Marine and Freshwater Research Laboratory Environmental Science
Murdoch University
Murdoch University
90 South Street, Murdoch, Western Australia 6150
Telephone: (08) 9360 6907 Web: www.murdoch.edu.au/mafrl

Measurement Uncertainty Tables

Contents

Introduction

The Marine and Freshwater Research Laboratory (MAFRL) has developed procedures for the estimation of uncertainty of measurement for all inhouse test methods in use. The major contributing sources of uncertainty are identified in each test method and grouped together to establish the measurement uncertainty.

The uncertainty estimates are calculated from information readily available from routine quality control procedures, instrument calibration data, validation data, interlaboratory comparisons and professional judgement. The degree of rigour required for determining uncertainty estimates takes into account all sources of uncertainty to provide a realistic estimate. The major sources contributing to uncertainty will vary for any given method.

The measurement uncertainty is reported as a combined standard uncertainty (u) and after multiplying by a suitable coverage factor (k) as an expanded uncertainty (U) which represents a certain probability range (95% for k=2). Combining the uncertainties for a given level of analyte produces a combined standard uncertainty at that level. Significant quantities of validation data are required at a selection of analyte levels to provide a table of uncertainty at different concentrations.

As the signal for a measurement decreases, relative to the noise of an instrument, at levels approaching the limit of detection, the relative uncertainty (percentage RSD) increases. At levels nearing the limit of detection this measure is equal to 100% and only at this point does the measured value begin to have any credibility. At levels nearing the limit of quantitation this measure can be in the range of 30-50% with a 95% confidence level.

The measurement uncertainty at different concentrations for analytes are presented as a percentage of the concentration in following tables. The uncertainty of a measurement is calculated by multiplying the percentage by the concentration. The result can then be expressed concentration ± uncertainty. For example a MS001 Cobalt concentration of 2.0 ug.L^{-1} from the table has a 20% uncertainty the result can be expressed as 2.0 ± 0.5 ug.L^{-1}.

For all other methods not listed please contact the laboratory for further details on (08) 9360 6907.

Method MS001: Saline method for determination of elements in natural waters by ICP-MS

ug/L	Be	Al	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	As	Se	Mo	Ag	Cd	Sn	Sb	Ba	La	Tl	Pb	Bi	U
0.05								31%																	
0.06								30%																	
0.07								29%																	
0.08								29%																	
0.1								28%								21%	40%					24%	34%	32%	
0.12								27%								20%	37%					23%	32%	31%	
0.14								26%								19%	35%					22%	30%	30%	
0.16								26%								19%	34%					22%	29%	29%	
0.18								25%								18%	32%					21%	28%	28%	
0.2					26%			25%		28%						18%	31%				43%	21%	27%	27%	17%
0.3				21%	22%			24%	24%	26%						16%	28%				41%	19%	25%	25%	16%
0.4				21%	20%			23%	22%	24%						15%	26%				39%	18%	23%	24%	16%
0.5				20%	19%	21%		22%	21%	23%			20%	33%	19%	15%	24%		28%	22%	39%	18%	22%	23%	15%
0.6				20%	18%	20%		22%	20%	22%			19%	31%	18%	14%	24%		27%	21%	38%	17%	21%	23%	15%
0.7				20%	17%	19%		22%	19%	22%			18%	30%	18%	14%	23%		26%	21%	38%	17%	21%	22%	15%
0.8				20%	16%	19%		22%	18%	21%			17%	28%	18%	14%	22%		26%	20%	37%	16%	20%	22%	15%
0.9				20%	16%	19%		21%	18%	21%			17%	27%	18%	13%	22%		25%	20%	37%	16%	20%	21%	15%
1	53%		43%	19%	15%	18%	23%	21%	17%	20%	28%	24%	16%	27%	18%	13%	21%	29%	25%	20%	37%	16%	20%	21%	15%
2	36%		36%	19%	14%	17%	20%	20%	15%	19%	24%	20%	14%	22%	17%	12%	20%	23%	23%	18%	35%	14%	18%	20%	14%
3	31%		34%	18%	13%	16%	19%	20%	14%	18%	23%	19%	14%	20%	16%	12%	19%	21%	22%	17%	35%	14%	17%	19%	14%
5	28%	33%	32%	18%	12%	15%	17%	20%	13%	17%	22%	18%	13%	18%	16%	11%	18%	19%	21%	17%	34%	13%	17%	19%	13%
7	26%	29%	31%	18%	12%	15%	17%	20%	13%	17%	22%	17%	12%	18%	16%	11%	18%	17%	20%	16%	34%	13%	17%	18%	13%
10	26%	25%	31%	18%	12%	14%	16%	19%	13%	17%	21%	17%	12%	17%	16%	11%	18%	16%	20%	16%	34%	12%	16%	18%	13%
12	25%	23%	30%	18%	12%	14%	16%	19%	13%	17%	21%	17%	12%	16%	16%	11%	18%	16%	20%	16%	34%	12%	16%	18%	13%
15	25%	22%	30%	18%	12%	14%	16%	19%	12%	17%	21%	17%	12%	16%	16%	11%	18%	16%	20%	16%	33%	12%	16%	18%	13%
20	25%	20%	30%	17%	12%	14%	16%	19%	12%	17%	21%	17%	11%	16%	15%	11%	18%	15%	20%	16%	33%	12%	16%	18%	13%
25	25%	20%	30%	17%	12%	14%	16%	19%	12%	16%	21%	17%	11%	15%	15%	11%	17%	15%	19%	16%	33%	12%	16%	18%	13%
30	25%	19%	30%	17%	11%	14%	16%	19%	12%	16%	21%	17%	11%	15%	15%	11%	17%	15%	19%	16%	33%	11%	16%	18%	13%
40	25%	18%	30%	17%	11%	13%	15%	19%	12%	16%	21%	17%	11%	15%	15%	11%	17%	14%	19%	15%	33%	11%	16%	18%	13%
50	25%	18%	29%	17%	11%	13%	15%	19%	12%	16%	21%	16%	11%	15%	15%	11%	17%	14%	19%	15%	33%	11%	16%	18%	13%
100	25%	18%	29%	17%	11%	13%	15%	19%	12%	16%	21%	16%	11%	15%	15%	11%	17%	14%	19%	15%	33%	11%	16%	18%	13%
200	25%	17%	29%	17%	11%	13%	15%	19%	12%	16%	21%	16%	11%	14%	15%	11%	17%	13%	19%	15%	33%	11%	16%	18%	12%
500	25%	17%	29%	17%	11%	13%	15%	19%	12%	16%	20%	16%	11%	14%	15%	10%	17%	13%	19%	15%	33%	11%	16%	18%	12%
1000	25%	17%	29%	17%	11%	13%	15%	19%	12%	16%	20%	16%	11%	14%	15%	10%	17%	13%	19%	15%	33%	11%	16%	18%	12%

Method MS002: Determination of aqua regia extractable heavy metals and metalloids in soil and sediment by ICP-MS

mg/kg	9Be	27Al	47Ti	51V	52Cr	55Mn	56Fe	59Co	60Ni	63Cu	65Cu	66Zn	75As	78Se	95Mo	98Mo	107Ag	111Cd	114Cd	118Sn	121Sb	138Ba	205Tl	208Pb	209Bi	238U
0.02	<	<	<	<	<	<	<	30%	<	<	<	<	<	<	<	<	40%	<	<	<	<	<	<	<	47%	<
0.03	<	<	<	<	<	<	<	28%	<	<	<	<	<	<	<	<	37%	<	<	<	<	<	<	<	41%	<
0.04	<	<	<	<	<	<	<	27%	<	<	<	<	<	<	<	<	36%	<	<	<	<	<	<	<	37%	<
0.05	<	<	<	<	<	<	<	26%	<	<	<	<	<	<	<	<	35%	<	<	<	<	<	<	<	35%	<
0.07	<	<	<	<	<	<	<	25%	<	<	<	<	<	<	<	<	34%	<	<	<	<	<	<	<	32%	<
0.1	<	<	<	28%	<	<	<	24%	<	<	<	<	26%	49%	<	<	33%	35%	26%	<	<	<	27%	31%	29%	25%
0.2	<	<	<	24%	24%	28%	<	23%	26%	26%	24%	<	24%	42%	<	<	32%	31%	24%	<	43%	33%	25%	26%	26%	23%
0.3	<	<	<	23%	23%	26%	<	22%	25%	24%	23%	<	23%	39%	<	<	32%	29%	23%	<	42%	29%	24%	24%	24%	22%
0.4	<	<	<	22%	22%	25%	<	22%	24%	23%	23%	<	22%	38%	<	<	32%	28%	22%	<	42%	27%	23%	23%	24%	22%
0.5	74%	<	61%	22%	22%	25%	<	22%	23%	23%	22%	<	22%	37%	25%	24%	32%	27%	22%	26%	42%	26%	23%	23%	23%	22%
0.7	62%	<	52%	22%	21%	24%	<	21%	23%	22%	22%	<	21%	35%	24%	23%	32%	26%	22%	25%	41%	24%	23%	22%	23%	21%
1	52%	<	45%	21%	21%	23%	<	21%	22%	22%	22%	26%	21%	34%	24%	23%	31%	26%	22%	24%	41%	23%	22%	21%	22%	21%
2	39%	<	34%	21%	21%	22%	22%	21%	22%	21%	21%	23%	21%	33%	23%	22%	31%	25%	21%	23%	41%	22%	22%	21%	22%	21%
3	34%	<	30%	20%	21%	21%	21%	20%	21%	21%	21%	22%	21%	33%	23%	22%	31%	24%	21%	23%	41%	21%	22%	21%	21%	20%
4	31%	<	28%	20%	21%	21%	21%	20%	21%	21%	21%	22%	20%	32%	23%	22%	31%	24%	21%	23%	41%	21%	22%	20%	21%	20%
5	30%	35%	26%	20%	20%	21%	21%	20%	21%	21%	21%	22%	20%	32%	22%	22%	31%	24%	21%	23%	41%	21%	22%	20%	21%	20%
7	28%	31%	25%	20%	20%	21%	21%	20%	21%	21%	21%	21%	20%	32%	22%	22%	31%	24%	21%	22%	41%	21%	22%	20%	21%	20%
10	27%	28%	24%	20%	20%	21%	20%	20%	21%	21%	21%	21%	20%	32%	22%	22%	31%	24%	21%	22%	41%	20%	22%	20%	21%	20%
20	25%	24%	22%	20%	20%	20%	20%	20%	21%	21%	21%	21%	20%	32%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
30	25%	23%	22%	20%	20%	20%	20%	20%	21%	20%	21%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
40	24%	22%	21%	20%	20%	20%	20%	20%	21%	20%	21%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
50	24%	22%	21%	20%	20%	20%	20%	20%	21%	20%	21%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
70	24%	21%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
100	24%	21%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
200	24%	20%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
300	24%	20%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
400	24%	20%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
500	24%	20%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
700	24%	20%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
1000	24%	20%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
2000	24%	20%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
5000	24%	20%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
10000	24%	20%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%
50000	24%	20%	21%	20%	20%	20%	20%	20%	21%	20%	20%	21%	20%	31%	22%	22%	31%	23%	21%	22%	41%	20%	22%	20%	21%	20%

Note: expressed on a dry weight basis

Method ICP001: Determination of elements in waters and other appropriate solutions by ICP-AES

ug/L	0.2	0.4	0.6	0.8	1	2	4	5	6	8	10	12	14	16	18	22	24	26	28	30	33	37	40	45	50	55	60	70	80	100	200	500	1000	2000	5000	10000
Ag	<	<	<	<	<	<	<	<	<	<	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Al	<	<	<	<	<	<	<	<	<	<	35%	31%	28%	26%	24%	22%	21%	20%	20%	19%	18%	18%	17%	17%	16%	16%	16%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%
As	<	<	<	<	<	<	<	<	<	<	46%	40%	35%	32%	29%	25%	24%	23%	22%	21%	20%	19%	18%	17%	17%	16%	16%	16%	15%	15%	14%	14%	14%	14%	14%	14%	14%
B	<	<	<	<	<	31%	21%	19%	18%	17%	16%	15%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Ba	32%	23%	19%	18%	17%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Be	18%	16%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Bi	<	<	<	<	<	<	<	<	<	<	<	<	<	<	19%	17%	17%	17%	16%	16%	16%	15%	15%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Ca	<	<	<	<	<	<	<	<	<	<	48%	40%	35%	31%	28%	24%	22%	21%	20%	19%	18%	18%	17%	16%	16%	16%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%
Cd	<	<	43%	35%	29%	20%	16%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Co	<	<	<	<	<	23%	17%	16%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Cr	<	<	<	<	31%	21%	16%	16%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Cu	<	<	<	<	36%	22%	17%	16%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Fe	<	<	<	<	39%	25%	19%	17%	17%	16%	15%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
K	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	30%	29%	28%	27%	26%	25%	23%	23%	22%	21%	20%	19%	19%	18%	17%	15%	14%	14%	14%	14%	14%	14%
Li	<	<	<	<	<	<	<	<	<	<	20%	18%	17%	17%	16%	16%	15%	15%	15%	15%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Mg	<	<	<	<	<	<	<	<	<	<	<	<	<	<	41%	32%	28%	26%	24%	22%	21%	19%	18%	17%	16%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Mn	35%	21%	17%	16%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Mo	<	<	<	<	<	<	19%	18%	17%	16%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Na	<	<	<	<	<	<	<	<	<	<	<	<	<	<	41%	32%	28%	26%	24%	22%	21%	19%	18%	17%	16%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Ni	<	<	<	<	<	<	30%	26%	23%	20%	18%	17%	16%	16%	15%	15%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
P	<	<	<	<	<	<	<	<	<	<	<	<	<	<	29%	26%	25%	24%	23%	22%	21%	20%	20%	19%	18%	18%	17%	17%	16%	16%	14%	14%	14%	14%	14%	14%	14%
Pb	<	<	<	<	<	<	<	<	<	<	25%	22%	21%	20%	19%	17%	17%	17%	16%	16%	16%	16%	15%	15%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Sb	<	<	<	<	<	<	<	<	<	<	<	<	<	<	21%	19%	18%	18%	17%	17%	16%	16%	16%	15%	15%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Se	<	<	<	<	<	<	<	<	<	<	<	<	<	<	35%	29%	28%	26%	25%	24%	22%	21%	20%	19%	18%	17%	17%	16%	16%	15%	14%	14%	14%	14%	14%	14%	14%
Sn	<	<	<	<	<	<	<	<	<	<	<	<	<	<	21%	19%	18%	18%	17%	17%	17%	16%	16%	16%	15%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Sr	<	<	<	<	51%	30%	20%	19%	17%	16%	15%	15%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Ti	<	<	<	<	25%	18%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Tl	<	<	<	<	<	<	<	<	<	<	32%	28%	25%	24%	22%	20%	19%	19%	18%	18%	17%	17%	16%	16%	16%	15%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%
V	<	<	<	<	30%	20%	16%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Zn	<	<	<	<	<	29%	21%	19%	18%	17%	16%	15%	15%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%

Method ICP002: Determination of aqua regia extractable heavy metals and metalloids in soil and sediment by ICP-AES

mg/kg	0.02	0.04	0.06	0.08	0.1	0.2	0.4	0.5	0.6	0.8	1	1.2	1.4	1.6	1.8	2.2	2.4	2.6	2.8	3	3.3	3.7	4	4.5	5	5.5	6	7	8	10	20	50	100	200	500	1000
Ag	<	<	<	<	<	<	<	<	<	<	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%
Al	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	26%	26%	26%	26%	26%	26%	26%
As	<	<	<	<	<	<	<	<	<	<	51%	44%	40%	37%	35%	32%	31%	30%	29%	29%	28%	27%	27%	26%	26%	26%	26%	25%	25%	25%	24%	24%	24%	24%	24%	24%	24%
Ba	31%	21%	17%	15%	14%	12%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%
Be	25%	24%	23%	23%	23%	23%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%
Ca	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	28%	26%	24%	21%	19%	17%	12%	12%	12%	12%	12%	12%	12%
Cd	<	<	26%	22%	20%	17%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Cd	<	<	44%	35%	30%	20%	17%	16%	16%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Co	<	<	<	<	<	22%	15%	14%	13%	12%	12%	12%	12%	12%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%
Cr	<	<	<	<	<	20%	15%	14%	14%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
Cu	<	<	<	<	<	21%	15%	14%	13%	12%	12%	12%	12%	12%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%
Fe	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
K	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	29%	29%	28%	28%	27%	27%	25%	25%	25%	25%	25%	25%
Mg	<	<	<	<	<	<	<	<	<	<	<	<	<	<	41%	32%	28%	26%	24%	22%	20%	19%	18%	17%	16%	15%	15%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Mn	<	18%	14%	12%	11%	10%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%
Mo	<	<	<	<	<	<	<	28%	27%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Na	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	26%	25%	25%	24%	23%	23%	21%	21%	21%	21%	21%	21%
Ni	<	<	<	<	<	<	31%	27%	24%	21%	19%	18%	18%	17%	17%	17%	17%	17%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%
P	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	24%	23%	22%	21%	20%	19%	18%	17%	16%	15%	14%	14%	13%	12%	12%	10%	9%	9%	9%	9%	9%	9%	9%
Pb	<	<	<	<	<	<	<	<	<	<	23%	21%	19%	18%	17%	15%	15%	14%	14%	14%	13%	13%	13%	13%	12%	12%	12%	12%	12%	11%	11%	11%	11%	11%	11%	11%	11%
Sb	<	<	<	<	<	<	<	<	<	<	<	<	<	<	27%	26%	25%	25%	25%	24%	24%	24%	23%	23%	23%	23%	23%	23%	23%	23%	23%	22%	22%	22%	22%	22%	22%	22%
Se	<	<	<	<	<	<	<	<	<	<	<	<	<	<	37%	32%	30%	29%	27%	26%	25%	24%	23%	22%	21%	21%	20%	20%	19%	19%	18%	18%	18%	18%	18%	18%	18%	18%
Sn	<	<	<	<	<	<	<	<	<	<	<	<	<	<	27%	25%	25%	24%	24%	24%	24%	23%	23%	23%	23%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%
Sr	<	<	<	<	50%	29%	19%	17%	16%	14%	13%	13%	13%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%
Ti	<	<	<	<	33%	27%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Tl	<	<	<	<	<	<	<	<	<	<	36%	33%	31%	29%	28%	27%	26%	26%	25%	25%	25%	24%	24%	24%	23%	23%	23%	23%	23%	23%	22%	22%	22%	22%	22%	22%	22%
V	<	<	<	<	33%	24%	21%	20%	20%	20%	20%	20%	20%	20%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%
Zn	<	<	<	<	<	<	<	<	<	<	20%	18%	16%	15%	15%	14%	14%	13%	13%	13%	13%	13%	13%	13%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%

Note: expressed on a dry weight basis

Method ICP003: Determination of total recoverable elements in biological tissue by ICP-AES

mg/kg	0.02	0.04	0.06	0.08	0.1	0.2	0.4	0.5	0.6	0.8	1	1.2	1.4	1.6	1.8	2.2	2.4	2.6	2.8	3	3.3	3.7	4	4.5	5	5.5	6	7	8	10	20	50	100	200	500	1000
Ag	<	<	<	<	<	<	<	<	<	<	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%
Al	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	31%	31%	30%	30%	30%	30%	29%	29%	29%	29%	29%	28%	28%	28%	28%	28%	28%	28%
As	<	<	<	<	<	<	<	<	<	<	47%	40%	35%	32%	29%	25%	24%	23%	22%	21%	20%	19%	19%	18%	17%	17%	17%	16%	16%	15%	15%	15%	15%	15%	15%	15%	15%
Be	25%	24%	23%	23%	23%	23%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%
Ca	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	31%	29%	28%	26%	24%	22%	19%	18%	18%	18%	18%	18%
Cd	<	<	24%	21%	18%	15%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
Cd	<	<	43%	34%	29%	19%	15%	14%	14%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
Co	<	<	<	<	<	22%	15%	14%	13%	12%	12%	12%	12%	12%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%
Cr	<	<	<	<	<	<	<	27%	27%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
Cu	<	<	<	<	<	22%	16%	15%	14%	14%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
Fe	<	<	<	<	<	<	<	<	<	<	18%	17%	16%	15%	15%	14%	14%	14%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
Mg	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	12%	12%	11%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Mn	<	<	<	<	17%	16%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Mo	<	<	<	<	<	<	29%	28%	27%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Ni	<	<	<	<	<	<	33%	29%	26%	24%	22%	21%	21%	21%	20%	20%	20%	20%	20%	20%	20%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%
P	<	<	<	<	<	<	<	<	<	<	<	<	<	<	28%	25%	24%	23%	22%	21%	20%	19%	18%	17%	17%	16%	16%	15%	14%	14%	12%	12%	12%	12%	12%	12%	12%
Pb	<	<	<	<	<	<	<	<	<	<	23%	21%	19%	18%	17%	15%	15%	14%	14%	14%	13%	13%	13%	13%	12%	12%	12%	12%	12%	11%	11%	11%	11%	11%	11%	11%	11%
S	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	29%	26%	25%	22%	20%	18%	14%	13%	13%	13%	13%	13%
Sb	<	<	<	<	<	<	<	<	<	<	<	<	<	<	27%	26%	25%	25%	25%	24%	24%	24%	23%	23%	23%	23%	23%	23%	23%	23%	23%	22%	22%	22%	22%	22%	22%
Se	<	<	<	<	<	<	<	<	<	<	<	<	<	<	37%	32%	30%	29%	27%	26%	25%	24%	23%	22%	21%	21%	20%	20%	19%	19%	18%	18%	18%	18%	18%	18%	18%
Sn	<	<	<	<	<	<	<	<	<	<	<	<	<	<	27%	25%	25%	24%	24%	24%	24%	23%	23%	23%	23%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%
Sr	<	<	<	<	50%	30%	20%	18%	17%	16%	15%	14%	14%	14%	14%	14%	14%	14%	14%	14%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
Ti	<	<	<	<	33%	27%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Tl	<	<	<	<	<	<	<	<	<	<	36%	33%	31%	29%	28%	27%	26%	26%	25%	25%	25%	24%	24%	24%	23%	23%	23%	23%	23%	23%	22%	22%	22%	22%	22%	22%	22%
V	<	<	<	<	39%	31%	29%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%
Zn	<	<	<	<	<	<	<	<	<	<	<	<	<	<	15%	14%	14%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%

Note: expressed on a dry weight basis

Method ICP006: Determination of total mercury in natural waters by CV-ICP-AES

Concentration µg.L^{-1}	Expanded Uncertainty	Percentage
0.1	0.05	47%
0.2	0.06	30%
0.3	0.07	23%
0.4	0.08	20%
0.5	0.09	17%
0.6	0.10	16%
0.7	0.10	15%
0.8	0.11	14%
0.9	0.12	13%
1	0.13	13%
2	0.21	11%
3	0.30	10%
4	0.38	10%
5	0.47	9%
10	0.90	9%
20	1.78	9%

Method ICP007: Determination of total mercury in soils, sediments and sludges by CV-ICP-AES

Concentration mg.kg^{-1}	Expanded Uncertainty	Percentage
0.01	0.005	48%
0.02	0.006	31%
0.03	0.008	25%
0.04	0.009	22%
0.05	0.010	20%
0.06	0.011	19%
0.07	0.012	18%
0.08	0.014	17%
0.09	0.015	16%
0.1	0.016	16%
0.2	0.029	14%
0.3	0.041	14%
0.4	0.054	14%
0.5	0.067	13%
1	0.132	13%
2	0.263	13%

Note: expressed on a dry weight basis

Method ICP008: Determination of total mercury in biological tissue by CV-ICP-AES

Concentration $mg.kg^{-1}$	Expanded Uncertainty	Percentage
0.01	0.005	48%
0.02	0.006	32%
0.03	0.008	25%
0.04	0.009	22%
0.05	0.010	20%
0.06	0.011	19%
0.07	0.013	18%
0.08	0.014	17%
0.09	0.015	17%
0.1	0.017	17%
0.2	0.030	15%
0.3	0.043	14%
0.4	0.057	14%
0.5	0.070	14%
1	0.139	14%
2	0.276	14%

Note: expressed on a dry weight basis

Method 2000: Ammonia in natural waters by FIA

Concentration $\mu g.L^{-1}$	Expanded Uncertainty	Percentage
3	0.8	27
4	0.9	23
5	1.0	20
6	1.2	20
7	1.3	19
8	1.4	18
9	1.6	18
10	1.8	18
20	2.9	15
40	5.5	14
100	13.4	13
500	66.1	13
1000	132.0	13

Method 2100: Nitrate + nitrite in natural waters by FIA

Concentration µg.L^{-1}	Expanded Uncertainty	Percentage
2	1.3	65
3	1.5	50
4	1.6	40
5	1.7	34
6	1.8	30
7	2.0	28
8	2.1	26
10	2.4	24
20	4.2	21
40	8.1	20
100	19.8	20
500	98.8	20
1000	197.6	20

Method 2200: Nitrite in natural waters by FIA

Concentration µg.L^{-1}	Expanded Uncertainty	Percentage
2	0.6	32
3	0.7	25
4	0.9	22
5	1.0	20
6	1.1	18
7	1.2	17
8	1.3	16
10	1.6	16
20	2.8	14
50	6.7	13
100	13.3	13
500	66.3	13
1000	132.6	13

Method 2300: Orthosilicate in natural waters by FIA

Concentration µg.L^{-1}	Expanded Uncertainty	Percentage
2	0.4	20
3	0.5	17
4	0.6	15
5	0.7	14
6	0.8	13
7	0.9	13
10	1.3	13
20	2.5	13
50	6:2	12
100	12.3	12
500	61.5	12
850	104.5	12
1000	123.0	12

Method 2700: Total nitrogen in natural waters by autoclave digestion

Concentration µg.L^{-1}	Expanded Uncertainty	Percentage
50	13.3	27
75	17.6	24
100	22.1	22
150	31.4	21
300	59.8	20
450	88.5	20
700	136.6	20
850	165.6	20
1000	194.6	20

Method 4100: Orthophosphate in natural waters by FIA

Concentration µg.L^{-1}	Expanded Uncertainty	Percentage
2	0.87	44
3	1.02	34
4	1.18	30
5	1.33	27
6	1.5	25
7	1.7	24
8	1.8	22
10	2.1	21
20	4.0	20
40	7.76	19
100	19.1	19
500	95.6	19
1000	191.2	19

Method 4700: Total phosphorus in natural waters by autoclave digest

Concentration µg.L^{-1}	Expanded Uncertainty	Percentage
5	1.3	27
6	1.4	24
7	1.5	22
8	1.6	20
9	1.7	19
10	1.8	18
15	2.6	17
20	3.3	16
50	7.6	15
100	14.9	15
500	73.7	15
1000	147.2	15

Method 6200: Total Organic Carbon

Concentration %	Expanded Uncertainty	Percentage
0.1	0.05	50
0.2	0.07	35
0.3	0.08	27
0.4	0.1	25
0.5	0.1	20
0.6	0.1	17
0.7	0.1	14
0.8	0.1	13
0.9	0.11	12
1	0.11	11
2	0.2	10
3	0.3	10
5	0.4	8
10	0.8	8
20	1.6	8
50	4.1	8

Note: expressed on a dry weight basis