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Data Center Considerations for Municipal Providers

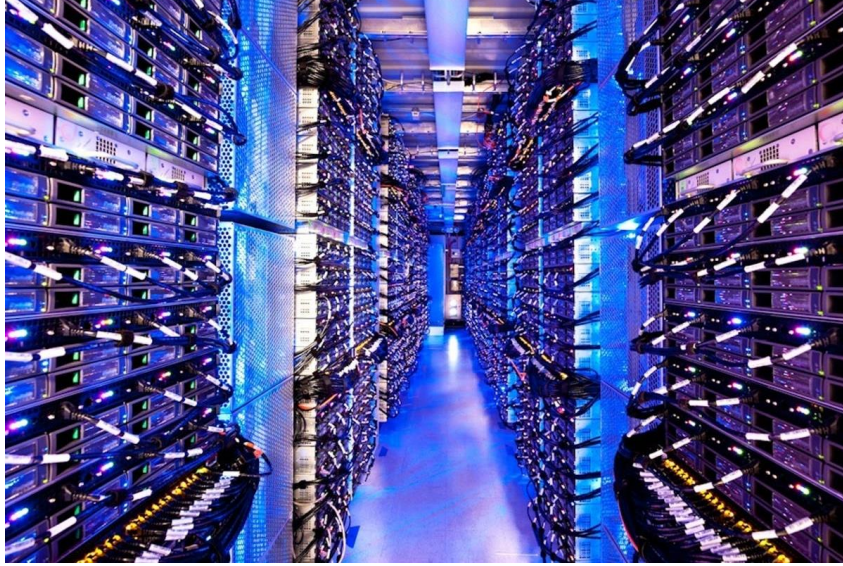
~Data Center 101: What-Why-How

~ Technical Considerations: Water and wastewater

~Municipal considerations for Data Center Development

What is a data center? (and common terminology)

"Where the internet lives": large buildings filled with servers and computers to store, process, and distribute data



"Enterprise"

For their own use (including services to others)

~Highly optimized/engineered for efficiency

~Corporate image drives sustainability efforts

aws

Meta

Google

Microsoft Azure

Colocation "Colo"

Multiple tenants; often one "anchor tenant"

~Prioritize flexibility in design over optimizing

EQUINIX

CORESITE

DIGITAL REALTY

CyrusOne

QTS

Developer Led/PE

Private Equity/Developers: do not operate

~Varying degrees of certainty

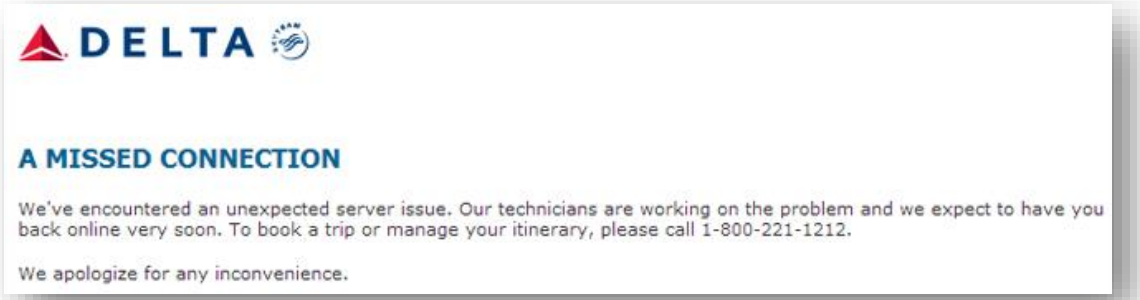
POWER HOUSE DATA CENTERS

o'leary ventures

BERKSHIRE HATHAWAY ENERGY

Key Considerations for DC Owner/Operator/Developers

- **Latency:** response time from Device=>Data Center=>Device
  - **Use Case**
    - High Frequency Trading/DoD (<1ms to microsecond)
    - Edge Computing (<10ms)
    - Gaming/Streaming (20-50ms)
    - Cloud Computing (50-150ms)
  - **Factors**
    - Geographic proximity near user base
    - Network proximity & Fiber density
- **Uptime:** High expectations from consumers
  - **"Five-nine" reliability** => 99.999% uptime = 5.25min/year downtime; 99% => 3.65 days/year downtime
  - Include Server maintenance.
  - Translation: **WATER CANNOT BE THE REASON FOR DOWNTIME**



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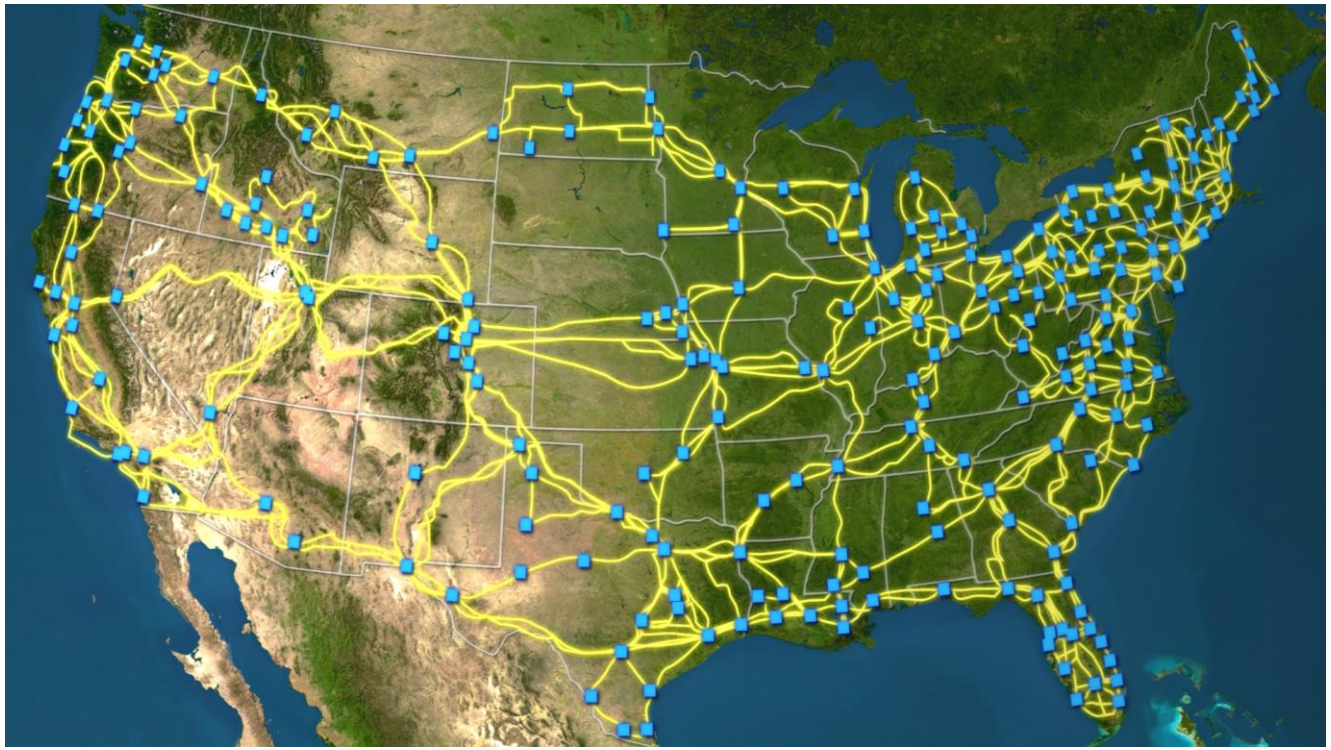
Factors for site selection and why Ohio?

- State Tax Incentives
- Land prices/availability
- Power costs/availability
- Fiber Optics
  - Proximity and connectivity
- Skilled labor force
  - Construct and Operate
- Climate & Natural Disasters
  - Operational risk and insurance costs
- Economic Development
  - State and local driver to attract industry
- Sustainability
- Water/Wastewater
  - Often considered a secondary criteria, until its



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History of Water in Site Selection

Historically

- Land with power, fiber, and water was available near population centers
- Water was well-developed utility: reliable, distributed to population, and available

Recently

- Water challenges have increased demand
  - Increased number and power density of facilities
- Trend to move to more rural locations
  - Land more available/ affordable
  - Water/wastewater infrastructure and capacity less developed

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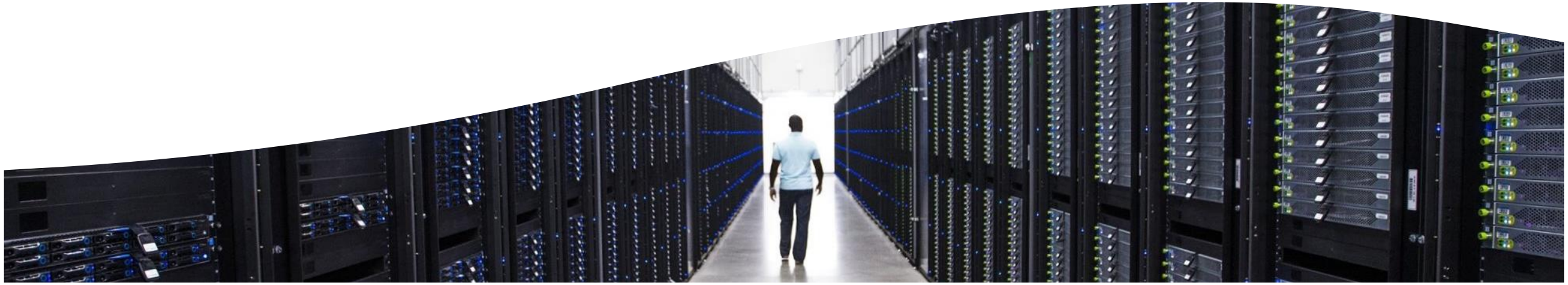
Technical Considerations

Power/heat and cooling water nexus; water/wastewater quantity/quality demands



Water and Wastewater Overview

Cooling water is the Elephant….in the room

Water Demands

Industrial Water

- **COOLING WATER (if required)**
  - **- Data center computing requirements/type**
  - **- Cooling type**
- Fill and Flush (pipe passivation during commissioning)

Everything Else

- Construction water (dust control, soil conditioning, concrete batching, etc.)
- Potable water (sinks, toilets, kitchens for onsite staff)
- Firewater (NFPA and local requirements)
- Landscape irrigation

Wastewater Discharges

Industrial Water

- **Cooling blowdown (if required)**
- Fill and Flush (pipe passivation during commissioning)

Everything Else

- Domestic wastewater

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Cooling Considerations

- **Why do we need to cool?**
  - Power for processing = heat generation = need for cooling
  - Hot chips degrade faster and run less efficiently
  - CPU vs GPU = 10x (Nvidia, ADM, Intel)

- **PUE/WUE Relationship**
  - **Power Use Efficiency (PUE):** measures energy efficiency by comparing power consumption of the facility to power used by IT equipment.
  - **Water Use Efficiency (WUE):** measures how efficiently water is used by comparing the amount of water used for cooling to the amount of energy used to power IT equipment (m^3/MWh)
  - Water isn't **NECESSARY** to cool, but it does improve PUE

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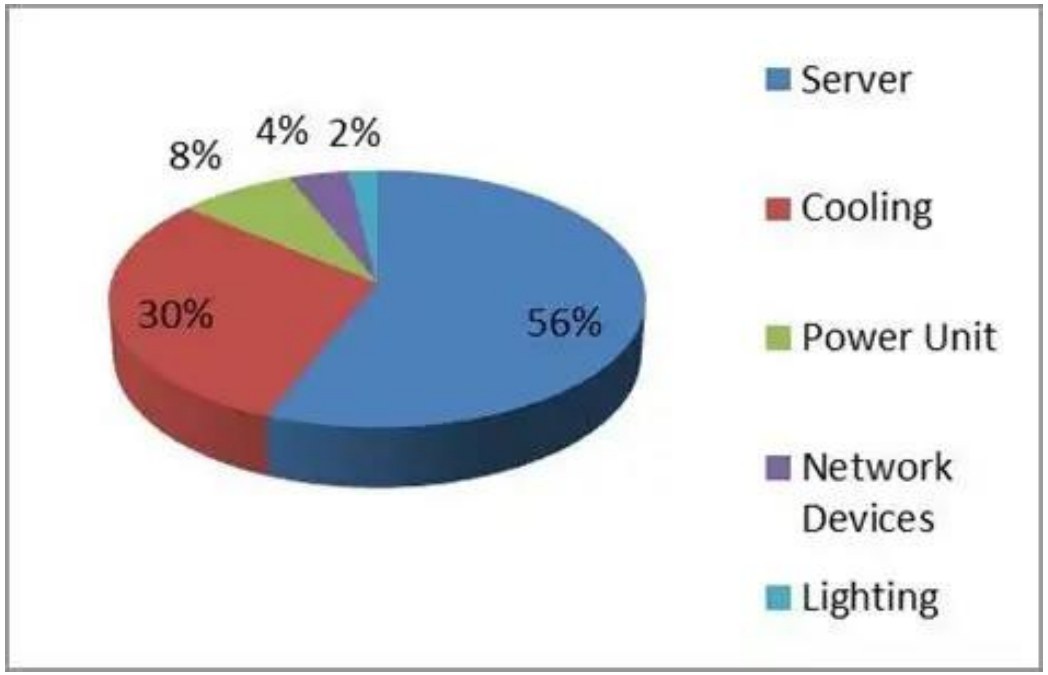
The Power, Cooling, Water Nexus

Hyperscale Data Centers – High Power Needs

- Typically, 1 to 3 GW (GW is 1,000 MW)
  - 1 GW powers 800,000 homes
- Cooling energy 10% (wet) to 30% (dry) of total power demand



Kyger Creek – Cheshire, Ohio - 1 GW Coal

Lordstown Energy Center Ohio – 1 GW Natural Gas

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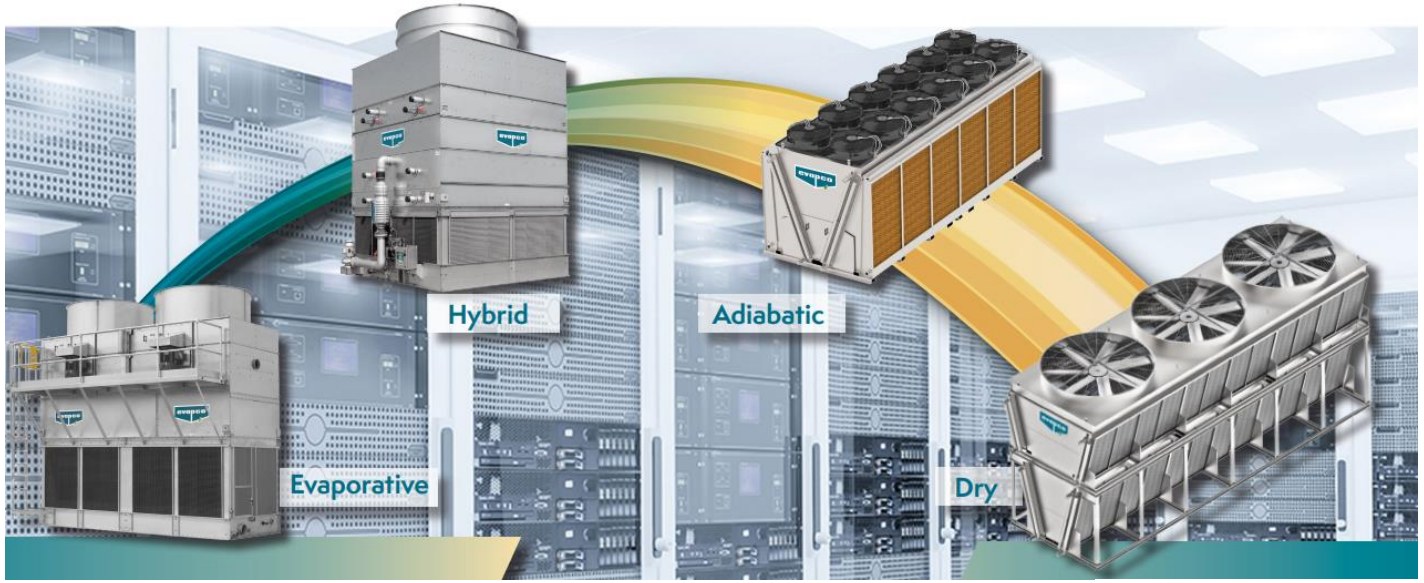
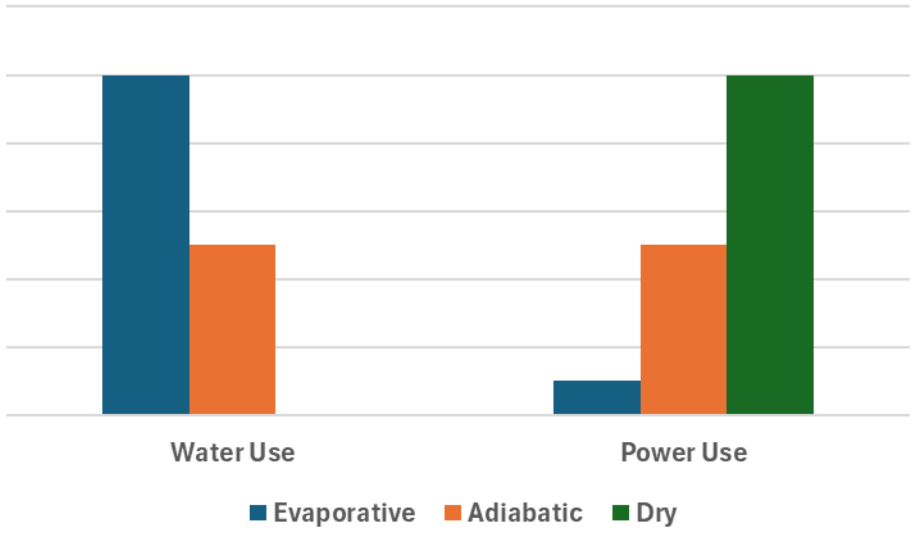
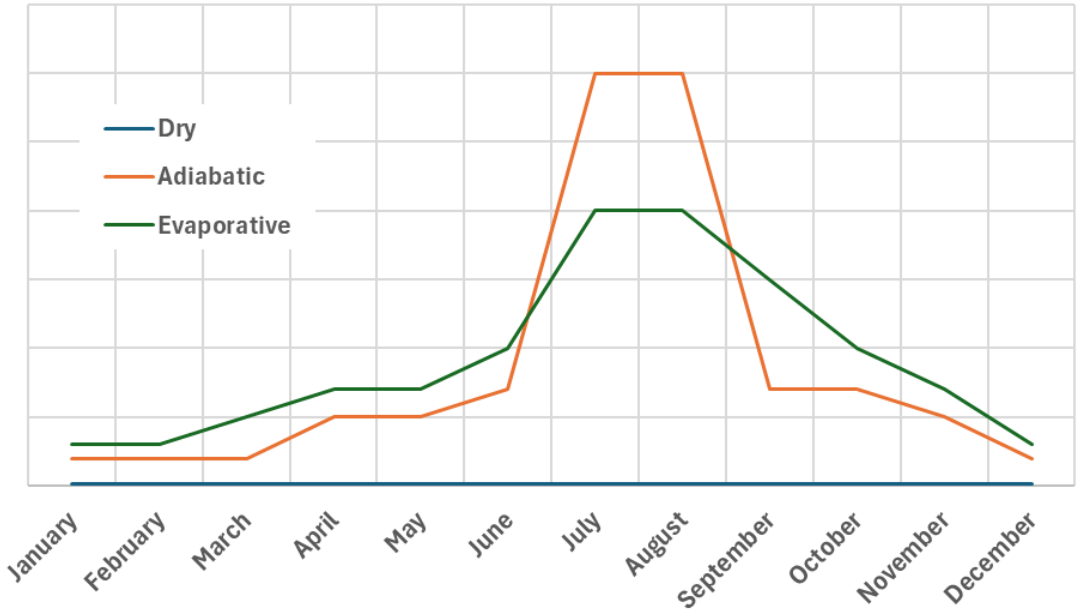
Data Center Cooling Types and Attributes



Keys

- Less water for cooling means more power use
- Less water cooling at site may mean more water use at power supply
- High seasonal variability for cooling water





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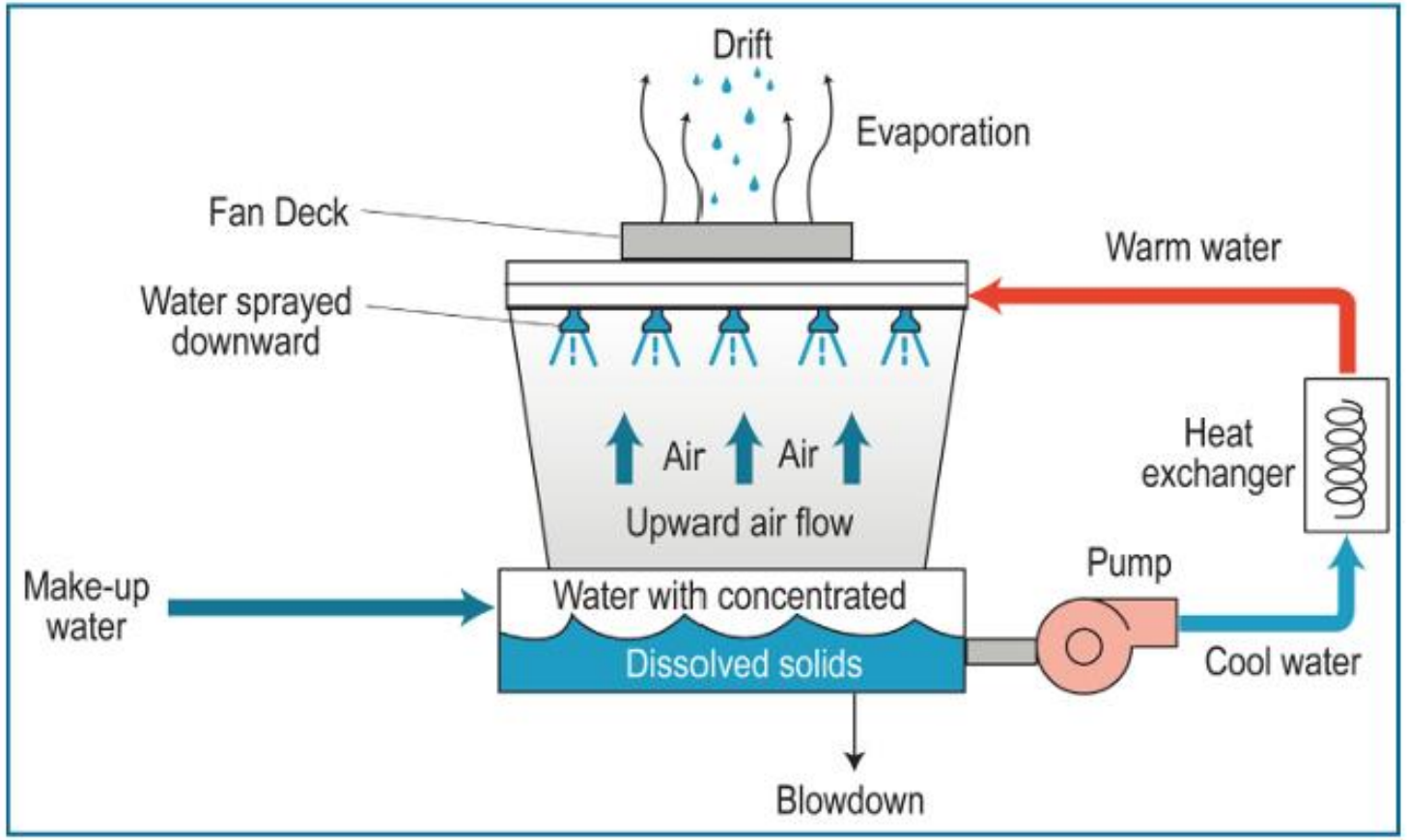
Data Center Cooling – Evaporative Cooling Concepts

$$COC = \frac{\text{Conductivity of recirculating water}}{\text{Conductivity of makeup water}}$$

Keys to CT Design and Operation

- Water is an excellent cooling medium
- Operational Goal is to limit corrosion, scaling, and biofouling
- Control Cycles of Concentration



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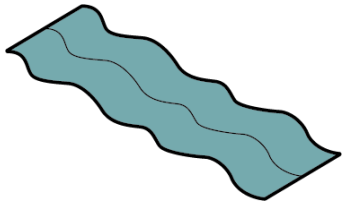
Water balance for water cooled data center

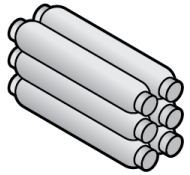
Evap/Drift

CT Makeup



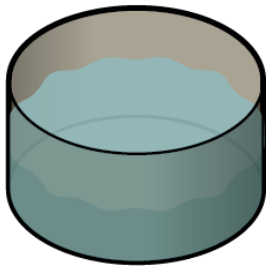
Cooling Water Source can be:

- Potable
- Surface water
- Groundwater
- Reclaim

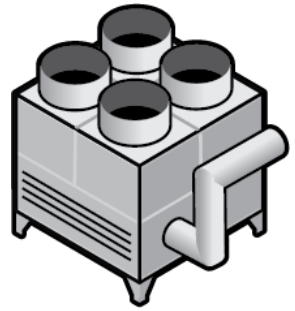


Treatment for corrosion/scaling

- pH, TSS, TDS, disinfect, softening

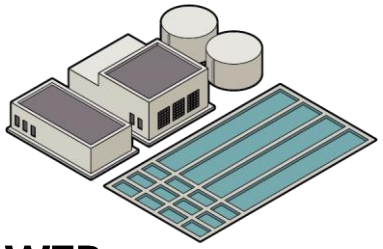


Storage



CT Blowdown:

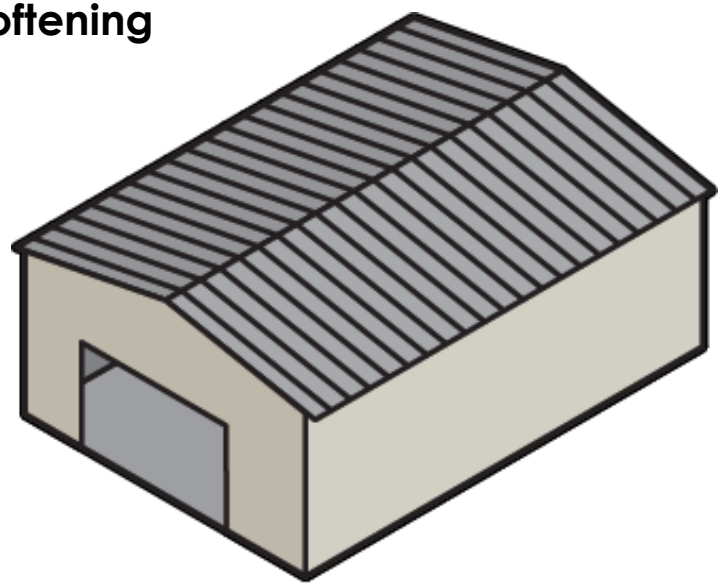
- POTW
- Surface Water
- Deep Well
- Reclaim



WTP

Data Center Supply

- Construction
- Flush and Fill
- Potable Supply
- Firewater

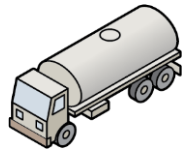


Data Center

Data Center Discharge

- Domestic WW
- Flush and Fill

POTW



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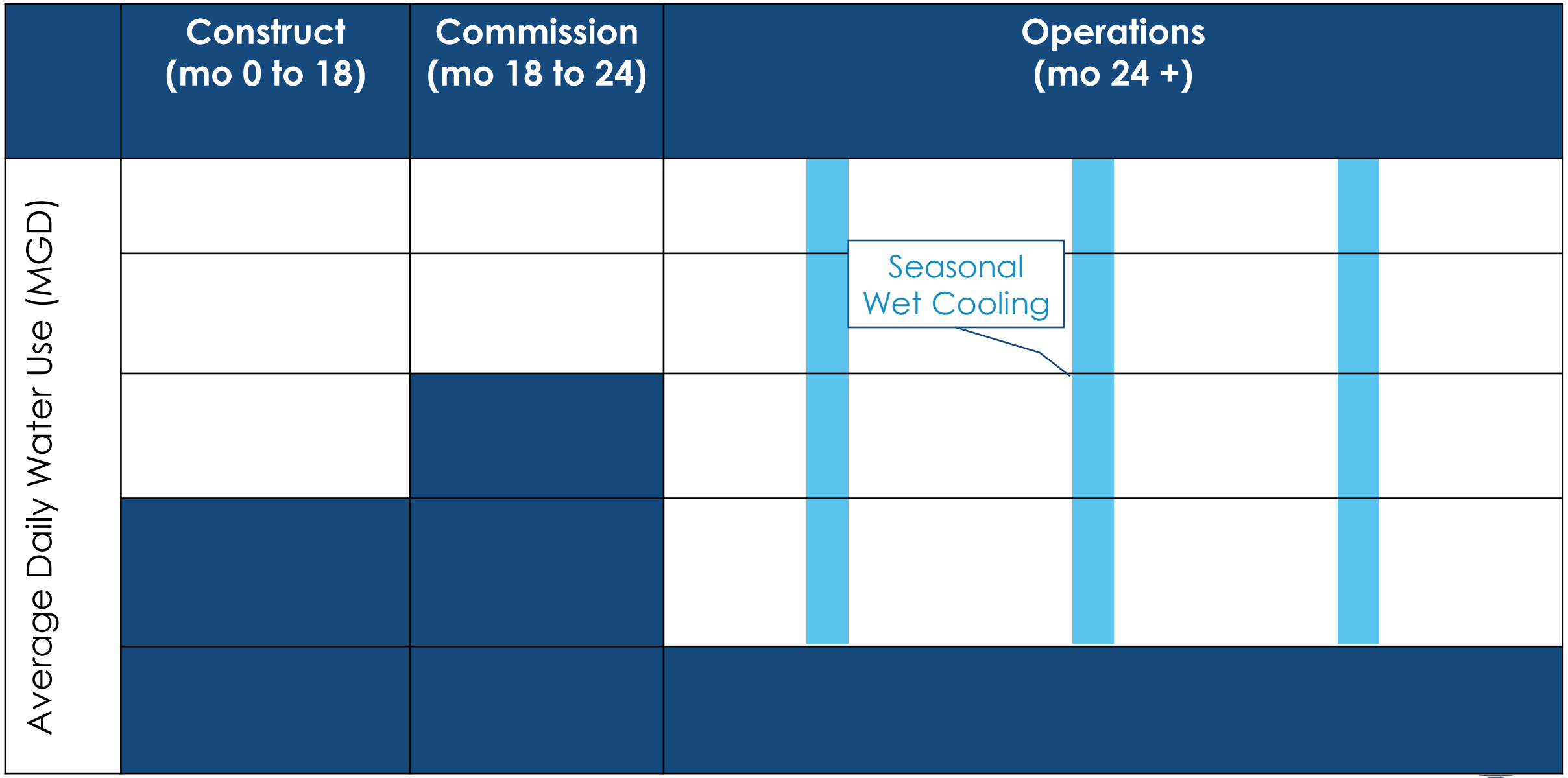
Water and Wastewater - Quantity Lifecycle

Hypothetical Data Center Facility



Water and Wastewater Quality

Water Quality Requirements

- **Ultrapure (better than potable)**
  - Flush and Fill – just during commissioning
- **Potable**
  - Sinks, restrooms, kitchens for onsite staff - steady
  - Firewater - intermittent
  - Landscape irrigation - seasonal
- **Cooling Water**
  - Can be Non-potable but does need to control non-corrosion and non-scaling
  - May need softening, pH control, disinfection, etc.
  - **HIGHLY** variable and season (more during hot days in summer)
- **Non-Potable**
  - Construction water (dust control, soil conditioning, concrete batching, etc.)

Wastewater Discharges

- Fill and Flush (pipe passivation during commissioning) – complex only during commission
- Cooling blowdown (if required) – No BOD or TSS, but higher TDS and possible additives
- Domestic wastewater – steady, typical quality

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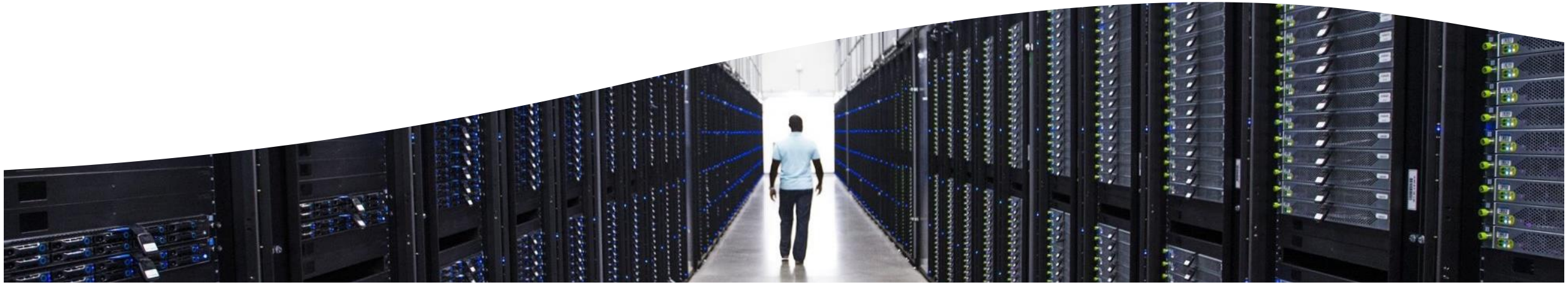
Municipal Considerations

Talking points and suggestions in support of our municipal clients



Municipalities and Data Center Interactions

- Data Center = Industrial Entity
- Things to remember from the start
  - Information Sharing – 2-way street
  - Mutual Benefit Discussion – goals may not be the same, but they parallel
  - Flexibility – How to get from here to there will require changes along the way

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Data Centers and Data Sharing

What to Ask and When?

- Highly Competitive Space
  - Real Estate, Technology Use, Silent Partners, etc.
  - Multiple entities may be looking
- Non-Disclosure Agreements (NDAs)
  - Permits and protects all the parties during project development
- Uncertainty and Change
  - Very likely that conceptual analysis is still ongoing when discussions begin
  - **Due diligence is ongoing at the early stages**

Common Information Discussion

Topic	Questions to Ask	Questions to Answer
Water/Wastewater Quantity	Demand Projections?	System Reliability?
Water/Wastewater Quality	Water Quality Requirements?	Water Quality Variability?
Implementation Schedule	Project Timeline?	Delivery Expectations?
Variability	Lifetime Variations?	System Sensitivity?
Flexibility	Process Changes?	Future Modifications?

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What's Next?

Before Data Center Contact

- Know your System – Quality and Quantity
- Evaluate System Pinch Points and Shortfalls
- Contact and Align with Economic Development Agencies
- Review and Revise the Master Plan and Capital Improvement Program
- Keep Pre-Treatment and Water Use Agreements Up To Date

After Data Center Contact

- Seek First to Understand
- Clearly Communicate and Acknowledge Uncertainty
- Identify Cost-Sharing Opportunities
- Negotiate Long-Term Water Agreements

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Key Takeaways

- Engage Early and with Transparency
- Be open to Uncertainty and Managing Change
- Quantity and Quality are Important but so is Pace of Play

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Tim Harrison

Senior Associate

Industrial Regional Practice Lead – MWR

tharrison@hazenandsawyer.com

513.649.4480

Paul Krehbiel

Senior Principal Engineer

pkrehbiel@hazenandsawyer.com

513.469.5118

Thank You

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