# On-the-Ground Demonstration of AI/ML

## Facing the Unknown


February 21, 2024

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WATEREUSE

# Agenda

- Why is Machine Learning (ML) and Artificial Intelligence (AI) important for water sector utilities?
- Advancements through multi-agency collaborations
- Considerations for implementation
  - Instrumentation and data management
  - Managing public perception
  - The evolving role of operators

01

# Why is ML/AI important for water utilities?

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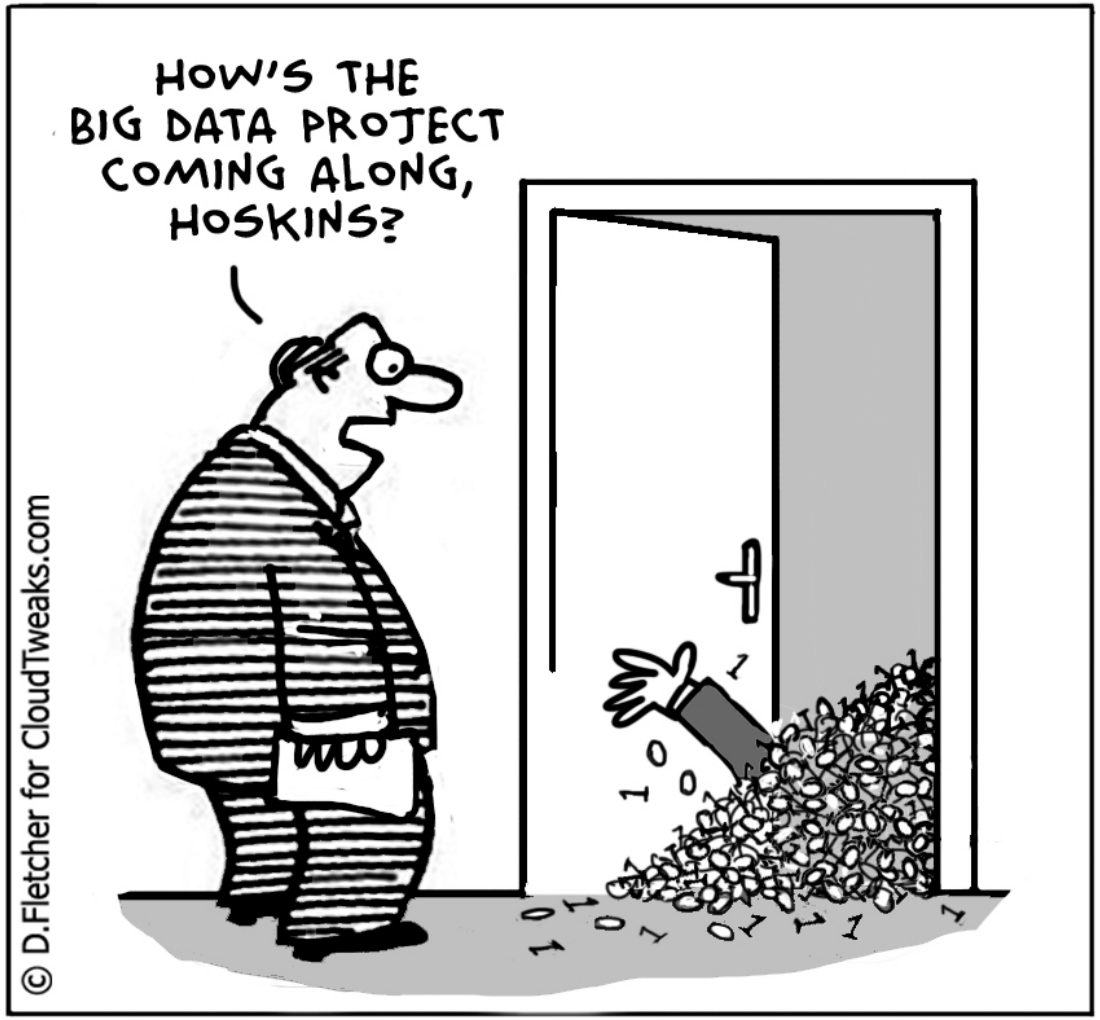
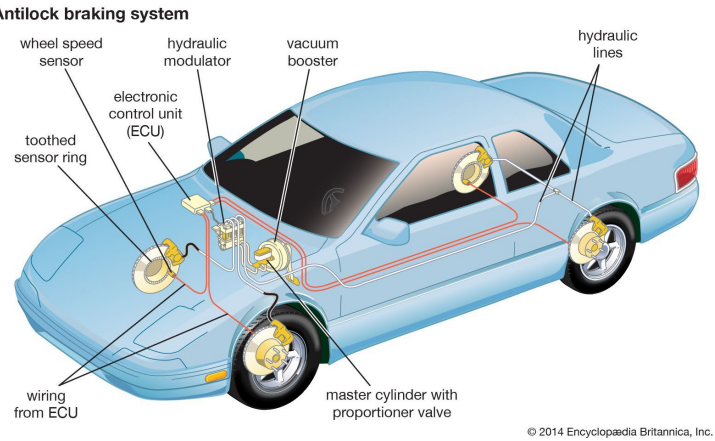
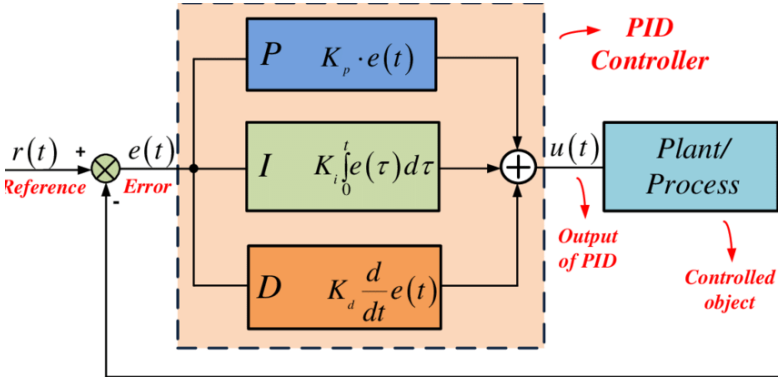
# Facilities generate increasing amounts of data – how can we use it to the fullest benefit?

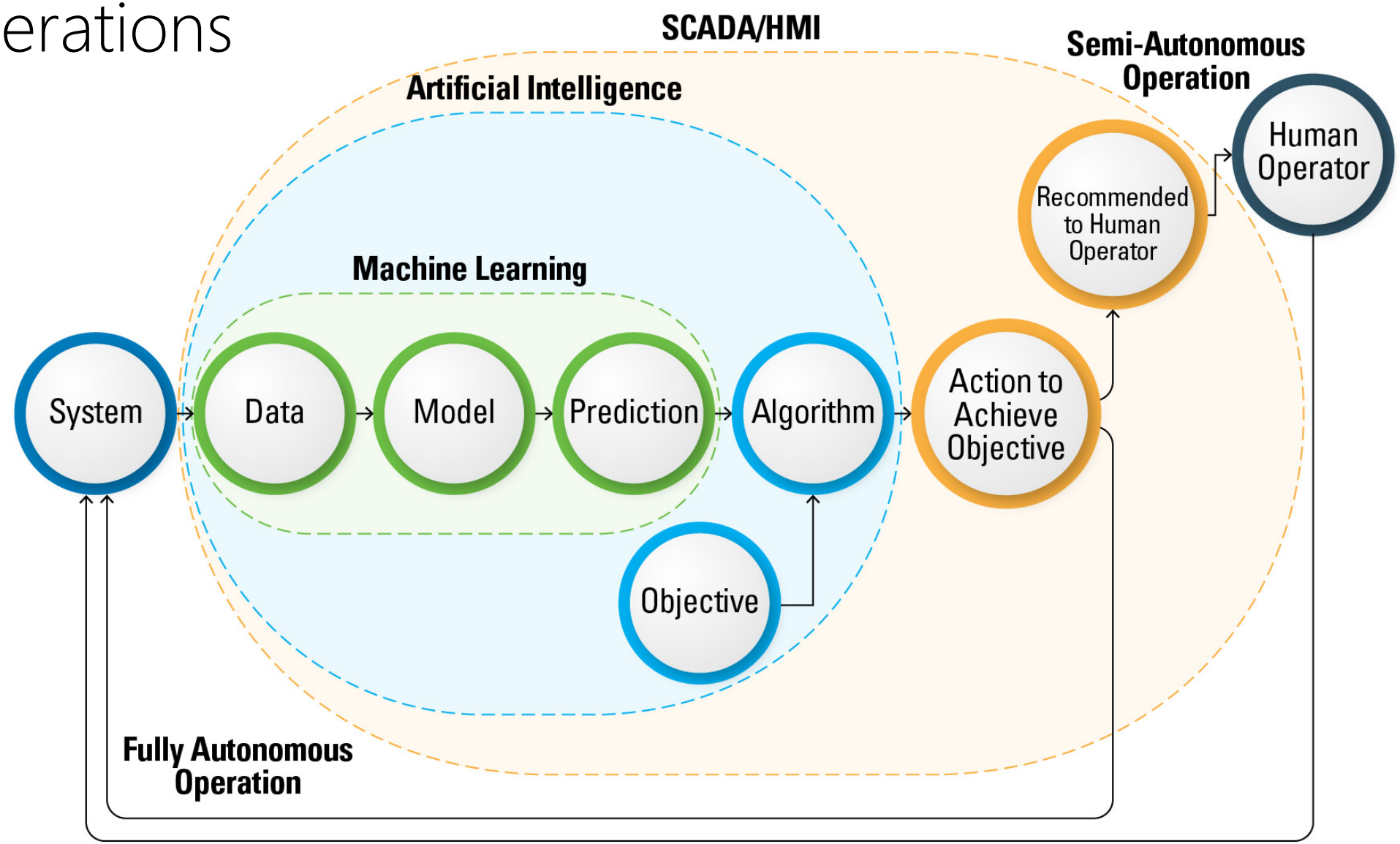


# Technology advancements still require human interaction



# Terminologies and the progression to semi-autonomous operations



02

# Advancements through multi-agency collaborations

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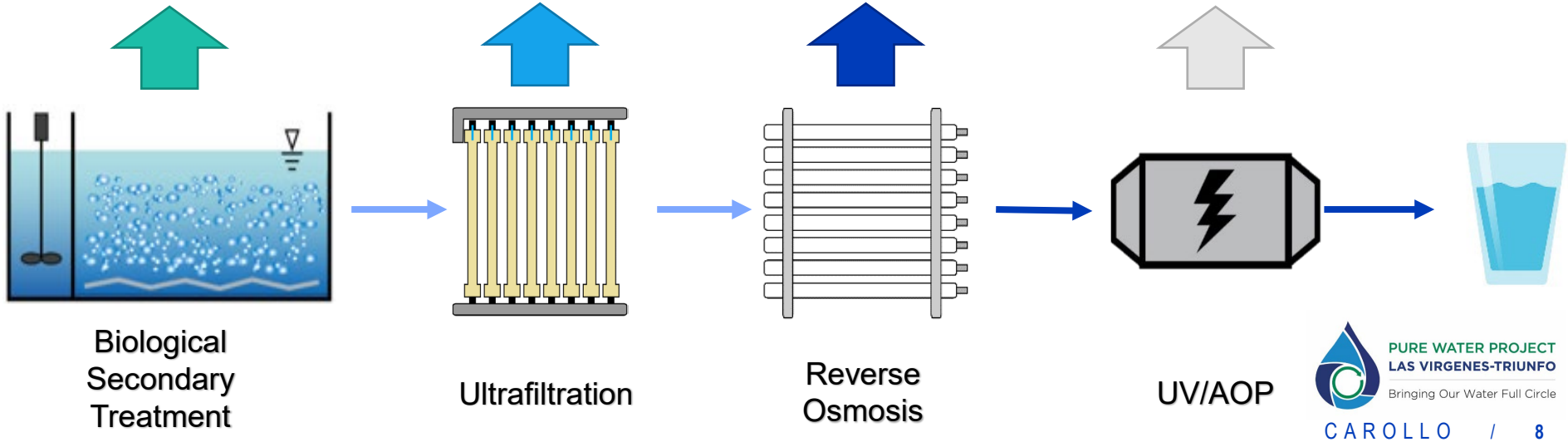
# Grant funding has supported many projects

| | | | | |
|---|---|---|---|---|
| Pilot/Full-Scale<br>Demonstration study | METI ('21) | USBR ('22) | USBR ('24) | NAWI ('24) |
| Desktop<br>Feasibility study | MWD & METI<br>('19 & '20) | METI ('21) | USBR ('23) | NAWI ('23) |

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# Collaborations

## Project Participants

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YOKOGAWA

IOSight

NORI

VTScada by Trihedral

## Funding Partners

METI
Ministry of Economy, Trade and Industry

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YOKOGAWA

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

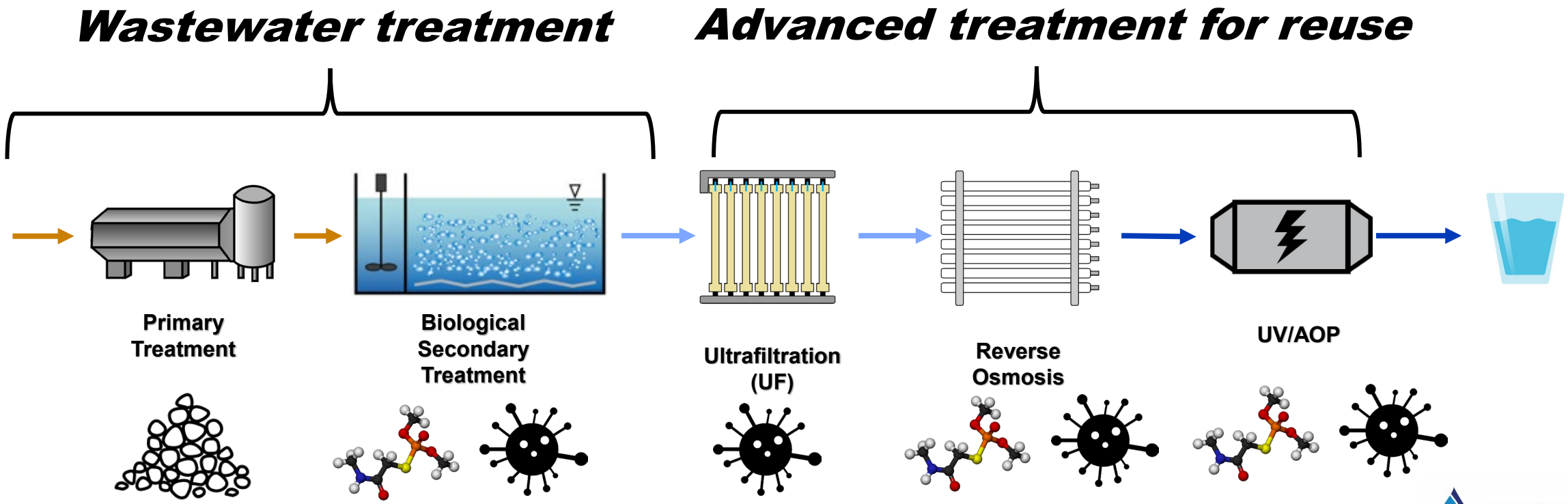
NAWI
National Alliance for Water Innovation

# A strong utility partner is important to develop AI/ML tools

**Tapia Water Reclamation Facility**

**Las Virgenes Triunfo JPA Pure Water Demonstration**

# Systematic testing and development of ML/AI at each step of the process



# 03

# Considerations for implementation

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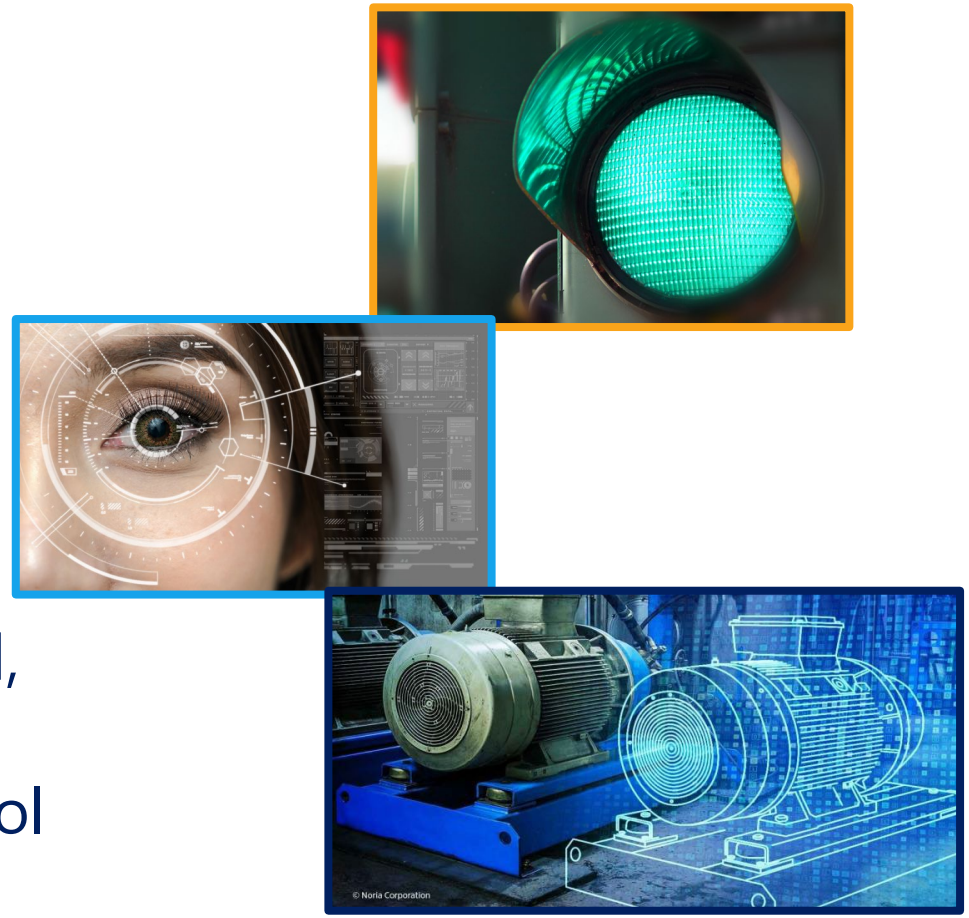
# Machine learning implementation

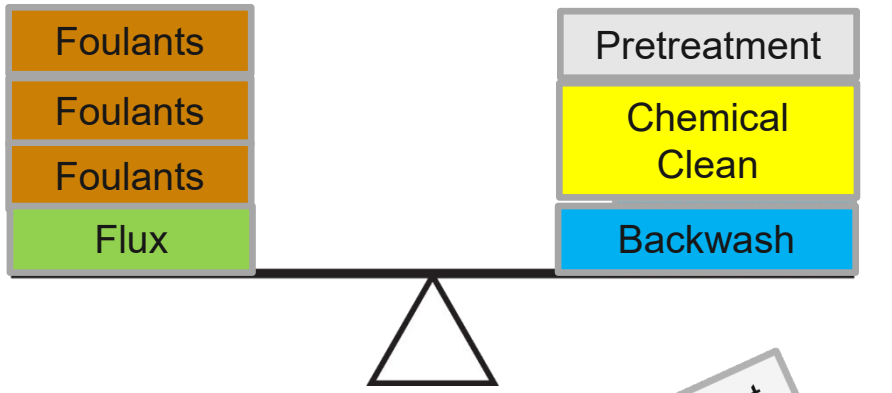
- **Fault Detection** – Monitoring for when an issue has occurred through pattern recognition on sensor data
- **Soft Sensors** – Predicting a slower or more expensive contaminant of concern with faster or cheaper data
- **Digital Twin** – A model with automated, bidirectional data connectivity to allow both real-time model updates and control adjustments



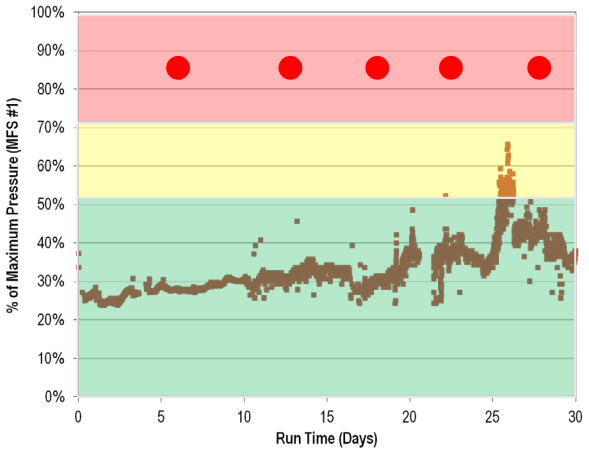
# Online monitoring is foundational to ML/AI

- Location, location, location!
- Instrument and data reliability
  - » Vendors
  - » What is measured (e.g., airflow vs. DO)
- Frequency of data collection
- Routine calibration and manual sample points for cross-checks
  - » Ease of maintenance and adequate water flow

# UF Operation is a Balancing Act Between Flux, Pretreatment Chemicals and Cleaning Strength + Frequency




TMP

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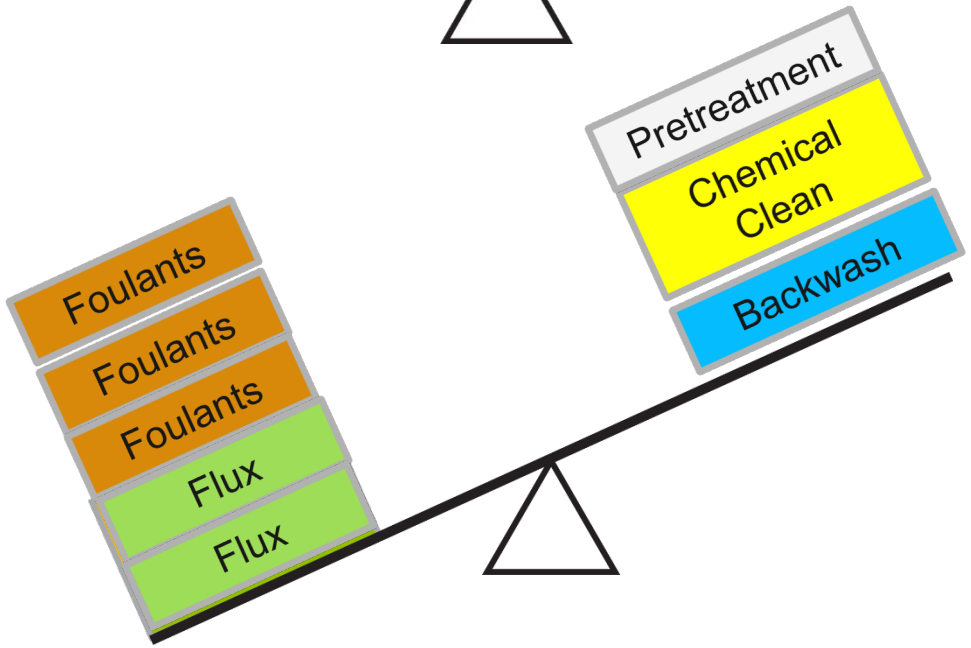


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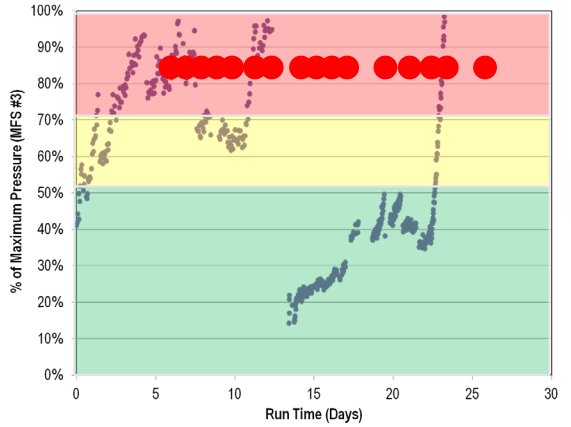


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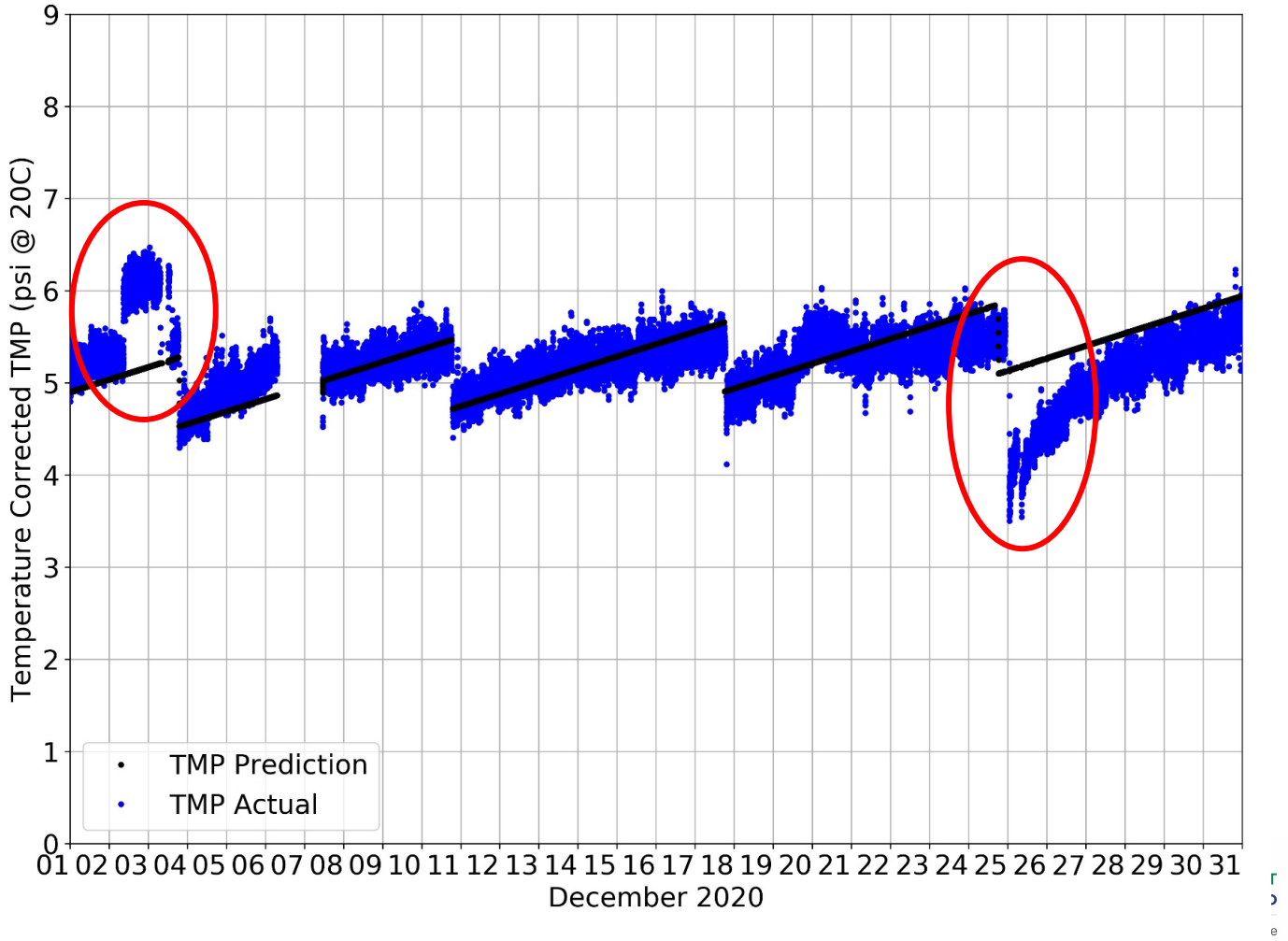
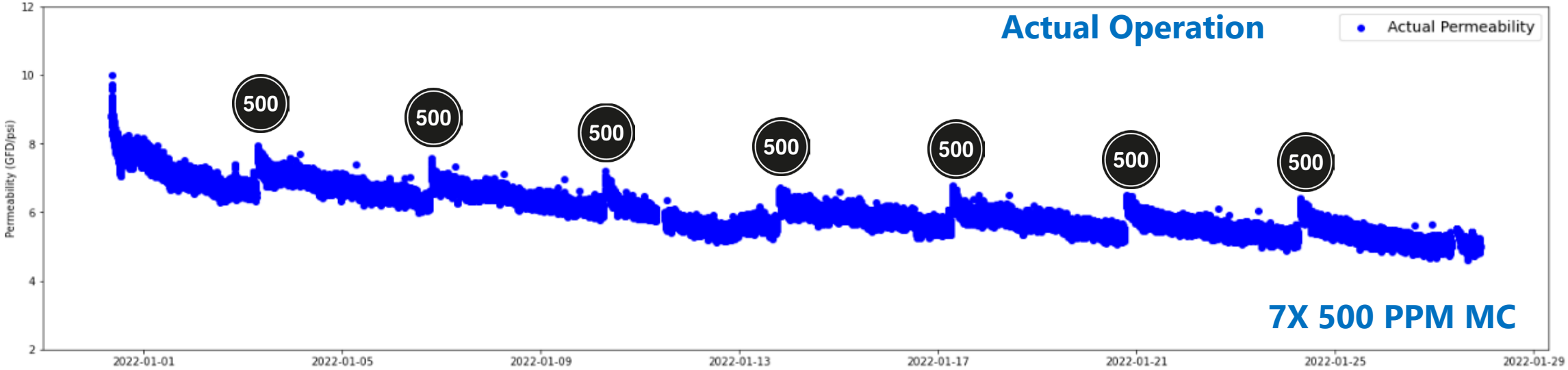
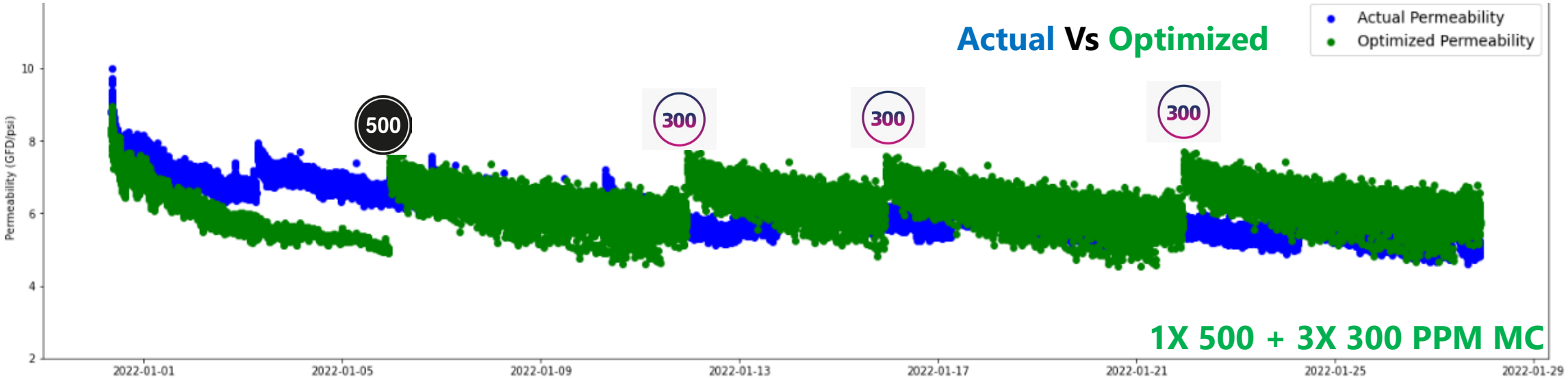
# Example of ML modeling of UF fouling

- 1-month blind trial
- Generally accurate except for 2 excursions
  - » Excursions were caused by changes in cleaning procedure that were not initially communicated to the modeling team.
  - » Example of Fault Detection



# AI simulations indicated lower chemical concentrations could still maintain membrane permeability.



# Dashboard for Operator Recommendations

## Dashboard

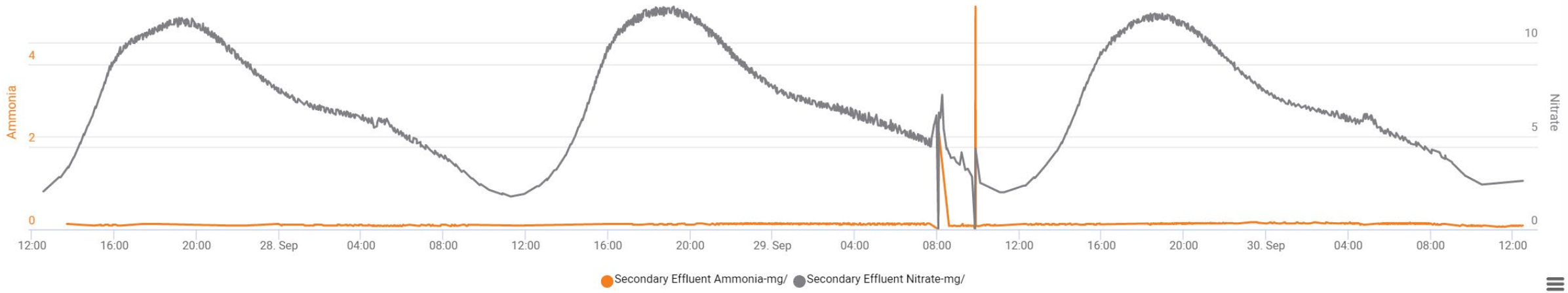
4 Hello, J

### Screen 1 - DO Recommendation

9/27/21 - 9/30/21

**Effluent Trend**

9/27/21 1:31:14 PM - 9/30/21 1:31:14 PM




**Basin 1 - Recommendation**

| Tag | Value |
|---|---|
| Previous Recommended DO Setpoint | 1.07 (mg/l) |
| Recommended DO Setpoint | 1.65 (mg/l) |

**Basin 2 - Recommendation**

| Tag | Value |
|---|---|
| Previous Recommended DO Setpoint | 1.2(mg/l) |
| Recommended DO Setpoint | 1.3(mg/l) |

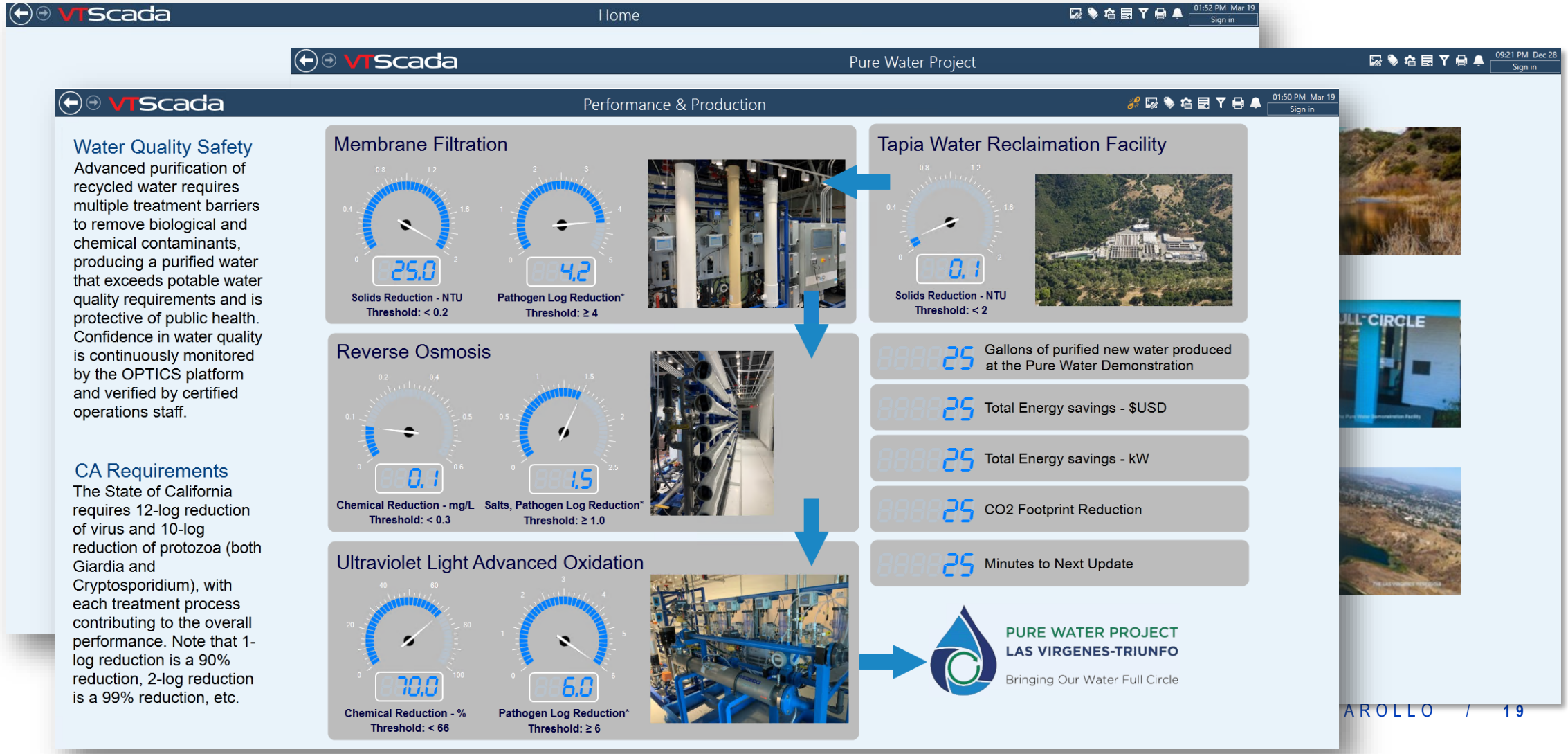
**Basin 5 - Recommendation**

| Tag | Value |
|---|---|
| Previous Recommended DO Setpoint | 1.04 (mg/l) |
| Recommended DO Setpoint | 1.7(mg/l) |

**Basin 6 - Recommendation**

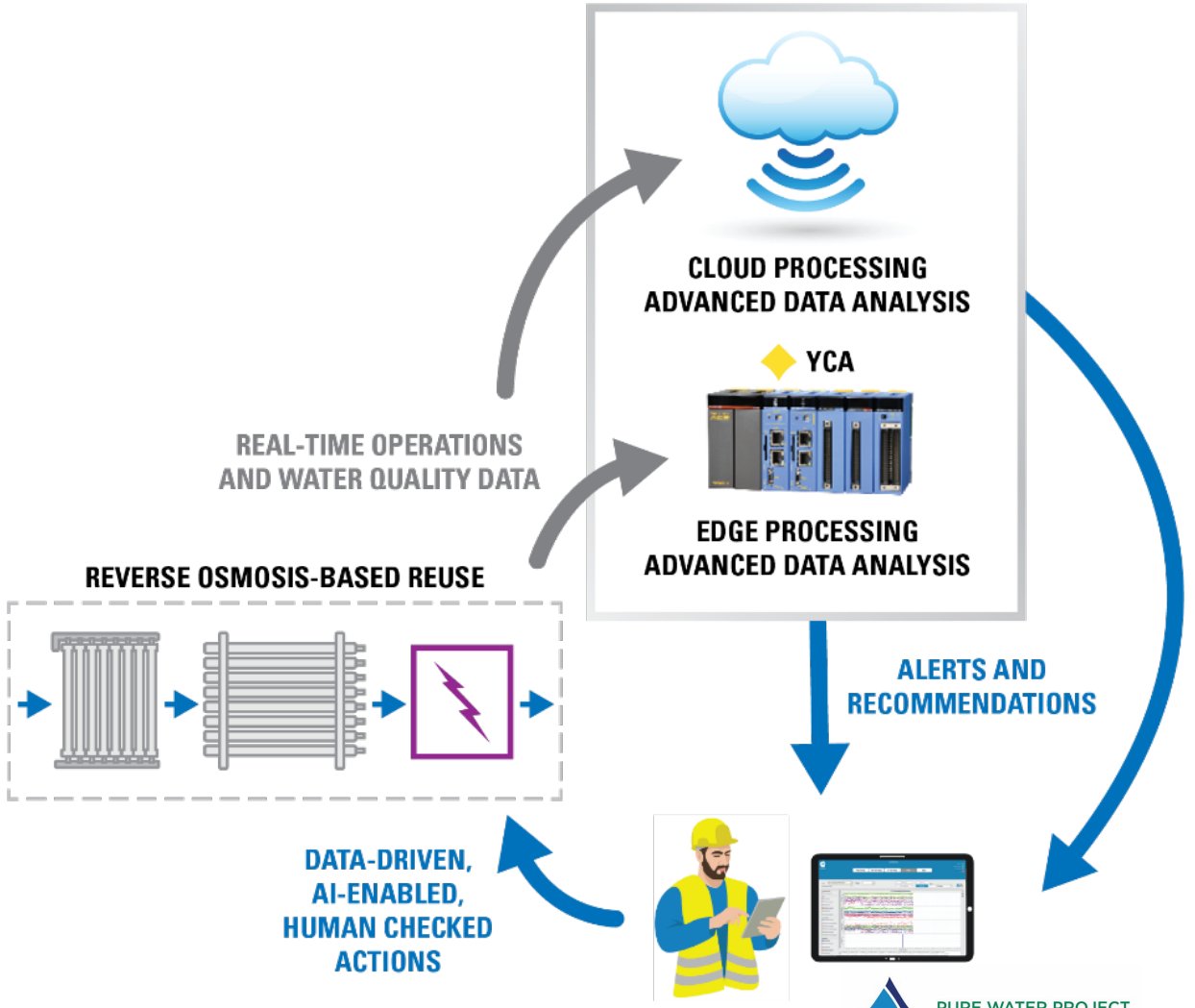
| Tag | Value |
|---|---|
| Previous Recommended DO Setpoint | 0.64 (mg/l) |
| Recommended DO Setpoint | 1.71 (mg/l) |

# Dashboard tailored for Operations, Public and Regulators



# Implications for ML/AI on the workforce

- Evolving roles and responsibilities for operations and maintenance staff
  - » More technical, instrumentation-focused, but still need to be hands on
- ML/AI can enhance focus and leverage available data
- Smaller pool of new hires entering the sector
  - » Higher pay scale will attract more (and diverse) talent

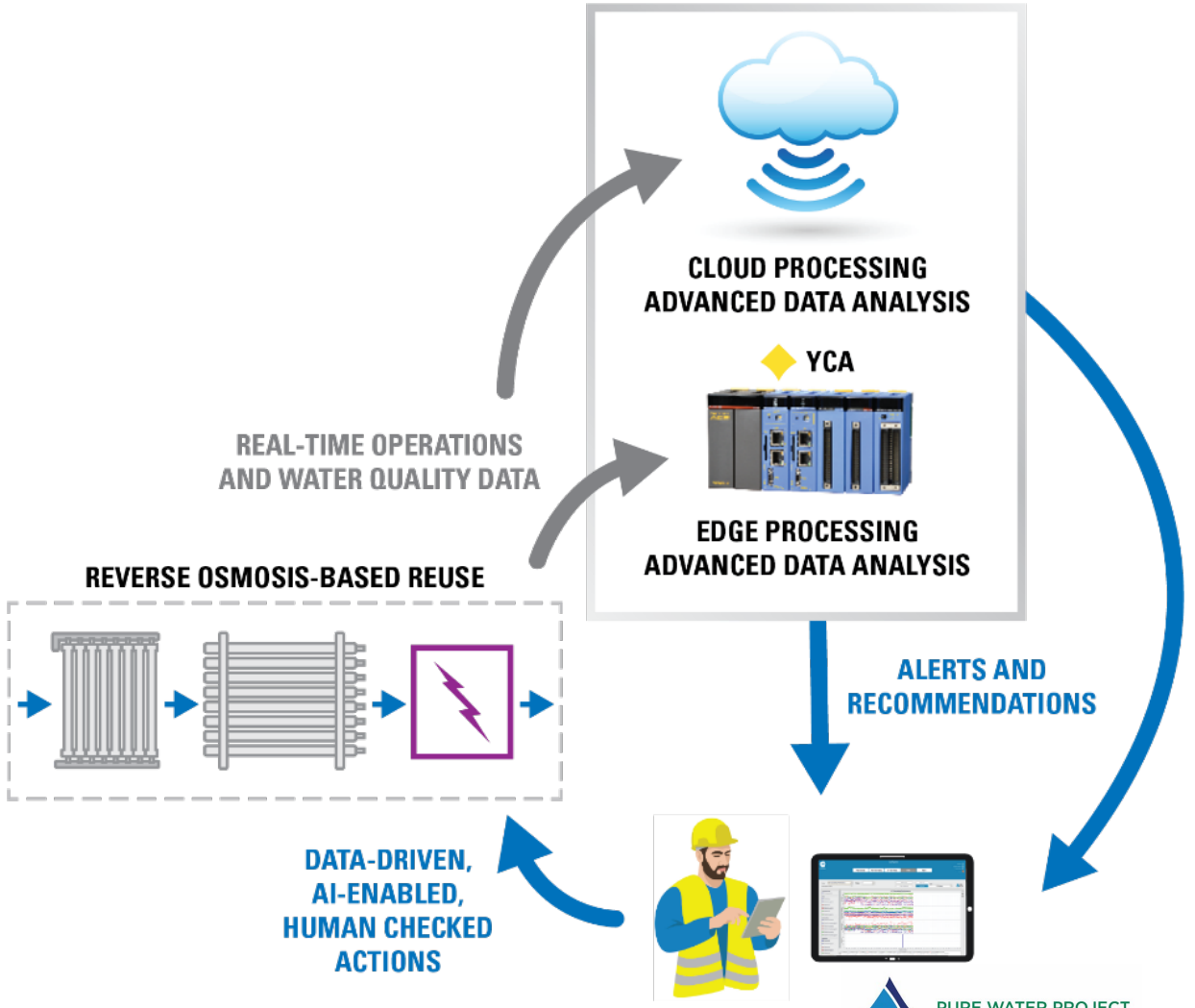


# Implications for ML/AI on the workforce

- Energy Efficiency
- Chemical Efficiency
- Operations Support
- Water Quality and Performance Monitoring

- DOES NOT Replace Operations Staff
- ML/AI can enhance focus and leverage available data

- <u>If Done Right</u>, Does Not Risk Data Security



Thank you

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