

Primer on quality factor codes for LTRMP Water Quality data

General description

The database for the LTRMP water quality component data contains information on the quality of the data. For in situ measurements and results of lab analysis, the quality factor codes are contained in the *parameter QF* fields (e.g., TEMPERATURE QF). For the data collected *in situ*, the *parameter QF* field contains a one character alpha or numeric code (Table 1). For the data produced by lab analysis, “chemical QA/QC flags” are contained in the *parameter QF* field. The QA/QC flags for the laboratory data are numeric codes that allow for multiple errors types to be combined into a single numeric code (Table 2). These codes include both fatal and nonfatal errors. The constituent data is not saved in the final database if the code is fatal, but the flag remains to explain the missing data. For the constituents that are analyzed in the laboratory, there is a second quality factor codes intended primarily for internal use only. This additional code is related to the quality of the sample collected. Because the collected sample is used for multiple constituents, a quality factor code for the sample, not the constituent, is in the database. These codes are found in *(un)filtered_sample_type* fields (e.g., FILTERED SS), and use a subset of the codes in Table 1. In Table 3, all the parameters that have quality factors are listed.

Hints on the use of quality factors in the LTRMP database:

1. For constituents determined in the laboratory, you may want to look both quality factor codes (QF and the [un]filtered fields). If you want to look at both codes, be sure to download the [un] filtered field if you intend to query based on these codes (only the QF field is automatically downloaded with the constituent data).
2. All chemical data with fatal error flags have been removed from the database, for their respective constituents. The code remains in the database to indicate why the data are missing.
3. The names for the laboratory sample quality factors fields (e.g. dissolved inorganic nitrogen sample) can be confusing. The names use a prefix of “filtered” or “unfiltered” followed by an abbreviation of the sample name. As stated above, these samples are used for multiple constituents. To clarify which field should be used for each constituent, Table 3 can be used as a cross reference. For Scanlog users, also note that sample names may vary from “data sheet” to the database (e.g., the *SRP* sample on data sheet is the *FILTERED CL* field in the database).
4. The field quality factor codes are not separated into non-fatal and fatal errors, thus no data has been removed from the database based on these codes. All fatal type errors likely resulted in omission of data entry in the field. Many codes are used in that way to explain missing data.

Table 1. Description of water quality data sheet quality factor codes used in the LTRMP for *in situ* parameters (modified from Table 13 in the LTMRP Water Quality Procedures manual)

Quality factor code	Description
Blank	No problems and no exceptional circumstances.
0	Equipment inoperative. Equipment will not function or function is so intermittent or erratic as to render data unusable. Conditions that prohibit operation are covered under quality factor (QF) code of 5.
1	Equipment questionable. Measurement is reasonable and probably correct, but intermittent, erratic, or erroneous instrument behavior was noted immediately before or after the measurement.
2	Reading off-scale (too high). Actual value was too high for the instrument to measure (not an instrument error). The instrument's maximum value is recorded. A negative sign is not used, but a QF code of 2 must be recorded.
3	Reading off-scale (too low). Actual value was too low for the instrument to measure (below detection or negative; instrument function is normal). The lower limit of the instrument is recorded. A negative sign is not used on the data sheet. A QF code of 3 must be recorded.
4	Sample returned to laboratory for processing. This indicates that because of instrument or field conditions, an <i>in situ</i> measurement was not taken, but the sample was returned to laboratory for measurement or processing. This QF code applies only to samples that are normally processed or measured in the field. For turbidity readings, this code is not appropriate if the determination is made within 24 hours of sample collection.
5	Sample unusable or unobtainable. This code provides explanation for missing data at a site. Additional site comments are required. If a sampling site is inaccessible so that no data can be obtained, this is indicated by absence of data rows (data sheet NROWS field is 0) and an appropriate site comment.
6	Sample not representative of ambient conditions. The best sample that could be obtained may not reflect general conditions at the site. The quality of the sample is questionable, but is probably OK. Use QF code of 7 if the problem is contamination. If the sample is obviously unsuitable, then another sample should be taken or QF code of 5 should be used if a sample cannot be obtained. If this condition applies to the site in general, an appropriate site summary code should also be recorded
7	Sample possibly contaminated. It is likely, but not certain, that foreign material has entered the sample bottle. Additional explanation in the site comment is recommended. This QF code is generally used only for samples that are returned to the laboratory for analysis.
8	Sample diluted for analysis (i.e., for turbidity measurement). This QF code is used exclusively for turbidity measurements. The dilution volumes and resulting factors are recorded in the sample comments. This QF code usually applies only to the calculated turbidity value that results from dilution; it is not used to flag the original raw nephelometric turbidity unit (raw NTU) instrument reading from which the diluted reading was derived, unless readings are above 1,000 NTU, and dilution is required to obtain a reading.
9	Not used.
A	Nonstandard (alternative) method used for collection or processing of sample or measurement. Some innovative technique was needed to obtain a suitable sample or measurement. Additional explanation in site comment is required.
C	Category measurement is being used (i.e., for current velocity measurement).
D	Instrument calibration is out of limits.
F	Operator error resulted in missed or unusable value.
H	Sample holding time exceeded.
X	Optional measurement not performed, or measurement is not applicable.

Table 2. LTRMP Water quality chemical QA/QC flags

The flagging system is intended to be EASY to separate the data into quality grades, e.g., Good, Questionable, or Bad.

The codes shown in the table below (0, A-P) can be assigned in any combination. ALL of the 16 flags can be used if needed. In the Oracle database, the numeric value of all the codes associated with a single measurement are converted to their numeric value and added together (i.e., bits 0-16 are set) to produce a single numeric flag value that ranges from 0 to 65,536 (64 K). Note that all the nonfatal flags in combination sum to 255 and the first fatal flag has a numeric value of 256. Thus, a flag value > 255 indicates a fatal problem with the measurement and a missing (null) value is transmitted from the lab to the Oracle database along with the flag value.

Table below lists the codes assigned in the lab. The number in parenthesis following each code is its bit (numeric) equivalent.

Sample perfect flag = (0 Zero)	Concentration below detection = (1 one)	Data questionable flag = (2-255; first byte)	Data useless or lost flag = (256 - 65536; 2nd byte)
Sample Perfect (0; Zero)	(1) Sample conc. is below detection limit*	NONFATAL SHIPMENT ERRORS	FATAL SHIPMENT ERRORS
		(2) Sample delayed in shipment	(256) Preservation error--sample ruined
		(4) Sample holding conditions (temperature, light) violated	(512) Labeling error--sample ID uncertain or unidentifiable or sample id is inconsistent with analytical results (i.e., blank values on nonblank sample or nonblank values on blank sample
		(8) Sample condition was marginal or questionable when received--sample analyzed anyway	(1024) Sample spilled, leaked, damaged, contaminated in shipment--unusable
			(2048) Sample data error--volume or weight incorrect/unusable
		NONFATAL LAB ERRORS	FATAL LAB ERRORS
		(16) Deviation from standard method--result probably OK.	(4096) Sample ruined/contaminated during analysis
		(32) Holding time or holding conditions violated	(8192) Sample lost in lab--not analyzed
		(64) Analysis uncertain--result unreliable or suspicious.	(16384) Not used
		(128) Analysis repeated	(32768) Result inconsistent with other parameter measurements--if erroneous member of inconsistent set cannot be identified, all related samples are marked with this fatal flag

* Concentrations < the minimum detection limit (MDL) are also reported as negative MDL (e.g., -0.005).

Table 3. Quality factor codes used for LTRMP water quality measures.

Field in data browser	Value codes (see Table 1 or Table 2 for more details)
WAVE HEIGHT QF Z MAX QF SECCHI QF Z ICE QF Z S ICE QF % ICE QF Z SNOW QF % SNOW QF Z QF TEMP QF DO QF PH QF TURB QF COND QF VEL QF DIR QF Instrument Reading QF	Blank = No problems 0 = Equipment inoperative 1 = Equipment questionable 2 = Reading Off-Scale Hi 3 = Reading Off-Scale Lo 4 = Sample Returned to Lab 5 = Sample Unusable or Unobtainable 6 = Sample Unrepresentative 7 = Sample Possibly Contaminated 8 = Sample Diluted A = Non-Standard Method C = Category Measurement D = Cal Off Excessive H = Hold Time Exceeded X = Parameter Optional
FILTERED NOX (NOX and NHX) FILTERED CL (SRP, Cl and Si) FILTERED SS FILTERED CHS FILTERED CHF UNFILTERED PYT UNFILTERED TNP (TN and TP) (historical) FILTERED SNP FILTERED MET	Blank = No sample 1 = Sample OK 4 = Sample Returned to Lab 5 = Sample Unusable or Unobtainable 6 = Sample unrepresentative 7 = Sample possibly contaminated 8 = Sample Diluted A = Non-Standard Method H = Hold Time Exceeded X = Parameter Optional
TOTAL PHOSPHORUS QF SOLUBLE REACTIVE PHOSPHORUS QF TOTAL NITROGEN QF NITRATE NITRITE QF AMMONIUM N QF SUSPENDED SOLIDS QF VOLATILE SUSPENDED SOLIDS QF ORGANIC MATTER QF CHLOROPHYLL FL1 QF CHLOROPHYLL A QF SILICA QF (historical) PHAEOPHYTIN QF DISSOLVED CALCIUM QF DISSOLVED IRON QF DISSOLVED MANGENESE QF DISSOLVED POTASSIUM QF CHLORIDE QF TOTAL SOLUBLE N QF TOTAL SOLUBLE PHOSPHORUS QF CHLOROPHYLL FLI1 QF SODIUM QF MAGNESIUM QF SULFATE QF	Blank = No Data or sample quality unknown 0 = Good. Sample OK; No known problems 1 = Below detection; report as negative (-) detection limit, e.g. - 0.02 2 to 255 = Questionable value > 255 = Bad; Data useless or lost

Table 3. (continued)

Field in data browser	Value codes (see Table 1 or Table 2 for more details)
<p>(historical) SUMMARY CODE (replaced by QF codes in mid-1993)</p>	<p>Circumstances surrounding the decision to accept or reject a site sample. Valid codes are as follows: 1 = One or more of the data values for this site sample are suspected or known to be in error. 2 = Possible equipment malfunction. 3 = Data potentially non-representative of that habitat type due to local short-term conditions. 4 = Post-entry data analysis suggests that this observation may be atypical, but no reporting or transcription errors have been identified. 5 = No apparent problems.</p>
<p>(historical) REPORT CODE (replaced by QF codes in mid-1993)</p>	<p>Numeric code documenting the overall quality of a specific sample as described below: 1 = Gear failure; site may be re-sampled within time period 2 = Site cannot be sampled (i.e., site is dry or inaccessible) 3 = Sample collected under unusual environmental conditions 4 = Weighing equipment may be in error due to wind and waves 5 = Normally completed sample; all LTRMP procedures followed 6 = Non-critical gear modification (e.g., fyke net lead shortened) 7 = Pseudo-shoreline used for shoreline gear 8 = Minor gear damage or noncritical gear failure</p>