



## National Environmental Monitoring Standard

# Glossary

Terms, Definitions and Symbols

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NEMS

# The National Environmental Monitoring Standards

The following National Environmental Monitoring Standards (NEMS) documents can be found at [www.lawa.org.nz](http://www.lawa.org.nz):

## Standards

- **Dissolved Oxygen**  
*Measuring, Processing and Archiving of Dissolved Oxygen Data*
- **Open Channel Flow**  
*Measuring, Processing and Archiving of Open Channel Flow Data*
- **Rainfall**  
*Measuring, Processing and Archiving of Rainfall Intensity Data for Hydrological Purposes*
- **Rating Curves**  
*Construction of Stage-Discharge and Velocity-Index Ratings*
- **Soil Water**  
*Measuring, Processing and Archiving of Soil Water Content Data*
- **Turbidity**  
*Measuring, Processing and Archiving of Turbidity Data*
- **Water Level**  
*Measuring, Processing and Archiving of Water Level Data*
- **Water Meter Data**  
*Measuring, Processing and Archiving of Water Meter Data for Hydrological Purposes*
- **Water Temperature**  
*Measuring, Processing and Archiving of Water Temperature Data*

## Codes of Practice

- Hydrological and Meteorological Structures
- Safe Acquisition of Field Data In and Around Fresh Water
- Site Surveys

## Supplementary Material

- **Glossary (this document)**  
*Terms, Definitions and Symbols*
- **National Quality Code Schema**

## Implementation

When implementing the Standards, current legislation relating to health and safety in New Zealand and subsequent amendments and the NEMS Codes of Practice shall be complied with.

## Limitations

It is assumed that as a minimum the reader of these documents has undertaken industry-based training and has a basic understanding of environmental monitoring techniques. Instructions for manufacturer specific instrumentation and methodologies are not included in this document.

The information contained in these NEMS documents relies upon material and data derived from a number of third-party sources.

The documents do not relieve the user (or a person on whose behalf it is used) of any obligation or duty that might arise under any legislation, and any regulations and rules under those acts, covering the activities to which this document has been or is to be applied.

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## Development

The National Environmental Monitoring Standards (NEMS) steering group has prepared a series of environmental monitoring standards on authority from the Regional Chief Executive Officers (RCEOs) and the Ministry for the Environment (MfE). The strategy that led to the development of these Standards was established by Jeff Watson (Chairman) and Rob Christie (Project Director), and the current steering group comprises Phillip Downes, Martin Doyle, Michael Ede, Glenn Ellery, Nicholas Holwerda, Jon Marks, Charles Pearson, Jochen Schmidt, Alison Stringer, Raelene Mercer (Project Manager) and Jeff Watson.

The development of these Standards involved consultation with regional and unitary councils across New Zealand, electricity-generation industry representatives and the National Institute for Water and Atmospheric Research Ltd (NIWA). These agencies are responsible for the majority of hydrological and continuous environmental-related measurements within New Zealand. It is recommended that these Standards are adopted throughout New Zealand and all data collected be processed and quality coded appropriately. The degree of rigour with which the Standards and associated best practice is applied will depend on the quality of data sought.

This document has been prepared by the Local Authorities Environmental Monitoring Group (LAEMG) to help provide consistency in the application of work practices specific to environmental monitoring and data collection across New Zealand. The input of NEMS members into the development of this document is gratefully acknowledged; in particular, the review undertaken by the NEMS steering group and non-technical editing by writer Chris Heath of Heath Research Services.

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- Northland Regional Council
- Otago Regional Council
- Taranaki Regional Council
- Tasman District Council
- West Coast Regional Council
- Waikato Regional Council.

## Review

This document will be reviewed by the NEMS steering group in February 2018, and thereafter every two years. Further details on the review process can be found at [www.lawa.org.nz](http://www.lawa.org.nz).

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# About this Glossary

## Introduction

A common vocabulary and set of symbols is essential to successful integration of the various Standards into a manageable quality programme, and to clear and consistent understanding and application of the requirements of each Standard.

## Objective

The objective of this document is to ensure a common vocabulary and symbology across the NEMS suite of documents.

## Scope

This document includes definition of technical terms, explanation of acronyms, and a list of symbols not normally encountered in common usage. It also includes common-use terms that have specific meanings in environmental monitoring.

The terms, acronyms and symbols in this Glossary apply to all other NEMS documents and may appear in any of the NEMS applicable to the measurement of any parameter covered by the suite.

## Exclusions

The NEMS Glossary does not include comprehensive coverage of quality management terms that may be encountered in referenced documents. Where conflict arises between definitions in referenced documents and this Glossary, the definitions in the Glossary shall prevail.

## Formatting

Variables are italicised when used in the NEMS suite of documents, but for readability, they are not italicised in this Glossary.

## Definitions

**absolute soil water content** The weight of water per weight of soil; for example, grams of water/grams of soil.

**accuracy** The degree of closeness of measurements of a quantity to that quantity's actual (true) value. (See also 'uncertainty'.)

**ADCP (Acoustic Doppler Current Profiler)** An instrument that uses acoustic signalling to measure water velocity, direction, depth and boat speed when undertaking a discrete discharge measurement (gauging).

**ADV (Acoustic Doppler Velocimeter)** A family of instruments that use acoustic signalling and Doppler principles to measure water velocities. Some devices may be used as a current meter to measure point velocities during a gauging while others are deployed in situ to measure velocity continuously.

**adjusted intensity gauge data** The rainfall intensity gauge data that has been rescaled to reconcile it with the primary reference gauge total.

**anode** An electrode at which electrons leave a cell and oxidation occurs. (See also 'cathode'.)

**archive rating** A rating stored indefinitely as part of the historic hydrological record for a site; deemed to suitably define the relation, constructed using all possible relevant calibration data, quality assured, assigned a period of applicability consistent with the period of stable control it represents, and appropriately transitioned to prevent discontinuities being generated in the derived flow series.

*Note: New data at any time, typically a new gauging of extremely high or low flow, may initiate review of and change to any or all archive ratings for a site, which may include adding new ratings and/or deleting ratings previously stored, or change to the period of applicability and/or transition period of a curve. The archive update process must ensure that no remnants of superseded curves remain in the data set nor unintended overlap of curves arise as they are applied.*

**archiving agency** The agency that is responsible for data archiving, quality assurance and control for data sets.

**auto-sampler** An electrically driven device that pumps water samples from a water body and stores them in an array of sample bottles.

**averaging interval** The period over which samples from a sensor are statistically summarised prior to logging the result as the value of the parameter being measured. The statistic is usually the arithmetic mean but may be a geometric mean or median.

**avulsing** A term used to describe a river or stream prone to rapid abandonment of all or part of its channel in favour of formation of a new channel.

**backsight (BS)** A reading 'looking back' along the line of progress to a position of known elevation when surveying. Since a survey progresses from a point of known

elevation to points of unknown elevation, the first reading of almost any survey should be a backsight onto a fixed point of known elevation, usually a benchmark of some sort.

**backwater** Water held up or pushed back by some downstream obstruction to free flow. Also known as the backwater effect.

**bankfull stage** The level in terms of gauge height below which discharge is confined to the active channel and above which water spills onto berms and/or a floodplain.

**baseline drift** A continuous and gradual change in the measured background response.

**benchmark** A fixed permanent reference point of known or assigned elevation used when levelling to determine elevation of other points in a circuit or traverse.

**biofilm** A thin resistant layer of micro-organisms; for example, bacteria and their secretions that stick to each other on a hard hydrated surface and may adhere or attach to the surface.

**biofouling** An accumulation of living organisms that has an adverse effect on measurements; for example, unwanted algae, on equipment such as a sensor lens.

**blanking distance** The area near the transducers of an ADCP in which no measurement is taken. Also known as the blank.

**blue tick** An accreditation program administered by IrrigationNZ.

**bottom tracking** An acoustic method used to determine boat speed and direction by computing the Doppler shift of sound reflected from the stream bed relative to the ADCP.

**bulk density** The mass of the soil particles divided by the volume occupied by soil and voids in the sample.

**calibration** The process of comparing the response of a measuring device to a traceable standard over a defined range and in controlled conditions. (See also 'validation' and 'verification'.)

*Note: Results may indicate a need for repair or adjustment of the device, in which case calibration is repeated after servicing. This subsequent calibration when the device is in good working order demonstrates a proper response has been re-established ready for deployment.*

**calibration range** The range over which the calibration has been made.

**cathode** An electrode at which electrons enter a cell and reduction occurs. (See also 'anode'.)

**cease to flow (CTF)** The lowest elevation of a hydraulic control below which water will be retained and therefore not flow.

**change point (CP)** A point of fixed location and elevation used as a temporary reference when the survey instrument must be moved to sight additional points in a circuit or traverse; for example, a nail in a tree or fencepost, a mark on a curb, or a

sturdy stake driven in an out-of-the-way area of a site. A CP is read first as a foresight, then again as a backsight after the instrument has been moved.

**channel** An open natural or artificial watercourse that periodically or continuously contains moving water.

**check data** A term used to describe reference values and their dates and times of observation particularly when applied to the verification and processing of logged data. *Note: For a water level series, the check data may be staff gauge or EPB readings; for a rain gauge, the check data is rainfall totals recorded from the primary reference gauge.*

**chemical fouling** An accumulation of inorganic substances that have an adverse effect on measurements; for example, unwanted salts and oxides on equipment such as a sensor lens.

**circuit** In surveying, also known as a traverse. (See 'traverse'.)

**clay** Mineral grains that have a diameter less than 0.004 mm.

**closing error** The difference between the elevation determined by leveling and the expected 'known' elevation of the end-point of a survey. Also known as misclose. Closing error cannot be calculated for an open traverse. (See 'traverse'.)

**comments file** A metadata file associated with the data file that provides time-stamped descriptive information about the site and data.

*Note: For a flow series, the comments file may include information about the gaugings, ratings and extreme flows.*

**commissioning agency** The agency that initiates data collection.

**complex rating** A relation intended to transform one variable to another, where the predicted variable is dependent on more than one input variable and/or may not be unique for a given input value.

**consent (resource consent)** Authorisation granted under the Resource Management Act and Amendments to use or modify a natural or physical resource.

**consent holder** The person or entity who has been granted authority to use or modify a natural or physical resource (i.e. a resource consent) and to whom any associated regulations apply.

**consenting authority** An organisation charged under the Resource Management Act and Amendments with managing the resource consent process; usually a regional, unitary or territorial council.

**control** The physical properties of a cross-section or reach of an open channel, natural or artificial, which determine the relationship between stage height and discharge at a location in the channel.

**artificial control** A hydraulic structure, e.g. a weir or flume, installed in an open channel to create a cross-section of reduced area in order to induce critical flow through or over the structure. In most cases discharge can be

derived from the upstream water level. In some cases it may be a pre-calibrated structure.

**bed control** A structure installed in an open channel to create a section control and/or improve stability of the channel in the recording reach; for example, a timber weir or rocked grade control.

**channel control** Where the relationship is governed by the geometry and features of a reach of channel, in almost all cases downstream of the recorder. In the absence of confining structures, e.g. a bridge, high-flow controls are usually channel controls.

**permanent control** A natural or artificial control that remains unchanged for a long period of time.

**section control** Where the relationship is governed by the geometry and features of a particular cross-section downstream of the recorder; these are usually low-flow controls.

**shifting control** A section or channel control that changes form and/or location frequently due to mobilisation of the stream bed and/or banks in alluvial or sand channels, or cycles of material such as weed or ice accumulating.

**Coriolis coefficient** The ratio of mean of velocity head to theoretical velocity head used to correct energy equations if velocity varies across the section. Also known as the kinetic energy correction coefficient.

**coverage factor** A multiplier applied to a standard uncertainty to determine expanded uncertainty to a desired level of confidence.

*For example: A coverage factor of 2 represents an interval of two standard deviations within which the true value might be found; that is, there is 95% probability that the true value is contained in the interval described by twice the standard uncertainty of the estimate. A coverage factor of 2 therefore provides for 95% level of confidence that the true value is contained within the expanded uncertainty calculated for the measurement result.*

**cross-section** A specified section of a water body bounded by a straight line across the free surface and the corresponding wetted perimeter.

*Note: For the calculation of area of discharge, the line across the free surface must be normal to the mean direction of discharge; that is, the shortest width across the flowing channel.*

**C-tick certification** A third-party declaration of compliance with standards for performance with respect to radio frequency and/or electromagnetic interference.

**current meter** An instrument for measuring water velocity.

**custodian** The agency responsible for ensuring the preservation and dissemination of data.

**CV (coefficient of variation)** A statistical measure of the dispersion of measurement results around the mean.

**daily manual gauge** A type of a primary reference rain gauge; usually read at the same time each day.

**datum** A reference level from which elevations are measured. It may be relative to some known level, e.g. mean sea level, or assumed. It should be used to determine elevation of station benchmarks.

**depth** The vertical distance below the free surface of a stream to a point of interest; for example, the position of a measuring instrument, or the bottom of the stream at any point on a cross-section.

**depth cell or bin** A truncated cone-shaped volume of water at a known distance and orientation from the ADCP transducers.

**DGPS (Differential Global Positioning System)** An enhanced GPS system that uses a network of fixed ground-based reference stations to broadcast the difference between measured satellite ranges and actual satellite ranges to roving receivers.

**diel** Pertaining to a 24-hour period, particularly a regular daily cycle, that includes day and night, as opposed to a diurnal (day) or nocturnal (night) phenomenon.

**discharge** The outflow of a conduit or drainage basin, expressed as the volume of liquid flowing through a cross-section in a unit time.

**discharge coefficient** The ratio of actual to theoretical discharge, used to account for irrecoverable energy losses arising from the resistance to fluid flow posed by structures and equipment.

**discharge rating** A curve, equation or table that expresses the relation between the surrogate measured parameter and the discharge in an open channel or conduit at a given cross-section.

**dissolved oxygen (DO)** The amount of gaseous oxygen present in water.

**drawdown** The effective lowering of surface water or groundwater levels relative to the surrounding water body; for example, near the outlet of a natural or artificial structure, such as a dam or lake outlet, or the lowering of the water table caused by pumping of groundwater from a well.

**drift** A continuous and gradual change in the response from an instrument referenced to some known or demonstrably stable condition. (See also 'baseline drift'.)

**edited data** Data that may have been altered to correct for changes in baseline drift, or been smoothed, or changed as a result of calibration or validation checks.

**effective stage** The height of the water surface above an orifice, stilling well intake, or other point of exposure of a sensor to the water body.

**effective water's edge** A position on a cross-section that is a boundary between flowing and non-flowing water.

**electric plumb bob (EPB)** See 'internal plumb bob'.

**electrochemical sensor** An instrument comprised of electrodes (anode and cathode, and possibly reference) housed in liquid electrolyte. When the substance to be measured makes contact with one electrode, a chemical reaction occurs that results in an electric current proportional to the concentration of the substance.

**electrolyte** A substance, usually a soluble salt, acid or base, that ionises when dissolved in a suitable solvent; for example, water.

**electromagnetic** Pertaining to the interaction between electricity and magnetism; specifically magnetism caused by an electric current, or induction of an electric current by changing a magnetic field.

**elevation** The vertical distance above a datum.

**ensemble** A single profile of the water velocity through the water column consisting of one or the mean of multiple acoustic measurements collected from an ADCP instrument.

**exposure** The degree to which the environment of a rain gauge's location affects its catch. The most significant influences are speed and distortion of airflow across the gauge and possible entry of additional water.

**external staff gauge (ESG)** A graduated scale mounted as permanently as possible either vertically or inclined in a water body, used to read water level in terms of the recording datum, in most cases as an independent check on an in situ sensor.

**ferrous** Of or containing iron, particularly as bivalent Fe<sup>2+</sup>.

**field calibrator** A portable device used at site to independently validate performance of the in situ measuring instrumentation.

**field capacity** The water content held in soil after gravitational drainage from a saturated condition falls to a rate that is insignificant (i.e. drainage rate  $\leq 1$  mm/day).  
*Note: This is usually estimated in the field by measuring the soil water content two to three days after heavy rainfall, or by measuring the water content of soil cores in the laboratory after they have been equilibrated at a soil matric potential. In New Zealand, the laboratory estimation of field capacity is measured at the nominal  $-10$  kPa soil matric potential, but direct field measurements show that it can vary between  $-2$  kPa and  $-30$  kPa, depending on soil texture.*

**firmware** Software for hardware; for example, the control program embedded in a device.

**flow** The movement of a volume of liquid. Used as a general term when referring to the movement of water, e.g. through a channel, and to the time series that results from applying a discharge rating to a record of stage. (See also 'discharge'.)

**flow cell** An enclosed vessel into which water is pumped, that also houses water quality sensors, to isolate the fluid from the surface environment and ensure minimal aeration.

**flow meter (water meter)** See 'water meter'.

**flow rate (Q)** Quotient of the actual volume of water passing through a water meter and the time taken for this volume to pass through the water meter.

**minimum flow rate, Q1** The lowest flow rate at which the water meter is required to operate within the maximum permissible error.

**overload flow rate, Q4** The highest flow rate at which a water meter is required to operate, for a short period of time, within its maximum permissible error, whilst maintaining its metrological performance when it is subsequently operated within its rated operating conditions.

**permanent flow rate, Q3** The highest flow rate within the rated operating conditions, at which the water meter is required to operate in a satisfactory manner within the maximum permissible error.

**transitional flow rate, Q2** The flow rate that occurs between the permanent flow rate, Q3, and the minimum flow rate, Q1, which divides the flow rate range into two zones, the upper flow rate zone and the lower flow rate zone, each characterised by its own maximum permissible error.

**fluvial** A collective term for processes in a river or stream associated with movement of sediment, and creation or alteration of landforms, by the action of the river or stream; that is, by erosion or deposition.

**FNU (Formazin Nephelometric Units)** The units used to report turbidity measured with instruments that meet the ISO 7027 Standard.

**formazin** A compound used to create reference solutions of suspended material that are used to calibrate turbidity sensors.

**foresight (FS)** A reading 'looking forward' to the next position along the line of progress when surveying. Since a survey progresses from a point of known elevation to points of unknown elevation, the last reading before moving the instrument during or at the end of any survey is a foresight.

**FRE3** The frequency of flows greater than three times the median flow; used as an index of flow variability particularly with respect to the frequency of events likely to disturb periphyton accumulation (Clausen and Biggs, 1997). Usually an exclusion period of five days is applied from the end of each event before the next event can be counted.

**full flood extent** The extremities to which water will spread at the conceivable highest stage.

**full pipe flow** Flow in a closed pipe or conduit that is full of water; that is, has no free surface.

**full-scale error** Absolute error divided by the measurement range of the device, often expressed as a percentage of full scale (%FS). The error is a fixed value and therefore less by proportion when the device is operating near its maximum range than when operating lower in its range. In contrast, error expressed as percentage of measured

value (reading) (%RD) is the same proportion of the flow throughout the measurement range.

**gauge height** The water level measured at a water monitoring site, typically when read from a staff gauge. (See also 'water level' and 'stage or stage height'.)

**gauging** The physical act of measuring discharge. May also be used to refer to the combined result of the measurement, including the stage, date and time representative of the measurement.

**geometric sequence** A mathematical progression in which the ratio of successive terms is constant; for example, 100, 300, 900...

**GPS (Global Positioning System)** A space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

**gravimetric method** A procedure for quantitative determination of an analyte by weighing the mass of collected solids.

**gravimetric water content** The mass soil water content relative to the mass of oven-dry soil; it is given in units of kg, kg<sup>-1</sup> or other consistent mass units.

**height of collimation** The elevation of the optical axis of the levelling instrument, determined by sighting onto a staff placed on a benchmark then adding the staff reading to the benchmark elevation. Also known as height of instrument (HI) or line of collimation.

**HDOP (horizontal dilution of precision)** A measure of the geometric quality of a GPS satellite configuration that is a factor in determining the relative accuracy of a horizontal position. A smaller dilution means better accuracy.

**height of instrument (HI)** See 'height of collimation'.

**hydraulic mean depth (mean depth)** The ratio of area to top-surface width of a cross-section.

**hydraulic parameters** The set of measureable factors that describe the behaviour of water when static and when conveyed in a pipe or channel.

**hydraulic radius** The ratio of area to wetted perimeter of a cross-section.

**hysteresis** The dependence of a system not only on its current environment but also on its past environment, producing values of physical properties that are looped or that lag behind changes in the effect acting on the system.

**in situ** Deployed continuously on site at a fixed location.

**instantaneous measurement** A measurement or average of a series of measurements spanning a period no greater than 20 seconds.

**instantaneous value** The value obtained by instantaneous measurement.

**intensity gauge** A rain gauge that provides a record of the onset, rate and cessation of rainfall.

**intermediate (sight) (IS)** Readings to determine elevation of additional points of interest aside from those that form the main traverse or circuit of a survey. Intermediate readings are not backsight-foresight pairs and therefore not verified unless observed twice from two different instrument positions during the survey, and are not used in the circuit close; that is, to determine closing error.

**internal plumb bob** A non-recording gauge that is normally used to measure the water level in a stilling well. Also known as an electric plumb bob or EPB.

**invert** The lowest part of the cross-section of a conduit or pipe, including an intake pipe, or the underside of a recorder housing.

**Kainga primary reference gauge** A type of a primary reference rain gauge.

**kinetic energy correction coefficient** See 'Coriolis coefficient'.

**Lidar** A remote sensing technology that analyses light reflected from a laser-illuminated target to measure distance. Capable of producing high-resolution maps and 3-D images from which profiles and sections can be extracted.

**logarithmic bias** A bias that occurs when a function is fitted statistically to the logarithms of data and is subsequently re-transformed back to the original scale of the data.

**logger volume** The volume of metered water extracted, as recorded on the logger between verification visits.

**macro-fouling** Interference caused by solid objects snagged on or caught within a sensor or its housing, or invading a sensor's detection volume; for example, suspended debris, loitering aquatic animals, or growing in-stream vegetation.

**mag flow or magnetic flow meter** A meter in which a magnetic field applied to the metering tube results in a potential difference proportional to the flow velocity perpendicular to the flux lines. Also known as a mag meter.

**matric potential** A measure of how tightly water is held in the soil. Water is held more tightly in smaller pores as the potential decreases (becomes more negative).

**metadata** A set of data that describes and gives information about other data. It may describe the content, quality, condition, location or other characteristics of the data, and operations on or modifications to that data.

**meter volume** The change in incremental volume of metered water extracted between inspections, as derived from the meter display.

**metrological** Of or pertaining to the science of all theoretical and practical aspects of measurement.

*Note: Not to be confused with 'meteorological', the study of the atmosphere, especially weather and weather conditions.*

**moving bed** Of or pertaining to the mobilisation of sediments on or near the bottom of a river or stream.

**MSL (mean sea level)** The level frequently used as datum for traditional survey levelling of station benchmarks. True elevation of MSL varies around New Zealand and over time.

**noise (noisy data)** The excessive variability in a parameter's measurement results that alters or obscures the signal representative of the parameter.

**non-volatile memory** A computer chip that holds its content without power applied.

**normative reference** A reference considered to be a prescriptive part of a Standard that should be read in conjunction with the document containing the reference.

**NZDT (New Zealand Daylight Time)** New Zealand (except Chatham Islands) summer time when clocks are moved forward 1 hour to UTC + 13 hours, to effect more 'daylight activity' hours. Usually begins around the first Sunday in October and ends on the last Sunday in April. Historically, different periods have applied. (See also 'NZST'.)

**NZGD2000 (New Zealand Geodetic Datum 2000)** The official geographic reference system for New Zealand, adopted in 1998, from which latitude, longitude and ellipsoidal height of any physical location are determined. It is compatible with GPS so positions between the two systems are equivalent for most practical purposes.  
*Note: Coordinates from GPS are generally referenced from the World Geodetic System 1984 (WGS84) or International Terrestrial Reference Frame (ITRF) global datum, which do not apply a tectonic plate deformation model and thus vary from NZGD2000 over time (up to 5cm/year since 2000).*

**NZMG (New Zealand Map Grid)** The unique NZGD1949 projection, based on the New Zealand Geodetic Datum 1949 (NZGD1949) using the International 1924 reference ellipsoid, that provides the coordinate system used for the NZMS260 1:50,000 topographic map series, applicable for New Zealand except the Chatham Islands. NZMG was replaced by NZTM2000 in 2001.

**NZST (New Zealand Standard Time)** New Zealand (except Chatham Islands) normal time when clocks are set to UTC + 12 hours. (See also 'NZDT'.)

**NZTM2000 (New Zealand Transverse Mercator 2000)** A Transverse Mercator projection, based on NZGD2000 datum using the GRS80 reference ellipsoid, that provides the coordinate system used for the Topo50 1:50,000 topographic map series, applicable for the main New Zealand island group (North, South, Stewart and the smaller coastal islands) as formally defined in the Land Information NZ (LINZ) Standard LINZS25002. NZTM2000 replaced NZMG in 2001.  
*Note: Transformation of coordinates between NZMG and NZTM2000 is not straight forward and it is not possible to have NZMG coordinates in terms of NZGD2000 or vice versa.*

**NZVD2009 (New Zealand Vertical Datum 2009)** The official vertical datum for New Zealand and its offshore islands as defined by the NZGeoid2009 reference surface that relates normal-orthometric height, i.e. elevation of the land surface, to ellipsoidal height given by the NZGD2000 datum, and formally described in the Land Information NZ (LINZ) standard LINZS25004.

*Note: Offsets are also defined to enable transformation of heights between NZVD2009 and*

*13 major existing local mean sea level (MSL) datums. In New Zealand, ellipsoidal height and sea level can differ by over 35 metres.*

**observation accuracy** With respect to water temperature measurement, the maximum expected difference between the in situ sensor measurement and the traceable reference value; that is, the sum of the observation tolerance and the precision of the reference sensor.

**observation tolerance** The range of variance between in situ sensor and reference measurements that is permitted or which defines agreement.

**octapent** A type of primary reference rain gauge with a 5" diameter orifice and 8" diameter receiver canister.

**ODBC (Open Database Connectivity)** A standard application programming interface (API) for accessing database management systems (DBMS) intended to be independent of database systems and operating systems and therefore make it possible for applications to access data from a variety of DBMS.

**off-season** The part of the year in which a particular activity, e.g. irrigation, reduces or ceases.

**open channel flow** The flow driven by gravity, exposed to the atmosphere in a conduit that does not completely enclose the fluid such as a canal, flume, ditch or race.

**operational rating** A rating stored indefinitely as part of an ongoing record of real or near-real time determination of flows for a site; deemed to suitably define the relation, constructed using best available calibration data at the time of determination, quality assured, and applicable from the date of publication forward.

*Note: Operational ratings are often used to assess compliance with consent rules and may be required for evidence, so while possibly provisional they are rarely retrospectively altered. If new data indicates an existing operational rating should be amended, it is usual to implement the alteration as an entirely new rating so as to not disturb the integrity of prior compliance tests.*

**optode** An optical sensing device used to measure a specific substance, usually with the aid of a chemical transducer.

**overall accuracy** The combined uncertainty of all errors in a composite measurement, e.g. a gauging, or a result, e.g. a rated flow series.

**over-ranging** When an instrument returns a value outside of the range for which it is calibrated or designed to measure.

**partially full pipe flow** The flow driven by gravity in a closed conduit where the conduit is not full, and the flow has a free surface subject to atmospheric pressure.

**peak clipping** Failure to record the actual values of a measured parameter in excess of some upper limit of the recording system; the data are truncated at the limit.

**permanent wilting point** The soil water content at which plants can no longer extract water from the soil and the plant is permanently wilted.

*Note: The actual soil water potential at which permanent wilting point occurs varies*

*between plant types, but in New Zealand it is nominally estimated in the laboratory by measuring the soil water content at  $-1500$  kPa soil water potential.*

**pipe nominal diameter (DN)** A sizing system for pipe based on its internal diameter. Also known as nominal bore (NB), and is related to nominal pipe size (NPS) in North America for diameters up to 12 inches.

**POEM (Pressure Operated Electronic Meter)** A depth and velocity measuring instrument that uses a forward-facing pitot tube on the front of a streamlined weight that houses velocity and depth sensors.

**point-pair** A coordinate pair of unrated and corresponding rated values that lie on the rating curve. An appropriately selected set of point-pairs and an interpolation method define a rating curve in most time-series software used in New Zealand.

**point velocity** A sample of velocity measured at a specific location on the cross-section and in the vertical.

**precipitation** Any form of water in liquid or solid form falling from the atmosphere to the surface of the earth, including rain, snow, sleet, hail, drizzle and dew. Fog is not considered precipitation because the water is suspended.

**precision** The degree to which repeated measurement of a quantity under unchanged conditions shows the same results.

**primary reference gauge** A gauge that allows measurement independent of the sensor and directly in terms of the measurement reference ; for example, a storage rain gauge deployed long-term at standard orifice height, or a staff gauge or electric plumb-bob with gauge zero in terms of the station datum.

**primary reference gauge data** One or more measurements from a primary reference gauge that is independent of the sensor. For rainfall, this data is often referred to as check gauge data. (See also 'check data'.)

**processing (data processing)** Quality control procedures applied to the data including actions that inspect, validate, qualify, adjust and/or repair data, trace those decisions and actions, and record a summary of the decisions and actions with the data.

**profile** A contoured vertical cross-section of a structure; for example, characteristics of a soil, distribution of temperature in a lake, or the velocity distribution of a stream, or the act of measuring that distribution. (See also 'velocity'.)

**profile available water (PAW)** The amount of water that a soil can hold for plant growth. It is defined as the water held in the soil profile between field capacity and permanent wilting point to a depth of 0.9 m, or to the potential rooting depth (whichever is the lesser). Values are weighted averages over the specified profile section (0–0.9 m) and are expressed in units of mm of water; for example, PAW 200 mm.

**propeller current meter** A current meter whose rotor is a propeller rotating around an axis approximately parallel to flow. Also known as a horizontal axis meter.

**provisional rating** A phase of rating development where the relation is still being determined, and/or the curve lacks the required minimum evidence, and for which collection of additional calibration data remains possible under normal circumstances; that is, notwithstanding opportunity to measure a relatively rare low or high flow extreme that may then initiate review of all ratings for a site.

*Note: A provisional rating may be altered and refined as new calibration data becomes available, thus flows derived from the relation may change after each iteration.*

*Provisional ratings are therefore quality coded QC 200 'of unknown quality', 'not assigned a final quality code'. The code(s) for all or part of the rating range may be revised subsequently when the rating is adopted for the record.*

*Both operational and archive ratings may be provisional until deemed suitably defined (adopted), or until superseded by a subsequent rating shift that prevents collection of more calibration data representing the prior state of control.*

**pulse output** A switch closure output from a meter or gauge that represents a set volume of water.

**QC** An abbreviation for quality code. For example, a quality code of 600 may be referred to as QC 600.

**quality assurance (QA)** Checking to ensure procedures have been followed, so that an acceptable product is likely to be achieved.

**quality codes** A series of defined codes attached to the data that convey information about the quality of the data.

**quality control** Evaluating conformity of the product by testing it, or samples of it, against the specification.

**range of expected flow rates** With respect to water metering, the range from minimum to maximum flow rates that the specific conduit would be expected to convey under normal conditions. The maximum expected flow rate is not limited to the maximum permitted flow rate, but to the capacity of the intake structure/system.

**rainfall** Precipitation that falls as drops greater than 0.5mm in diameter.

**rainfall intensity** The rate of rainfall.

**rating** A relation intended to transform one variable to another, or the process of determining and applying the relation.

**rating change** A major change in the relation between two variables necessitating a change in shape of the rating curve; that is, the new curve does not conform to the shape of an established 'family' or 'type'.

**rating model** The complete set of rating definitions and associated periods of applicability necessary and the rating interpolation and transition method(s) applied to transform a record at a site from one variable to another; for example, stage to discharge or flow to sediment concentration.

**rating (curve) segment** A contiguous portion of a rating curve with consistent shape and/or application over a particular range of flows; for example, can be described by a single equation, or is regarded as covering, for example, only the low flow range.

**rating shift** A minor change in the relation as a result of a relatively small change in stream bed and/or control level, where the overall shape of the rating does not change and the new curve conforms to the established 'family' or 'type'.

**raw data** Data sourced directly from a data logger.

**raw intensity gauge data** The record of rainfall logged from the intensity gauge and sourced directly from the data logger.

**reach** A defined length of river channel.

**receiver canister** The receptacle within a storage rain gauge that holds precipitation and can be removed from the gauge.

**recording agency** The agency responsible for carrying out the monitoring that results in a given data set.

**recording zero** Reduced level of zero gauge height adopted for the station.

**reduced level (RL)** The surveyed elevation above datum of a particular object or location.

**reference point** Objects at a recording station whose elevation above or below an adopted datum is known; for example, an electric plumb bob, external staff gauge, underside of recorder hut, etc.

**reference thermometer** Any thermometer used to perform a field check. This thermometer is validated against the traceable reference thermometer.

**relative soil water content** An estimate of the soil water content relative to the true soil water content. It normally refers to estimates of soil water content from remote sensing but may be used for uncalibrated data where only the relative changes in soil moisture content are of interest.

**relevant regional council** The regional council or unitary authority that granted consent to use or modify a natural resource under the Resource Management Act and Amendments.

**residual** A statistical term meaning the difference between an observed value and the corresponding value of the same variable when predicted by a function.

**resistance temperature detector (RTD)** A temperature sensor that operates on the measurement principle that a material's electrical resistance changes predictably with temperature. A constant current is applied and the voltage drop across the resistor is measured. For RTDs, the resistor is typically formed using pure metals. (See also 'thermistor'.)

**resolution** The smallest change in a measured parameter that a particular instrument can detect and/or represent.

**response time** The time required by an instrument to respond completely to a change in input.

**rotating cup current meter** A current meter whose rotor is composed of a wheel fitted with cups turning on a vertical axis that is perpendicular to flow. Also known as a vertical axis meter.

**roughness coefficient** A factor representing the resistance to flow (largely friction) exerted by irregularities in the surface of the conduit or channel.

**S Map** Web-based soil maps on a site hosted by Landcare Research.  
(<http://smap.landcareresearch.co.nz/home>).

**sacrificial anode** A metal of more 'active' electrochemical potential attached to another metal object, such as a boat, that is consumed in preference to the object, thus inhibiting the object's corrosion.

**salinity** A measure of the concentration of dissolved salts in water.

**sand** Mineral grains that have a diameter ranging between 0.063 mm and 2 mm.

**saturation** The degree or extent to which something is dissolved or absorbed compared with the maximum possible.

**scatterers** Suspended particles that reflect an incident beam of sound (acoustic instruments) or light (for example, back-scattering turbidity sensor). The incident and returned signals are compared for the purposes of measurement.

**SDI-12 (Serial Data Interface at 1200 baud)** An asynchronous ASCII serial communications protocol that was developed for intelligent sensory instruments that typically monitor environmental data.

**seiche** A wave that oscillates in lakes, bays or gulfs from a few minutes to a few hours, typically as a result of atmospheric disturbances; that is, water sloshing to and fro.

**sensitivity** The degree of change in the measured parameter relative to either the background signal or the change in the actual parameter of interest when the measured parameter is a surrogate; for example, a control is sensitive if there is a relatively large change in stage for the corresponding increase in flow.

**sensor** A device that detects or measures a physical property and records, indicates or otherwise responds to it.

**signal to noise ratio (SNR)** A measure of signal strength relative to background noise, defined as the ratio of signal power to noise power.

Mineral grains that have a diameter ranging between 0.004 mm and 0.063 mm.

**simple rating** A relation intended to transform one variable to another, where the predicted variable is dependent only on the other variable.

**site** The geographical location where monitoring takes place. (See also 'station'.)

**site number** A unique numeric station identifier usually derived from a national numbering system such as Catchments of New Zealand or a map grid.

*For example: site number 75207, where 752 = Clutha River, and 01 = Balclutha Station, or modified from a MetService Network Number; for example 941301 for C94131, Tarata.*

**site identifier** A unique label for a site, which may be numeric or alphanumeric.

**SoE (State of Environment) monitoring** A programme of observations intended to provide information about environmental conditions, trends and pressures.

**soil horizon** A distinct layer of soil that has a unique combination of soil attributes, different to the soil immediately above and below.

**soil profile** The combination of soil horizons to a defined depth of interest. In soil survey, this is typically to 1 m depth.

**soil water content** The mass or gravimetric soil water content is the mass of water in a soil relative to the mass of oven-dry soil and has units of kg, kg<sup>-1</sup> or other consistent mass units. Alternatively it can be defined as the volume of water per bulk volume of soil and is expressed as a percentage, or the depth of water per unit depth of soil.

**sonde** A complex instrument that continuously and unattended measures and records in situ a range of physical parameters associated with water quality.

**sounding** The operation of measuring the depth of water from the free surface to the bed.

**spike** Sporadic spurious high or low values in a time series; usually of no more than one or two successive logging intervals.

**spin test** An on-site reliability check of performance of a mechanical current meter to ensure the meter is rotating freely. The meter is held in a sheltered position out of the water, the rotating element set in motion manually (usually by blowing on it), and the duration timed until rotation stops.

**SSC (suspended sediment concentration)** The amount of sediment present in a given volume of water, usually expressed in units of mg/l or the equivalent g/m<sup>3</sup>, but may be reported in parts per million (ppm) by weight, which are equivalent up to concentrations of approximately 12,000 mg/l. (See 'suspended sediment'.)

**stable channel** A waterway contained between banks and bed that change very little over time; that is, the shape of bends and banks do not change and the bed is not subject to scour or deposition.

**stage-area relationship** The relationship between stage height and cross-sectional area of the stream at or near the location where stage is measured.

**stage-discharge rating curve** The curve that results from plotting the relationship between stage height and discharge.

**stage or stage height** The elevation of the free surface of a water body relative to a known fixed datum. (See also 'water level' and 'gauge height'.)

**standard error (of the regression)** A measure of how well a model fits the data; specifically an estimate of the average error associated with predictions made using the model, calculated as the root-mean-square of the residuals.

**standpipe gauge** A type of primary reference precipitation gauge; generally used without a receiver canister.

**station** The collective term for sensors at a particular site.

**stationarity of record** A property of the data whereby variation in the data over time is not a result of how the data were collected. It is achieved when the variability of the parameter being measured is only caused by the natural processes associated with the parameter.

**step-change** A break in the continuity of pattern of a data series, characterised by a sudden shift in value up or down between successive logging intervals, usually associated with some change in recording datum.

**stilling well** A chamber, usually a tower of one or more steel or concrete pipe sections, connected to the water body by a much smaller diameter inlet pipe. The intake dampens the effect of waves and surge in the main flow so there is a still water surface in the chamber on which the float can ride.

**storativity** The volume of water released from storage with respect to the change in water level (head) and surface area of the aquifer. Also known as the storage coefficient.

**suitably qualified hydrologist** A hydrologist with no less than five years of relevant practical experience and trained in the practical aspects of open channel flow measurement.

**supersaturation** When dissolved oxygen of the water body is greater than for atmospheric equilibrium.

**suspended sediment** Mineral sediment grains suspended in moving water by turbulent eddies.

**suspended sediment load** The instantaneous mass rate at which suspended sediment is carried through a river or stream cross-section, usually derived from the product of concentration in  $\text{g}/\text{m}^3$  and flow in  $\text{m}^3/\text{s}$ .

**suspended sediment yield** Suspended sediment load integrated over some specified period of time, usually a year.

**synthetic data (record)** An estimated time series usually derived from relationships and/or calculations and/or limited measured data, typically created to fill a gap in a continuous time series of measured data.

**target characteristic** The variable to be observed and its spatial and temporal resolution.

**telemetry** A system of automated measurement and transmission of data from a network of remotely deployed instruments to a centralised data management facility.

**thalweg** A line joining the lowest points down a length of stream bed or valley, thus defining the deepest channel and therefore marking the natural direction; that is, the profile, of the watercourse.

**thermal response** The time needed by an instrument or device to reach a desired threshold of temperature change; for example, achieving equilibrium with the contact fluid.

**thermistor** A type of resistor, usually ceramic or polymer, whose resistance varies significantly with temperature, more so than in standard resistors. (See also 'resistance temperature detector (RTD)'.)

**time series** A set of values measured sequentially at successive intervals of time (not necessarily regular) and for which the chronological ordering is an essential characteristic of the resulting data.

**time-series manager (TSM)** A database management system optimised for time-series data. Parameter values are stored as a sequence at known intervals of time (not necessarily regular), are indexed by time, and able to be analysed with respect to time.

**tolerance** See 'observation tolerance'.

**totaliser** A device that computes and displays a running tally of some incremental activity.

**traceable reference thermometer** A thermometer that has a unique identifier and a valid certificate documenting its calibration against another traceable reference thermometer.

**transect** One sweep across a water course from one bank to the opposite bank with an ADCP on a moving boat.

**transform** A process within time-series software that enables data to be modified with respect to values or time or both.

**transformation matrix** An array of functions used to convert vectors from one coordinate system to another.

**transmissivity** The rate at which water moves horizontally through the entire thickness of an aquifer, being a measure of the amount of water that may be delivered to a pumped well. It is determined usually by pump test with results expressed as the flow through an aquifer section of unit width under unit hydraulic gradient.

**traverse** A line or path of travel along which survey stations are placed so previously surveyed points may be used as a base for observing subsequent points. A closed traverse either ends (closes) back at its starting point, or begins and ends on stations of known positions. An open traverse does not close on either itself or a station of known position. As such, an open traverse does not provide any means for checking for errors and mistakes so should generally be avoided. Also known as a circuit.

**turbidity** An optical property of a solution; the degree of loss of transparency, i.e. cloudiness, caused by the effect of suspended particulate and colloidal material.

**turbulence** The space-time variability in water velocity caused by three-dimensional eddies.

**uncertainty** An estimate of accuracy. Express as expanded uncertainty, i.e. as an interval about the result, at a stated level of confidence. (See also 'accuracy'.)  
*Note: The level of confidence is the fraction of the distribution of values likely to be obtained from measurement of the quantity that is encompassed by the interval.*

**unstable channel** A waterway contained between banks and bed that change over time; that is, the shape of bends and banks alter and/or the bed is affected by scour and/or deposition of sediments.

**USGS OSW** The Office of Surface Water of the United States Geological Survey.

**UV (ultra-violet) light** Electromagnetic radiation with a wavelength shorter than that of visible light, but longer than X-rays; that is, in the range between 400 nm and 10 nm.

**validation** A check to determine if a device is performing to specification, or a defined procedure is being followed. If validation of a device fails or cannot be performed, calibration is required. (See also 'verification' and 'calibration'.)

*Note: Validation of a device may be similar to calibration except for lack of traceability and/or controlled conditions e.g. using a field calibration device to check a tipping bucket rain gauge, or a Druck hand-held pressure calibrator to check a pressure transducer, or pre-deployment bench-testing of a FlowTracker ADV.*

**velocimeter** An instrument used to measure velocity of a fluid, either submerged or non-contact. Most employ Doppler shift, either of radar, laser or acoustic signals. Other techniques process images to measure particle movement.

**velocity** The speed at which water flows in a given direction; specifically the rate of displacement of a fluid particle from one point to another.

**verification** Routine inspection and testing of the measurement system to determine and document whether it is operating normally, meeting expected accuracy and performing as required. (See also 'validation' and 'calibration'.)

*Note: The measurement system includes the instrumentation, the on-site installation, the means of data collection and the data collected. Testing usually involves comparisons between some form of reference gauge and the sensor and/or data. If results of those comparisons are outside tolerance, validation of components of the measurement system may be necessary to identify the cause of the anomaly. Examples of verification processes are a field site inspection and data processing.*

**verified data** Data that have been processed to the required standard, and peer reviewed.

**vertical** The water column at a location on a cross-section in which depth and velocity are measured when gauging; in order to determine discharge.

**volumetric water content** The volume of water per bulk volume of soil.

**water level** The elevation of the free surface of a water body without reference to a known fixed datum; for example, water level read from a staff, i.e. gauge height, is not stage unless it can be directly related to the known site datum. (See also 'stage' and 'gauge height'.)

**water meter (flow meter)** All the components of the measurement configuration that measures and records the volumetric flow rate of water that passes through a conduit.

**water year** A period during the term of the water resource consent:

- starting on 1 July or, for the consent's first water year, starting on the first day on which the Regulations apply to the consent; and
- ending on the next 30 June or, for the consent's last water year, ending on the last day on which these regulations apply to the consent.

**wet lab certificate** A certificate of conformance from an accredited laboratory undertaking a volumetric analysis of the flow meter against a traceably calibrated reference.

**wetted length** The length of line immersed in the water when sounding depths and/or carrying out a gauging using cable-suspended equipment.

**wetted perimeter** The total length of stream banks and bed in contact with the water that forms the non-free surface boundary of a cross-section.

**WGS84 (World Geodetic System 1984)** The datum used by the Global Positioning System (GPS), defined and maintained by the United States National Geospatial-Intelligence Agency (NGA). For most practical purposes it is coincident with the New Zealand Geodetic Datum 2000 (NZGD2000), which is the official geodetic datum for New Zealand ([www.linz.govt.nz](http://www.linz.govt.nz)).

**WMO (World Meteorological Organization)** The global body that advises on the state and behaviour of Earth's climate and atmosphere.

*Note: The WMO promotes international cooperation and knowledge sharing. Their published information includes standards and best-practice guidance for observation systems and networks, technical advice and resources for learning.*

**working file** An electronic file containing a copy of a period of data collected from a site. Data in the working file is then processed, i.e. compared and possibly edited and/or adjusted to reference data, prior to archiving.

**WS16** A standard form developed by the Water and Soil Division of the Department of Scientific and Industrial Research (DSIR) used to record station history metadata. Earlier versions of this form were known as SCC16's or Form 16's.

## Symbols

$\alpha$	Coriolis coefficient, a factor in velocity head formula, estimated from conveyance and area
$A$	cross-section area
$\bar{A}$	mean cross-section area
$A_1$	upstream cross-section area
$A_2$	downstream cross-section area
$A_c$	contracted cross-section area
$A_{mb}$	area of section with moving bed
$A_p$	area of intake pipe
$A_w$	area of stilling well
$b$	cross-section width
$b_n$	cross-section width from initial point to vertical $n$
$c$	conversion factor for converting ppm to mg/l
$C$	Chezy's channel roughness coefficient
$C_D$	discharge coefficient (Matthai (1967))
$C_d$	coefficient of discharge to correct for head loss and contraction
$C_s$	equilibrium (saturation) dissolved oxygen
$\Delta$	a difference
$d$	water depth (sounded), depth of water column
$d_n$	water depth at vertical $n$ (sounded)
$D$	depth (in general terms)
$D_p$	diameter of intake pipe
$e$	effective gauge height of zero flow, stage height at zero flow, an offset
$F_r$	Froude number
$g$	gravitational constant, acceleration due to gravity = $9.81 \text{ m/s}^2$
$G_f$	gauging frequency
$h_{alt}$	altitude
$h$	stage, stage height, gauge height (of the water surface)
$\bar{h}$	mean gauge height
$h-e$	effective stage
$H$	head of water, measured head (in general terms)
$H_e$	effective head
$H_u$	upstream measured (gauge) head
$H_v$	velocity head
$\Delta H$	head loss, change in elevation of water surface between upstream and downstream cross-sections
$\Delta H_v$	change in velocity head between upstream and downstream cross-section

<b>K</b>	conveyance
<b>k</b>	a constant, or factor
<b>k<sub>h</sub></b>	correction applied to compensate for effects of viscosity and surface tension
<b>L</b>	length of reach
<b>L<sub>p</sub></b>	intake pipe length
<b>m</b>	exponent in the general discharge equation
<b>n</b>	Manning's channel roughness coefficient
<b>N</b>	sample size
<b>ρ<sub>s</sub></b>	density of sediment (typically assumed = 2.65 g/cm <sup>3</sup> )
<b>ρ<sub>w</sub></b>	density of water (typically assumed = 1.00 g/cm <sup>3</sup> )
<b>p</b>	a probability
<b>P</b>	wetted perimeter
<b>P<sub>atm</sub></b>	barometric pressure, atmospheric pressure
<b>P<sub>w</sub></b>	pressure head (of water)
<b>π</b>	pi, a constant, being the ratio of circumference to diameter of a circle
<b>Q</b>	discharge, total discharge
<b>Q<sub>corrected</sub></b>	discharge adjusted for moving bed (ADCP method)
<b>Q<sub>g</sub></b>	gauged discharge
<b>Q<sub>measured</sub></b>	discharge as measured (ADCP method)
<b>Q<sub>n</sub></b>	discharge of cross-section segment bounded by verticals <i>n</i> and <i>n+1</i>
<b>Q<sub>o</sub></b>	discharge as a constant
<b>Q<sub>r</sub></b>	rated flow; that is, flow predicted from a stage series by application of a rating curve
<b>q<sub>n</sub></b>	an instance of discharge at time interval <i>n</i>
<b>r</b>	radius
<b>r<sup>2</sup></b>	regression coefficient
<b>r<sub>m</sub></b>	mean time between detectable rating changes
<b>R</b>	hydraulic radius (= A/P)
<b>S</b>	salinity
<b>S</b>	water surface slope
<b>S<sub>e</sub></b>	standard error of the estimate
<b>S<sub>f</sub></b>	friction slope (approximates <i>S</i> in uniform reaches under uniform flow)
<b>S<sub>o</sub></b>	water surface slope (corresponding to steady state discharge)
<b>t</b>	time, elapsed time
<b>t<sub>c</sub></b>	Student's 't' correction
<b>t<sub>n</sub></b>	duration of time in interval <i>n</i>
<b>T</b>	temperature
<b>θ</b>	angle, notch angle (in degrees)
<b>U</b>	uncertainty

<b>v</b>	velocity
<b>v<sub>0.2</sub></b>	point velocity at 20% of water depth from surface; etc. for other percentiles
<b>v<sub>bed</sub></b>	velocity near stream bed
<b>v<sub>boat</sub></b>	velocity of moving ADCP boat
<b>v<sub>c</sub></b>	velocity at critical flow
<b>v<sub>mb</sub></b>	average moving bed velocity
<b>v<sub>n</sub></b>	mean velocity at vertical <i>n</i>
<b>v<sub>surface</sub></b>	velocity near water surface
<b>v<sub>w</sub></b>	mean water velocity (ADCP methods)
$\bar{v}$	mean velocity
$\bar{v}_1$	mean velocity in the upstream cross-section
<b>W</b>	width (in general terms)
<b>x<sub>m</sub></b>	minimum detectable value of <i>x</i>
<b>x<sub>s</sub></b>	characteristic size of <i>x</i>
<b>y</b>	mean depth
<b>y<sub>c</sub></b>	critical depth
<b>z</b>	stage change
<b>Z</b>	vertical height or elevation (in general terms)

## Unit Abbreviations

°	degrees of a plane angle (0 to 360)
°C	degrees Celsius
%	percent (parts per hundred)
% Sat	percent saturation
‰	parts per thousand (or <b>ppt</b> ) (1000 ppm = 1 ppt)
cm	centimetre (100 cm = 1 m)
cm <sup>2</sup>	square centimetres (10000 cm <sup>2</sup> = 1 m <sup>2</sup> )
deg	degrees of a plane angle (0 to 360)
FBU	Formazin Backscatter Units
FNU	Formazin Nephelometric Unit
g/m <sup>3</sup>	grams per cubic metre or g m <sup>-3</sup> (1 g/m <sup>3</sup> = 1 mg/l)
hPa	hectopascal
hrs	hours
Hz	hertz
K	Kelvin <i>Note: There is no 'degree' symbol when using Kelvin.</i>
kg	kilogram
kHz	kilohertz
km <sup>2</sup>	square kilometres
kN	kilonewtons
kPa	kilopascals
l or L	litres (1000 l = 1 m <sup>3</sup> )
l/s or L/s	litres per second or l s <sup>-1</sup> (1000 l/s = 1 m <sup>3</sup> /s)
lbs	pounds (mass)
ln	natural logarithm to base <i>e</i>
m	metre
m/s	metres per second or m s <sup>-1</sup>
m/s <sup>2</sup>	metres per second squared or m s <sup>-2</sup>
m <sup>2</sup>	square metres

<b>m<sup>3</sup></b>	cubic metres
<b>m<sup>3</sup>/h</b>	cubic metres per hour or m <sup>3</sup> h <sup>-1</sup>
<b>m<sup>3</sup>/s</b>	cubic metres per second (cumecs) or m <sup>3</sup> s <sup>-1</sup>
<b>mA</b>	milliamps
<b>mbar</b>	millibar
<b>mg/l or mg/L</b>	milligrams per litre or mg l <sup>-1</sup> (1 mg/l = 1 g/m <sup>3</sup> )
<b>mH<sub>2</sub>O</b>	metres head of water
<b>min</b>	minute(s)
<b>ml or mL</b>	millilitre (1000 ml = 1 l; 1000 000 ml = 1 m <sup>3</sup> )
<b>ML/d</b>	megalitres per day (1 ML = 1000 m <sup>3</sup> ; 1 ML = 1000 000 l)
<b>ml/s or mL/s</b>	millilitres per second (1000 ml/s = 1 l/s)
<b>mm</b>	millimetres (10 mm = 1 cm; 1000 mm = 1 m)
<b>mm/hr</b>	millimetres per hour or mm h <sup>-1</sup>
<b>mm/s</b>	millimetres per second or mm s <sup>-1</sup>
<b>nm</b>	nanometre (1000 000 nm = 1 mm; 1000 000 000 nm = 1 m)
<b>NTU</b>	Nephelometric Turbidity Units
<b>ppm</b>	parts per million (1 ppm = 0.0001%; 1% = 10,000 ppm)
<b>ppt</b>	parts per thousand (or ‰) (1000 ppm = 1 ppt)
<b>s</b>	second(s)
<b>µS/m</b>	microSiemens per metre or µS m <sup>-1</sup>

## Annex A – Bibliography

In preparing this Glossary, the following publications have been given due consideration.

Australian Government Bureau of Meteorology. (2013, August). Part 0: Glossary. In *Water information standards business forum; National industry guidelines for hydrometric monitoring* (WISBF GL 100.00-2013). Melbourne, Australia: Author.

Goulburn-Murray Water. (2010). *Groundwater terms and definitions* (Document No. 2977263). Tatura, Victoria, Australia: Author.

International Organization for Standardization (ISO). (2010). ISO 1100-2: 2010 (E). In *Hydrometry – Measurement of liquid flow in open channels – Part 2: Determination of the stage-discharge relationship*. Geneva, Switzerland: Author.

Kennedy, E. J. (1984). Discharge ratings at gaging stations. In *Techniques of Water-Resource Investigations of the United States Geological Survey – Book 3: Applications of Hydraulics* (Chapter A10; 59 pp.). Reston, VA: US Geological Survey. Retrieved from [http://pubs.usgs.gov/twri/twri3-a10/pdf/TWRI\\_3-A10.pdf](http://pubs.usgs.gov/twri/twri3-a10/pdf/TWRI_3-A10.pdf)

Matthai, H. F. (1967). Measurement of peak discharge at width contractions by indirect methods. In *Techniques of Water-Resource Investigations of the United States Geological Survey – Book 3: Applications of Hydraulics* (Chapter A4; 44 pp.). Reston, VA: US Geological Survey. Retrieved from [http://pubs.usgs.gov/twri/twri3-a4/pdf/twri\\_3-A4\\_a.pdf](http://pubs.usgs.gov/twri/twri3-a4/pdf/twri_3-A4_a.pdf)

National Environmental Monitoring Standards (NEMS). (Various dates). *National Environmental Monitoring Standards* (various, as listed in the preamble to this document). Wellington, New Zealand: Ministry for the Environment. Available from <http://www.lawa.org.nz>

Plummer, N., Allsopp, T., & Lopez, J. A. (2003). *Guidelines on climate observation networks and systems* (WMO/TD No. 1185). Geneva, Switzerland: World Meteorological Organization (WMO).

RD Instruments. (1998). *ADCP coordinate transformation*. San Diego, CA: Author.

The following web resources have been consulted to help construct the definitions:

- Wikipedia and associated services
- online dictionaries, and
- various online tutorials and education resources published by recognised institutions, affiliations and societies available in the .edu and .org domains.