

Notes: Error bars represent standard error of the mean.

Dotted line represents analytical detection limit; values below the detection limit are plotted at half the detection limit.

Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

Red dashed line represents the CCME interm sediment quality guideline (0.6 mg/kg); the CCME probable effects level (3.5 mg/kg) is not shown.

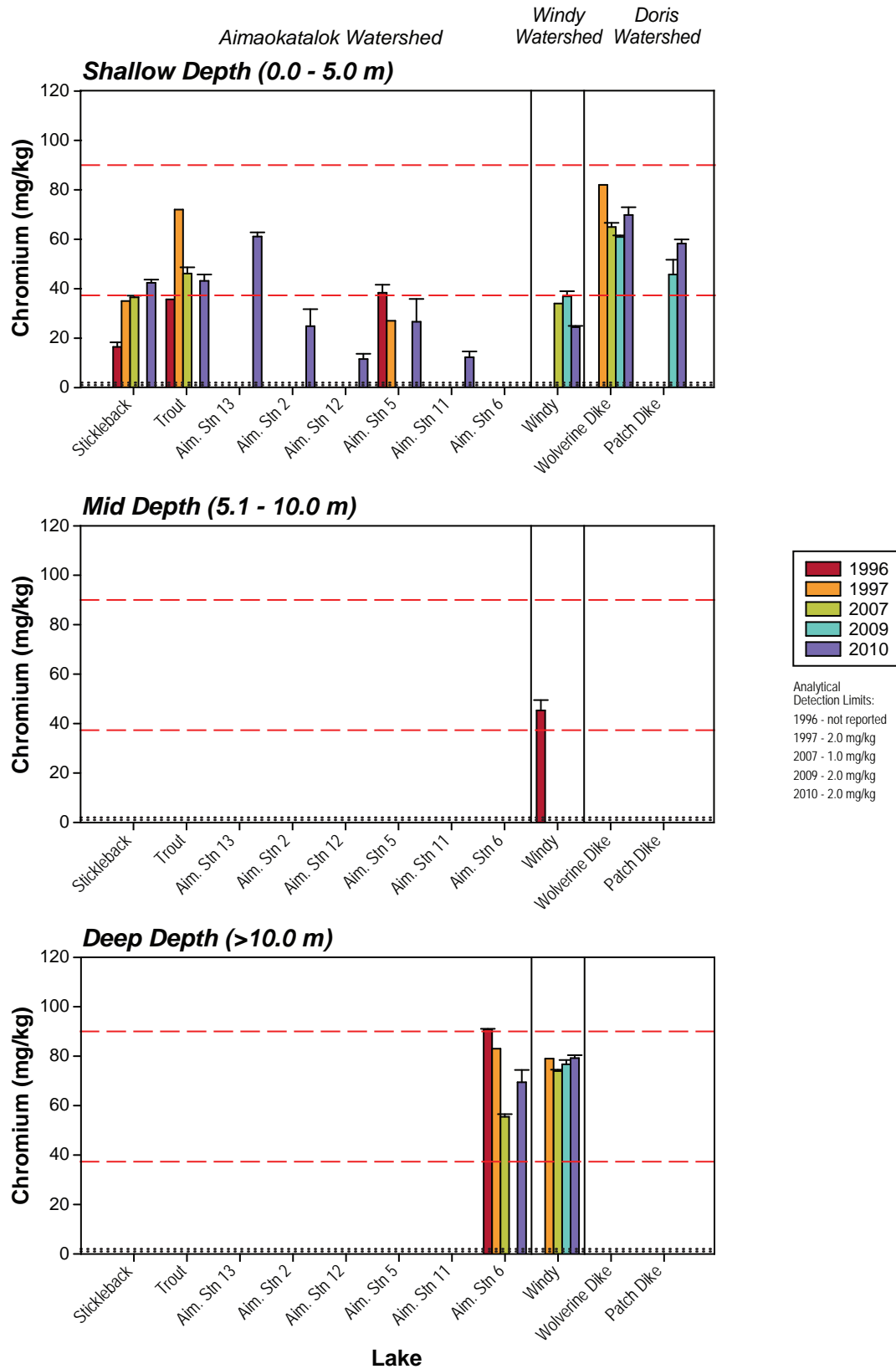
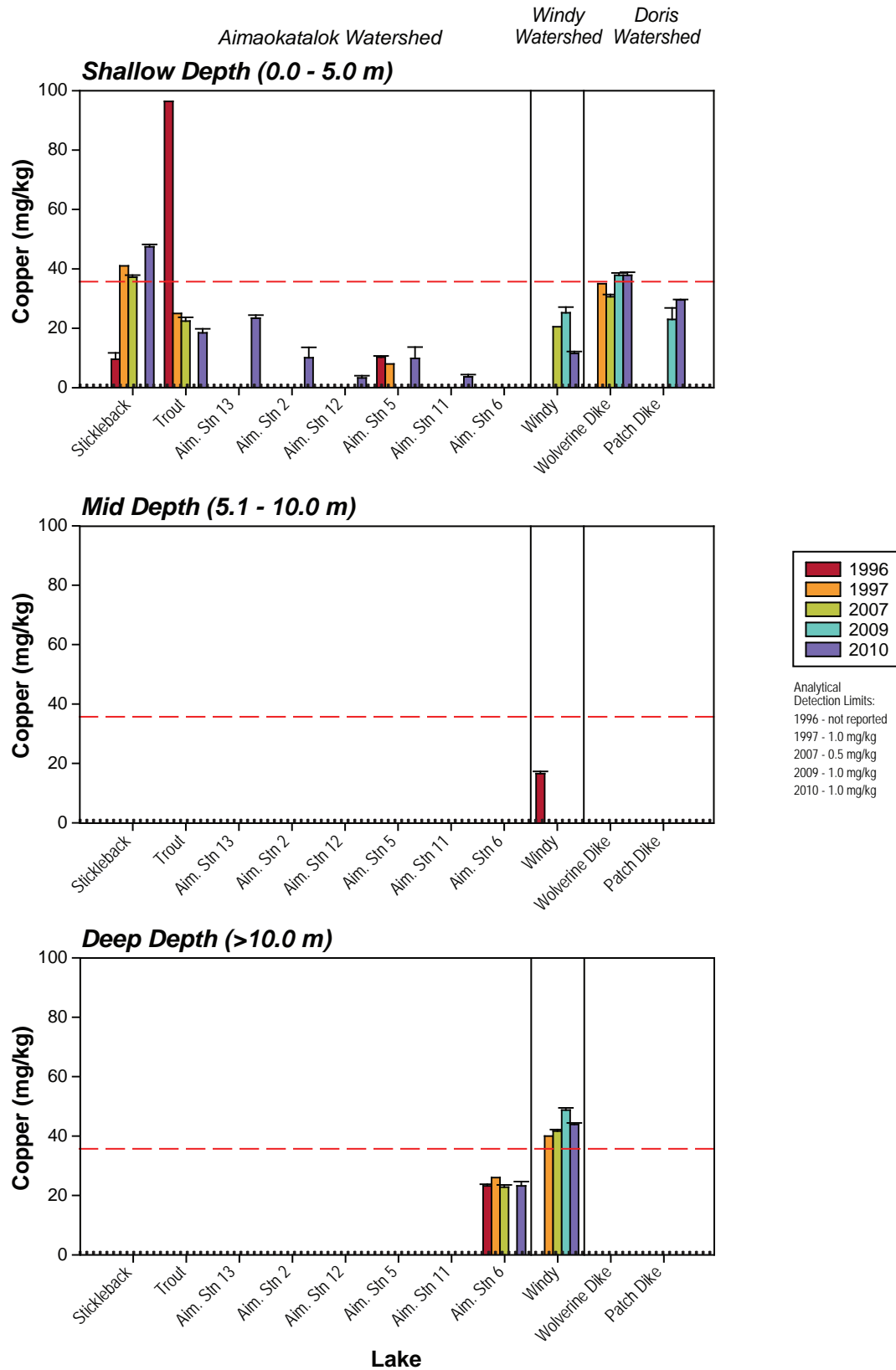


Figure 3.4-3g



Notes: Error bars represent standard error of the mean.

Dotted line represents analytical detection limit; values below the detection limit are plotted at half the detection limit.

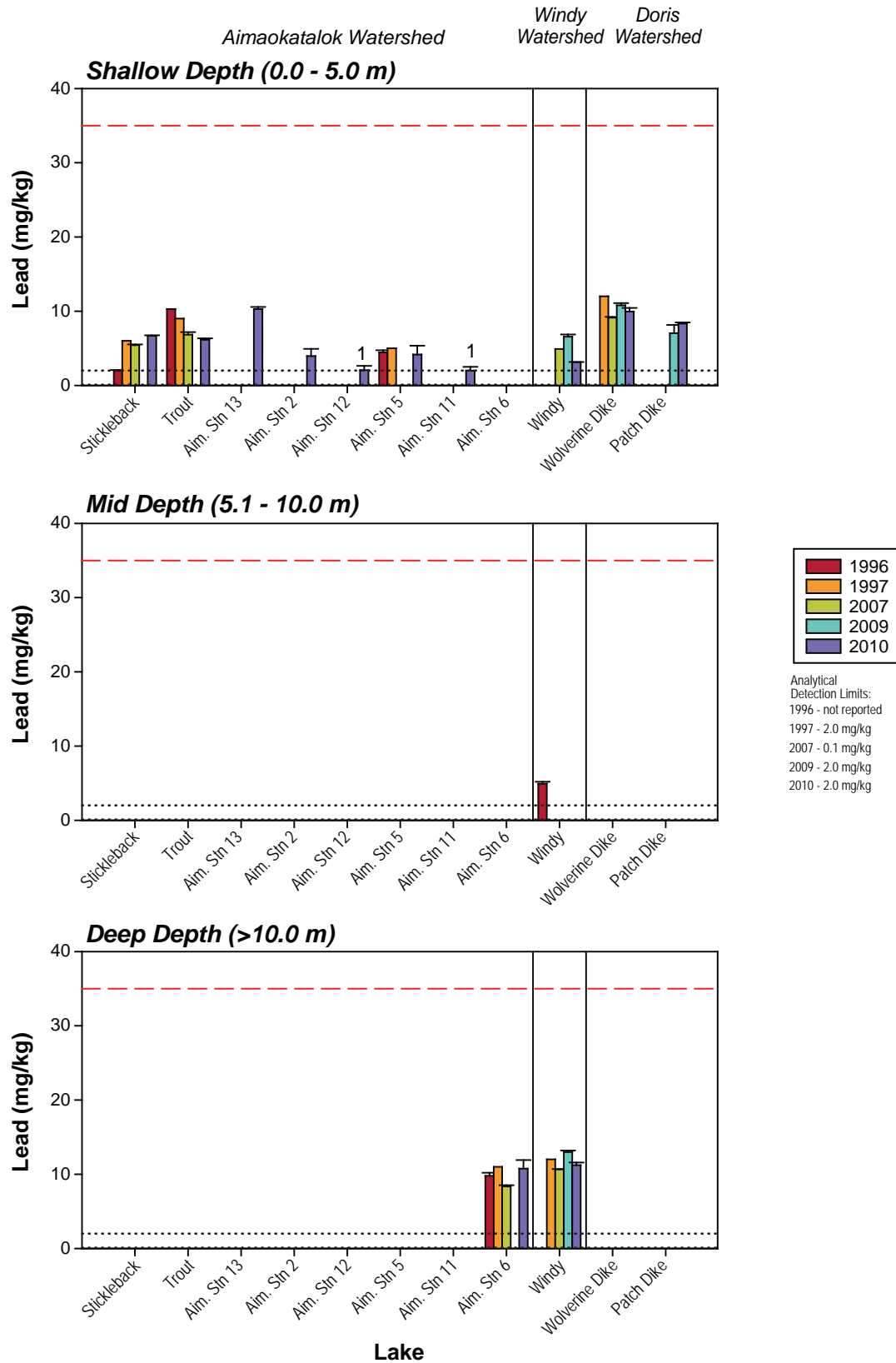
Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

Red dashed line represents the CCME interim sediment quality guideline (35.7 mg/kg);

the CCME probable effects level (197 mg/kg) is not shown.

Figure 3.4-3h



Notes: Error bars represent standard error of the mean.

Dotted line represents analytical detection limit; values below the detection limit are plotted at half the detection limit.

Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

Red dashed line represents the CCME interm sediment quality guideline (35 mg/kg);

the CCME probable effects level (91.3) is not shown.

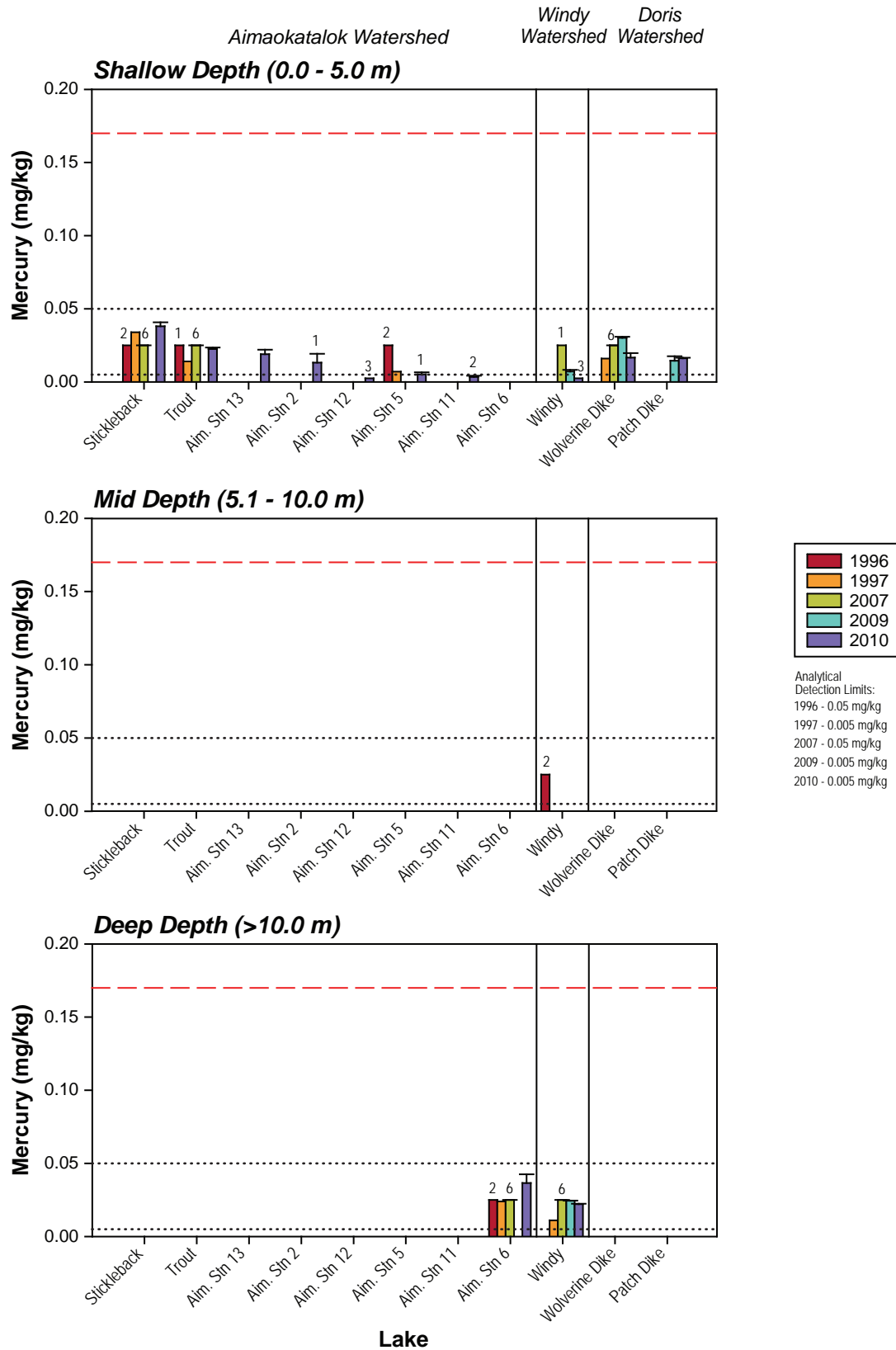
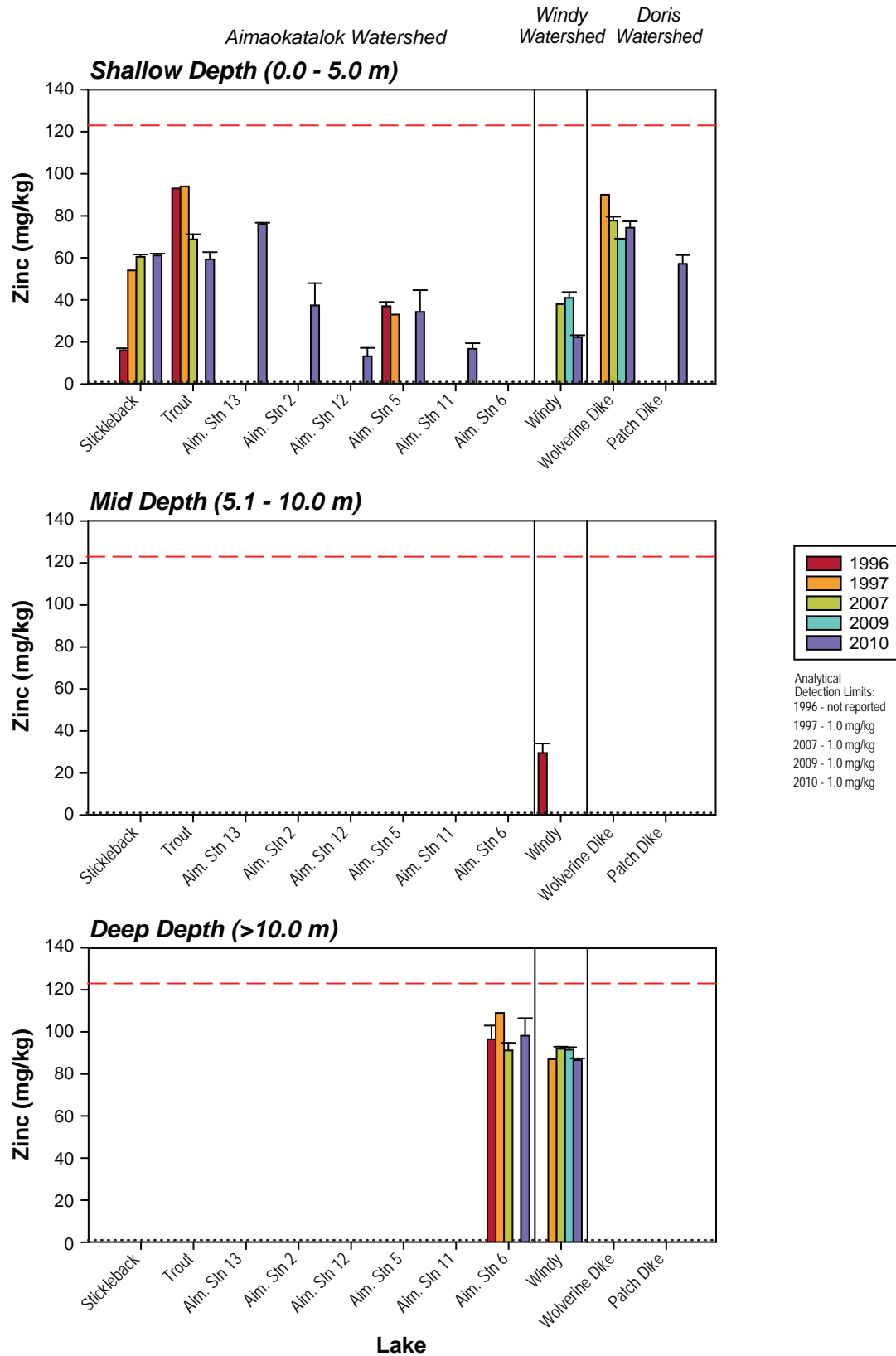


Figure 3.4-3j



### 3.5.1 Spatial Variation

Figure 3.5-1 presents stream and river sediment particle size composition. Stream sediments sampled in 2010 consisted of a highly variable mixture of gravel, sand, silt and clay. Sand and silt were the most common grain sizes at most sites. Clay made up a substantial proportion (31 to 44%) of sediments at Trout OF, S6, and AWRd. These three stream sites were dominated by fine sediments, as clay and silt together made up at least 85% of the particle composition at these sites. At all other stream and river sites, fine sediments (clay and silt) made up less than 65% of the particle composition. At most sites, gravel was a minor component of sediments (<10%); however, gravel made up 12% of the sediment at Koig. D/S.

Figures 3.5-2a to 3.5-2k present 2010 stream and river sediment quality results. Sites dominated by fine sediments (e.g., Trout OF, S6, and AWRd) tended to have higher sediment parameter concentrations than sites dominated by coarser sediments (e.g., Stickleback OF and Koig. D/S). This relationship between particle size composition and parameter concentration was evident for TOC (Figure 3.5-2a), available ammonium (Figure 3.5-2c), total nitrogen (Figure 3.5-2d), cadmium (Figure 3.5-2f), copper (Figure 3.5-2h), and mercury (Figure 3.5-2j).

### 3.5.2 Comparison with CCME Guidelines

All sediment samples collected were compared to both ISQG and PEL CCME sediment quality guidelines for the protection of aquatic life. Table 3.5-1 presents the percentage of stream and river sediment samples in which metal concentrations were higher than CCME guidelines, and Table 3.5-2 provides the factor by which average 2010 sediment metal concentrations were higher than CCME guidelines.

Similar to lake sediments, stream and river sediments were naturally elevated in arsenic, chromium, and copper, and concentrations of these metals were sometimes higher than CCME ISQGs. Arsenic concentrations in two out of three replicate samples collected at AWRd exceeded the ISQG for arsenic of 5.9 mg/kg, and one of these replicates exceeded the PEL of 17 mg/kg. This was the only sample to exceed a CCME PEL for any metal. Out of all the metals for which there are CCME sediment quality guidelines, chromium most commonly exceeded its ISQG in streams and rivers. Chromium concentrations in at least one sediment sample collected from Trout OF, Koig. U/S and AWRb exceeded the ISQG of 37.3 mg/kg. At both S6 and Koig. R., the copper concentration in a single replicate was slightly higher than the ISQG of 35.7 mg/kg.

### 3.5.3 Annual Variation

Only historical sampling locations that were also sampled in 2010 were included in the comparison of annual sediment quality data shown in Figures 3.5-3a to 3.5-3k. Note that historical sampling locations may not correspond exactly with those sampled in 2010, and this, in addition to methodological differences, may contribute to variability observed among years (see Table 2.14-4 and Figures 2.14-2a to 2.14-2c for historical sampling methodologies and locations).

Historical stream and river sediment quality data are available from 1993 for Stickleback OF and 2009 for Koig. U/S and Koig. D/S. Although there was limited historical stream and river sediment quality data available, most sediment parameters were similar over time, and spatial variability was generally greater than annual variability.

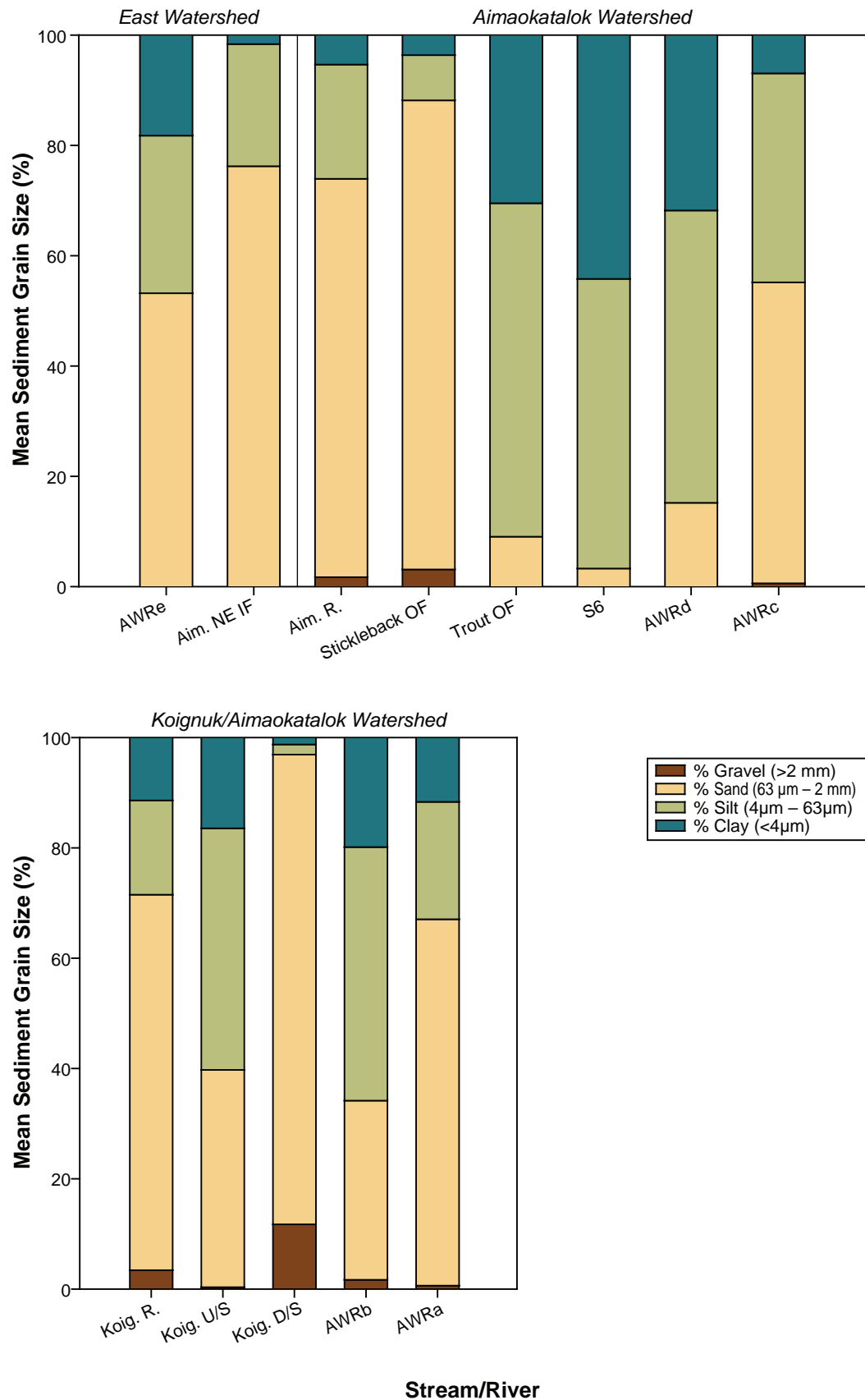
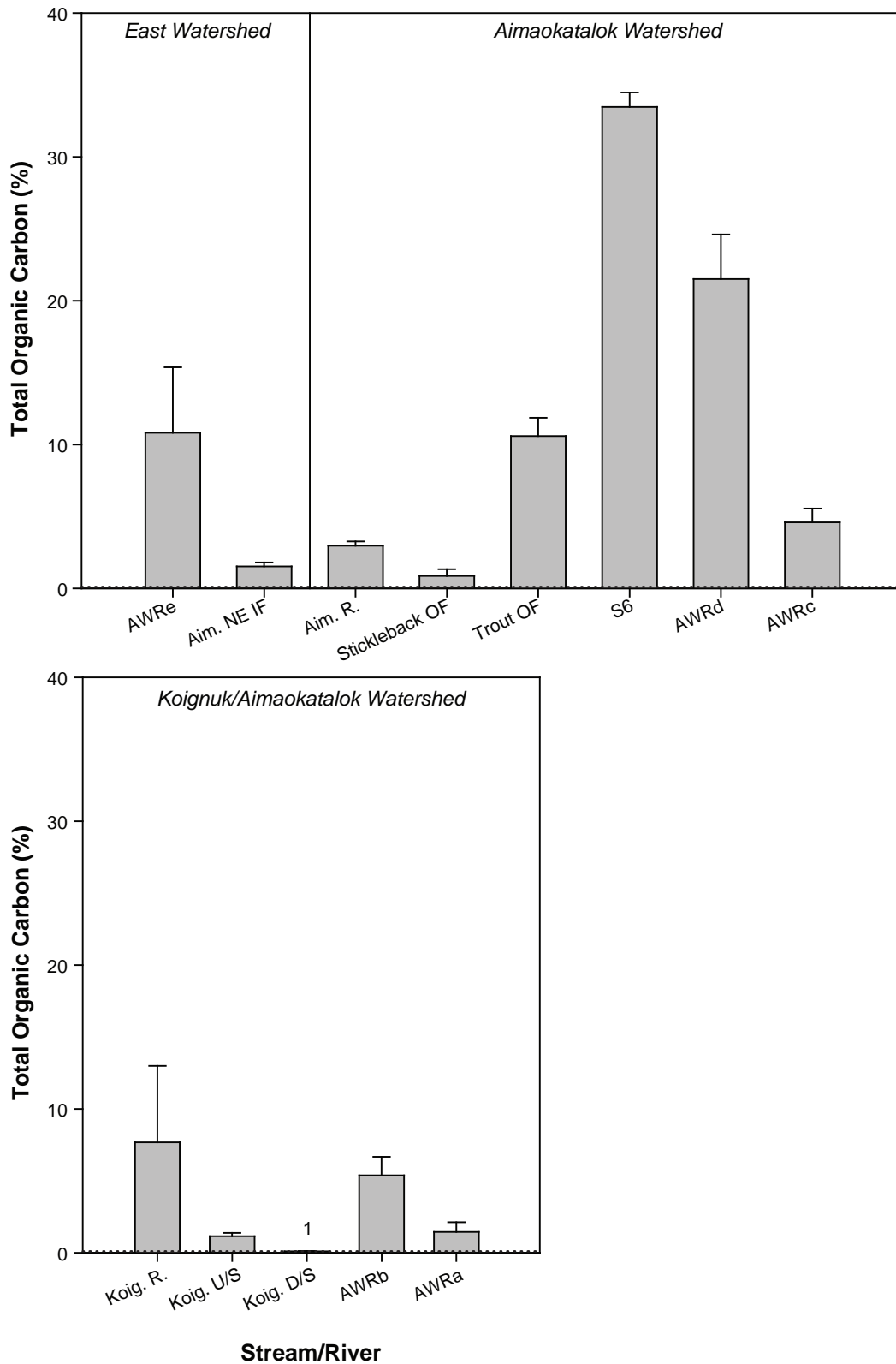
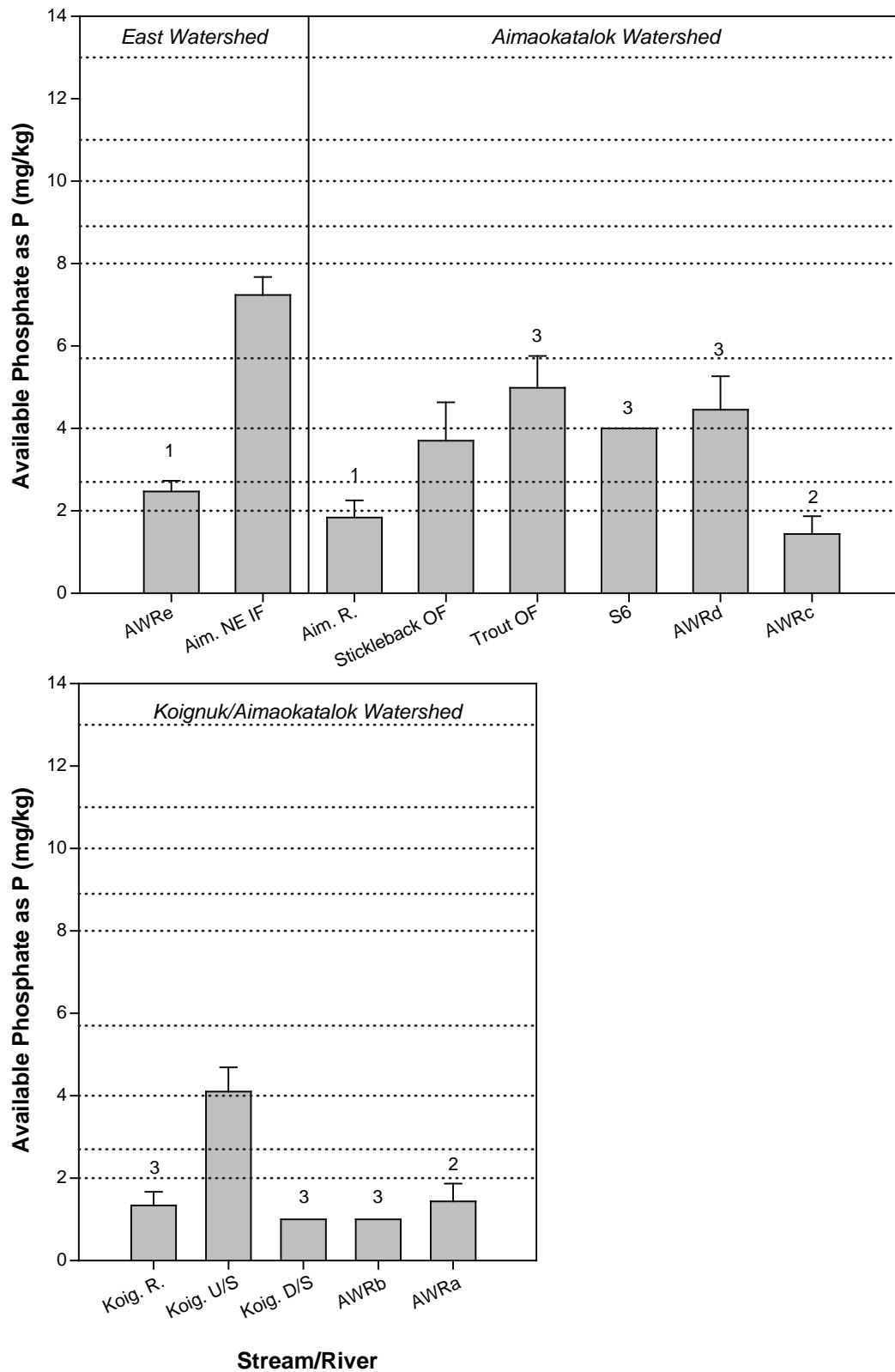


Figure 3.5-1



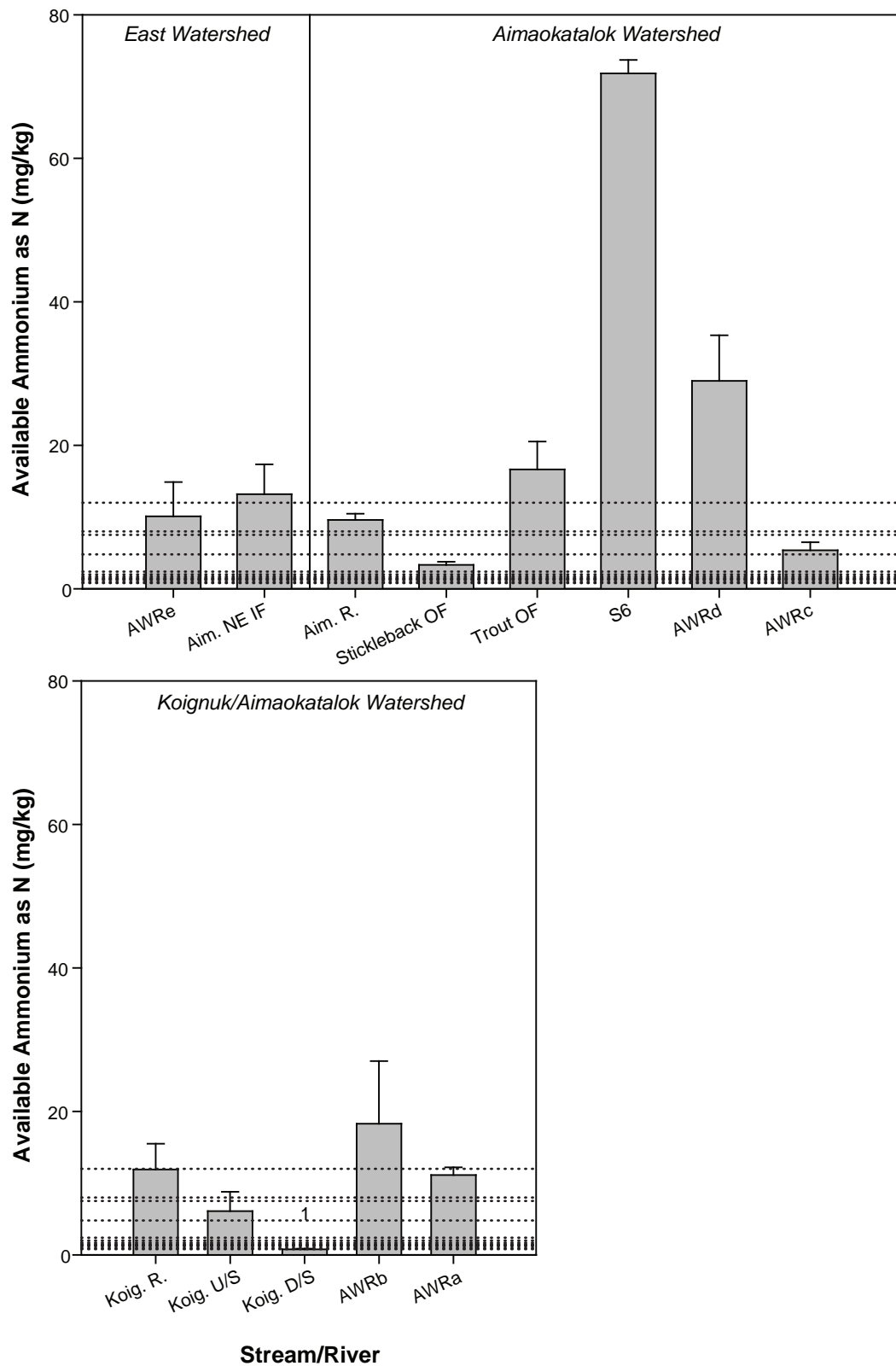
Notes: Error bars represent standard error of the mean of replicates.  
 Dotted line represents analytical detection limit (0.10 %); values below the detection limit are plotted at half the detection limit.  
 Numbers above bars indicate the number of replicates with concentrations below the analytical detection limit;  
 absence of a number indicates all replicates were above the detection limit.  
 There is no CCME guideline for total organic carbon.

Figure 3.5-2a



Notes: Error bars represent standard error of the mean of replicates.  
Dotted lines represent analytical detection limits (2.0, 2.7, 4.0, 5.7, 8.0, 8.9, 10, 11, or 13 mg/kg);  
values below the detection limit are plotted at half the detection limit.  
Numbers indicate the number of replicates with concentrations below the analytical detection limit;  
absence of a number indicates all replicates were above the detection limit.  
There is no CCME guideline for available phosphate.

Figure 3.5-2b



Notes: Error bars represent standard error of the mean of replicates.

Dotted lines represent analytical detection limit (0.8, 0.92, 1.2, 1.3, 1.4, 1.5, 1.7, 2.0, 2.4, 4.8, 7.5, 8.0, or 12 mg/kg);

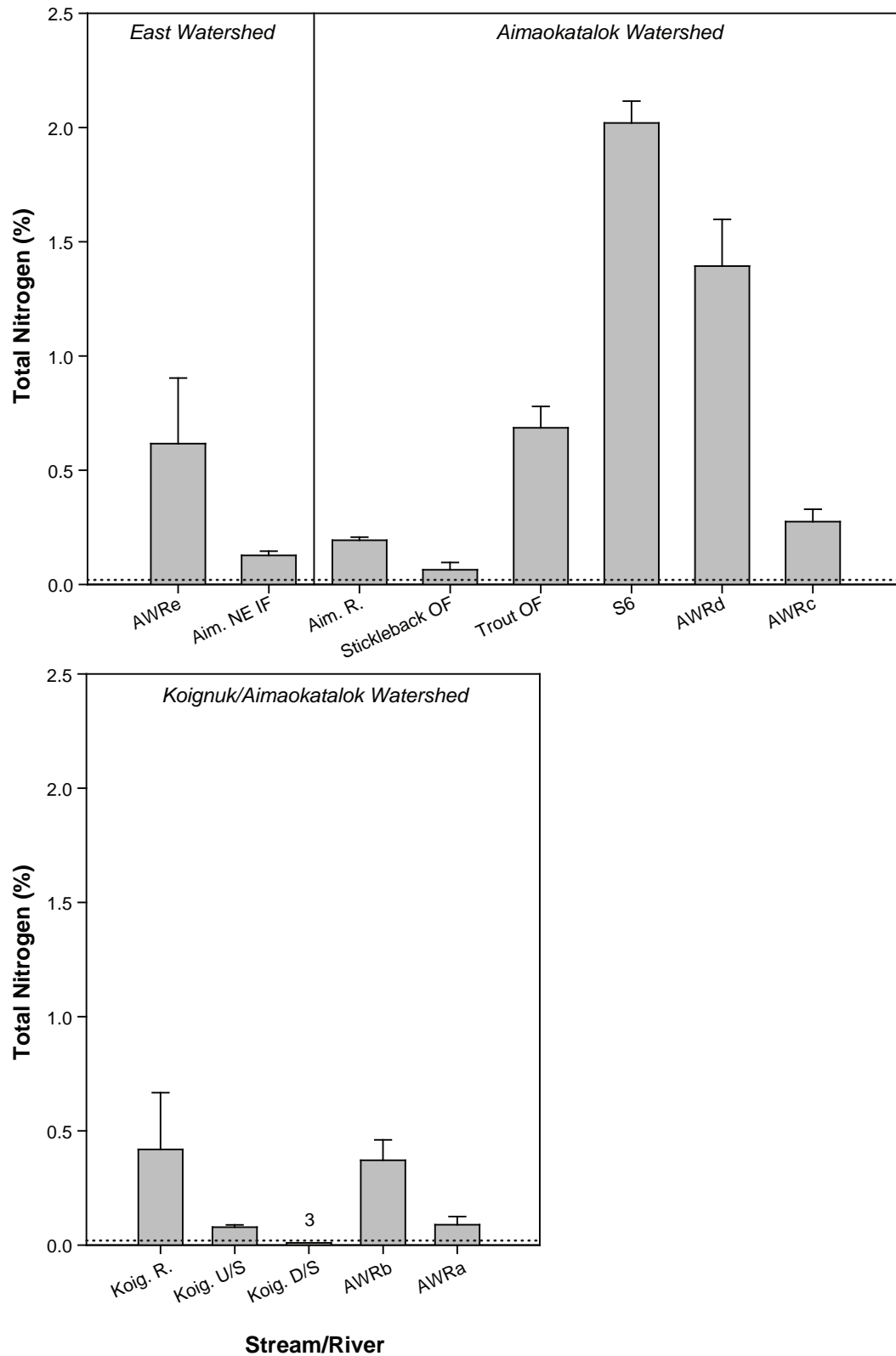
values below the detection limit are plotted at half the detection limit.

Numbers indicate the number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

There is no CCME guideline for available ammonium.

Figure 3.5-2c



Notes: Error bars represent standard error of the mean of replicates.

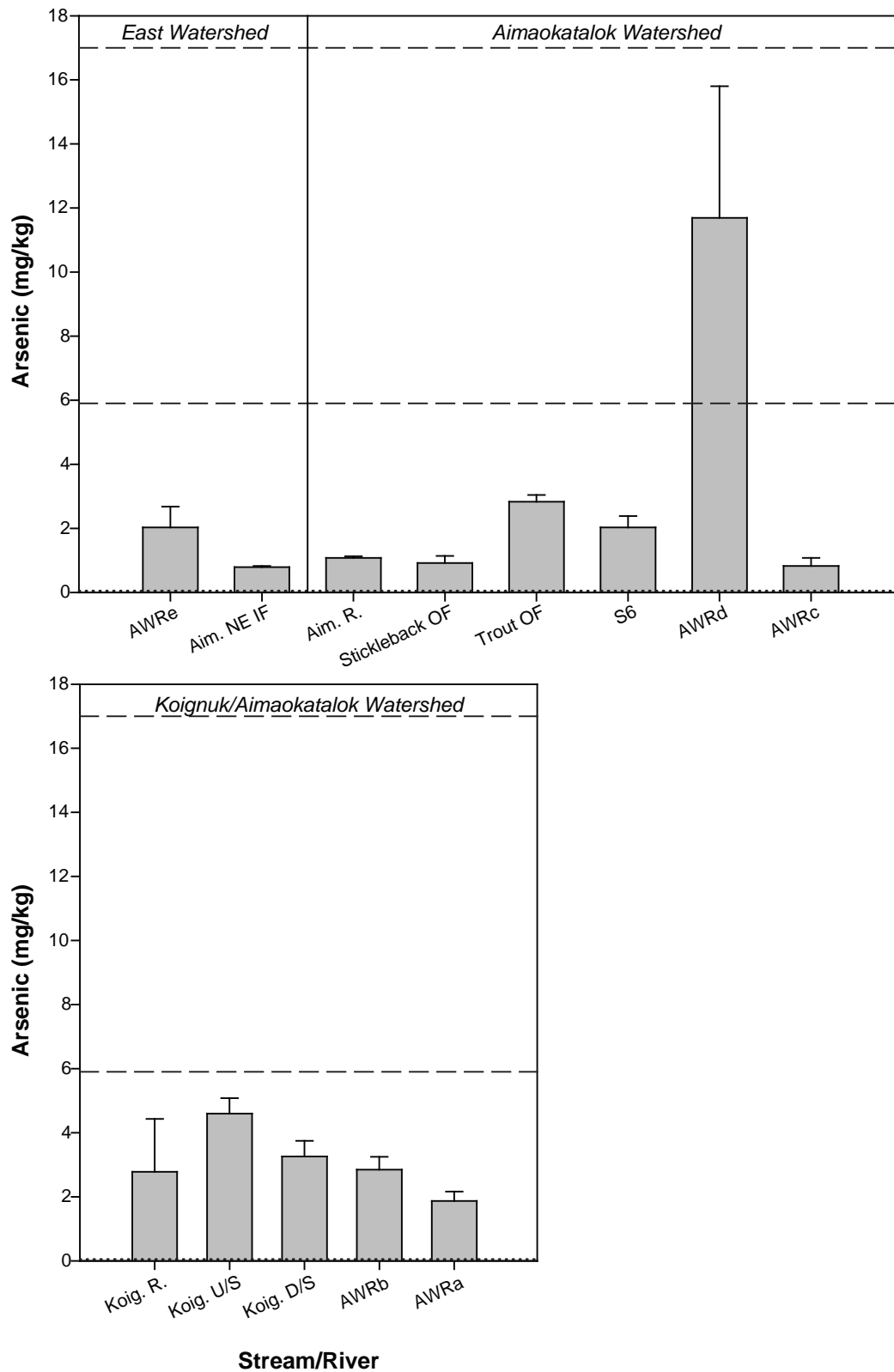
Dotted line represents analytical detection limit (0.02 %); values below the detection limit are plotted at half the detection limit.

Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

There is no CCME guideline for total nitrogen.

Figure 3.5-2d



Notes: Error bars represent standard error of the mean of replicates.

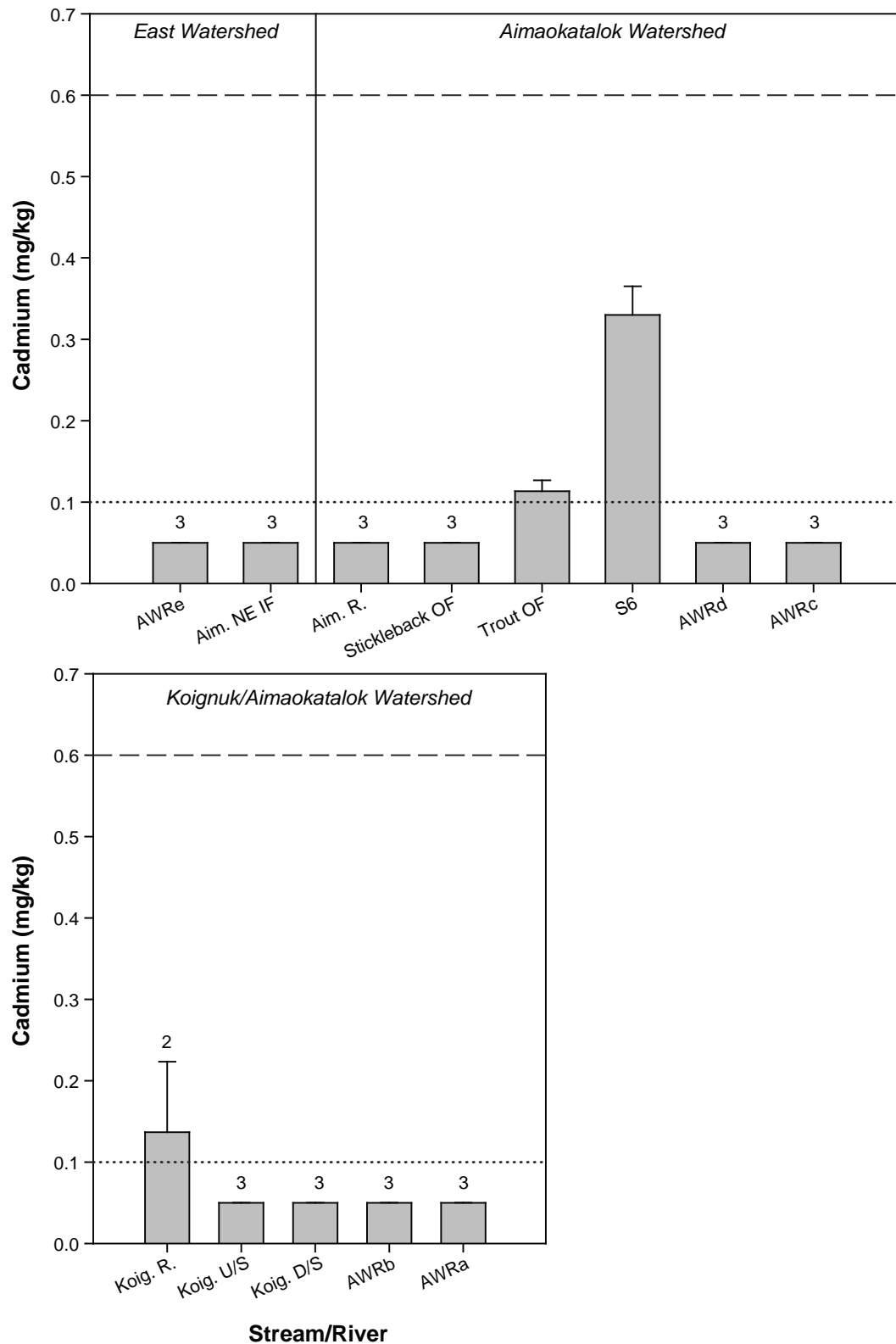
Dotted line represents analytical detection limit (0.05 mg/kg); values below the detection limit are plotted at half the detection limit.

Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

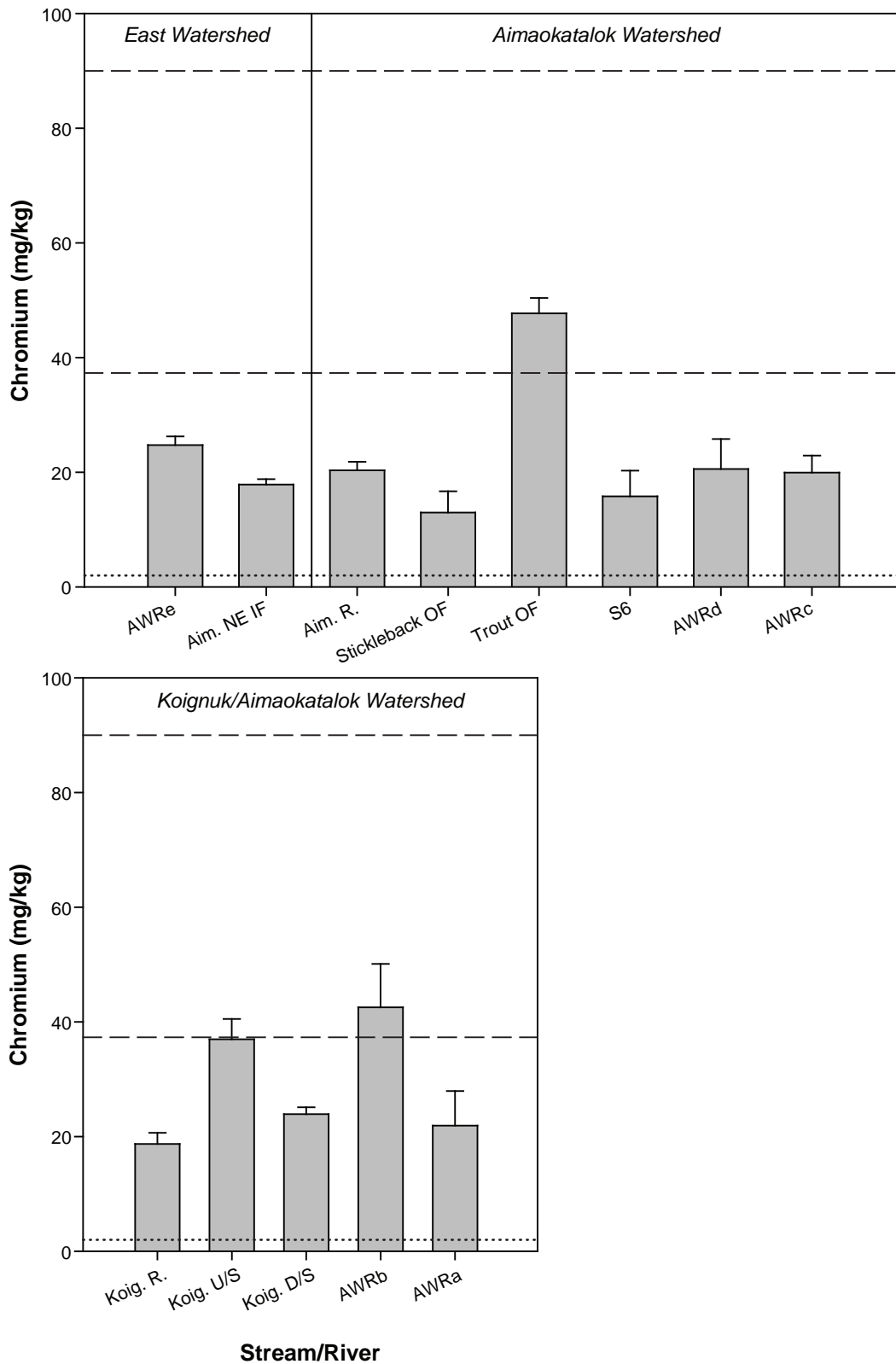
Dashed lines represent CCME interim sediment quality guideline (5.9 mg/kg) and probable effects level (17 mg/kg).

Figure 3.5-2e



Notes: Error bars represent standard error of the mean of replicates.  
Dotted line represents analytical detection limit (0.1 mg/kg);  
values below the detection limit are plotted at half the detection limit.  
Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;  
absence of a number indicates all replicates were above the detection limit.  
Dashed line represents the CCME interm sediment quality guideline (0.6 mg/kg);  
the CCME probable effects level (3.5 mg/kg) is not shown.

Figure 3.5-2f



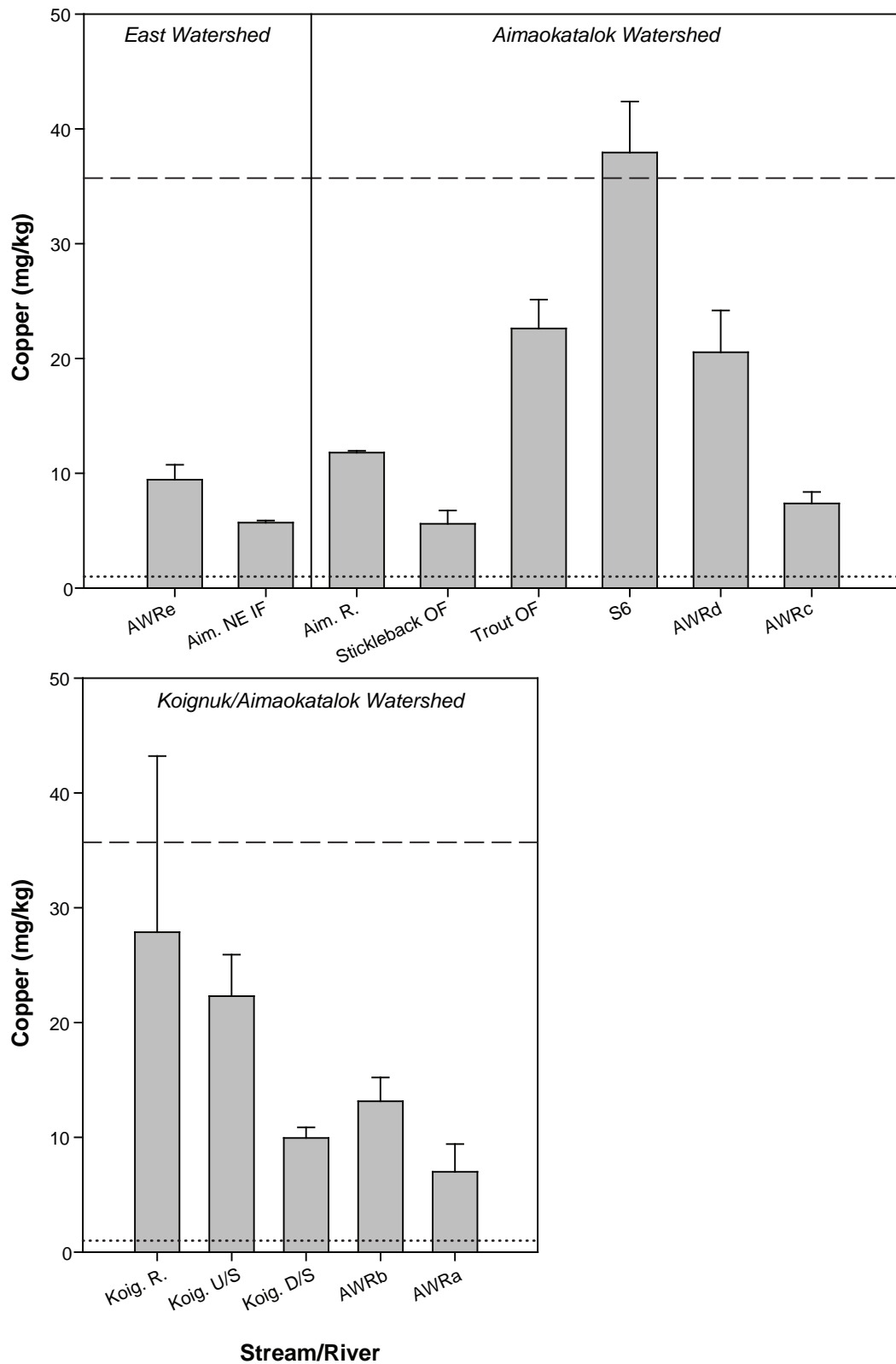
Notes: Error bars represent standard error of the mean of replicates.

Dotted line represents analytical detection limit (2.0 mg/kg); values below the detection limit are plotted at half the detection limit.

Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

Dashed lines represent CCME interim sediment quality guideline (37.3 mg/kg) and probable effects level (90 mg/kg).



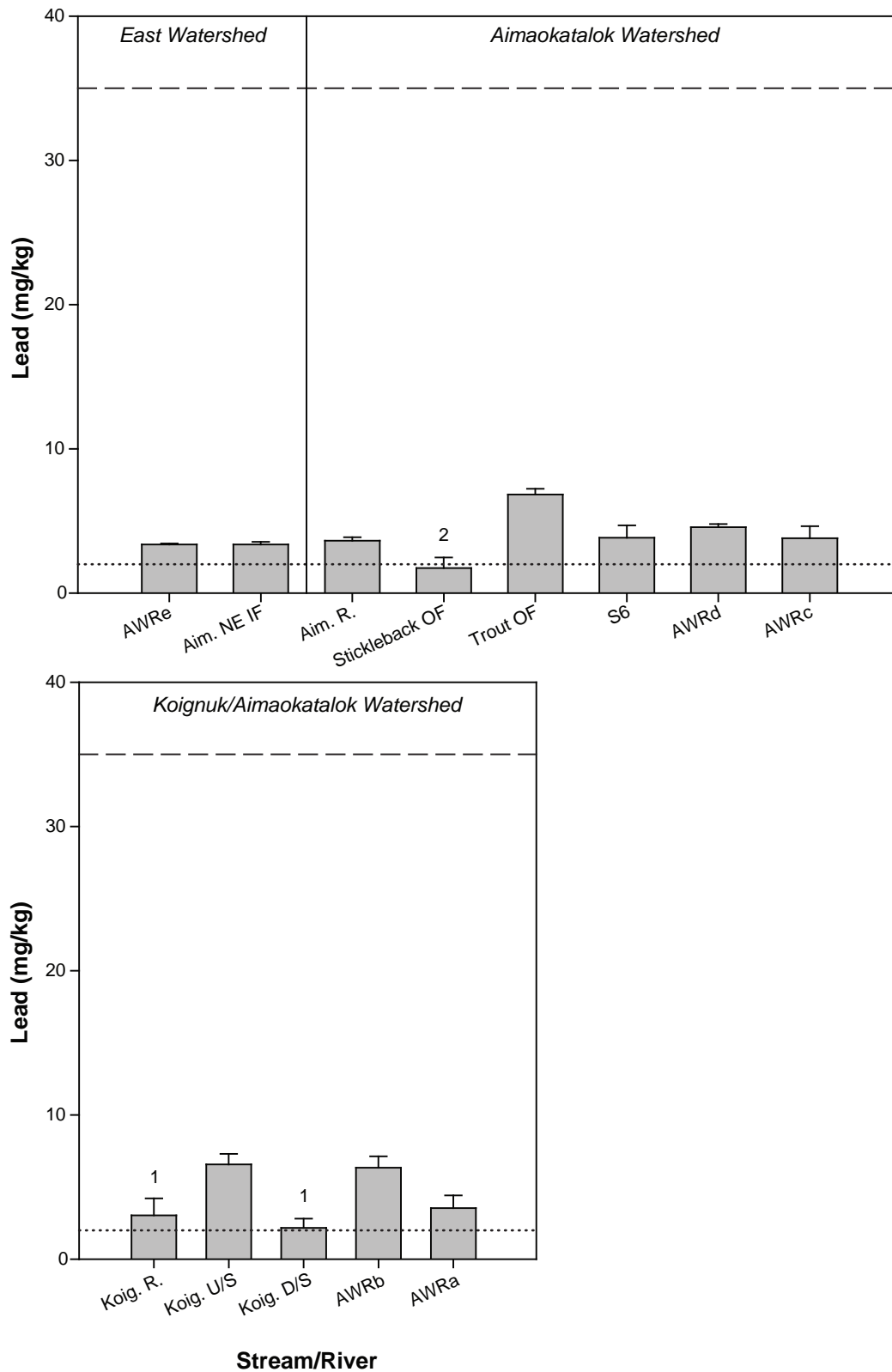
Notes: Error bars represent standard error of the mean of replicates.

Dotted line represents analytical detection limit (1.0 mg/kg); values below the detection limit are plotted at half the detection limit.

Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

Dashed line represents the CCME interm sediment quality guideline (35.7 mg/kg); the CCME probable effects level (197 mg/kg) is not shown.



Notes: Error bars represent standard error of the mean of replicates.

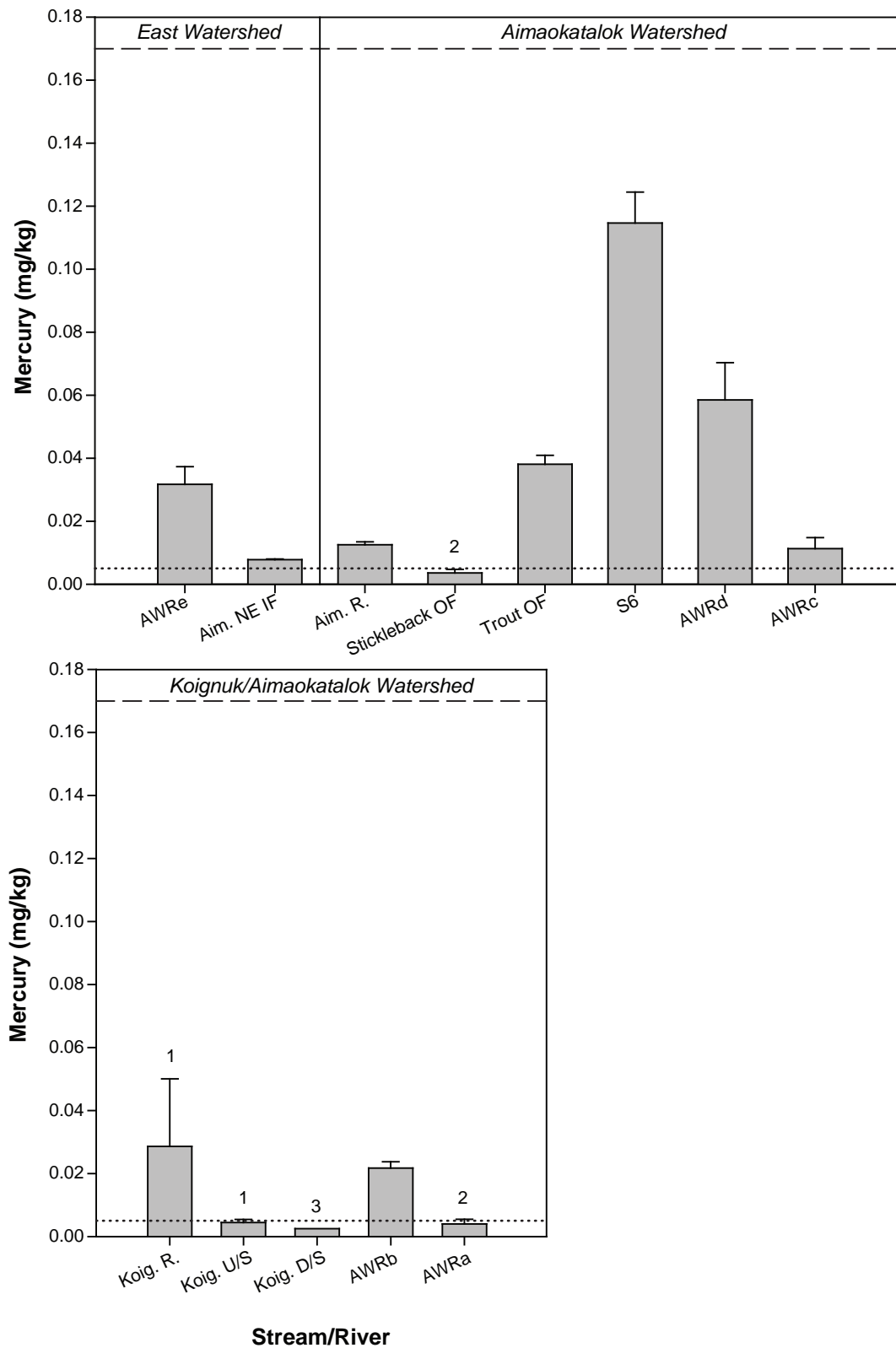
Dotted line represents analytical detection limit (2.0 mg/kg); values below the detection limit are plotted at half the detection limit.

Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

Dashed line represents the CCME interm sediment quality guideline (35 mg/kg); the CCME probable effects level (91.3) is not shown.

Figure 3.5-2i



Notes: Error bars represent standard error of the mean of replicates.

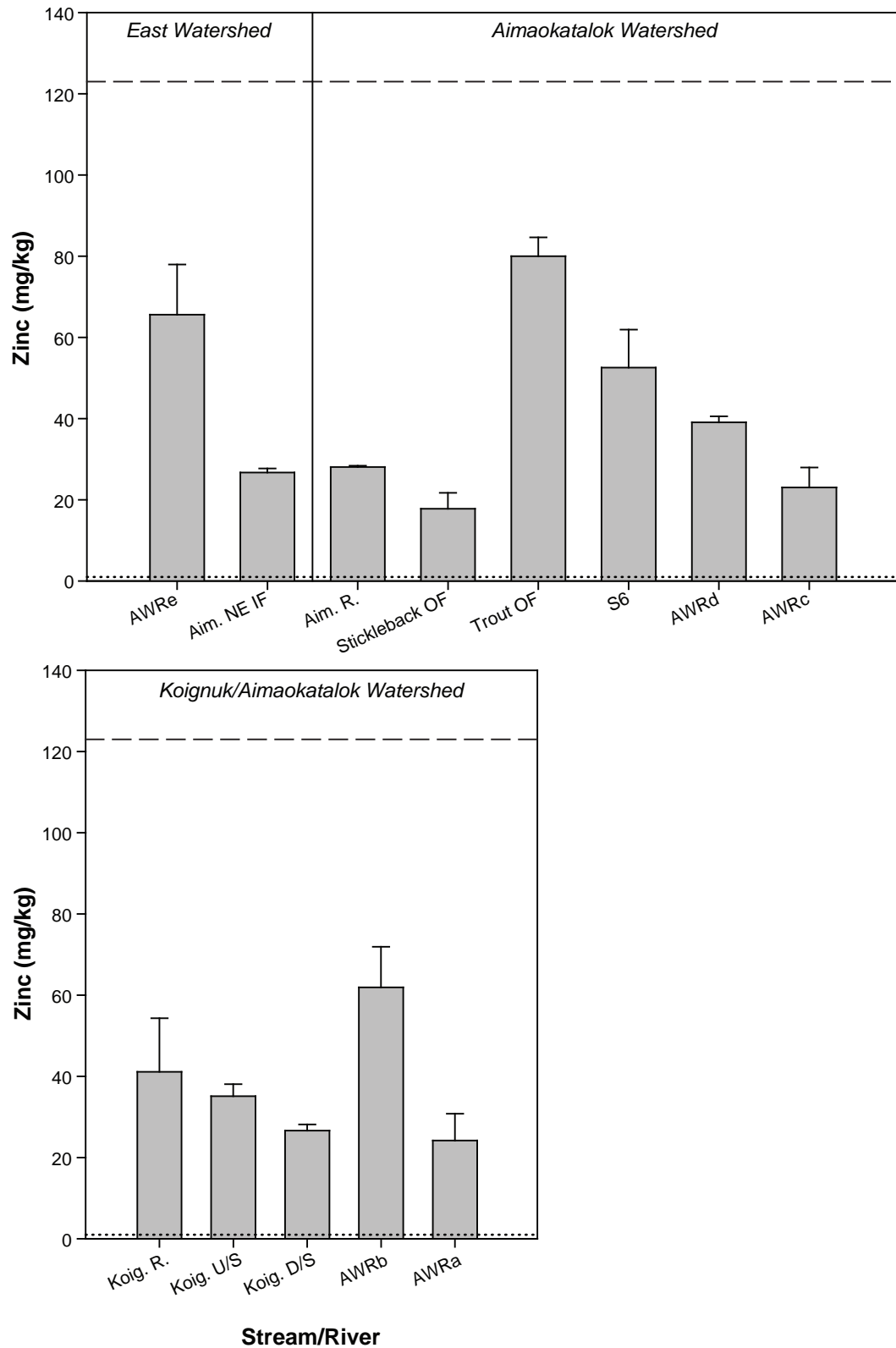
Dotted line represents analytical detection limit (0.005 mg/kg); values below the detection limit are plotted at half the detection limit.

Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

Dashed line represents the CCME interm sediment quality guideline (0.17 mg/kg); the CCME probable effects level (0.486 mg/kg) is not shown.

Figure 3.5-2j



Notes: Error bars represent standard error of the mean of replicates.

Dotted line represents analytical detection limit (1.0 mg/kg); values below the detection limit are plotted at half the detection limit.

Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

Dashed line represents the CCME interm sediment quality guideline (123 mg/kg); the CCME probable effects level (315 mg/kg) is not shown.

**Table 3.5-1. Stream and River Sediment Quality, Percent of Samples in which Concentrations are Higher than CCME Guidelines, Hope Bay Belt Project, 2010**

Stream/River	Total Number of Samples Collected	CCME Guideline value <sup>a</sup> (mg/kg):	Percent of samples higher than ISQG <sup>b</sup> guidelines							Percent of samples higher than PEL <sup>c</sup> guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
			5.9	0.6	37.3	35.7	35	0.17	123	17	3.5	90	197	91.3	0.486	315
<b>East</b>																
AWRe	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aim. NE IF	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Aimaokatalok</b>																
Aim. R.	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stickleback OF	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trout OF	3		-	-	100	-	-	-	-	-	-	-	-	-	-	-
S6	3		-	-	-	33.3	-	-	-	-	-	-	-	-	-	-
AWRd	3		66.7	-	-	-	-	-	-	33.3	-	-	-	-	-	-
AWRc	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Koignuk/Aimaokatalok</b>																
Koig. R.	3		-	-	-	33.3	-	-	-	-	-	-	-	-	-	-
Koig. U/S	3		-	-	66.7	-	-	-	-	-	-	-	-	-	-	-
Koig. D/S	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
AWRb	3		-	-	66.7	-	-	-	-	-	-	-	-	-	-	-
AWRa	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-

All values represent percentages of 2010 samples that are both higher than the CCME guidelines and above analytical detection limits.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME 2002)

b) ISQG = Interim sediment quality guideline

c) PEL = Probable effects level

**Table 3.5-2. Stream and River Sediment Quality, Factor by which Average Concentrations are Higher than CCME Guidelines, Hope Bay Belt Project, 2010**

Stream/River	Total Number of Samples Collected	CCME Guideline value <sup>a</sup> (mg/kg):	Factor by which samples are higher than ISQG <sup>b</sup> guidelines							Factor by which samples are higher than PEL <sup>c</sup> guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
			5.9	0.6	37.3	35.7	35	0.17	123	17	3.5	90	197	91.3	0.486	315
<b>East</b>																
AWRe	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aim. NE IF	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Aimaokatalok</b>																
Aim. R.	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stickleback OF	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trout OF	3		-	-	1.28	-	-	-	-	-	-	-	-	-	-	-
S6	3		-	-	-	1.06	-	-	-	-	-	-	-	-	-	-
AWRd	3		1.98	-	-	-	-	-	-	-	-	-	-	-	-	-
AWRc	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Koignuk/Aimaokatalok</b>																
Koig. R.	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Koig. U/S	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Koig. D/S	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-
AWRb	3		-	-	1.14	-	-	-	-	-	-	-	-	-	-	-
AWRa	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-

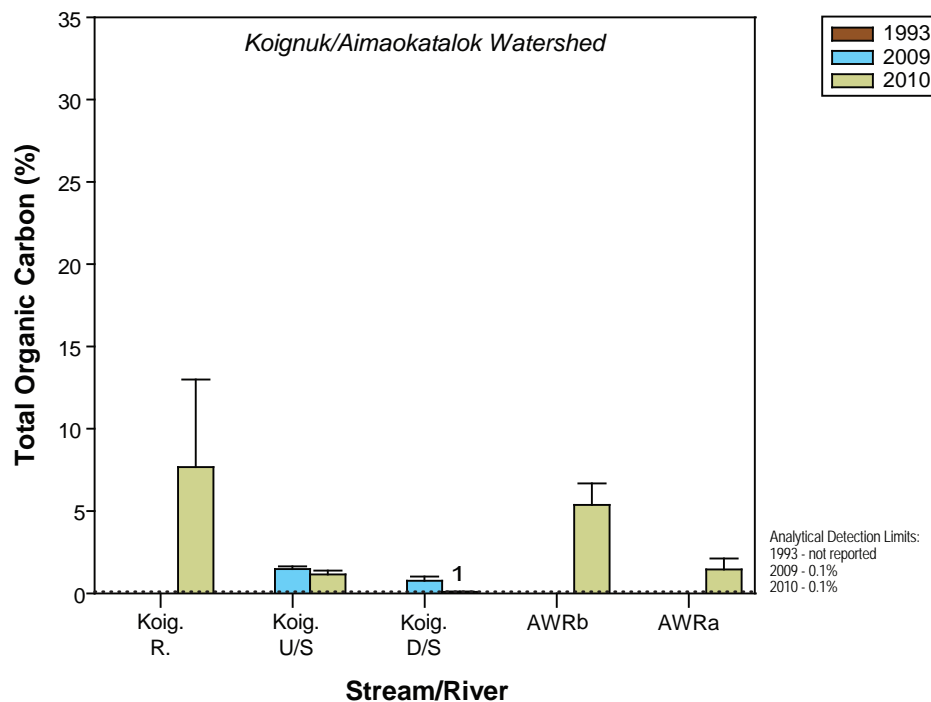
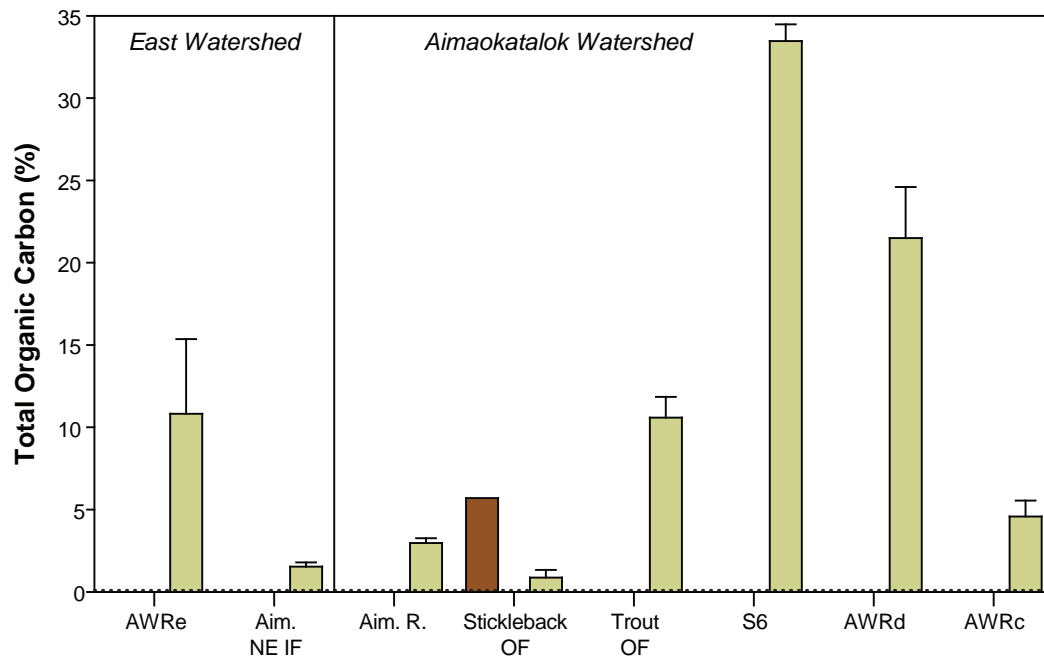
All values represent the factor by which 2010 stream/river averages are higher than CCME guidelines.

Even though a percentage of samples may be higher than a guideline amount, the calculated stream average may not be higher than a guideline amount.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME 2002)

b) ISQG = Interim sediment quality guideline

c) PEL = Probable Effects Level



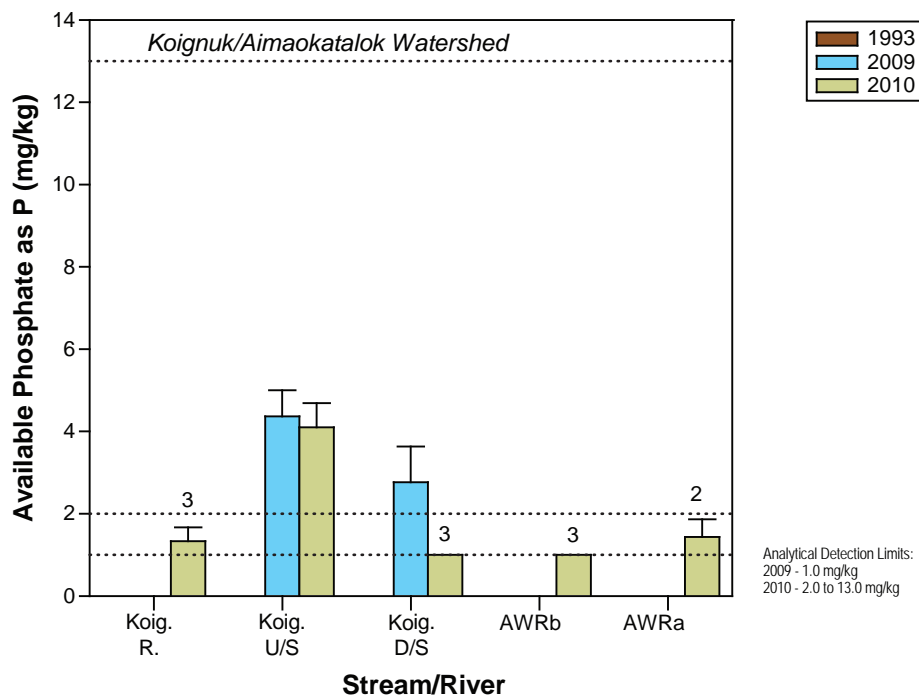
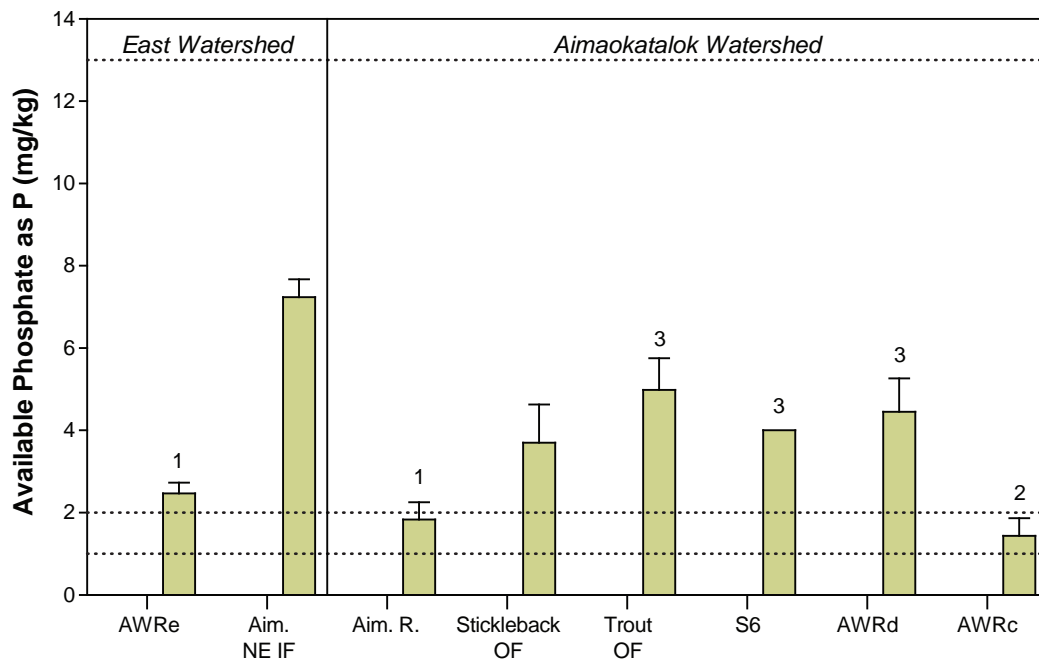
Notes: Error bars represent standard error of the mean.

Dotted lines represent analytical detection limits; values below the detection limit are plotted at half the detection limit.

Numbers above bars indicate the number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

There is no CCME guideline for total organic carbon.



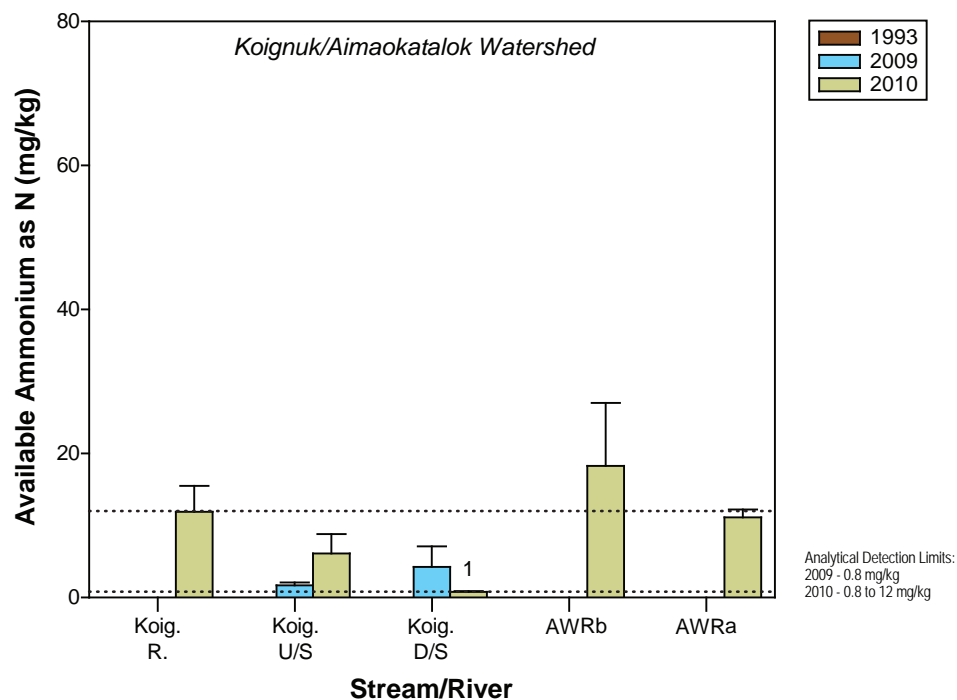
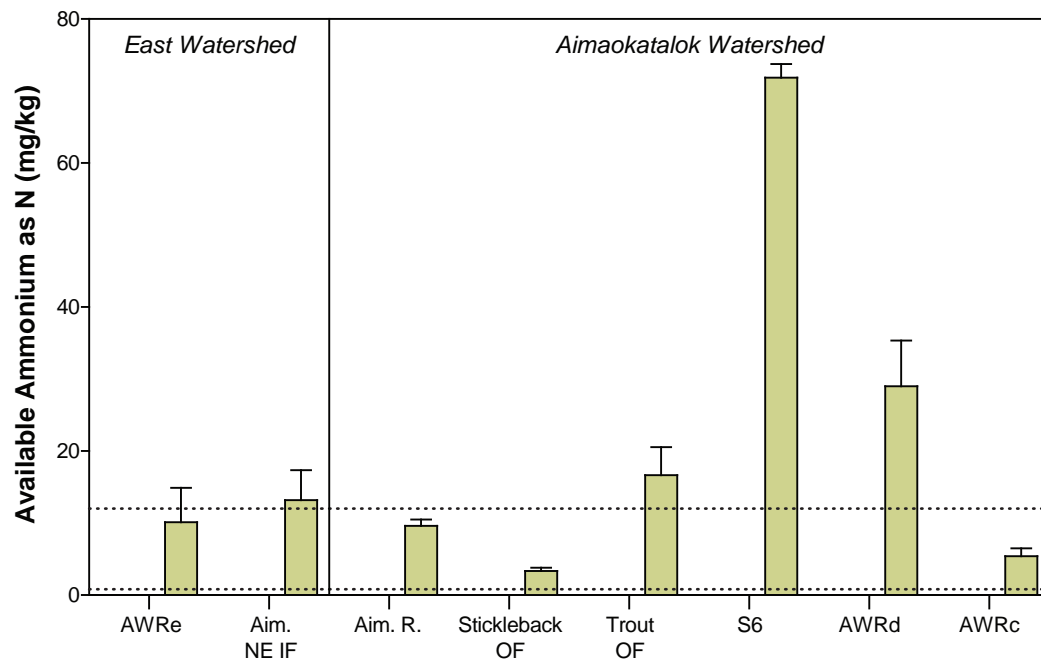
Notes: Error bars represent standard error of the mean.

Dotted lines represent analytical detection limits; values below the analytical detection limit are plotted at half the detection limit.

Numbers above bars indicate the number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

There is no CCME guideline for available phosphate.



Notes: Error bars represent standard error of the mean.

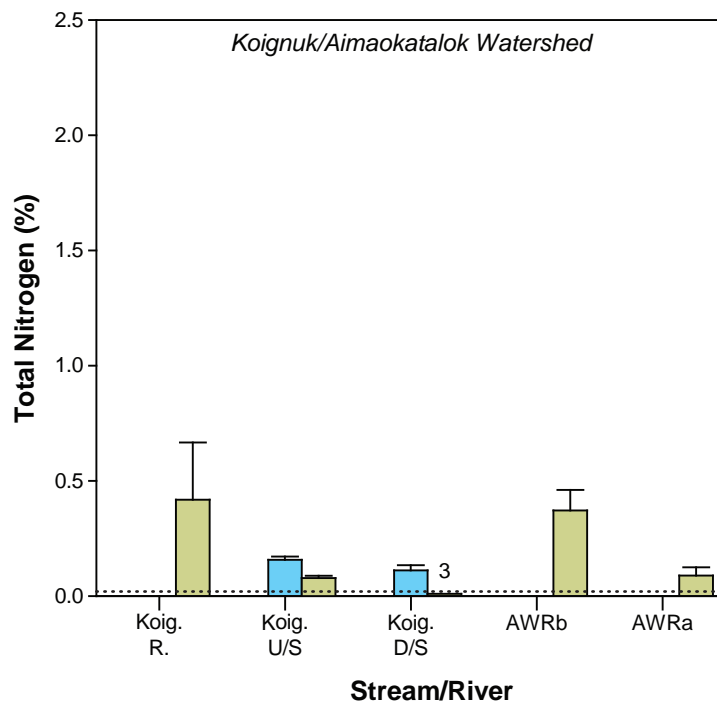
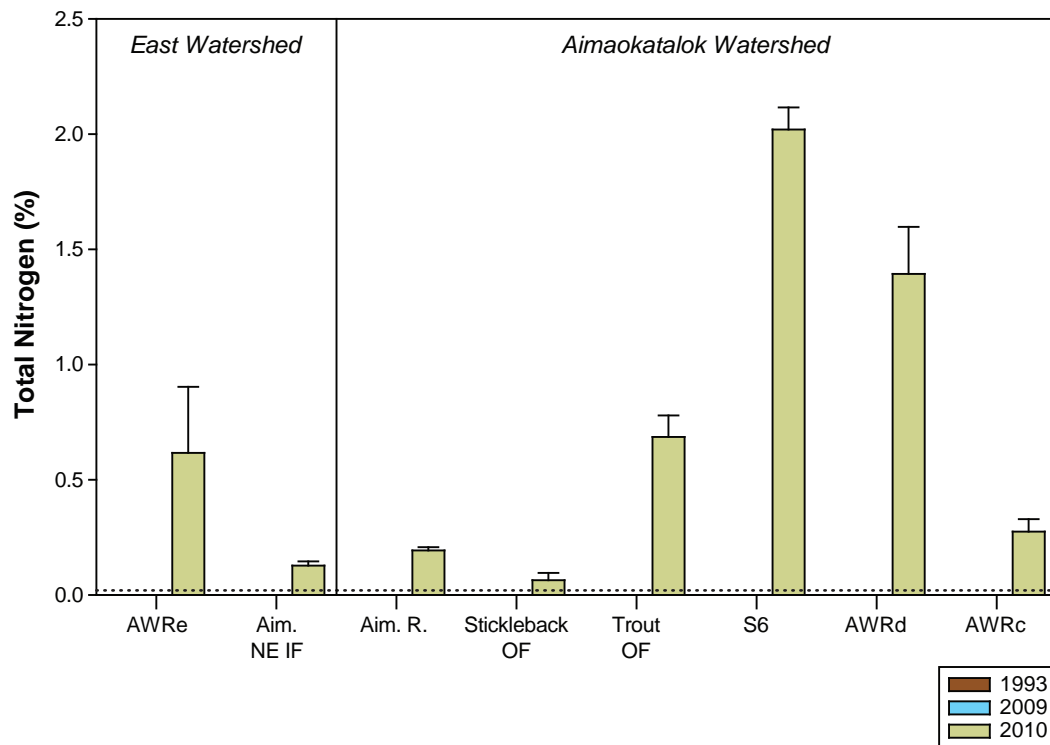
Dotted lines represent analytical detection limits; values below the analytical detection limit are plotted at half the detection limit.

Numbers above bars indicate the number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

There is no CCME guideline for available ammonium.

Figure 3.5-3c



Analytical Detection Limits:  
2009 - 0.02%  
2010 - 0.02%

Notes: Error bars represent standard error of the mean.

Dotted lines represent analytical detection limits; values below the analytical detection limit are plotted at half the detection limit.

Numbers above bars indicate number of replicates with concentrations below the analytical detection limit;

absence of a number indicates all replicates were above the detection limit.

There is no CCME guideline for total nitrogen.