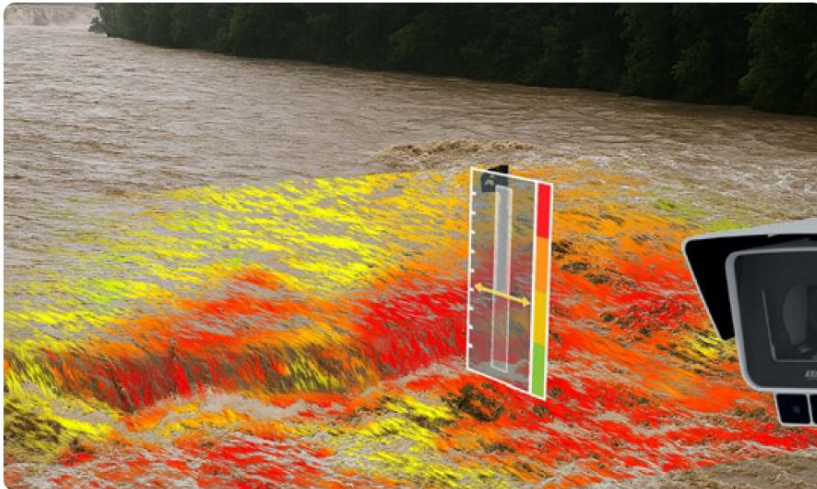


Camera-based Solutions for Water Monitoring – OTT HydroSight

HydroSight Level (real-time water level) and HydroSight Flow (real-time discharge)



HydroSight

Applications

- Surface water
- Water quantity
- Flood monitoring



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1 Overview

With HydroSight, OTT HydroMet provides a portfolio of camera-based hydrological monitoring solutions for both real-time operations and offline stream gauging. With a high level of operational maturity, these solutions can be integrated into existing monitoring networks and supervisory systems. Both HydroSight Level and HydroSight Flow are available as Edge applications that run directly on selected AXIS camera models via the Axis Camera Application Platform (ACAP), enabling onboard image processing (edge computing) without external computer hardware.

2 Real-time Water Level Measurements with HydroSight Level

2.1 Product description

HydroSight Level turns a compatible video camera into a robust, non-contact water level sensor suitable for rivers, canals, harbors, dams, lakes and other water bodies. The system provides continuous water-level time series and augmented images for remote validation. Customizable overlays include a virtual staff gauge with graduations, the detected water level value, configurable threshold markers (up to four), and optional historical flood marks. Automatic detection focuses on the waterline on staff gauges and does not require a specific gauge design. When an additional level sensor (e.g., RLS 500 or PLS 500) is present on site, its value can be integrated into the overlay for redundancy and simplified verification.

For night operation, infrared (IR) illumination ensures visibility of gauge markings. Integrated IR in the camera typically covers distances up to ~30 m; external IR projectors can be used for greater distances.

Measurement accuracy depends on pixel resolution at the gauge. With appropriate camera model, focal length and installation geometry, sub-centimeter (<1 cm) accuracy is achievable. Where a single staff gauge cannot cover the full level range, multiple gauges can be used; HydroSight Level handles multi-gauge configurations seamlessly.

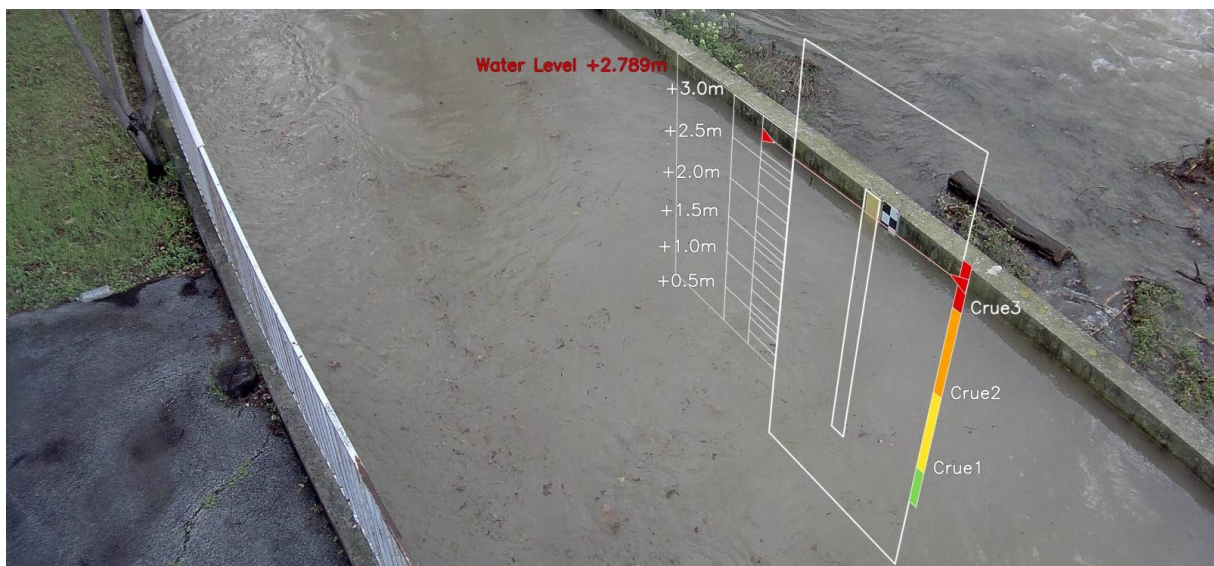


Image 1: HydroSight Level Raw Image

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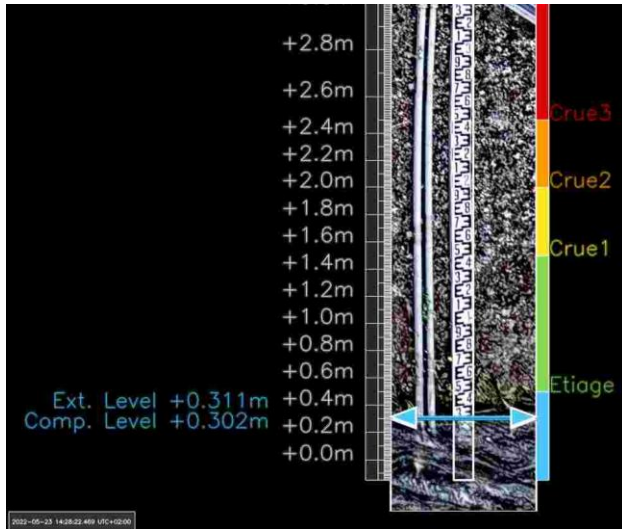


Image 2: HydroSight Level Ortho Image with external level sensor

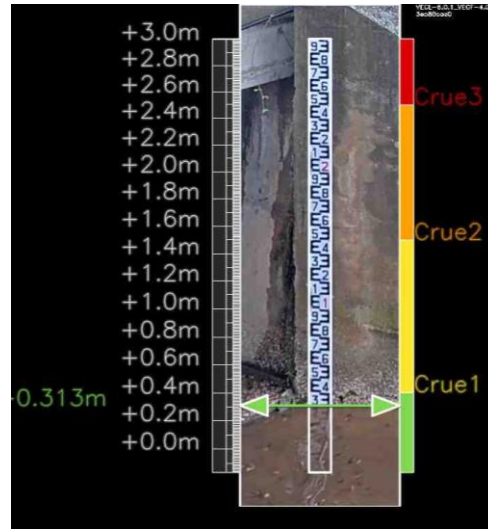


Image 3: HydroSight Level Ortho Image



Image 4: HydroSight Level Raw Image, multiple staff gauges

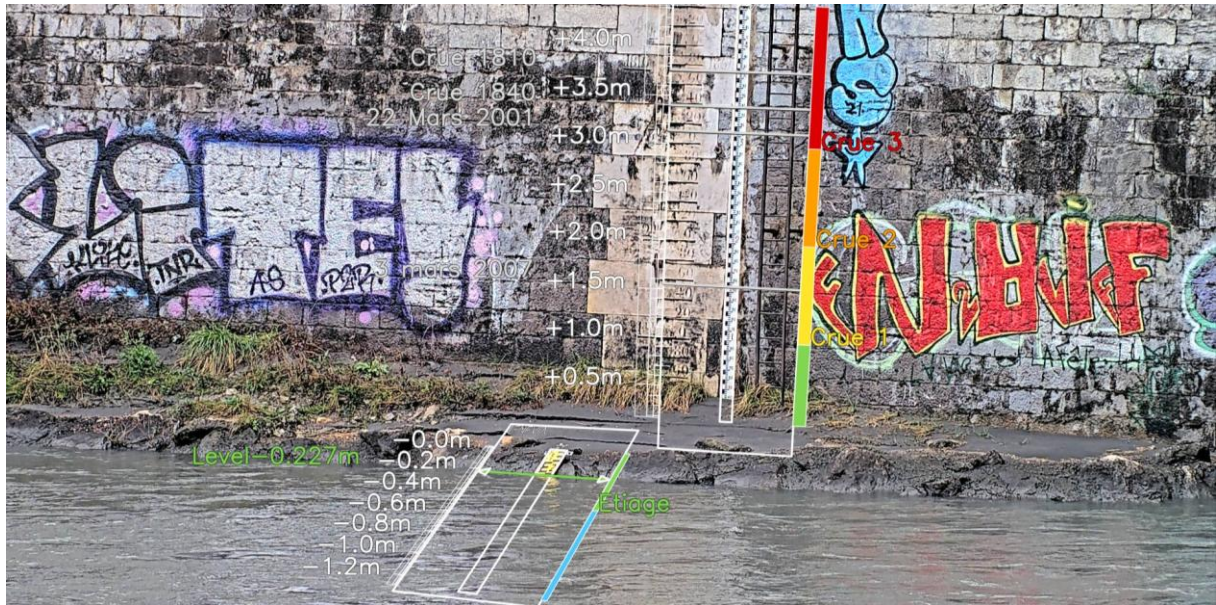


Image 5: HydroSight Level Raw Image, multiple staff gauges



Image 6: HydroSight Level Raw Image, multiple staff gauges at night

2.2 Practical implementation

A typical HydroSight Level station consists of:

- one or several staff gauges covering the target level range
- a compatible AXIS camera
- power and network devices;
- dataloggers or PLCs for advanced features such as smart energy management, dynamic time steps, or integration with other sensors.

HydroSight Level is based on the detection of the waterline on staff gauges. The use of this optical target for our camera-based solution enables robust and accurate measurements, a simple and efficient calibration process and straightforward verification.

Practical recommendations for staff gauges and site setup include:

- Select locations and implementations that cover the targeted level range.
- Use gauges with a uniform background color; avoid changes in background color that hinder detection.
- A minimum visible gauge length of 1 m is recommended.
- Gauge width: minimum 12 cm; 18–20 cm is preferred at distances >30 m or with limited optical zoom.
- Ensure clear visibility of the upper part of the gauge for automatic correction of minor camera movements.
- For sites with multiple gauges, ensure at least 20 cm vertical overlap to prevent gaps at range transitions.
- Plan IR illumination so that all gauges are sufficiently lit at night.
- Schedule routine maintenance (gauge cleaning, vegetation control) to preserve visibility.

Calibration & configuration:

- OTT HydroMet provides services to define measurement areas, enter calibration points (pixel → level mapping), configure thresholds and labels, and export per-site XML calibration files for upload to the camera.
- HydroSight Level Edge installs on supported AXIS cameras similarly to an app; configuration is exposed via extended pages within the camera firmware.



Image 7: HydroSight Level - Variety of staff gauges

2.3 Commercialization

OTT HydroMet offers:

- HydroSight Level – Edge software license: perpetual license tied to the specific camera (per-camera licensing). Software updates include bug fixes within the delivered major version.
- Annual update & extended warranty; includes license transfer in case of camera hardware replacement subject to standard conditions.
- System integration (optional)
- Installation services (optional)
- Calibration services (mandatory)

3 Real-time Flow Measurements with HydroSight Flow

3.1 Product description

HydroSight Flow measures surface velocities and computes discharge using camera imagery. It also provides water level, either from HydroSight Level or an external sensor. The system is especially valuable where contact sensors are impractical, and for dynamic flood conditions where safety and access are constrained.

Surface velocity is derived by tracking visible features advected by the flow (e.g., waves, foam, bubbles, floating debris, and texture). The resulting velocity vectors are mapped into real-world coordinates using site calibration parameters. A streamwise surface velocity profile is estimated and combined with water level and cross-section geometry to compute discharge.



Image 8: HydroSight Flow - Velocity Vectors

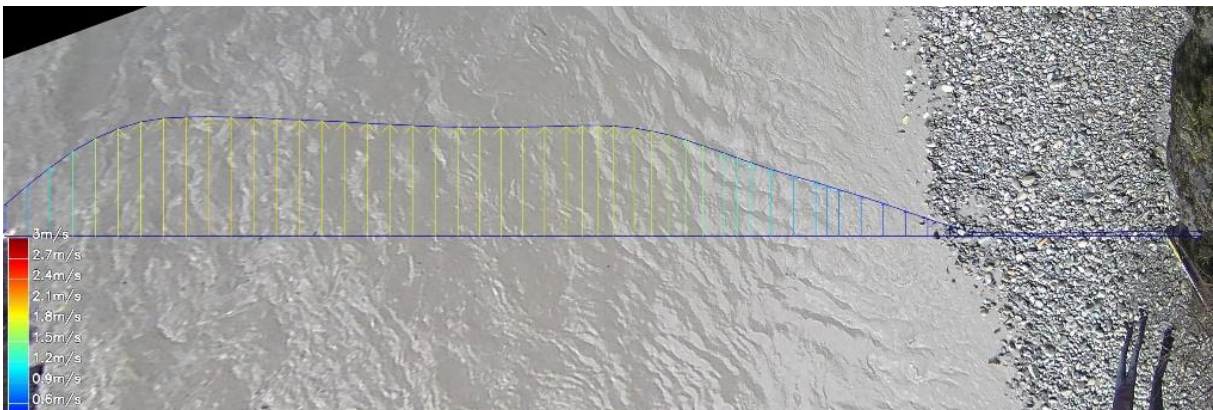
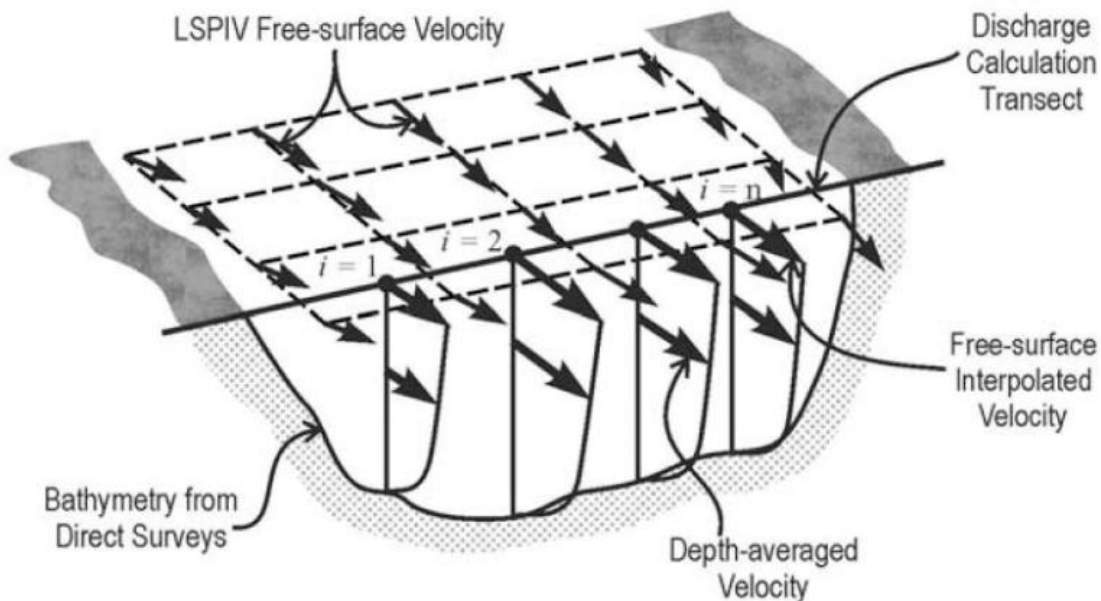


Image 9: HydroSight Flow - streamwise surface velocity profile

HydroSight Flow uses a default surface-to-depth velocity coefficient of 0.85, which corresponds to the logarithmic vertical velocity profile commonly observed in natural open-channel flows. This value is widely used in hydrometry when site-specific calibration data are not available.

ISO 748:2007 notes that for the surface one-point method, coefficients between 0.88 and 0.90 may be appropriate in hydraulically smooth channels, reflecting similar profile assumptions.

The updated ISO 748:2021 retains the requirement to correct surface velocities using appropriate coefficients and emphasizes uncertainty reduction and site-specific selection. Therefore, while 0.85 remains a practical default for natural channels, HydroSight allows adjustment when local calibration or channel physics justify alternative values.

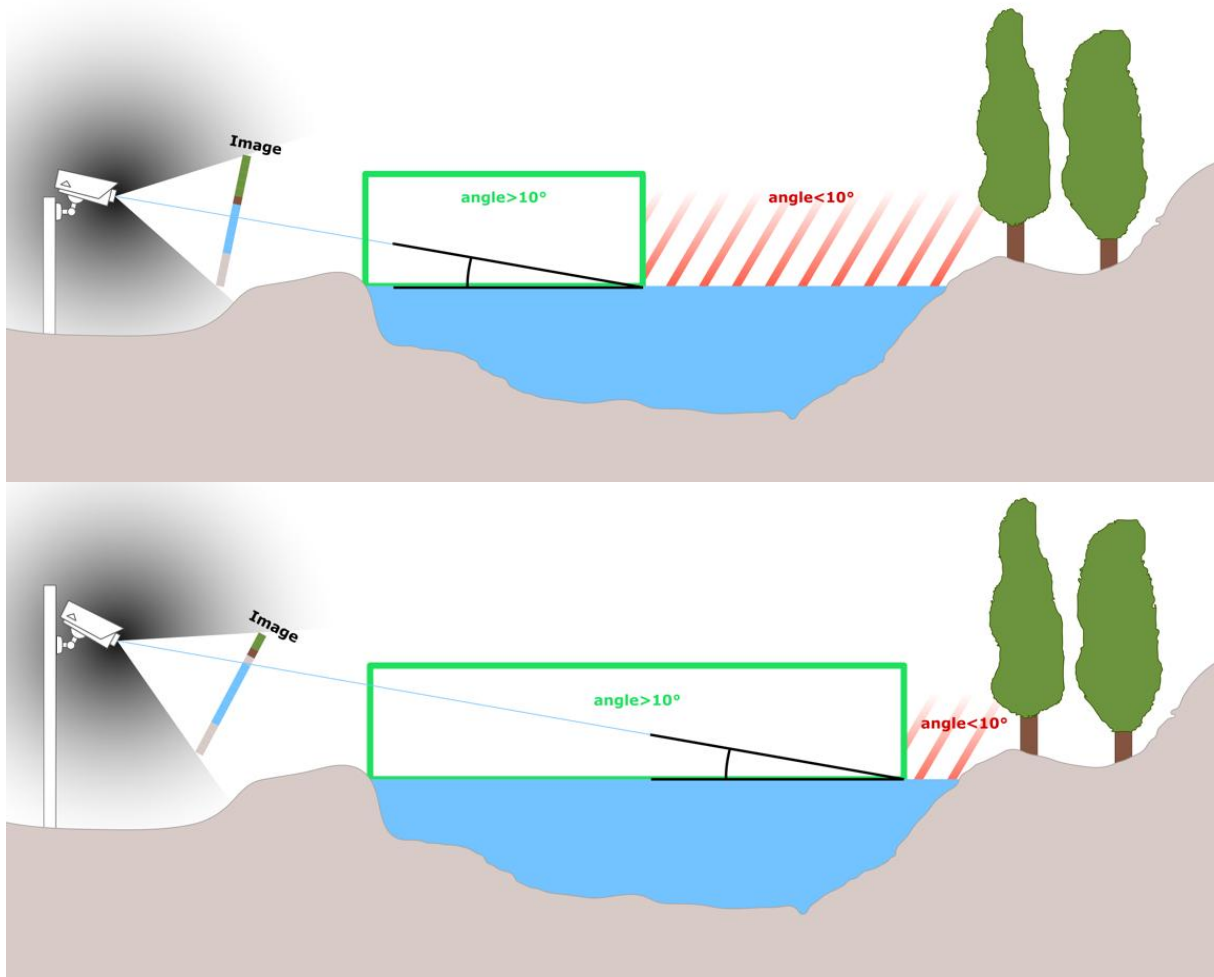


Graphic 1: Discharge calculation with surface velocity measurement

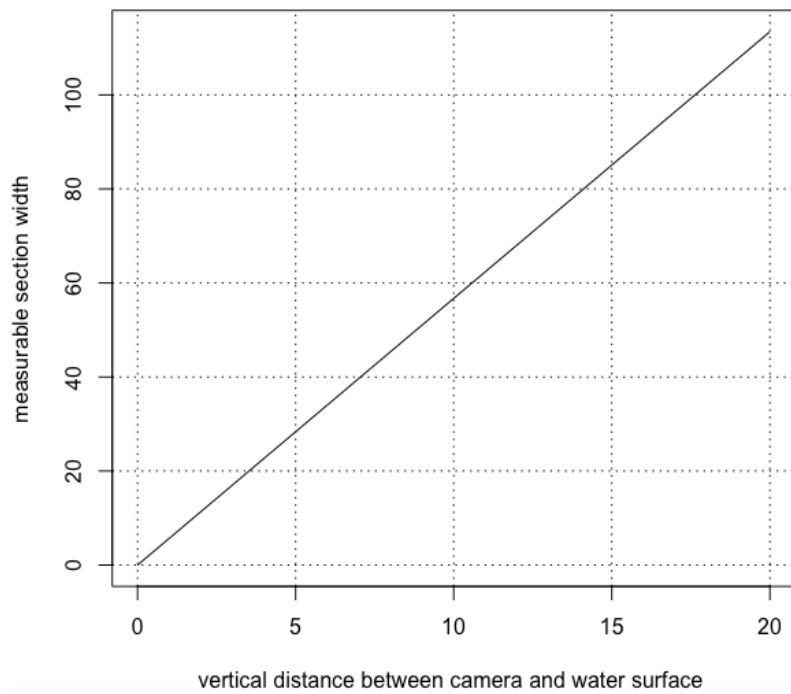
3.2 Practical implementation

Site eligibility and setup:

- Focus on flow regimes with sufficient surface texture; very low flows may lack trackable patterns.
- Target fully developed flow around the measurement section; avoid strong disturbances (sudden contractions, wakes).
- Camera installation on the bank is typical; select the bank with higher velocities and discharge contribution.
- Maintain incident angles $\geq 10^\circ$; otherwise, vectors are extrapolated in areas lacking measurable texture.



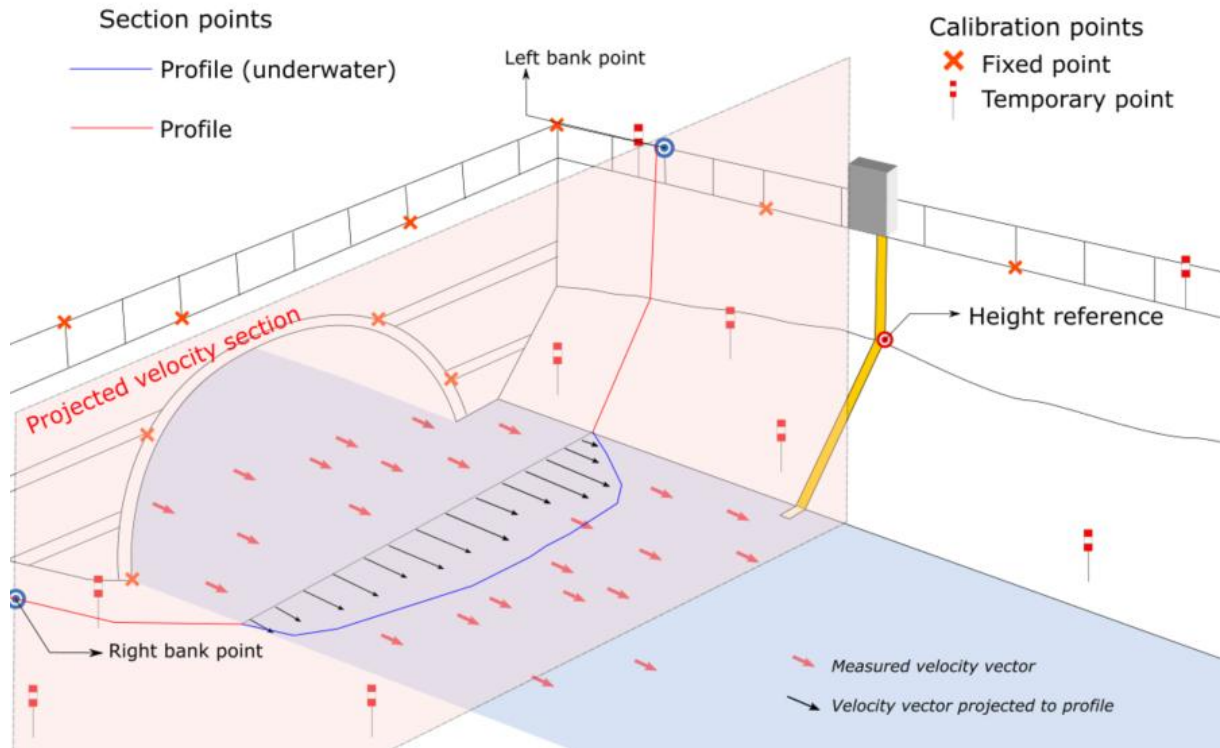
Graphic 2: HydroSight Flow - Incident Angles



Graphic 3: HydroSight Flow - Vertical distance between camera and water surface

Calibration workflow (executed by OTT HydroMet Service)

- conduct field surveys to acquire topographic and bathymetric references
- site calibration
- generate an XML configuration file and upload it to the camera
- Update the cross-section whenever morphological changes occur (e.g., post-flood).



Graphic 4: HydroSight - Calibration of measuring site

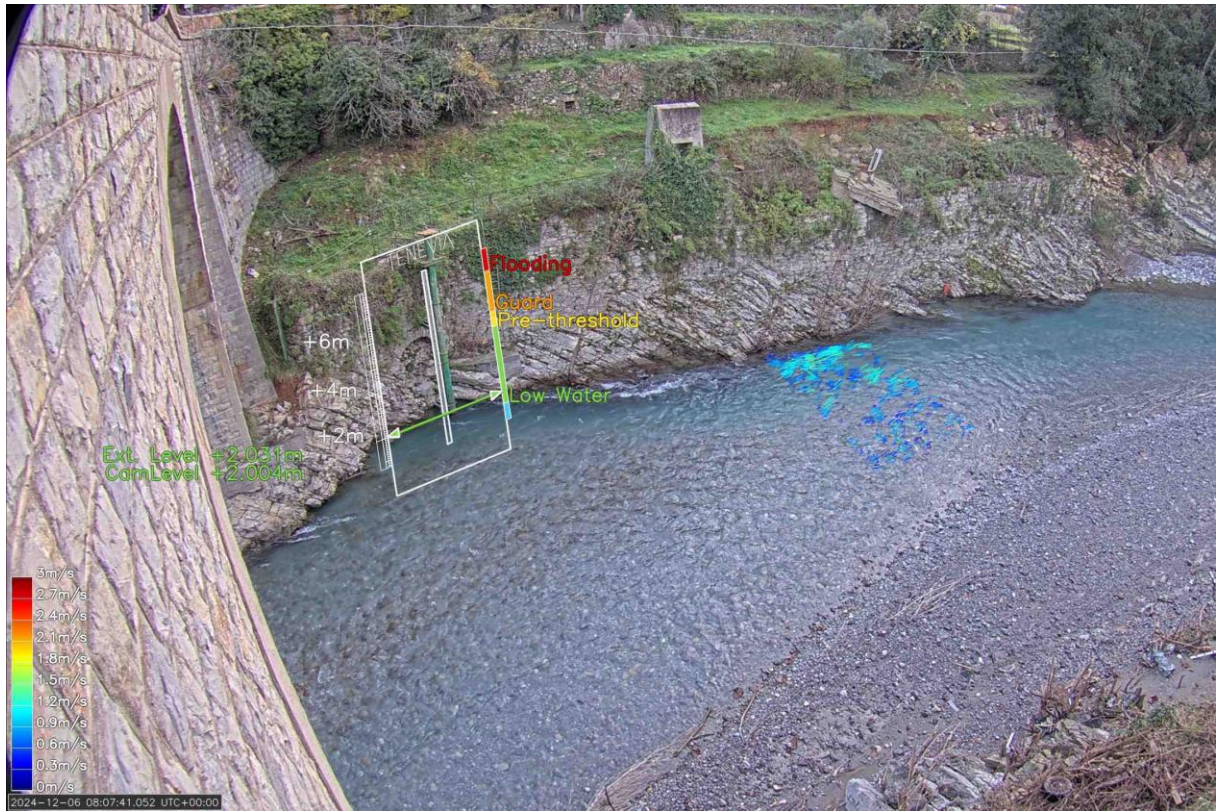


Image 10: HydroSight Flow - Output Image with level and velocity vectors

3.3 Limitations

3.3.1 Night-Time Measurements

HydroSight Flow requires visible surface texture to compute velocities. At night, this texture must be illuminated with visible white light, as IR illumination normally does not create enough contrast for optical-flow tracking.

However, during flood conditions, acceptable results have been achieved when IR illumination was positioned away from the camera and projected onto the water from an angle, which increases surface contrast and can temporarily support nighttime measurements when white-light installation is not feasible.

Typical issues: low contrast, insufficient texture, sensor noise.

Mitigation: white-light projectors, distributed lighting on wide channels, optimized exposure settings, angled IR setups in exceptional situations.



Image 11: HydroSight Flow - Nighttime measurement with surrounding whitelight

3.3.2 Heavy Rain & Heavy Snowfall

Both heavy rain and heavy snowfall reduce visibility of the water surface. Falling rain or snow creates bright moving reflections at night, which interfere with the velocity algorithm. During daytime, heavy snowfall is particularly problematic, as the algorithm cannot reliably distinguish snowflakes moving across the camera view from actual water surface motion.

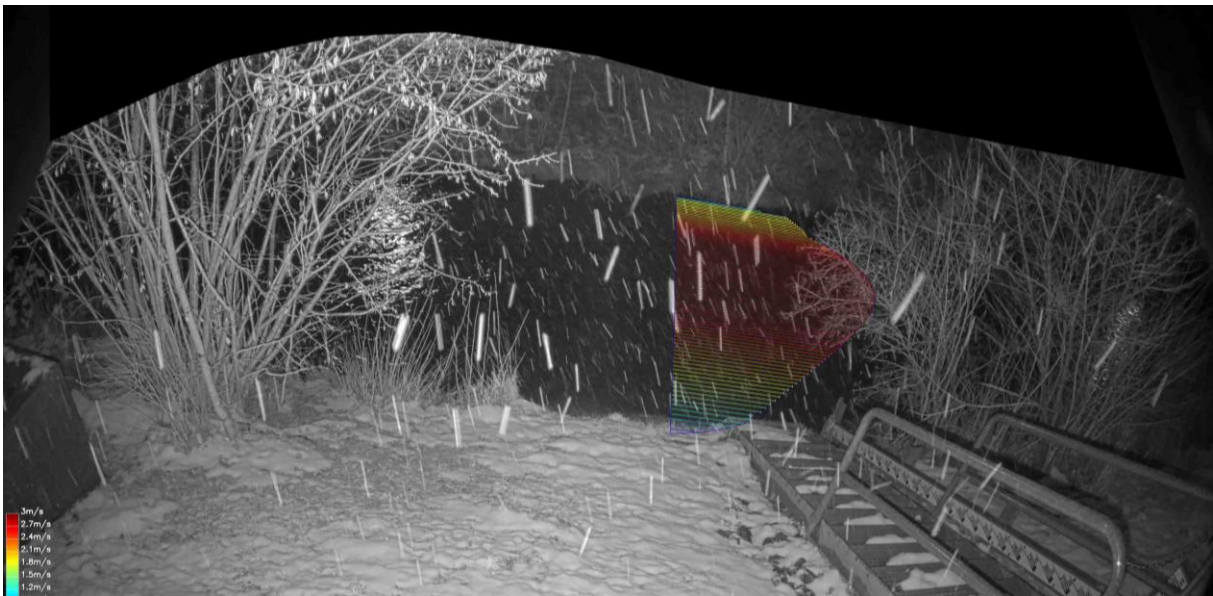


Image 12: HydroSight Flow - Disturbed measurements due to IR reflections of snow



Image 13: HydroSight Flow - Velocity measurement at snowfall conditions

3.3.3 Low Flow Conditions

Low flow can limit measurable surface velocity because the water surface may show very little texture, especially in smooth, slow, or glassy flow conditions. Without visible natural tracers such as foam, ripples, or small debris, optical-flow algorithms cannot generate a stable velocity field.



Image 14: HydroSight Flow - Low flow conditions and clear water

3.3.4 Large River Width

Very wide channels reduce pixel resolution and limit the usable viewing angle, especially toward the far bank. Illumination becomes more challenging, and flow texture may not be visible across the full width.

Mitigation: higher installation height, cameras with stronger optical zoom, distributed light sources, and focusing the velocity transect on the most hydraulically relevant portion of the channel.

3.4 Commercialization

OTT HydroMet offers:

- HydroSight Flow – Edge software license: perpetual per-camera license; updates include bug fixes within the delivered major version.
- Annual update & extended warranty; includes license transfer in case of camera hardware replacement subject to standard conditions.
- System integration (optional)
- Installation services (optional)
- Calibration services (mandatory)

4 Technical description and guidelines for integration

4.1 Camera station

Hardware integration depends on transmission, power strategy, sampling approach, and system integration needs.

A typical station includes:

- a compatible AXIS camera (e.g., AXIS P1388-LE, AXIS Q1808-LE, AXIS Q3558-LVE)
- SD storage (≥ 128 GB)
- IR illumination (external projectors for distances >30 – 40 m)
- optional water level sensor (e.g. RLS 500, PLS 500)
- IP datalogger (OTT netDL 1000, OTT XLink 2000) for smart power and bridging between devices
- Router or modem for remote access,
- Power supply with mains or solar power with batteries and charge controller.



Image 15: HydroSight - Typical measuring site

4.2 Camera hardware

Minimum 5 MP resolution is recommended. Edge processing is available on AXIS models with ARMv7–v9 (ARTPEC 7/8/9).

Pixel density at the gauge is the key accuracy driver: aim for ≥ 20 pixels in gauge width and ≥ 100 pixels in gauge length within the image.

Use the AXIS Lens Calculator to validate focal length vs. distance trade-offs.

Optical zoom enables larger distances; if a wide field-of-view is required for HydroSight Flow or situational awareness, adapt the gauge width accordingly.

Camera Selection guidance:



Q1808-LE: Preferred for Flow where image quality matters; longer IR; higher typical power.



Q3558-LVE: Newer, promising; validate for project-specific requirements.



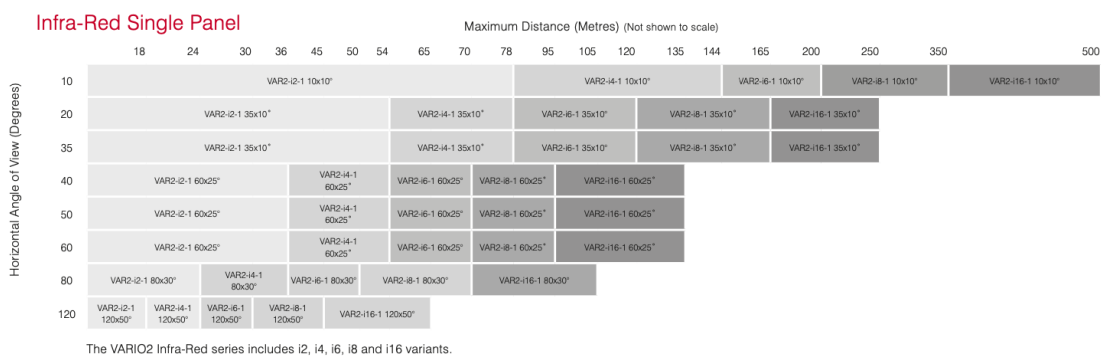
P1388-LE: Cost-effective; internal IR up to ~ 50 m; mind spider webs for internal IR; good for Level and Flow with suitable distance.

Table 1: Camera selection

4.3 Illumination

When the required range exceeds the camera's integrated IR, use external IR projectors. Selection is based on distance and horizontal beam angle; the Raytec VARIO2 series provides reference distance vs. beam diagrams to guide model choice.

VARIO2 Distance Chart



Graphic 5: Distance chart for IR Illuminator selection

For velocity measurements sufficient white light is required; the Raytec VARIO2 series provides reference distance vs. beam diagrams to guide model choice.

4.4 Communication standards for HydroSight

HydroSight apps provide three export types:

- Alarms
- values (with metadata)
- augmented images

Integration with OTT netDL

- HydroSight: can receive level data from netDL 1000 channels via HTTP request
- netDL 1000:
 - Receive and forward augmented images from HydroSight via HTTP request
 - (Planned) Receive, store and transmit values (with metadata) from HydroSight via HTTP request

Integration with OTT XLink 2000

- HydroSight: can receive level data from netDL 1000 channels via Modbus-TCP
- XLink 2000:
 - Receive and forward augmented images from HydroSight via HTTP request
 - (Planned) Receive, store and transmit values (with metadata) from HydroSight via HTTP request

Logical outputs (alarms):

Use camera I/O ports to trigger external actions (e.g., switch from intermittent to continuous power when a level threshold is exceeded, activate warning lights, etc.).

Modbus-TCP (alarms, values):

- A datalogger/PLC acts as Modbus Master, writing data to the camera on port 502. Function 16 (Write Multiple Holding Registers) is used, starting at Register 0, using 32-bit floating point (Big Endian).

- External level sensors can be integrated via Modbus; the external level can be shown on augmented images and used by HydroSight Flow calculations.

(S)FTP push (alarms, values, augmented images):

- Configure up to three recipients
- Customize CSV content and formatting (timestamp, decimal, separators)
- Configure transmission frequency (immediate, hourly, daily).

HTTP Edge API (alarms, values, augmented images):

- Full access to outputs via HTTP requests
- Suitable for simple integrations and testing from a web browser when on the same network.

ONVIF events and MQTT (alarms and values):

- Stateful ONVIF events for threshold exceedances
- Stateless events for measurements.
- The camera can publish MQTT messages to a broker
- Message content, frequency and formatting are configurable, including static key-value metadata

5 Services Provided by OTT HydroMet

OTT HydroMet provides comprehensive, end-to-end services to ensure that every HydroSight installation delivers accurate, reliable, and traceable hydrological data. These services cover the full lifecycle of a monitoring site—from selecting the right location to long-term operation and maintenance. All field surveys and site calibrations for HydroSight must be performed by certified OTT HydroMet service technicians to guarantee data quality and compliance with recommended workflows.

5.1 Selecting the Right Measuring Site

A successful HydroSight deployment begins with choosing an appropriate site. OTT HydroMet experts support customers in:

- Evaluating hydraulic suitability (flow conditions, texture availability, channel geometry)
- Assessing visibility, viewing angles, and expected water-level range
- Checking infrastructure availability (mounting points, power, communication)
- Identifying potential obstructions and environmental challenges (vegetation growth, access, safety)

Proper site selection ensures stable long-term performance and minimizes measurement uncertainties.



Image 16: HydroSight Testsite

5.2 System Integration

OTT HydroMet delivers fully integrated systems by engineering, assembling, and wiring the complete electrical cabinet—including power supply, datalogger, modem, interfaces, and all required components. The cabinet is pre-configured, programmed, and factory-tested to ensure seamless communication, reliable operation, and compatibility with OTT devices. This turnkey approach minimizes on-site effort and ensures that customers receive a ready-to-install, fully validated system.



Image 17: HydroSight Integrated System

5.3 Installation Services

OTT HydroMet technicians and authorized partners ensure that every HydroSight system is installed for optimal performance:

- Mounting and adjusting the AXIS camera
- Installing IR or white-light illumination based on site geometry and range
- Setting up power systems (mains, solar, battery) and communication hardware
- Verifying framing, focus, exposure, and pixel density for both Level and Flow applications

Correct installation reduces commissioning time and ensures reliable operation.



Image 18: HydroSight Installation

5.4 Field Survey

Accurate HydroSight Flow measurements require a detailed site survey performed exclusively by OTT HydroMet service specialists.

Topographic Survey

- Precise camera mounting geometry

- Fixed and temporary reference points for calibration
- Bank geometry and alignment features for automatic correction of camera movement



Image 19: HydroSight topographic site survey

Bathymetric Survey

- For discharge calculations, a bathymetric cross-section survey is conducted:
- Mapping depth distribution across the selected transect
- Identifying morphological features (bars, scour, pools, blockages)
- Establishing conditions for accurate depth-averaged velocity and discharge computation

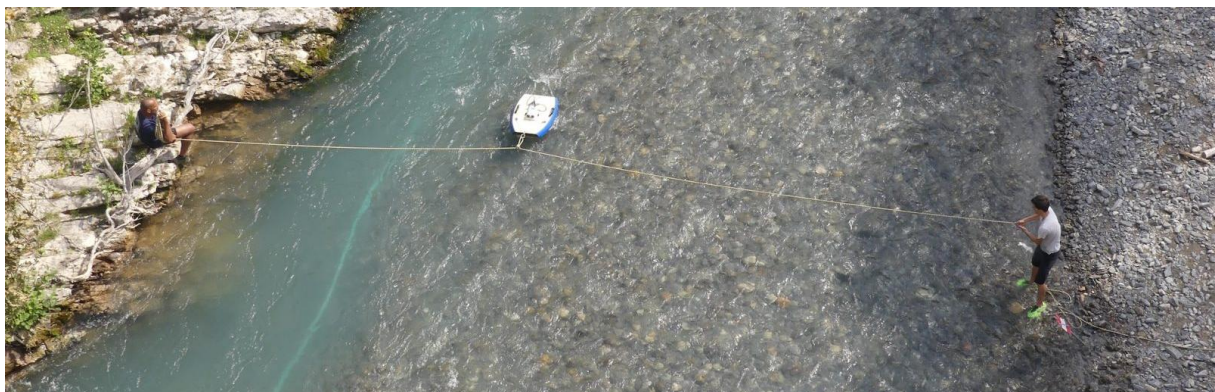


Image 20: HydroSight bathymetric site survey

These surveys provide the foundational data required for HydroSight's site-specific calibration.

5.5 Site Calibration

Site calibration is mandatory for every HydroSight Flow installation and is always performed by OTT HydroMet service technicians. Calibration includes:

- Creating the real-world coordinate system for mapping velocity vectors
- Defining the measurement area and discharge transect
- Linking pixel coordinates to physical distances using survey data
- Importing topographic and bathymetric measurements
- Generating and uploading the HydroSight XML configuration file to the camera

Precise calibration directly affects velocity estimation accuracy and overall discharge uncertainty.

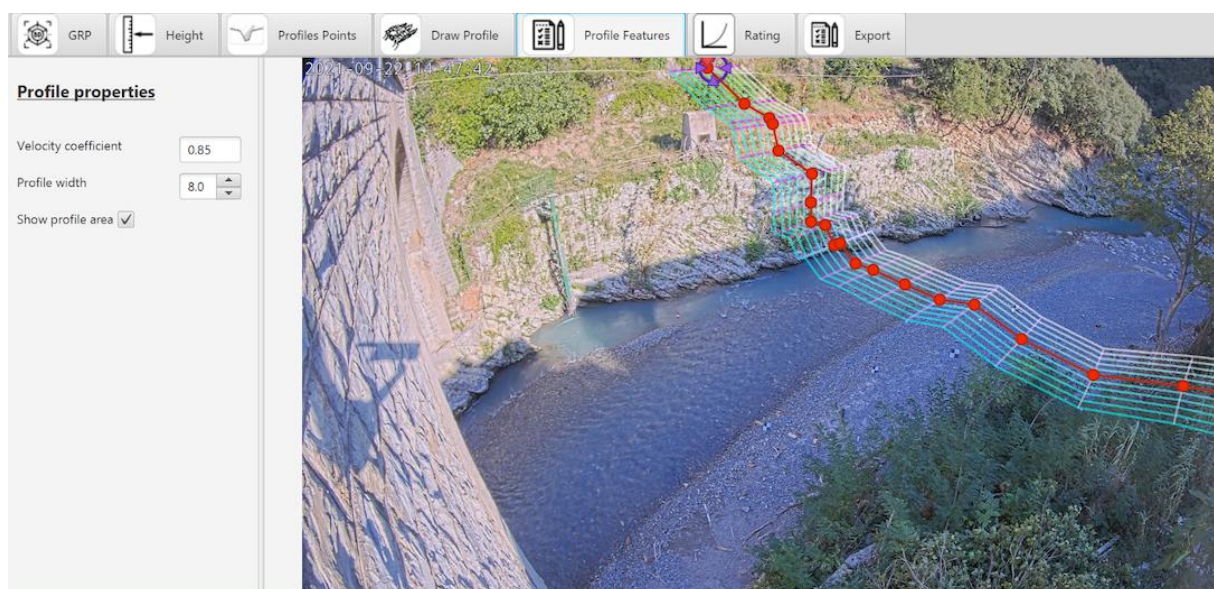


Image 21: HydroSight Flow - Site Calibration

5.6 Maintenance

For long-term reliability and stable operation, OTT HydroMet provides maintenance services and guidance:

- Routine cleaning of camera optics and staff gauges
- Vegetation control to maintain line-of-sight
- Verification of IR/white-light illumination
- Periodic cross-section checks after floods or morphological change events
- Firmware and HydroSight Edge application updates
- Validation of data quality and performance over time

Proactive maintenance ensures that the station remains accurate, safe, and fully operational.

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