DISCHARGE MONITORING

AUTOMATED SALT DILUTION GAUGING

PACIFIC SALMON FOUNDATION

Salt dilution gauging is a method used to measure stream discharge (flow rate) that involves depositing (injecting) a known amount of salt (slug) into the stream and measuring its concentration at a downstream location. The process allows calculation of discharge based on the degree of dilution. It can be implemented over a large range of flows, and does not require the technician to enter the stream. The method is most commonly implemented manually, but automating the method allows targeting of peak flows that are difficult to capture manually. Many details in this summary are specific to the AutoSalt system offered by Fathom Scientific Ltd. (Fathom); however, several practitioners have developed similar systems for individual applications. This summary is supplemental to that for manual salt dilution gauging (see related summary for a more general overview of the dilution method).

SUMMARY OF TECHNOLOGY

The AutoSalt from Fathom is an autonomous flow measurement system that can target specific water levels in highly turbulent streams. The system consists of a control module, large salt brine tank (e.g., 300 litres at 20% NaCl concentration) and stand, in-stream pressure transducer and two self-logging probes that record electrical conductivity and temperature (EC-T), and a salt injection system.

The controller reads sensors to determine the stream water level and system parameters, determines when discharge measurements are required based on a combination of logical rules, injects brine into the stream, and interfaces with the user and/or other connected loggers/modems to record the measurement (i.e., EC-T data). It is also possible to set a regular measurement interval, or trigger measurements via telemetry.

The volume of injected brine is measured to achieve a specific salt concentration in the stream (e.g., 1 litre of brine per m3/s of flow). A cumulative total of ~300 m3/s of flow can be measured before the salt brine requires replenishing (e.g., 10 measurements at 30 m3/s, or 300 measurements at 1 m3/s; in practice, a range of different flows would be measured).

Photo credit: Fathom Scientific Ltd.

IMPORTANT CONSIDERATIONS

Automated implementation requires all of the understanding involved with manual salt dilution gauging, as well as strong capability with installing complex hardware, and with programming control modules and sensors. Fathom offers fee-based installation services.

The site for the injection system must be located on a stable and level area upstream from a highly turbulent mixing reach, and have good access to a road or staging area for manually transporting bulky equipment. Good solar exposure is recommended for the site, as a solar panel is required to power the system.

The AutoSalt system calculates discharge in real-time, but requires follow-up review and possible adjustment for changing background EC-T or missing data.

Fathom provides a portal to assist with post-processing and offers hydrometric data management tools as part of the software suite (e.g., development of stage-discharge rating curves).

STREAM CHARACTERISTICS

- No lower limit on discharge that can be measured; upper limit is typically ~200 m3/s
- Well suited to highly turbulent flow
- Flatwater requires a long mixing reach (e.g., 25 wetted channel widths)
- Not suited to frozen conditions
- Not suited to streams losing substantial flow to the subsurface or with excessive storage in pools

MEASUREMENT CHARACTERISTICS

- Automated data acquisition
- Can be connected to telemetry system for real-time monitoring
- Integrated measurement across stream
- Point measurement along stream network
- Streams with naturally variable electrical conductivity require greater salt injection

SITE ACCESSIBILITY FACTORS

- Not suitable for remote foot access
- Salt mass increases with increasing discharge
- Can avoid entering stream after installation
- Initial set up involves large equipment (e.g., 300 litre salt brine tank and stand)
- Ongoing monitoring involves large equipment (e.g., 60 kg salt to resupply tank)

SCALE OF EFFORT: INITIAL SET UP

Equipment cost: moderate
Field time: moderate; ~1 day for 2 people
Field expertise: high; see Considerations

SCALE OF EFFORT: ONGOING MONITORING

Equipment cost: low
Field time: low; occasional resupply of salt brine
Field expertise: high; see Considerations
Analysis time: low; see Considerations
Analysis expertise: high; see Considerations

PRODUCTS TO CONSIDER

Automated setup: Fathom Scientific Ltd. AutoSalt

ADDITIONAL RESOURCES

Coastal Hydrology Research Lab, n.d.
Dobriyal et al., 2017
Hofmeister et al., 2023
Johnstone, 1988
Richardson et al., 2017a,b
Sentlinger et al., 2019