



Industrial Water Systems

Virtual Training – Session 4

Session 4

Tuesday – July 7th, 2026

10 am – 12:30 pm

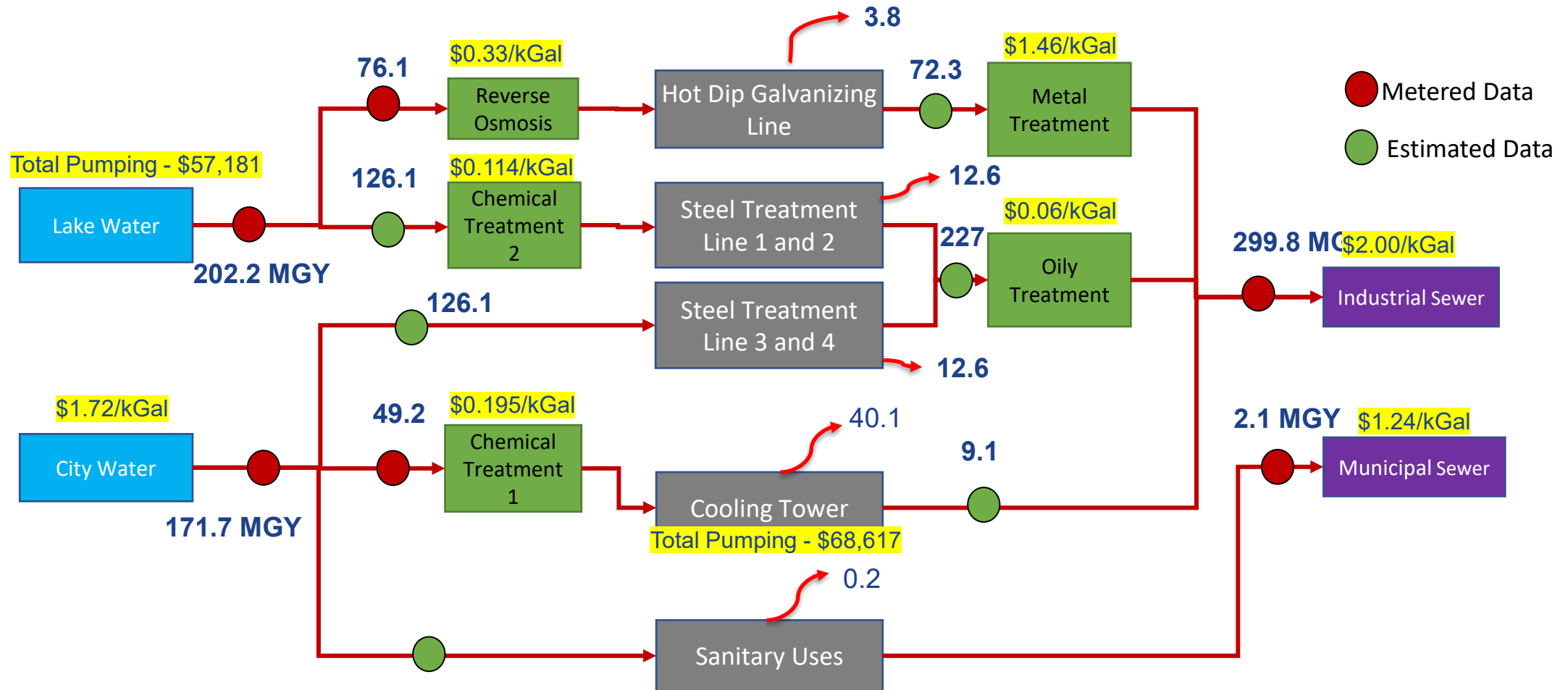
Water Virtual Training Agenda

- **Week 1 (June 16th) – Introduction to Industrial Water Assessment**
- **Week 2 (June 23rd) – Understanding System Level Water use**
- **Week 3 (June 30th) – True Cost of Water**
- **Week 4 (July 7th) – Water Quality and MEASUR Tool Working Session**
- **Week 5 (July 14th) – Identifying Water Savings Opportunity**
- **Week 6 (July 21th) – Virtual Water Treasure Hunt**
- **Week 7 (July 28th) – Estimating Water Savings Opportunities**
- **Week 8 (Aug 4th) – Industrial Water System VINPLT Wrap-up Presentations**

Review – Session 1 to 3

- Water Risks
- Industrial Water Assessment
 - Step 1 - Water Baseline
 - Step 2 - True Cost of Water
 - Step 3 – Water Quality Characterization
 - Step 4 - Identifying water savings opportunities
- Water Baseline
 - Plant Water Flow diagram
 - Data Collection (system level and facility level)
- True Cost of Water
 - Data Collection (water intake, discharge, treatment and embodied energy)

Example Facility – With Data (From Session 3)



Agenda – Session Four

Today's Content:

- Water Quality and Compliance
- MEASUR Water Assessment Module - Overview
- MEASUR Water Assessment Module – Working Session
- Q&A



Better Buildings is an initiative of the
U.S. Department of Energy

Dr. Naushita Sharma, Oak Ridge National Lab

Qualification

- Ph.D. (2021) | Environmental Engineering | School of Sustainable Engineering and The Built Environment, Arizona State University
- M.S. (2018) | Civil, Environmental and Sustainable Engineering | School of Sustainable Engineering and The Built Environment, Arizona State University
- B.Tech. (2017) | Mechanical Engineering, Department of Mechanical Engineering, National Institute of Technology
- Certified Energy Manager (2025 – present) | Association of Energy Engineers

Professional Experience

- R&D Staff (2023 – present) | Oak Ridge National Laboratory
- Water Resources Engineer (2021 – 2023) | Jacobs Engineering Group
- Faculty Associate (2019 – 2023) | Arizona State University
- Adjunct Faculty (2022) | City College of New York



Water Quality and Compliance

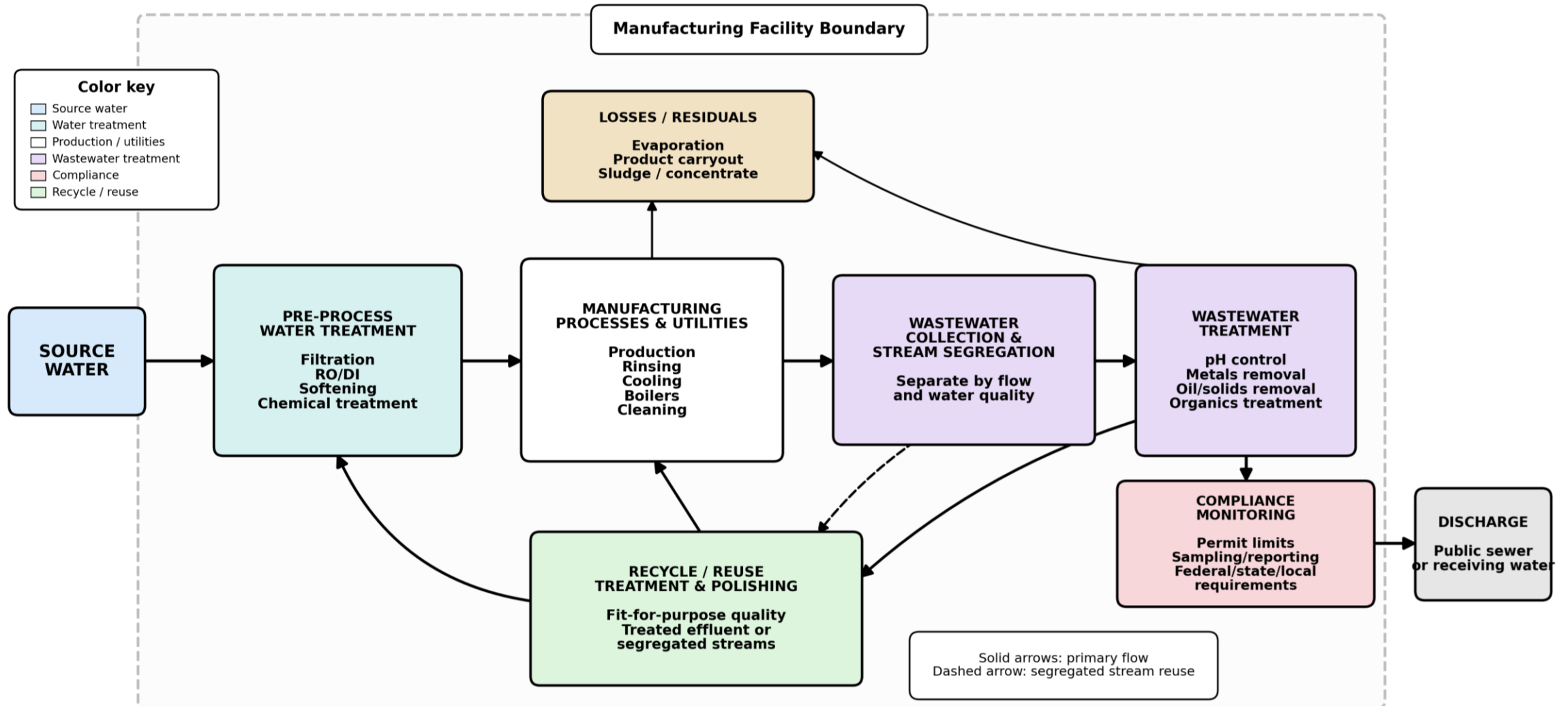
Purpose of Water/Wastewater Treatment

Process Requirements: Process and product specifications determine required input water quality and therefore required pre-process water treatment.

Regulatory Compliance: Many industries must treat wastewater to meet federal/state/local environmental regulations before discharging it into public sewers or natural bodies of water.

Recycling and Reuse: Treating water to determined desirable standards allow for recycling and reusing within the plant, contributing to volumetric water savings goals and lowers operational costs.

Water/Wastewater treatment in a manufacturing facility



Per Process Requirements

Typical Source Water Characteristics

Parameter	Unit	Municipal water	Surface water	Groundwater	Industrial significance
pH	standard units	6.5–8.5	6.0–9.0	6.5–8.5	Corrosion, scaling, treatment chemical demand, process compatibility
Hardness	mg/L as CaCO ₃	50–250	20–200	50–500+	Scaling in boilers, cooling towers, heat exchangers, RO, and process systems
Conductivity	μS/cm	200–800	50–800	200–2,000+	Indicator of dissolved salts, TDS, salinity, RO need, and reuse suitability
TSS	mg/L	<5	5–500+	<10	Filtration/clarification loading, fouling potential, solids removal requirements
Turbidity	NTU	<0.3–1	1–100+	<1–10	Particulate/colloidal loading, filter performance, seasonal variability
Iron (Fe)	mg/L as Fe	<0.1–0.3	<0.1–1	0.1–10	Fouling, staining, membrane plugging, resin fouling, deposit formation
Silica	mg/L as SiO ₂	5–25	2–30	5–60+	Boiler scaling, RO recovery limitation, cooling tower concentration limits

**Values are representative screening ranges for U.S. industrial source-water evaluation and should not be interpreted as design limits or compliance thresholds. Site-specific sampling is required before selecting pretreatment, reuse, or wastewater management strategies.

Measuring Water Quality

- **Online sensors:** continuous monitoring for real-time control and alarms
 - pH, turbidity, conductivity, temperature, oxidation-reduction potential, dissolved oxygen
- **Spot measurements:** quick field checks using handheld meters
- **Grab samples:** single-point samples for specific conditions or troubleshooting
- **Composite samples:** time- or flow-weighted samples for representative wastewater quality
- **Laboratory analysis:** validated testing for compliance, metals, organics, solids, and detailed chemistry

Common Water Quality Measurement Practices

- What we use during our In-Plt Trainings for spot measurements
 - Drinking Water Quality Test Strips
 - Multi-parameter water quality analyzer



Water Treatment for Process Requirements

Water Type	Typical Water Quality		Treatment Process	Industrial Applications
	Total Dissolved Solids (mg/L)	Conductivity (µS/cm)		
Softened	50–200	100–500	Chemicals and/or ion exchange	• Food & Beverage (cleaning, rinsing) • Automotive/Metal Finishing • Cooling towers • Pretreatment for boilers/Low pressure boilers • HVAC
Filtered	50–150	10–200	Reverse osmosis (RO; single-pass)	• Boilers • Recirculating cooling systems • Chemical/on-site laboratories • Electronics manufacturing
Deionized	5–25	5–10	Ion exchange RO + chemicals	• Chemical/on-site laboratories • Food & Beverage (liquids) • Pharmaceuticals • Electronics manufacturing • Precision manufacturing in Automotive/Metal Finishing
Ultrapure	<5	<5	Multi-pass reverse osmosis, ultra- or nano-filtration	• Semiconductor • Pharmaceuticals

Basic Water Treatment: *Softened Water*

- **Quality target:** reduce hardness-driven scaling while maintaining stable, cost-effective water chemistry
- **Treatment types**
 - **Screen/filter:** Remove grit and solids via sand-filtration, activated carbon
 - **Softening:** hardness (Ca/Mg removal)
 - **Chemical Addition:** pH, corrosion, biological growth adjustments

Intermediate Water Treatment: *Filtered/deionized Water*

- **Quality target:** consistent low-solids and low-ionic-strength water for process reliability and product quality
- **Treatment Types**
 - **Filtration:** media based (ion-exchange/granulated activated carbon)
 - **Reverse Osmosis:** membrane-based filtration

Advanced Water Treatment

Ultrapure Water/Specific process water requirement

- **Quality target:** water quality is defined by the most sensitive process/product specification, not by source-water quality alone
- **Multi-staged process:**
 - Primary Filtration.
 - Reverse Osmosis/Ion-exchange
 - Electrodeionization/mixed-bed ion-exchange
 - Disinfection via UV or non-chemical based

Water Quality Characteristics

Parameter	Contributing Contaminant	Impact	Unit of Measurement	Treatment Technology
Hardness	Calcium, magnesium ions	Scale formation on equipment and pipes	mg/L as CaCO ₃	Ion exchange, lime softening, scale inhibitors (e.g., phosphonates)
Conductivity (TDS)	Dissolved ions	Enhances corrosivity, affects processes	µS/cm	Reverse osmosis, deionization, corrosion inhibitors
pH	Acids, bases	Can lead to corrosion or scaling	pH scale	Acid/base neutralization, corrosion inhibitors
Specific Ions (Chloride, Sulfate, Fluoride)	Natural sources, industrial discharges, water treatment chemicals	Corrosion, toxicity, taste issues	mg/L	Reverse osmosis, ion exchange, activated alumina, corrosion inhibitors
Total Suspended Solids (TSS)	Soil, organic matter, oil and grease	Clogs filters, harms aquatic life	mg/L	Filtration, sedimentation, chemical flocculation
Turbidity	Suspended solids, soil, organic matter, oil and grease	Blocks light, carries pollutants	NTU	Filtration, sedimentation, flocculation

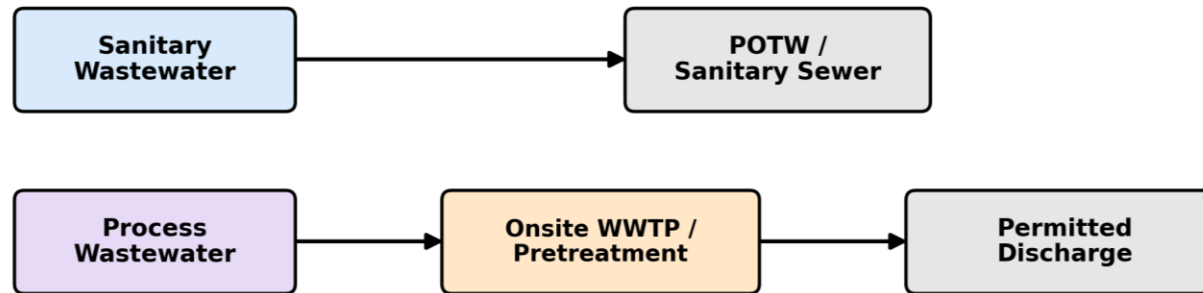
Per Regulatory Compliance

Wastewater Management Drivers

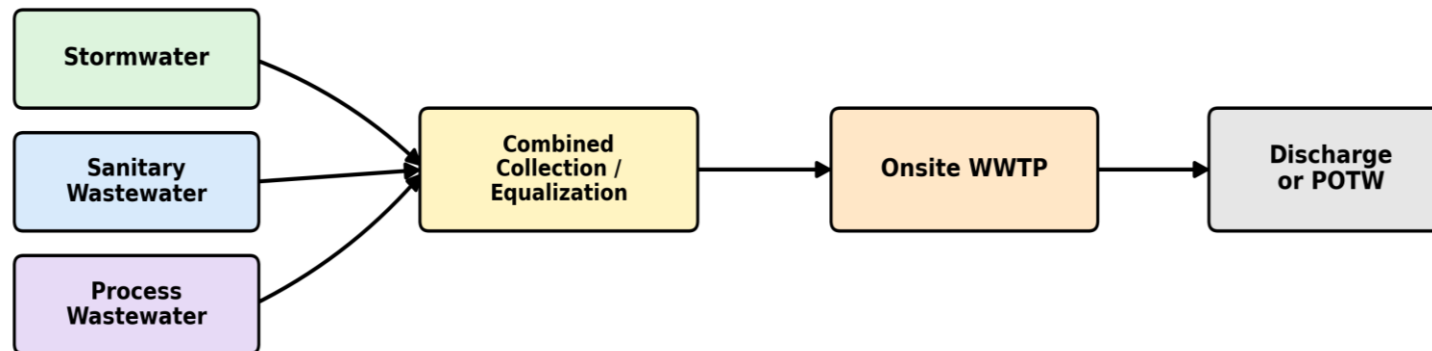
- **Discharge Pathway:** Requirements depend on whether the facility discharges directly to surface water or indirectly to a publicly owned treatment works (POTW).
- **NPDES Permit Limits:** Direct dischargers must meet effluent limits specified in their permit. Limits are typically based on available treatment technology and/or protection of receiving-water quality.
- **State/Local Compliance:** State environmental agencies often administer NPDES programs, while local sewer authorities may impose additional limits for discharges to POTWs.
- **Categorical Pre-treatment Standards:** Industries that discharge into municipal sewage/POTWs.
- **Cost and surcharge exposure:** Wastewater management driven by treatment cost, sewer fees, surcharges, and disposal costs.

Typical Wastewater Management Configurations

Configuration 1: Sanitary Separate; Process Wastewater Treated

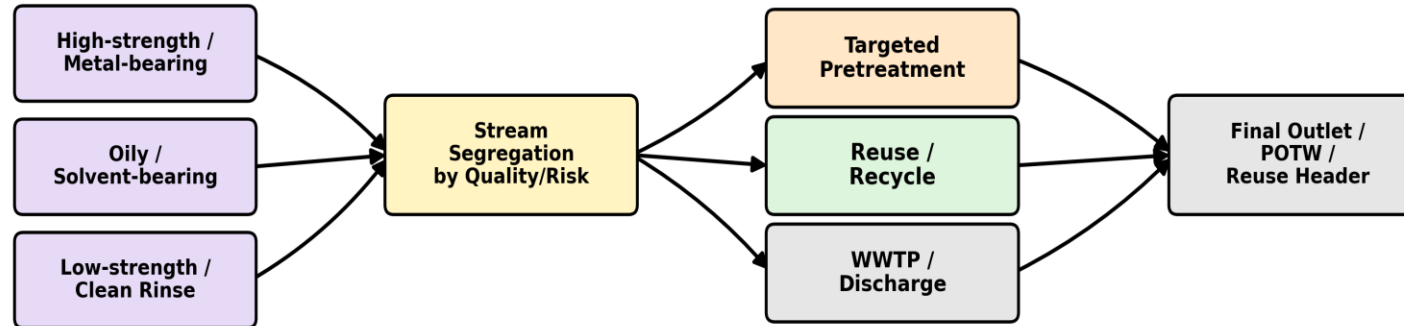


Configuration 2: Stormwater + Sanitary + Process Wastewater Mixed



Typical Wastewater Management Configurations

Configuration 3: Segregated Waste Streams Before Treatment or Reuse



Configuration 4: Third-Party Disposal



What does Regulatory Compliance typically look like?

Applicable Standards: Local Limits

Parameter	Concentration (mg/L)	Daily Max Limit (mg/L)
Cadmium, Cd	<0.00027	0.42
Chromium, Cr	0.00063	6.30
Copper, Cu	0.015	6.00
Lead, Pb	0.026	0.62
Nickel, Ni	0.0083	2.18
Silver, Ag	<0.00053	1.34
Zinc, Zn	0.045	1.23
pH (field)	8.52	Between 5.5-9.5 SU



Enforcement and Compliance History Online

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Use EPA's Enforcement and Compliance History Online website to search for facilities in your community to assess their compliance with environmental regulations. You can use ECHO to:

- Search for Facilities
- Investigate Pollution Sources
- Search for EPA Enforcement Cases
- Examine and Create Enforcement-Related Maps
- Analyze Trends in Compliance & Enforcement Data



[Read the Quick Start Guide](#)



[Watch a Video Tutorial](#)



[Explore the Tool Guide](#)

Permittee Name _____ NPDES Permit No. _____ EPA Lab Code _____

EPA Chemistry/Microbiology Analyte Checklist
DMR-QA Study 45

2025

Analyte Test	Test Required	Method Number Used (Optional)	Laboratory's Graded Result		Analyte determined by state-certified lab*
			Acceptable	Not Acceptable (Corrective Action Required)	
Microbiology					
E. coli, MF or MPN	☐		☐	☐	☐
Fecal Coliform, MF or MPN	☐		☐	☐	☐
Total Coliform, MF or MPN	☐		☐	☐	☐
Trace Metals					
Aluminum	☐		☐	☐	☐
Antimony	☐		☐	☐	☐
Arsenic	☐		☐	☐	☐
Barium	☐		☐	☐	☐
Beryllium	☐		☐	☐	☐
Cadmium	☐		☐	☐	☐
Chromium, total	☐		☐	☐	☐
Chromium, hexavalent	☐		☐	☐	☐
Cobalt	☐		☐	☐	☐
Copper	☐		☐	☐	☐
Iron	☐		☐	☐	☐
Lead	☐		☐	☐	☐
Manganese	☐		☐	☐	☐
Mercury	☐		☐	☐	☐
Mercury (Low-Level)	☐		☐	☐	☐
Molybdenum	☐		☐	☐	☐
Nickel	☐		☐	☐	☐
Selenium	☐		☐	☐	☐
Silver	☐		☐	☐	☐
Thallium	☐		☐	☐	☐
Vanadium	☐		☐	☐	☐
Zinc	☐		☐	☐	☐
Demands					
5-day BOD	☐		☐	☐	☐
5-day Carbonaceous BOD	☐		☐	☐	☐
COD	☐		☐	☐	☐
TOC	☐		☐	☐	☐
Minerals					
Alkalinity, total (CaCO ₃)	☐		☐	☐	☐
Chloride	☐		☐	☐	☐
Fluoride	☐		☐	☐	☐
Hardness, total (CaCO ₃)	☐		☐	☐	☐
Specific conductance (25°C)	☐		☐	☐	☐
Sulfate	☐		☐	☐	☐
Total Dissolved Solids (180°C)	☐		☐	☐	☐
Nutrients					
Ammonia as N	☐		☐	☐	☐
Nitrate as N	☐		☐	☐	☐
Nitrite as N	☐		☐	☐	☐
Orthophosphate as P	☐		☐	☐	☐
Total Kjeldahl Nitrogen as N	☐		☐	☐	☐

<https://www.epa.gov/npdes/about-npdes>

U.S. DEPARTMENT OF
ENERGY

Wastewater Quality Characteristics

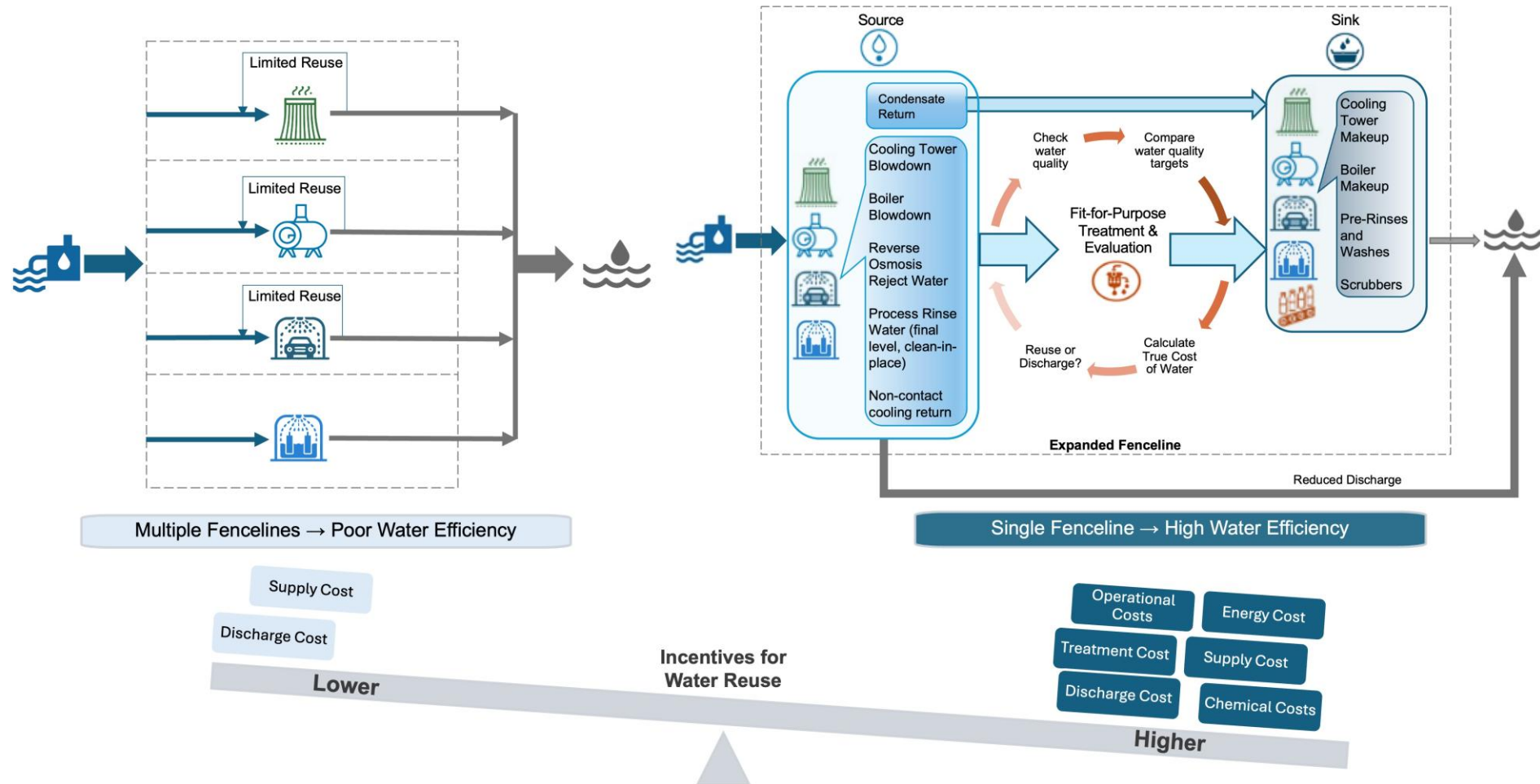
Parameter	Contributing Contaminant	Impact	Unit of Measurement	Treatment Technology
Turbidity	Suspended solids, soil, organic matter, oil and grease	Blocks light, carries pollutants	NTU	Filtration, sedimentation, flocculation
Biochemical Oxygen Demand (BOD)	Organic matter, food waste, oil and grease	Indicates potential oxygen depletion	mg/L	Activated sludge, trickling filters
Chemical Oxygen Demand (COD)	Organic and inorganic pollutants, oil and grease	High pollution levels, treatment challenges	mg/L	Chemical oxidation, biological processes
Nutrients (Nitrogen, Phosphorus)	Agricultural runoff, wastewater, fertilizers	Causes eutrophication and algal blooms	mg/L	Biological nutrient removal, chemical precipitation
Toxic Organic Compounds	Pesticides, solvents, industrial chemicals	Hazardous to health and environment	mg/L or µg/L	Advanced oxidation, activated carbon, bioremediation

Wastewater Quality Characteristics

Parameter	Contributing Contaminant	Impact	Unit of Measurement	Treatment Technology
Hardness	Calcium, magnesium ions	Scale formation on equipment and pipes	mg/L as CaCO ₃	Ion exchange, lime softening, scale inhibitors (e.g., phosphonates)
Conductivity (TDS)	Dissolved ions	Enhances corrosivity, affects processes	µS/cm	Reverse osmosis, deionization, corrosion inhibitors
pH	Acids, bases	Can lead to corrosion or scaling	pH scale	Acid/base neutralization, corrosion inhibitors
Specific Ions (Chloride, Sulfate, Fluoride)	Natural sources, industrial discharges, water treatment chemicals	Corrosion, toxicity, taste issues	mg/L	Reverse osmosis, ion exchange, activated alumina, corrosion inhibitors
Heavy Metals	Industrial discharges, mining runoff	Toxicity, bioaccumulation	mg/L or µg/L	Chemical precipitation (ferric chlorides), ion exchange, Adsorption (activated carbon)
Total Suspended Solids (TSS)	Soil, organic matter, oil and grease	Clogs filters, harms aquatic life	mg/L	Filtration, sedimentation, chemical flocculation

Per Recycling and Reuse

Mapping facility water sources to sinks



Sharma, N., & Lemar, P. (2026). Redrawing facility boundaries to promote industrial water reuse. *Nature Reviews Clean Technology*, 2(5), 323-324.

Best Practices

- Knowing the process requirements from water quality perspective
- Coordinate and communicate the manufacturing process operations with environmental compliance group and treatment vendors
- Segregation of process wastewater streams
- Measurements and awareness of water quality at treatment reject streams, post-wastewater treatment
- Coupling flow measurement areas with water quality measurements
- Stormwater segregation and management when possible

MEASUR Software Toolsuite

DOE Industrial Software Tools

Designed to help energy and sustainability teams identify savings opportunities in their operational energy usage and emissions

Energy Systems



MEASUR

Electrification for Decarbonization
Compressed Air Scoping Tool

Energy Management



VERIFI

50001 Ready Navigator
Energy Footprint Tool
Plant Energy Profiler
Implementation Guidance Toolkit

Carbon, Water, & Waste



Plant Water Profiler
Plant Carbon Footprint &
Decarbonization Assessment Tool
Carbon Emissions Calculator
Waste Stream Energy Content

Software Tools help implement energy projects

50001 Ready Navigator

Energy management

- Resources
- Track progress



VERIFI

Facility energy use

- Utility bill tracking and analysis
- Utility/ GHG savings analysis



MEASUR

System energy use

- Industrial System Analysis
- Treasure Hunts
- Inventory



JUSTIFI

Additional impacts

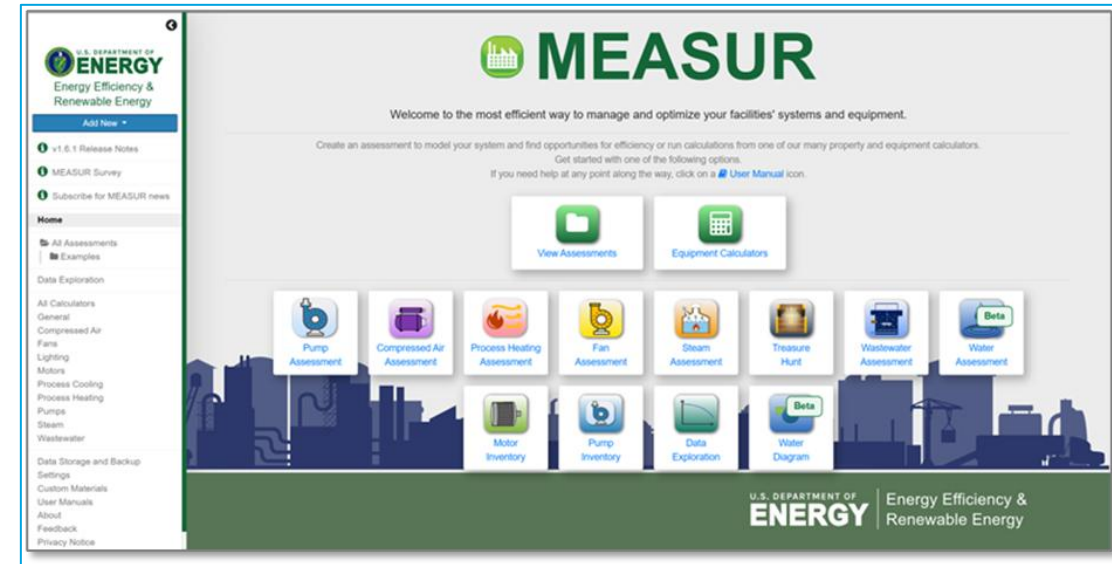
- Financial & performance metrics impacts of energy projects



MEASUR is an Integrated Energy Assessment Tool

Helps **identify, assess, and quantify** energy **savings** opportunities in operations and energy support systems.

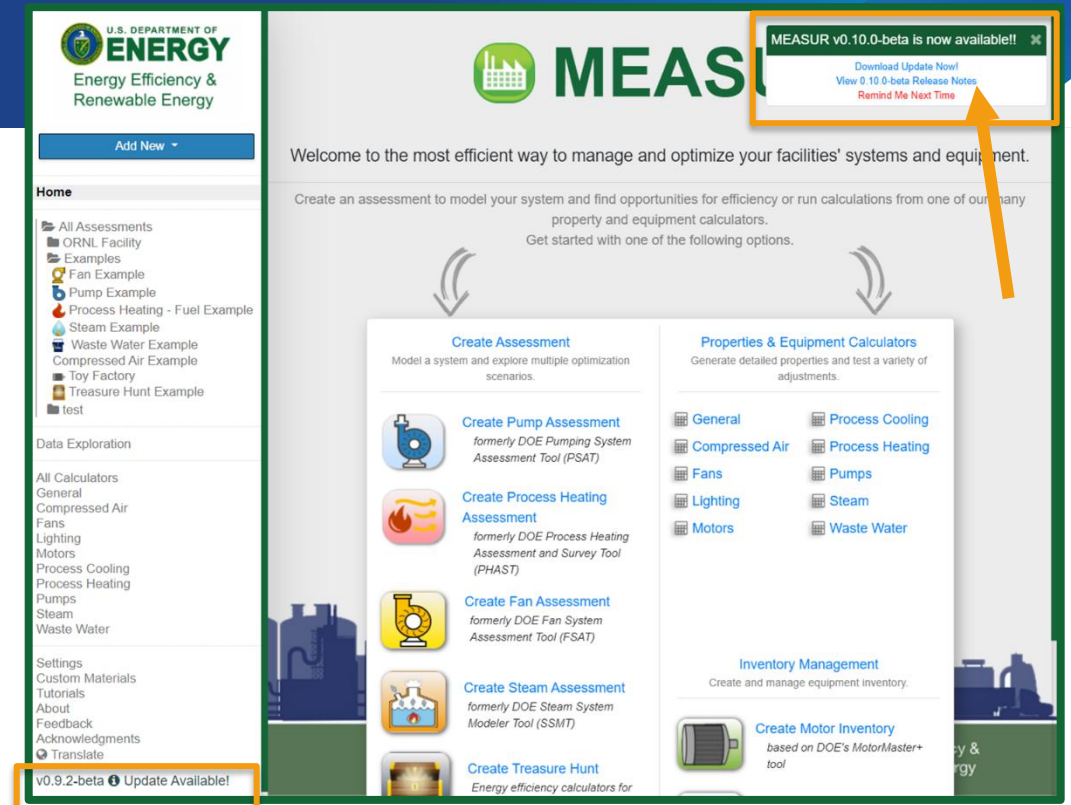
- FREE & Open source, cross-platform tool
- Technology and vendor agnostic
 - Desktop/Mobile; Windows, Mac, Linux, Android
- Private data & Global useability
 - Data is stored on *YOUR* device
- Key User Features
 - Similar workflow for all assessment modules
 - Graphs, figures, accessible help text & examples
 - Regular updates



Find this tool at
<https://measur.ornl.gov>
<https://industrialresources.ornl.gov>

Finding MEASUR

- Officially released March 2022
- Updates will occur often
 - Automatic notification of updates if connected to the internet
 - Please report bugs to measur-help@ornl.gov
- Download from DOE or GitHub
 - Uninstalling will delete your assessments!
- If using online –
 - Clearing cache will delete your assessments!



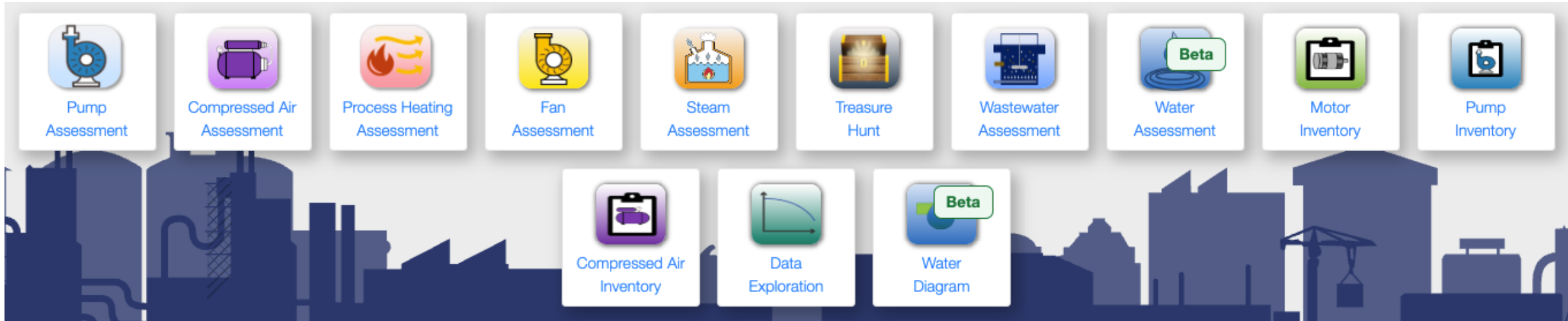
Download here:

<https://industrialresources.ornl.gov>

Or Google “MEASUR”

Web version: <https://measur.ornl.gov/>

MEASUR's Modules



- 7 Assessment Modules
- 1 Diagram Module – Water
- 1 Data Exploration Module – Compressed Air
- 3 Inventorying Modules – Pump, Motor and Compressed Air
- Treasure Hunt Module
- 80 calculators

System Setup

Reheat Furnace
Fuel-fired
Last modified: Nov 16, 2021

1 Assessment Settings 2 Heat Balance 3 Aux Equipment 4 Design Energy Use 5 Metered Energy

REHEAT FURNACE SETTINGS

Language: Translate Application Using Google Translate

Currency: \$

Units of Measure: ☒ Imperial ☐ Metric

Energy Result Unit: Millions British Thermal Units (MMBtu)

Select Energy Source Type: ☒ Fuel-fired ☐ Electrotechnology ☐ Steam-based

Common Result Unit: Millions British Thermal Units (MMBtu)

Common Fuel Unit: Millions British Thermal Units (MMBtu)

Common Electricity Unit: Millions British Thermal Units (MMBtu)

Common Steam Unit: Millions British Thermal Units (MMBtu)

Equipment Notes: Add additional information for your equipment

Operating Conditions at time of Assessment: The furnace was running at the full load capacity during the PH assessment.

Start with current equipment and operations -
Baseline

Fan 1
Last modified: Nov 15, 2021

1 Assessment Settings 2 Operations 3 Fan and Fluid 4 Motor 5 Field Data

MOTOR

Line Frequency: 60 Hz

Rated Motor Power: 500 hp

Motor RPM: 1785 rpm

Efficiency Class: Energy Efficient

Rated Voltage: 460 V

Full-Load Amps: 557.95 A

[Estimate Full-Load Amps](#)

HELP

Motor Help

Enter measured data to calculate your system's annual savings potential.

Motor RPM

Motor RPM is the nameplate speed of the motor.

This value is used with the line frequency to determine the number of motor poles. This, in turn, is used (along with motor class and size) to estimate motor efficiency and output shaft power for the measured electrical power or current conditions.

Standard and Energy Efficient Motors

Motor Size	Minimum	Maximum
60 Hz	540 rpm	3600 rpm
50 Hz	450 rpm	3000 rpm

Premium Efficient Motors

Motor Size	Minimum	Maximum
60 Hz	1080 rpm	3600 rpm
50 Hz	900 rpm	3000 rpm

- Assessment Settings: Set units and basic assessment settings
- Assessment Specific Tabs
 - Data Entry for baseline assessment
 - Intermediate Results
 - Help text for each data entry field

Assessments

Explore energy savings opportunities

Cooling Pump 2
Last modified: Sep 23, 2020

System Setup **Assessment** Diagram Report Sankey Calculators

Explore Opportunities Modify All Conditions
Novice View Expert View

SELECT POTENTIAL ADJUSTMENT PROJECTS
Select potential adjustment projects to explore opportunities to increase efficiency and the effectiveness of your system.

Add New Scenario

Modification Name: Improve Belt, Motor and Pump Eff

☒ Install VFD

☒ Install More Efficient Drive
Baseline Motor Drive: V-Belt Drive
Modification Motor Drive: Direct Drive

☒ Install More Efficient Pump
Baseline Pump Type: End Suction ANSI/API
Modification Pump Type: End Suction ANSI/API
Modification Pump Efficiency: 86.72 %

The efficiency of your pump has been calculated based on your flow rate and selected pump type. Click "Known Efficiency" to use the efficiency calculated by your system setup.

☒ Reduce System Flow Rate
☒ Reduce System Head Requirement
☒ Adjust Operational Data
☒ Install More Efficient Motor
Baseline Efficiency Class: Standard Efficiency
Modification Efficiency Class: Premium Efficient

RESULTS

	Baseline	Improve Belt, Motor and Pump Eff
Percent Savings (%)	—	32.0%
Pump efficiency (%)	63.5	86.7
Motor rated power (hp)	200	200
Motor shaft power (hp)	142	99.9
Pump shaft power (hp)	136.3	99.9
Motor efficiency (%)	93.8	96.4
Motor power factor (%)	82.9	74.9
Percent Loaded (%)	71	50
Drive efficiency (%)	96	100
Motor current (amps)	164.1	124.2
Motor power (kW)	113	77.3
Annual Energy (MWh)	990	577
Annual Energy Savings (MWh)	—	313
Annual Cost	\$49,494	\$33,864
Annual Savings	—	\$15,630

View Report

Process Heating - Fuel Example
Fuel-fired
Last modified: Sep 23, 2020

System Setup **Assessment** Diagram Report Sankey Calculators

Explore Opportunities Modify All Conditions
Novice View Expert View

Operations Charge Materials Flue Gas Fixture Wall Cooling Atmosphere Opening Leakage Extended Surface Other

BASELINE

Operating Hours	6912	hrs/yr
Fuel Costs	5	\$/MMBtu
Steam Costs	8	\$/MMBtu
Electricity Costs	0.05	\$/kWh

ALL OPPORTUNITIES

Operating Hours	6912	hrs/yr
Fuel Costs	5	\$/MMBtu
Steam Costs	8	\$/MMBtu
Electricity Costs	0.05	\$/kWh
Implementation Cost		\$

RESULTS

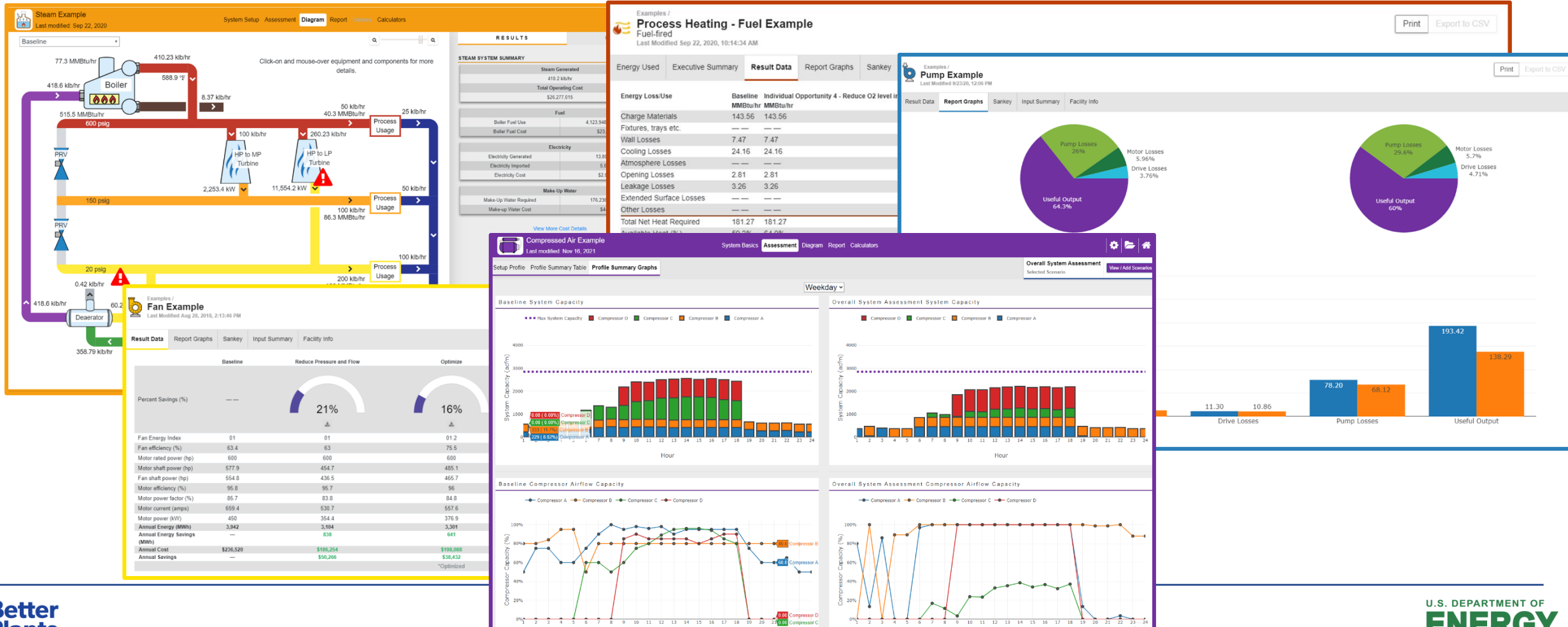
	Baseline	All Opportunities
Energy Loss/Use	MMBtu/hr	MMBtu/hr
Charge Materials	143.55	128.20
Fixtures, trays etc.	—	—
Wall Losses	7.47	3.50
Cooling Losses	24.16	24.16
Atmosphere Losses	—	—
Opening Losses	2.81	1.56
Leakage Losses	3.26	1.63
Extended Surface Losses	—	—
Other Losses	—	—
Total Net Heat Required	181.27	159.06
Available Heat (%)	59.2%	64.0%
Flue Gas Losses	124.82	89.60
Exothermic Heat from Process	—	—
Gross Heat Input	306.09	248.65

Next View Report

- Explore Opportunities: build scenarios from pre-established energy savings measures
- Modify All Conditions: build scenarios using same forms as baseline
 - Badges and field highlighting for visual cues

Reports

View side-by-side comparison of all scenarios and graphs for data visualization



Simple, easy-to-use Calculators

- 80 Stand alone Calculators

- Motors
- Pumps
- Fans
- Process Heating
- Process Cooling
- Steam
- Compressed Air
- Lighting
- General

- Most have graphical results





COOLING TOWER MAKEUP WATER

BASELINE

[+Add Case](#)

Case #1

[+Remove Case](#)

Water Flow Rate	2500	gpm
Water Cost	0.0025	\$/gal
Cooling Load	10	MMBtu/h
Calculate Cooling Load		
Annual Operating Hours	1000	hrs/yr
Cycles of Concentration	3	
Drift Eliminator	No	▼
Drift Loss Factor	0.2	%
Evaporation Loss Correction Factor	100	%

[Generate Example](#)[Reset Data](#)

MODIFICATION

Case #1

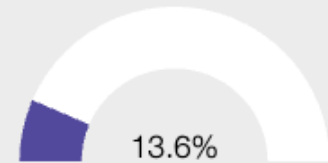
Water Flow Rate 2,500 gpm
Cooling Load 10 MMBtu/h
Calculated Cooling Load
Annual Operating Hours 1,000 hrs/yr

Cycles of Concentration	3	
Drift Eliminator	Yes	▼
Drift Loss Factor	0.01	%
Evaporation Loss Correction Factor	100	%

RESULTS

HELP

Water Savings



Baseline Results

Water Cost	\$5,250
Water Consumption	2,100.0 kgal

Modification Results

Water Cost	\$4,538
Water Consumption	1,815.0 kgal

Annual Savings

Cost Savings	\$713
Water Savings	285.0 kgal

[Copy Table](#)



BOILER BLOWDOWN RATE

BASELINE

Conductivity Readings

Feedwater Conductivity	400	μS/cm
Blowdown Conductivity	5500	μS/cm

Boiler

Steam Flow	100	klb/hr
Steam Temperature	500	°F
Boiler Efficiency	85	°

[Calculate Efficiency](#)

Operations

Operating Hours	8760	hrs/yr
Fuel Cost	3.99	\$/MMBtu
Water Cost	0.0025	\$/gal
Makeup Water Temperature	50	°F

Generate Example

Reset Data

MODIFICATION

Conductivity Readings

Feedwater Conductivity	400	μS/cm
Blowdown Conductivity	6000	μS/cm

Boiler

Steam Flow	100	klb/hr
Steam Temperature	500	°F
Boiler Efficiency	85	°

[Calculate Efficiency](#)

Operations

Operating Hours	8760	hrs/yr
Fuel Cost	3.99	\$/MMBtu
Water Cost	0.0025	\$/gal
Makeup Water Temperature	50	°F

RESULTS

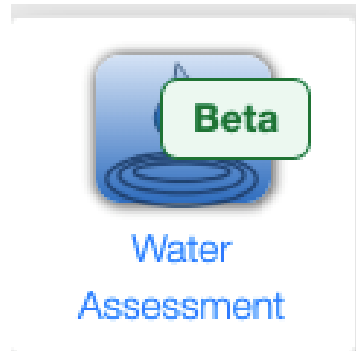
	Baseline	Modification
Blowdown Rate (%)	7.27 %	6.67 %
Blowdown Rate (klb/hr)	7.84	7.14
Feedwater Rate (klb/hr)	107.84	107.14
Fuel Use	35,211 MMBtu	32,277 MMBtu
Makeup Water Use	8,235 kgal	7,500 kgal
Fuel Cost	\$140,491	\$128,784
Makeup Water Cost	\$20,588	\$18,750
Total Cost	\$161,079	\$147,534
Fuel Savings	\$11,708	
Makeup Water Savings	\$1,838	
Total Savings	\$13,546	

Copy Table

HELP

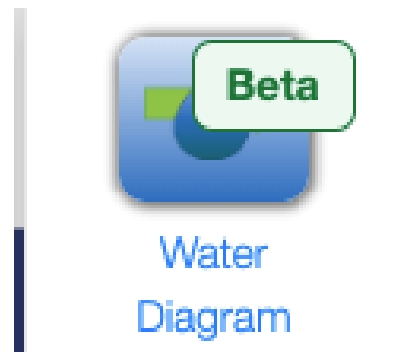
MEASUR – Water Assessment Module

Water Assessment Module



Baseline: Field Based Data Entry

- Visual Data Entry
- Input Water flow Components
 - Define Components Relationships
 - Input Flow and Cost data



Assessment Water Savings Projects

Diagram: Visual Data Entry

Reporting: Result tables and



Water Assessment Module - Baseline

 Demo
Last modified: Jul 6, 2026

Beta

Baseline

Assessment

Diagram

Report

1 Assessment Settings

2 Water Intake

3 Water Discharge

4 Water Treatment

5 Water Using System

6 Wastewater

Intake Data

Added Energy

INTAKE DATA

Name

City Water

Cost

1.72

\$/kGal

Source

Municipal Water (Potable)

Annual Use

177.2

Mgal/yr

[Enter Monthly Intake Data](#)

COMPONENTS	RESULTS	HELP
Intake Source		
> Lake Water		
> City Water		

Add New Component

 Demo
Last modified: Jul 6, 2026

Beta

Baseline

Assessment

Diagram

Report

1 Assessment Settings

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3 Water Discharge

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5 Water Using System

6 Wastewater

System Data

Added Energy

Water Treatment

WATER SYSTEM DATA

Name

Hot Dip Galvanization Line

System Type

Process Use

Hours Water Used Per Year

8760

hrs/yr

WATER SOURCE AND DISCHARGE FLOWS

Total Source Water

76.1

Mgal/yr

Recirculated Water

0

Mgal/yr

Total Discharge Water

72.3

Mgal/yr

Known Losses

3.799999999999997

Mgal/yr

Water In Product

0

Mgal/yr

System Gross Water Use

Mgal/yr

[Estimate With System Data](#)

COMPONENTS	RESULTS	HELP
Water Using System		
> Steel Treatment Line 1 and 2		
> Steel Treatment Line 3 and 4		
> Hot Dip Galvanization Line		
> Cooling Tower		
> Sanitary Use		

Add New Component

Water Assessment Module - Baseline

 Demo
Last modified: Jul 6, 2026

Beta

Baseline

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Intake Data

Added Energy

INTAKE DATA

Name

City Water

Cost

1.72

\$/kGal

Source

Municipal Water (Potable)

Annual Use

177.2

Mgal/yr

[Enter Monthly Intake Data](#)

COMPONENTS	RESULTS	HELP
Intake Source		
> Lake Water		
> City Water		

Add New Component

 Demo
Last modified: Jul 6, 2026

Beta

Baseline

Assessment

Diagram

Report

1 Assessment Settings

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System Data

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Water Treatment

WATER SYSTEM DATA

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System Type

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hrs/yr

WATER SOURCE AND DISCHARGE FLOWS

Total Source Water

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Mgal/yr

Total Discharge Water

72.3

Mgal/yr

Known Losses

3.799999999999997

Mgal/yr

Water In Product

0

Mgal/yr

System Gross Water Use

Mgal/yr

[Estimate With System Data](#)

System	Total System Water (Mgal/yr)		Water Imbalance		
	Incoming Water	Outgoing Water	Net Imbalance	Percent of Incoming Water	Percent of Total Plant Balance
> Steel Treatment Line 1 and 2	126.1	126.1	—	—	—
Steel Treatment Line 3 and 4	126.1	126.1	—	—	—
Hot Dip Galvanization Line	76.1	76.1	—	—	—
Cooling Tower	49.2	49.2	—	—	—
Sanitary Use	1.9	1.9	—	—	—
Annual Total	379.4	379.4	—	—	—

Water Assessment Module - Diagram



New Assessment
Last modified: Jul 6, 2026

Beta

Baseline Assessment **Diagram** Report





BUILD RESULTS OPTIONS NOTES ALERTS >

Drag site water system components into the pane

Intake Source

Water Using System

Discharge Outlet

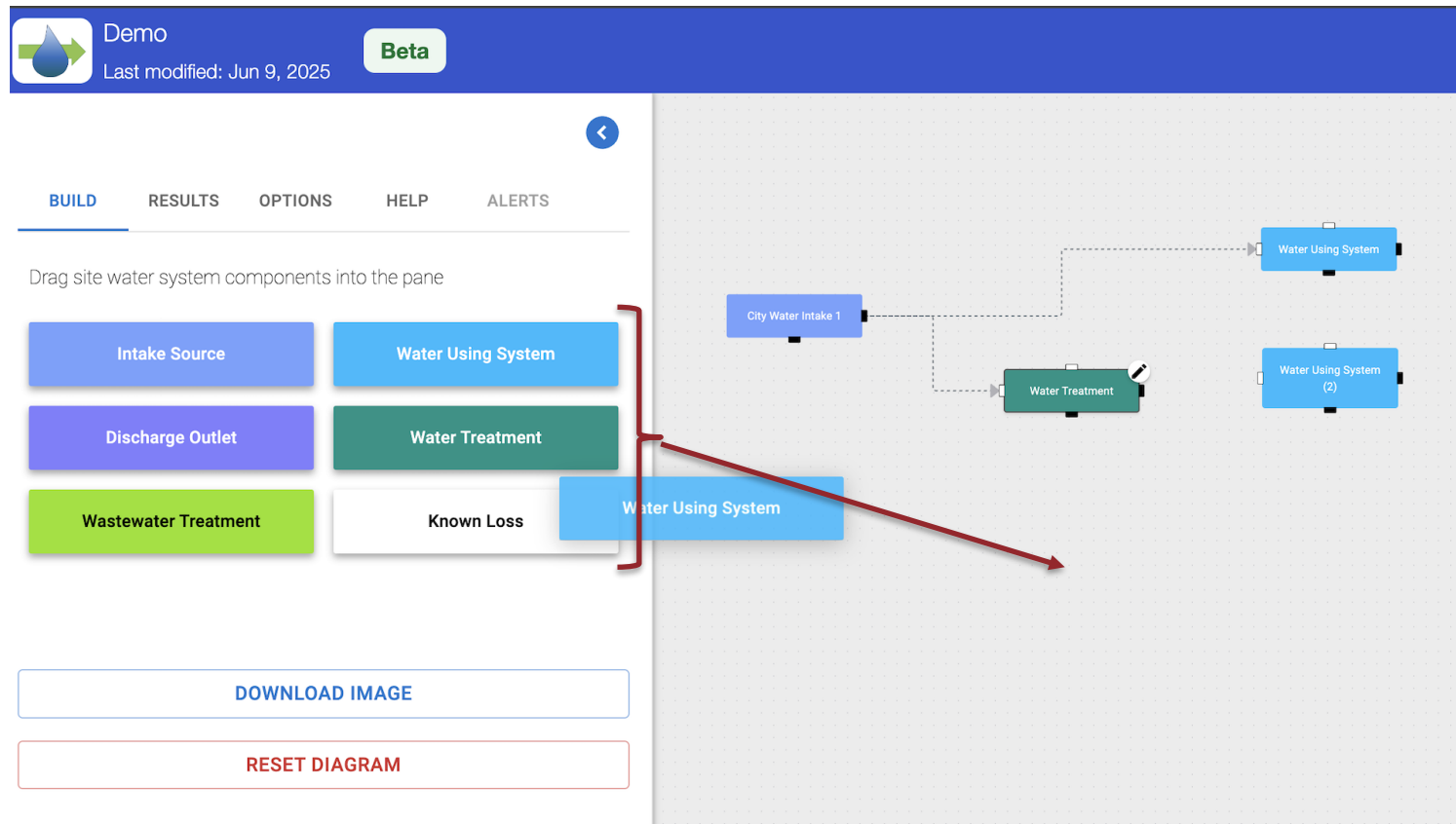
Water Treatment

Wastewater Treatment

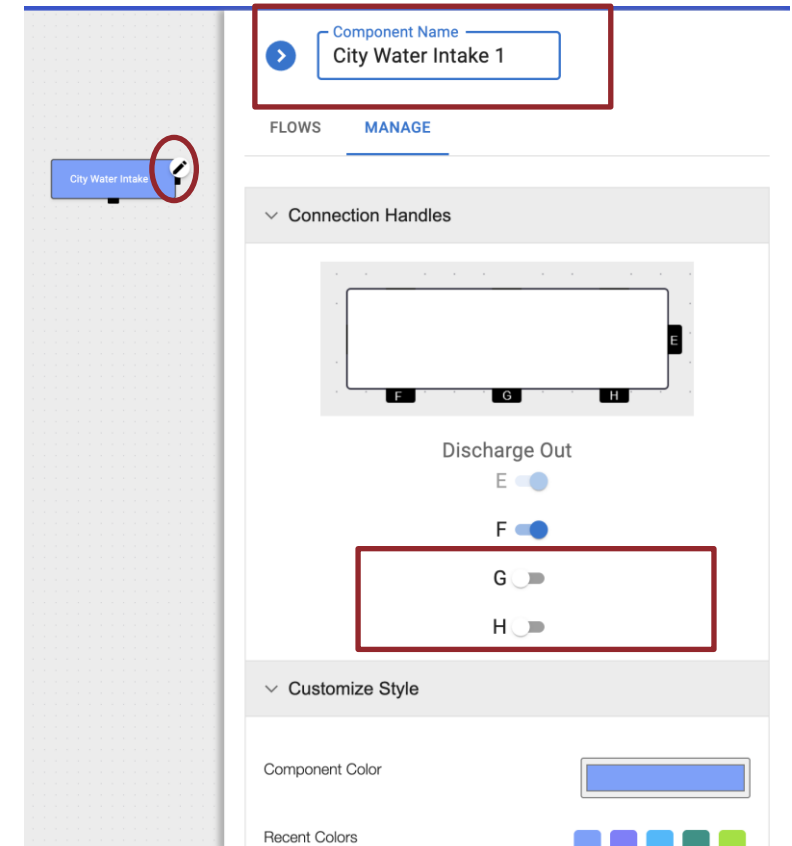
Known Loss

Water Assessment Module - Diagram

- Drag, Drop and Connect Components as per water flows



- Edit individual components using pencil icon



Water Assessment Module - Diagram

Use “Options” tab to
customize flow
diagram

 Demo
Last modified: Jun 9, 2025 Beta

BUILD RESULTS OPTIONS HELP ALERTS

Units of Measure

Imperial

Electricity Cost (\$/kWh)

0.066 \$/kWh

Decimal Precision

0

Conductivity Unit

mmho

Default Line Type

Curve

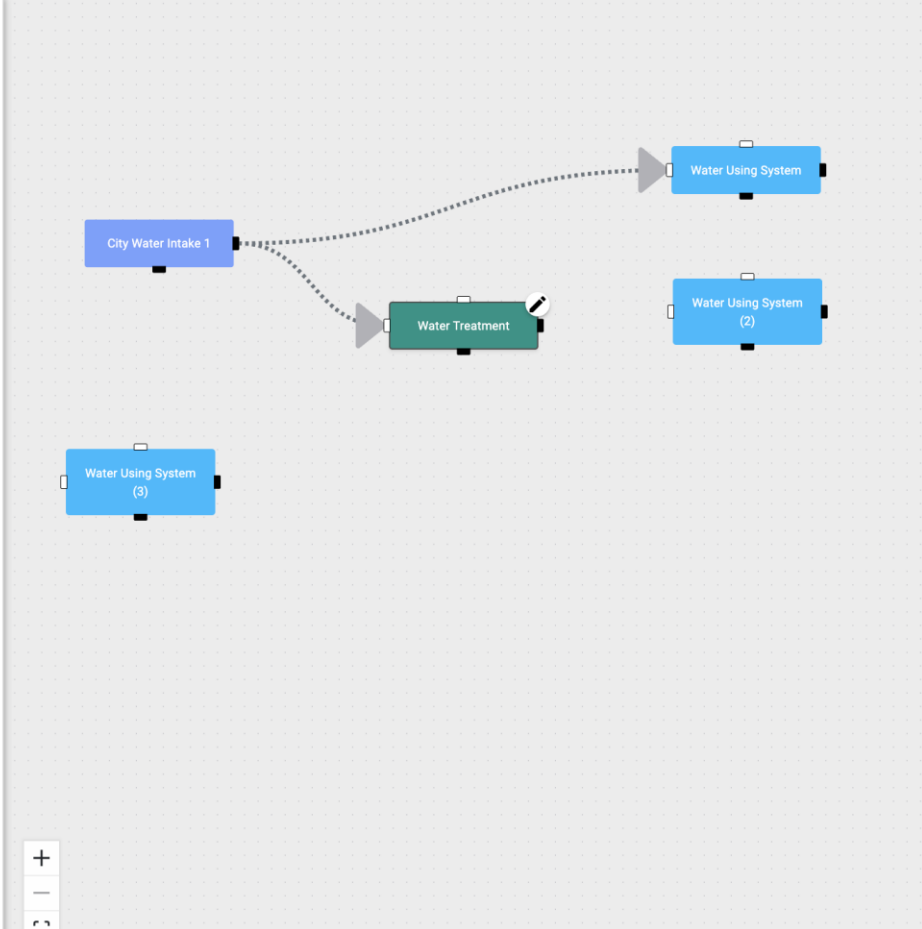
Line Thickness

1 px 10 px

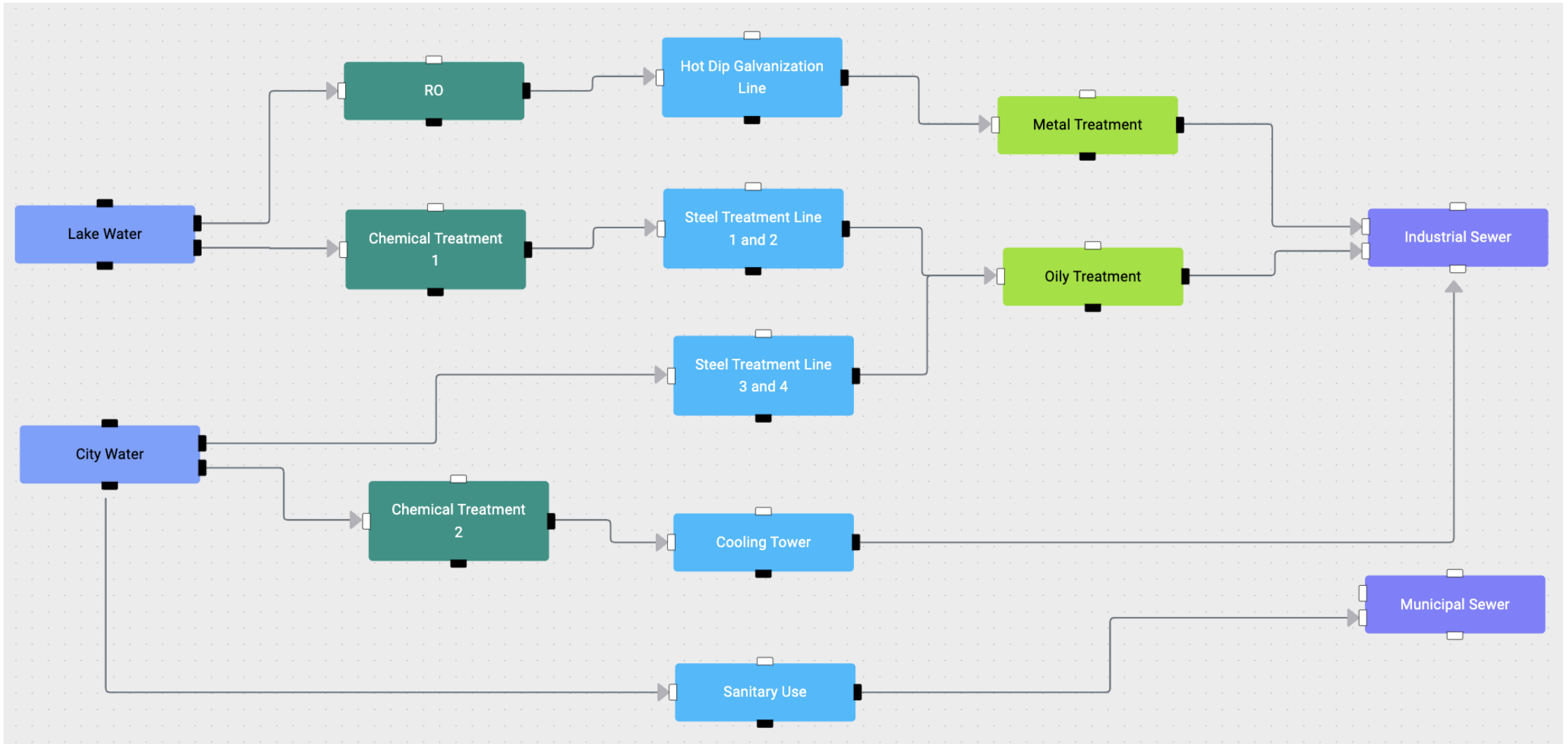
Flow Label Size Scale

0.5 2

☒ Show Connected Flow Values (Mgal)



Water Assessment Module - Diagram



Water Assessment Module - Report

 Demo
Click to go back, hold to see history
Last modified: Jul 6, 2026

Beta

Baseline Assessment Diagram **Report**



Last Modified 7/6/26, 7:00 PM

Executive Summary System Annual Summary True Cost of Systems

Facility-wide Source Water Intake	Baseline
Intake (Mgal)	379.4
Intake (kGal per 1000 lb)	0
Direct Cost of Water (\$)	\$615,292

Copy Table

True Cost of Water	Baseline
True Cost (\$)	\$989,852.82
True Cost (\$ per 1000 lb)	0
True Cost / Direct Cost	1.61

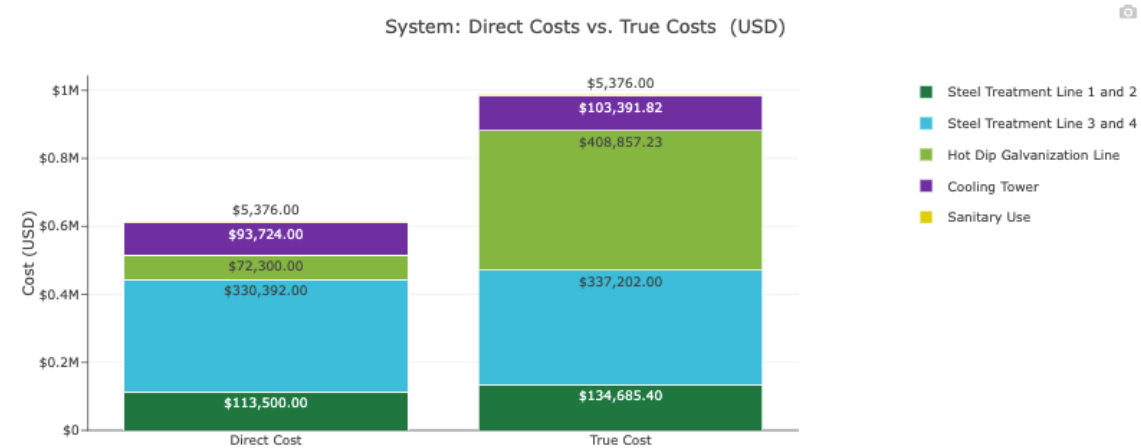
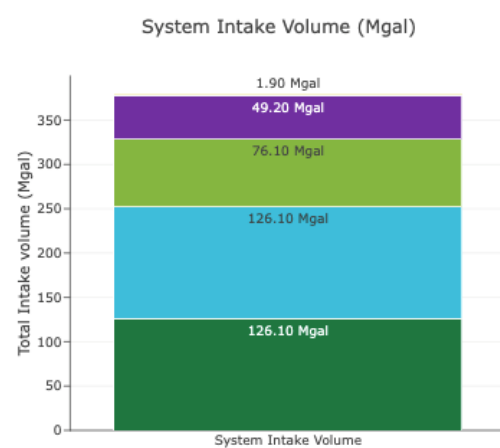
Copy Table

Water Assessment Module - Report

Executive Summary **System Annual Summary** True Cost of Systems

System	Source Water Intake	Direct Costs		True Cost of Water		True Cost/Direct Cost of Water
	Mgal/yr	\$/yr	\$/kGal	\$/yr	\$/kGal	
Steel Treatment Line 1 and 2	126.1	\$113,500	\$0.9001	\$134,685.4	\$1.0681	1.19
Steel Treatment Line 3 and 4	126.1	\$330,392	\$2.6201	\$337,202	\$2.6741	1.02
Hot Dip Galvanization Line	76.1	\$72,300	\$0.9501	\$408,857.23	\$5.3726	5.66
Cooling Tower	49.2	\$93,724	\$1.905	\$103,391.82	\$2.1015	1.1
Sanitary Use	1.9	\$5,376	\$2.8295	\$5,376	\$2.8295	1
Plant	379.4	\$615,292	\$1.6218	\$989,512.45	\$2.6081	1.61

[View Units/Cost](#) [View Percent](#)



- Steel Treatment Line 1 and 2
- Steel Treatment Line 3 and 4
- Hot Dip Galvanization Line
- Cooling Tower
- Sanitary Use

Water Assessment Module - Report

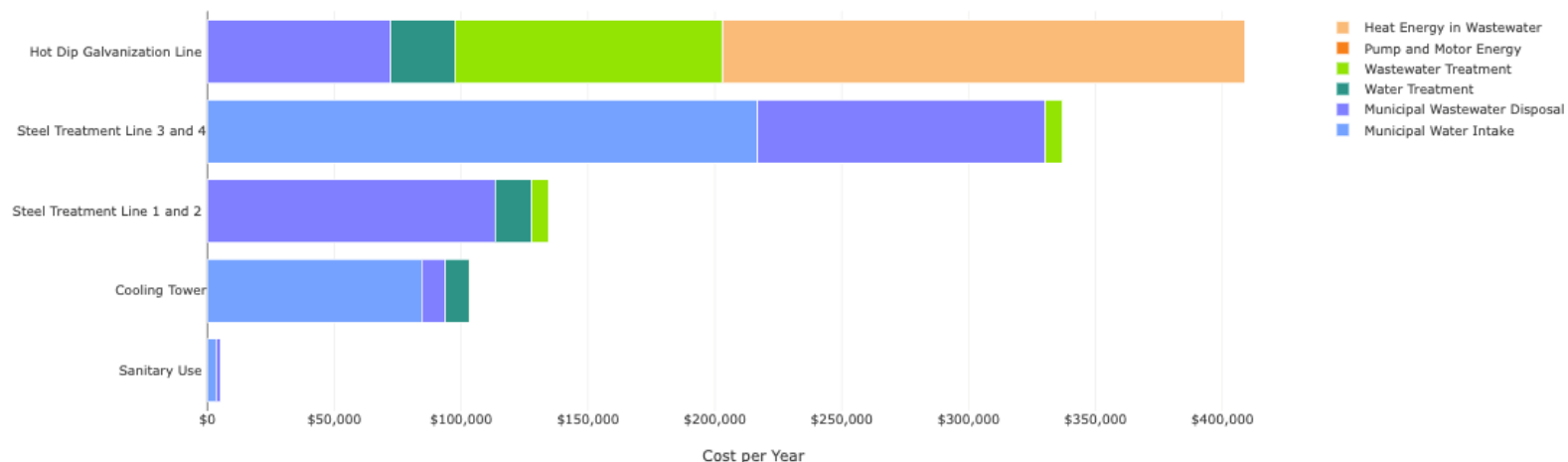
Executive Summary System Annual Summary **True Cost of Systems**

System	Municipal Water Intake	Municipal Wastewater Discharge	Third-party Disposal	Water Treatment	Wastewater Treatment	Pump and Motor Energy	Heat Energy	Total
Hot Dip Galvanization Line	0	\$72,300	0	\$25,113	\$105,558	0	\$205,886.23	\$408,857.23
Steel Treatment Line 3 and 4	\$216,892	\$113,500	0	0	\$6,810	0	0	\$337,202
Steel Treatment Line 1 and 2	0	\$113,500	0	\$14,375.4	\$6,810	0	0	\$134,685.4
Cooling Tower	\$84,624	\$9,100	0	\$9,594	0	\$73.82	0	\$103,391.82
Sanitary Use	\$3,268	\$2,108	0	0	0	0	0	\$5,376

 Adjusted Cost Attribution

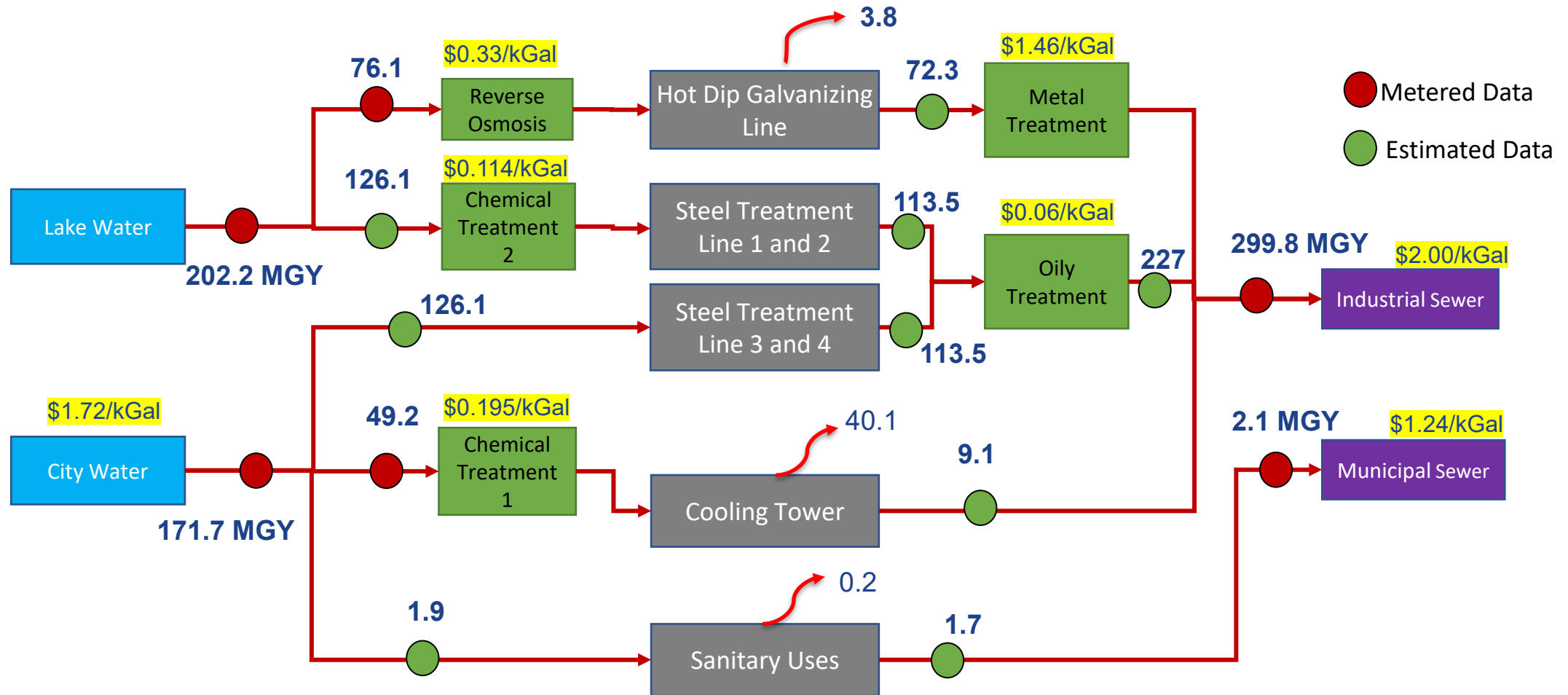
Copy Table

True Cost of Water Systems



MEASUR Tool – Working Session

Example Facility – With Data



Pump and Heat Energy

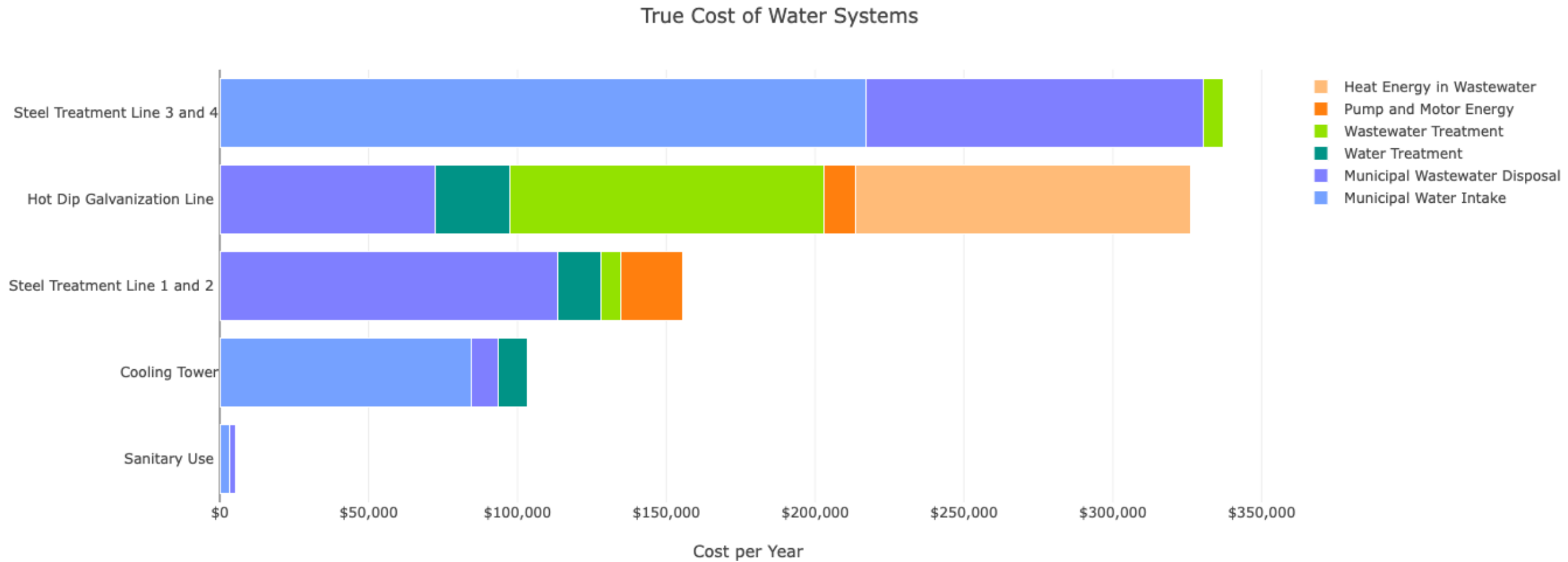
Pump Energy

- Steel treatment line 1 and 2 being served by the lake have 2– 40hp pumps running 80% loaded (system efficiency 90% and operates 6000 hrs per year)
- HDGL line being served by the lake water has 1 – 40hp pumps running 80% loaded (system efficiency 90% and operates 6000 hrs per year)

Heat Energy in Discharge

- Water used in HDGL line is also heated by a fuel fired heater (90% efficiency). Ambient water is a 60 F and discharges the line at 100F

Results



Thank You all for attending today's webinar.

**See you all on next Thursday – July 14th, 2026 – 10 am
ET**

**If you have specific questions, please stay online and
we will try and answer them.**

**Alternately, you can email questions to me at
thirumarank@ornl.gov**