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Ensuring Reliable Data with Online Sensors

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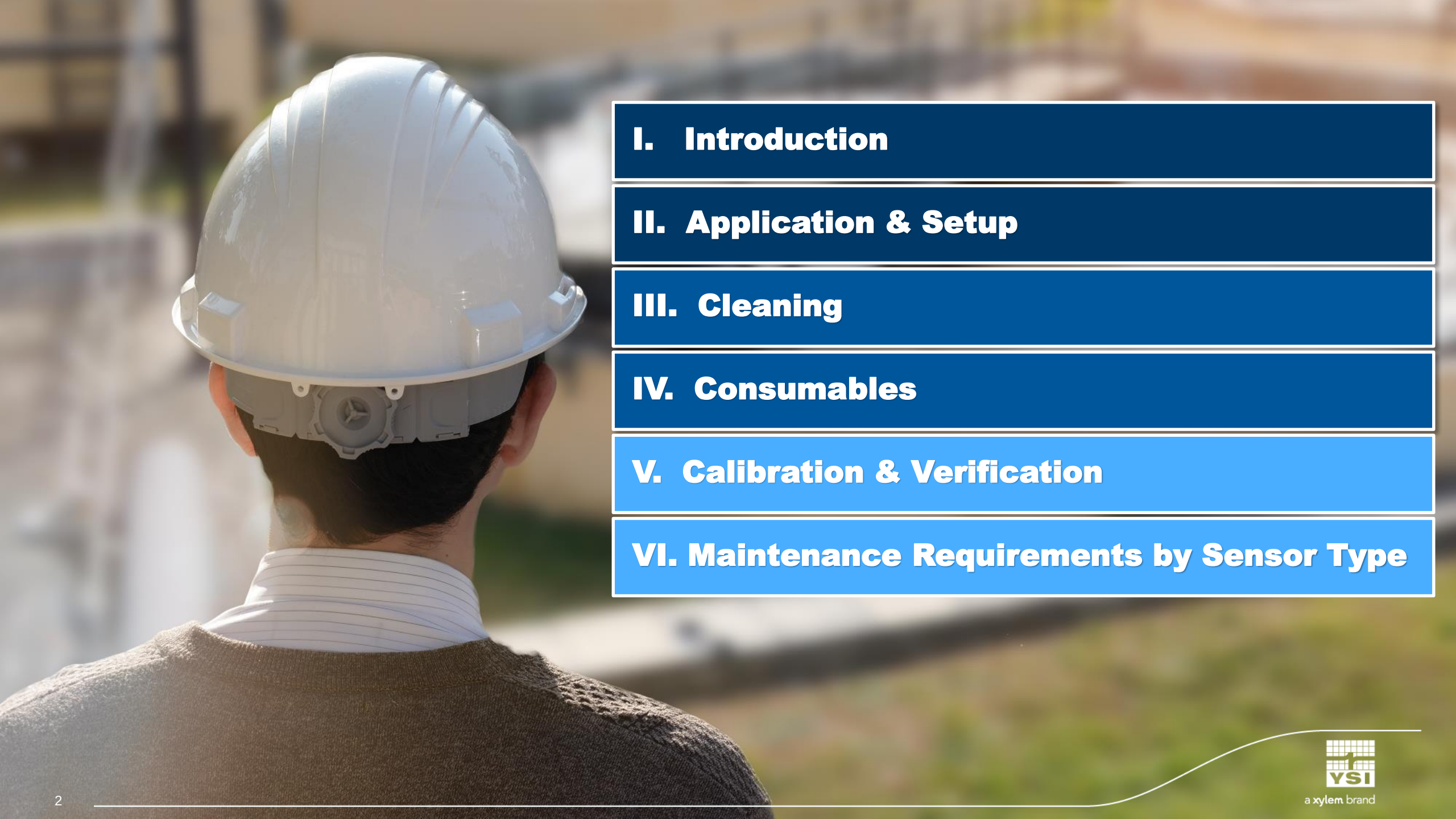

I. Introduction

II. Application & Setup

III. Cleaning

IV. Consumables

V. Calibration & Verification

VI. Maintenance Requirements by Sensor Type

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Part I:
Introduction

What is “Reliable Data”?

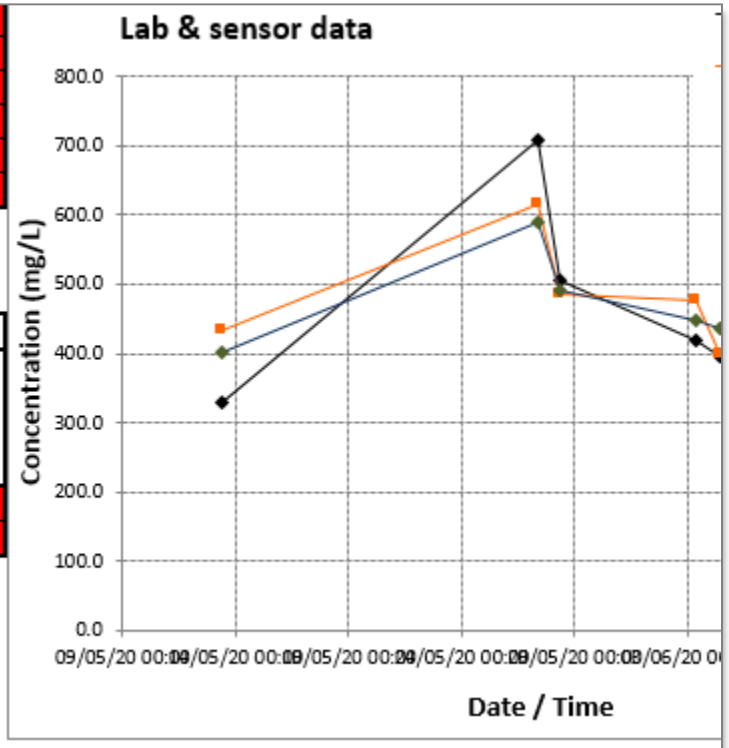
The collected data are accurate, consistent, and meet the intended purposes

- Accuracy
- Consistency
- Meets the intended purpose

616.0	590.9
486.0	490.2
477.0	446.9
400.0	435.4
603.0	614.8
402.0	464.8
400.0	
616.0	

r user calibration	
sensor value mg/L	calculated lab referenc value calculated with slope and asymetrie of
330	402
756	615

d



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Link between Reliable data and Sensor Care

- The biggest factor in the success of a sensor is how it is cared for.
- A sensor in the correct application and maintained well will provide reliable data a vast majority of the time
- Maintenance requirements vary greatly depending on the application and type of sensor

How can you achieve reliable data?

1. Proper Application & Set Up

2. Preventative Maintenance Schedule
   - Routine Cleaning
   - Replace Consumables
   - Calibrate Regularly (or as needed)

3. Verify Sensor Performance

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Part II:
Application & Set Up

Application

Choose the correct sensor for the application

- Type of water
  - Is the sensor designed for the type of water?
- Goal
  - What is the intended use of the sensor?
- Environmental requirements
  - Are there any special requirements of the sensors or controllers?
- Communication Requirements
  - How is the data being communicated to PLC/SCADA?

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Installation

Ensure the sensor is installed correctly

- Sensor Location
  - Is the sensor mounted in the correct location?
- Mounting
  - Is the sensor mounted according to the manufacturers' guidelines?
- Startup & Commissioning
  - Has the sensor system been commissioned by a qualified rep?

Settings

Ensure the correct settings are input

- Controller Settings
  - Set the date/time, start data recording, output settings
- Sensor Settings
  - Correct measuring mode, measuring location, measuring range, cleaning modes, etc.

Why is proper setup/application important?

- Ensures a good start with the instrumentation
- Prevents many potential issues in the future
- Prevents wasted time and effort

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Part III:
Cleaning

Sensor Cleaning

Most important maintenance requirement for ensuring reliable data

- Types of Cleaning
  - Manual vs. Automatic
- Benefits of sensors with automatic cleaning systems
  - Reduces frequency of manual cleanings
- Manual Cleaning Frequency
  - Highly dependent on application
  - Routine cleaning prevents sensor issues and inaccuracy
  - Better to overclean than underclean

Automatic Cleaning Systems

- Ultrasonic
  - YSI UltraClean™ System
  - Continuous vibration over the measuring window

UltraClean™ – Ultra Sonic Cleaning

Without cleaning system (30 days)

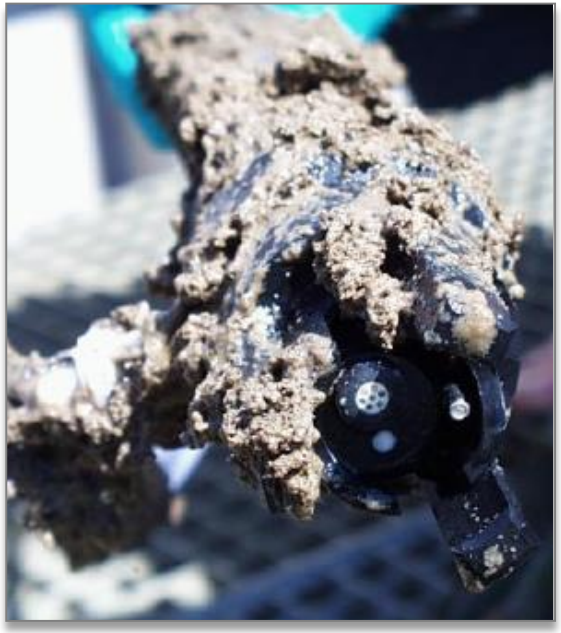
With cleaning system (30 days)

A clean sensor ensures accurate measurements! Maintenance-free sensor lowers ownership and operational costs.

Automatic Cleaning Systems

- Ultrasonic
  - YSI UltraClean™ System
  - Continuous vibration over the measuring window

- Compressed Air
  - Plant-provided air
  - Compressor mounted near measuring location



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Automatic Cleaning Systems

- Ultrasonic
  - YSI UltraClean™ System
  - Continuous vibration over the measuring window
- Compressed Air
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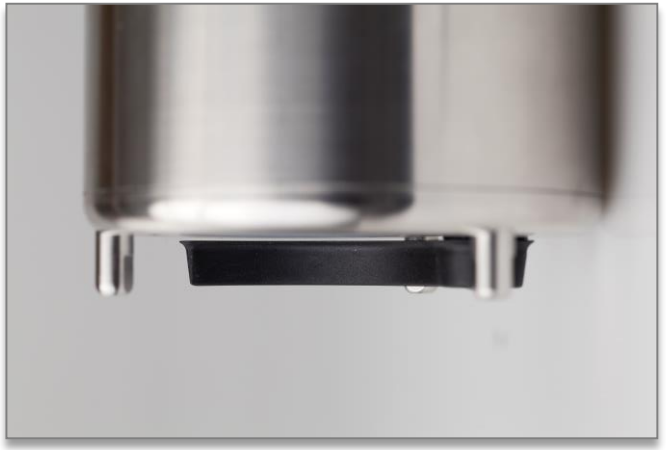
- Wiper systems



Manual Cleaning

- Always required periodically
- Frequency dependent on several factors
  - Process conditions
    - Location, ragging, solids content, biological growth, etc
  - Automatic cleaning system
- Manual cleaning only requires a couple minutes per sensor
  - Regular cleaning ensures biological growth is minimal

How to Manually Clean

Specifics are dependent on the manufacturer and type of sensor, but follow the same general steps

1. Pull sensor from process

2. Rinse measuring component
   - Electrode, cap, optical window, etc

3. Clean measuring component using manufacturer recommended procedure
   - Soft brush, rag, etc.

4. Rinse measuring component and return to process

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Part IV:
Consumables

Consumables

Regular replacement of consumables is essential for reliable data

- Some sensor types require periodic replacement of components
- These components have a life-span which can either cause drift in sensor measurements or lose functionality
- Frequency of replacement is dependent on the sensor type, application, and the quality of care

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Types of Consumables

- Electrodes
- Sensor Caps
- Seals/wipers
- Reagents & Filters (wet-chemistry analyzers)

Tips for Consumable Parts

- Follow the procedures provided by the manufacturer when replacing
- Shelf-life: Electrodes and Reagents have a shelf-life, meaning they “age” even when not currently being used
  - Be careful when ordering backup electrodes and reagents
- Proper sensor care will extend the life of consumables. Damaging electrodes or sensor caps with rough or improper cleaning is common.

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Part V:
Calibration & Verification

Why is calibration important?

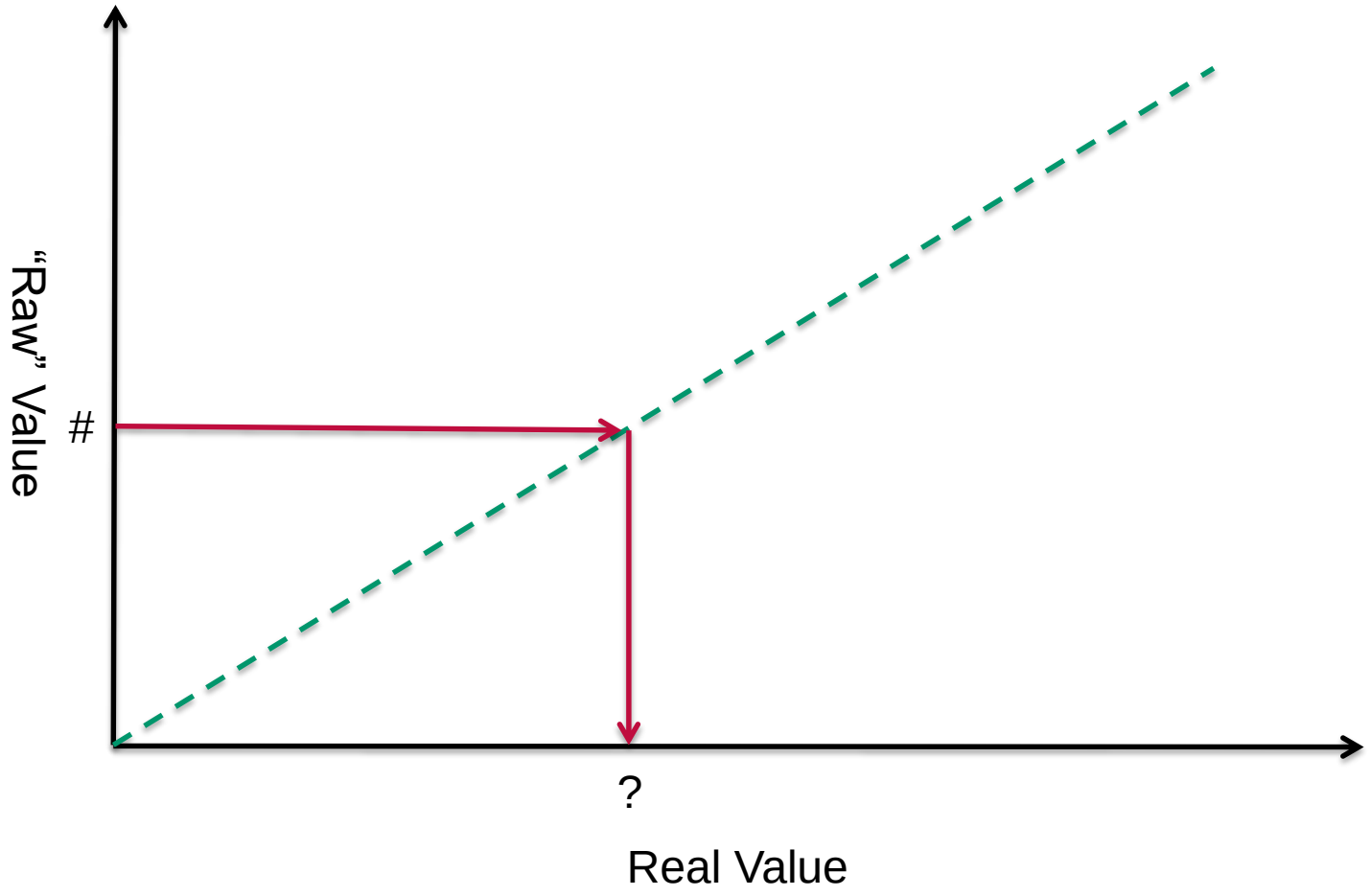
Without calibrations, sensor data is not reliable

- Calibration establishes a relationship between “raw” sensor data and real values
  - Ex. Translates mV into pH values
- Routine calibrations adjust this relationship for sensors that have aging or drifting components (consumables)
  - pH, ORP, Ammonium/Nitrate ISE, wet-chemistry
- Some sensors have automatic compensation for drift, so calibrations are required less often
  - Optical D.O., Optical TSS, UV sensors

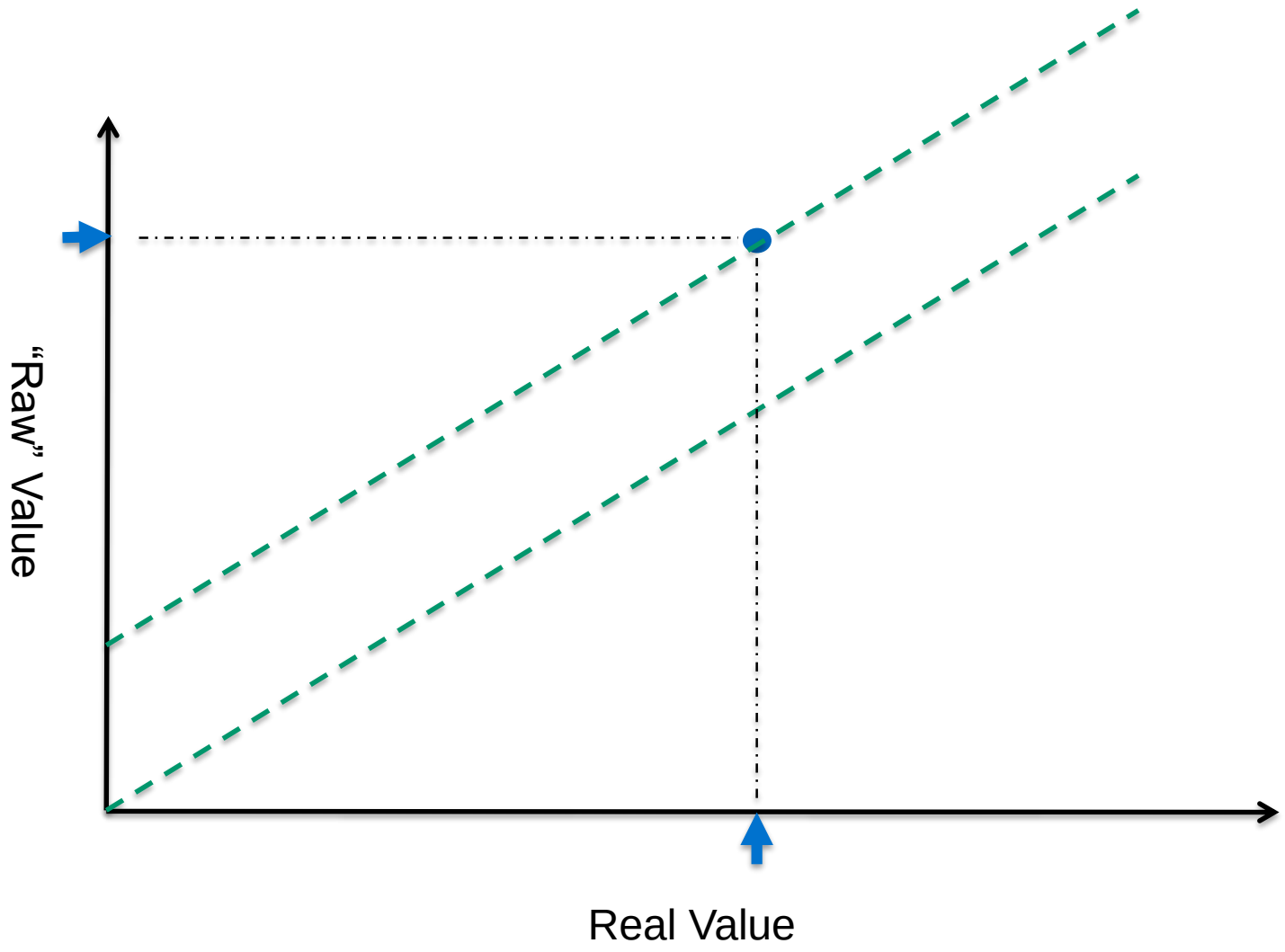
Types of Calibrations

1. Factory
2. Calibration with Standards (1-3 points)
3. Match to Lab Sample (1 point adjustment)
4. Multipoint Calibration (2+ point adj)

How do calibrations work?

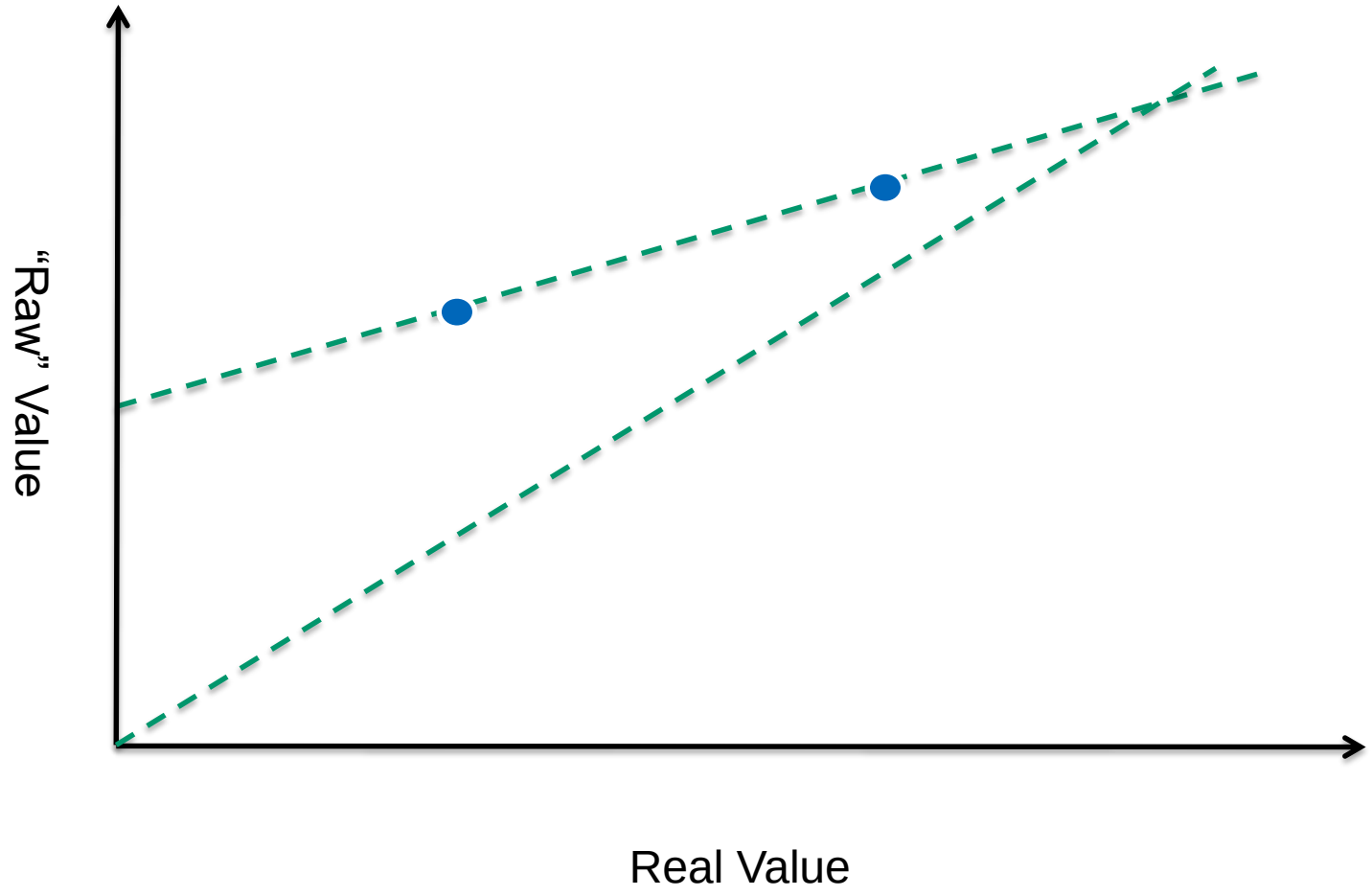


How do calibrations work?



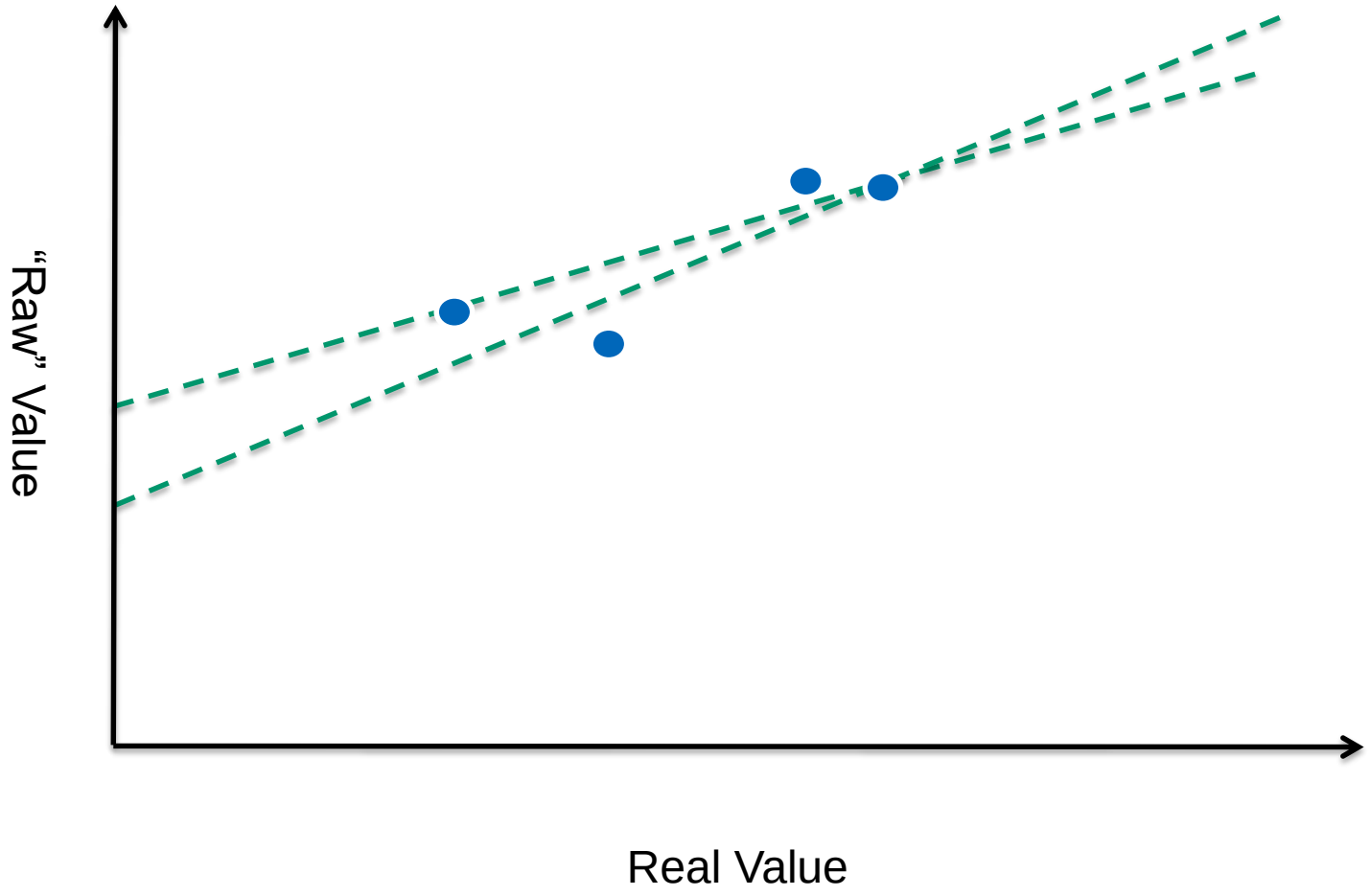
- 1-point adjustments
  - 1-point cal with standard
  - Match to Lab sample (1 point value pair)

How do calibrations work?



- 2-3 point cal with standard
- Multipoint adjustment

How do calibrations work?



- Multipoint adjustment

Tips for Calibrations

- Clean the sensor previously
- Careful sample collection and laboratory procedures are VERY important for value pair calibrations
  - Sensor data is only as good as the calibration data
- If calibrations drift quickly or are not accepted by the instrument, it may be time to replace the consumables

Why is Verification Important?

- Verifies sensor performance
- Ensures correct function of the sensor
- Ensures a good calibration
- Can “alert” when sensor maintenance is required
- Instill confidence in the validity of the sensor readings

Methods for Verification

- Portable Sensor
  - DO, pH, ORP, TSS (Sludge Level)
- Portable Colorimeter
  - NH_4^+ , NO_3^- , PO_4^{3-}
- Laboratory Analysis
  - NH_4^+ , NO_3^- , PO_4^{3-} , TSS
  - COD, BOD, TOC

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Sampling Tips for Lab Analysis

- Sample as close to the sensor as possible
- Record everything
- Filter Immediately (when filtration is required)
- Performing duplicate measurements can ensure accuracy


IQ SensorNet How To...
Right Sampling for Matrix Adjustment of ISE Electrodes
www.YSI.com/IQSN
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Troubleshooting Strategy

When you suspect a sensor is inaccurate

1. Ensure the sensor is clean
2. Verify the sensor reading with a reference measurement
3. Re-calibrate the sensor
4. Consider replacing consumables

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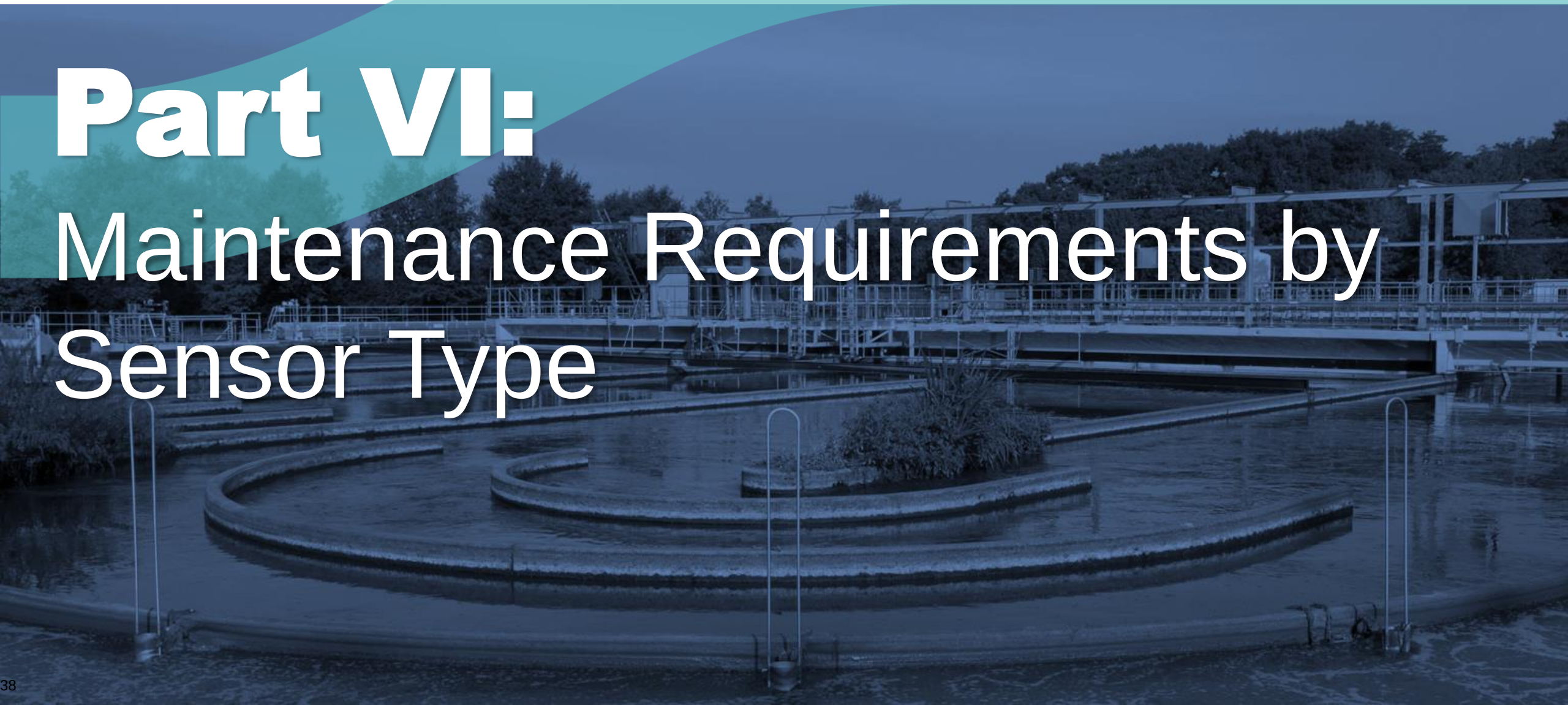
Part VI:

Maintenance Requirements by Sensor Type



Optical D.O.

- Pull for cleaning
  - 2 weeks

Cleaning

- Replace Sensor Cap
  - 2-5 years

Consumables

- No Calibration required

Calibration

Time Investment (per sensor/month): ~10 minutes

Optical DO Tip:

- If portable DO is reading higher than online DO, invert the sensors to reduce effects of bubbles bursting on membranes

pH

- Pull for cleaning
  - 2 weeks

Cleaning

- Replace Electrodes
  - 12-18 months

Consumables

- Calibration to Standards
  - 1 month

Calibration

Time Investment (per sensor/month): ~20 minutes

pH Tip:
- Always ensure buffers are fresh, opened buffers only last a few months

ORP

- Pull for cleaning
  - 2 weeks

Cleaning

- Replace Electrodes
  - 12-18 months

Consumables

- Offset
  - 1 month

Calibration

Time Investment (per sensor/month): ~20 minutes

ORP Tip:

- Be careful when verifying with an ORP handheld, ORP is non-specific so they will often not match closely

Ammonium/Nitrate ISE

- Pull for cleaning
  - 2 weeks

Cleaning

- Replace Electrodes
  - 12-24 months

Consumables

- Match to lab sample
  - 1 month

Calibration

Time Investment (per sensor/month): ~40 minutes

ISE Tip:

- This sensor requires special attention below 1 mg/L, careful calibrations of all electrodes are required, including K+/Cl-

Optical TSS

- Pull for cleaning
  - Monthly

Cleaning

- No Consumables

Consumables

- Match to lab sample
  - As needed

Calibration

Time Investment (per sensor/month): ~20 minutes

TSS Tip:
- Proper set up, installation, and initial calibration are most important for this sensor

UV/Vis

- Pull for cleaning
  - Monthly

Cleaning

- No Consumables

Consumables

- Multipoint Adjustment
  - As needed

Calibration

Time Investment (per sensor/month): ~20 minutes

UV/Vis Tip:

- Careful multipoint calibrations for carbon measurements are very important (COD, BOD, TOC, etc)

Online Instrumentation for Wastewater

Sensolyt
pH,ORP

ViSolid
TSS

FDO
D.O.

VARiON
NH_4^+,NO_3^-

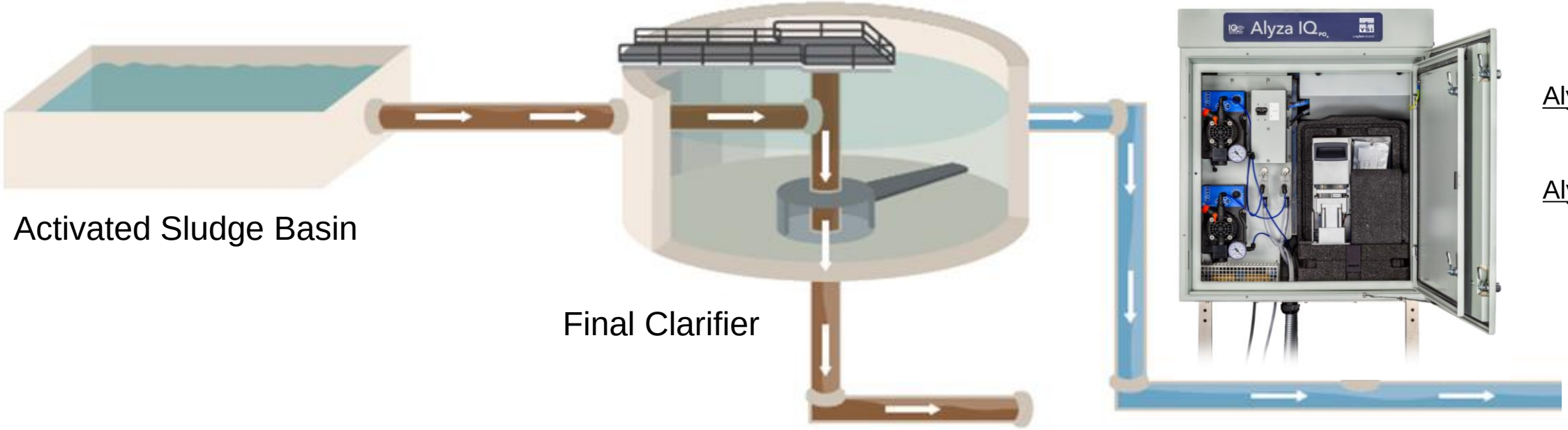
IFL
Sludge Level

NitraVis
NO_3^-,NO_2^-,*TSS*

CarboVis
COD, BOD, TOC
UVT-254, TSS

NiCaVis
NO_3^-,NO_2^-
COD, BOD, TOC
UVT-254

VisoTurb
Turbidity,TSS



Alyza-PO_4
PO_4^{-3}

Alyza-NH_4
NH_4^+

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Benefit from our 70+ years experience with monitoring instrumentation & analytics.

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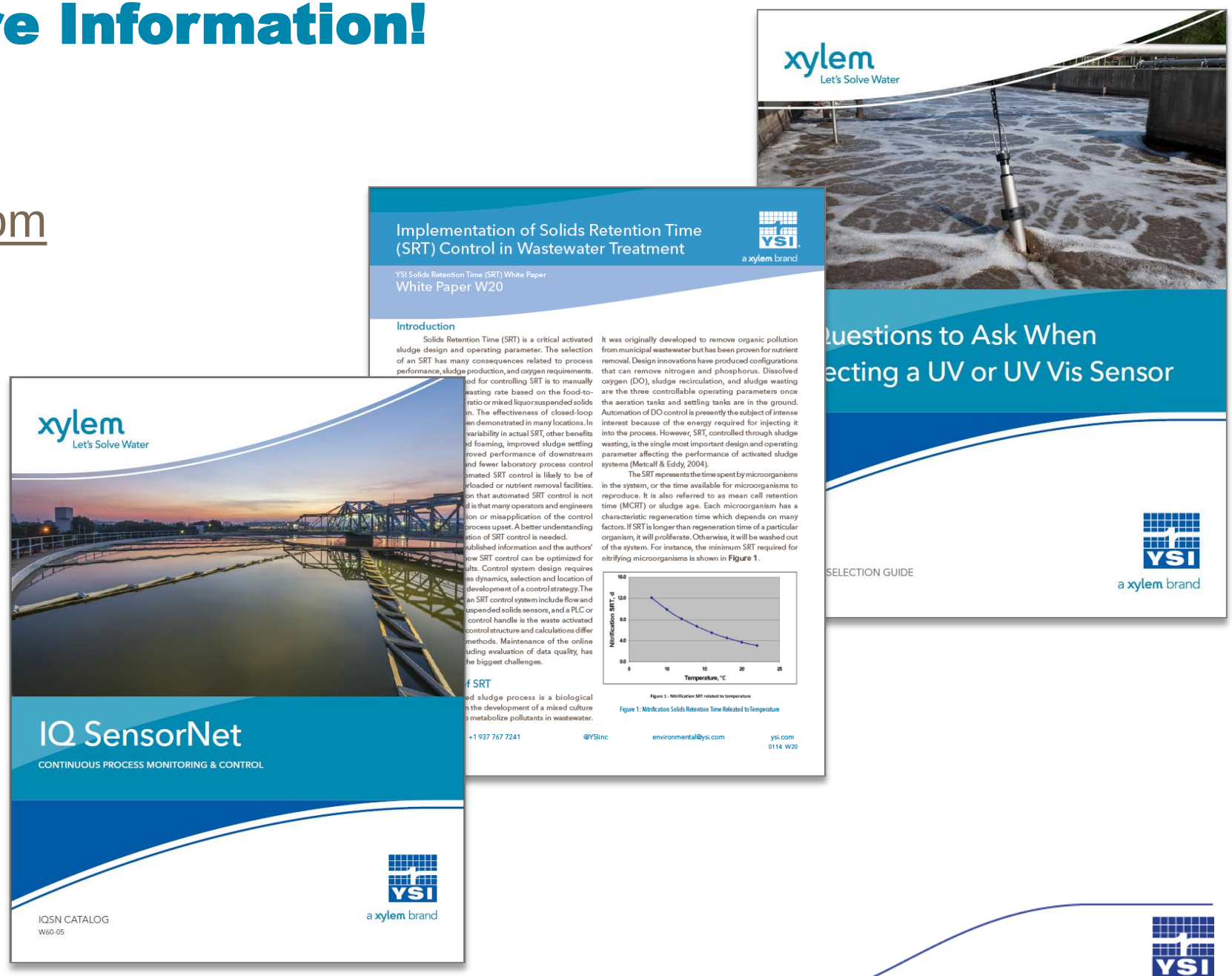

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Q&A