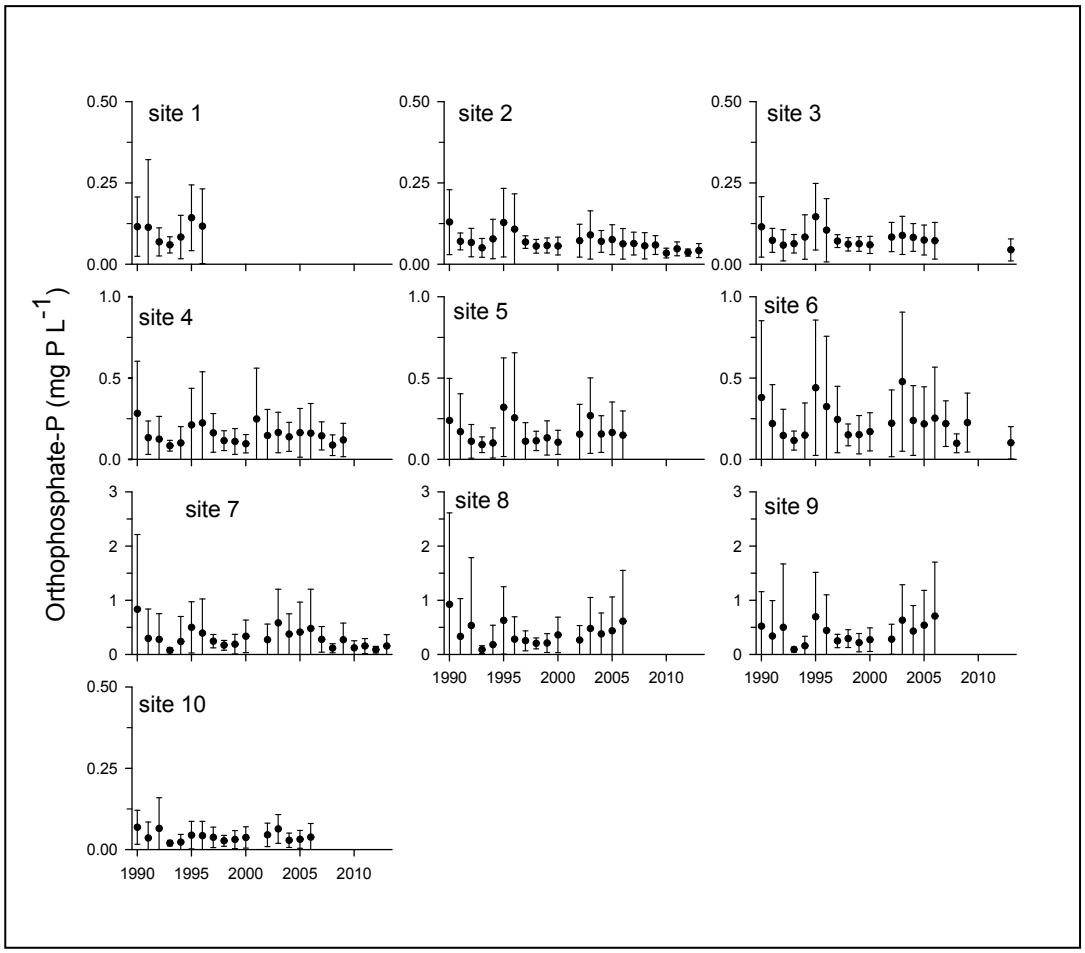
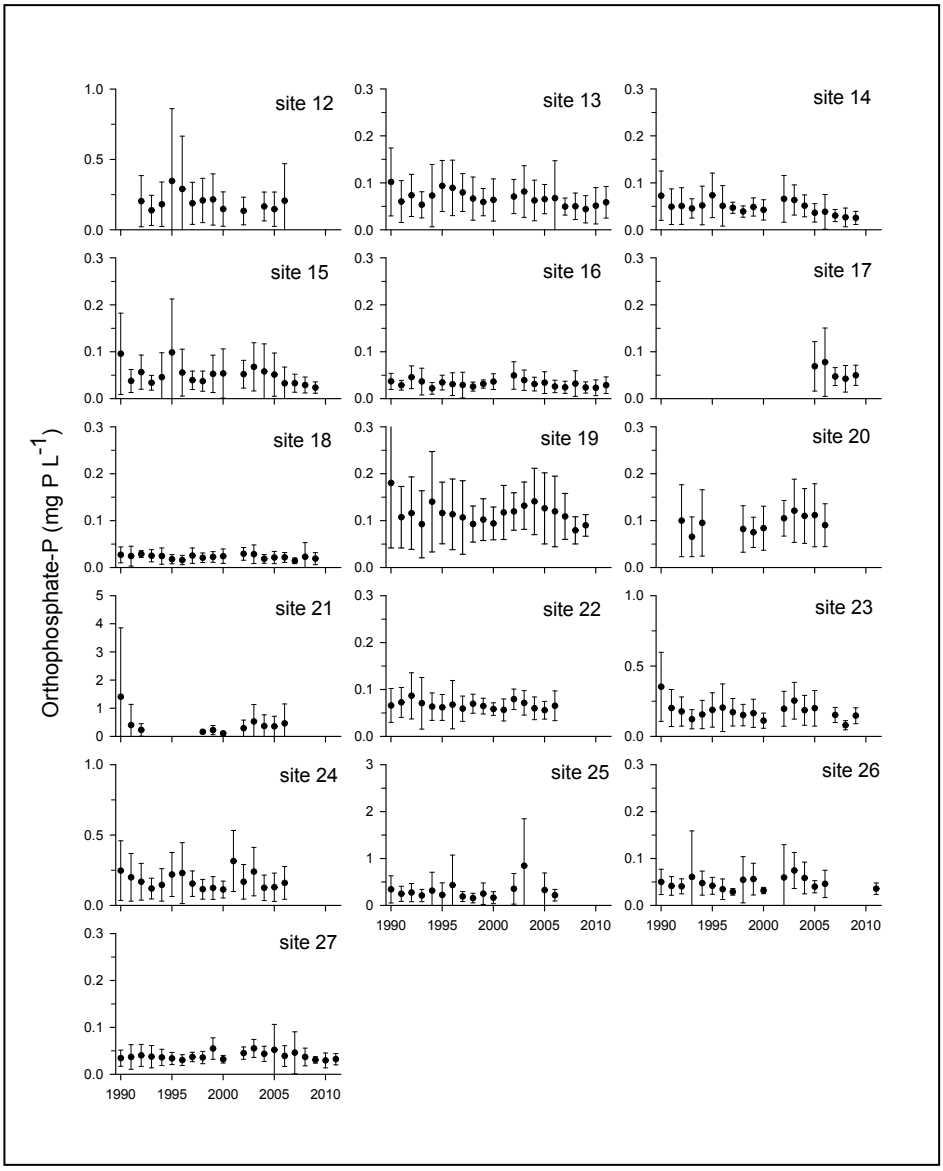
Supplementary Information 1. Sampling site, data availability, location and altitude.

River (tributary)	Sampling site	Data years	NGR	Altitude (m)[a]
Taw	(1) New Bridge	1990-1996	SS5699028280	6
Taw	(2) Chapelton F'bridge	1990-2013	SS5822026100	11
Taw	(3) Umberleigh	1990-2013	SS6079923682	19
Taw	(4) Newnham Bridge	1990-2013	SS6603017320	47
Taw	(5) Kersham Bridge	1990-2006	SS6620713554	52
Taw	(6) Chenson	1990-2013	SS7021509533	68
Taw	(7) Taw Bridge	1990-2013	SS6729406589	89
Taw	(8) Bondleigh	1990-2006	SS6578104549	100
Taw	(9) Yeo Farm	1990-2006	SS6512602871	121
Taw	(10) Rowden Moor	1990-2006	SX6550299476	128
Taw	(11) Sticklepath	1990-2006	SX6435794030	195
Mole	(12) S Molton d/s STW	1990-2006	SS7227425547	102
Mole	(13) New Bridge	1990-2012	SS7248022570	77
Mole	(14) Head Barton	1990-2009	SS6674018270	43
Mole (Crooked Oak)	(15) Alswear	1990-2010	SS7247022280	137
Mole (Little Silver Stream)	(16) Alswear	1990-2012	SS7234822104	81
Little Dart	(17) Dart Bridge	2005-2009	SS6690613720	59
L. Dart (Huntacott Water)	(18) u/s Chulmleigh	1990-2010	SS6968113830	72
Lapford Yeo (Dalch)	(19) Canns Mill Bridge	1990-2012	SS7851010490	121
Lapford Yeo (Dalch)	(20) u/s Lapford STW	1991-2006	SS7362907623	80
Lapford Yeo (Dalch)	(21) u/s Lapford Yeo confluence	1991-2006	SS7356407425	92
Lapford Yeo	(22) Bow Bridge	1990-2006	SS7173001740	102
Lapford Yeo	(23) Bury Bridge	1990-2010	SS7377806793	81
Lapford Yeo	(24) Nymet Bridge	1990-2006	SS7141709269	80
Lapford Yeo (Ash Brook)	(25) A377 bridge	1990-2006	SS7369006670	84
Barnstaple Yeo	(26) Collard Bridge	1990-2012	SS5955235665	39
Barnstaple Yeo	(27) Brockham Bridge	1900-2012	SS6034740817	137

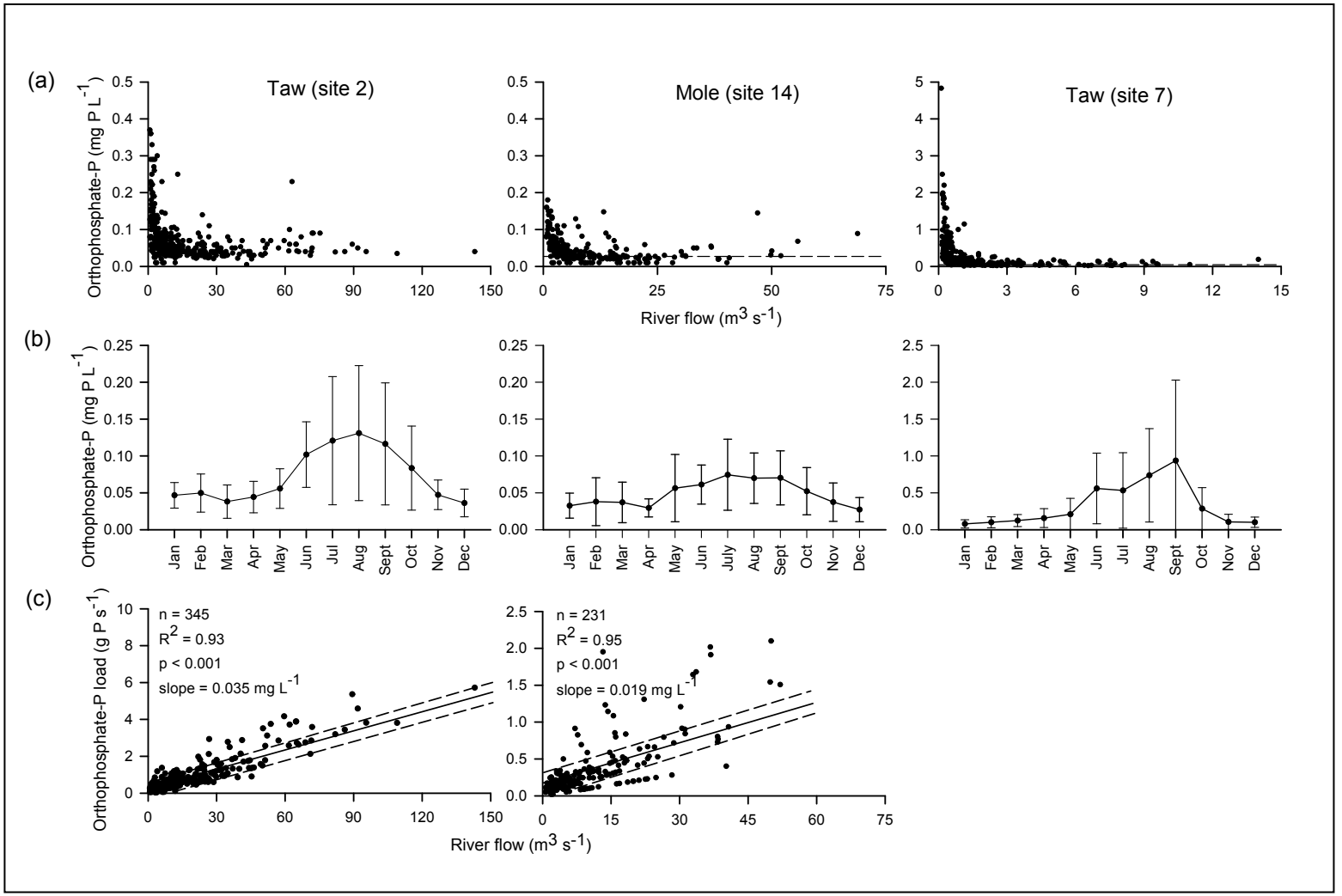
[a] Altitudes from gridreferencefinder.com. d/s, downstream; u/s, upstream



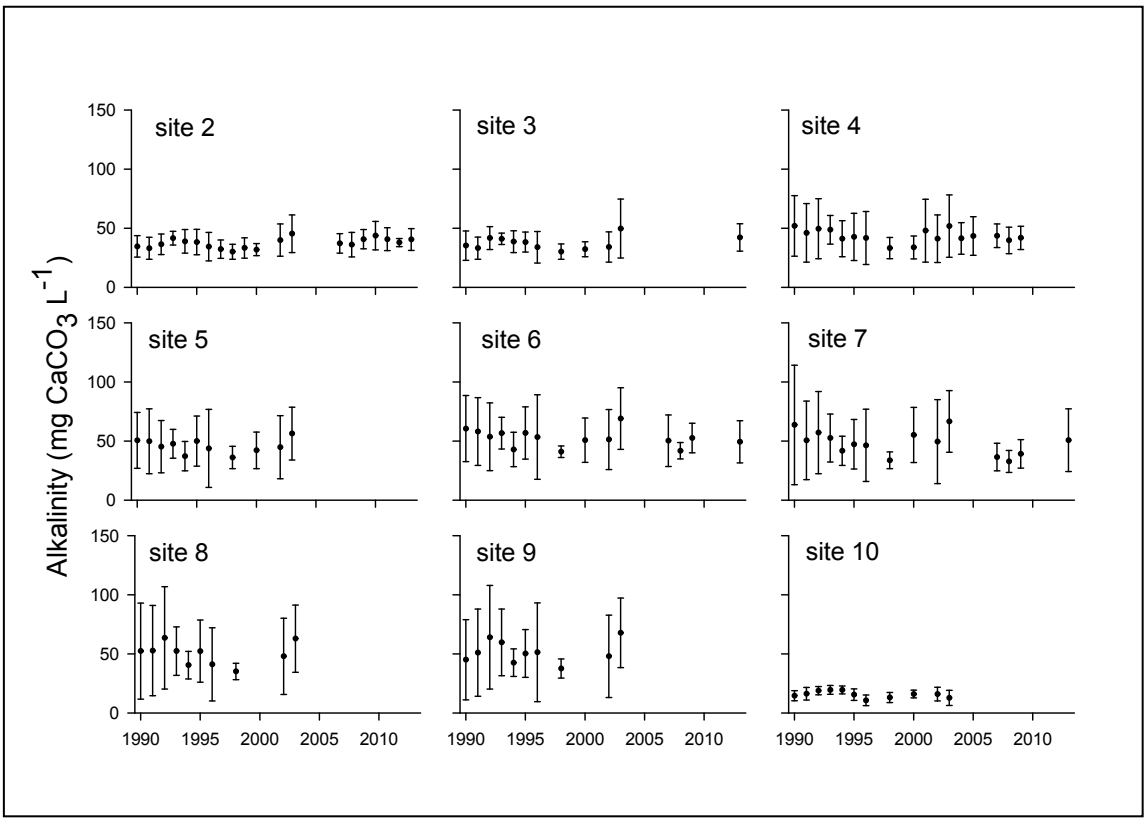
Supplementary Information 2. Annual mean (± 1 standard deviation) concentrations of orthophosphate-P (mg P L^{-1}) in the R. Taw (site locations are shown in Fig. 1). Note changes in concentration scales. Concentrations at site 11 were generally less than the limit of detection (0.04 mg P L^{-1}) and are not included.



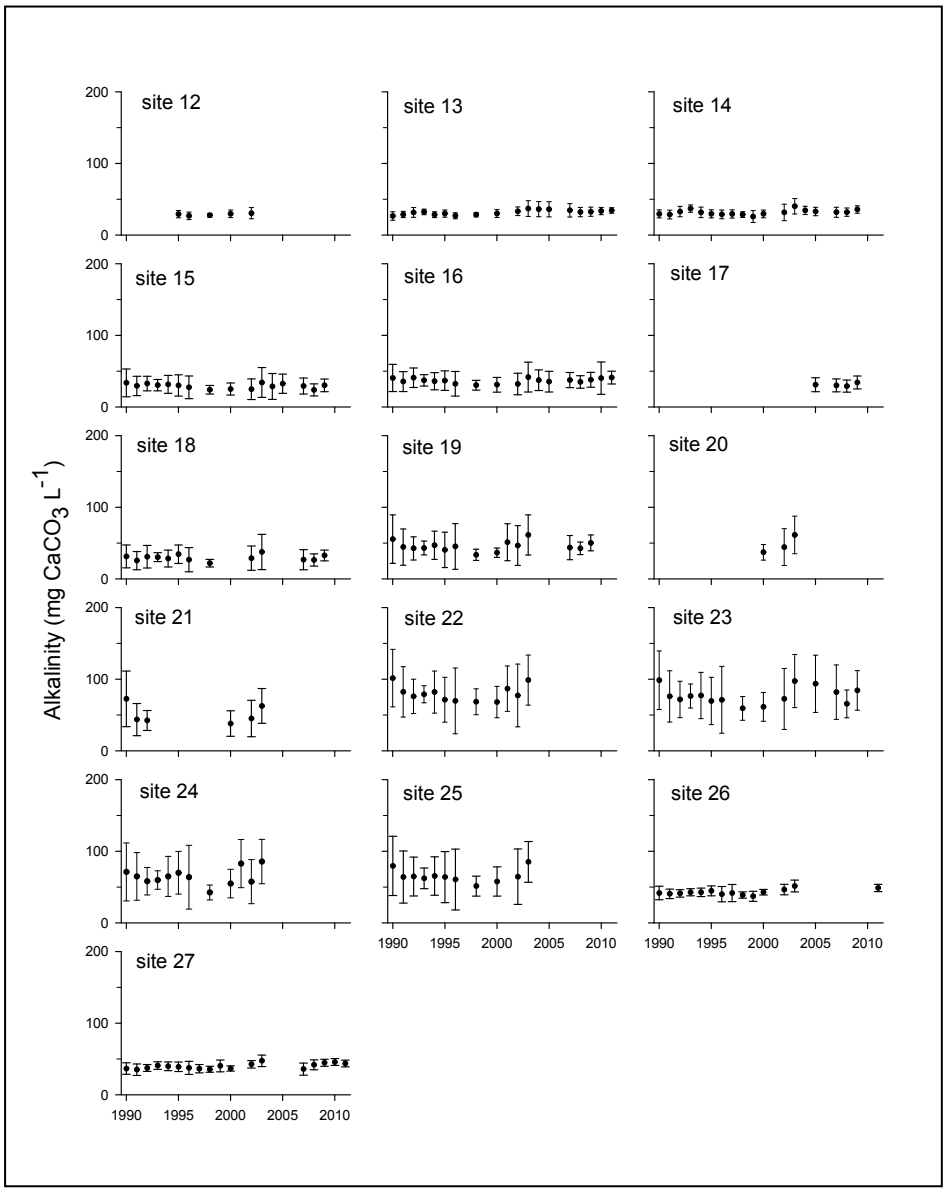
Supplementary Information 3. Annual mean (± 1 standard deviation) concentrations of orthophosphate-P (mg P L^{-1}) in the Taw tributary rivers (site locations are shown in Fig. 1). Note changes in concentration scales.



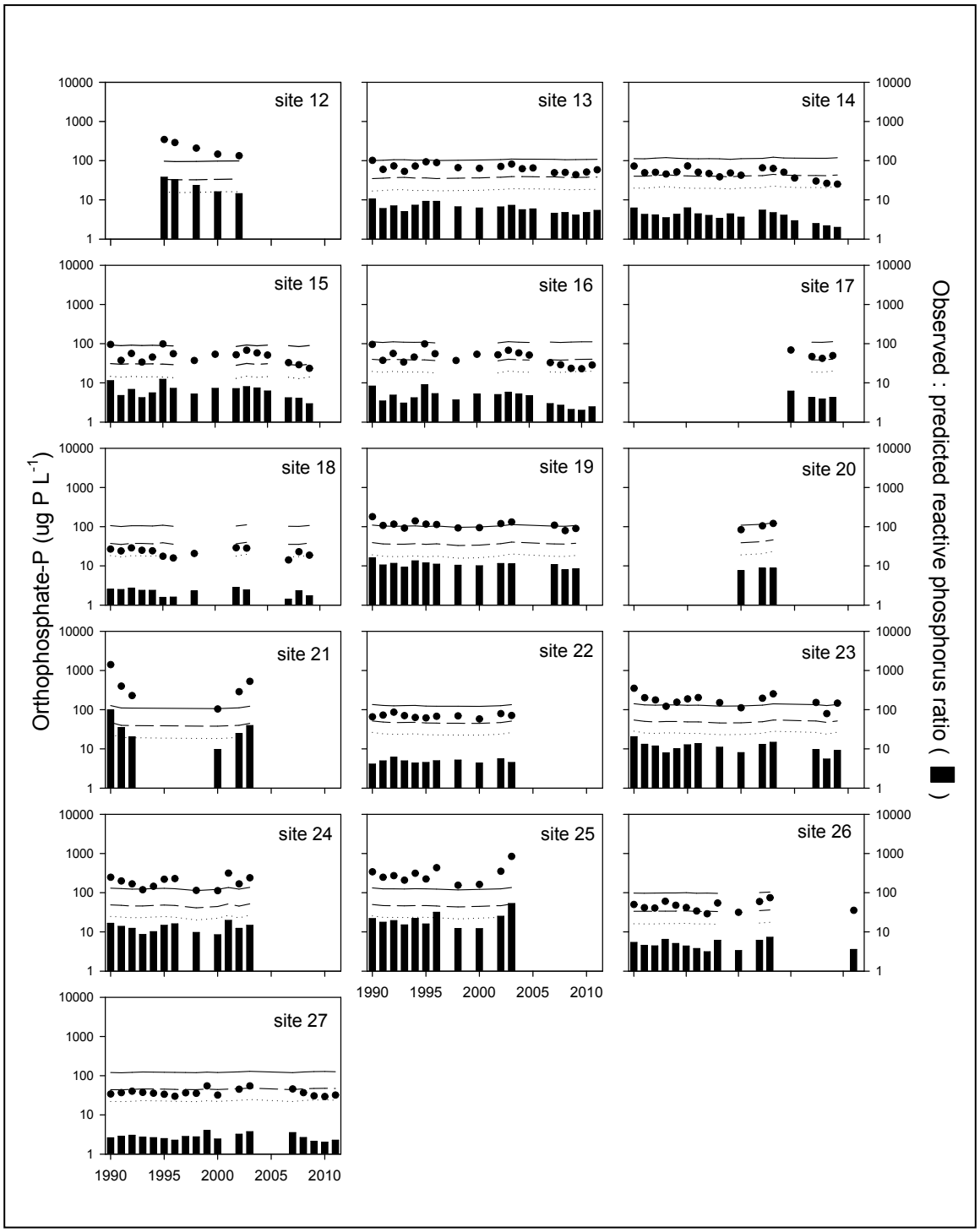
Supplementary Information 4. (a) Concentrations of orthophosphate-P (mg P L^{-1}) *vs* river flow (m^3 s^{-1}) for all years (1990 – 2013) at gauged sites on the R. Taw and R. Mole (site locations are shown in Fig. 1). (b) Monthly mean (± 1 standard deviation) concentrations of orthophosphate-P (mg P L^{-1}) for the same sites. (c) Orthophosphate-P load (g P s^{-1}) *vs* river flow (m^3 s^{-1}) for all years for the sites representing the outlets of the two rivers. Solid and dashed lines are the bisquare weight linear regression best fit and 95 % CI, respectively. Note changes in scales.



Supplementary Information 5. Annual mean (± 1 standard deviation) concentrations of total alkalinity (mg $CaCO_3$ L^{-1}) in the R. Taw (site locations are shown in Fig. 1)



Supplementary Information 6. Annual mean (± 1 standard deviation) concentrations of total alkalinity (mg $CaCO_3$ L^{-1}) in Taw tributary rivers (site locations are shown in Fig. 1).



Supplementary Information 7. Water Framework Directive (phase 2) reactive phosphorus standards for Taw tributary rivers. Solid line, poor/moderate boundary; dashed line, moderate/good boundary; dotted line, good/high boundary (all µg P L^{-1}). Mean annual concentrations of orthophosphate-P (●; µg P L^{-1}). Vertical bars show the ratio of the observed and predicted reactive phosphorus concentrations. Site locations are shown in Fig. 1.