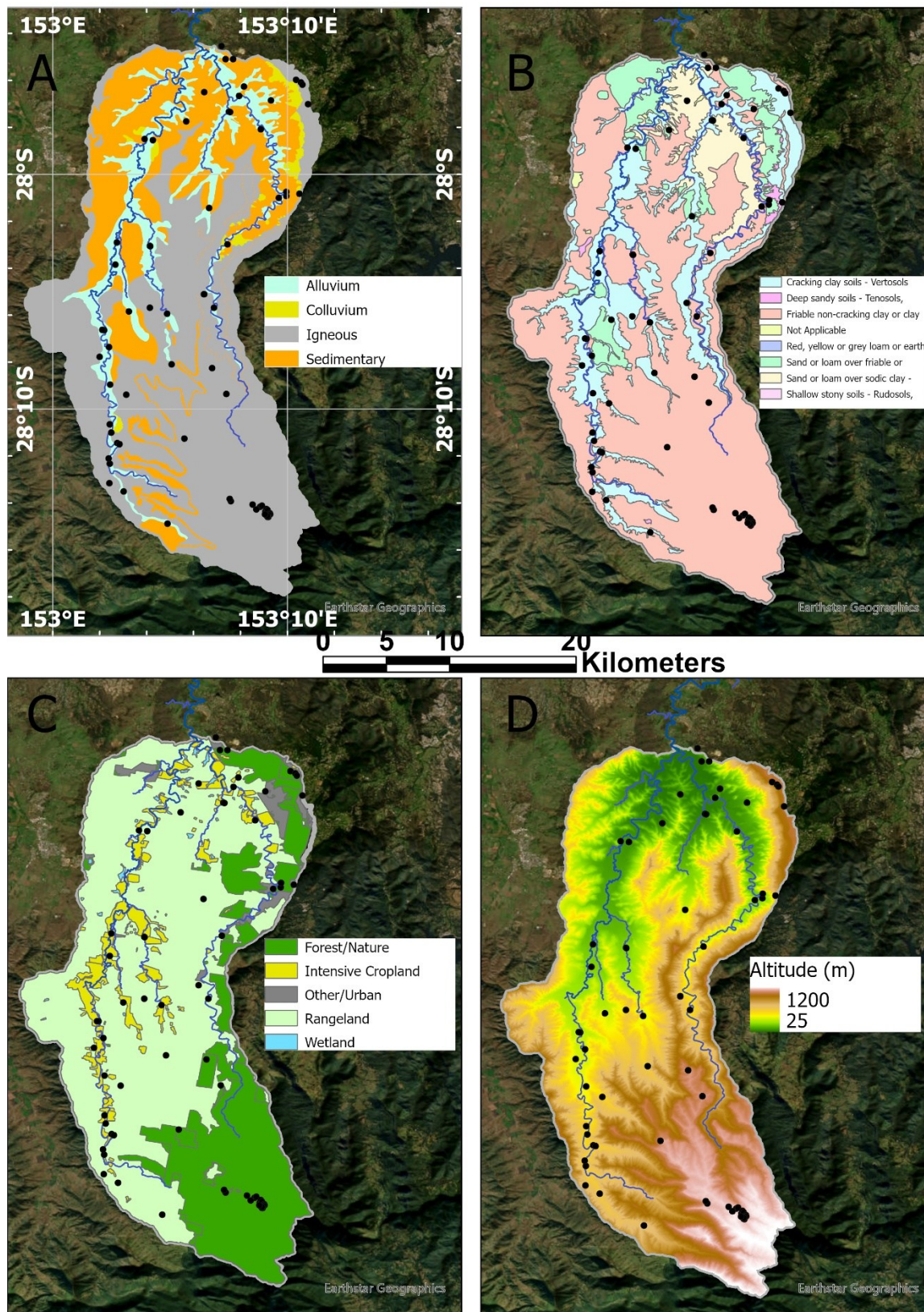




**Figure S1: Lithology (A), Soil (B), Land use (C), and Topography (D) of the Albert Catchment upstream of Bromfleet with indication of sampling points in black and rivers in blue.**

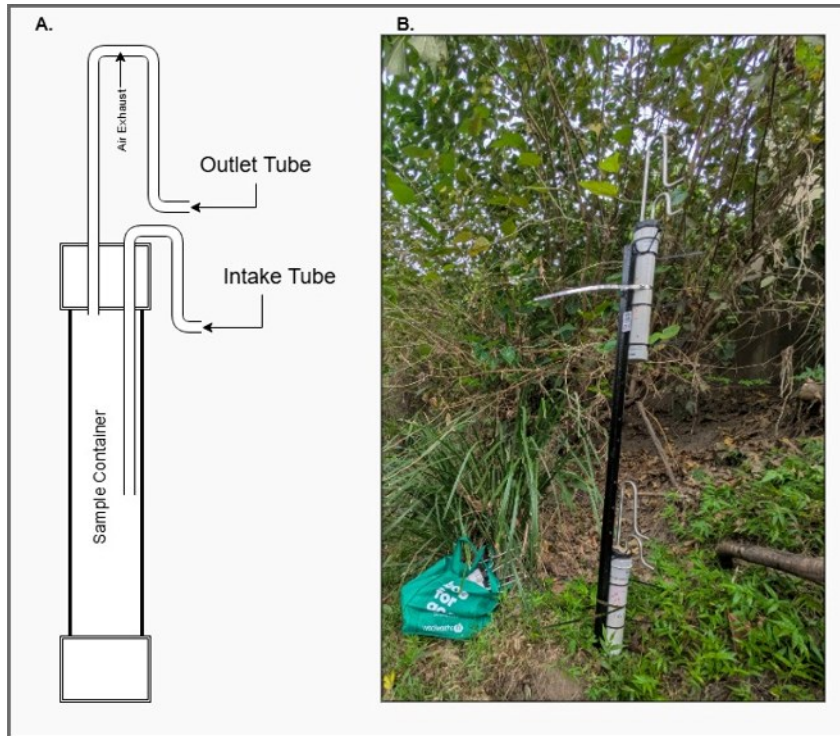
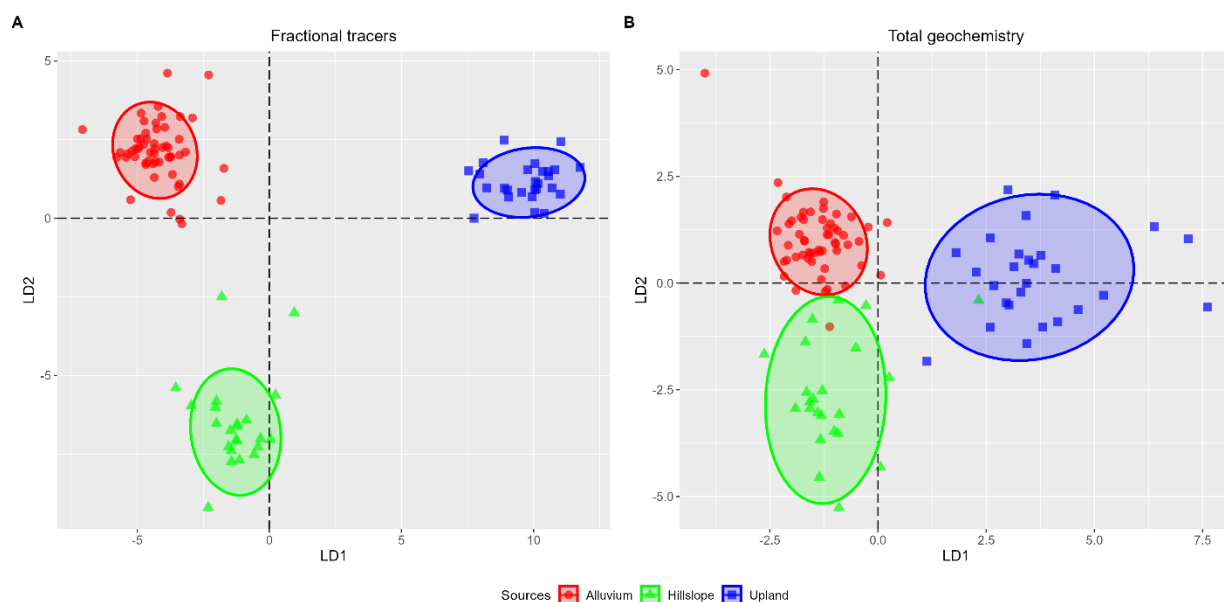


Figure S2: Rising stage sampler design (A) and example of deployment on river bank (B).

Table S1: results of the Spearman correlation analysis between predictors (Q = discharge; Hysteretic slope of phosphorus = HS\_PPC; Hysteretic slope of suspended sediment = HS\_SSC; and rainfall intensity) and response variables.  $\rho$ -value gives the strength and direction of the relationship and p-value below 0.05 is considered significant.

| Predictor                         | Response       | $\rho$ | p-value |
|-----------------------------------|----------------|--------|---------|
| Q (discharge)                     | PPC_tot        | 0.240  | 0.353   |
| Q (discharge)                     | PPC_ex         | 0.863  | 0.000   |
| Q (discharge)                     | PPC_car        | 0.115  | 0.660   |
| Q (discharge)                     | PPC_oxtot      | -0.225 | 0.384   |
| Q (discharge)                     | PPC_rec        | 0.456  | 0.066   |
| Q (discharge)                     | prop_PP_ex     | 0.865  | 0.000   |
| Q (discharge)                     | prop_PP_car    | -0.081 | 0.758   |
| Q (discharge)                     | prop_PP_ox     | -0.576 | 0.016   |
| Q (discharge)                     | prop_PP_rec    | 0.480  | 0.051   |
| Q (discharge)                     | Dx_10          | -0.689 | 0.002   |
| Q (discharge)                     | Dx_50          | -0.549 | 0.022   |
| Q (discharge)                     | Dx_90          | 0.020  | 0.940   |
| Q (discharge)                     | perc_below_63  | 0.248  | 0.338   |
| Q (discharge)                     | SSC_mgL.1      | 0.002  | 0.993   |
| Q (discharge)                     | mean_Alluvium  | -0.489 | 0.046   |
| Q (discharge)                     | mean_Hillslope | 0.448  | 0.072   |
| Q (discharge)                     | mean_Upland    | 0.264  | 0.307   |
| HS_PPC (Hysteretic Slope for PPC) | PPC_tot        | 0.550  | 0.027   |

|                                   |                |        |       |
|-----------------------------------|----------------|--------|-------|
| HS_PPC (Hysteretic Slope for PPC) | PPC_ex         | 0.062  | 0.820 |
| HS_PPC (Hysteretic Slope for PPC) | PPC_car        | 0.624  | 0.010 |
| HS_PPC (Hysteretic Slope for PPC) | PPC_oxtot      | 0.035  | 0.897 |
| HS_PPC (Hysteretic Slope for PPC) | PPC_rec        | 0.221  | 0.412 |
| HS_PPC (Hysteretic Slope for PPC) | prop_PP_ex     | -0.065 | 0.812 |
| HS_PPC (Hysteretic Slope for PPC) | prop_PP_car    | 0.121  | 0.656 |
| HS_PPC (Hysteretic Slope for PPC) | prop_PP_ox     | -0.018 | 0.948 |
| HS_PPC (Hysteretic Slope for PPC) | prop_PP_rec    | -0.615 | 0.011 |
| HS_SSC (Hysteretic Slope for SSC) | Dx 10          | 0.309  | 0.244 |
| HS_SSC (Hysteretic Slope for SSC) | Dx 50          | 0.324  | 0.222 |
| HS_SSC (Hysteretic Slope for SSC) | Dx 90          | 0.112  | 0.680 |
| HS_SSC (Hysteretic Slope for SSC) | perc below 63  | -0.282 | 0.289 |
| HS_SSC (Hysteretic Slope for SSC) | SSC mg/L       | 0.326  | 0.217 |
| HS_SSC (Hysteretic Slope for SSC) | mean Alluvium  | 0.094  | 0.729 |
| HS_SSC (Hysteretic Slope for SSC) | mean Hillslope | -0.047 | 0.863 |
| HS_SSC (Hysteretic Slope for SSC) | mean Upland    | -0.377 | 0.150 |
| Rainfall intensity                | PPC_tot        | 0.821  | 0.000 |
| Rainfall intensity                | PPC_ex         | 0.015  | 0.955 |
| Rainfall intensity                | PPC_car        | -0.165 | 0.527 |
| Rainfall intensity                | PPC_oxtot      | 0.648  | 0.005 |
| Rainfall intensity                | PPC_rec        | 0.555  | 0.021 |
| Rainfall intensity                | mean Alluvium  | -0.363 | 0.152 |
| Rainfall intensity                | mean Hillslope | 0.523  | 0.031 |
| Rainfall intensity                | mean Upland    | -0.203 | 0.435 |



**Figure S3: Linear discriminant analysis of the three source groups with A. the fractional elements (carbonates, oxides, and recalcitrant), and B. the total geochemistry (sum of exchangeable, carbonated, oxides, and recalcitrant).**

**Table S2: overview of all CTS outcomes with supporting tracers and the quantitative indicators of support (number of tracers, pairs, mean conservative and discrimination score), and the contribution of different sources. Selected in green.**

| Sediment Mixture               | # CTS tracers | CTS selected tracers                                                                                                           | Cluster pairs | Mean Cons | Mean disc | Mean Alluvium | SD Alluvium | Mean Hillslope | SD Hillslope | Mean Upland | SD Upland |
|--------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------|---------------|-----------|-----------|---------------|-------------|----------------|--------------|-------------|-----------|
| PSA22<br>Option 1<br>Cluster 1 | 10            | Ba_oxtot<br>Ca_rec<br>Cr_oxtot<br>Fe_oxtot<br>Mn_rec<br>Mo_rec<br>P_oxtot<br>P_rec<br>Ti_oxtot<br>V_oxtot                      | 57            | 0.62      | 0.27      | 0.17          | 0.06        | 0.77           | 0.05         | 0.06        | 0.04      |
| PSA22<br>Option 2<br>Cluster 2 | 10            | Al_oxtot<br>Al_rec<br>Ba_oxtot<br>Ca_oxtot<br>Cd_oxtot<br>Cu_rec<br>Ni_oxtot<br>Ni_rec<br>Pb_rec<br>U_rec                      | 64            | 0.63      | 0.20      | 0.71          | 0.04        | 0.06           | 0.03         | 0.23        | 0.02      |
| PSA22<br>Option 3<br>Cluster 3 | 12            | Al_oxtot<br>Al_rec<br>As_rec<br>Ba_oxtot<br>Ca_rec<br>Cd_oxtot<br>Co_rec<br>Mn_rec<br>Mo_rec<br>P_oxtot<br>Pb_car<br>U_oxtot   | 68            | 0.70      | 0.27      | 0.15          | 0.04        | 0.51           | 0.04         | 0.34        | 0.03      |
| PSA22<br>Option 4<br>Cluster 1 | 12            | Al_oxtot<br>Al_rec<br>Ba_oxtot<br>Cd_oxtot<br>Co_oxtot<br>Co_rec<br>Mn_rec<br>Mo_rec<br>Pb_car<br>Pb_oxtot<br>U_oxtot<br>V_rec | 57            | 0.62      | 0.27      | 0.27          | 0.04        | 0.42           | 0.03         | 0.31        | 0.03      |

|                                |    |                                                                                                                                       |    |      |      |      |      |      |      |      |      |
|--------------------------------|----|---------------------------------------------------------------------------------------------------------------------------------------|----|------|------|------|------|------|------|------|------|
| PSA22<br>Option 5<br>Cluster 1 | 11 | As_rec<br>Ba_oxtot<br>Co_oxtot<br>Cr_oxtot<br>Fe_oxtot<br>Mo_rec<br>P_rec<br>Pb_car<br>Pb_oxtot<br>U_oxtot<br>V_rec                   | 57 | 0.62 | 0.27 | 0.46 | 0.05 | 0.54 | 0.04 | 0.01 | 0.04 |
| PSA22<br>Option 6<br>Cluster 4 | 10 | As_oxtot<br>Ba_oxtot<br>Ca_rec<br>Co_oxtot<br>Cs_oxtot<br>Mn_rec<br>Pb_oxtot<br>Pb_rec<br>U_rec<br>V_rec                              | 19 | 0.45 | 0.49 | 0.14 | 0.04 | 0.08 | 0.11 | 0.78 | 0.12 |
| PSA23<br>Option 1<br>Cluster 1 | 13 | Al_oxtot<br>Al_rec<br>Ba_oxtot<br>Ca_rec<br>Cd_oxtot<br>Cs_rec<br>Cu_rec<br>Mn_rec<br>Mo_rec<br>P_oxtot<br>Pb_car<br>U_oxtot<br>V_rec | 21 | 0.77 | 0.08 | 0.44 | 0.03 | 0.44 | 0.03 | 0.12 | 0.02 |
| PSA23<br>Option 2<br>Cluster 2 | 10 | Al_oxtot<br>Al_rec<br>As_rec<br>Ba_oxtot<br>Cd_oxtot<br>Co_oxtot<br>Co_rec<br>Cr_rec<br>Mo_rec<br>Ni_oxtot                            | 19 | 0.82 | 0.07 | 0.66 | 0.04 | 0.25 | 0.03 | 0.09 | 0.02 |
| PSA23<br>Option 3<br>Cluster 3 | 11 | As_rec<br>Ba_oxtot<br>Ca_rec<br>Cd_oxtot<br>Co_oxtot<br>Co_rec<br>Cr_rec<br>Mn_rec<br>Mo_rec<br>Ni_rec<br>V_rec                       | 10 | 0.98 | 0.09 | 0.44 | 0.03 | 0.26 | 0.03 | 0.30 | 0.04 |

|                                |    |                                                                                                                                                                          |    |      |      |       |      |      |      |      |      |
|--------------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|------|------|-------|------|------|------|------|------|
| PSA24<br>Option 1<br>Cluster 1 | 4  | Cr_car<br>Cs_oxtot<br>Cs_rec<br>Mg_oxtot                                                                                                                                 | 14 | 0.60 | 0.20 | 0.73  | 0.04 | 0.12 | 0.04 | 0.15 | 0.04 |
| PSA24<br>Option 2<br>Cluster 2 | 3  | Ba_car<br>Cs_rec<br>Mn_car                                                                                                                                               | 3  | 0.73 | 0.15 | 0.27  | 0.12 | 0.13 | 0.06 | 0.60 | 0.12 |
| PSA24<br>Option 3<br>Cluster 3 | 4  | Ca_rec<br>Cs_oxtot<br>Pb_car<br>U_rec                                                                                                                                    | 1  | 0.39 | 0.39 | -0.02 | 0.08 | 0.97 | 0.18 | 0.06 | 0.19 |
| PSA25<br>Option 1<br>Cluster 1 | 14 | Al_oxtot<br>Al_rec<br>Ca_rec<br>Cd_car<br>Co_car<br>Co_oxtot<br>Co_rec<br>Cr_oxtot<br>Fe_oxtot<br>Fe_rec<br>Mo_oxtot<br>Sb_car<br>V_car<br>Zn_oxtot                      | 15 | 0.87 | 0.07 | 0.52  | 0.03 | 0.42 | 0.03 | 0.06 | 0.02 |
| PSA25<br>Option 2<br>Cluster 2 | 16 | Al_oxtot<br>Al_rec<br>Cd_car<br>Co_car<br>Cr_rec<br>Cs_oxtot<br>Cs_rec<br>Mg_rec<br>Mo_oxtot<br>Mo_rec<br>Ni_oxtot<br>Ni_rec<br>Pb_car<br>Pb_oxtot<br>Sb_car<br>Zn_oxtot | 23 | 0.92 | 0.06 | 0.73  | 0.03 | 0.22 | 0.02 | 0.05 | 0.02 |
| PSA25<br>Option 3<br>Cluster 3 | 11 | Ca_rec<br>Cd_car<br>Co_oxtot<br>Cr_rec<br>Cs_rec<br>Fe_rec<br>Mo_rec<br>Ni_rec<br>Sb_car<br>V_car<br>Zn_oxtot                                                            | 4  | 0.98 | 0.07 | 0.48  | 0.04 | 0.27 | 0.03 | 0.25 | 0.04 |
| PSA25<br>Option 4<br>Cluster 4 | 13 | Al_oxtot<br>Al_rec<br>Co_car                                                                                                                                             | 7  | 0.92 | 0.08 | 0.31  | 0.05 | 0.59 | 0.04 | 0.10 | 0.02 |

|                                |    |                                                                                                                                     |    |      |      |      |      |      |      |      |      |
|--------------------------------|----|-------------------------------------------------------------------------------------------------------------------------------------|----|------|------|------|------|------|------|------|------|
|                                |    | Co_rec<br>Cr_oxtot<br>Fe_oxtot<br>Mn_rec<br>Mo_oxtot<br>P_oxtot<br>Sb_car<br>Ti_rec<br>V_car<br>V_rec                               |    |      |      |      |      |      |      |      |      |
| PSA25<br>Option 5<br>Cluster 5 | 8  | Cd_car<br>Co_rec<br>Mn_rec<br>Ni_rec<br>P_oxtot<br>Sb_car<br>V_car<br>V_rec                                                         | 1  | 0.99 | 0.08 | 0.22 | 0.06 | 0.45 | 0.04 | 0.33 | 0.07 |
| PSA26<br>Option 1<br>Cluster 1 | 10 | Al_rec<br>Ca_rec<br>Co_rec<br>Cr_rec<br>Cs_rec<br>Fe_rec<br>Ni_rec<br>Sb_car<br>Ti_rec<br>V_rec                                     | 13 | 0.97 | 0.08 | 0.55 | 0.03 | 0.35 | 0.02 | 0.11 | 0.02 |
| PSA26<br>Option 2<br>Cluster 2 | 11 | Al_oxtot<br>Al_rec<br>Co_rec<br>Cs_rec<br>Mg_rec<br>Ni_oxtot<br>Ni_rec<br>Pb_car<br>Sb_car<br>Ti_rec<br>Zn_car                      | 27 | 0.73 | 12   | 0.69 | 0.03 | 0.29 | 0.02 | 0.02 | 0.02 |
| PSA26<br>Option 3<br>Cluster 3 | 13 | Al_oxtot<br>Al_rec<br>Ca_rec<br>Co_oxtot<br>Co_rec<br>Cr_rec<br>Fe_rec<br>Mn_rec<br>Ni_rec<br>Sb_car<br>Ti_rec<br>V_rec<br>Zn_oxtot | 9  | 0.87 | 0.07 | 0.51 | 0.03 | 0.39 | 0.02 | 0.10 | 0.02 |
| PSA26<br>Option 4<br>Cluster 4 | 3  | Al_rec<br>Pb_oxtot<br>Sb_car                                                                                                        | 1  | 0.54 | 0.05 | 0.96 | 0.09 | 0.02 | 0.07 | 0.02 | 0.03 |

|                                   |   |                                                                                       |    |      |      |       |      |      |      |       |      |
|-----------------------------------|---|---------------------------------------------------------------------------------------|----|------|------|-------|------|------|------|-------|------|
| PSA28_29<br>Option 1<br>Cluster 1 | 2 | Cr_car<br>Zn_oxtot                                                                    | 2  | 0.53 | 0.18 | 0.14  | 0.24 | 0.57 | 0.19 | 0.28  | 0.08 |
| PSA28_29<br>Option 2<br>Cluster 2 | 3 | Co_car<br>Cs_oxtot<br>Cs_rec                                                          | 1  | 0.30 | 0.11 | 0.69  | 0.11 | 0.37 | 0.10 | -0.06 | 0.05 |
| PSA28_29<br>Option 3<br>Cluster 3 | 5 | Ba_car<br>Ca_rec<br>Cs_rec<br>Mn_car<br>Zn_oxtot                                      | 7  | 0.43 | 0.36 | -0.02 | 0.05 | 0.35 | 0.10 | 0.67  | 0.10 |
| PSA28_29<br>Option 4<br>Cluster 4 | 2 | Cr_car<br>Cs_rec                                                                      | 3  | 0.81 | 0.25 | 0.39  | 0.15 | 0.37 | 0.11 | 0.24  | 0.07 |
| PSA28_29<br>Option 5<br>Cluster 5 | 4 | Co_car<br>Cs_oxtot<br>Ti_car<br>Zn_oxtot                                              | 2  | 0.34 | 0.53 | 0.32  | 0.18 | 0.79 | 0.17 | -0.11 | 0.09 |
| PSA30<br>Option 1<br>Cluster 1    | 7 | Ba_rec<br>Cr_rec<br>Mo_oxtot<br>Ni_rec<br>P_rec<br>Pb_rec<br>U_rec                    | 4  | 0.53 | 0.07 | 0.72  | 0.05 | 0.09 | 0.03 | 0.19  | 0.04 |
| PSA30<br>Option 2<br>Cluster 2    | 8 | Al_oxtot<br>Ca_rec<br>Co_rec<br>Cr_oxtot<br>Cu_rec<br>Mo_oxtot<br>Pb_oxtot<br>W_oxtot | 7  | 0.85 | 0.07 | 0.19  | 0.04 | 0.57 | 0.03 | 0.09  | 0.03 |
| PSA30<br>Option 3<br>Cluster 3    | 7 | Al_rec<br>As_rec<br>Ca_rec<br>Mo_oxtot<br>P_rec<br>Pb_rec<br>V_rec                    | 9  | 0.98 | 0.09 | 0.38  | 0.03 | 0.35 | 0.04 | 0.27  | 0.03 |
| PSA30<br>Option 4<br>Cluster 4    | 7 | Al_oxtot<br>As_rec<br>Cr_oxtot<br>Fe_rec<br>Mg_rec<br>Mo_oxtot<br>Pb_rec              | 15 | 0.96 | 0.08 | 0.64  | 0.04 | 0.31 | 0.03 | 0.05  | 0.03 |
| PSA30<br>Option 5<br>Cluster 5    | 7 | Ca_oxtot<br>Ca_rec<br>Cr_rec<br>Fe_rec<br>Mo_oxtot<br>Pb_rec<br>U_rec                 | 4  | 0.89 | 0.09 | 0.39  | 0.03 | 0.13 | 0.05 | 0.48  | 0.06 |

|                                |    |                                                                                                                   |    |      |      |      |      |       |      |      |      |
|--------------------------------|----|-------------------------------------------------------------------------------------------------------------------|----|------|------|------|------|-------|------|------|------|
| PSA30<br>Option 6<br>Cluster 6 | 10 | Al_oxtot<br>Ca_oxtot<br>Cr_oxtot<br>Cu_rec<br>Mn_rec<br>Mo_oxtot<br>P_rec<br>Pb_oxtot<br>Ti_rec<br>W_oxtot        | 11 | 0.76 | 0.11 | 0.14 | 0.07 | 0.68  | 0.05 | 0.19 | 0.05 |
| PSA31<br>Option 1<br>Cluster 1 | 11 | Al_oxtot<br>As_rec<br>Ca_oxtot<br>Ca_rec<br>Cd_oxtot<br>Co_rec<br>Cr_oxtot<br>Cu_rec<br>Pb_rec<br>Ti_rec<br>V_rec | 11 | 0.85 | 0.10 | 0.26 | 0.05 | 0.63  | 0.03 | 0.11 | 0.04 |
| PSA31<br>Option 2<br>Cluster 2 | 7  | Al_rec<br>Ba_rec<br>Cd_oxtot<br>Fe_rec<br>Mg_rec<br>Ni_rec<br>P_rec                                               | 12 | 0.79 | 0.09 | 0.50 | 0.04 | 0.24  | 0.03 | 0.26 | 0.03 |
| PSA31<br>Option 3<br>Cluster 3 | 7  | Al_oxtot<br>Ba_rec<br>Cd_oxtot<br>Cr_oxtot<br>Fe_rec<br>Mg_rec<br>Pb_rec                                          | 5  | 0.77 | 0.08 | 0.55 | 0.04 | 0.39  | 0.03 | 0.06 | 0.03 |
| PSA31<br>Option 4<br>Cluster 4 | 6  | Al_rec<br>Ca_oxtot<br>Ca_rec<br>Cd_oxtot<br>P_rec<br>Pb_rec                                                       | 8  | 0.99 | 0.08 | 0.30 | 0.04 | 0.43  | 0.05 | 0.27 | 0.04 |
| PSA31<br>Option 5<br>Cluster 5 | 6  | Ba_rec<br>Cd_oxtot<br>Cr_rec<br>Ni_oxtot<br>Ni_rec<br>U_rec                                                       | 4  | 0.50 | 0.07 | 0.86 | 0.05 | -0.01 | 0.03 | 0.15 | 0.05 |
| PSA31<br>Option 6<br>Cluster 6 | 6  | Al_rec<br>Cd_oxtot<br>Co_rec<br>P_rec<br>Pb_rec<br>V_rec                                                          | 10 | 0.62 | 0.11 | 0.15 | 0.07 | 0.56  | 0.06 | 0.30 | 0.05 |

|                                   |   |                                                                                  |    |      |      |       |      |       |      |      |      |
|-----------------------------------|---|----------------------------------------------------------------------------------|----|------|------|-------|------|-------|------|------|------|
| PSA32_33<br>Option 1<br>Cluster 1 | 5 | Al_oxtot<br>Ca_oxtot<br>Mn_rec<br>Mo_oxtot<br>U_oxtot                            | 12 | 0.67 | 0.13 | 0.64  | 0.04 | 0.13  | 0.04 | 0.23 | 0.03 |
| PSA32_33<br>Option 2<br>Cluster 2 | 7 | Ca_oxtot<br>Co_oxtot<br>Cr_oxtot<br>Fe_oxtot<br>Mn_rec<br>Mo_oxtot<br>P_oxtot    | 25 | 0.68 | 0.17 | 0.57  | 0.04 | 0.34  | 0.04 | 0.10 | 0.03 |
| PSA32_33<br>Option 3<br>Cluster 3 | 4 | Al_rec<br>Co_oxtot<br>P_oxtot<br>U_oxtot                                         | 6  | 0.90 | 0.13 | 0.36  | 0.07 | 0.15  | 0.07 | 0.49 | 0.06 |
| PSA32_33<br>Option 4<br>Cluster 4 | 4 | Al_oxtot<br>Ba_rec<br>Fe_oxtot<br>Ti_rec                                         | 8  | 0.57 | 0.33 | 0.09  | 0.14 | 0.54  | 0.08 | 0.37 | 0.08 |
| PSA32_33<br>Option 5<br>Cluster 5 | 5 | Ba_rec<br>Co_oxtot<br>P_oxtot<br>P_rec<br>W_oxtot                                | 3  | 0.38 | 0.24 | 0.26  | 0.10 | -0.04 | 0.11 | 0.78 | 0.12 |
| PSA32_33<br>Option 6<br>Cluster 6 | 5 | Al_rec<br>Ba_rec<br>Ti_rec<br>U_oxtot<br>U_rec                                   | 5  | 0.42 | 0.36 | -0.10 | 0.12 | 0.51  | 0.08 | 0.59 | 0.08 |
| PSA34<br>Option 1<br>Cluster 1    | 5 | Al_car<br>Ba_rec<br>Co_car<br>Cu_oxtot<br>Pb_oxtot                               | 9  | 0.53 | 0.26 | 0.95  | 0.03 | -0.01 | 0.04 | 0.07 | 0.02 |
| PSA34<br>Option 2<br>Cluster 2    | 8 | Ca_rec<br>Co_car<br>Cr_oxtot<br>Cr_rec<br>Mg_rec<br>Ni_oxtot<br>P_rec<br>U_oxtot | 21 | 0.77 | 0.15 | 0.23  | 0.03 | 0.69  | 0.03 | 0.08 | 0.03 |
| PSA34<br>Option 3<br>Cluster 5    | 4 | Ca_rec<br>Cu_oxtot<br>Ni_oxtot<br>U_rec                                          | 9  | 0.67 | 0.19 | 0.24  | 0.02 | 0.18  | 0.08 | 0.58 | 0.08 |
| PSA34<br>Option 4<br>Cluster 4    | 5 | Co_car<br>Cs_rec<br>Ni_rec<br>U_oxtot<br>U_rec                                   | 7  | 0.85 | 0.19 | 0.51  | 0.09 | 0.38  | 0.06 | 0.11 | 0.04 |

|                                |    |                                                                                                       |    |      |      |      |      |      |      |      |      |
|--------------------------------|----|-------------------------------------------------------------------------------------------------------|----|------|------|------|------|------|------|------|------|
| PSA34<br>Option 5<br>Cluster 3 | 6  | Ca_rec<br>Mg_rec<br>Ni_oxtot<br>Ni_rec<br>U_oxtot<br>U_rec                                            | 9  | 0.90 | 0.16 | 0.23 | 0.03 | 0.49 | 0.05 | 0.28 | 0.05 |
| PSA34<br>Option 6<br>Cluster 5 | 4  | Ca_rec<br>Cu_oxtot<br>Ni_oxtot<br>U_rec                                                               | 9  | 0.67 | 0.19 | 0.24 | 0.02 | 0.18 | 0.08 | 0.58 | 0.08 |
| PSA35<br>Option 1<br>Cluster 1 | 10 | Al_rec<br>As_oxtot<br>Ba_oxtot<br>Ba_rec<br>Ca_rec<br>Co_rec<br>Cs_oxtot<br>Fe_rec<br>Mg_rec<br>U_rec | 19 | 0.82 | 0.11 | 0.60 | 0.03 | 0.32 | 0.03 | 0.08 | 0.03 |
| PSA35<br>Option 2<br>Cluster 2 | 9  | Al_oxtot<br>Al_rec<br>As_oxtot<br>Ba_oxtot<br>Ca_oxtot<br>Cs_oxtot<br>Mn_rec<br>U_rec<br>V_rec        | 12 | 0.72 | 0.13 | 0.37 | 0.06 | 0.54 | 0.05 | 0.09 | 0.04 |
| PSA35<br>Option 3<br>Cluster 3 | 9  | As_oxtot<br>Ba_oxtot<br>Ba_rec<br>Ca_oxtot<br>Ca_rec<br>Co_oxtot<br>Mg_car<br>Mg_rec<br>Ti_car        | 8  | 0.59 | 0.13 | 0.63 | 0.03 | 0.02 | 0.07 | 0.36 | 0.06 |
| PSA35<br>Option 4<br>Cluster 4 | 6  | As_oxtot<br>Co_rec<br>Mg_car<br>Mn_rec<br>U_rec<br>V_rec                                              | 6  | 0.97 | 0.12 | 0.24 | 0.06 | 0.39 | 0.05 | 0.37 | 0.07 |
| PSA35<br>Option 5<br>Cluster 5 | 6  | As_oxtot<br>Co_car<br>Cu_rec<br>Mn_rec<br>Ti_car<br>U_rec                                             | 5  | 0.65 | 0.15 | 0.17 | 0.07 | 0.09 | 0.07 | 0.75 | 0.09 |

|                                |    |                                                                                                                    |    |      |      |      |      |      |      |      |      |
|--------------------------------|----|--------------------------------------------------------------------------------------------------------------------|----|------|------|------|------|------|------|------|------|
| PSA36<br>Option 1<br>Cluster 1 | 10 | Al_oxtot<br>Al_rec<br>Ba_rec<br>Ca_rec<br>Co_rec<br>Cs_oxtot<br>Cu_rec<br>U_oxtot<br>U_rec<br>V_rec                | 12 | 0.85 | 0.07 | 0.59 | 0.03 | 0.34 | 0.03 | 0.07 | 0.02 |
| PSA36<br>Option 2<br>Cluster 2 | 10 | Al_rec<br>Ba_rec<br>Ca_oxtot<br>Cs_oxtot<br>Cu_rec<br>Fe_rec<br>Mg_rec<br>Ni_oxtot<br>Ti_car<br>U_rec              | 14 | 0.72 | 0.07 | 0.76 | 0.03 | 0.18 | 0.03 | 0.06 | 0.03 |
| PSA36<br>Option 3<br>Cluster 3 | 7  | Ca_rec<br>Cs_oxtot<br>Fe_rec<br>Mg_car<br>Mg_rec<br>Ti_car<br>U_rec                                                | 6  | 0.74 | 0.08 | 0.64 | 0.03 | 0.13 | 0.04 | 0.23 | 0.05 |
| PSA36<br>Option 4<br>Cluster 4 | 11 | Al_oxtot<br>Al_rec<br>As_rec<br>Co_oxtot<br>Co_rec<br>Cs_oxtot<br>Cu_rec<br>Mn_rec<br>P_oxtot<br>Ti_rec<br>U_oxtot | 11 | 0.87 | 0.09 | 0.37 | 0.04 | 0.47 | 0.03 | 0.15 | 0.03 |
| PSA36<br>Option 5<br>Cluster 5 | 9  | As_rec<br>Co_oxtot<br>Co_rec<br>Cs_oxtot<br>Cu_rec<br>Mg_car<br>Mn_rec<br>U_rec<br>V_rec                           | 6  | 0.99 | 0.09 | 0.39 | 0.04 | 0.37 | 0.03 | 0.24 | 0.05 |
| PSA36<br>Option 6<br>Cluster 6 | 6  | Fe_rec<br>Mn_rec<br>Ni_rec<br>Ti_car<br>U_rec<br>V_rec                                                             | 1  | 0.95 | .009 | 0.34 | 0.06 | 0.13 | 0.06 | 0.53 | 0.09 |
| PSA37<br>Option 1              | 13 | Al_oxtot<br>As_rec                                                                                                 | 37 | 0.88 | 0.09 | 0.39 | 0.04 | 0.50 | 0.03 | 0.11 | 0.04 |

|                                |    |                                                                                                                     |    |      |      |      |      |      |      |      |      |
|--------------------------------|----|---------------------------------------------------------------------------------------------------------------------|----|------|------|------|------|------|------|------|------|
| Cluster 1                      |    | Ba_oxtot<br>Ca_oxtot<br>Ca_rec<br>Mn_rec<br>Pb_oxtot<br>Se_oxtot<br>Ti_car<br>Ti_rec<br>U_oxtot<br>U_rec<br>W_oxtot |    |      |      |      |      |      |      |      |      |
| PSA37<br>Option 2<br>Cluster 2 | 9  | Al_rec<br>As_oxtot<br>Ba_oxtot<br>Ba_rec<br>Fe_rec<br>Mg_rec<br>Ni_rec<br>P_rec<br>Pb_rec                           | 13 | 0.52 | 0.09 | 0.77 | 0.04 | 0.01 | 0.03 | 0.22 | 0.03 |
| PSA37<br>Option 3<br>Cluster 1 | 11 | Al_oxtot<br>As_rec<br>Ba_oxtot<br>Ba_rec<br>Pb_rec<br>Ti_car<br>Ti_rec<br>U_oxtot<br>U_rec<br>V_rec<br>W_oxtot      | 37 | 0.88 | 0.09 | 0.56 | 0.06 | 0.43 | 0.04 | 0.00 | 0.05 |
| PSA38<br>Option 1<br>Cluster 1 | 11 | Al_oxtot<br>As_oxtot<br>Ba_rec<br>Ca_oxtot<br>Ca_rec<br>Co_rec<br>Cu_rec<br>P_rec<br>Sb_car<br>U_oxtot<br>U_rec     | 82 | 0.75 | 0.24 | 0.45 | 0.04 | 0.37 | 0.03 | 0.18 | 0.03 |
| PSA38<br>Option 2<br>Cluster 1 | 8  | Al_oxtot<br>As_oxtot<br>Cu_rec<br>Fe_rec<br>Mg_rec<br>P_rec<br>Sb_car<br>U_rec                                      | 82 | 0.75 | 0.24 | 0.67 | 0.04 | 0.22 | 0.03 | 0.11 | 0.03 |

|                                |    |                                                                                                                                                     |    |      |      |      |      |      |      |      |      |
|--------------------------------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------|----|------|------|------|------|------|------|------|------|
| PSA38<br>Option 3<br>Cluster 2 | 14 | As_rec<br>Ba_rec<br>Ca_oxtot<br>Co_oxtot<br>Cr_oxtot<br>Fe_oxtot<br>Mn_rec<br>P_oxtot<br>P_rec<br>Pb_rec<br>Sb_car<br>Se_oxtot<br>Ti_rec<br>U_oxtot | 85 | 0.66 | 0.29 | 0.21 | 0.06 | 0.68 | 0.04 | 0.10 | 0.05 |
| PSA38<br>Option 4<br>Cluster 3 | 8  | As_oxtot<br>Ba_oxtot<br>Ba_rec<br>Cs_oxtot<br>Mn_rec<br>Ni_rec<br>U_rec<br>V_rec                                                                    | 30 | 0.54 | 0.39 | 0.14 | 0.06 | 0.26 | 0.07 | 0.60 | 0.09 |
| PSA39<br>Option 1<br>Cluster 1 | 7  | Al_oxtot<br>Ba_rec<br>Ca_rec<br>Cd_oxtot<br>Pb_car<br>Ti_rec<br>U_oxtot                                                                             | 14 | 0.71 | 0.10 | 0.41 | 0.04 | 0.44 | 0.04 | 0.15 | 0.03 |
| PSA39<br>Option 2<br>Cluster 2 | 9  | Al_oxtot<br>Ba_rec<br>Ca_oxtot<br>Cd_oxtot<br>Mn_rec<br>P_oxtot<br>U_oxtot<br>U_rec<br>V_rec                                                        | 17 | 0.93 | 0.11 | 0.61 | 0.03 | 0.27 | 0.03 | 0.12 | 0.03 |
| PSA39<br>Option 3<br>Cluster 3 | 8  | Al_rec<br>Ba_rec<br>Ca_oxtot<br>Cd_oxtot<br>Cr_rec<br>Mn_rec<br>P_oxtot<br>U_rec                                                                    | 6  | 0.49 | 0.12 | 0.62 | 0.03 | 0.04 | 0.04 | 0.34 | 0.03 |
| PSA39<br>Option 4<br>Cluster 4 | 8  | Al_rec<br>Ba_rec<br>Ca_rec<br>Cd_oxtot<br>P_oxtot<br>U_oxtot<br>U_rec<br>V_rec                                                                      | 6  | 0.93 | 0.10 | 0.47 | 0.03 | 0.18 | 0.04 | 0.35 | 0.04 |

|                                |    |                                                                                                        |    |      |      |      |      |      |      |       |      |
|--------------------------------|----|--------------------------------------------------------------------------------------------------------|----|------|------|------|------|------|------|-------|------|
| PSA39<br>Option 5<br>Cluster 5 | 6  | Al_rec<br>Cd_oxtot<br>Co_oxtot<br>Pb_car<br>Ti_rec<br>U_oxtot                                          | 4  | 0.87 | 0.12 | 0.15 | 0.07 | 0.44 | 0.05 | 0.41  | 0.06 |
| PSA39<br>Option 6<br>Cluster 6 | 7  | Ca_rec<br>Cd_oxtot<br>Cr_rec<br>Ni_rec<br>P_oxtot<br>U_rec<br>V_rec                                    | 3  | 0.40 | 0.15 | 0.42 | 0.05 | 0.01 | 0.06 | 0.57  | 0.07 |
| PSA40<br>Option 1<br>Cluster 1 | 9  | Al_oxtot<br>Ba_rec<br>Ca_oxtot<br>Ca_rec<br>Cr_oxtot<br>P_rec<br>Ti_rec<br>U_rec<br>V_rec              | 18 | 0.74 | 0.08 | 0.61 | 0.04 | 0.36 | 0.03 | 0.03  | 0.03 |
| PSA40<br>Option 2<br>Cluster 2 | 8  | Al_rec<br>As_oxtot<br>Ba_rec<br>Ca_oxtot<br>Ca_rec<br>Co_rec<br>U_rec<br>V_rec                         | 11 | 0.92 | 0.08 | 0.61 | 0.03 | 0.22 | 0.03 | 0.17  | 0.03 |
| PSA40<br>Option 3<br>Cluster 3 | 7  | Al_rec<br>As_oxtot<br>Ba_rec<br>Ca_oxtot<br>Fe_rec<br>Mg_rec<br>Ni_rec                                 | 8  | 0.68 | 0.07 | 0.74 | 0.03 | 0.06 | 0.03 | 0.20  | 0.03 |
| PSA40<br>Option 4<br>Cluster 4 | 10 | Al_oxtot<br>As_oxtot<br>Ba_rec<br>Co_rec<br>Cr_oxtot<br>Fe_rec<br>Mg_rec<br>Ni_oxtot<br>P_rec<br>U_rec | 5  | 0.49 | 0.08 | 0.83 | 0.03 | 0.19 | 0.03 | -0.02 | 0.03 |
| PSA40<br>Option 5<br>Cluster 5 | 6  | Al_rec<br>Ba_oxtot<br>Co_oxtot<br>Cr_oxtot<br>P_oxtot<br>Pb_rec                                        | 5  | 0.81 | 0.09 | 0.16 | 0.09 | 0.62 | 0.07 | 0.23  | 0.04 |

|                                |    |                                                                                                                                                                 |    |      |      |      |      |       |      |      |      |
|--------------------------------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----|------|------|------|------|-------|------|------|------|
| PSA40<br>Option 6<br>Cluster 6 | 8  | As_oxtot<br>Ba_oxtot<br>Ba_rec<br>Co_rec<br>Mn_rec<br>Ni_rec<br>U_rec<br>V_rec                                                                                  | 3  | 0.83 | 0.09 | 0.44 | 0.05 | 0.18  | 0.04 | 0.38 | 0.06 |
| PSA98<br>Option 1<br>Cluster 1 | 12 | Al_oxtot<br>Al_rec<br>Ba_oxtot<br>Ba_rec<br>Cd_car<br>Co_rec<br>Cs_rec<br>Fe_rec<br>Mg_rec<br>Ni_oxtot<br>Pb_car<br>Pb_oxtot                                    | 26 | 0.81 | 0.07 | 0.80 | 0.03 | 0.19  | 0.02 | 0.01 | 0.02 |
| PSA98<br>Option 2<br>Cluster 2 | 10 | As_rec<br>Ba_oxtot<br>Ca_rec<br>Cd_car<br>Co_car<br>Mg_rec<br>Ni_oxtot<br>Ni_rec<br>Pb_car<br>Pb_oxtot                                                          | 6  | 0.66 | 0.07 | 0.75 | 0.03 | -0.01 | 0.03 | 0.26 | 0.04 |
| PSA98<br>Option 3<br>Cluster 3 | 15 | Al_oxtot<br>Al_rec<br>Ba_oxtot<br>Cd_car<br>Co_oxtot<br>Cr_oxtot<br>Cs_rec<br>Cu_rec<br>Fe_oxtot<br>Mn_rec<br>P_oxtot<br>Ti_rec<br>U_oxtot<br>V_rec<br>Zn_oxtot | 10 | 0.64 | 0.08 | 0.60 | 0.04 | 0.37  | 0.03 | 0.03 | 0.02 |
| PSA98<br>Option 4<br>Cluster 4 | 12 | Ba_oxtot<br>Cd_car<br>Co_car<br>Co_oxtot<br>Co_rec<br>Cs_rec<br>Fe_rec<br>Mn_rec<br>P_oxtot<br>Ti_rec<br>V_rec                                                  | 8  | 0.98 | 0.08 | 0.52 | 0.04 | 0.24  | 0.03 | 0.24 | 0.04 |

|                                |    |                                                                                                                                                                                                                            |    |      |      |      |      |      |      |       |      |
|--------------------------------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|------|------|------|------|------|------|-------|------|
|                                |    | Zn_oxtot                                                                                                                                                                                                                   |    |      |      |      |      |      |      |       |      |
| PSA98<br>Option 5<br>Cluster 5 | 11 | Al_oxtot<br>Al_rec<br>Ba_oxtot<br>Co_car<br>Cr_oxtot<br>Fe_oxtot<br>Mn_oxtot<br>Ti_oxtot<br>U_oxtot<br>V_oxtot<br>Zn_car                                                                                                   | 1  | 0.59 | 0.15 | 0.10 | 0.13 | 0.75 | 0.10 | 0.14  | 0.04 |
| PSA99<br>Option 1<br>Cluster 1 | 21 | Al_oxtot<br>Al_rec<br>As_oxtot<br>As_rec<br>Ba_oxtot<br>Cd_car<br>Co_rec<br>Cr_oxtot<br>Cs_rec<br>Cu_rec<br>Fe_oxtot<br>Fe_rec<br>Mg_rec<br>Mn_rec<br>P_oxtot<br>Ti_rec<br>U_oxtot<br>U_rec<br>V_rec<br>Zn_car<br>Zn_oxtot | 20 | 0.74 | 0.07 | 0.59 | 0.03 | 0.36 | 0.02 | 0.05  | 0.02 |
| PSA99<br>Option 2<br>Cluster 2 | 20 | Al_oxtot<br>Al_rec<br>As_oxtot<br>As_rec<br>Ba_oxtot<br>Ba_rec<br>Cd_car<br>Co_rec<br>Cr_oxtot<br>Cs_rec<br>Cu_rec<br>Fe_oxtot<br>Fe_rec<br>Ni_oxtot<br>P_oxtot<br>Ti_car<br>Ti_rec                                        | 7  | 0.73 | 0.08 | 0.74 | 0.04 | 0.29 | 0.02 | -0.03 | 0.02 |

|                                |    |                                                                                                                                                                                                                         |    |      |      |      |      |      |      |      |      |
|--------------------------------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|------|------|------|------|------|------|------|------|
|                                |    | U_oxtot<br>U_rec<br>V_car                                                                                                                                                                                               |    |      |      |      |      |      |      |      |      |
| PSA99<br>Option 3<br>Cluster 3 | 6  | Al_oxtot<br>As_oxtot<br>As_rec<br>Ba_oxtot<br>Cd_car<br>Co_rec<br>Cr_oxtot<br>Cs_rec<br>Cu_rec<br>Fe_rec<br>Mg_rec<br>Mn_rec<br>P_oxtot<br>Ti_car<br>Ti_rec<br>U_oxtot<br>U_rec<br>V_car<br>V_rec<br>Zn_car<br>Zn_oxtot | 16 | 0.95 | 0.09 | 0.58 | 0.03 | 0.33 | 0.02 | 0.08 | 0.03 |
| PSA99<br>Option 4<br>Cluster 3 | 14 | As_oxtot<br>As_rec<br>Cd_car<br>Co_car<br>Co_rec<br>Cs_rec<br>Fe_rec<br>Mn_rec<br>P_oxtot<br>Ti_car<br>Ti_rec<br>U_rec<br>V_rec<br>Zn_oxtot                                                                             | 16 | 0.95 | 0.09 | 0.44 | 0.04 | 0.27 | 0.03 | 0.29 | 0.05 |
| PSA99<br>Option 5<br>Cluster 4 | 4  | Al_oxtot<br>Al_rec<br>As_oxtot<br>Cd_car<br>Co_oxtot<br>Fe_oxtot<br>Ti_oxtot<br>U_oxtot<br>Zn_car                                                                                                                       | 7  | 0.94 | 0.09 | 0.39 | 0.07 | 0.58 | 0.06 | 0.04 | 0.03 |
| 11791<br>Option 1<br>Cluster 2 | 14 | Ba_rec<br>Ca_rec<br>Cd_oxtot<br>Cr_oxtot<br>Cs_rec<br>Cu_car<br>Cu_rec<br>Mg_oxtot<br>Ni_oxtot                                                                                                                          | 12 | 0.57 | 0.06 | 0.80 | 0.03 | 0.13 | 0.02 | 0.07 | 0.02 |

|                                |    |                                                                                                                                                                       |    |      |      |      |      |       |      |      |      |
|--------------------------------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|------|------|------|------|-------|------|------|------|
|                                |    | Ti_oxtot<br>U_rec<br>V_car<br>V_oxtot<br>Zn_car                                                                                                                       |    |      |      |      |      |       |      |      |      |
| 11791<br>Option 2<br>Cluster 2 | 16 | Co_oxtot<br>Co_rec<br>Cr_oxtot<br>Cr_rec<br>Cu_car<br>Cu_rec<br>Fe_oxtot<br>Mg_rec<br>Mn_rec<br>Ni_oxtot<br>Ni_rec<br>Ti_oxtot<br>Ti_rec<br>V_car<br>V_oxtot<br>V_rec | 23 | 0.81 | 0.06 | 0.62 | 0.03 | 0.30  | 0.02 | 0.08 | 0.02 |
| 11791<br>Option 3<br>Cluster 3 | 10 | Ba_rec<br>Ca_rec<br>Cd_oxtot<br>Cs_rec<br>Cu_car<br>Mg_oxtot<br>Ti_oxtot<br>U_rec<br>V_car<br>Zn_car                                                                  | 4  | 0.56 | 0.06 | 0.84 | 0.03 | 0.05  | 0.03 | 0.11 | 0.03 |
| 11791<br>Option 4<br>Cluster 4 | 14 | Cd_oxtot<br>Co_rec<br>Cr_oxtot<br>Cu_car<br>Cu_rec<br>Fe_oxtot<br>Fe_rec<br>Ni_car<br>Ni_rec<br>Ti_oxtot<br>Ti_rec<br>V_car<br>V_oxtot<br>V_rec                       | 9  | 0.98 | 0.07 | 0.46 | 0.04 | 0.37  | 0.02 | 0.17 | 0.03 |
| 11791<br>Option 5<br>Cluster 5 | 10 | As_oxtot<br>Cd_oxtot<br>Co_oxtot<br>Cs_rec<br>Mg_rec<br>Mn_rec<br>Mo_oxtot<br>P_car<br>U_rec<br>V_car                                                                 | 2  | 0.60 | 0.07 | 0.54 | 0.05 | -0.04 | 0.06 | 0.50 | 0.08 |

|                                  |    |                                                                                                                    |    |      |      |      |      |      |      |      |      |
|----------------------------------|----|--------------------------------------------------------------------------------------------------------------------|----|------|------|------|------|------|------|------|------|
| All_PSA<br>Option 1<br>Cluster 1 | 10 | Al_rec<br>As_oxtot<br>Ba_oxtot<br>Ba_rec<br>Ca_rec<br>Co_rec<br>Cu_rec<br>Pb_rec<br>U_rec<br>W_oxtot               | 22 | 0.81 | 0.08 | 0.54 | 0.04 | 0.29 | 0.03 | 0.17 | 0.03 |
| All_PSA<br>Option 2<br>Cluster 2 | 10 | Al_rec<br>As_oxtot<br>Ba_oxtot<br>Ba_rec<br>Ca_oxtot<br>Cu_rec<br>Fe_rec<br>Mg_rec<br>P_rec<br>U_rec               | 21 | 0.74 | 0.08 | 0.74 | 0.03 | 0.16 | 0.03 | 0.10 | 0.02 |
| All_PSA<br>Option 3<br>Cluster 3 | 7  | As_oxtot<br>Ba_oxtot<br>Ca_rec<br>Cu_rec<br>Fe_rec<br>Pb_rec<br>U_rec                                              | 7  | 0.86 | 0.09 | 0.54 | 0.04 | 0.19 | 0.04 | 0.28 | 0.05 |
| All_PSA<br>Option 4<br>Cluster 1 | 11 | Al_oxtot<br>Al_rec<br>As_oxtot<br>As_rec<br>Ba_oxtot<br>Co_oxtot<br>Mn_rec<br>P_rec<br>Pb_rec<br>Ti_rec<br>U_oxtot | 22 | 0.81 | 0.08 | 0.31 | 0.05 | 0.56 | 0.04 | 0.14 | 0.03 |
| All_PSA<br>Option 5<br>Cluster 3 | 9  | As_oxtot<br>Ba_oxtot<br>Co_oxtot<br>Co_rec<br>Cu_rec<br>Mn_rec<br>Pb_rec<br>V_rec<br>W_oxtot                       | 7  | 0.86 | 0.09 | 0.25 | 0.05 | 0.36 | 0.04 | 0.39 | 0.07 |

Table S3: Hysteresis state average SSC and PPC values used for extrapolation to 24-25 hydrograph.

| Hysteresis state | SSC (mg L <sup>-1</sup> ) | % alluvium | % hillslope | % upland | PPC <sub>ex</sub> (µg L <sup>-1</sup> ) | PPC <sub>car</sub> (µg L <sup>-1</sup> ) | PPC <sub>ox</sub> (µg L <sup>-1</sup> ) | PPC <sub>rec</sub> (µg L <sup>-1</sup> ) |
|------------------|---------------------------|------------|-------------|----------|-----------------------------------------|------------------------------------------|-----------------------------------------|------------------------------------------|
| Baseflow         | 345.2                     | 55.8       | 24.9        | 19.3     | 2.2                                     | 262.2                                    | 78.1                                    | 14.3                                     |
| Rising 1         | 1351.3                    | 69.5       | 27.4        | 3.1      | 75.8                                    | 339.3                                    | 1578.5                                  | 121.6                                    |
| Rising 2         | 592.3                     | 50.4       | 39.5        | 10.1     | 272.8                                   | 293.5                                    | 548.5                                   | 113.0                                    |
| Peak             | 1294.1                    | 23.2       | 69.1        | 7.6      | 2029.9                                  | 274.2                                    | 396.1                                   | 181.2                                    |
| Falling          | 428.3                     | 43.5       | 40.2        | 16.3     | 97.5                                    | 181.4                                    | 416.3                                   | 51.2                                     |

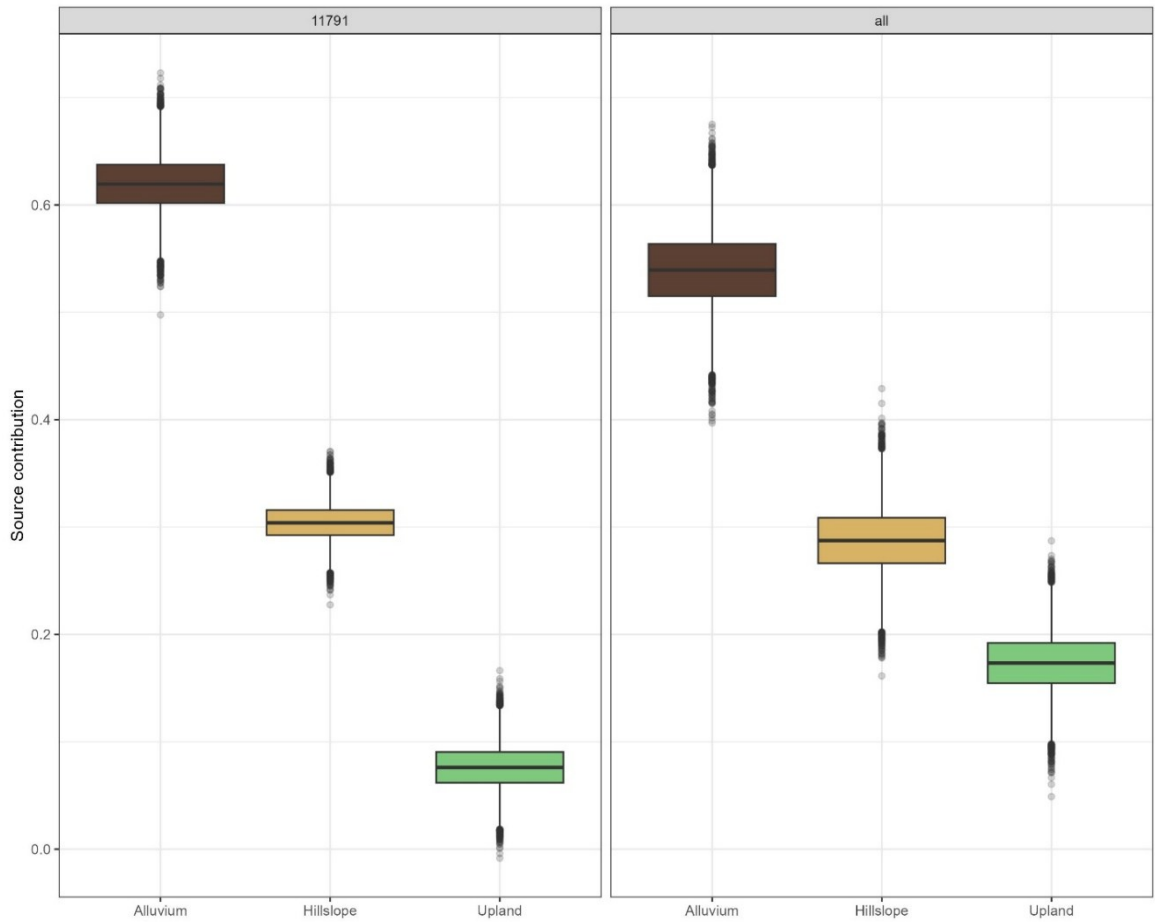


Figure S4: proportional contribution of sources outcomes derived from unmixing the sediment drupe sample (11791) and all RSS samples averaged into one mixture.

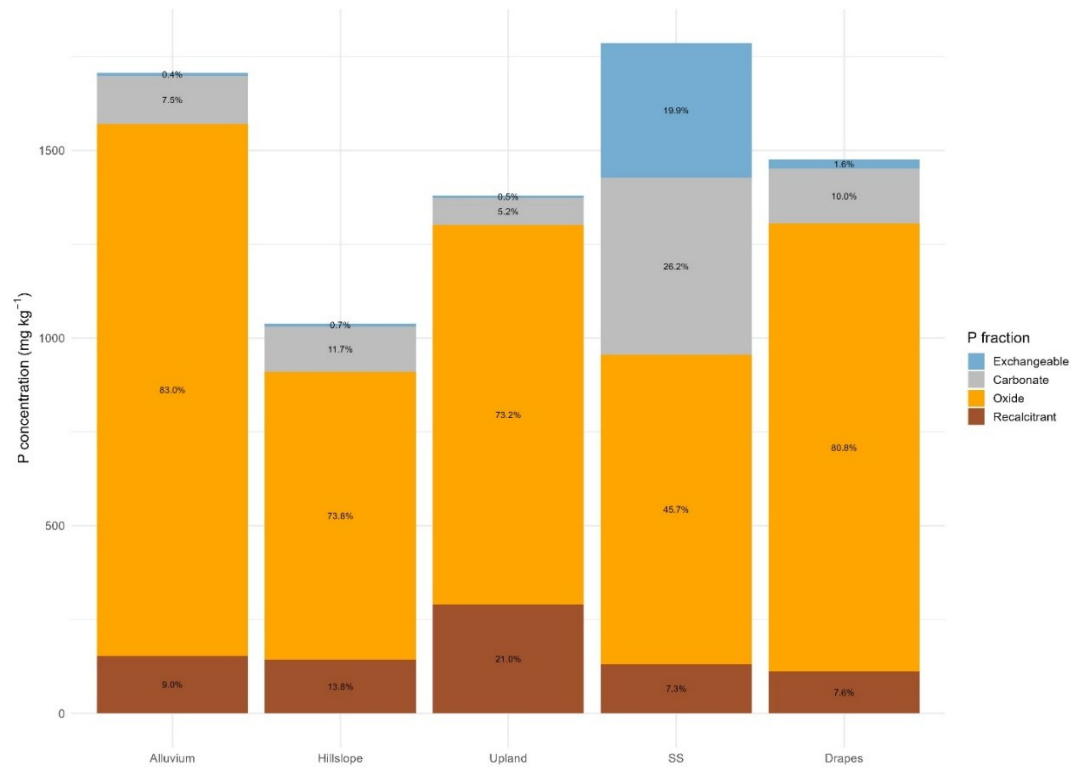


Figure S5: P fraction distribution in different source soils, gauge suspended sediment, and sediment drapes.

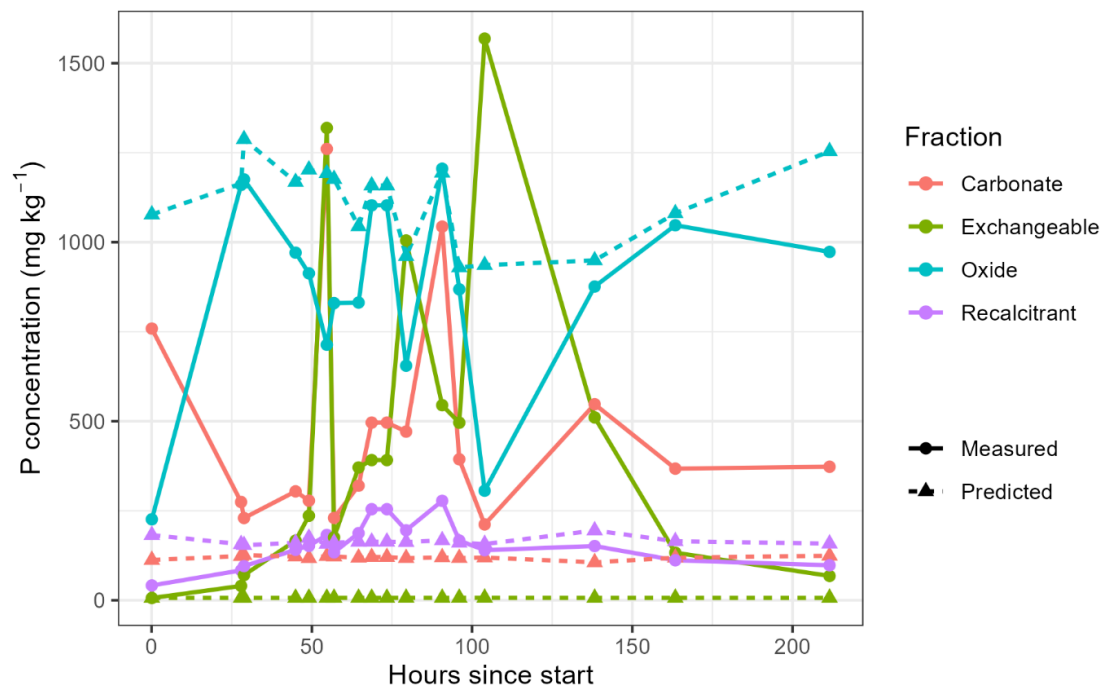


Figure S6: Temporal variation in measured (dots and full lines) and predicted (triangles and dashed) concentrations of exchangeable (PP\_ex; in green), carbonate-associated (PP\_car; in red), oxide-associated (PP\_ox; in blue), and recalcitrant (PP\_rec; in purple) phosphorus in suspended sediment. Predicted concentrations were estimated by a simple mass balance multiplying the mean source contributions obtained from sediment fingerprinting with the corresponding mean phosphorus concentrations of the identified source classes and summing across sources.



**Figure S7: land clearing for urban development exposing subsoils with limited runoff management to the intermittent Finch Creek during the time of the *Cyclone Alfred* event in Canungra township (-28.016426, 153.167009)**