

# Water Quality Assessment of AC Condensate for Onsite Collection and Use

Michael Jahne<sup>1</sup>, Dawn King<sup>1</sup>, Kasey Kovalcik<sup>1</sup>, Maura Donohue<sup>1</sup>, Stacy Pfaller<sup>1</sup>, Kate Helmick<sup>2</sup>, Greg Eades<sup>1</sup>, Matt Pait<sup>3</sup>, Michael Nye<sup>1</sup>, Sean Thimons<sup>2</sup>, Jay Garland<sup>1</sup>, Site Collaborators<sup>4</sup>

<sup>1</sup>Office of Research and Development; <sup>2</sup>Oak Ridge Institute for Science and Education; <sup>3</sup>Office of Administration and Resources Management, U.S. Environmental Protection Agency

<sup>4</sup>Purdue University: David Warsinger, Andrew Freeman, Andrew Fix; Rice University: Hugh Ton-That, Ian Housman, Keaton Kinstley; CSS/Space Life Sciences Laboratory: Holly Loesel, Carol Ann Taylor, Johnny Burrows

Contact: Michael Jahne | [jahne.michael@epa.gov](mailto:jahne.michael@epa.gov) | 513-487-2354

## Why Collect AC Condensate?

- Significant quantities of high-quality water produced
  - Estimated 3-10 gpd per 1000 ft<sup>2</sup> cooled space
  - Forms as essentially distilled water
  - Low TDS ideal for cooling tower applications
- Climate conditions that drive AC use correlate with water scarcity (e.g., southern U.S.)
  - Peak production during peak demand
- Water and energy conservation potential through on-site collection and use
  - Reduced potable demand and wastewater load
  - Associated economic and environmental benefits

## Condensate Quality – Safe for Use?

- Potential concerns:
  - Microbes: *Legionella* and *Mycobacterium* spp.
  - Chemistry: metals leached from components
- Initial study at EPA-RTP (NC) campus
  - Condensate use for cooling towers and green roof irrigation
  - 40 samples across 4 systems; outdoor air/return
  - Additional 36 biofilm samples from coils, pipes, and drains
- Expanded under WRAP Action 4.5
  - 3 additional locations in FL, TX, and IN
  - 42 samples across 9 systems; outdoor air/return
  - Various levels of reuse (current, planned, none)

## Preliminary Results: Microbiology

Figure 1. Heterotrophic Plate Counts (HPC)

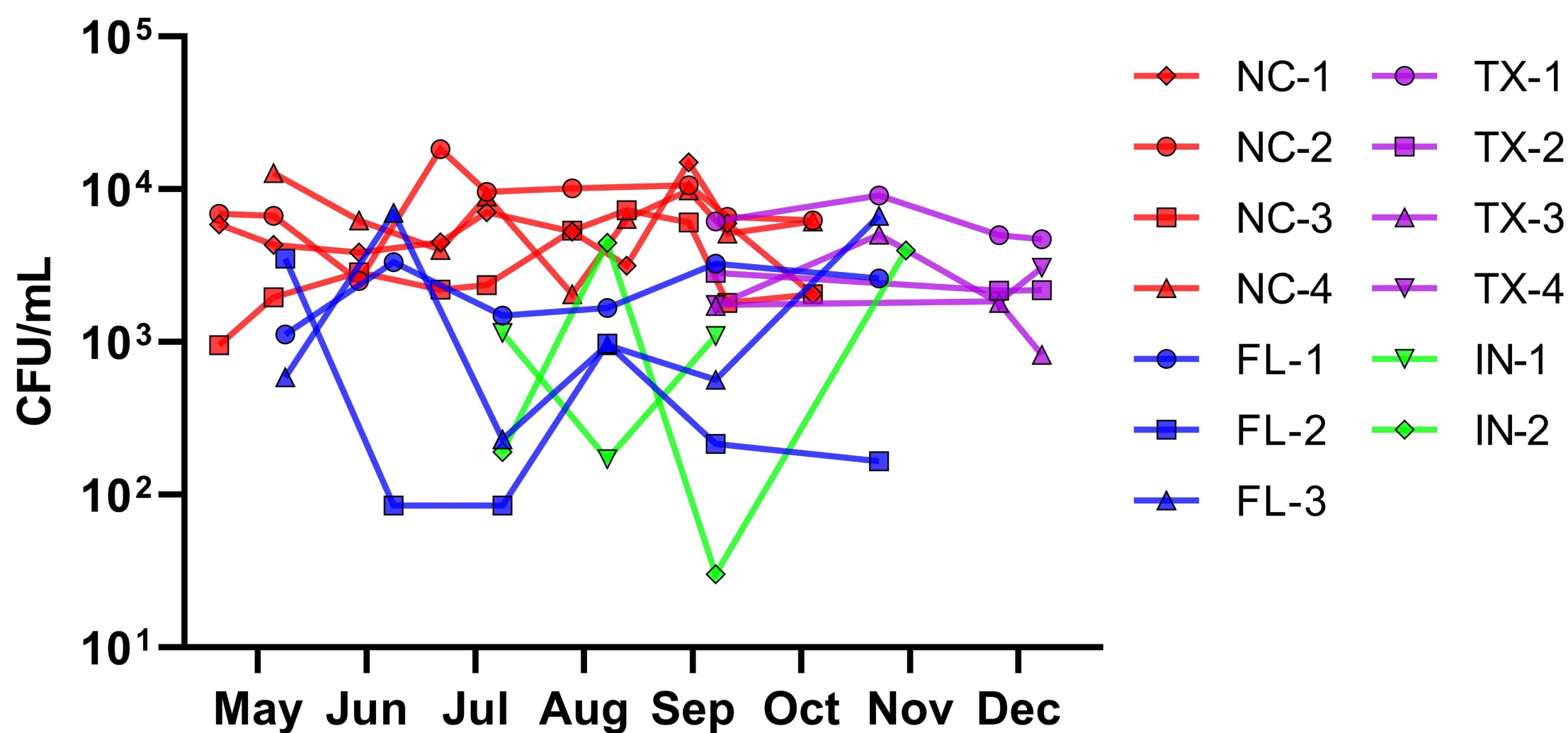


Figure 2. *L. pneumophila* Culture (Legiolert)

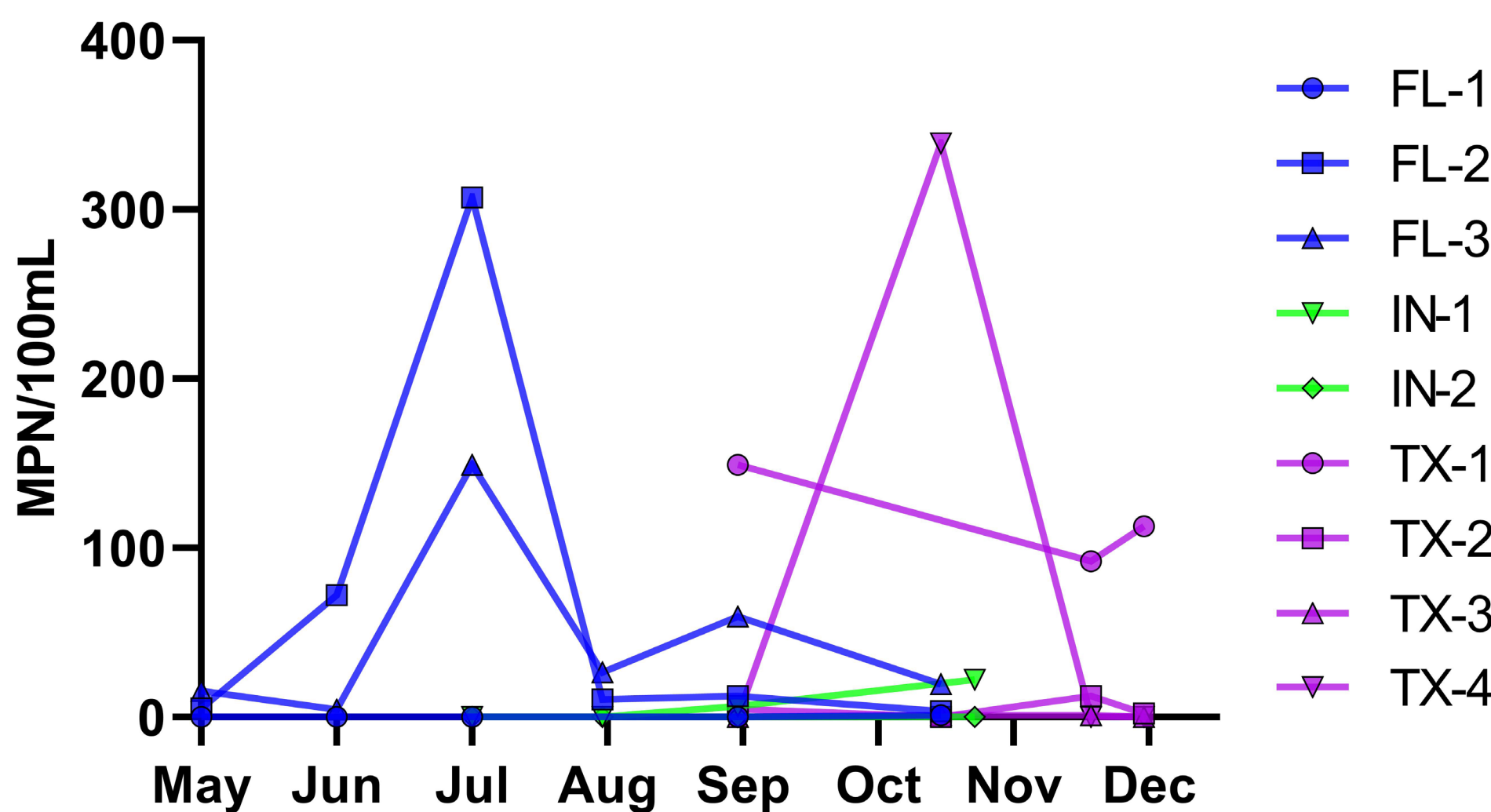


Figure 3. Collection Site Photos



Figure 4. Opportunistic Pathogens (qPCR)

	<i>L. pneumophila</i> serogroup 1		<i>Mycobacterium avium</i>		<i>Mycobacterium intracellulare</i>	
	Detection	gc/L	Detection	gc/L	Detection	gc/L
FL-1	0/6	-	0/6	-	0/6	-
FL-2	1/6	BLQ	0/6	-	0/6	-
FL-3	1/6	BLQ	0/6	-	0/6	-
IN-1	0/4	-	0/4	-	3/4	BLQ to 400
IN-2	0/4	-	0/4	-	3/4	BLQ to 3900
TX-1	0/4	-	0/4	-	0/4	-
TX-2	0/4	-	0/4	-	0/4	-
TX-3	0/4	-	0/4	-	0/4	-
TX-4	0/4	-	0/4	-	0/4	-
NC-1	0/10	-	1/10	200	0/10	-
NC-2	0/10	-	0/10	-	0/10	-
NC-3	1/10	BLQ	0/10	-	0/10	-
NC-4	0/9	-	0/9	-	3/9	BLQ to 1000
NC-1 BF	0/10	-	0/10	-	0/10	-
NC-2 BF	0/6	-	0/6	-	0/6	-
NC-3 BF	0/10	-	0/10	-	0/10	-
NC-4 BF	1/10	BLQ	0/10	-	2/10	BLQ to 100

## Preliminary Results: Metals and Major Ions

- Trace metal analyses of 50 elements by High Resolution ICP-MS
- Major soluble anions (fluoride, chloride, bromide, nitrate, nitrite, sulfate, and phosphate) by ion chromatography
- Rare Cu and Pb detections near or above drinking water MCLs
  - From TX location only; all other samples notably lower
  - Cu: 1/4 samples from oldest building and 2/4 from its receiving plant
  - Pb: 3/4 samples from oldest building, increasing over time to 7X MCL
  - Known copper piping with likely lead solder given age of construction
- Low levels of scale compounds (Ca, Fe, Sr, Ba, sulfate)
  - Elevated in one TX sample only that also contained yellow particulate
  - Unique characteristic: enthalpy wheel
  - Live oak or cedar pollen bypassing air filter?

## Best Management Practices for Reuse

- Data indicate potential for opportunistic pathogens in AC condensate
  - Cooling towers known source of legionellosis outbreaks
  - OSHA guideline *Legionella* spp. <10 CFU/mL
- Disinfection of collected condensate is important to maintain quality
  - 0.2 mg/L free chlorine residual at point of use
  - Biocides already included in cooling tower makeup
- Care and maintenance of air handling units and reuse systems
  - Routine cleaning of collection surfaces and drainpipes
  - Management of storage and distribution processes
  - Appropriate plumbing materials and corrosion control
- Bottom line: Same requirements for all building water systems, regardless of source – potable or non-potable

*The views expressed in this poster are those of the authors and do not necessarily reflect the views or policies of the U.S. Environmental Protection Agency. Any mention of trade names, manufacturers or products does not imply an endorsement by the United States Government or the U.S. Environmental Protection Agency. This presentation contains preliminary findings and conclusions subject to revision following EPA's quality assurance review.*