2025 Report Card for America's Infrastructure

Drinking Water & Wastewater

December 11, 2025

2025 REPORT CARD FOR AMERICA'S INFRASTRUCTURE

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AMERICAN SOCIETY OF CIVIL ENGINEERS

Agenda

- Overview of ASCE Report Card
- Projects & Case Studies
- Panel Discussion
- Q&A

Speakers

Samir Mathur
Senior Vice President and Water Reclamation Practice Leader
CDM Smith

Lita Laven
Manager of Design – Plants
Northeast Ohio Regional Sewer District

Sunil Sinha
Professor & Director
Virginia Tech Sustainable Water Infrastructure Management Institute

Celine Hyer
Senior Vice President
ARCADIS

Presentation FYI

- Webinar is being recorded
- Recording and slides will be made available
- Attendee input via typed questions
- Send any technical issues/questions through the chat function

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2025 REPORT CARD FOR AMERICA'S INFRASTRUCTURE

2025 Report Card for America's Infrastructure

AVIATION	D+
BRIDGES	C
BROADBAND NEW	C+
DAMS	↑ D+
DRINKING WATER	C-
ENERGY	↓ D+
HAZARDOUS WASTE	↑ C
INLAND WATERWAYS	↑ C-
LEVEES	↑ D+
PARKS AND RECREATION	↑ C-
PORTS	↑ B
RAIL	↓ B-
ROADS	↑ D+
SCHOOLS	D+
SOLID WASTE	C+
STORMWATER	D
TRANSIT	↑ D
WASTEWATER	D+

America's Cumulative Infrastructure Grade

C

A	EXCEPTIONAL
B	GOOD
C	MEDIOCRE
D	POOR
F	FAILING

Key Trends

1.
Aging infrastructure systems are increasingly vulnerable to natural disasters and extreme weather events, creating unexpected and often avoidable risks to public safety and the economy.

2.
Recent federal and state investments have had a positive impact, but the full force of increased funding will take years to realize. Sustained investment is key to providing certainty and ensuring planning goes to development, as well as making larger infrastructure projects attainable.

3.
Unreliable or unavailable data on key performance indicators continues to impact certain infrastructure sectors.

Methodology

CAPACITY

OPERATION AND MAINTENANCE

CONDITION

PUBLIC SAFETY

FUNDING

RESILIENCE

FUTURE NEED

INNOVATION

National Trends in Drinking Water that Shaped the Grade

2021 Grade = C-　　　　2025 Grade = C-

- Capacity: ⬌
  - Nearly 150,000 public water systems, 93% serve communities of less than 10,000.
  - 2018 data showed public supply withdrawal of 39 billion gallons of water per day, but a 2024 study indicated estimates are likely higher.

- Condition: ⬌
  - Utah State reports a 20% annual reduction in watermain breaks per 100 miles of pipe totaling 240,000 breaks, down from between 250-300,000 (2018).
  - Continued challenges –
    - 2023: average life expectancy of pipes is 78 years, 6 years less than 2018 In FY23
    - 33.3 trillion gallons of water lost annually, resulting in $187 billion in lost revenue

- Funding:
  - Between 2012 and 2023, monthly household water bills increased by roughly 64%; however, AWWA reports that only 20% of utilities report being able to fully cover service costs.
  - Annual Federal DWSRF appropriations have remained flat since 2020; more than $1.5 billion of appropriated dollars have been set aside for earmarks since 2022 reducing available state loan funding.

- Future Need:
  - 2023: EPA 20-year drinking water infrastructure need estimated at $625 billion, two-thirds for transmission & distribution ($420.8 billion).
    - ➢ 30% increase from previous assessment ($473B, 2018).
  - 2024: ASCE Bridging the Gap found funding gap of $91 billion across the entire water sector, which is expected to grow to over $2 trillion by 2043.

- Operation and Maintenance:
  - AWWA Benchmarking Ratio of planned maintenance to reactive maintenance has increased slightly from 50% to 54% since 2021.
  - Workforce remains a challenge with EPA reporting 1/3 of utility operators eligible for retirement in the next 10 years and the median age at 48.

- Public safety:
  - Risk
    - Utilities are complying with Risk and Resilience planning but 70% of systems inspected violated assessment requirements due to cyber vulnerabilities reported by EPA.
  - Lead service lines
    - 2023 EPA assessment found approximately 9.2 million lead service lines that should be replaced within 10 years.
  - PFAS
    - USGS found present at some level in 45% of drinking water supplies.

- Resilience:
  - Climate change and the increased intensity of weather events continues to pose challenges.
  - AWWA 2023: 72% of water systems had completed risk and resilience assessments of their systems, despite completion of these assessments being required by all utilities by 2021.
- Innovation:
  - Greater use of digital technologies and data driven decision making to support greater efficiency.
  - AWWA 2024, 43% of utilities planned to install new IT systems or upgrade existing systems for water treatment, while 46% of utilities planned to install or upgrade digital meter reading systems.

National Trends in Wastewater that Shaped the Grade

2021 Grade = D+ 2025 Grade = D+

- Condition & Capacity:
  - Number of centralized systems increased to provide services.
    - 16k to 17.5k from 2012 to 2022.
  - Wastewater treatment systems are increasingly expected to produce advanced treatment requiring upgraded facilities.
    - Tightening environmental regulations, greater ability to detect contaminants, and changing public opinion about pollutants.
  - 2017-21, decreased integrity of the system.
    - Average number of failures for combined water systems grew from 2 to 3.3 failures per 100 miles of pipe indicating aging infrastructure.

- Operation and Maintenance:
  - 65% of utilities using digital tools to address O&M needs
  - 54% noted though data is being collected, its not effectively managed or leveraged
  - 45% are challenges by using legacy systems not meeting all needs

- Funding:
  - Average bill is increasing but not keeping pace with growing costs of O&M and related
    - Average of $35/month in 2010 to $65/month in 2020
  - 15% of 50 largest cities report having rates posing challenges to economically distressed households
  - CWSRF increased through IIJA by $1B in potential appropriations from 2021 levels to 2026 but most funding is allocated for disadvantaged communities and emerging contaminants

- Future Need:
  - 2024: ASCE Bridging the Gap found funding gap of $91 billion annually across the entire water sector, of which $69 billion is for wastewater and stormwater. Gap expected to grow to $690 billion by 2044
  - 2022: AWWA reported the renewal and replacement rate is between 1.5 – 2.1%. Significant underestimation is likely to be able to address enhanced treatment needs and address future emerging contaminants
- Public Safety:
  - EPA reports a slight drop in the number of combined sewer systems, 746 in 2004 to 738 municipalities today
  - Occurrences of SSOs at combined utilities have generally decreased over time
    - In 2015, 0.7 overflow events per 100 square miles of utility pipe falling slightly to .16 overflow events in 2021

- Resilience and Innovation:
    - Providing Research and Estimates of Changes in Precipitation Act (PRECIP Act) was enacted in 2022
        - Resources were directed to NOAA to determine probable maximum precipitation estimates to facilitate enhanced planning.
    - ENVISION framework adopted in 30 projects nationwide, 3 of which are wastewater in 2024. Ongoing efforts to promote resources for best practices in sustainability, resilience, and innovation with tools and fact sheets, and case studies developed by WEF and other professional organizations.

General Recommendations to Raise the Drinking Water and Wastewater Grades

- Encourage Asset management to helps prioritize limited funding
- Ensure utility rates cover full cost of service (develop affordability programs where necessary)
- Maintain investment levels provided by the IIJA and fully fund DWSRF and CWSRF Programs and continue to prioritize funding and support for lead service line removals
- Factor in resiliency toward climate change/severe weather needs during planning
- Expand collaboration between researchers, technologists, wastewater utilities and operators, and federal decision-makers to address 21st-century concerns such as PFAS (forever chemicals) or novel biological components.
- Where feasible merge smaller utilities
- Increase federal and local support to recruit, train, and retain the next generation of the workforce

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NORTHEAST OHIO REGIONAL SEWER DISTRICT

VT VIRGINIA TECH

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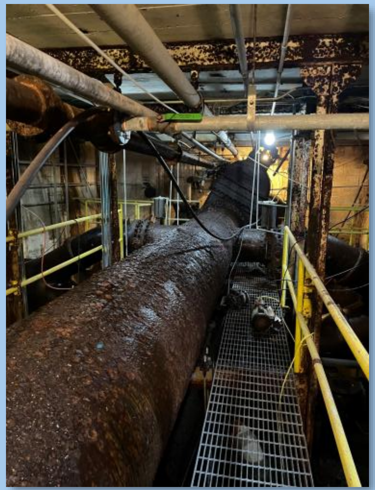
Agenda

- Drinking Water Market Trends
- Wastewater and Reuse Market Trends
- Intensification Processes in Wastewater
- Case Study – City of Wichita BNR Improvements Project

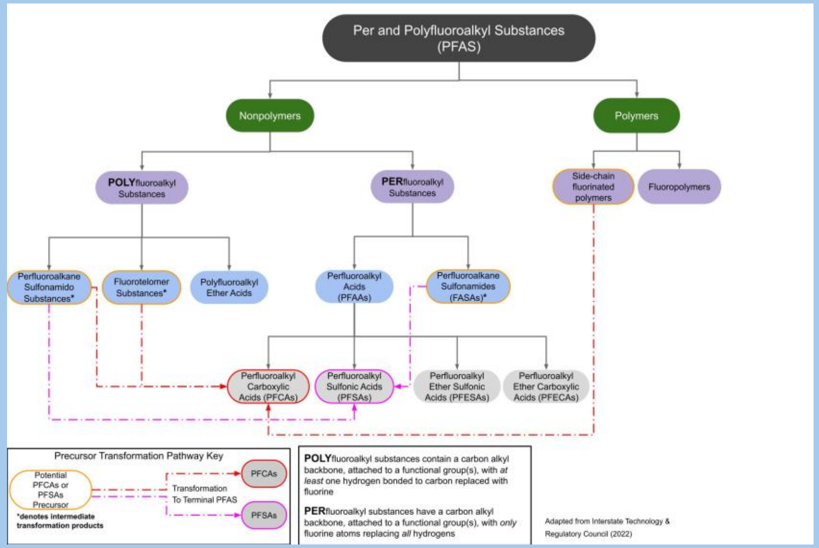
Drinking Water Market Trends

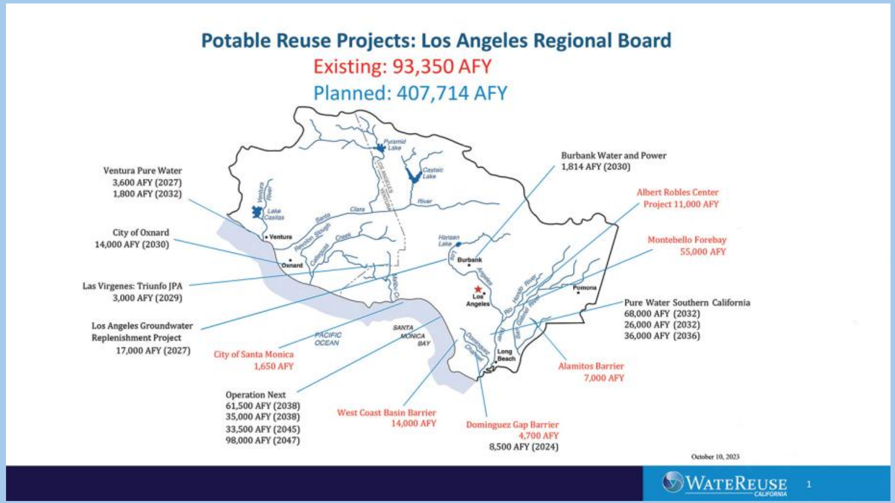
- Lead Service Line Replacement
  - Transition from push for initial inventories to ongoing LSL replacement and corrosion control studies
- Aging Infrastructure
  - Significant need to replace WTP processes across the USA
- Climate Change Impacts
  - Changes in treatment needed to address changes to source water quality (floods, fires, drought)



Wastewater Market Trends

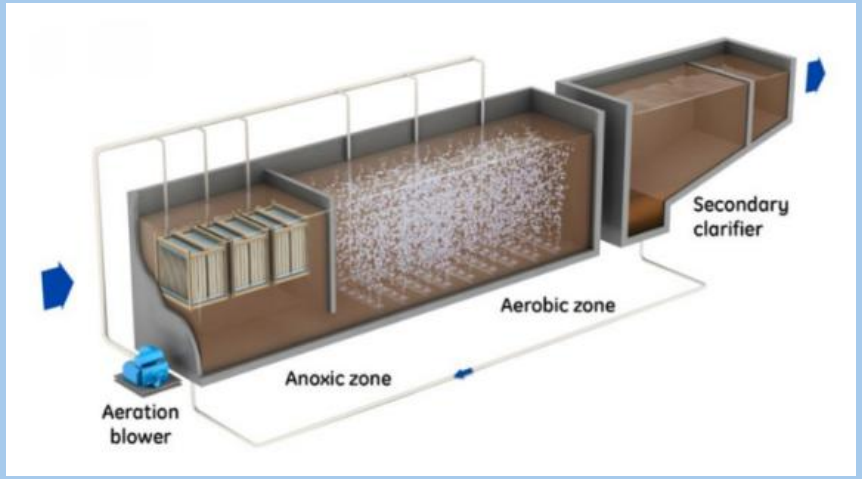
- PFAS in Wastewater and Biosolids
  - States are driving regulations
- Treatment Optimization and Efficiency
  - Aging infrastructure and lack of funding driving “doing more with less”
- Digital Tools
  - Digital Twin, O&M Assist, etc.
- Rapid evolution of DPR Regulations
  - CO, CA, FL, NM, AZ
  - Growth in “non-traditional” states (OH, IA, KS, IL)





Process Intensification in Wastewater Treatment

- Use of innovative technologies to make treatment more:
  - Efficient
  - Compact
  - Cost-effective
  - Benefits: lower energy use, less chemical reliance, higher capacity, better effluent quality, and increased resource recovery.
  - Examples: Aerobic Granular Sludge, Densification, Membrane Aerated Bioreactors, etc.



Case Study - City of Wichita, Kansas Wastewater Plant 2 BNR Improvements

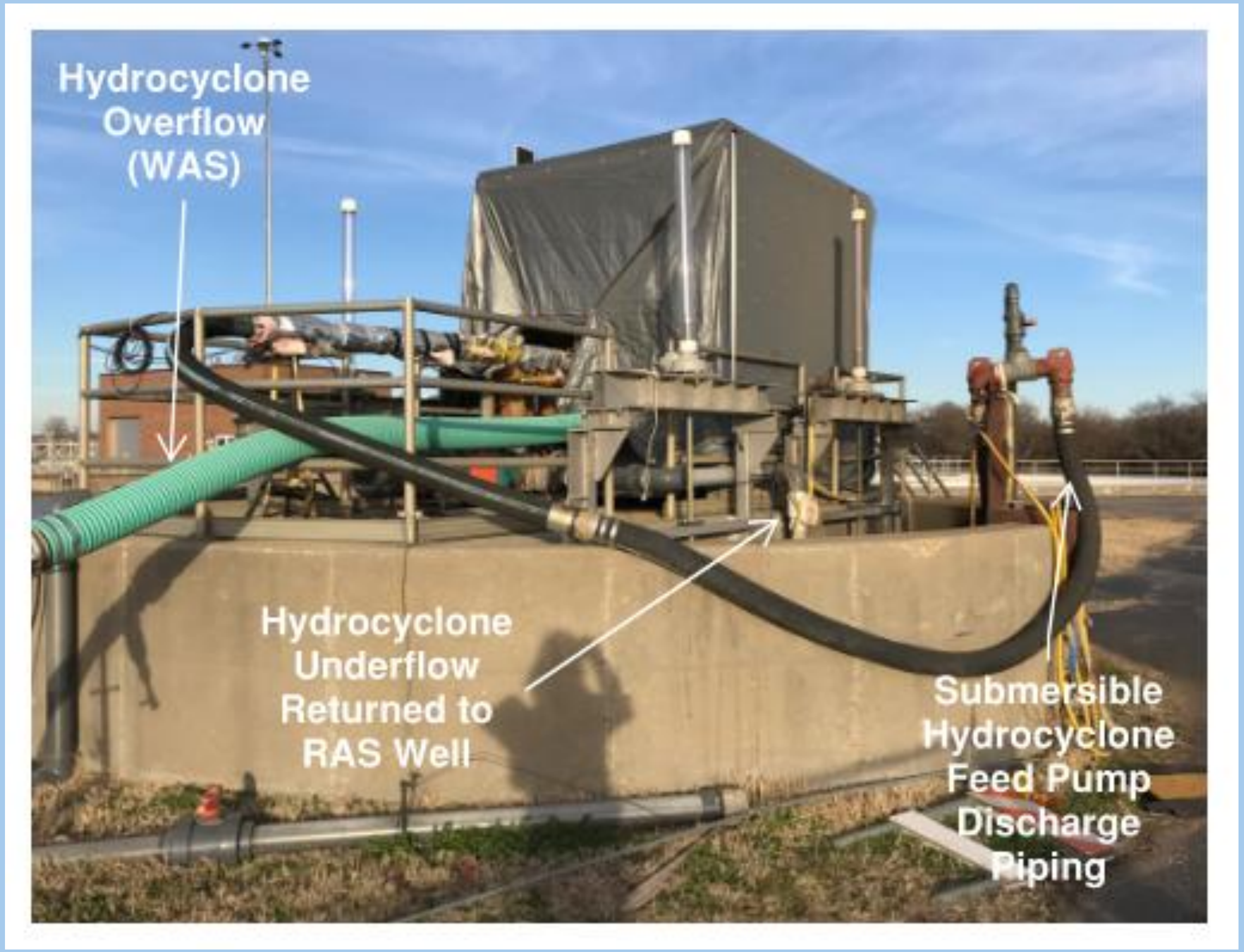
- **Permitted Capacity:** 54 mgd
- **Current Annual Average Flow:** 30 mgd
- Discharges to Lower Arkansas River

Existing Secondary Treatment: Trickling Filters and Nitrifying Activated Sludge

- Nitrifying activated sludge facilities were built in the late 1980s
- Existing aeration basins are not designed for BOD removal or BNR
- Three separate sludges:
  - Aeration Basins 1 and 2
  - Aeration Basins 3 and 4
  - Aeration Basins 5 and 6
- Trickling filters will be abandoned after construction is complete

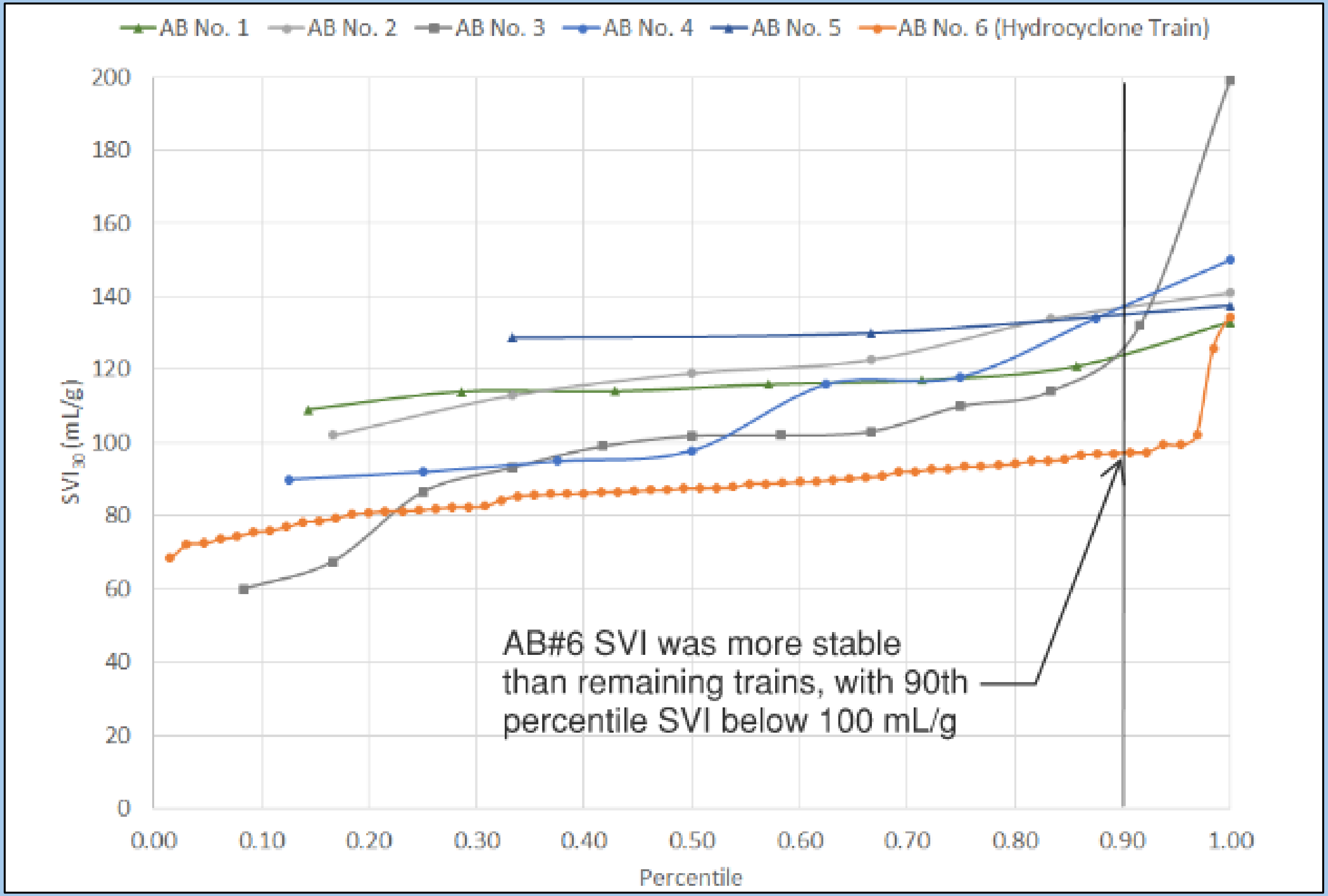
City of Wichita Plant 2 Hydrocyclone Pilot

- Installed in Fall 2020 at RAS distribution box to Trains 5 and 6
- Equipment installed:
  - A four-cyclone InDense Skid
  - A feed pump in RAS well
  - A cyclone underflow return pipe to effluent dropbox to Train 6
  - A cyclone overflow pipe to drain for sludge wasting
- Expanded in 2021 to perform all sludge wasting for ABs 5 and 6 through InDense



Pilot Results: Settleability

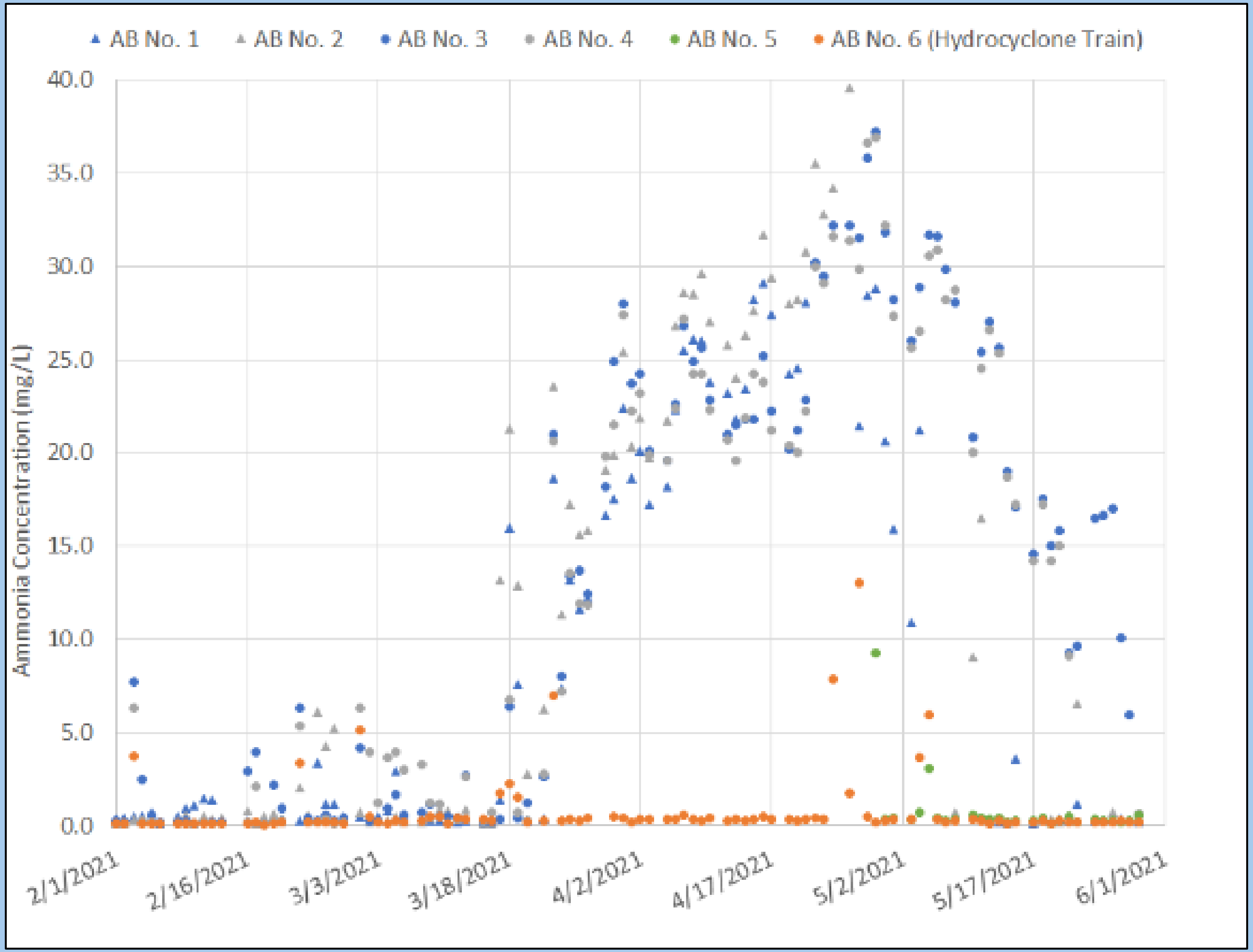
- Pilot basin (AB6) had mixed liquor and consistently lower Sludge Volume Index measurements throughout 2021
- 90th percentile SVI30:
  - < 100 mL/g in AB6
  - >120 mL/g in ABs 1-5



Winter Storm Uri – February 2021

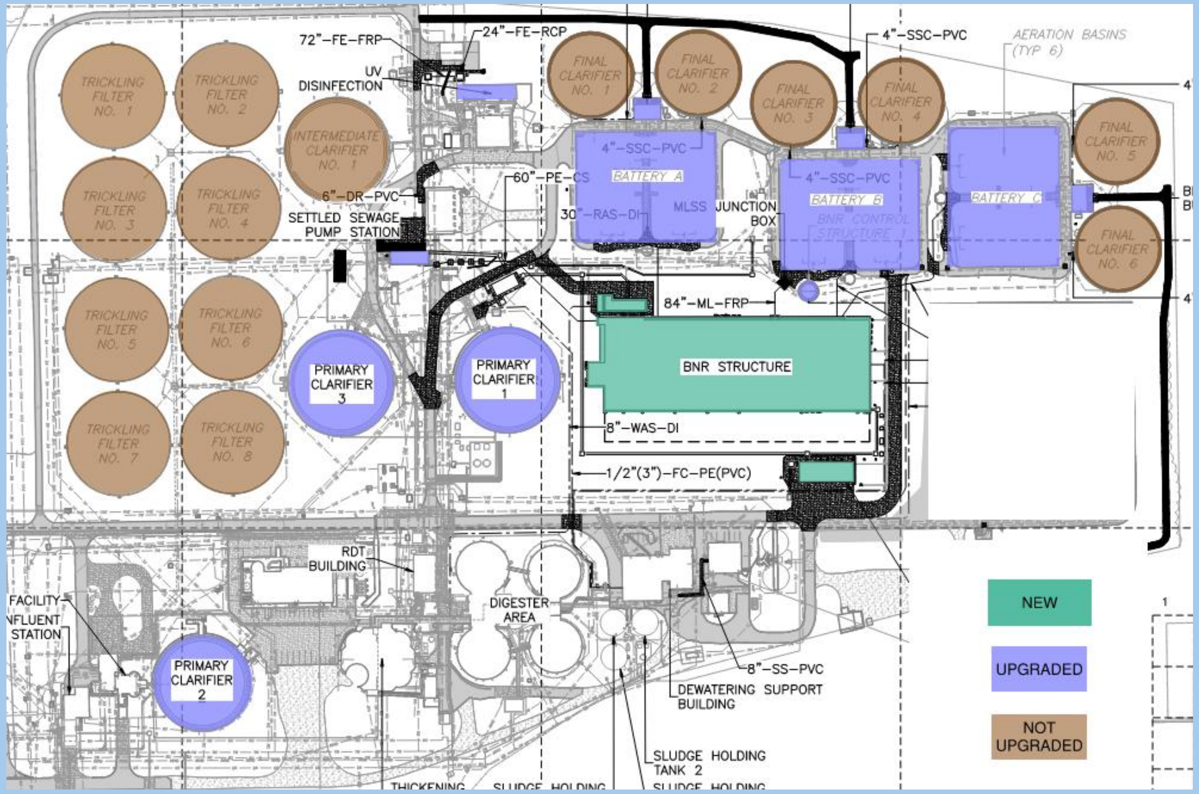
Pilot Results: Ammonia Removal

- All basins except AB #6 had bulking sludge in response to increased BOD load after winter storm
    - Pilot basin (AB #6) did not have the same level of sludge bulking
- Pilot basin (AB #6) retained nitrification during winter storm in February 2021 when other basins stopped nitrifying for over two months
- City spent substantial funds and over 400 hours re-seeding the remaining five basins to bring facility back into compliance



Design Goals

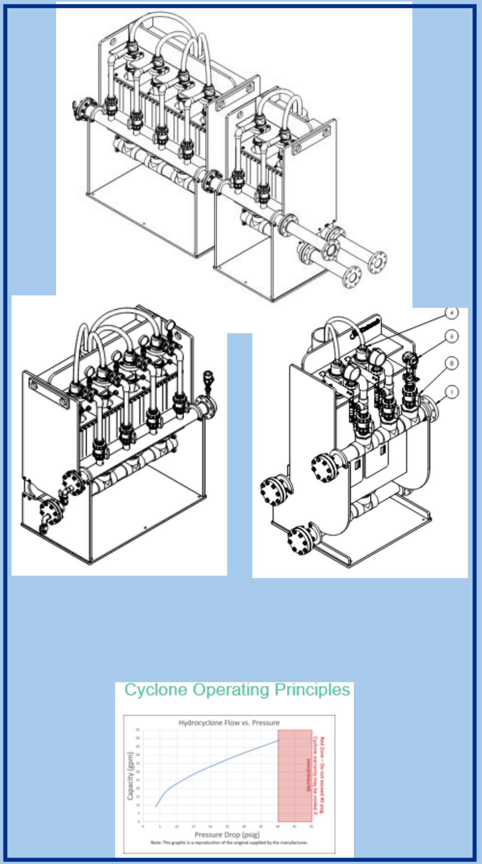
- Expand plant capacity
- Meet new BNR permit limits
- Abandon trickling filters
- Modify operation to one sludge system
- Incorporate full-scale hydrocyclone facility in upgraded plant design



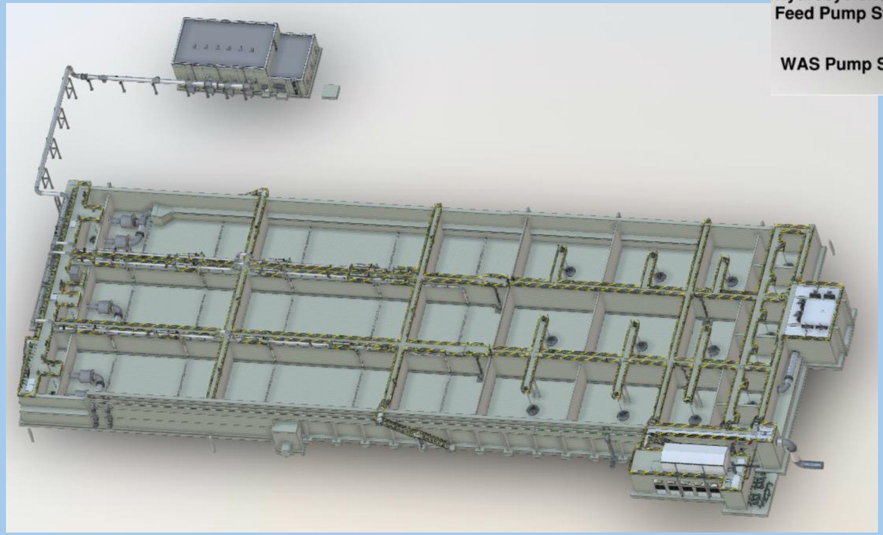
Wichita Bardenpho Layout

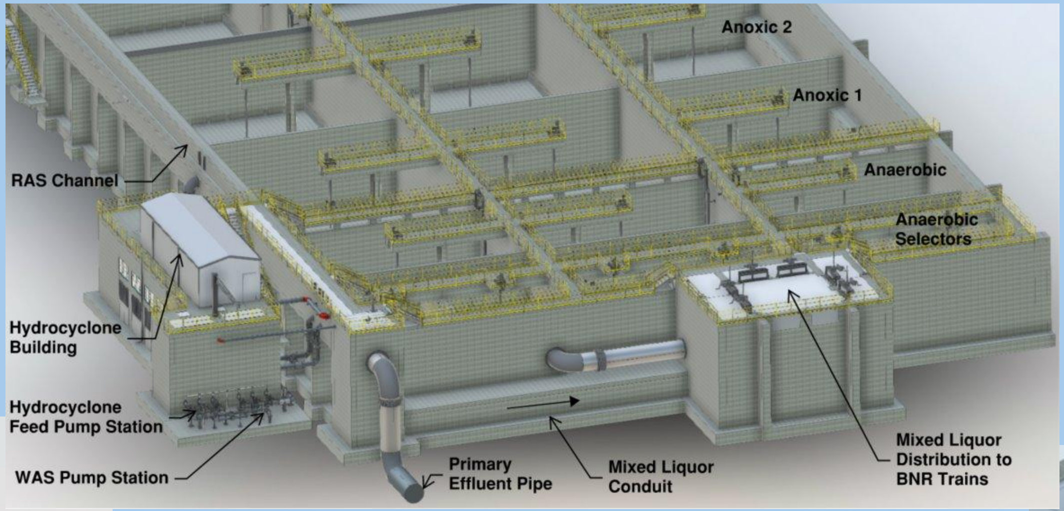
Full Scale Design Steps

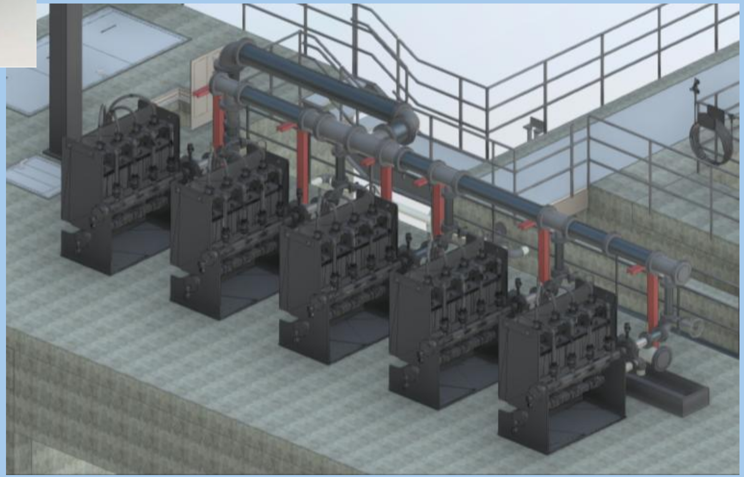
- Location based on Process consideration
- Number of hydrocyclones based on wasting
- Location of the hydrocyclones facility based on physical layout and pumping versus gravity
- Hydrocyclone feed pumping, underflow return to RAS, overflow to WAS
- Building/structure to house hydrocyclones
- Operations Considerations
- Bypass



3D Models: New BNR Structure & Hydrocyclones







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Construction Pictures

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Summary

- The project incorporates several criteria from ASCE’s report:
  - Capacity and Condition: Increase in plant capacity and rehabilitation of existing infrastructure
  - Funding: WIFIA was used to fund the project
  - Operation and Maintenance: High level of automation and data management
  - Future need: Plant flow will meet population growth needs and future nutrient limits
  - Public Safety and Resilience: New infrastructure provides increased safety and resiliency
  - Innovation: Use of process intensification using hydrocyclones

Northeast Ohio Regional Sewer District (Greater Cleveland)

A Regional Utility Supporting Local Infrastructure Issues

What We Do: *Organization*

- Sanitary Services to 62 Member Communities and Stormwater Services to 56 Member Communities
  - 1 million customers
  - 90+ billion gallons of wastewater treated annually
  - 200 MGD average flow at **3** regional wastewater treatment centers
  - 344miles of interceptor sewers
  - 484 miles of Regional Stormwater System
- Water Quality Monitoring
- Lake Erie Beach Monitoring and Maintenance

What We Do: *Regional Wet Weather Programs*

PROJECT CLEAN LAKE
GREAT LAKE • GREAT FUTURE

- $3 billion in 25 years
- Combined sewer overflow control
- Wastewater Sewer Fee
    - Based on water consumption

NORTHEAST OHIO REGIONAL SEWER DISTRICT
REGIONAL STORMWATER MANAGEMENT PROGRAM

- $50 million (annual revenue)
- Flooding, erosion & water quality
- Stormwater Fee
    - Impervious surfaces based

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344 miles

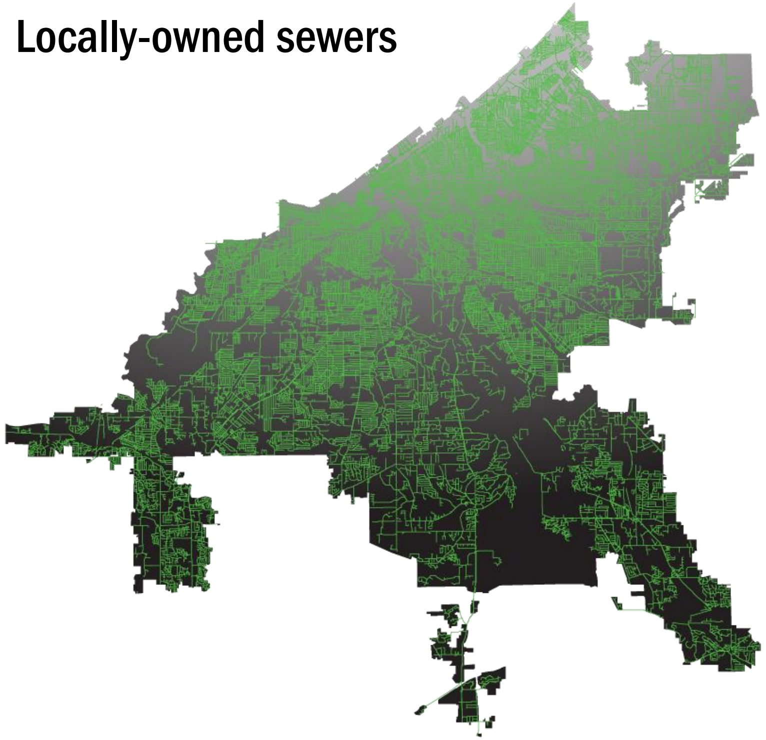
District-owned sewers

PROJECT CLEAN LAKE

GREAT LAKE • GREAT FUTURE

3,300 miles

Locally-owned sewers



NEORSD Obligations:

CSO

Treatment Plants

Local Obligations:

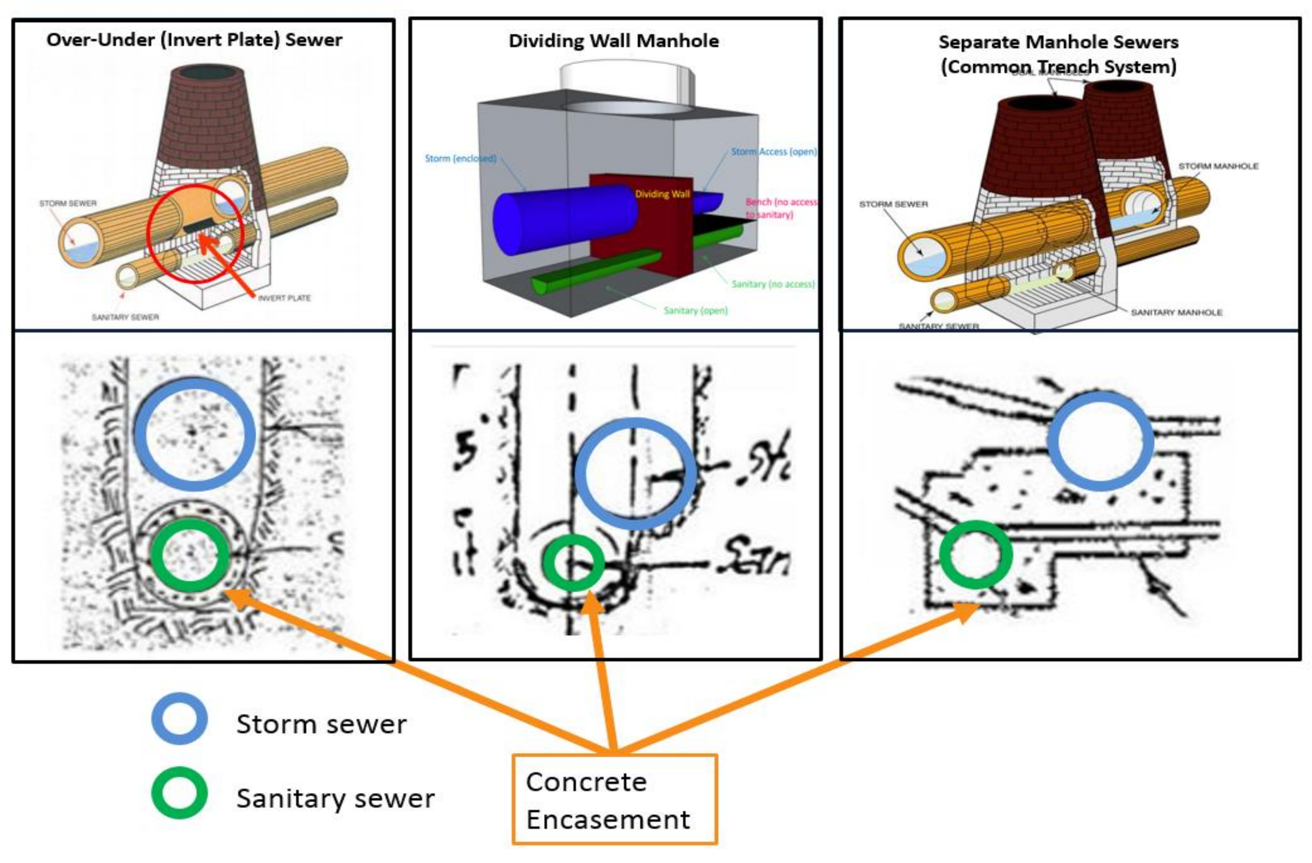
SSOs

Inflow and Infiltration

Illicit Connections

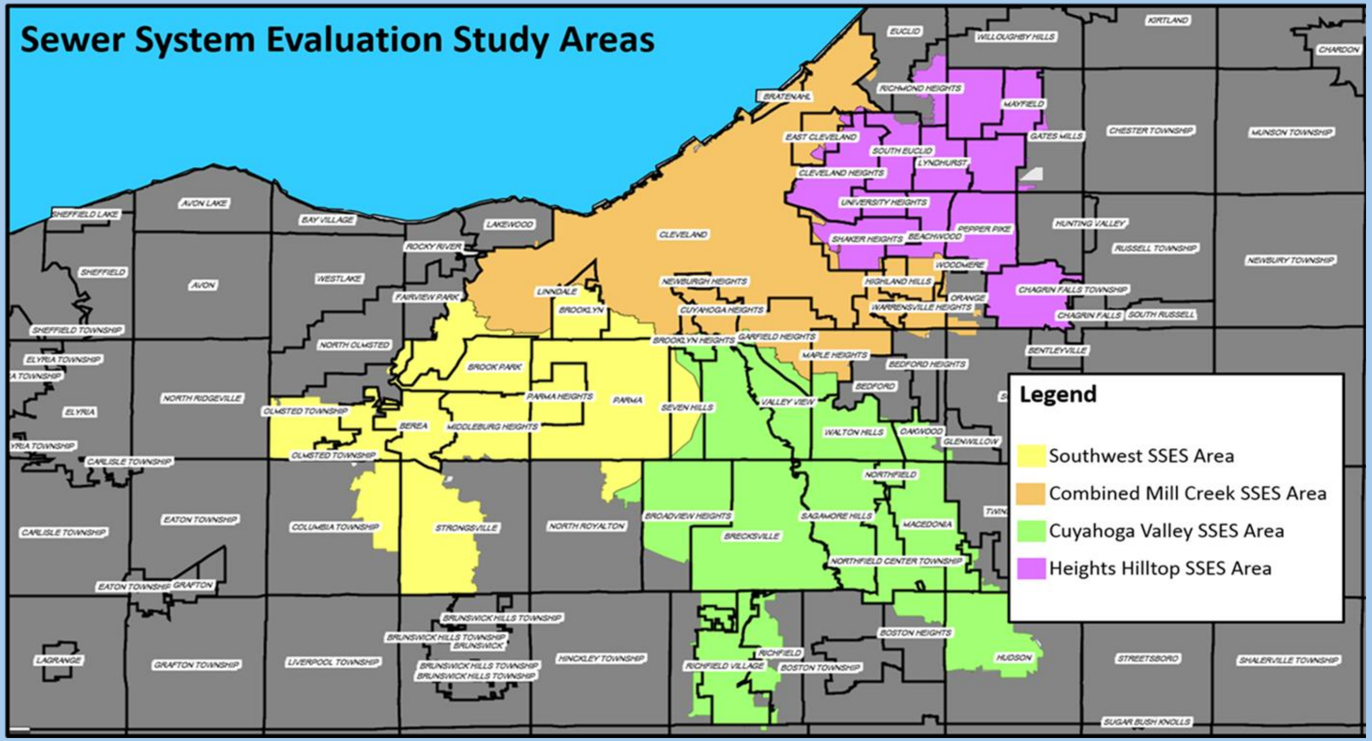
Septic tanks

Common Trench Sewer Manhole and Trench Configurations



Local Sewer System Evaluation Studies (LSSES)

- Planning-level studies focusing on **local** sewer system issues
  - $40 M investment, over 6 years
  - Evaluation of community reported and <u>model</u> projected problems
  - Potential solutions documented in community reports



LSSES Solutions in 3 Categories:

1 Known problems

Community reported problems (mostly basement backups)
Known active SSOs
Short-term (5-15 years)

$950 million

2 Excessive inflow, infiltration

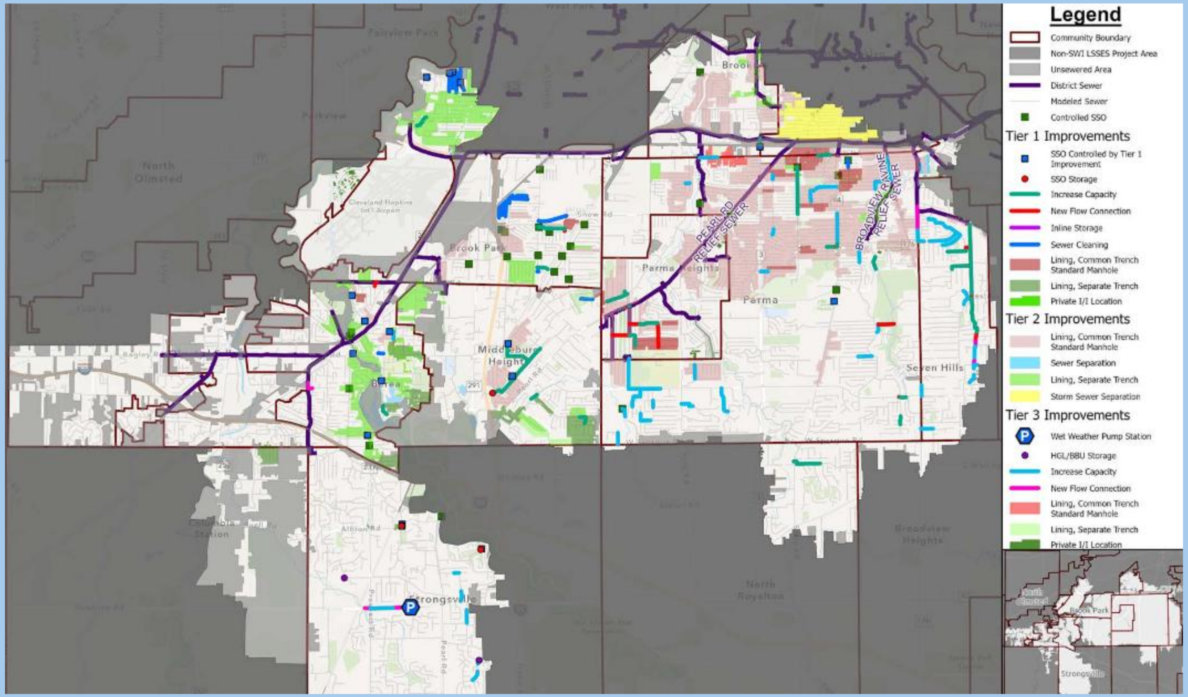
Over/under common trench systems (>50K gpad)
Sewage/stormwater cross-flow pollution
Mid-term (10-30 years)

$1.6 billion

3 Model predicted

Basement backups, flooded roads
Aging infrastructure
Long-term (20-50 years)

$840 million



Southwest Interceptor LSSES Recommendations

Total Districtwide: $3.4 billion

Member Community Infrastructure Program

- Facilitate renewal of aging and antiquated local sewer infrastructure to:
  - — Improve function, condition of local sewers;
  - — Reduce inflow and infiltration;
  - — Reduce basement flooding; and
  - — Reduce bacteria to local receiving streams.

$15 Million Annually 2022-2026

- Approved by NEORSD Board of Trustees | July 15, 2021

Goal: Improve water quality, public health, environmental justice and economic vitality in Northeast Ohio.

Member Community Infrastructure Program

NEORSD's MCIP program has invested ***$123 million*** towards **159 *publicly owned sewer infrastructure improvement projects*** which has leveraged an additional ***$110 million*** in member community sewer infrastructure investments.

MCIP Program: *Cumulative Benefits*

Year	Basement Flooding Remediation	Reduced Impact on SSO/CSO	Removal of WWTP	HSTS Removal	Linear Feet Lining and New Sewers
2017	427	3		779	67,855
2018	39	2	1	402	18,130
2019	659	3	2	232	34,147
2020	149	2		182	20,276
2021	596				20,651
2022	561	5		73	42,392
2023	928	2			48,460
2024	881	6		90	54,864
2025	582	6		175	58,372
2026	264	5		37	30,164
Total	**5,086**	**34**	**3**	**1,970**	**395,311**

IIJA Support and Funding to Date

- Through the IIJA, Ohio EPA receives an additional $50-70 million in supplemental base program principal forgiveness loans (effectively grants) through state fiscal years 2023-2027

- That funding is eligible for state defined *disadvantaged communities*
  - ~20 District member communities are *disadvantaged*

- The District has offered to assist all *disadvantaged communities* with pre-award assistance (project nomination etc.), post-award assistance (manage the project/assist in loan resolutions) and any other necessary technical assistance needed related to IIJA funding

- Since 2023, the District has helped 9 member communities apply for $35 M in IIJA funding
  - $16M* in principal forgiveness loans have been received or are eligible by 5 member communities
  - All projects not offered principal forgiveness, were offered traditional low interest loans

*Includes draft 2026 Program Management Plan

Innovation, Investment, and Resilience

Good Planning and Available Resources to Address Local Sewer Issues

- Local Sewer System Evaluation Studies
  - Modeling to assess 5-year Level of Service
  - Prioritized Solutions
  - IIJA Principal Forgiveness Nomination and Application Support
- Member Community Infrastructure Program
  - Dedicated Funding Source

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Dr. Sunil Sinha, Professor & Director
Virginia Tech,
Sustainable Water Infrastructure Management (SWIM) Center

Artificial Intelligence to Improve National Water Efficiency from Source-to-Tap

Billions of dollars and Trillions of gallons of water are lost every year from the U.S. water systems!

Innovation | **Resilience** | **Water Security** | **Asset Management** | **Economics**

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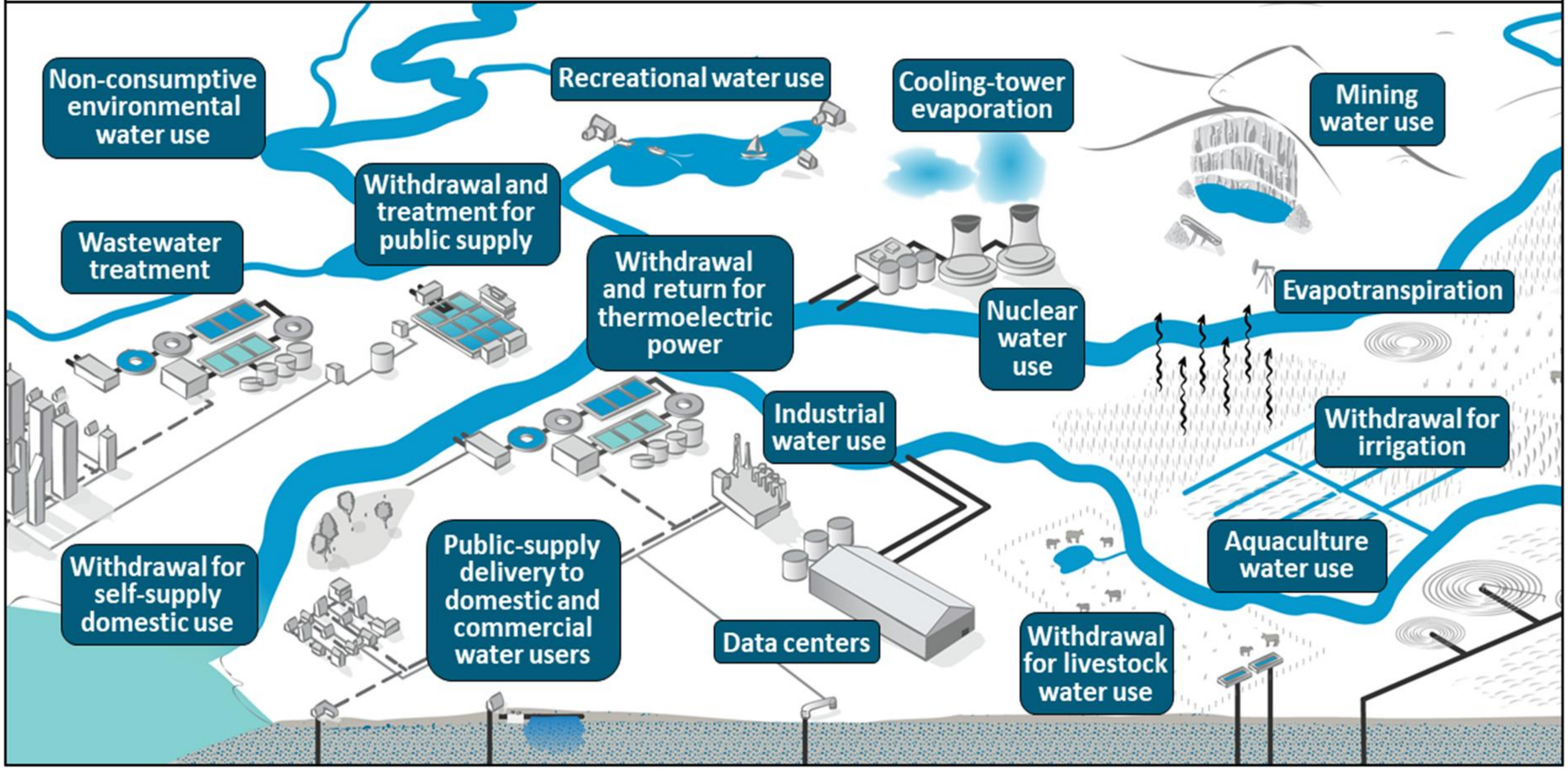
General Categories of Water Use in the United States of America



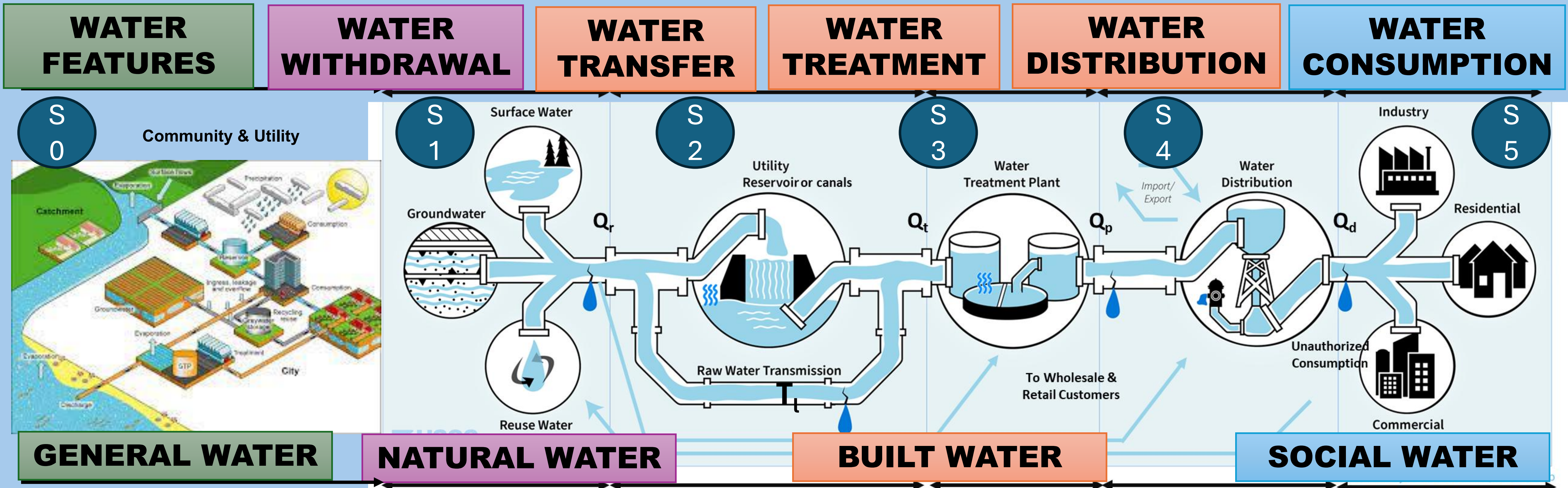
PROBLEM STATEMENT

A collaboration between USGS, ORNL, and VT will bring together the PIPEiD, WATERiD, and historical water use data to develop a series of pilot systems for developing a national water efficiency data driven model using machine learning and artificial intelligence.

The research provides nation-wide estimates of water uses and losses based on scalable, explainable, reliable, and trustworthy models, thereby advancing resilient and sustainable provision of Water in Communities across the Nation.

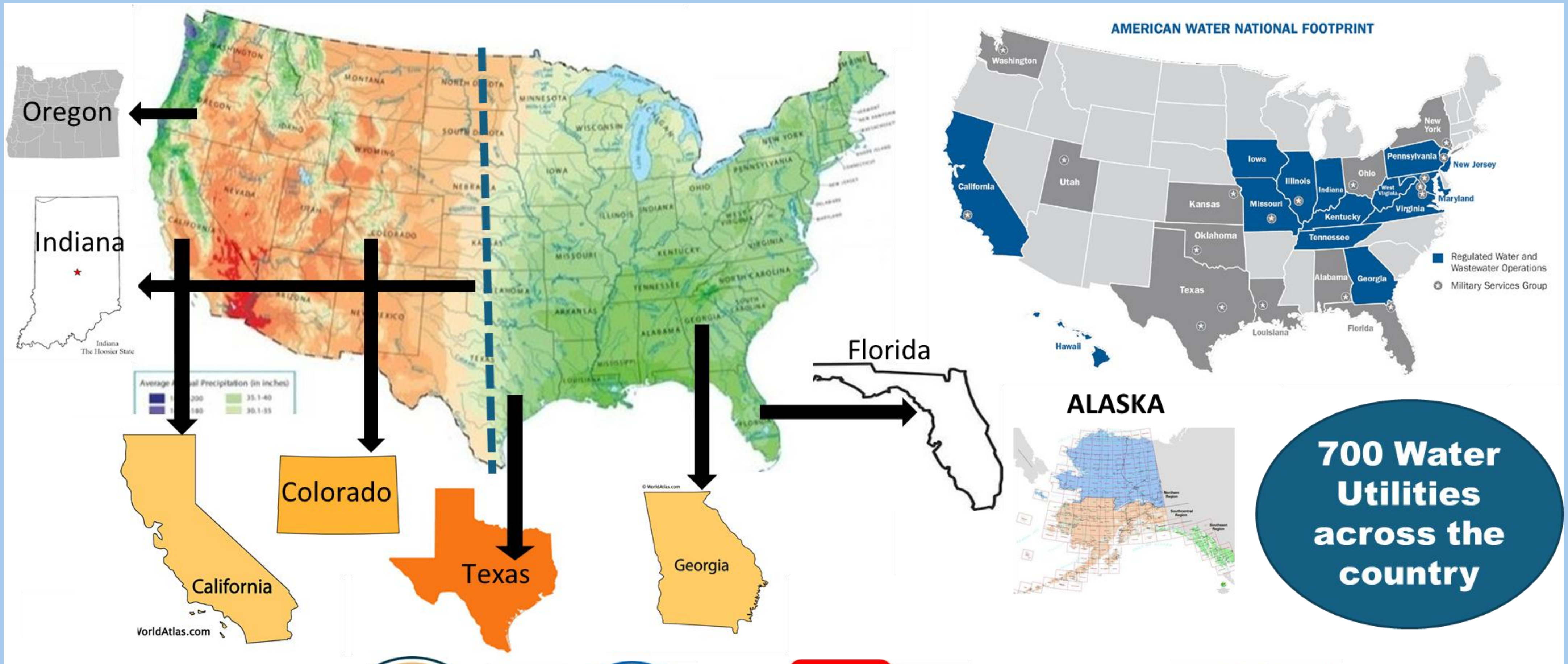
National compilations of water use is critical to the National Water Census in order to include public supply water use as part of the nine water budget components for the Nation, and to meet the SECURE Water Act requirements.

WATER EFFICIENCY ESTIMATION
from Source-to-Tap



SYSTEM-OF-SYSTEMS UNDERSTANDING

PILOTING APPROACH AND SCALING TO ENTIRE COUNTRY



USGS science for a changing world

BUREAU OF RECLAMATION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

US Army Corps of Engineers

NOAA

NASA

United States Census Bureau

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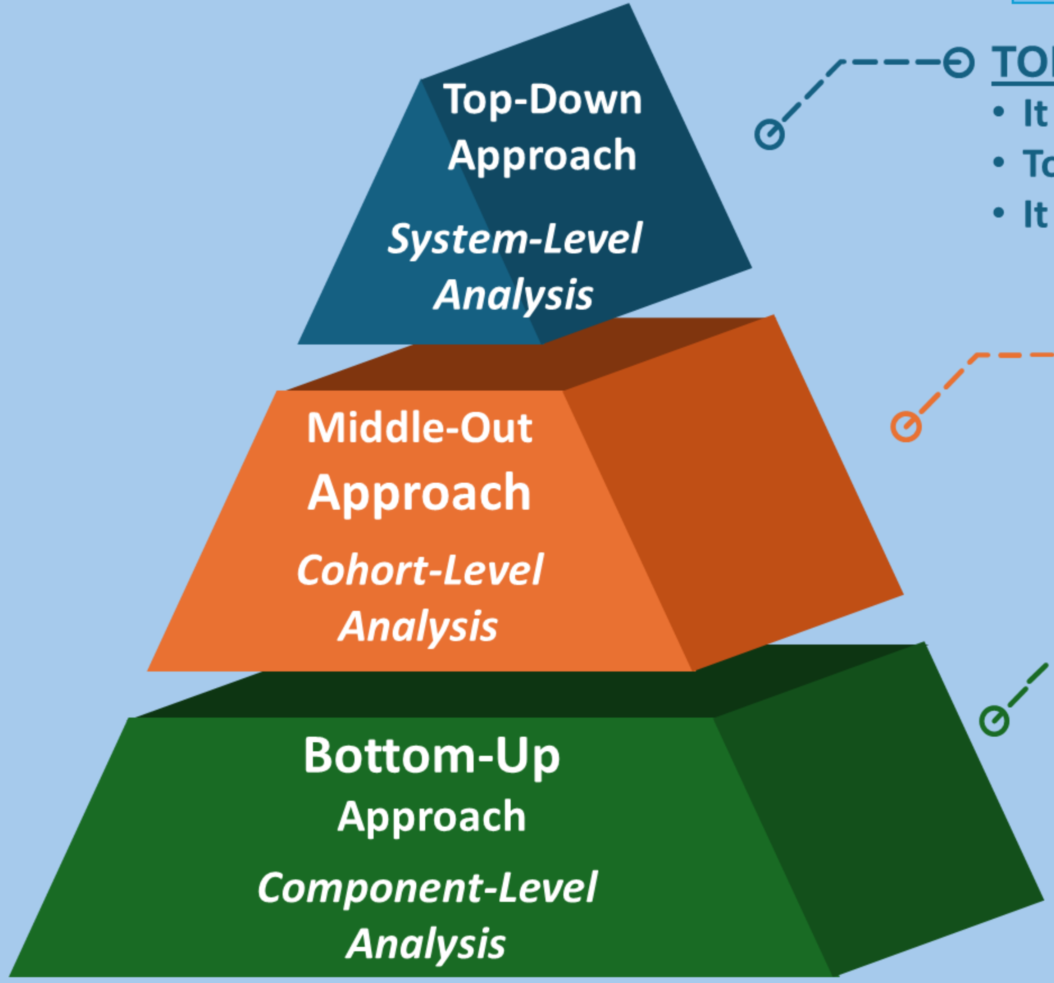
WATER LOSS DECISION SUPPORT SYSTEMS CHARACTERISTICS



DATA ANALYTICS APPROACH

TOP-DOWN APPROACH (PRELIMINARY ESTIMATE)

- It often makes it faster to collect and put together the data
- Top down does not require as much data as other strategies
- It offers a big picture look at the water system infrastructure

MIDDLE-OUT APPROACH (HYBRID ESTIMATE)

- It offers a more accurate picture than top-down analysis
- It takes into consideration knowledge and other data
- It doesn’t take data as much as bottom-up modeling

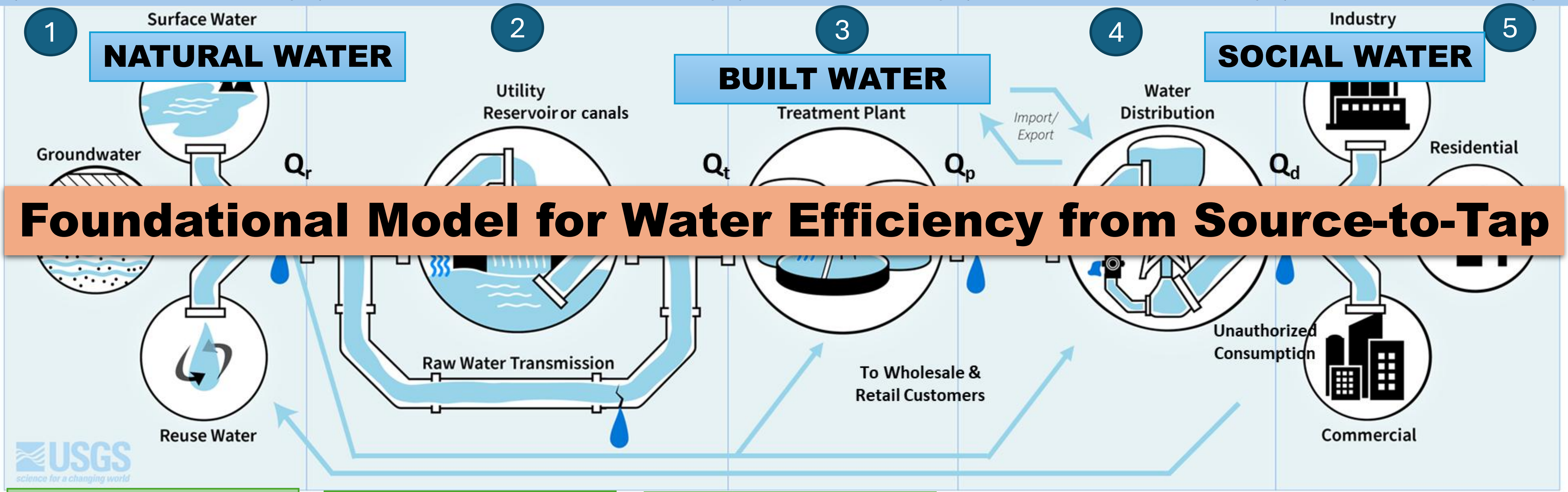
BOTTOM-UP APPROACH (DETAILED ESTIMATE)

- It offers a more detailed look at the asset levels
- It incorporates data & knowledge from more sources
- Greater understanding of water system performance

Next-generation AI platform for improving water systems efficiency, asset management, and economic viability.

SURROGATE MODELS TO INTERACT WITH FOUNDATIONAL MODEL FOR VARIOUS ANALYSIS

QUALITY & QUANTITY | **TRENDS & PERFORMANCE BENCHMARKING** | **ACCESSABILITY & AFFORDABILITY**



System 1: Agents | **System 2: Agents** | **System 3: Agents** | **System 4: Agents** | **System 5: Agents**

COMPONENTS LEVEL AGENT MODLES TO FEED INTO THE FOUNDATIONAL MODEL

MAJOR STEPS FOR WATER EFFICIENCY ESTIMATION

STEP 1: Source-To-Tap Flow Diagram

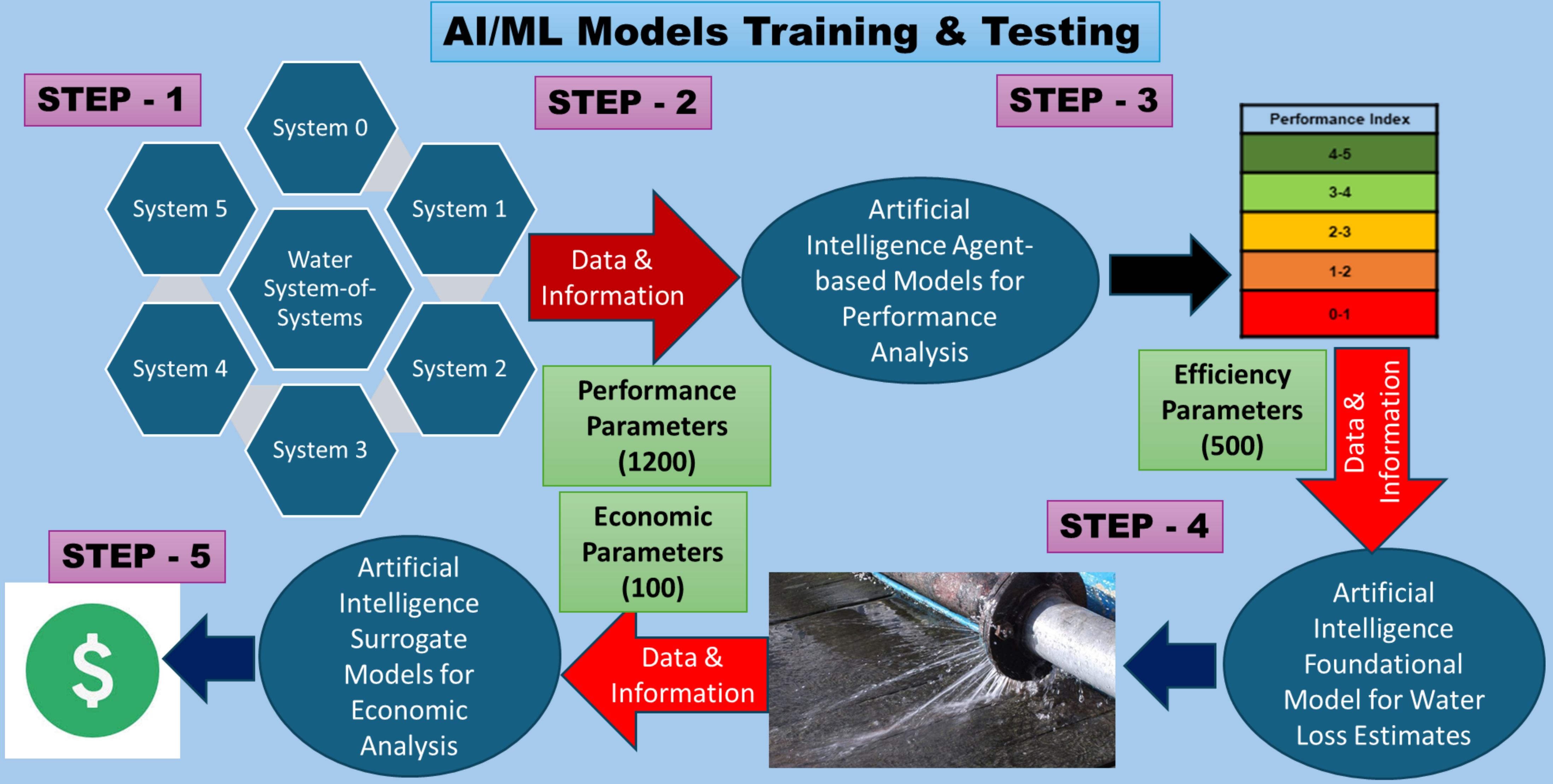
STEP 2: Source-To-Tap Data Collection

STEP 3: Source-To-Tap Performance Analysis

STEP 4: Source-To-Tap Water Efficiency

STEP 5: Source-To-Tap Economic Analysis

SYSTEM-OF-SYSTEMS WATER EFFICIENCY ANALYSIS



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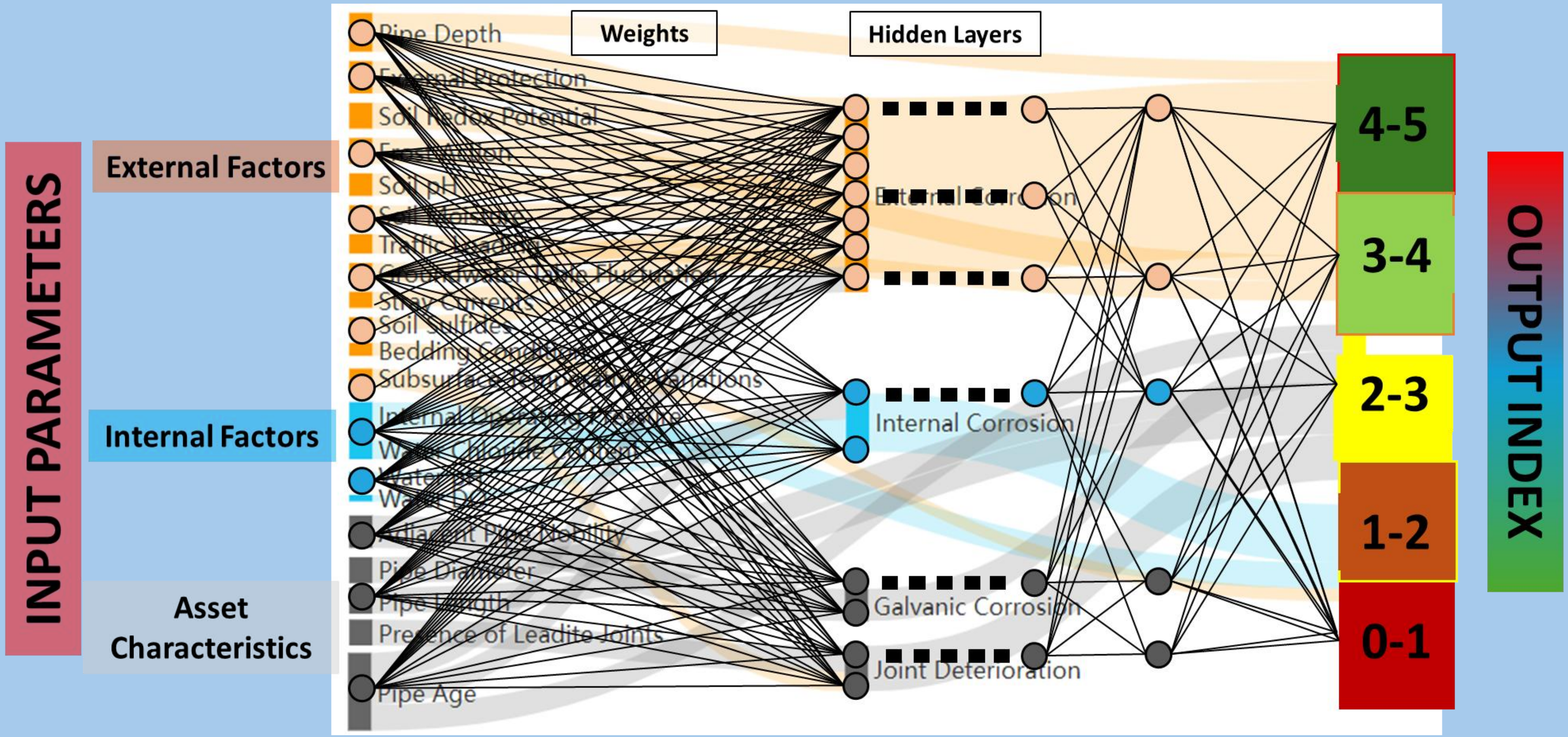
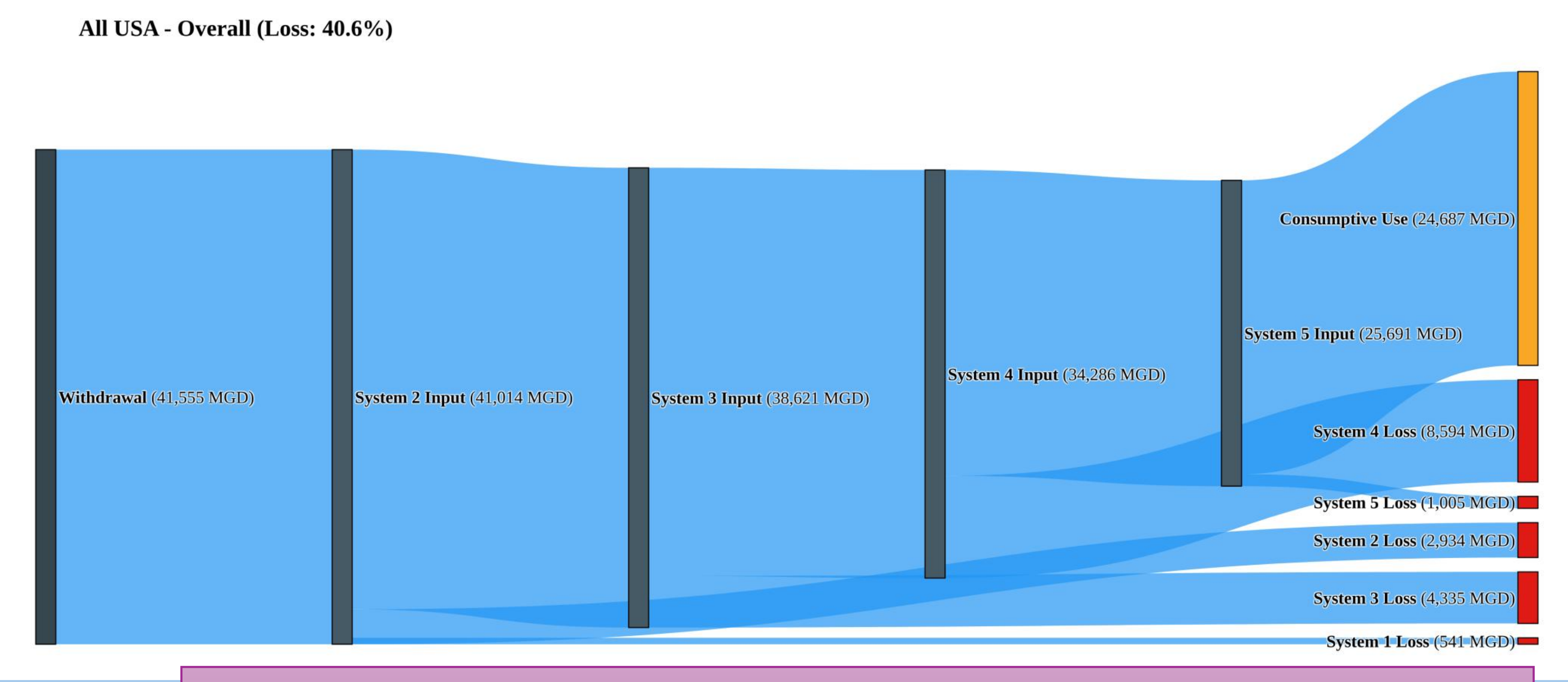
ASSET PERFORMANCE ESTIMATES FOR THE U.S.



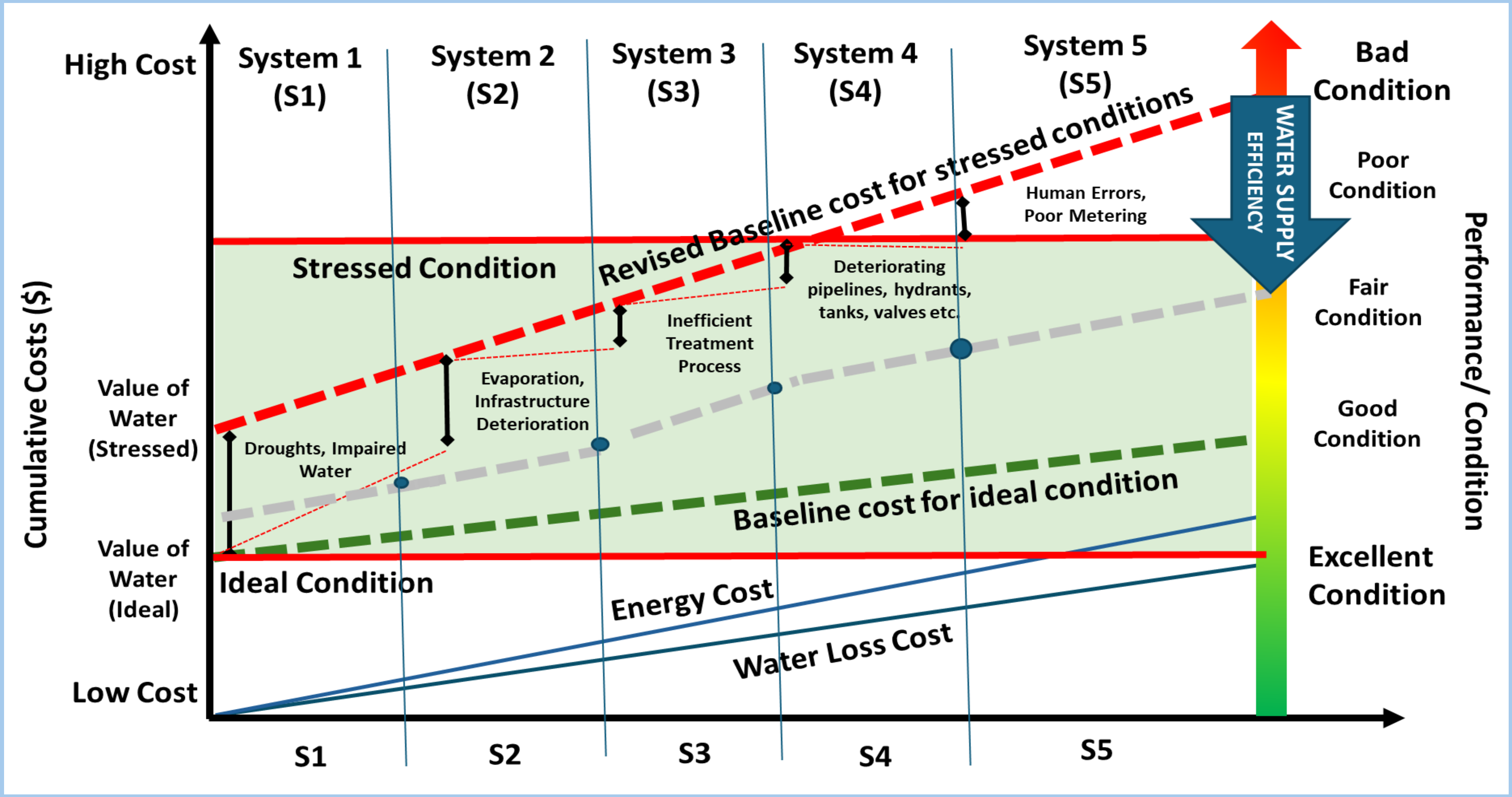
WATER EFFICIENCY ESTIMATES FOR THE U.S.

Actions on water efficiency has the potential to save trillions of gallons of water and 100s of billions of dollar per annum!



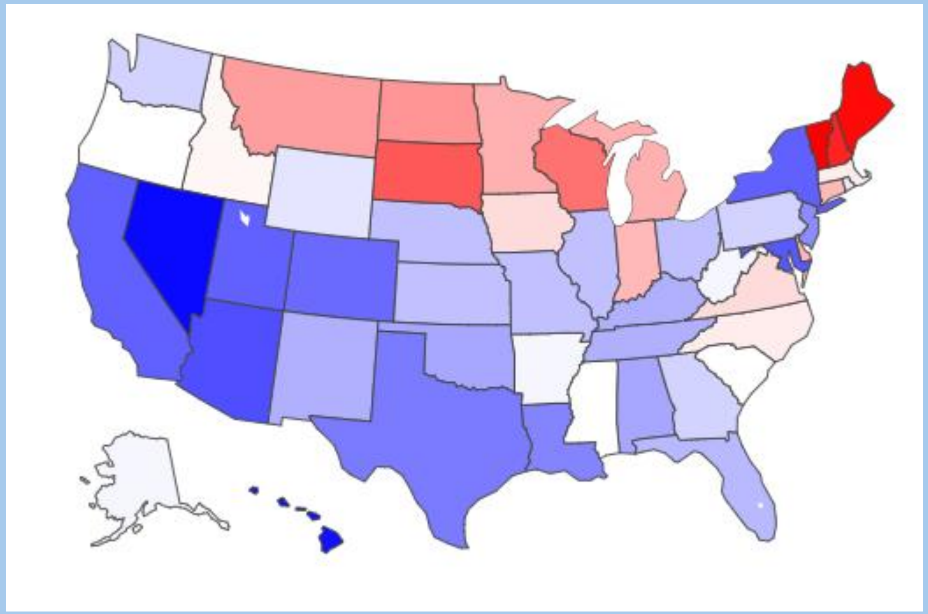
Overall Water Loss from Source-To-Tap = 40.6%
Disclaimer: Based on Preliminary Estimate

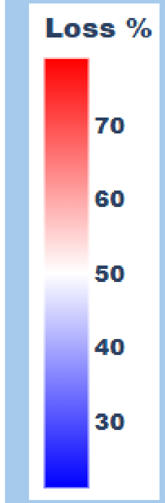
EFFICIENCY ECONOMIC ANALYSIS FOR THE U.S.

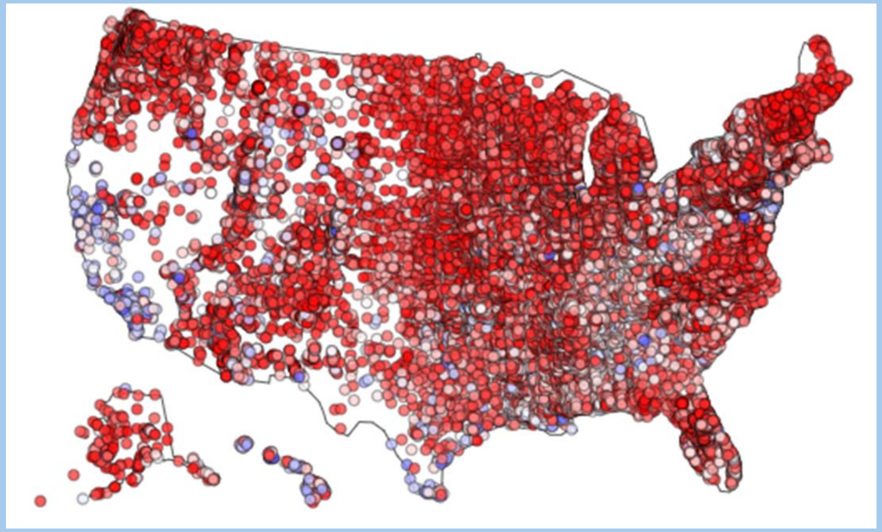


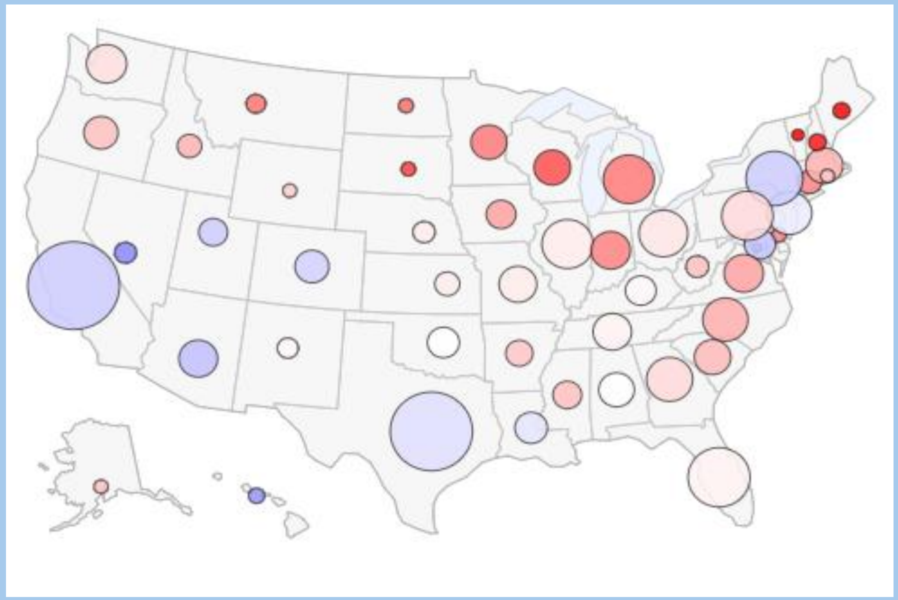
National, State, and Utility Levels Water Efficiency Estimation

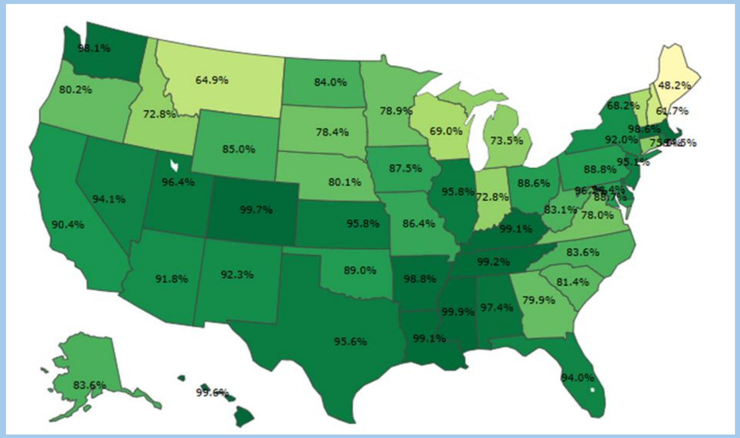
Disclaimer: Preliminary Results are Presented for Information Only

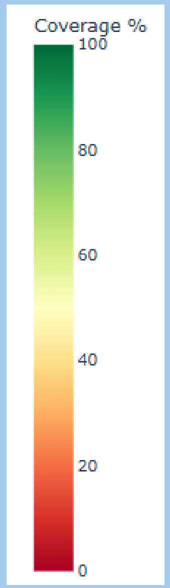








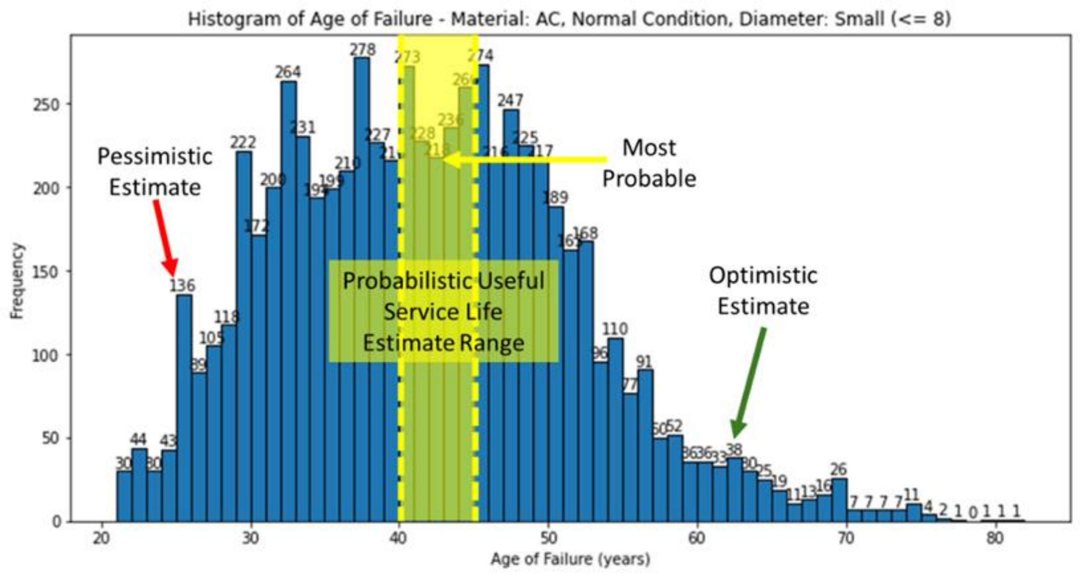


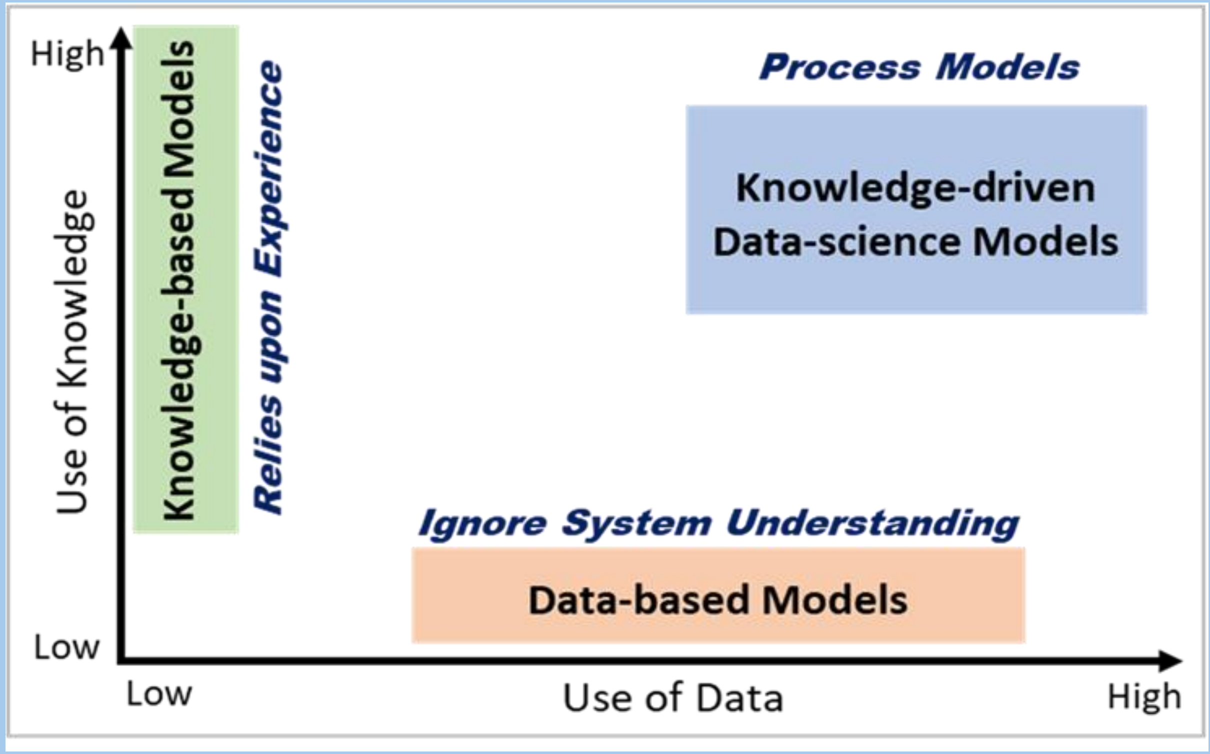


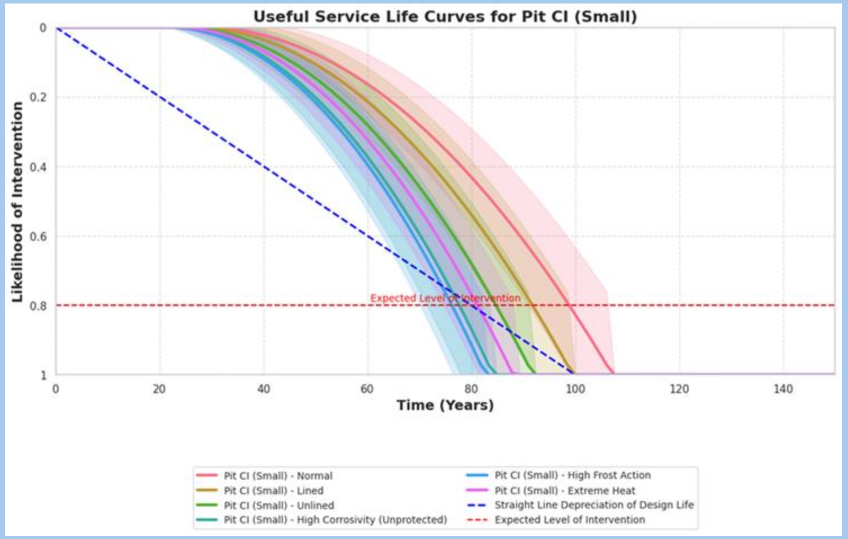
High Confidence (85% – 100%)
Medium Confidence (70% - 85%)
Low Confidence (55% - 70%)

WATER EFFICIENCY DATA ANALYSIS

Knowledge-Driven Data-Science Models & Tools







Design Life is NOT Performance Life

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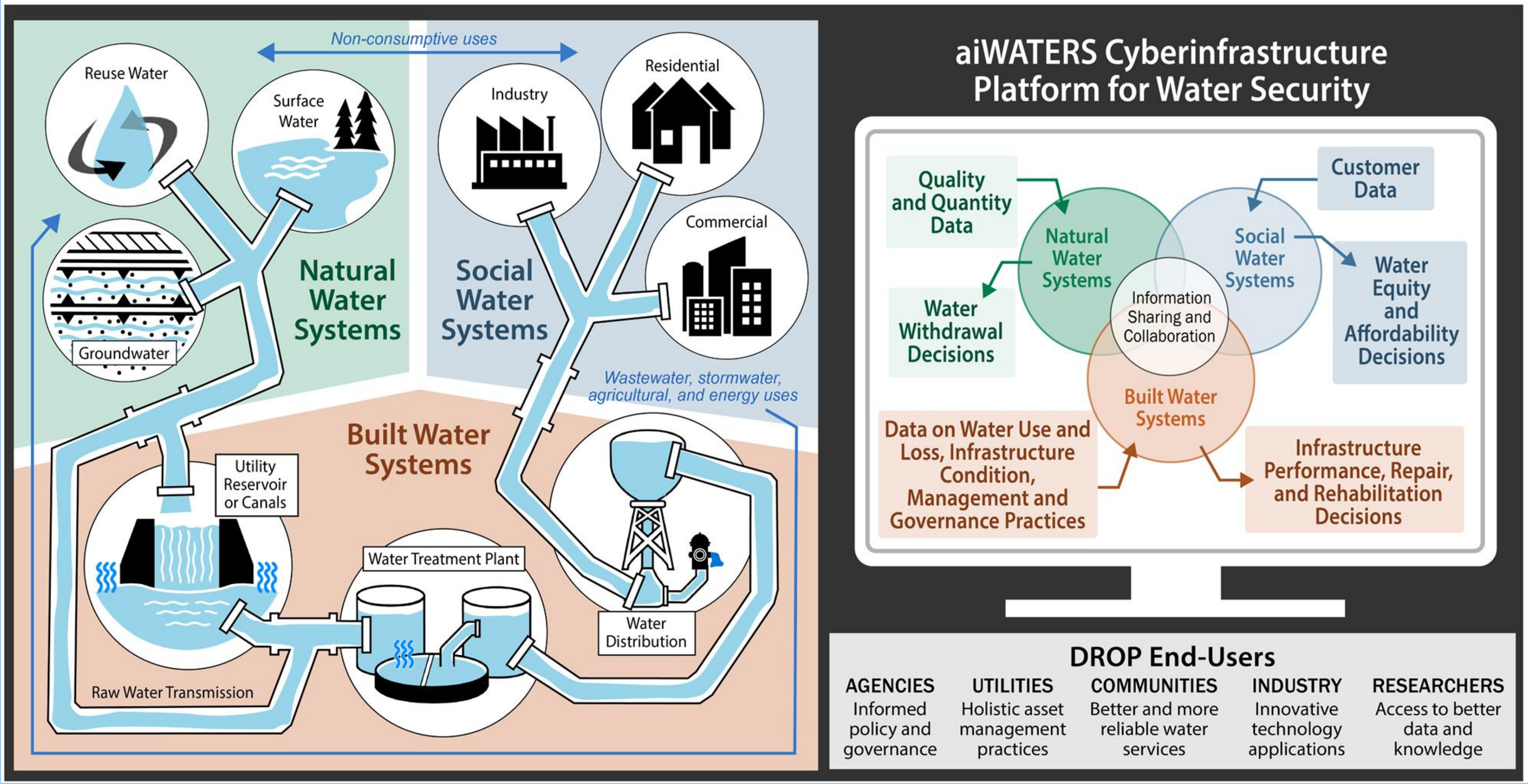
Northeast Ohio Regional Sewer District

Virginia Tech

ASCE American Society of Civil Engineers

End-to-End Service Delivery for Utilities of All Sizes



Benefits of the aiWATERMAPS

- **Data integration - intensive patterns require combining and analyzing water data from multiple sources.**

- **Long-term patterns require sustained access to resources over a long period to accomplish a well-defined objectives.**

- **Holistic Water Use and Loss Estimate for Water Efficiency.**

- **Encourage Standardized Data Collection and Compilation.**

- **Predictive Analytics for Water Sustainability & Resilience.**

- **Support Asset Management Practices across the Country.**

- **Free Access to National-Scale Water Models & Tools.**

CDM Smith NORTHEAST OHIO REGIONAL SEWER DISTRICT VIRGINIA TECH ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS

THANK YOU!

Sunil Sinha, PhD
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814-404-2150 (cell)

Panel Discussion




Questions?

CDM Smith

Thank you to today’s sponsor!

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