Whitepaper SiloTect 80 GHz Radar Level Transmitter

Precision Radar for Water & Wastewater Level Control:

Replacing Ultrasonic Level Sensors with Non-Contact Radar Sensors

Focus on measurement reliability:

How can 80 GHz FMCW radar technology eliminate the measurement failures caused by foam, vapor, condensation, and temperature variation — and replace every ultrasonic sensor in a water or wastewater plant with a single, more capable device?

Wastewater treatment plants face a persistent measurement challenge: traditional ultrasonic level sensors degrade in the very environments they are tasked to monitor. Foam, vapor, high humidity, rapid temperature swings, and turbulent surfaces all compromise ultrasonic signal integrity — generating false readings, forcing frequent recalibration, and eroding confidence in critical process data.

SiloTect is Bindicator's 80 GHz FMCW (Frequency Modulated Continuous Wave) non-contact radar level transmitter. Operating at 80 GHz — a frequency at which the signal travels at the speed of light rather than the speed of sound — SiloTect is categorically immune to the environmental variables that defeat ultrasonic technology.

With **±2 mm accuracy, zero dead zone,** built-in **open-channel flow calculation** supporting Parshall and Palmer-Bowlus flumes and weir formulas, **dual totalizers**, and Bluetooth® configuration via the Bindicator app, MobileEView, SiloTect serves as a complete, drop-in replacement for ultrasonic sensors at every measurement point in a water or wastewater facility.

The Problem with Ultrasonic in Wastewater Environments

How Ultrasonic Measurement Works — and Why It Fails

Ultrasonic level sensors emit a pulse of sound and calculate distance by measuring the time-of-flight of the reflected echo. The speed of sound in air (approximately 343 m/s at 20 °C) is the fundamental assumption underpinning this calculation. Any factor that alters the speed of sound — or absorbs, scatters, or blocks the sound pulse — directly corrupts the measurement. In a controlled environment, ultrasonic sensors perform adequately. Wastewater treatment plants are the opposite: warm, humid, chemically active, and physically turbulent environments where every known ultrasonic failure mode is present simultaneously.

Failure Modes in Wastewater Applications

Temperature & Humidity Drift The speed of sound increases approximately 0.6 m/s for every 1 °C rise in temperature. A 20 °C seasonal swing produces a measurement error of ~3.5 % in an uncompensated sensor. Even temperature-compensated sensors struggle when gradients form in confined wet wells or enclosed sumps.

Foam and Surface Turbulence Foam is acoustically opaque. A foaming surface in a primary clarifier or aeration basin will absorb or scatter the ultrasonic pulse, producing near-complete signal loss. Turbulent, rippled surfaces generate unstable, noisy readings.

Vapor and Gas Interference Hydrogen sulfide (H_2S), methane, carbon dioxide, and ammonia vapors — all common in wastewater systems — alter the acoustic properties of the air column, introducing systematic measurement bias that cannot be corrected by temperature compensation.

Condensation Buildup In wet wells and enclosed structures, condensation accumulates on the transducer face, damping the outgoing pulse and distorting the received echo. This leads to erratic readings or complete signal loss.

Dead Zone Limitations Ultrasonic sensors have a physical dead zone — typically 0.3 to 1.0 m directly below the transducer — within which measurement is impossible. In shallow wet wells or sumps, this dead zone represents a significant proportion of usable measurement range.

No Native Flow Capability Ultrasonic level transmitters do not natively compute open-channel flow rates. When flow measurement is required at a flume or weir, a separate secondary flow computer must be added, increasing installation cost, wiring complexity, and points of failure.

SiloTect Technology: Why 80 GHz Radar Is the Correct Solution

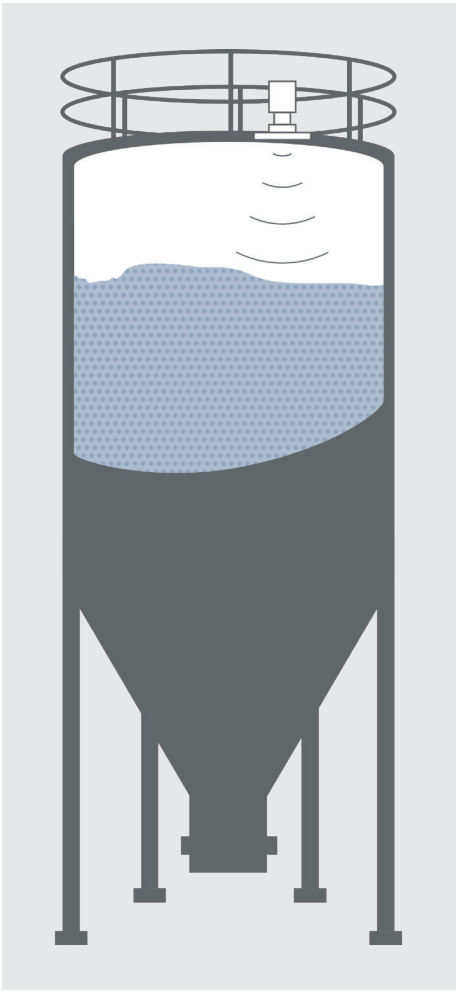
FMCW Radar Measurement Principle

SiloTect operates on FMCW (Frequency Modulated Continuous Wave) radar at 77–81 GHz. Rather than measuring a sound pulse time-of-flight, it emits a continuous radar signal whose frequency is swept linearly over time. The reflected signal returns with a frequency shift (the "beat frequency") that is precisely proportional to the distance between sensor and medium surface. Because the signal travels at the speed of light — a constant unaffected by temperature, humidity, pressure, or the presence of gases — the measurement is inherently immune to the environmental variables that corrupt ultrasonic technology.

The speed of light is constant. The speed of sound is not. That single physical fact is why 80 GHz radar outperforms ultrasonic in every wastewater application.

Key Technical Advantages Over Ultrasonic

Advantage	Technical Explanation
Zero dead zone	SiloTect measures from the antenna tip with 0 ft dead zone (where εr ≥ 1.9). No low-level measurement gap.
±2 mm accuracy	Achieved in both near and far-field measurement, independent of temperature, humidity, or vapor content.
Narrow 7–12° beam angle	Minimizes signal interference from vessel walls, internal structures, and filling streams. Critical for confined sumps and standpipes.
Foam and vapor immunity	Millimeter-wave signals at 80 GHz penetrate or reflect off the liquid surface beneath foam layers. Vapor and gas have no measurable effect on signal velocity.
No temperature drift	Signal velocity is constant at the speed of light. No temperature compensation is required or possible to go wrong.
Echo mapping	EView2 software allows users to map and suppress false echoes from vessel internals, filling streams, or structural obstructions.
IP66/IP67 (NEMA 4X/6)	Sealed against full jet wash and temporary submersion. Suitable for all wet well, pump station, and outdoor channel installations.



Open-Channel Flow Measurement: Built-In, No Secondary Device Required

One of the most significant limitations of ultrasonic level sensors in wastewater treatment is their inability to compute flow rates natively. When flow measurement at a flume or weir is required, engineers must add a dedicated flow computer or secondary transmitter, increasing installation cost, wiring, calibration burden, and points of system failure.

SiloTect eliminates this requirement entirely. Flow measurement — including flume calculations, weir formulas, a user-defined power-law formula, and dual totalizer outputs — is built into the firmware and accessed through the same EView2 software used for all other configuration.

Supported Flow Measurement Methods

Parshall Flumes The most widely deployed open-channel flow measurement structure in the water and wastewater industry. SiloTect measures the upstream water depth and applies the Parshall formula Q = K × h^n to calculate instantaneous flow rate, eliminating the need for a remote flow indicator.

Typical applications:

· Influent flow channels at headworks
· Inter-process flow between treatment stages
· Effluent and reclaimed water discharge
· Industrial pretreatment monitoring

Palmer-Bowlus Flumes Installed inside circular pipes and sewers to measure flow without requiring full-pipe conditions. Particularly valuable for in-line sewer monitoring, I/I studies, pump station inflow, and billing measurement at service connections.

Weir Calculations SiloTect supports V-notch (Thompson), rectangular (Francis), and Cipolletti (trapezoidal) weir formulas. The sensor measures head height above the crest and computes flow directly. Common applications include secondary clarifier effluent launders, treatment pond outlets, constructed wetland monitoring, and irrigation canal measurement.

Custom Power-Law Formula For non-standard structures or legacy flumes, SiloTect accepts a user-defined formula Q = K × h^n, where K and n are entered directly by the operator — providing flow measurement capability at virtually any open-channel structure without site modifications.

Dual Totalizer Outputs Two independent totalizers: TOT1 (clearable, ideal for daily reporting and permit compliance intervals) and TOT2 (permanent lifetime cumulative volume). Both output directly over the 4–20 mA + HART® loop, eliminating a separate flow data acquisition system for NPDES permit reporting.

Application Mapping: Water & Wastewater Treatment Plants

Collection System & Conveyance

Wet Wells and Lift Stations The wet well is the single most demanding ultrasonic measurement environment: enclosed, humid, H_2S-laden, and subject to violently turbulent inflow during wet weather events. SiloTect's sealed antenna, IP67 rating, and radar-based measurement are unaffected by any of these conditions. The zero dead zone ensures accurate pump control down to the lowest achievable wet well level, preventing dry-run conditions and reducing pump cycling.

Influent Flow Measurement at Headworks At the plant headworks, a Parshall flume typically provides the primary plant influent flow measurement for NPDES permit compliance and process control. Replacing an aging ultrasonic transmitter with SiloTect provides improved accuracy, native flow calculation, dual totalizer output, and elimination of recalibration events caused by seasonal temperature swing.

Pump Station Sumps Intermediate pump stations face similar challenges to primary wet wells. SiloTect provides stable level measurement for pump start/stop control, high-level alarms, and trending. The relay output option enables direct pump control without a separate controller for simple two-pump installations.

Primary and Secondary Treatment

Primary Clarifiers Primary clarifiers present a combination of challenges: foaming from surfactants and biological activity, turbulence from influent distribution, and vapor from heated processes. SiloTect measures the water surface level in the clarifier influent channel, the clarifier itself, and the effluent launder with equal reliability, unaffected by any surface condition.

Sludge Holding Tanks Primary sludge and scum holding tanks contain high-concentration sludge with active gas generation — conditions lethal to ultrasonic measurement. SiloTect's radar signal reflects off the sludge surface regardless of vapor blanket or gas evolution.

Aeration Basins and BNR Processes Aeration basins and oxidation ditches create highly turbulent, partially aerated surfaces. SiloTect's narrow beam angle and echo mapping allow the sensor to track the true liquid surface through aerator turbulence. Biological nutrient removal (BNR) processes require precise level control across anoxic, aerobic, and anaerobic zones; SiloTect's ±2 mm accuracy provides the measurement precision that level-based residence time control requires.

Chemical Feed, Sludge Processing & Effluent

Chemical Storage Tanks Sodium hypochlorite, ferric chloride, caustic soda, polymer emulsions, and alum storage present corrosive environments. SiloTect's chemical-resistant PTFE and PVDF antenna options provide containment-compliant measurement for virtually all chemical feed applications without corrosion risk. The non-contact principle eliminates sensor contamination.

Sludge Thickeners and Digesters High-viscosity, gas-generating media with active surface agitation defeat pressure transmitters and ultrasonic sensors alike. SiloTect's non-contact radar signal reflects from the sludge surface regardless of viscosity or gas blanket. For anaerobic digesters under positive pressure, the stainless steel antenna variant supports process pressures up to 580 psi.

Effluent and Discharge Measurement Effluent weir boxes, discharge channels, and outfall structures require accurate flow measurement for NPDES permit compliance. SiloTect's built-in weir and flume calculations provide compliant flow data directly from the transmitter, with dual totalizer output for permit reporting. The IP67 rating ensures performance through storm events and high-water conditions.

Adjacent Industry Applications

The capabilities that make SiloTect the ideal ultrasonic replacement in wastewater treatment apply across a broad range of industries where level and flow measurement accuracy is critical.

Industry	Key Applications
Drinking Water Treatment	Clearwell and reservoir level, sedimentation basin monitoring, filter backwash sumps, chemical storage (chlorine, fluoride, coagulant). Open-channel flow at Parshall flumes on raw water intake. Radar's immunity to chlorine gas and accurate low-level measurement are key advantages.
Stormwater Management	Retention basin, detention pond, and bioretention cell level monitoring. Culvert and outfall flow measurement. SiloTect's outdoor-rated enclosure and wide temperature range support unmanned, unheated installations.
Industrial Wastewater / Pretreatment	Equalization basin level, pH adjustment tank level, oil/water separator level, and flume flow measurement at industrial discharge points subject to pretreatment permit limits. PVDF and PTFE antenna options handle aggressive chemical streams.
Food & Beverage Processing	CIP solution tanks, water recovery sumps, process vessel level, and effluent flow at flumes. High-temperature version supports steam CIP applications. PVDF/PTFE antenna options comply with hygienic material requirements.
Pharmaceutical & Biotech	Pure water storage, WFI (water for injection) tank level, solvent and reagent storage. Non-contact principle eliminates contamination risk. PVDF antenna rated for aggressive solvents.
Agriculture & Irrigation	Canal and lateral flow measurement at Parshall and trapezoidal flumes. Retention pond and lagoon level monitoring. V-notch weir measurement for irrigation allocation and billing.
Power Generation	Cooling tower basin level, ash sluicing pond level, demineralized water storage, and intake channel flow. Compatible with high-temperature and chemically active environments.

Technical Specifications

Parameter	SiloTect Specification
Signal Frequency	77–81 GHz FMCW (W-band)
Accuracy	±2 mm (±0.078") at 1½" connection; ±4 mm (±0.157") at 1" connection
Measurement Range	S80S: Up to 33 ft (10 m) or 66 ft (20 m) | S80L Long Range: Up to 98 ft (30 m)
Dead Zone	0 ft from antenna tip
Supply Voltage	12–36 V DC (2-wire loop powered)
Output	4–20 mA + HART®, Bluetooth® optional, Relay optional
Flow Measurement	Parshall, Palmer-Bowlus flumes; V-notch, rectangular, Cipolletti weirs; custom Q = K×h^n; dual totalizers
Process Temperature	Standard: −40 to +158 °F | High-Temp version: up to +400 °F (coming soon)
Ambient Temperature	−40 to +158 °F (transmitter only) | −4 to +158 °F (with display)
Process Pressure	PP / PVDF / PTFE antenna: up to 43.5 psi | SS antenna: up to 580 psi
Ingress Protection	IP66 / IP67 (NEMA 4X / 6)
Antenna Materials	Polypropylene (PP), PVDF, PTFE, Stainless Steel 316Ti
Housing Materials	Painted Aluminum, Stainless Steel
Process Connections	S80S: 1½" NPT, 1½" BSP | S80L: DN100–DN150 / 4"–6" ANSI flanges
Configuration	Bluetooth® via MobileEView app (iOS & Android), EView2 PC software, plug-in display
Warranty	5 Years

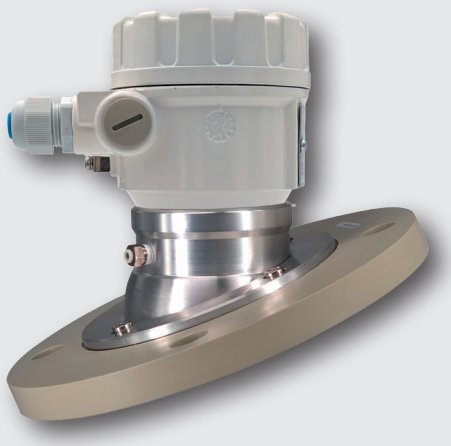
Product Configurations

S80S (Short Range)

1½" NPT or BSP process connection. Ranges to 33 ft or 66 ft. PP, PVDF, PTFE, and stainless steel antenna options.

Ideal for:

- Wet wells & pump stations
- Chemical storage tanks
- Clarifiers & sumps
- Flume & weir flow measurement



S80L (Long Range)

3" lens antenna. Ranges to 98 ft. DN100–DN150 and 4"–6" ANSI flange process connections. Built-in air purge.

Ideal for:

- Large clarifier basins
- Reservoirs & storage lagoons
- Sludge storage vessels
- Open channels & wide structures

Selection Checklist

Use the following criteria when specifying SiloTect for your application:	
Does the application involve foam, vapor, H_2S, or condensation?	✓ SiloTect is immune.
Is accurate low-level measurement critical?	✓ Zero dead zone ensures full-range coverage.
Is flow measurement required at a flume or weir?	✓ Built-in, no secondary device needed.
Is NPDES permit flow reporting required?	✓ Dual totalizers output directly over HART®.
Does the medium contain corrosive chemicals?	✓ PTFE, PVDF, or SS 316Ti antenna options.
Measurement range beyond 66 ft / 20 m?	✓ S80L Long Range to 98 ft.
High process pressure (digesters)?	✓ SS antenna rated to 580 psi.

Contact & Support

Everything from a single source

SiloTect is backed by Bindicator's application engineering team and the broader Anderson-Negele network of measurement specialists. We offer comprehensive support from initial application review to commissioning and ongoing technical service.

To request an application review, site-specific product recommendation, or demonstration unit for your facility, contact our applications team:

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