Application note: Field calibration of the Proteus BOD

Foreword

The material presented in this application note is intended to help the reader gain an understanding of the field calibration of the *ProteusBOD*.

Suggestions that would improve the clarity of the information presented in this manual or additional information that would enhance the operation of the equipment is welcomed.

RS Hydro is committed to improvement of its products and services and thus reserves the right to change instructions, specifications and schematics without notice.

Acknowledgments

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BIOCHEMICAL OXYGEN DEMAND (BOD) FIELD CALIBRATION FOR THE PROTEUS SENSOR RANGE

RATIONALE

To ensure accurate field measurement of Biochemical Oxygen Demand concentration (BOD mg L^{-1}) using the Proteus BOD a field calibration is highly recommended. The sensor is shipped with a generic BOD calibration based on samples collected from urban and rural river systems (Figure 1) that will provide users with a good indication of BOD concentration. However, for (semi-) permanent installation a field based calibration can markedly improve accuracy (See Khamis *et al*. 2017 for the scientific rationale for this). The Proteus BOD uses a real-time Tryptophan Like Fluorescence, corrected for temperature quenching and turbidity interference, to calculate BOD concentration at high frequency. The relationship between tryptophan and BOD can vary between sites e.g. urban vs rural as the composition of the dissolved organic matter contributing to BOD varies. Khamis *et al*. (2007) show that a field calibration can overcome issues associated with time or space variable dissolved organic matter composition.

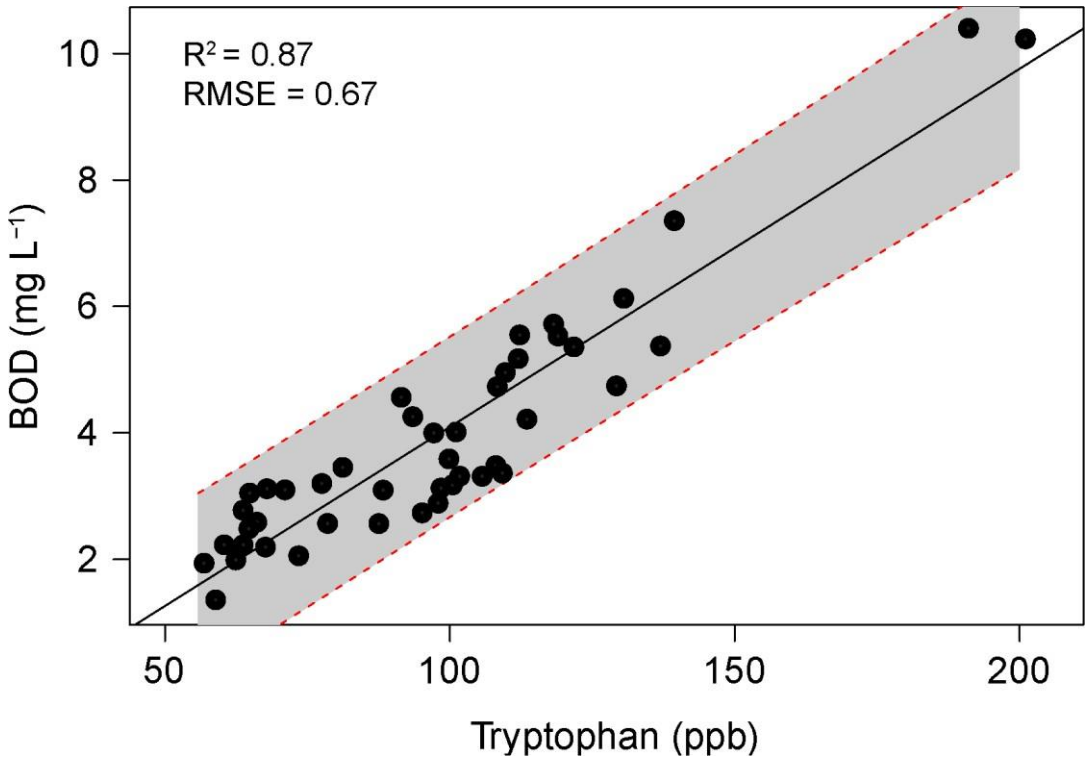

Figure 1. Proteus BOD default low range calibration (note tryptophan reading has been turbidity and temperature corrected).

METHOD

The goal of the field based calibration is to develop a statistical relationship between the sensor signal and the BOD concentration of samples collected from the site, then analysed in the laboratory.

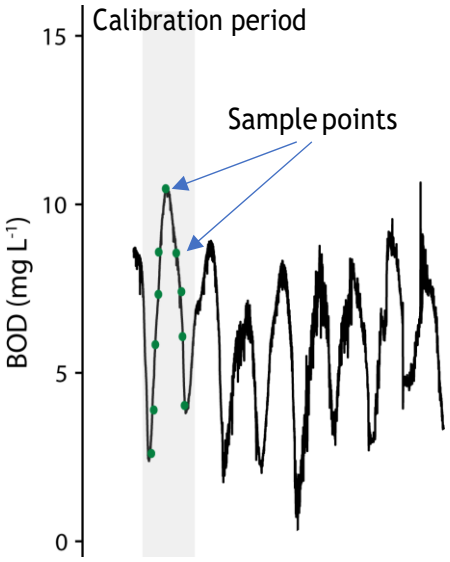

Figure 2 Example calibration for a WWTW

Once the *ProteusBOD* has been securely installed in a suitable location - preferably housed in a stilling well (see user manual *Section 4* for details) - a sampling schedule can be established. This will vary depending on the application water body in which the sensor has been installed. For example, when calibrating a *ProteusBOD* for a wastewater treatment works it is likely that diurnal variability in the BOD signal will be pronounced, hence sampling ~ 10 discrete points across a 24 hour cycle will usually be sufficient to cover the normal operating range of BOD concentrations. While for a hydrologically responsive urban river system the BOD concentration is likely to respond to increases in discharge so the aim here is to sample across a storm event (See Figure 3A).

Water samples for laboratory BOD analysis should be collected as close to the sensor as possible either by hand or automatic pump sampler (Figure 3B) using clean acid washed bottles. Collected samples should then be time stamped, to enable direct comparison with *ProteusBOD* measurements, transported to the laboratory as quickly as possible and analysed for BOD following standard methods (e.g. ISO 5815-1:2003, 2003). If samples can't be processed within 4h they should be refrigerated and analysed within 24h. Laboratory measurements of BOD should then be compared to the measurements logged using the Proteus BOD factory calibration using linear regression (Figure 3D). For example this can easily be done using the scatterplot function in excel. A linear trend can be fitted to the data and the slope (multiplier) and intercept (offset) extracted and used to amend the BOD calibration, thus providing a site-specific calibration for the installation location.

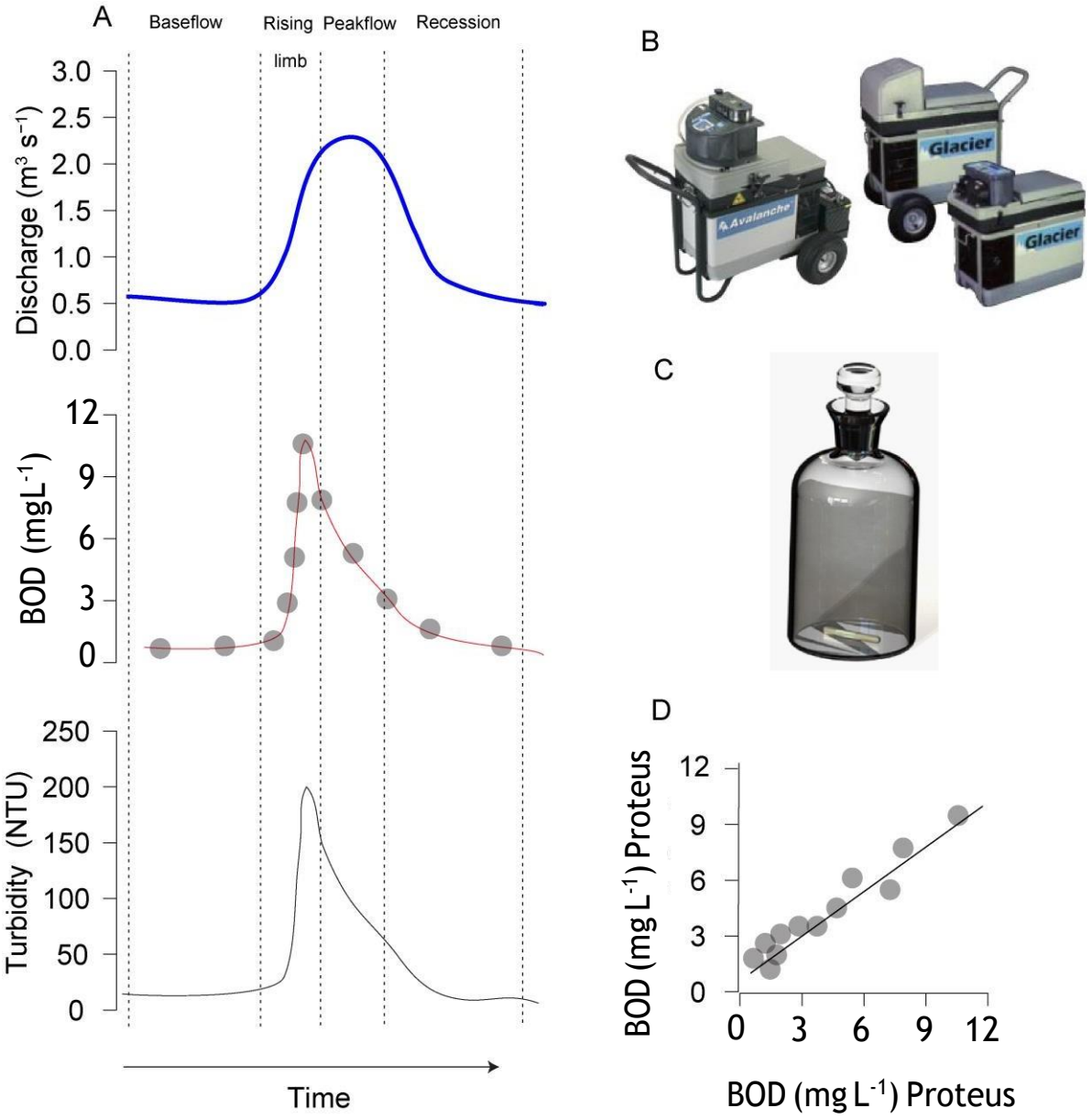

Figure 3. Schematic representation of the field based calibration procedure. A. The components of a storm hydrograph with desired sampling points highlighted. To ensure a good calibration it is important to sample at a range of points in time across the hydrograph to get a wide range of BOD values and turbidity readings. B. displays the automatic pump sampler RS Hydro can provide for sampling storm events. C. If users do not have access to lab facilities RS Hydro can arrange for BOD sample bottles to be delivered and collected after sampling and analysis then conducted in an accredited laboratory. D. A site-specific BOD calibration can then be established to improve measurement accuracy.

REFERENCES

ISO 5815-2. 2003. Water quality - Determination of biochemical oxygen demand after n days (BODn) - Part 2: Method for undiluted samples.

Khamis K, Bradley C, Stevens R, Hannah DM. 2017. Continuous field estimation of dissolved organic carbon concentration and biochemical oxygen demand using dual-wavelength fluorescence, turbidity and temperature. *Hydrological Processes* **31**: 540–555.

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