Water Reuse for Data Centers

Hosted by ACWA and EPA

National Water Reuse Action Plan

WRAP

EPA

Welcoming Remarks

- 2026 WateReuse Symposium
  - Save the date: March 8–11, 2026
  - Los Angeles, California
- State Regulator Summit
  - Last day of symposium: **March 11, 2026**
- Materials from previous webinar on DPR and crediting
  - Available on ACWA website

Ward Scott,
ACWA

Introduction and Meeting Agenda

- Part I. Introduction to Data Center Sector (50-60 minutes)
  - **Data center landscape:** *Sargon de Jesus, U.S. EPA*
  - **Regulatory landscape for cooling:** *Sharon Nappier, U.S. EPA*
  - **Perspectives from industry:** *Usman Khan, AWS; Diana Rodriguez, AWS*
  - **Legionella and cooling technology:** *Mark LeChevallier, Dr. Water Consulting*
  - **Perspectives from utilities:** *Kendra Sveum, Loudoun Water*
  - *Discussion session*

Sargon de Jesus,
U.S. EPA

Sharon Nappier,
U.S. EPA

Usman Khan
AWS

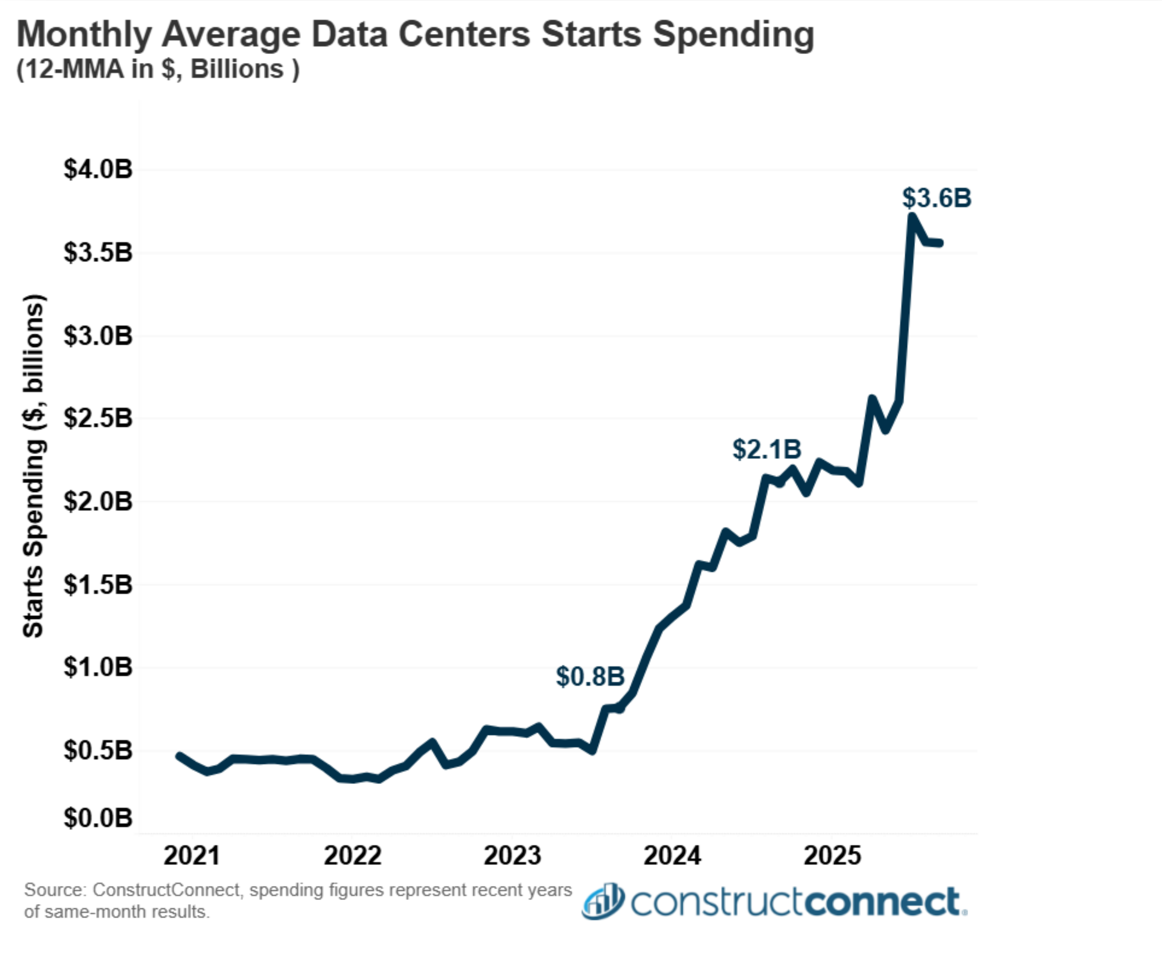
Diana Rodriguez,
AWS

Mark LeChevallier
Dr. Water Consulting

Kendra Sveum,
Loudoun Water

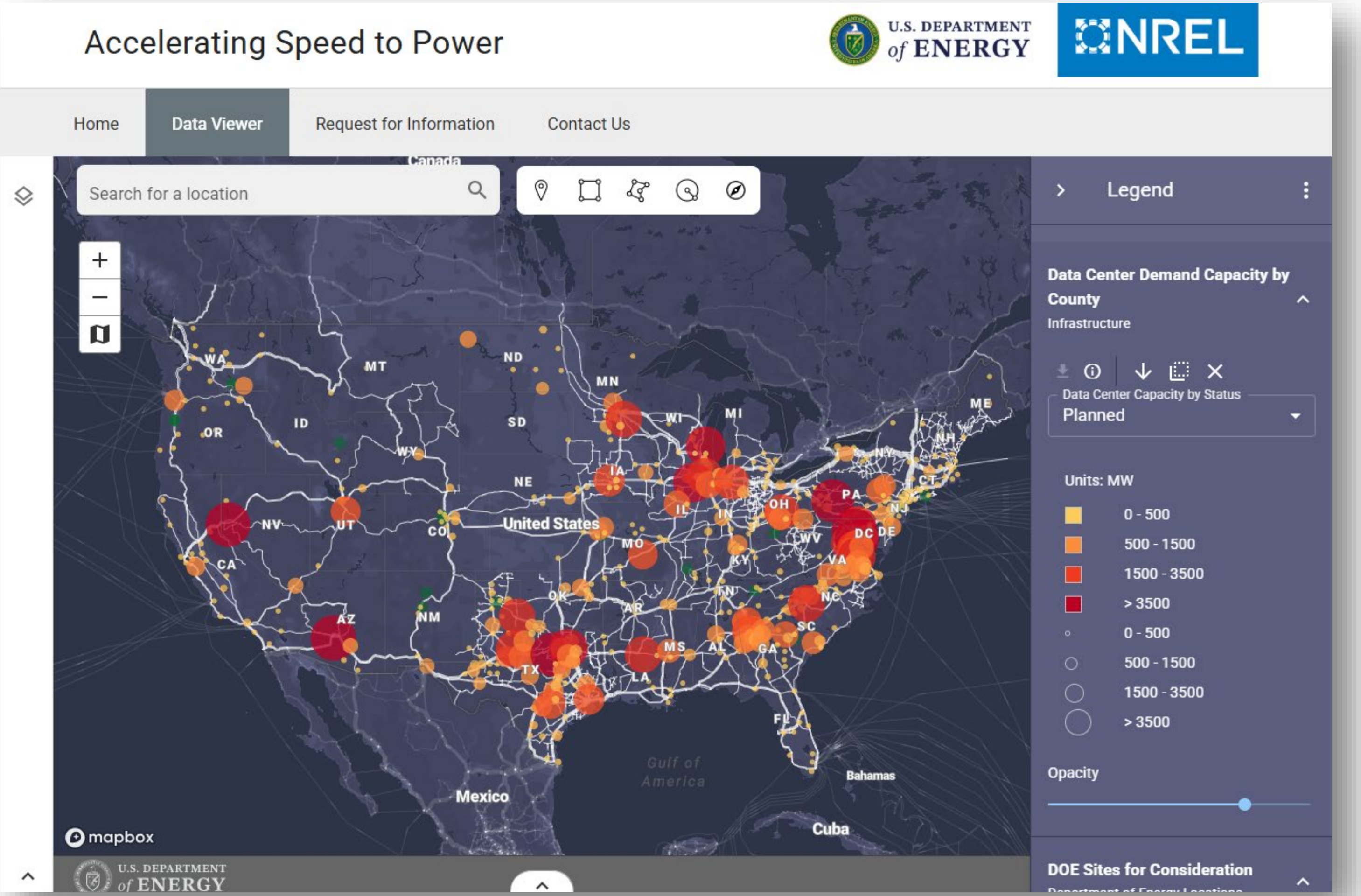
Data Center Construction Starts

- U.S. data center starts up more than 5-fold in two years
- Growth coupled to power and cooling infrastructure
- Strong leading indicator for increased water demand
- Market growth is uneven, but accelerating



Geographic Scope

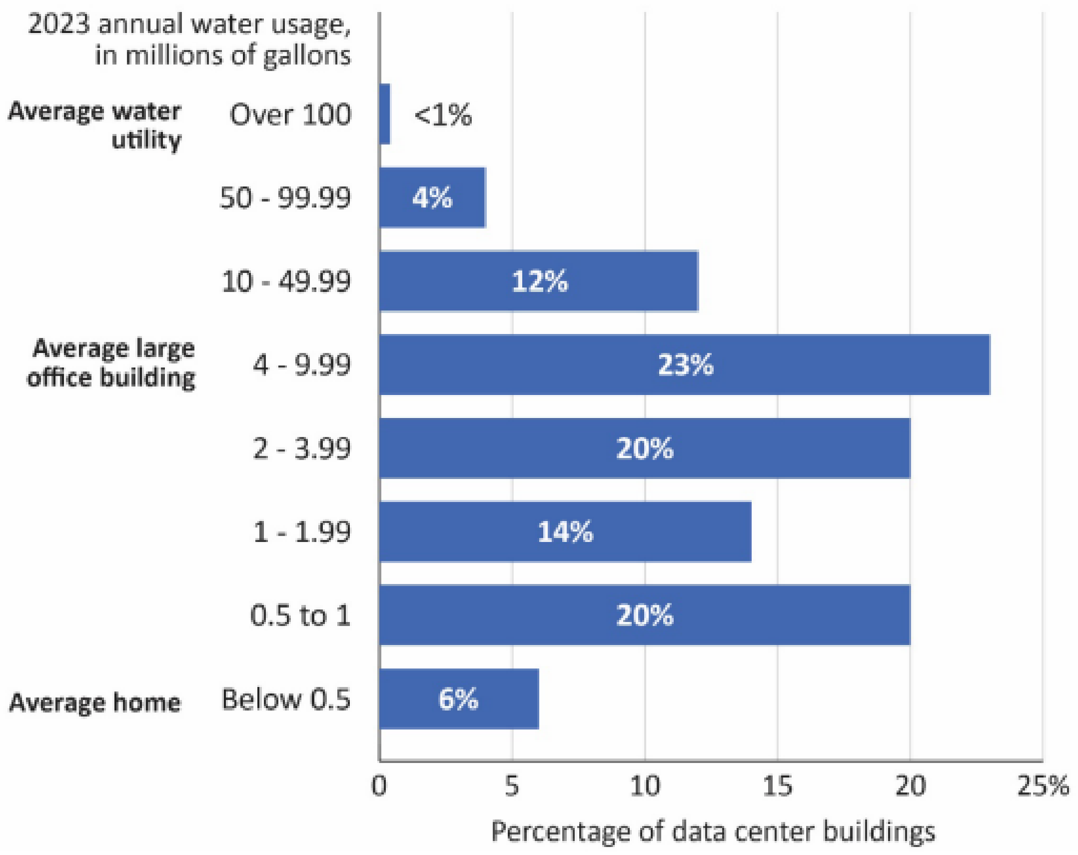
- Siting and access considerations:
  - Power availability/reliability
  - Land and zoning
  - Connectivity and latency
- Growth regions include water-constrained areas
- DOE projects significant and widespread expansion
- Demand capacity is stronger signal than facility counts



Wide Range of Water Demands

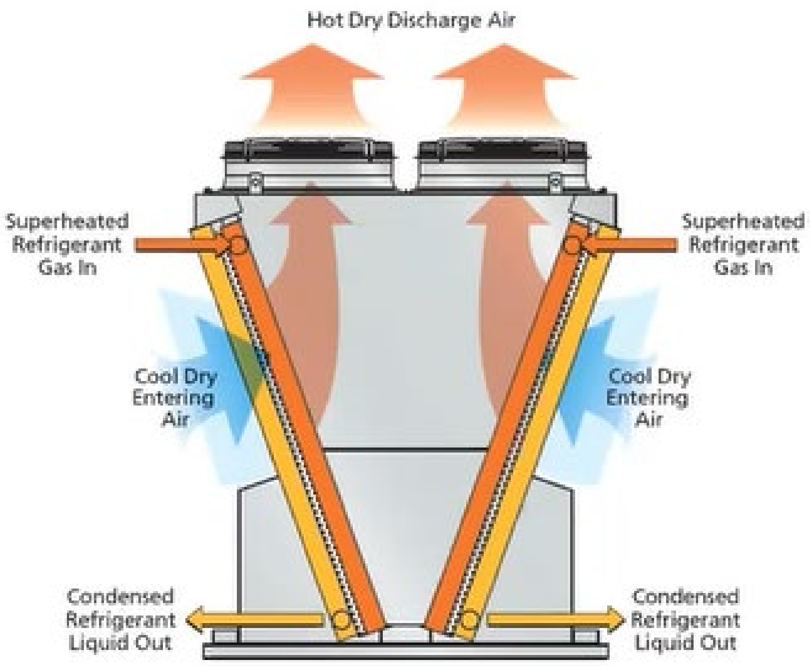
- Size variety:
  - From a few thousand sq. ft. to >1 million sq. ft.
- Water demand spans two orders of magnitude
- Cooling water consumption is:
  - Seasonal
  - Climate-dependent
  - Design-dependent
- Complications:
  - Supply planning
  - Peak capacity
  - Feasibility of reuse

Annual data center building water use varied widely, but most used the same amount of water as an average large office building or less (2023)

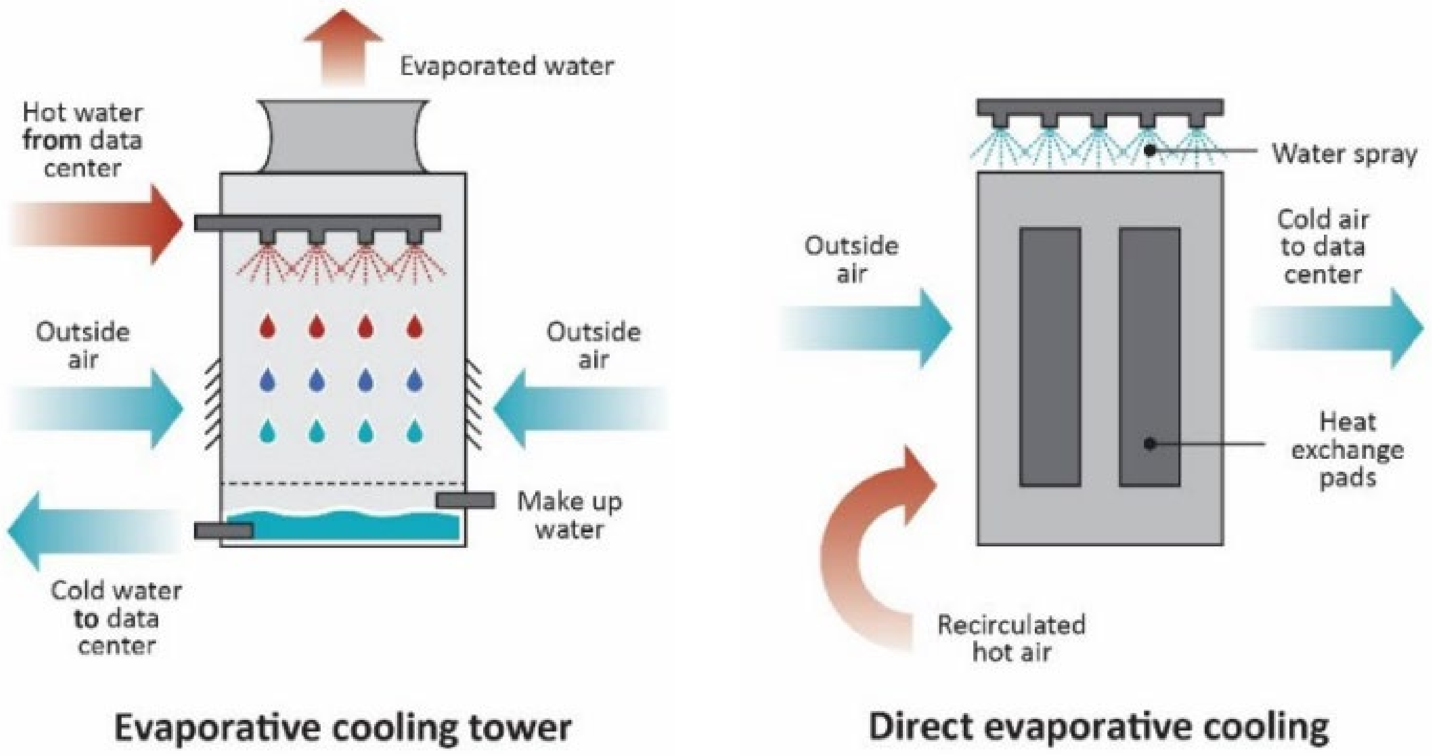


Predominant cooling technologies

Dry Cooling/ Non-Evaporative

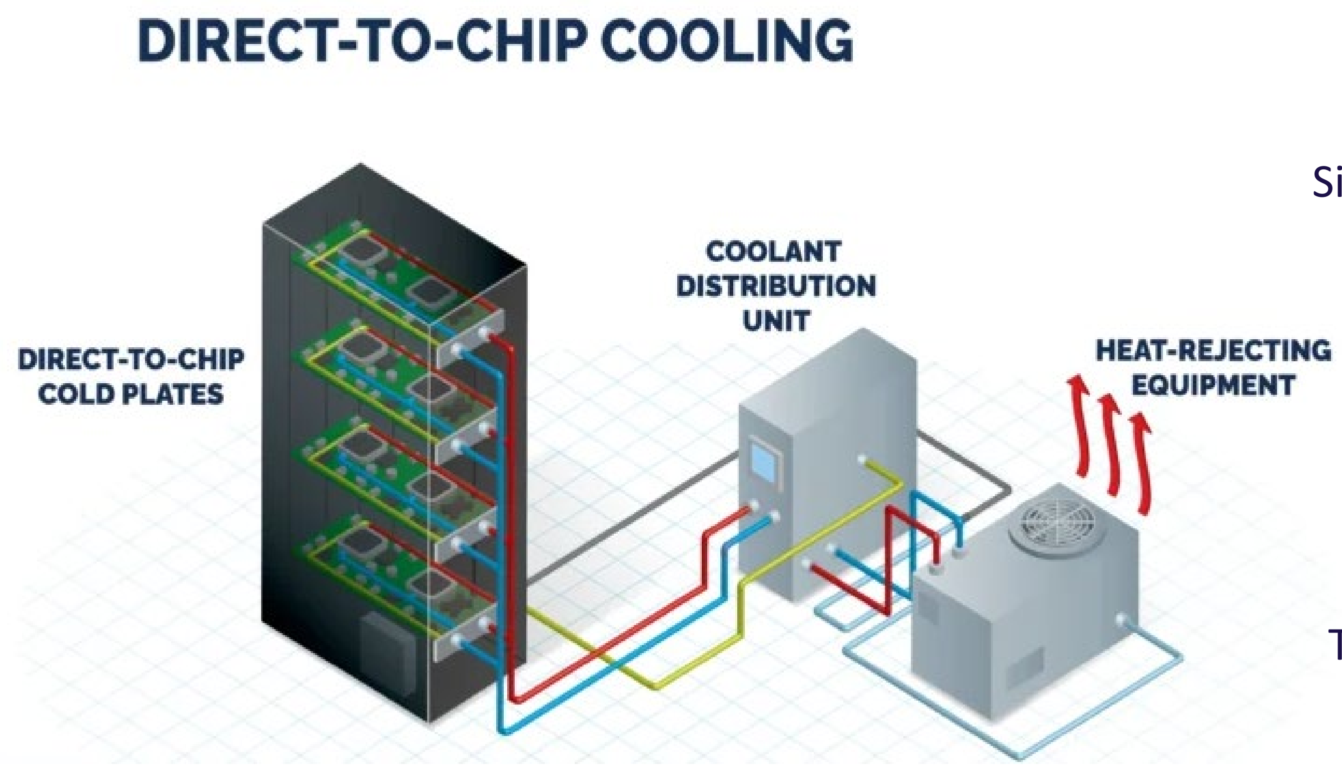


Evaporative Cooling



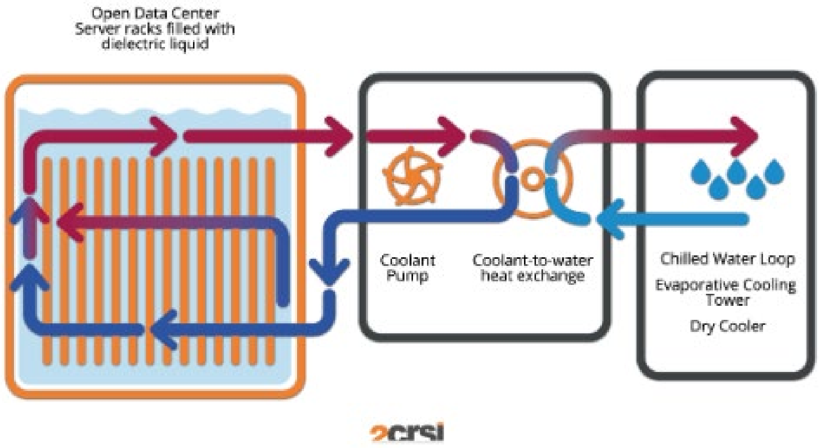
Source: Arcadis, WateReuse Association, JLARC

Cooling technologies for AI and advanced computing

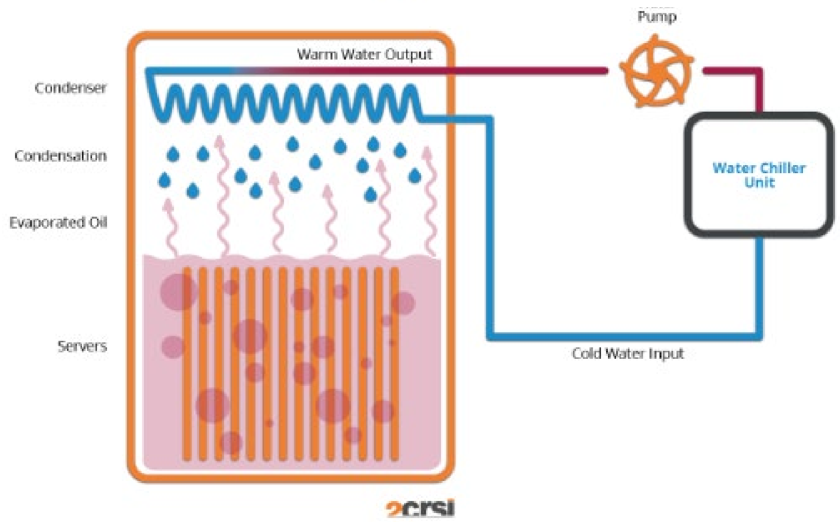


Immersion Cooling

Single Phase



Two-Phase



Sources: Park Place Technologies, 2crsi

CREATED REUSEXPLORER TOOL SUMMARIZING >185 STATE REUSE REGS (WRAP Action 3.1)

REUSExplorer

National Water Reuse Action Plan
WRAP

Support states as they develop reuse regulations and guidelines

REUSExplorer Demo: Multi-Search Capabilities

State or Country

- Alabama
- Arizona
- Arkansas
- California
- Colorado
- Delaware
- District of Columbia
- Florida
- Georgia
- Hawai'i

Sources of Water

- Industry Process Water
- Onsite Collected Waters
- Rainwater Collected Onsite
- Stormwater
- Treated Municipal Wastewater

Search

Reuse Application

- Agriculture
- Centralized Non-Potable Reuse
- Consumption by Livestock
- Environmental Restoration
- Impoundments
- Industry
- Landscaping
- Onsite Non-Potable Water Reuse
- Potable Water Reuse

State or Country

Optional Selection

Sources of Water

Treated Municipal Wastewater ×

Reuse Application

Centralized Non-Potable Reuse ×

Search

State	Sources of Water	Reuse Application	Summary Document
Arizona	Treated Municipal Wastewater	Centralized Non-Potable Reuse	See Results
Australia	Treated Municipal Wastewater	Centralized Non-Potable Reuse	See Results
California	Treated Municipal Wastewater	Centralized Non-Potable Reuse	See Results
Colorado	Treated Municipal Wastewater	Centralized Non-Potable Reuse	See Results
Florida	Treated Municipal Wastewater	Centralized Non-Potable Reuse	See Results
Georgia	Treated Municipal Wastewater	Centralized Non-Potable Reuse	See Results
Hawai'i	Treated Municipal Wastewater	Centralized Non-Potable Reuse	See Results

Summary of California's Water Reuse Guideline or Regulation for Centralized Non-potable Reuse

This page is part of the EPA's REUSExplorer tool, which summarizes the different state level regulations or guidelines for water reuse for a variety of sources and end-uses.

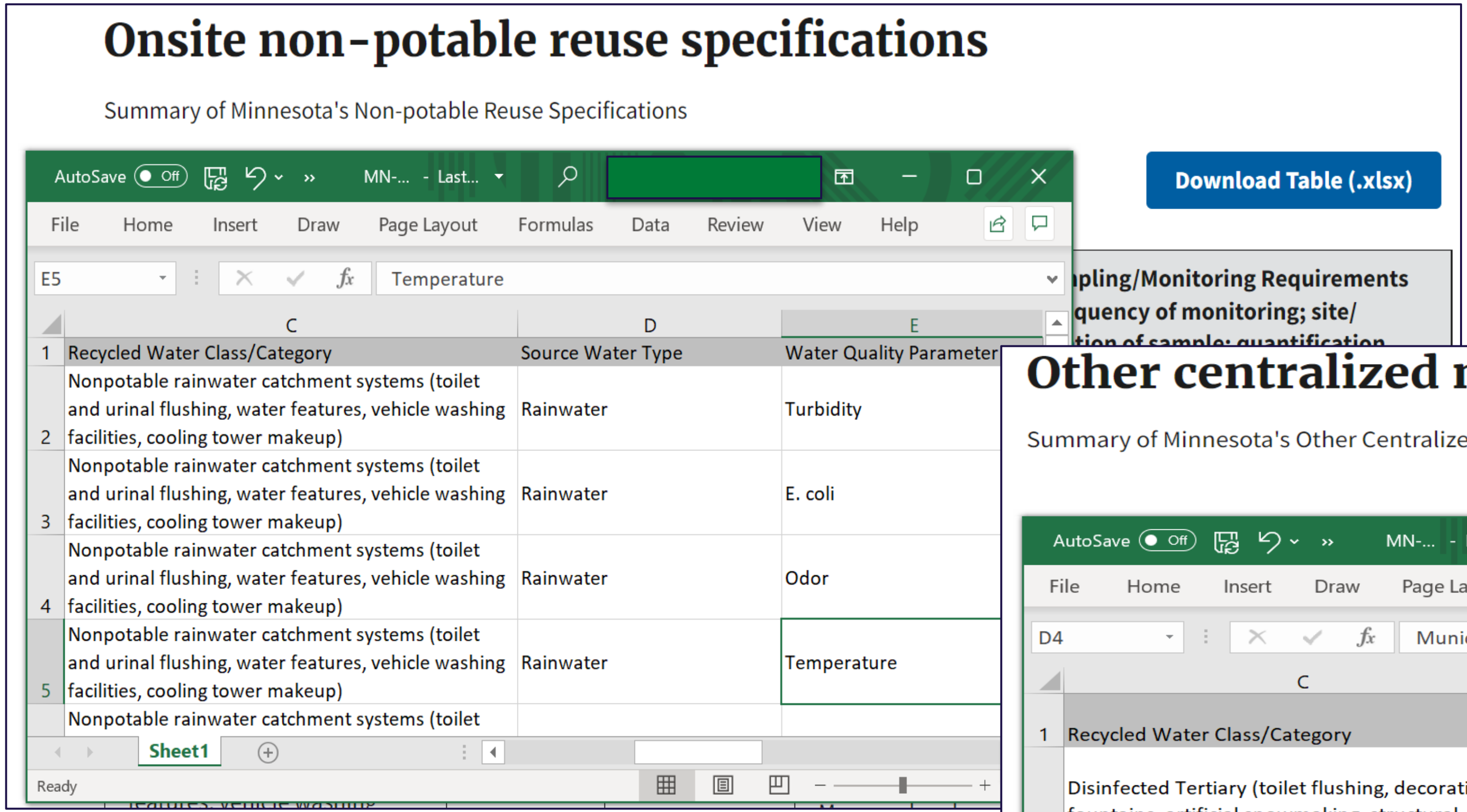
The source water for this summary is **Treated Municipal Wastewater**.

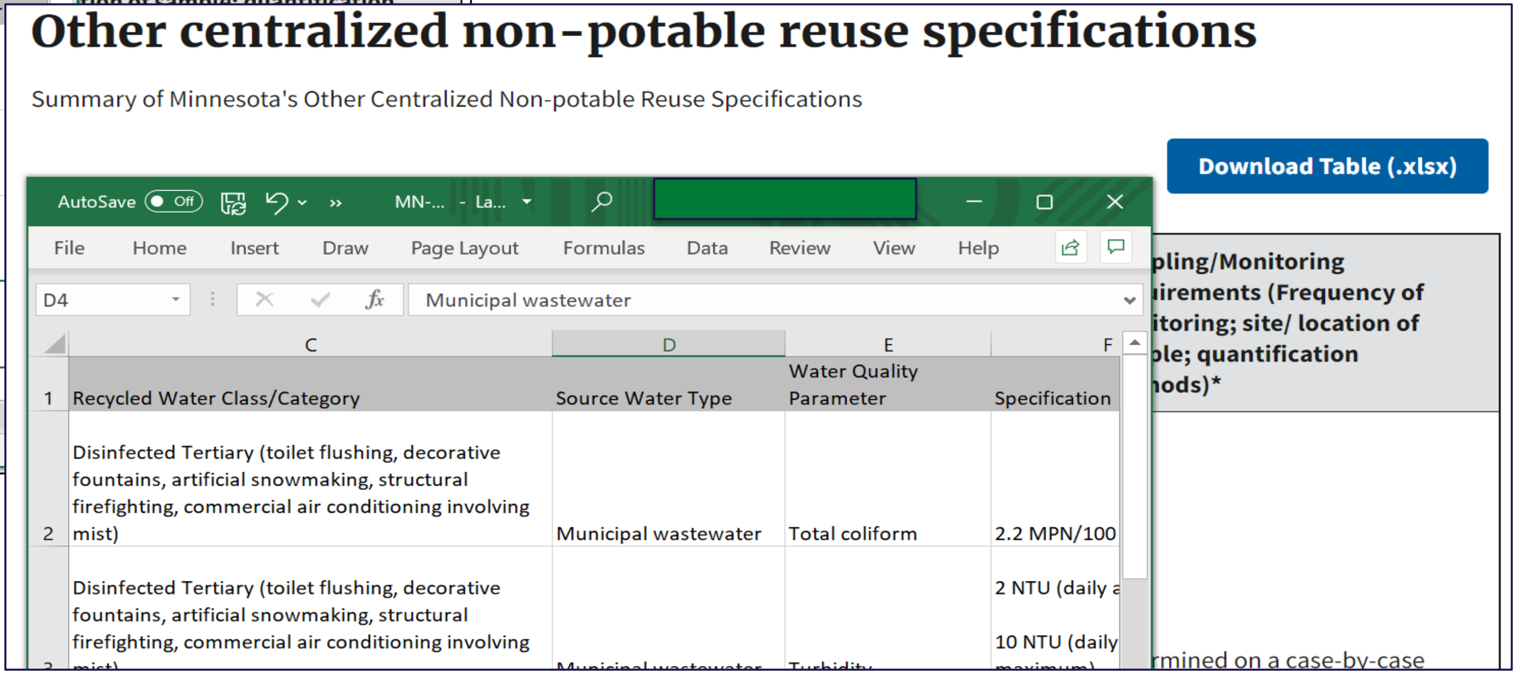
On this page:

This page is a summary of the state's water reuse law or policy and is provided for informational purposes only. Please always refer to the state for the most accurate and updated information.

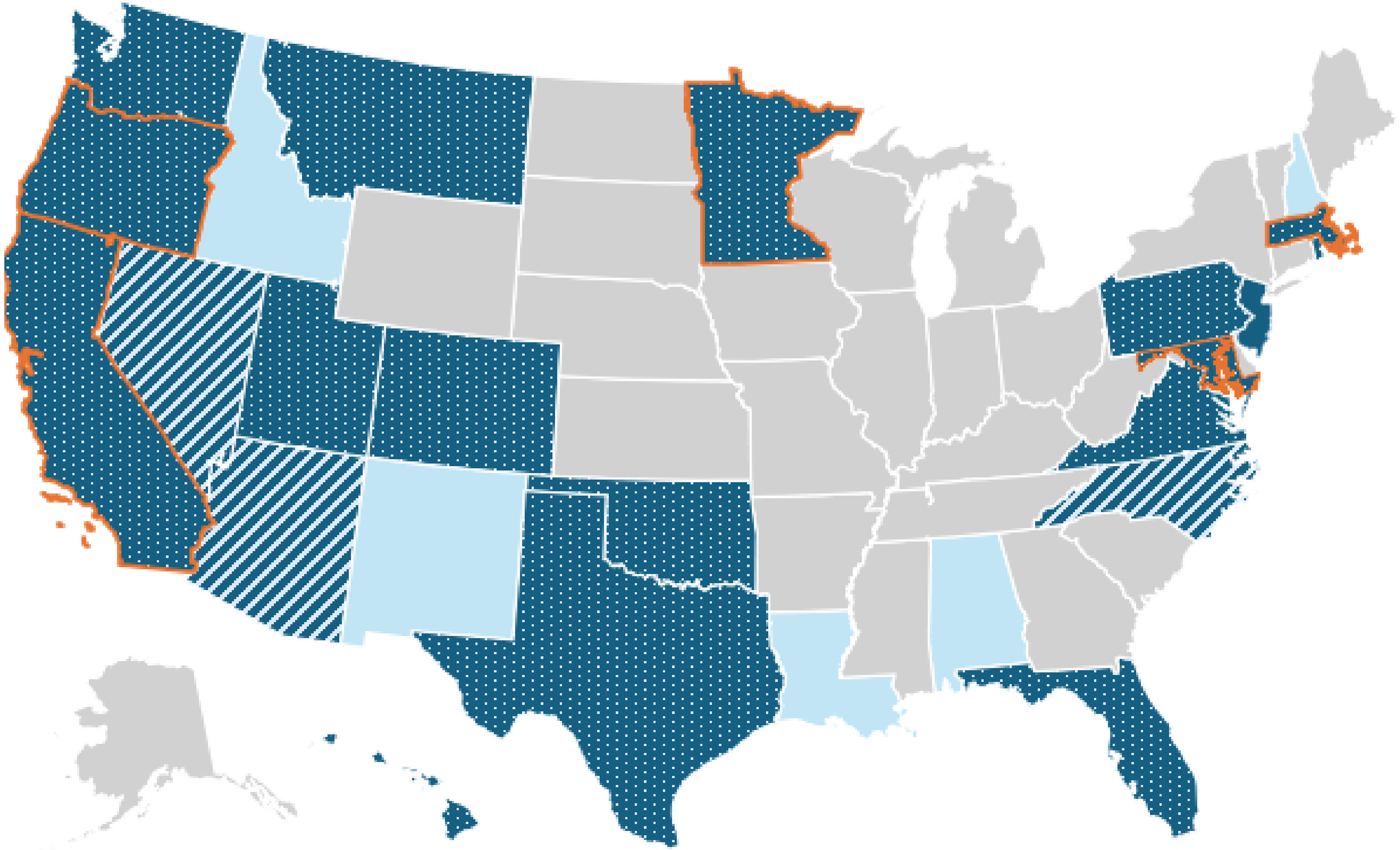
In California, centralized non-potable reuse applications include toilet and urinal flushing, decorative fountains and firefighting among others. The source of water (treated municipal wastewater) is specified by the state as domestic wastewater. The write-up uses state

Downloadable Specifications Tables





States with Water Reuse Regulations or Guidelines: Treated Municipal Wastewater for Cooling Applications



- Guideline/Regulation for Cooling
- Generation of Cooling Mists/Aerosols Allowed
- Generation of Cooling Mists/Aerosols Prohibited
- Control of *Legionella* considered in Cooling
- Cooling Permitted on a Case-by-Case Basis
- No Guideline/Regulation for Cooling

Cooling applications include **evaporative cooling (mists/vapors)** and **non-evaporative (closed loop)**.

Additional states may permit treated municipal wastewater for cooling purposes on a case-by-case basis. However, there was not enough information to include additional states on the map.

REUSExplorer: epa.gov/reusexplorer

State Treatment Requirements for Cooling Applications (with mists/aerosols)

States	Treatment Requirements	Disinfection Types
Montana, Oklahoma, Rhode Island, Washington	Oxidation, coagulation, filtration, and disinfection	Chlorine, ozone, UV radiation, or other chemical disinfectants
California (Disinfected tertiary), Colorado (Category 2 and 3), **Minnesota**, Virginia	Filtration and disinfection	Chlorine, ozone, UV radiation or another disinfection process
California (Disinfected secondary-23), Hawai'i, **Oregon**	Oxidation and disinfection	Chlorine, ozone, or another disinfection process
Colorado (Category 1), Florida, Maryland, **Massachusetts**, Pennsylvania, Utah	Disinfection[a]	Chlorine, ozone, UV radiation, or other chemical disinfectants
Texas	Not specified in the regulation	

Note: Some states have multiple classes or categories of water (with different treatment requirements) approved for use in cooling applications that generate aerosols/mists. All state treatment requirements are beyond secondary treatment.
States in orange have design specifications or other requirements aimed at controlling *Legionella.*

Enabling the Use of Recycled Water in Direct Evaporative Cooling Systems

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AWS Water Positive Commitment

By 2030, AWS will return more water to communities than we use in our direct operations

53%

of the way toward water positive 2024

aws

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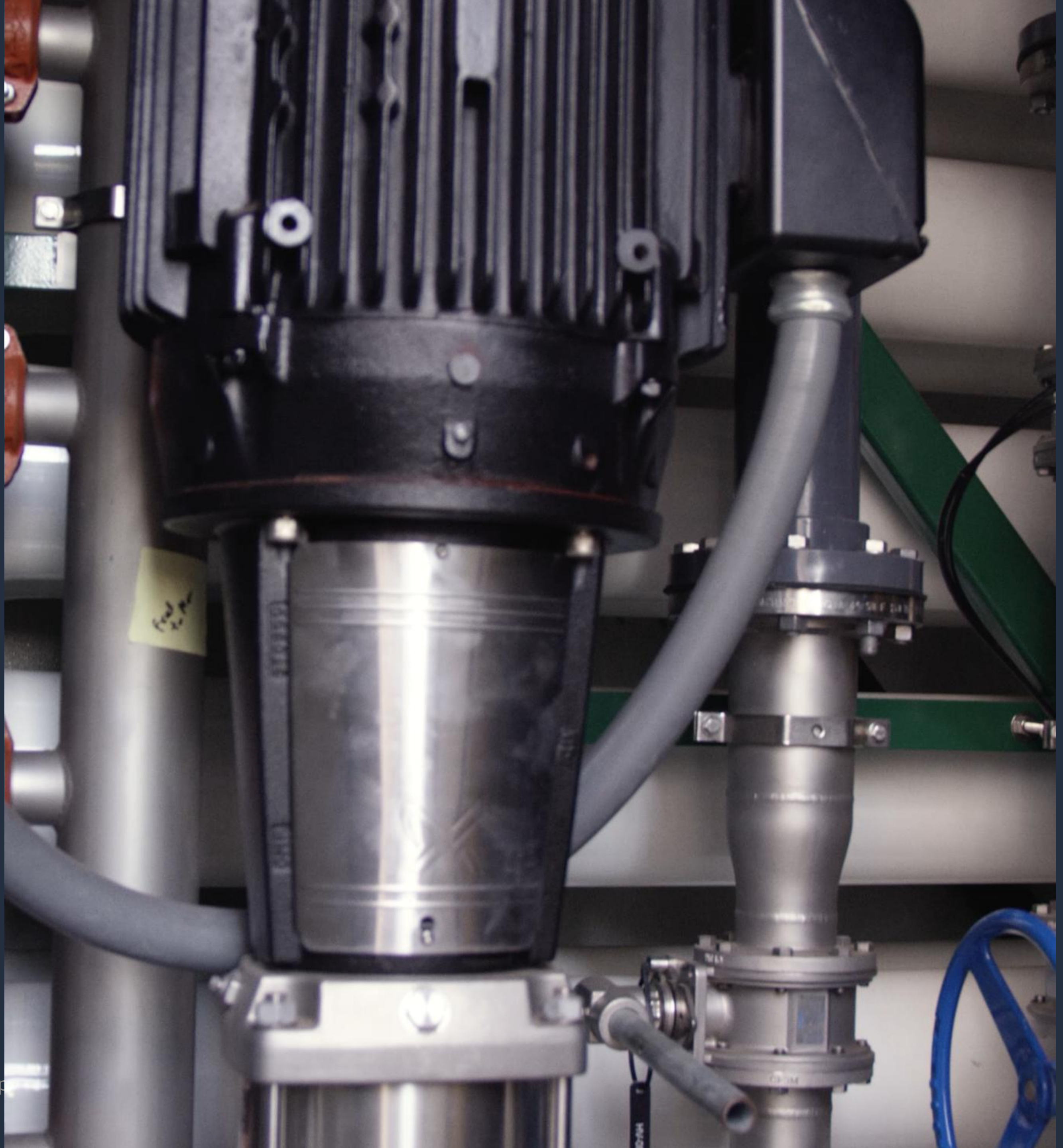
Water Efficiency

Maximize efficiency for any water used in data center cooling



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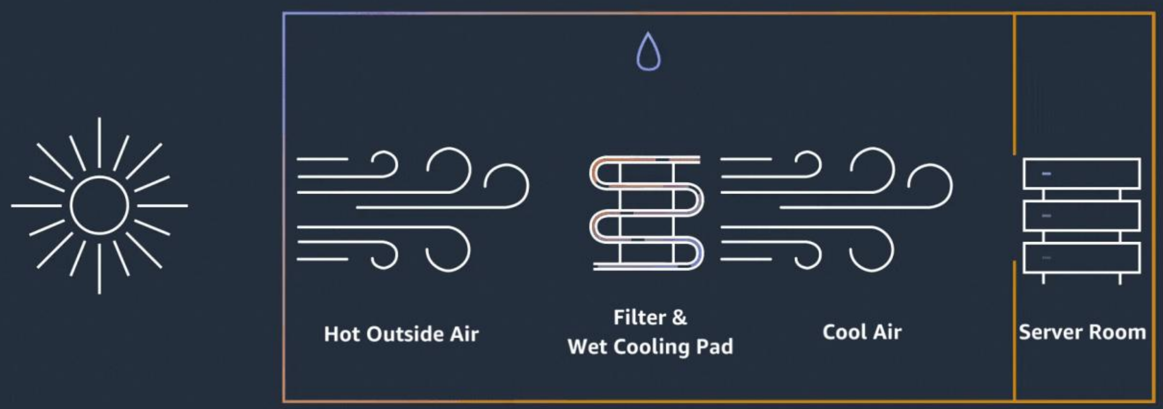
Evaporative Cooling

Global WUE (L/kWh)

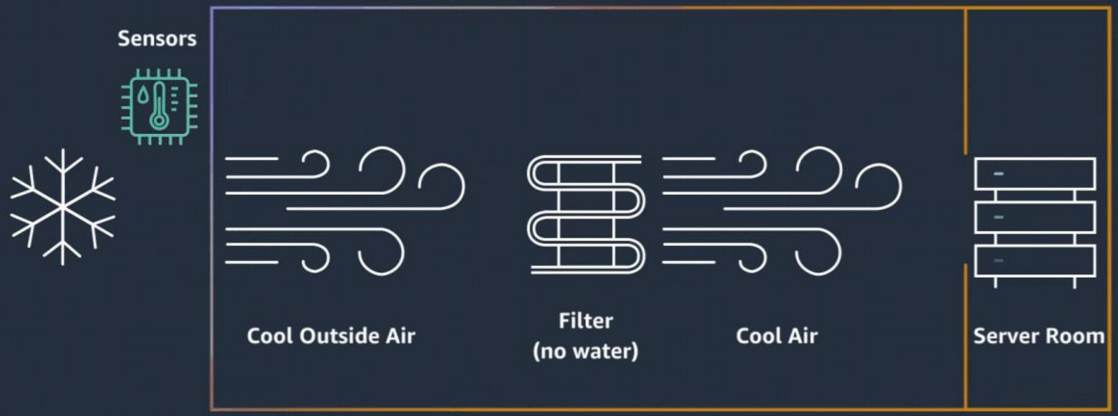
0.15

(2024)

Direct Evaporative Cooling



Free-Air Cooling



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Efficiency as Core Tenant

- Depending on location water used for <1% to approx. 15% of the annual hours, significantly reducing water use

- AWS Water Efficiency (WUE) of 0.15 L/kWh

    - 10x less water than cooling towers (legacy/traditional cooling technology)

    - 2.4x less water than industry average for datacenters (LBNL, 2024)

- Why use Water for Cooling?

    - Using water to extract heat reduces power consumption requirements on the hottest days of the year between **25-35%**

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aws

Sustainable Sources

Use sustainable sources like recycled water (e.g., Loudoun Water & City of Santa Clara) and rainwater harvesting wherever possible

Recycled Water

26

Data centers using recycled water or rain water harvesting

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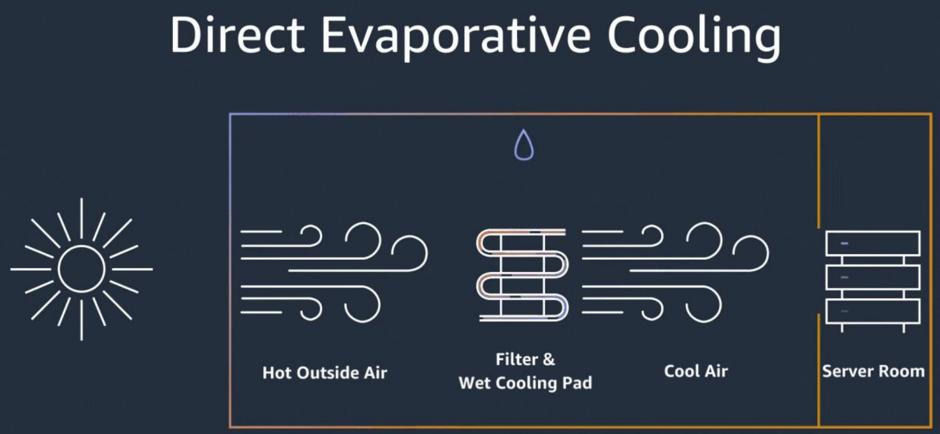
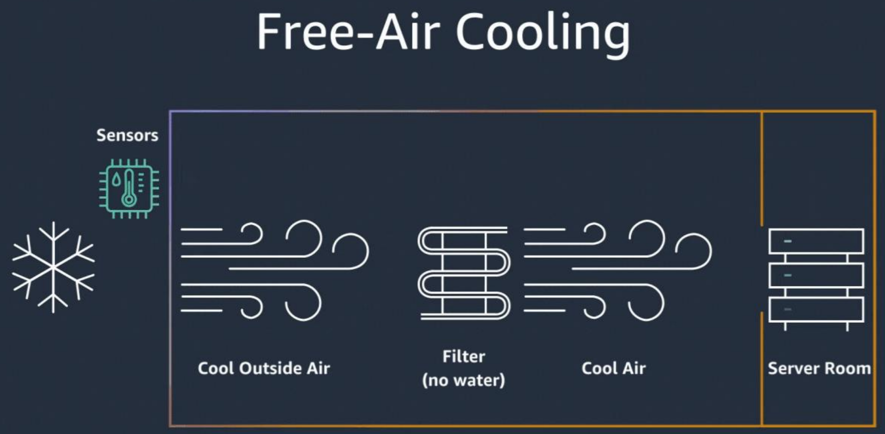
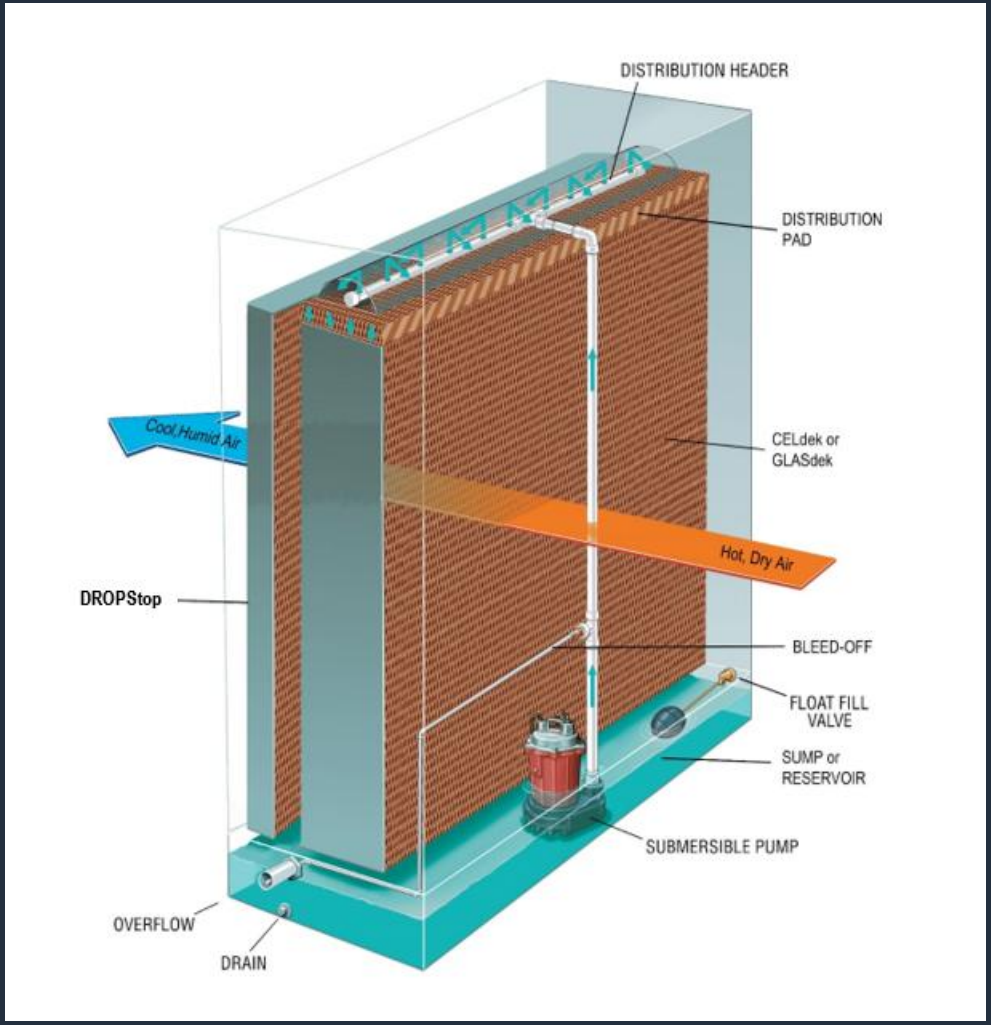
Direct Evaporative Cooling (DEC) System







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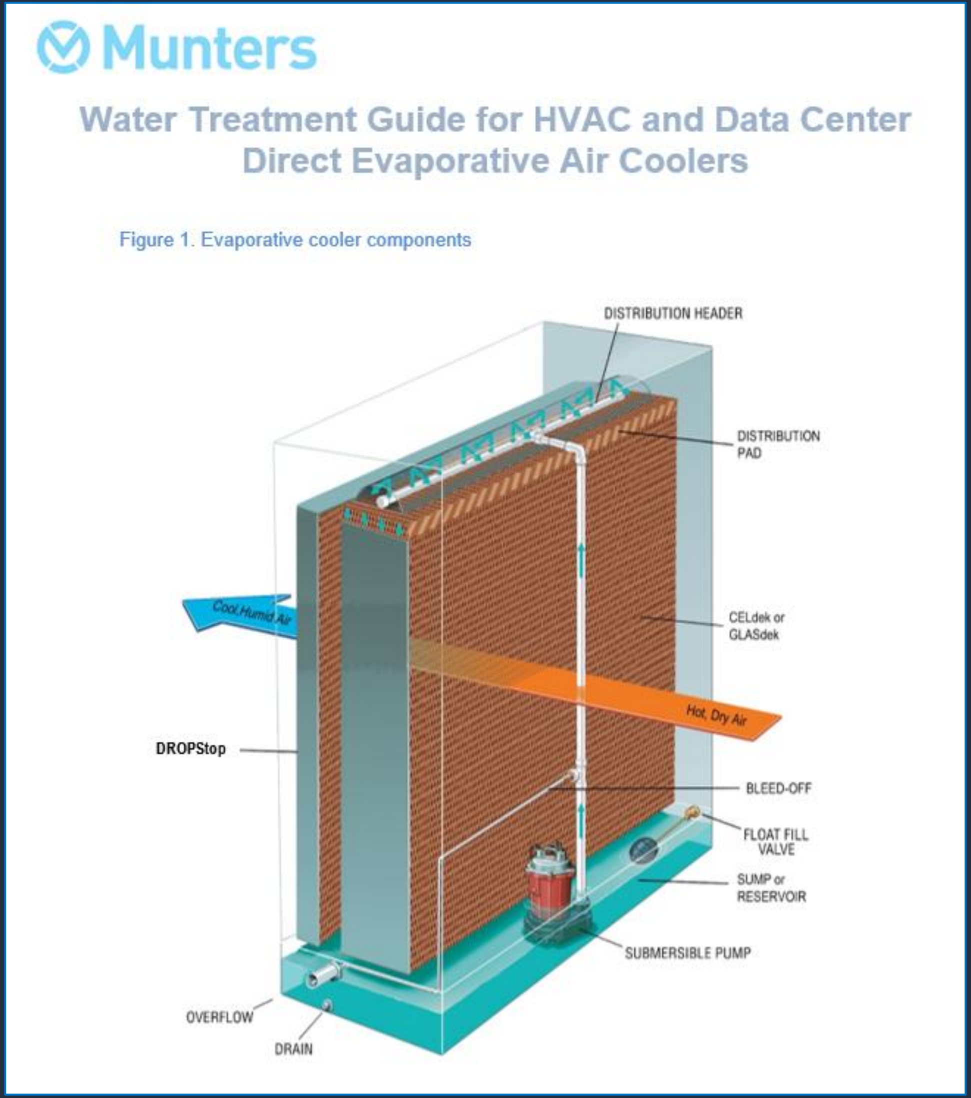

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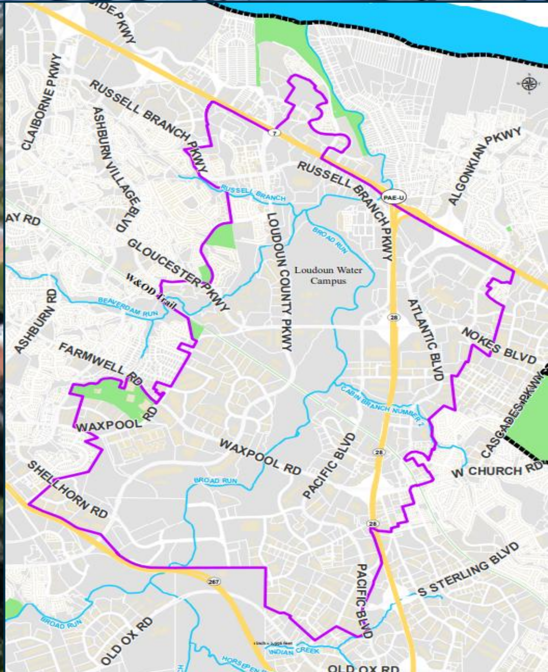
Loudoun Water

- 19 AWS Datacenter Locations Currently Use Recycled Water for Cooling

- Loudoun Water Reclaimed Water System
  - Initiated in 2010
  - 20 miles of pipeline
  - In 2023, produced 815 million gallons/yr for customers including data centers
  - Reduces nutrient load to the Bay

- DEC Enablement
  - VPDES updated to cover DEC systems

- End-user Requirements
  - Design, Construction and Contractual
  - On-Going (*E. coli* and *Legionella* monitoring in storage tanks and DEC units)



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City of Santa Clara

- 2 AWS Datacenter Locations Currently Use Recycled Water for Cooling
- Recycled Water System
  - Silicon Valley Advanced Water Purification Center with tertiary recycled water from the San José-Santa Clara Regional Wastewater Facility
  - 33 miles of pipeline
- DEC Enablement
  - Case by Case Approval
- End-user Requirements
  - Design and Construction
  - On-Going (No monitoring in storage tanks and DEC units required)

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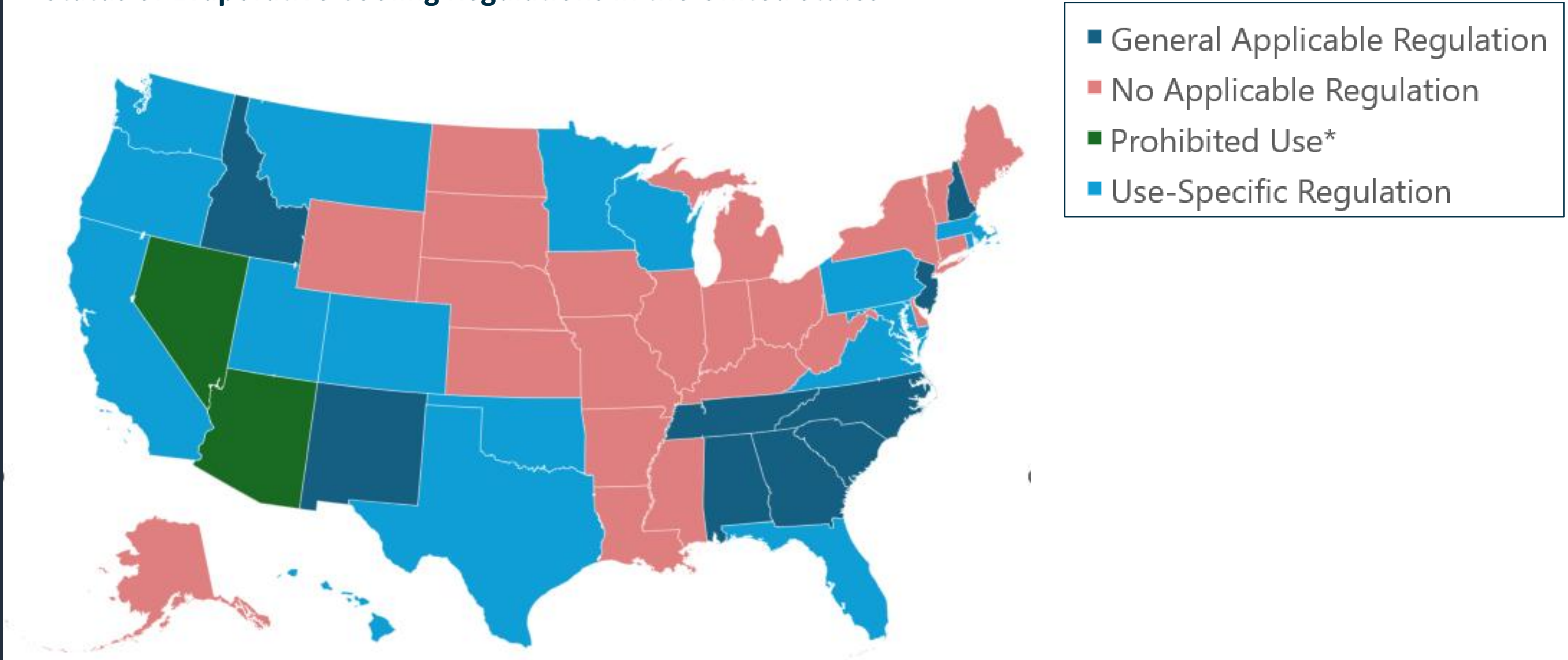
High Variability in State Regulations

Status of Evaporative Cooling Regulations in the United States



Brown and Caldwell Analysis

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Questions

Thank you!

Usman Khan

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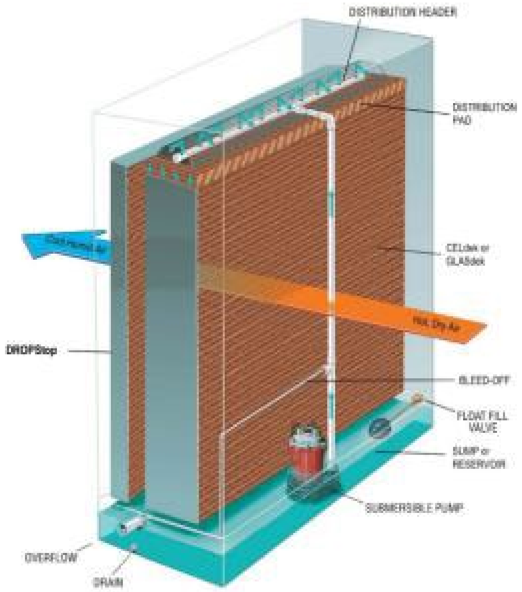
Sustainability of Direct Evaporative Cooling

- Evaporative cooling is the most common cooling method employed at data centers
- The demand for data centers in the US is projected to increase by more than 2.5-fold by 2030 (Shehabi et al., 2024)
- Use of reclaimed water is a sustainable source of water to meet cooling system needs and avoid freshwater consumption
- Direct Evaporative Cooling uses less water and less energy than cooling towers (can be up to 10x less, partially because DEC may only use cooling water 1 to 15% of the year)

Difference between DEC and Cooling Towers

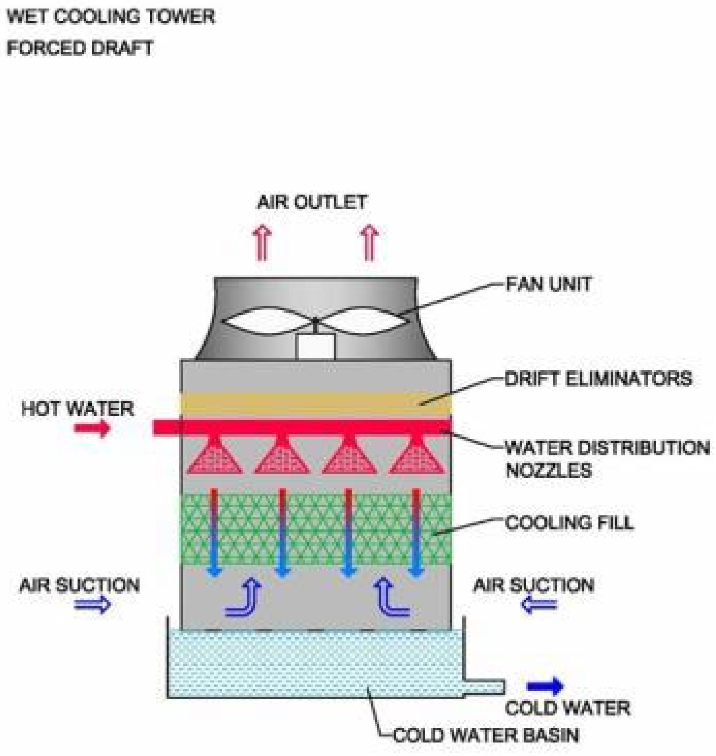
Direct Evaporative Cooler

Drift Eliminator



Evaporation of the water cools the air

Cooling Tower



Spray of water in air is used to cool the water

DEC and Cooling Towers are NOT the Same!

Direct Evaporative Coolers	Cooling Towers
Has a lower tendency to form $CaCO_3$ scale and higher tendency to precipitate silicates because water temperature is lower, typically 65-80 F (18- 27 C).	Has a higher tendency to form $CaCO_3$ scale and lower tendency to precipitate silicates because water temperature is higher, typically 85-120 F(29-49 C)
Has a thin film of water spread over the media. Contaminants in the film become more concentrated than the bulk water.	Has a thicker film of water on the media that can be 15-20x thicker than on evaporative cooler media.
Water treatment strategies focus on the media where evaporation takes place.	Water treatment strategies focus on the heat exchanger where the water is the hottest.
Typically supplies air to occupied spaces. Minimal aerosols produced. Consider volatilization of water chemicals.	Not intended for indoor spaces. Aerosols pose risk for human exposure. Avoid drawing the air into buildings.
Evaporative coolers cycle on and off to meet the control demand, the contaminants from the water can dry out on the media during cycles.	Cooling tower operations are less cyclical and media do not retain water, so the water returns to the sump when the pump is shut down.
Less prone to microbial growth but treated to avoid scale formation.	Corrosion inhibitors are commonly used to protect the cooling water loop.

Water treatment, operations, and water chemistry is different between cooling towers and direct evaporative cooling systems!

Reuse Regulations

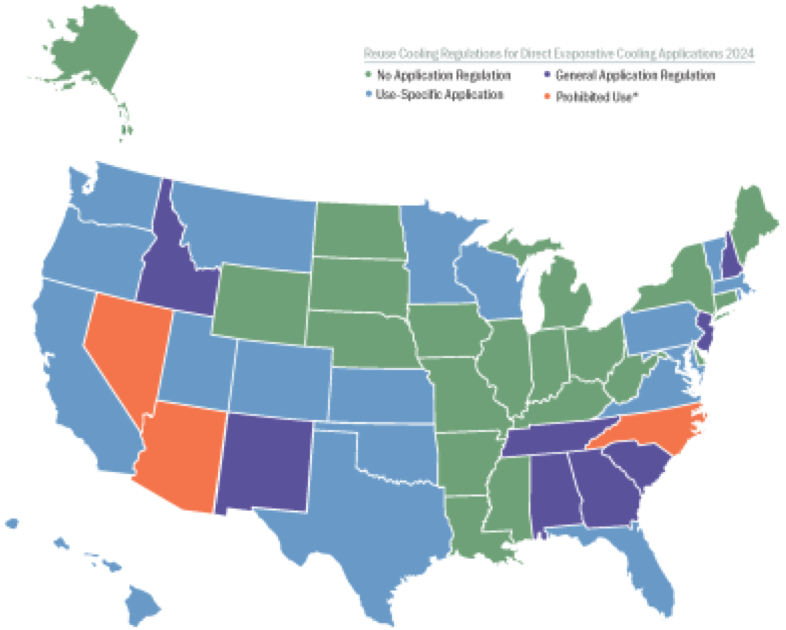
- Less than half (21) of states have regulations for use of reclaimed water for industrial applications

- None have regulations specific for DEC systems

- Most regulations focus on treatment of fecal/oral pathogens (*E. coli*, viruses, protozoa)

- Few have risk-based guidelines for inhalation exposure like *L. pneumophila* (VPDES)

- Development of DEC-based regulations would facilitate the adoption of reclaimed water for hyper-scale data centers



Guidelines for Legionella in Cooling Towers

- In 2016, New York City regulation requires, in part, that owners monitor for *Legionella* and report the results if levels exceed 1000 CFU/mL.

- The American Industrial Hygiene Association (AIHA) provides guidelines for cooling towers and evaporative condensers, the action level for *Legionella* species is 1000 CFU/mL.

- NSFI standard 453 (NSFI, 2017) provided minimum practices for treating, operating, and maintaining cooling towers to avoid *Legionella* growth:
    - <10 CFU/mL, no action is needed
    - 10 - 100 CFU/mL, a program review and on-line remedial treatment
    - 100 and 1,000 CFU/mL, a visual inspection, draining and repair if needed
    - >1,000 CFU/mL, take the system off-line and apply remedial treatment

- In 2014, the Province of Quebec required cooling towers to be tested for *L. pneumophila* and take corrective actions if levels exceed 10 CFU/mL and implement disinfection if levels exceed 1,000 CFU/mL.

- Nocker et al. (2020) examined the transport of *L. pneumophila* in aerosols from cooling towers and did not detect the bacteria by either culture or qPCR when levels were <10 cfu/mL in the cooling tower water.

Differences in Legionella control for DEC vs CT

- DEC with drift eliminator when operated as designed doesn't produce aerosols:
  - Macher et al., (1995) spiked the pigmented bacteria, *Micrococcus luteus*, at levels greater than a million per milliliter (10^6 cfu/mL) in a residential evaporative air cooler (without a drift eliminator) and operated the units at high air flow rates (>44 m^3 min^{-1}).
  - Dr. Sebastian Lemmen, *L. pneumophila* were into a commercial evaporative humidifier (Munters FA6) at levels up to 10^7 cfu/mL (Lemmen 2001). No *L. pneumophila* were detected in downstream even at very high air speeds (4.2 m/sec).
  - Additional experiments spiked 10^5 CFU/ml *Flavimonas oryzihabitans* in real-world operating Munters FA6. No bacteria were detected 00 measurements of 25,000 L of air over a 12-hour period.
- ASHREA (2020) concurs that *Legionella* risk is low with wetted-media evaporative coolers.
- Puckorius et al. (1995) notes that direct evaporative cooling systems have not been associated with Legionnaires' Disease. Recommends application of oxidizing biocides (like chlorine or bromine), proper maintenance, and system design.
- Use of a drift eliminator or ultraviolet light treatment provides additional protection, particularly at high air velocities (>3.5 - 4.2 m/s (Koseoglu, 2013; Kim et al., 2018).

Suggested Guidelines for Legionella in DEC

Treatment	• Reclaimed water should be treated by secondary wastewater treatment and filtration
	• The treatment facility must be operated by a qualified, certified operator
	• All DEC units must include certified drift eliminators
Disinfection	• A disinfectant residual of 0.5 mg/L should be maintained in the pipeline between the water recycle facility and the data center
	• A minimum of 0.2 mg/L free chlorine residual should be maintained within the DEC units
	• Disinfectant residuals should be monitored with a continuous analyzer and alarmed <0.2 mg/L
Turbidity / Total Suspended Solids	• Turbidity values should be < 3 NTU and not exceed 5 NTU in 95% of the measurements
	• TSS values should be < 5 mg/L
Microbiological Indicators	• *E. coli* should be nondetectable in 75% of the samples, no single sample exceeding 25 CFU/100 mL
	• *L. pneumophila* should be <100 cfu/mL in the water storage tank and DEC units
Cross Connection Control	• The hyperscale data center should have an active cross connection control program, appropriate signage, "purple pipes," and annual inspections
Personnel Safety Programs	• Signage and restricted access limited to authorized personnel. Personnel must have appropriate training and documentation.

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LOUDOUN WATER

Providing Water in the Heart of Data Center Alley

Kendra Sveum, PE

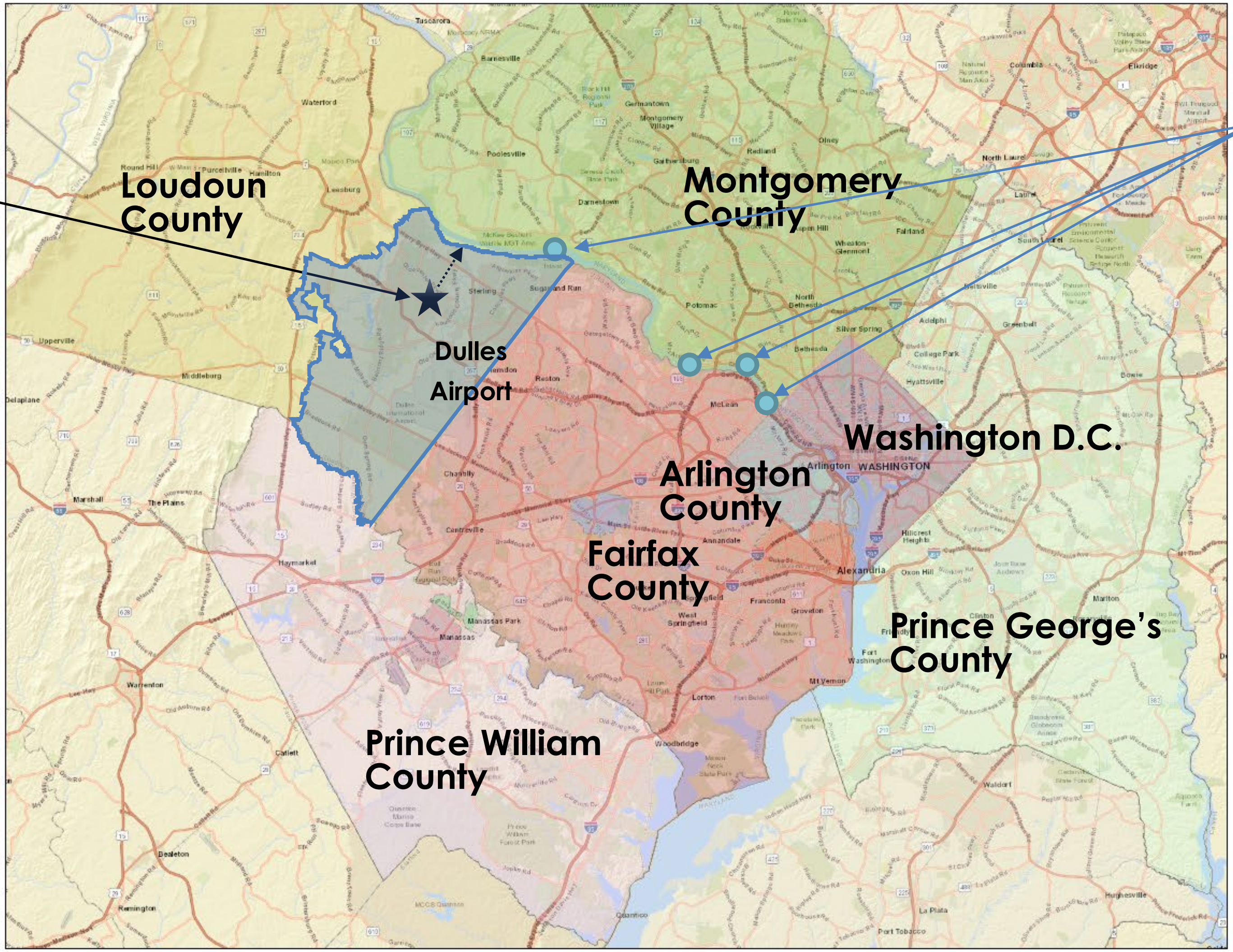
Executive Director of Operations and Maintenance

December 3, 2025

Loudoun Water - Location

LOUDOUN WATER

BRWRF



Drinking Water Intakes on the Potomac

County Population

455,000

Loudoun Water Customers

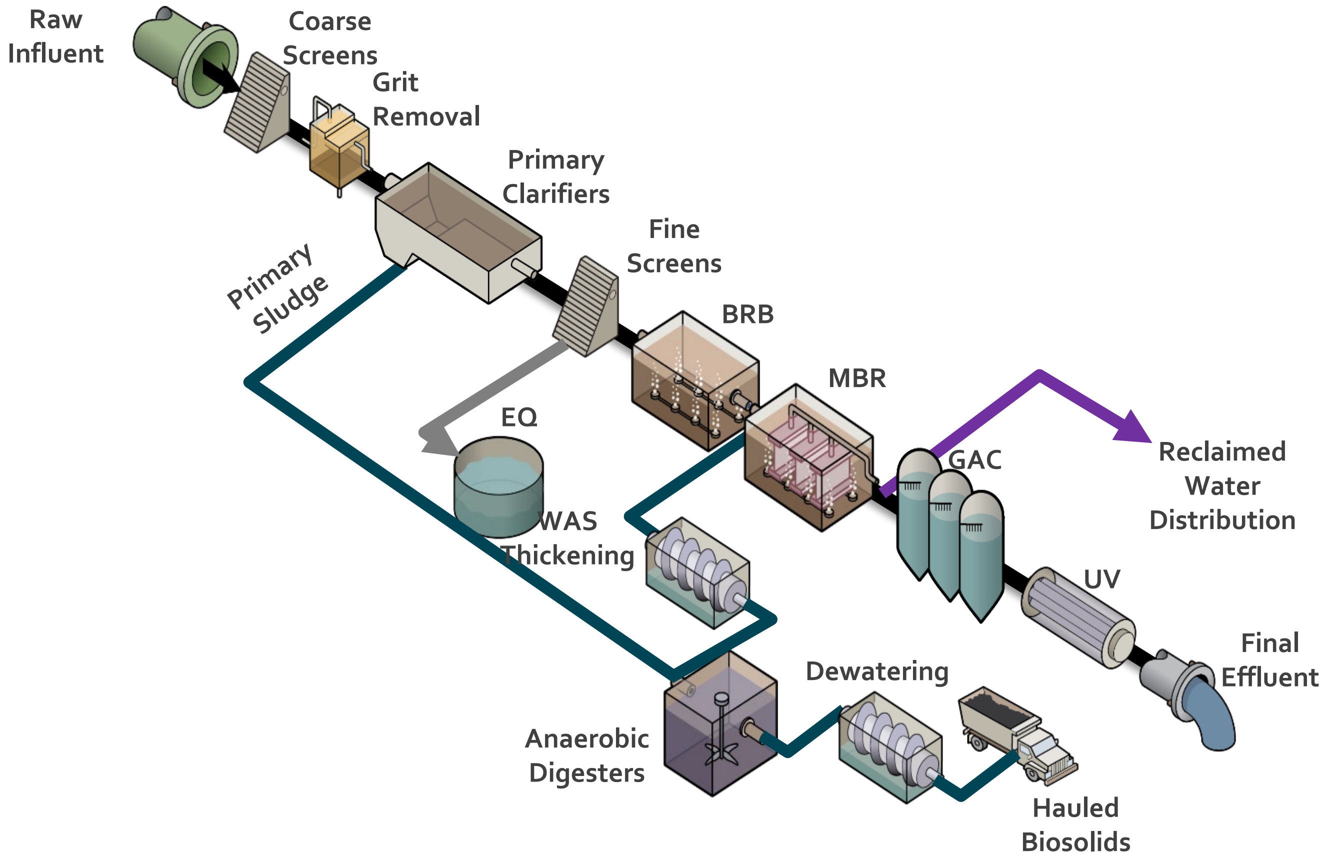
340,000 *population*

87,000 *accounts*

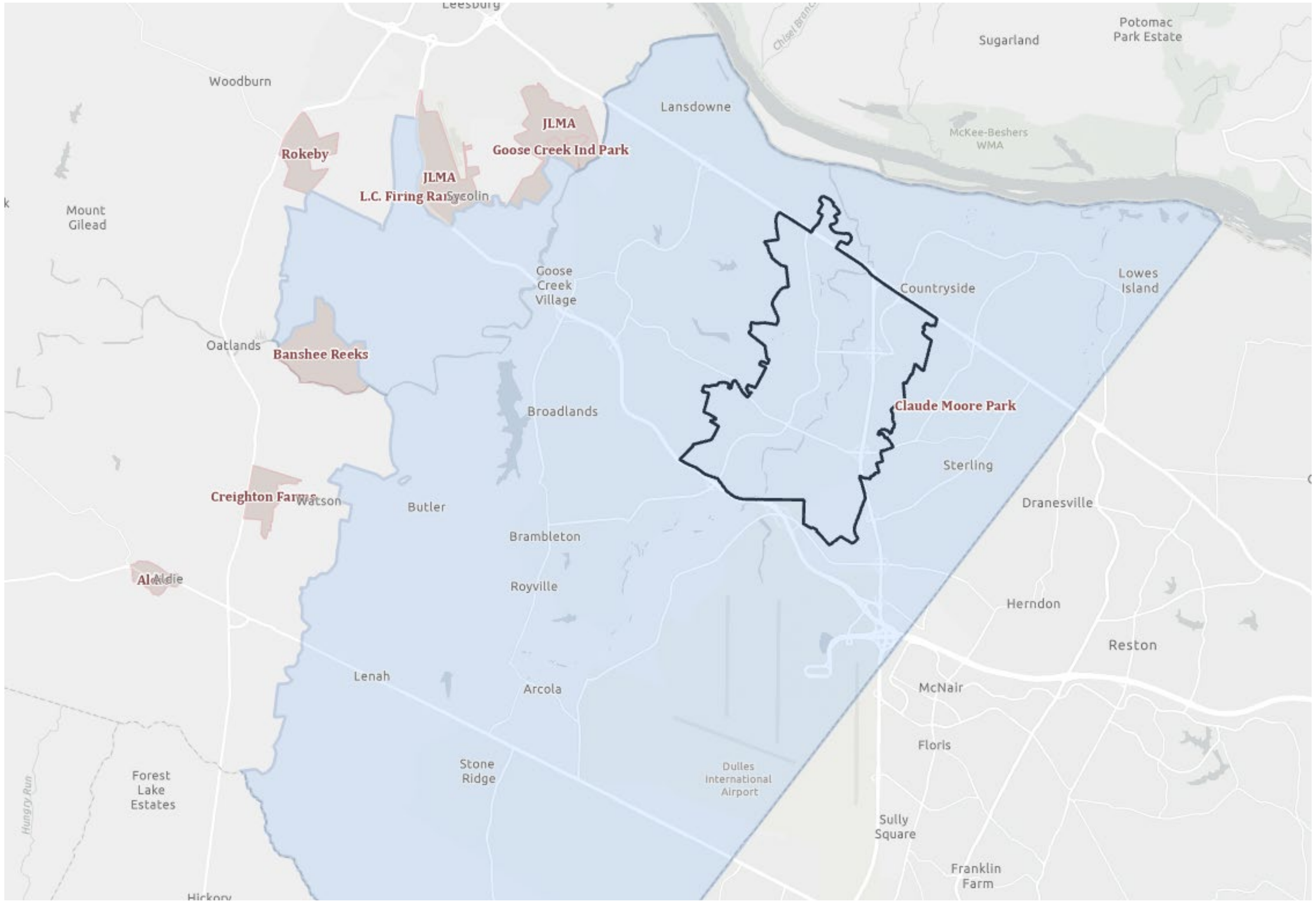
29 MGD *(Avg)*
49 MGD *(Max)*

Broad Run Water Reclamation Facility

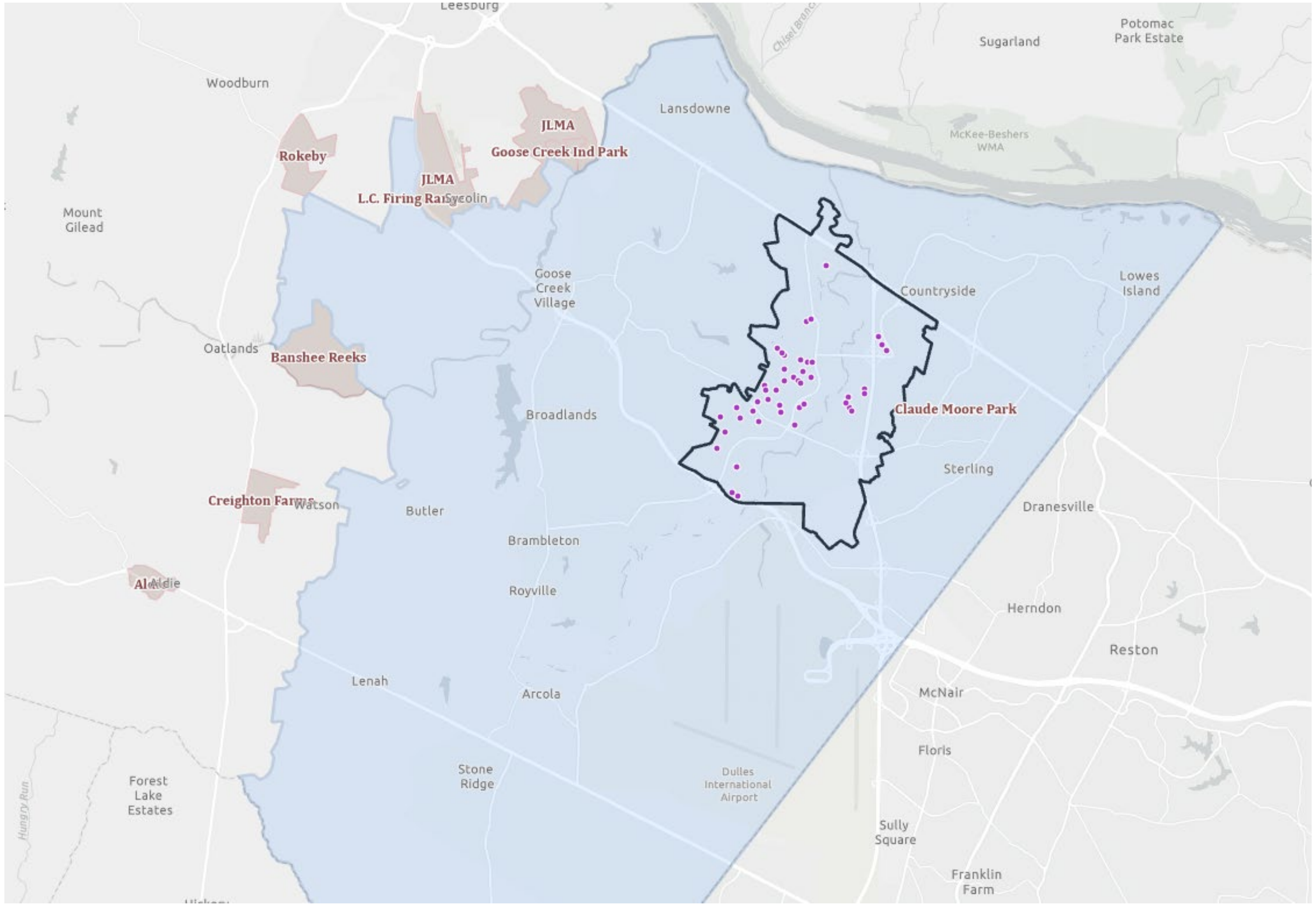
Water Quality Parameter	Monthly Average
Chemical Oxygen Demand (COD)	10 mg/L
Total Suspended Solids (TSS)	1.0 mg/L
Total Kjeldahl Nitrogen (TKN = DON + NH_3)	1.0 mg/L
Total Nitrogen (TN) *Annual Concentration Limit*	3 mg/L
Total Phosphorus (TP)	0.1 mg/L
Turbidity	0.5 NTU
E. Coli	Less than 2 per 100 mL



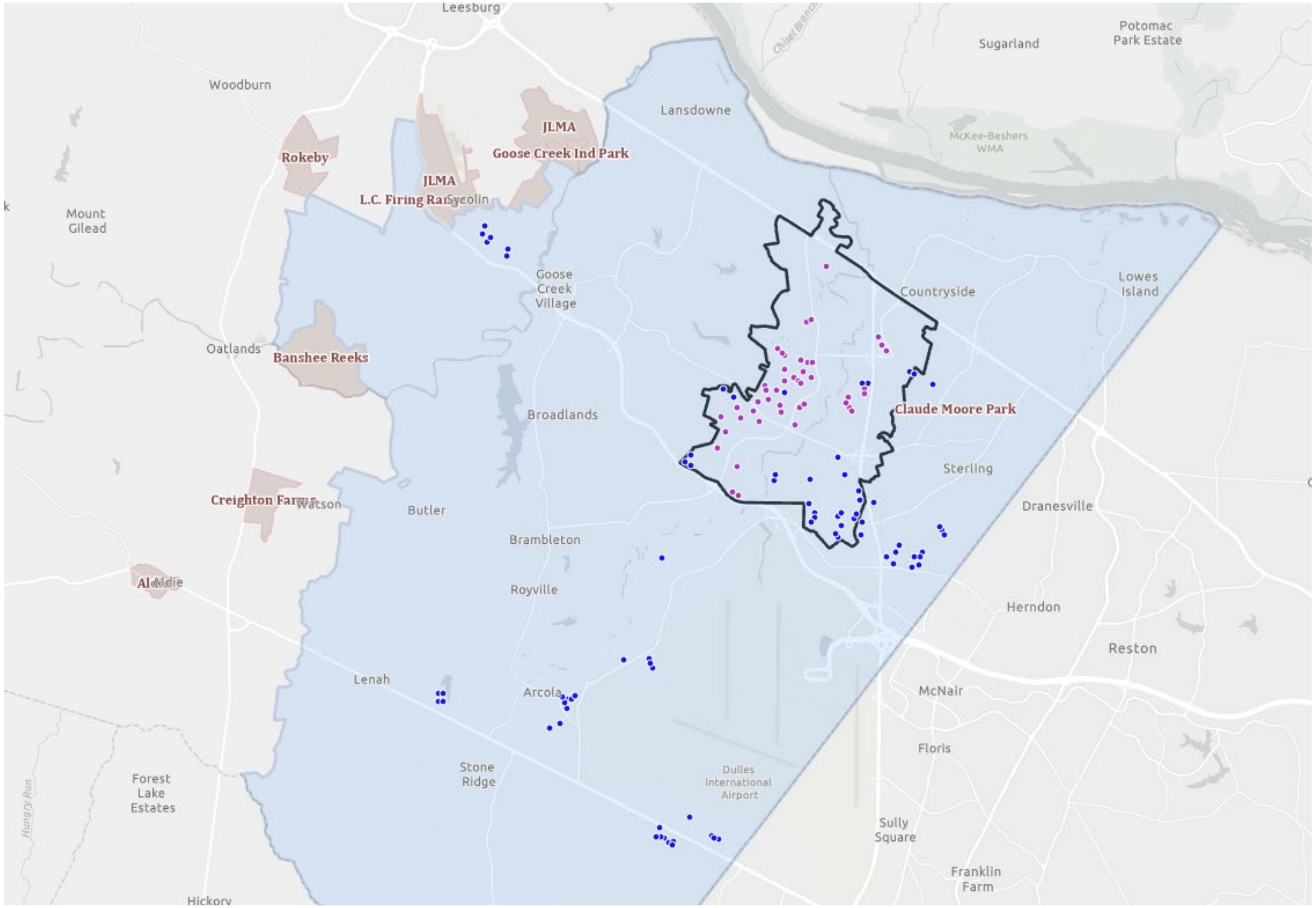
Reclaimed Water Service Area



RW Cooled Data Centers

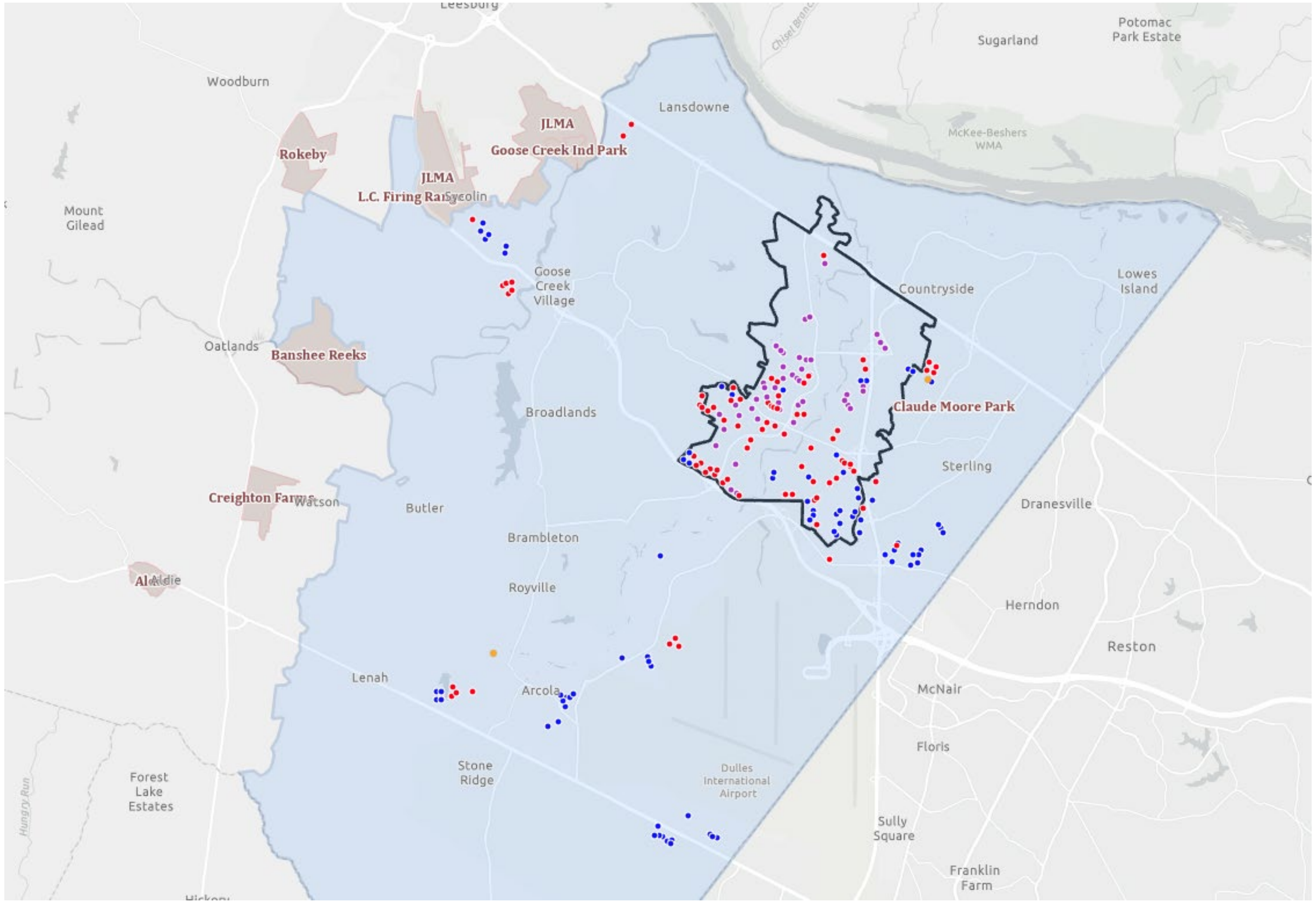


Potable Water Cooled Data Centers

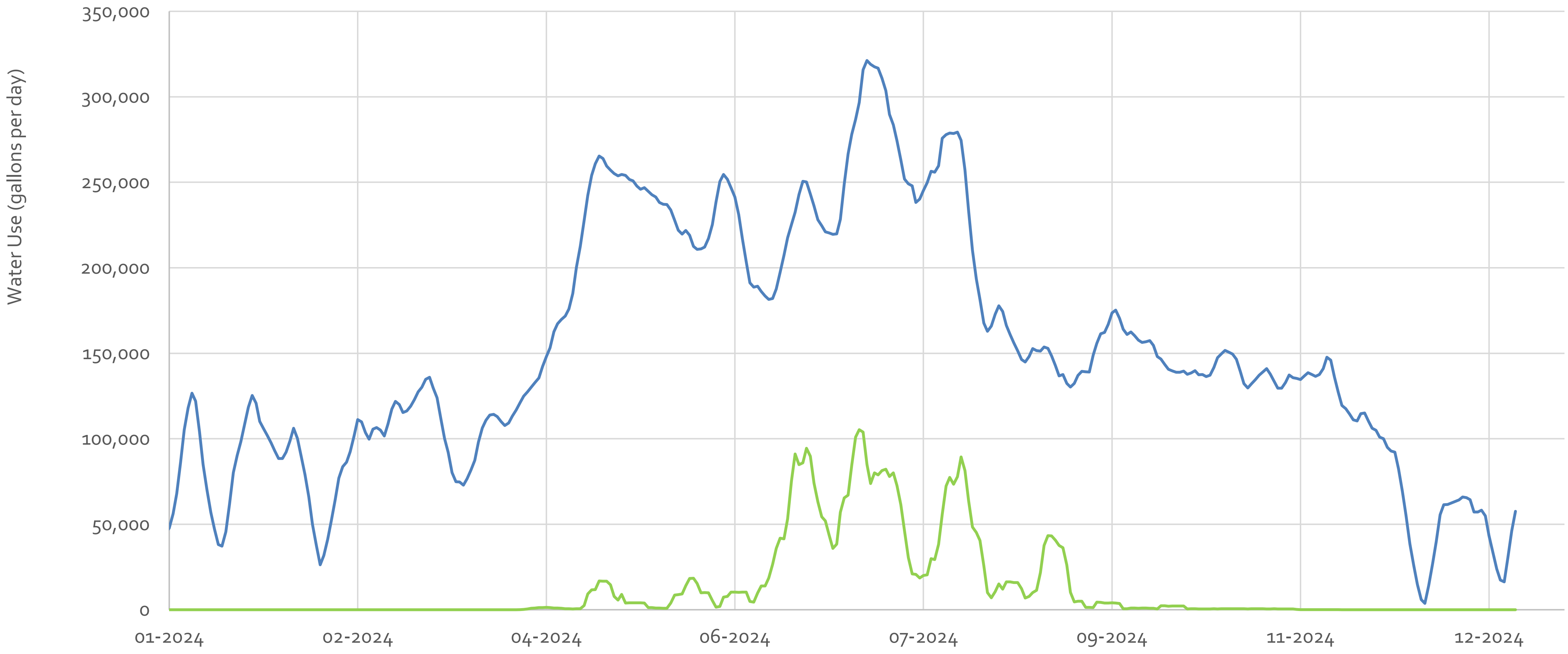


Air Cooled Data Centers

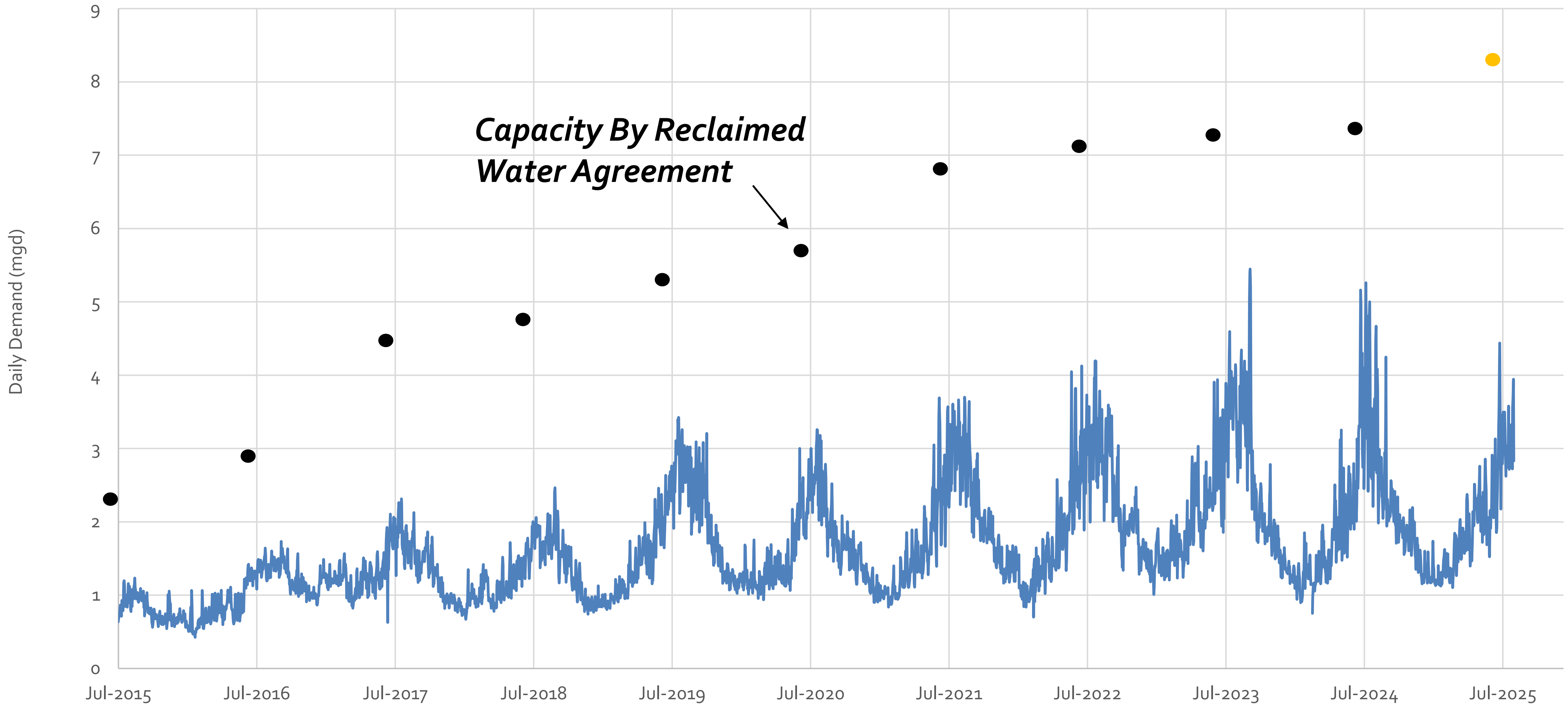
LOUDOUN WATER



Different Data Center Use Examples



Reclaimed Water Demands



9VAC25-740-70 Standards for Reclaimed Water

LOUDOUN WATER

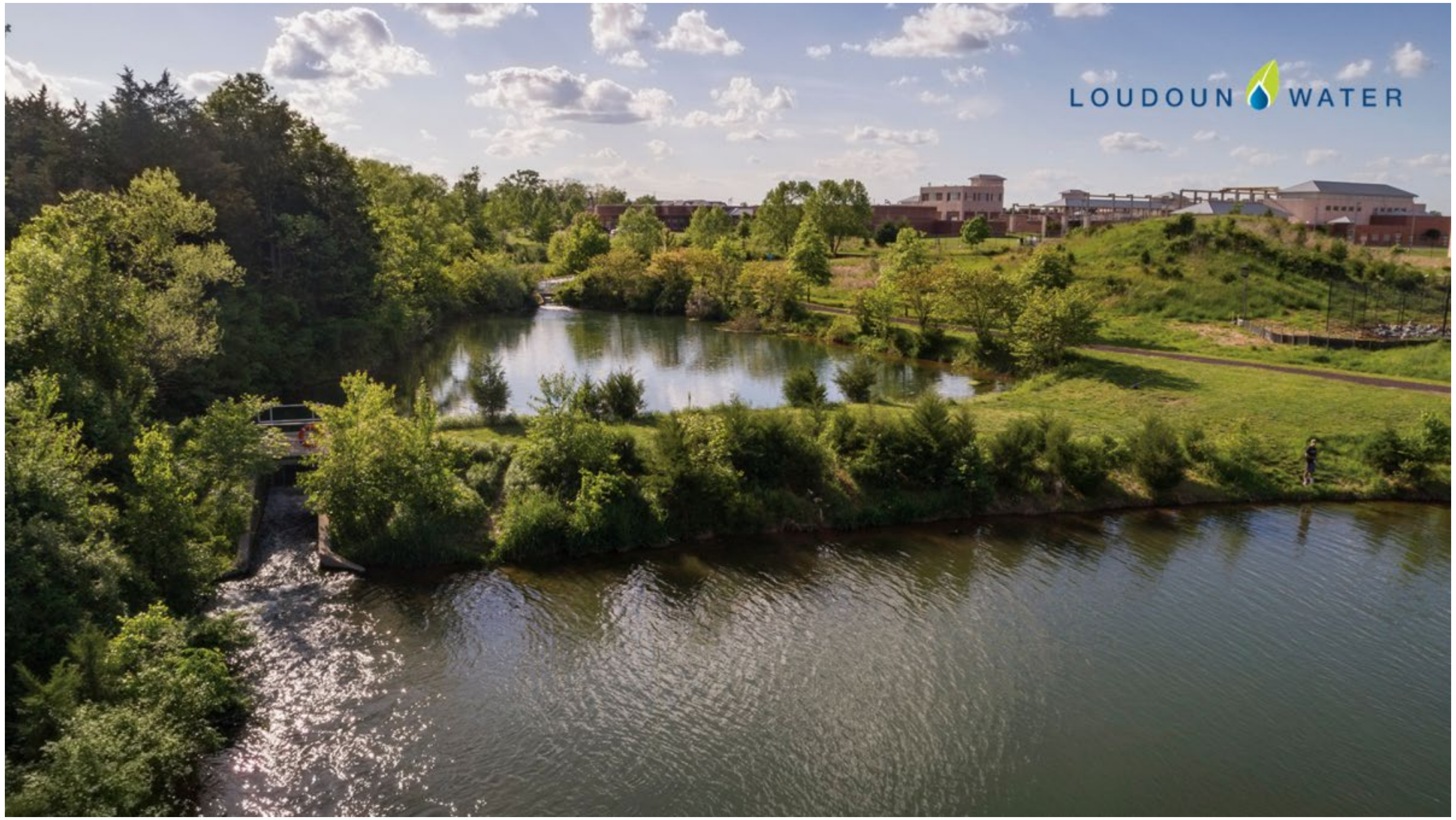
Parameters	Standard [1]	Units	Frequency	Sample Type
E. coli [2]	Geometric mean [3]: ≤ 11	Colonies/100 ml	5D/W [4]	Grab
	CAT: 35	Colonies/100 ml	NA	Grab
Total Residual Chlorine (TRC) [5]	NL	mg/L	Continuous	Recorded
	CAT: < 1.0	mg/L	Continuous	Recorded
pH	6.0 – 9.0	Standard Units	1/Day	Grab
BOD_5	≤ 10	mg/L	1/Month	Grab
COD	Monthly average: ≤ 50	mg/L	1/Week	Grab
Turbidity [6]	Daily average [7]: ≤ 2.0	NTU	Continuous	Recorded
	CAT: > 5.0	NTU	Continuous	Recorded

Loudoun Water

Reclaimed Water Quality

	E. Coli CFU/100mL	TRC mg/L	pH	BOD5 mg/L	COD mg/L	Turbidity mg/L	TN mg/L	TP mg/L	TDS mg/L
2020	<2	3.8	6.9	<2	9.9	0.14	3.4	0.05	392
2021	<2	3.9	6.9	<2	11.2	0.14	3.7	0.06	413
2022	<2	4.0	6.9	<2	11.3	0.22	3.5	0.05	412
2023	<2	3.9	6.9	<2	10.7	0.45	3.5	0.05	409

Thank You



Kendra Sveum
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Part I: Discussion

Part II: Permitting Approaches for Data Centers

Pat Heins
(Oregon Department of Environmental Quality)

Walter Ariss
(Ohio Environmental Protection Agency)

Art Jenkins
(Washington Department of Ecology)

Don Bloomquist
(Washington Department of Ecology)

Reuse / Water Quality Permitting for Data Centers

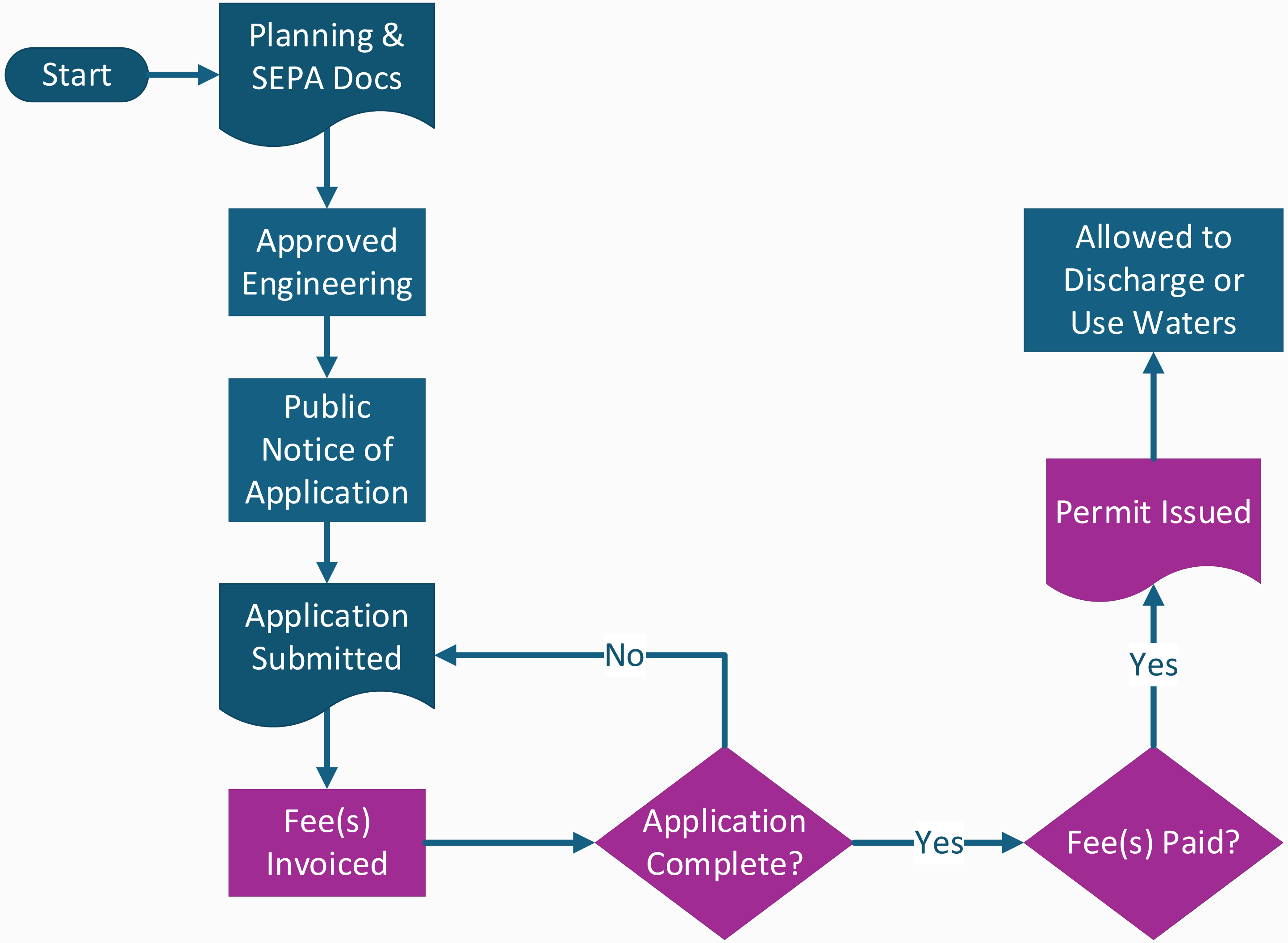
Art Jenkins & Don Bloomquist

12/3/2025

Outline

- Path to Permitted Discharge or Use
- Planning & SEPA
- State’s Water Quality Permitting
- Pre-project Process / Permitting Rationale
- Current Process
- Permitting Requirements & Results

Path to Permitted Discharge or Use



Planning & SEPA

- State Environmental Policy Act (SEPA)
- Requires project proponents to complete checklists and submit project concept or plan.
- Reviewing agencies (including the Department of Ecology) comment on possible environmental permitting / requirements for the project.

WQ Permitting Based on Discharge to Waterbody Type (RCW 90.48)

Discharge to Ground: State Waste Discharge Permit

- WAC 173-200 (standards)
- WAC 173-216 (permit program)
- WAC 173-240 (engineering)

Discharge to Surface Waters: State/Federal NPDES Permit

- WAC 173-201A (standards)
- WAC 173-220 (permit program)
- WAC 173-240 (engineering)

Reclaimed Water (RCW 90.46)

1. Reclaimed water (WAC 173-219)

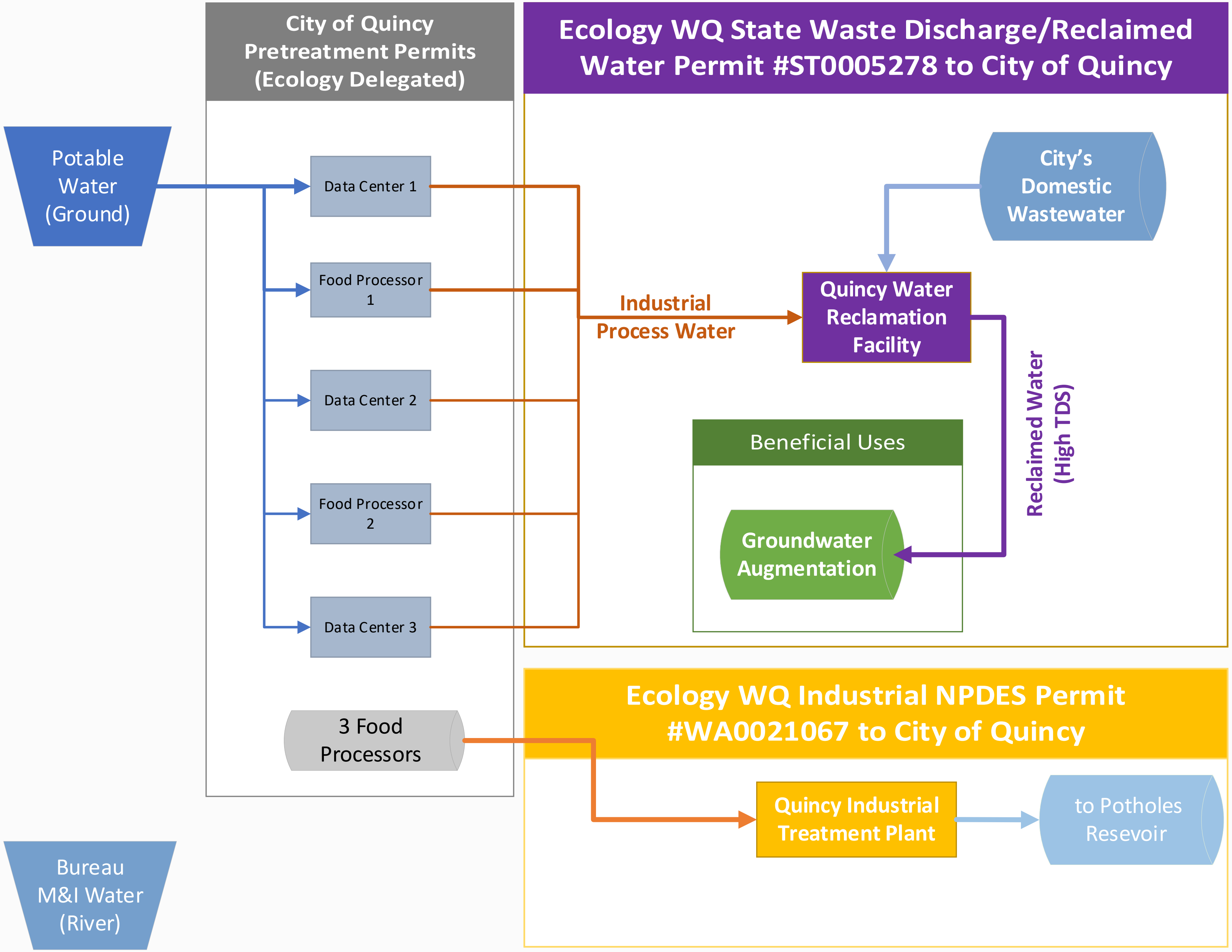
- <u>Domestic</u> wastewater source from greywater, toilet or urinal
- After adequate & reliable treatment, suitable for <u>beneficial</u> uses

2. Industrial reuse water

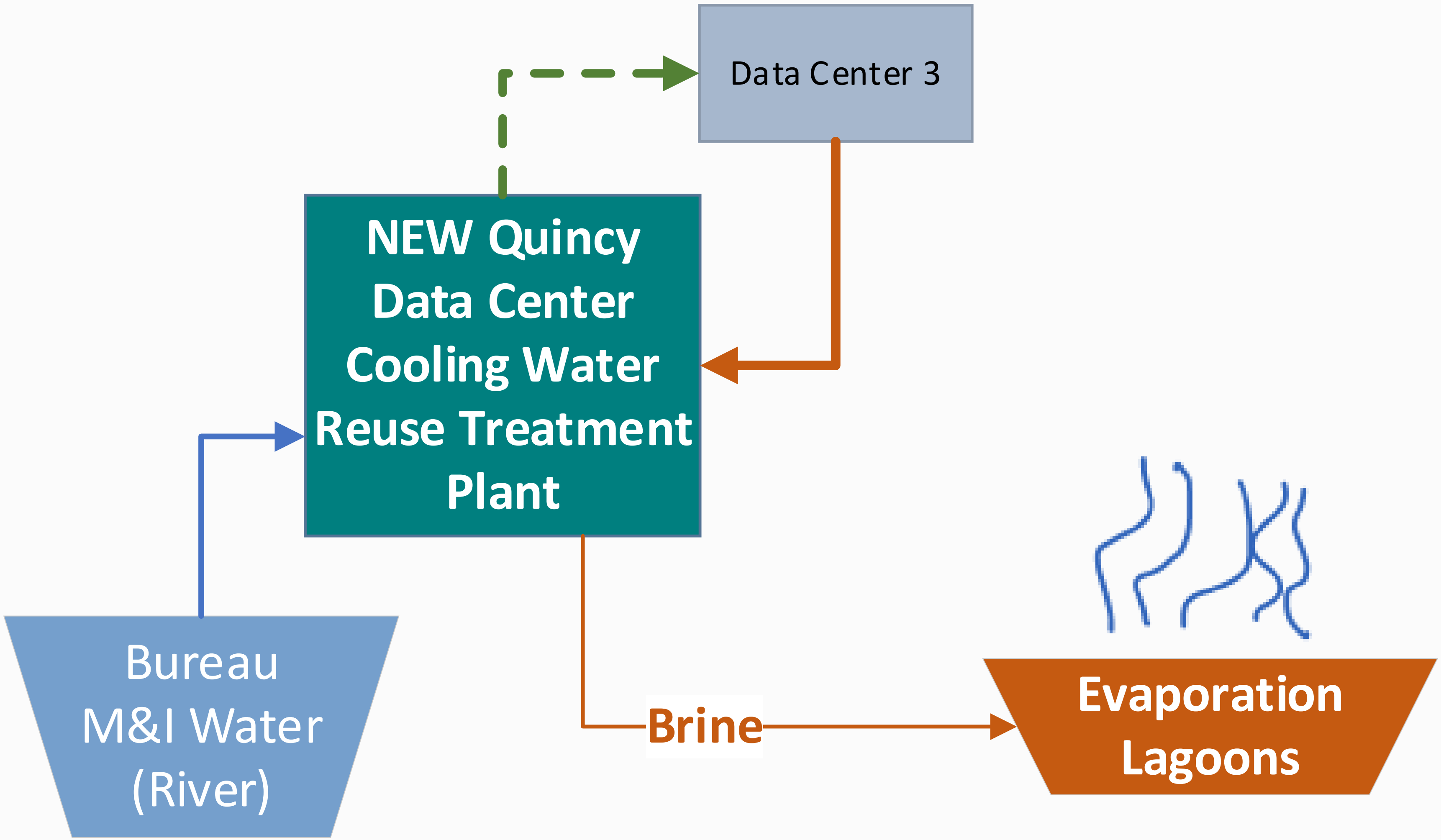
- Source: <u>Industrial</u> process wastewater
- After adequate & reliable treatment, suitable for <u>other</u> uses

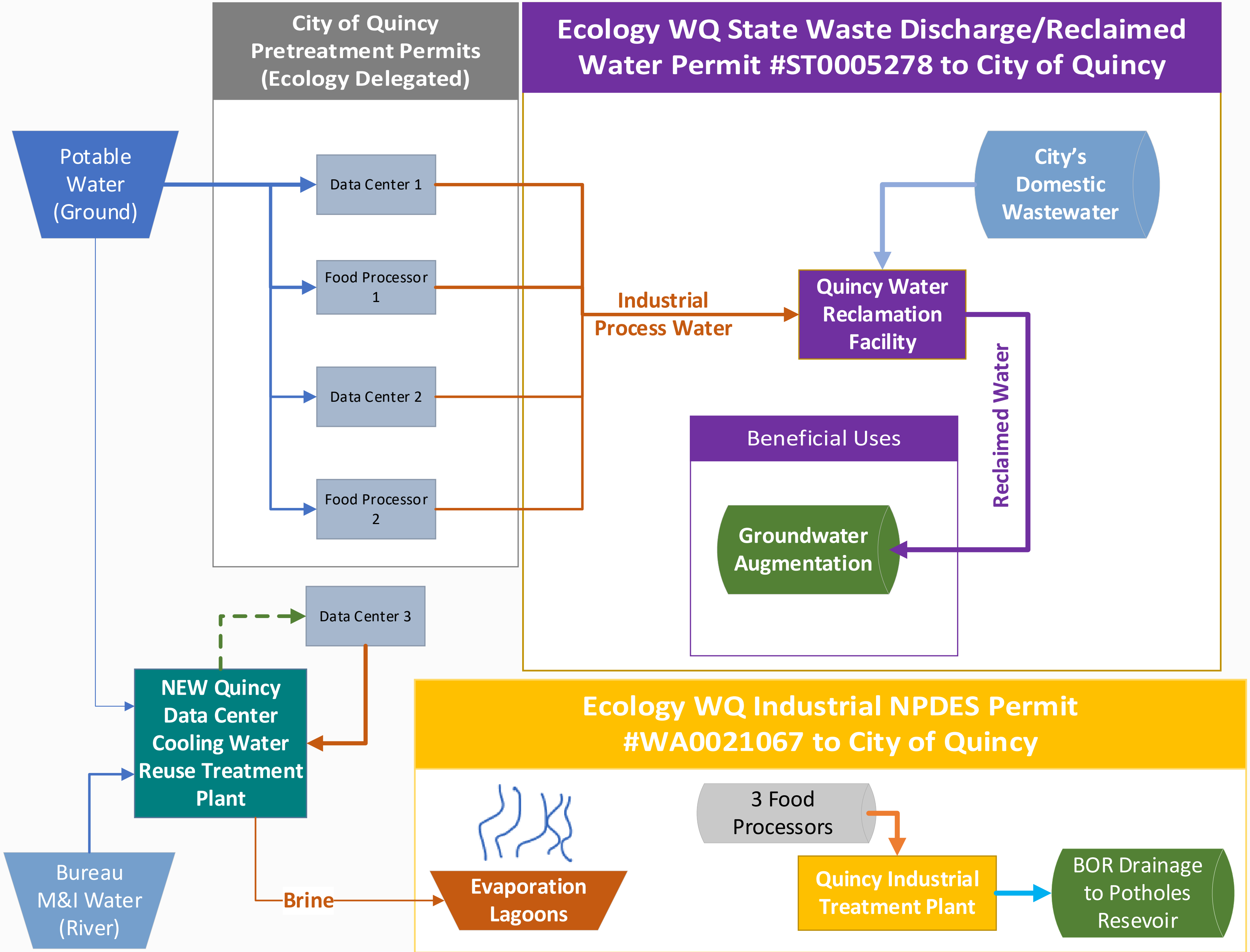
3. Agricultural industrial process water

- Source: <u>Agricultural</u> processing
- After adequate & reliable treatment, water is suitable for <u>other agricultural</u> uses


City of Quincy Pretreatment Permits (Ecology Delegated)
Ecology WQ State Waste Discharge/Reclaimed Water Permit #ST0005278 to City of Quincy
Potable Water (Ground)
Data Center 1
Food Processor 1
Data Center 2
Food Processor 2
Data Center 3
3 Food Processors
City's Domestic Wastewater
Industrial Process Water
Quincy Water Reclamation Facility
Reclaimed Water (High TDS)
Beneficial Uses
Groundwater Augmentation
Ecology WQ Industrial NPDES Permit #WA0021067 to City of Quincy
Quincy Industrial Treatment Plant
to Potholes Resevoir
Bureau M&I Water (River)

Proposed Solution




City of Quincy Pretreatment Permits (Ecology Delegated)
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Potable Water (Ground)
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Food Processor 2
City's Domestic Wastewater
Industrial Process Water
Quincy Water Reclamation Facility
Reclaimed Water
Beneficial Uses
Groundwater Augmentation
Data Center 3
NEW Quincy Data Center Cooling Water Reuse Treatment Plant
Bureau M&I Water (River)
Brine
Ecology WQ Industrial NPDES Permit #WA0021067 to City of Quincy
Evaporation Lagoons
3 Food Processors
Quincy Industrial Treatment Plant
BOR Drainage to Potholes Resevoir

Figure 13: Quincy Industrial Brine Ponds

Permitting Requirements & Results

- Industrial NPDES Permit for Evaporation Pond:
  - Must sample brine pond influent for flow, TDS, and other parameters
  - Brine water influent not to exceed concentration of 35,000 mg/L for TDS.
  - A leak detection plan for the brine ponds
  - Sampling of listed parameters if leak(s) detected
  - Solids Management of Residuals

DEPARTMENT OF
ECOLOGY
State of Washington

Thank you

For project specifics see:
https://www.epa.gov/waterreuse/water-reuse-case-study-quincy-washington

Contact: Don Bloomquist dobl461@ecy.wa.gov

Part II: Discussion