Data Interpretation, Reporting & Regulatory Compliance

Caroline Williams
Data Analytics & Reporting Specialist, HTT

SCADA ACADEMY

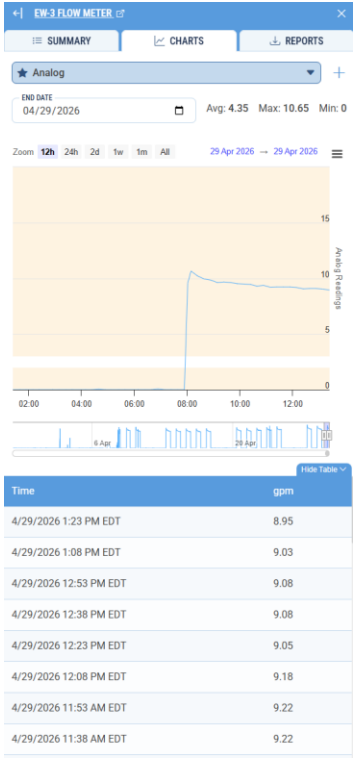
Data Interpretation & Trend Analysis

Introduction to Trend Analysis

Turning Operational Data into Actionable Intelligence

- Water Systems: Monitor pressure, flow, and quality to detect treatment failures, distribution losses, and demand shifts early
- Wastewater Systems: Track influent loading, effluent quality, and I/I events to stay ahead of permit exceedances
- Gas Systems: Analyze pressure, flow, and methane readings to identify leaks, meter drift, and inefficiencies

Core Value: Trend analysis shifts operations from reactive to predictive

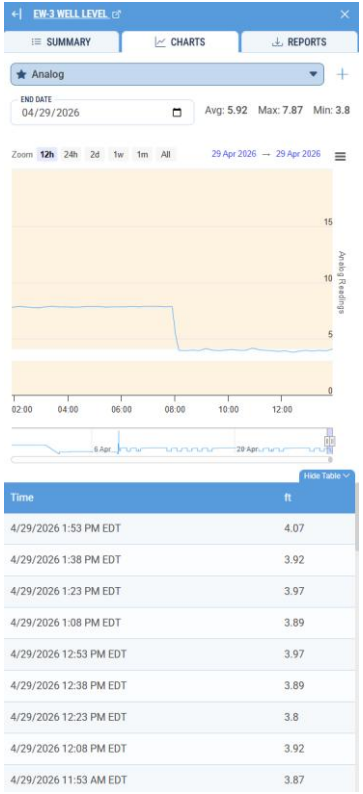


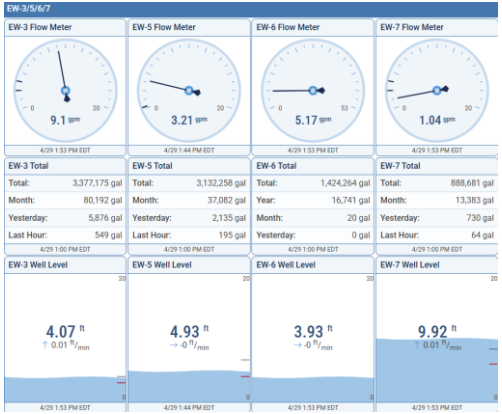
Understanding Tank Level Trends

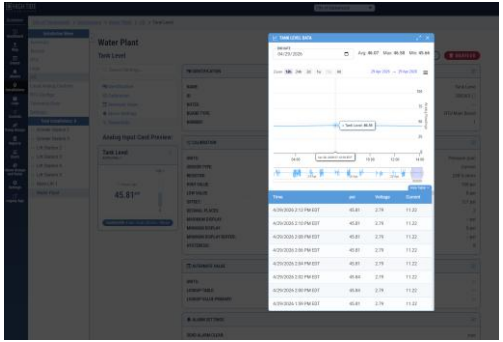
Tank Level is Your System's Real-Time Balance Sheet

- Normal Fill/Empty Cycles: Learn your tank's predictable signature — level drops, pump activation, fill, shutoff — that's your baseline
- Slow Fills & Rapid Drops: Longer fill times signal reduced pump output or increased demand; unexpected drops may indicate leaks or pressure zone issues
- Level Drift & Sensor Issues: Gradual creep up or down can indicate sensor calibration drift or a mechanical issue like a check valve

Key Takeaway: A deviation isn't always an emergency, but it's always worth a second look





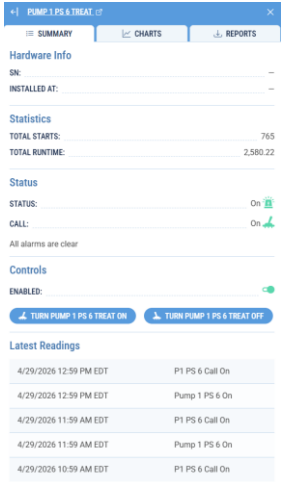


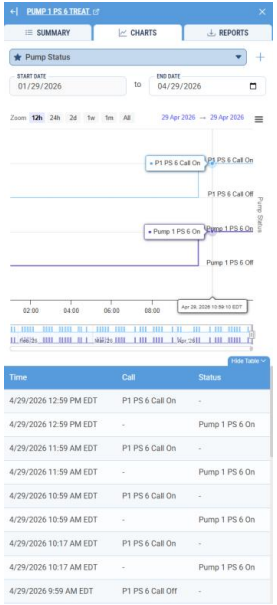
Pump Runtime & Cycle Trends

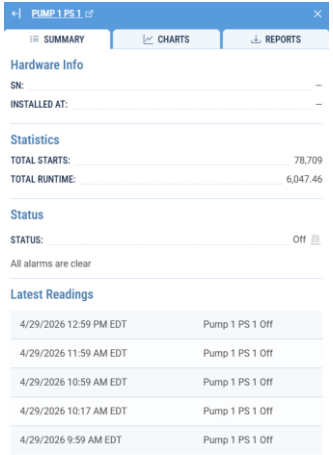
Pump Runtime is the Effort Required to Maintain Your System

- Increased Runtime: Signals demand–supply imbalance — common causes include I/I after rain, pump wear, or new demand in the service area
- Decreased Runtime: Flow restrictions, failing check valves, or pump degradation can reduce output even when the pump appears to run normally
- Short-Cycling: Rapid on/off patterns signal control setpoint issues, a leaking check valve, or a failing bladder tank — easy to catch early in SCADA

Key Takeaway: Know your runtime baseline for wet and dry weather — deviation in either direction is a signal worth investigating





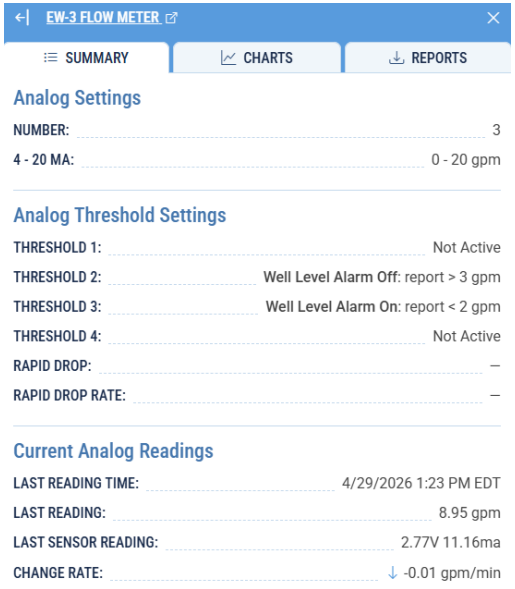


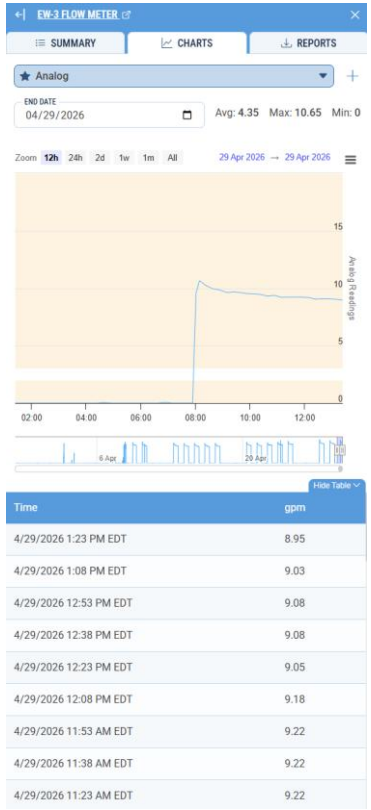
Flow & Inflow Trends

Where SCADA Trends Connect Directly to Regulatory Reporting

- Daily & Hourly Variation: Every system has a diurnal curve — deviations from it are information worth acting on
- Peak Demand Identification: SCADA reveals your true observed maximum, giving you defensible data for capacity planning and capital project justification
- I&I Detection: Wet-weather flow spikes 3–5x the dry-weather baseline are a direct regulatory exposure and capital planning trigger

Key Takeaway: If you're seeing significant wet/dry variation, document it and get ahead of it with your regulatory agency



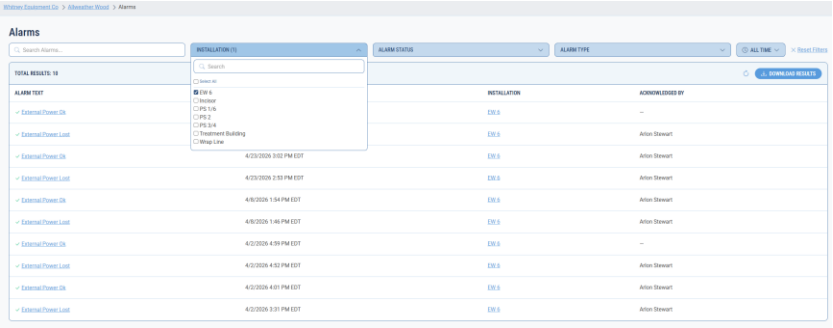


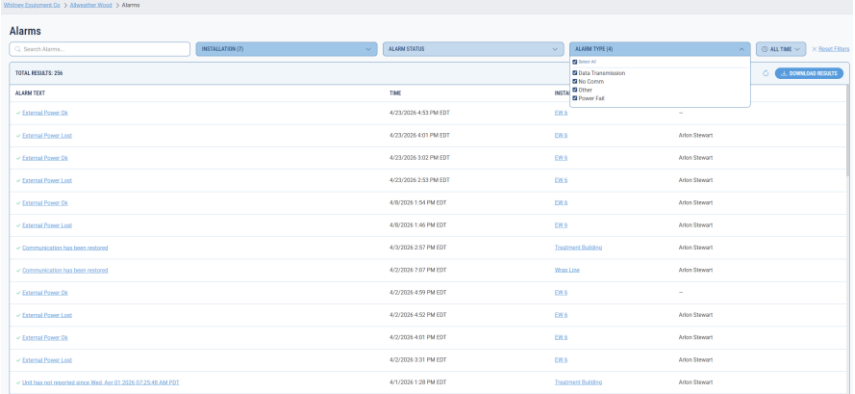
Alarm History Interpretation

Alarms Are Data, Not Interruptions.

- Repeating Patterns: The same alarm on a predictable schedule is a signal — something systematic is driving it
- Maintenance Planning: A station jumping from 2 alarms to 14 in a month is telling you it needs attention before it becomes a failure
- Validating Operator Response: Timestamped logs document acknowledgment times — defensible proof for permit compliance and incident review

Key Takeaway: Do a monthly alarm frequency review sorted by type and station — the outliers will tell you where to focus





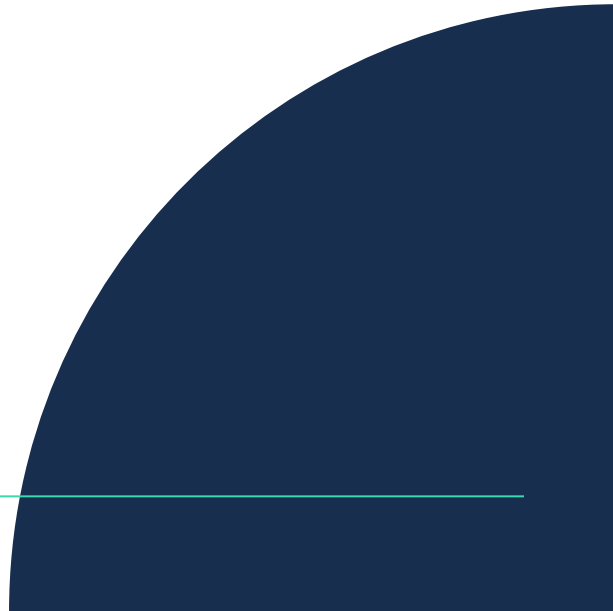
Identifying Patterns

Know Your System Well Enough That the Wrong Data Points Stand Out

- Operational Baselines: Your baseline is observed system behavior under typical conditions — not a design number; SCADA gives you the real ones
- Spotting Spikes & Dips: A flow spike during a rainstorm is expected; the same spike on a dry day is not — regular trend review builds that instinct
- Historical vs. Current Comparison: A 15% flow increase over three years is a capacity signal; a 20% runtime increase with no new connections means something has changed

Key Takeaway: Pull trend reports monthly and archive them — they become your evidence base for compliance, capital planning, and incident response

Calculations Using SCADA Data



Why Calculations Matter

SCADA logs the data. The operator makes it mean something.

Accurate Reporting

- Daily Flow Totals
- Fill out your Discharge Monitoring Report accurately and on time

Early Detection

- Pump GPM from Runtime
- Know whether your pump is performing to spec — or quietly degrading

Maintenance Planning

- Cycle Count Tracking
- Catch control logic problems before they cause equipment failures

Flow Calculations

- Daily Flow Total
  - Formula: Sum of interval readings × interval duration
  - Example: 96 readings at 15-min intervals → convert total to MGD
- Average Daily Flow (ADF)
  - Formula: Total Flow ÷ Number of Days
  - Example: 30-day total ÷ 30 = monthly ADF
- Peak Flow Formula:
  - Maximum recorded interval value in the reporting period
  - Example: Highest 15-min reading — note the date and conditions

Know your permitted ADF limit — if you're approaching it, that's a planning signal, not just a number.

Pump Runtime Calculations

Pump GPM

Volume Pumped (gallons) ÷ Runtime (minutes)

e.g. Wet well drops 4 ft in a 10-ft diameter tank, pump ran 8 min → 295 GPM

- Estimate Capacity
  - Compare actual GPM to the pump's rated curve. Significant shortfall = worn impeller, air in the line, or system head change.
- Evaluate Health Over Time
  - A pump trending from 450 → 380 GPM hasn't failed — but it's telling you something. Track monthly to get ahead of it.
- Plan Maintenance by Runtime Hours
  - Manufacturers spec maintenance in hours, not months. A pump running 8 hrs/day hits 1,000 hours in 4 months. One running 2 hrs/day takes 17 months.

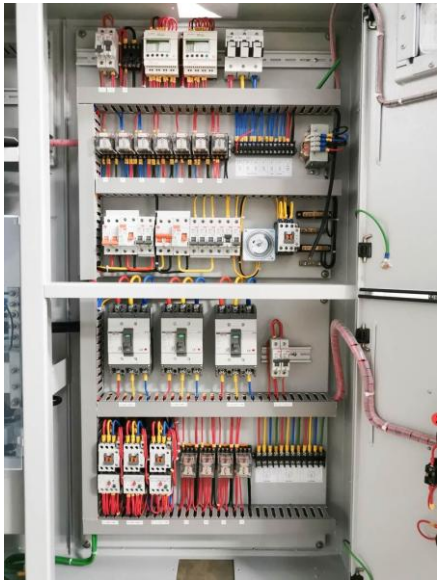
Cycle Count Analysis

- Poor control logic or setpoints
  - On/off levels set too close together
- Wet well too small or inflow too high
  - Insufficient buffer volume
- Sticking floats or inaccurate sensor readings
  - System responding to false signals
- Check valve failure
  - Backflow triggering rapid re-starts

Know your pump's max starts per hour. Exceeding it consistently shortens motor life, increases seal wear, and drives up energy costs.

Cycles Per Hour

- Total Cycles ÷ Total Hours
- e.g. 42 cycles ÷ 24 hrs = 1.75/hr → normal
- e.g. 215 cycles ÷ 24 hrs = 9/hr → investigate

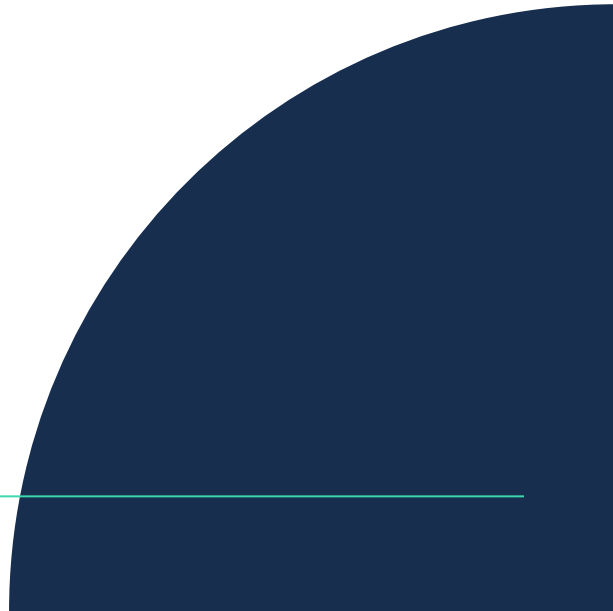


Common Calculations Operators Perform

- Pump GPM Volume Pumped (gal) ÷ Runtime (min)
  - Use wet well geometry to get volume from level change
- Daily Lift Station Volume (Inflow rate × time) + (Pump displacement per cycle × cycle count)
  - Accounts for both continuous inflow and pumped volume
- Average Pump Cycle Time Total Runtime ÷ Number of Cycles
  - Declining cycle time with same inflow = pump may be moving less volume per run

These three feed your daily logs, your O&M records, and your regulatory reports.

Reporting & Regulatory Compliance



The Regulatory Framework – Who's Watching and Why

Federal Level

- Safe Drinking Water Act (SDWA): Administered by EPA; sets maximum contaminant levels (MCLs), mandates monitoring and reporting, and requires public notification of violations. Primary framework for public water systems.
- Clean Water Act (CWA): Governs discharges to U.S. waters. For wastewater utilities, the NPDES permit is your central compliance mechanism — it specifies what you can discharge, in what quantities, and how to report it.

State Level

- States are the primary implementers of both SDWA and CWA. Most states have primacy – meaning EPA has delegated enforcement authority to the state agency. Your state drinking water or environment quality agency is typically your day-to-day regulatory contact. State requirements often exceed federal minimums, so know your state rules specifically.

Local / Permit-Specific

- Your individual operating permit – whether an NPDES permit, a state groundwater discharge permit, or a drinking water operating license – is the document that governs your specific facility. When in doubt, read your permit.

NPDES Permits and Discharge Monitoring Reports

Discharge Monitoring Reports (DMR) Requirements

- Your NPDES permit specifies monitoring parameters (flow, BOD, TSS, pH, nutrients, pathogens, etc.), monitoring frequency, sampling type (grab vs. Composite), and reporting period. The DMR is your self-certification that you monitored as required and that results were within permit limits.

Where SCADA Data Feeds In

- Flow is almost always a DMR parameter – and flow is exactly what your SCADA system tracks. Your daily totals, average daily flow, and peak flow values from SCADA become direct DMR inputs. This is why accurate SCADA data and accurate calculations matter: errors in your SCADA record become errors in a federal compliance document

Submission

- Most NPDES permittees submit DMRs electronically through EPA's NetDMR system or a state equivalent. Deadlines are typically the 28th of the month following the reporting period. Late submissions are a violation. Missing submissions are a more serious violation.

Drinking Water Reporting Requirements

Consumer Confidence Reports (CCR)

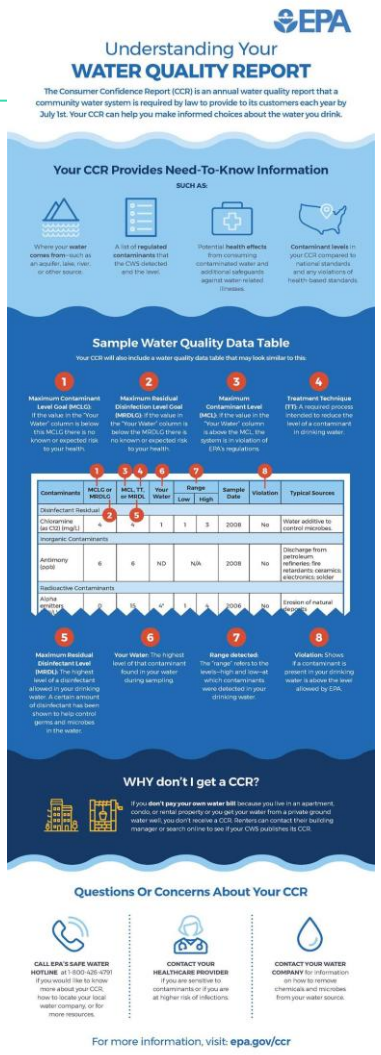
- Community water systems must publish an annual CCR – also called a water quality report – by July 1 of each year covering the prior calendar year. The CCR must report detected contaminant levels, the MCLG and MCL for each regulated contaminant detected, the likely source of contaminants, and any violations that occurred. SCADA monitoring is a source input for CCR values.

Violation Reporting

- When a violation occurs – a monitoring and reporting (M&R) violation, an MCL exceedance, or a treatment technique violation – there are strict notification timelines.
  - Tier 1 Violations -> Notify the public within 24 hours. Notify that state within 24 hours.
  - Tier 2 Violations -> Notify within 30 days.
  - Tier 3 Violations -> Notify within one year, include in CCR.

Electronic Reporting

- EPA's Safe Drinking Water Information System (SDWIS) is the federal database for public water system compliance data. Many states use their own portals that feed into SDWIS. Know your state's system.



Violations & Penalties

Types of Violations

- Monitoring and Reporting (M&R) Violations: you were required to sample and report, and you didn't or you report late. These are administrative violations, but they compound quickly.
- Maximum Contaminant Level (MCL) Violations: A regulated contaminant exceeded its permitted level.
- Treatment Technique (TT) Violations: Required treatment processes weren't performed or documented correctly.
- Permit Effluent Limit Violations: Wastewater discharge exceeded a permitted concentration or load limit.
- Sanitary Sewer Overflow (SSO): Untreated sewage discharged to the environment or backed up into buildings. SSOs have mandatory reporting requirements and can trigger significant enforcement.

Penalty Structure

- CWA civil penalties can reach $25,000 per day per violation; courts have imposed substantially higher amounts in serious cases. State penalties are generally comparable.

Enforcements

Enforcement Escalation

- Enforcement typically follows a progression:
  - Notice of Violation (NOV) -> Administrative Order -> Consent Order -> Civil Penalty Action -> Criminal Referral

The earlier you self-report and engage with your regulatory agency, the more control you retain over the outcome.

SCADA as a Compliance Documentation Tool

Everything we've covered today – trends, calculations, reports – showcases that your SCADA system is not just an operational tool. It's a compliance documentation system.

- SCADA provides the timestamped data record that supports your DMR values
- Alarm logs document when events occurred and when operators responded
- Runtime and flow records substantiate your reported volumes
- Historical trends demonstrate normal operating conditions when you need to explain an anomaly