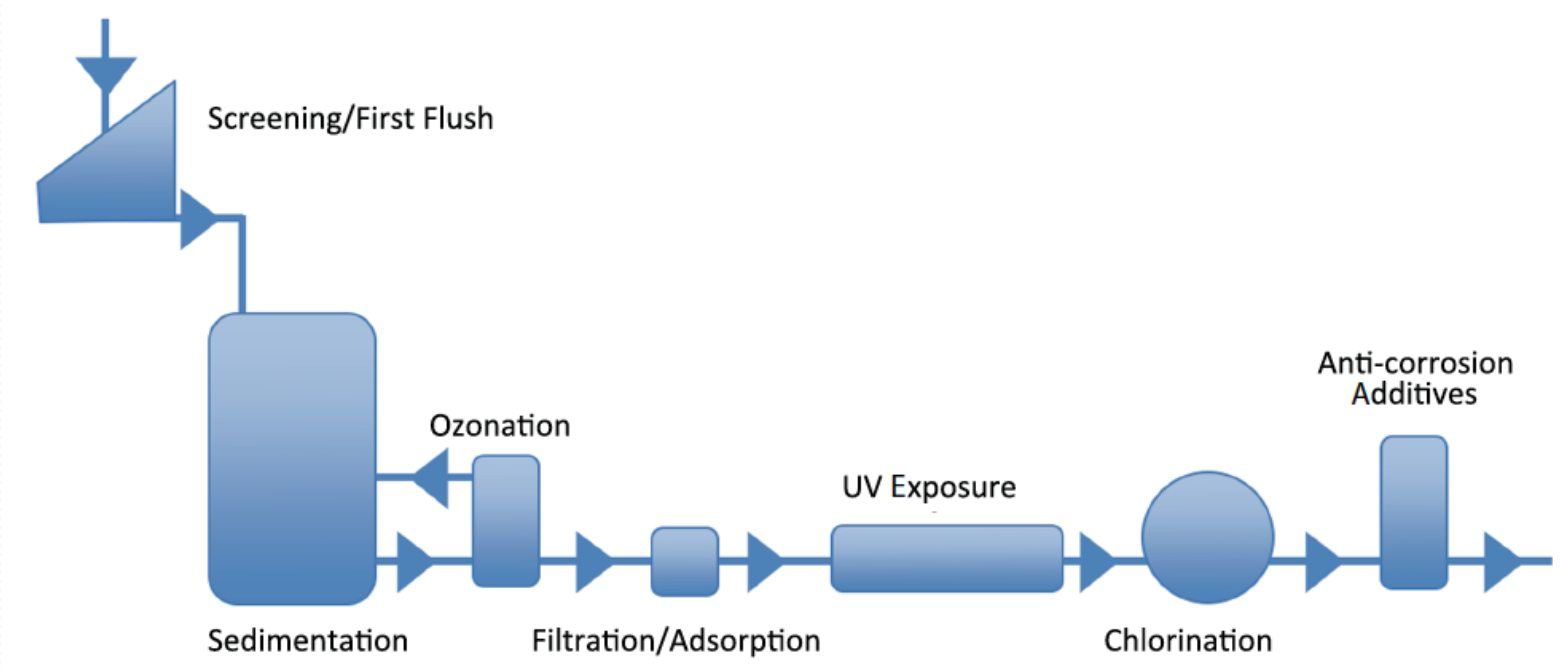


- Auxiliary (backup) drainage system and/or warning alarm recommended for all air seal designs

(Source: *San Antonio Condensate Collection and Use Manual for Commercial Buildings. Pending publication*)

Effective Design – Treatment Train

- Depends on reclaimed water source(s)
- Depends on reclaimed water application



(Source: Adapted from Mechell et. al, *Rainwater Harvesting: System Planning.* 2010)

Effective Design - Optimization

- Match application to water quantity
  - Predict quantity
  - Storage tank sizes to provide 50% water demand per annum (SAWS)
  - Consider commingling other reclaimed water sources
- Consider treatment requirements
  - Treatment train options
  - Monitoring and reporting requirements
- Consider operation and maintenance

Effective Design – Automated Monitoring

- Drip pan overflow alarm
- Condensate meter data collection
- Make-up water meter data collection
- Water quality sensors in treatment train
- Make it difficult for system failures to go unnoticed

Operation and Maintenance -Scheduled Maintenance Program

- Start with commissioning during installation!
- Document operating procedures – checklist
- AHU: air filter, cooling coils, drain pan
- Drain seal
- Piping, pumps, and valves
- Storage Tank: overflow and makeup water control
- Backflow valve inspection (required annually by city code)
- Water treatment filters, lamps, etc.
- Water quality tests

Overcome Challenges - Continued

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

Codes and Standards (jurisdiction - city, state, federal policy)

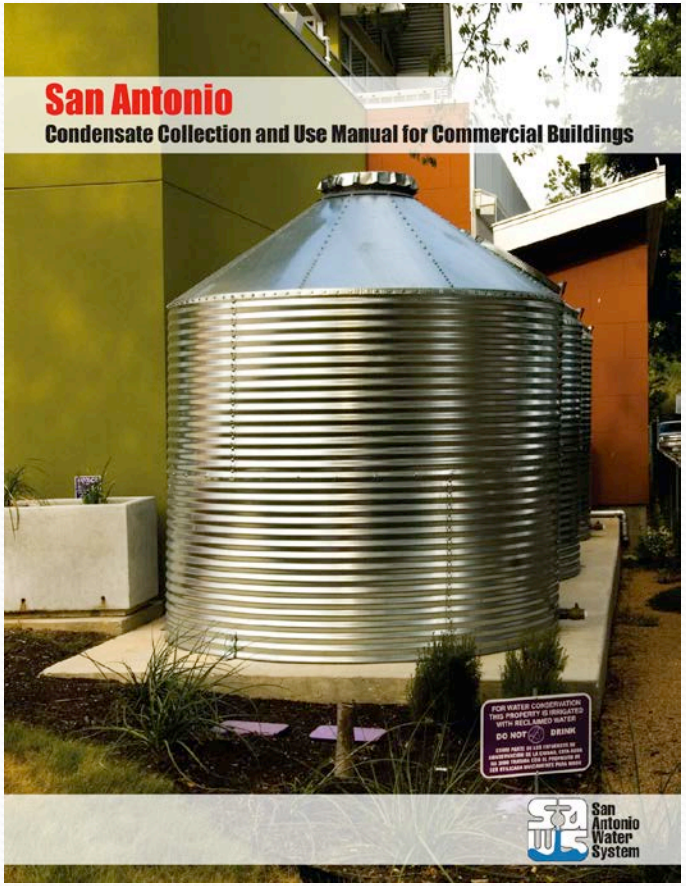
- San Antonio City Code 34-274.1
  - Information bulletin 163
  - Single condensate discharge point
  - Discharged to sanitary drain if not used
- Adopt national/international codes and standards
  - International Green Construction Code
  - ASHRAE Standard 189.1
  - Green Plumbing and Mechanical Code Supplement

Water Rates & Incentives (water provider policy)

- Increasing water rates make reclaiming water attractive
- San Antonio Water System (SAWS) rebates for commercial, institutional, and industrial users
  - $400 per acre-foot water saved over 10 years
  - Up to 50% of installed cost
- Fee avoidance (incidental)
- Free meter in support of metering program

Condensate User Manual (addressing the educational aspect)

- In collaboration with San Antonio Water System (SAWS)
- Design through maintenance
- Public domain
- Currently in “Proof Copy” for review
- Feedback requested by end of October



Quality & Quantity Research at Trinity (addressing the technology aspect)

Funded by Associated Colleges of the South Grant*

- ELEMENTS
- MICROBES
- CHARACTERISTICS

- MICROSOFT ACCESS DATABASE (prediction models)
- GRAVITY DRIVEN PD METER TESTS

Collaboration with SAWS

- METER PILOT PROGRAM (feeds DATABASE)

*Faculty: D. Glawe (ENGR), F. Healy (BIO), M. Bushey (CHEM)
Students: J. Erdman, C. Edge, E. Jayamanne (ENGR) H. Duong (CSCI) *Class* (CHEM)

Quantity Data

MICROSOFT ACCESS DATABASE (prediction models)

GRAVITY-DRIVEN PD METER TESTS

Accuracy?

Automated Data

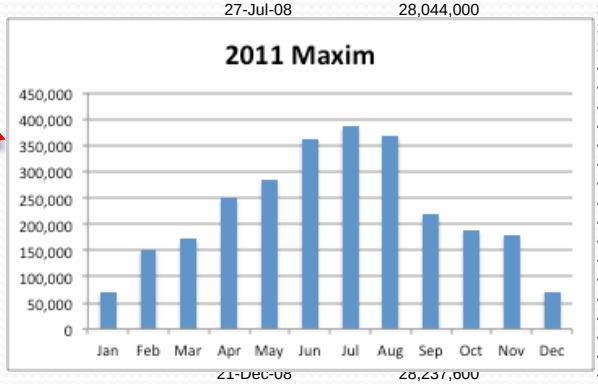
METER PILOT PROGRAM (feeds DATABASE)

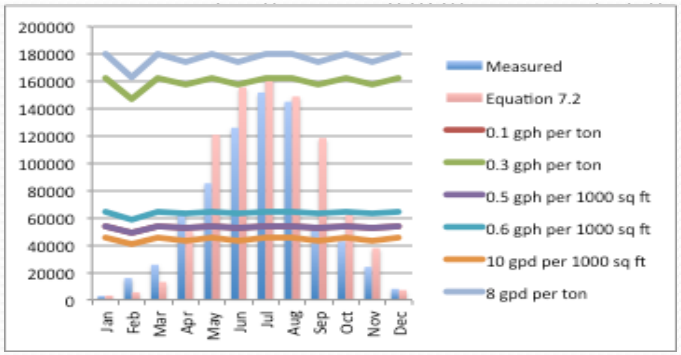
Data

Report

Prediction Model

Date	Basin 1	Basin 2	Basin 3	Basin 4
8-Jun-08		27,829,600		33,101,500
15-Jun-08		27,869,200		33,908,100
22-Jun-08		27,910,500		34,711,800
29-Jun-08		27,935,000		35,428,700
7-Jul-08		27,942,300		35,961,800
13-Jul-08		27,966,300		36,549,300
20-Jul-08		28,003,700		37,265,700
27-Jul-08		28,044,000		37,937,600
				38,648,900
				39,503,400
				40,179,300
				41,239,200
				41,895,000
				42,570,500
				43,434,000
				43,975,600
				44,453,700
				44,883,000
				45,217,100
				45,600,100
				45,987,700
				46,308,600
				46,552,800
				46,867,100
				47,080,100
				47,313,200
21-Dec-08		28,237,600		47,600,500
28-Dec-08		28,237,600		47,896,500
4-Jan-09		28,237,600		48,106,300
11-Jan-09		28,237,600		48,431,500
18-Jan-09		28,237,600		48,686,300
25-Jan-09		28,237,600		49,032,500
1-Feb-09		28,237,600		49,131,900
8-Feb-09		28,237,600		49,154,300
15-Feb-09		28,237,600		49,363,300
22-Feb-09		28,237,600		49,635,600
1-Mar-09		28,664,800		49,688,100





Questions

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