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The role of phosphorus in the decline of chalk streams

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Project status - update

PhD Student to start in January:
- Arthur Leung

Additional funding from the University of Southampton (£18,000 thus far)

Exploration of existing data

Phosphate in the upper Itchen
Phosphate concentrations
Phosphate as a function of flow
Phosphate fluxes
Summary and closing remarks

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Phosphate in the upper Itchen

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Sampling sites for this analysis

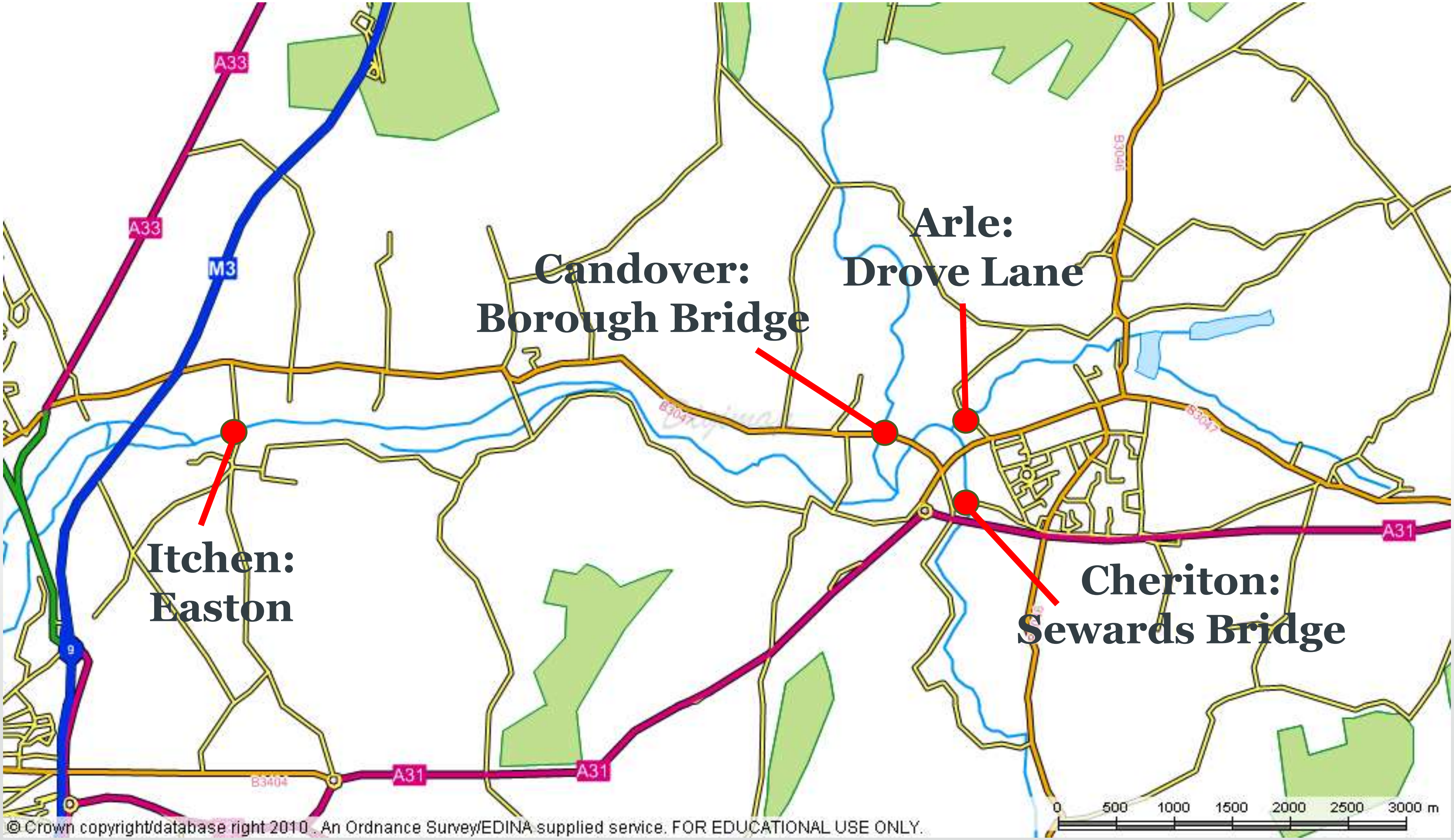
Three main tributaries of the Itchen:

- River Arle (Drove Lane)
- Candover Brook (Borough Bridge)
- Cheriton Stream (Sewards Bridge)

Plus:

- River Itchen (Easton)

Sampling sites



Data records: reactive phosphate

Arle:	1979-present
Candover:	1979-present
Cheriton:	1990-present
Itchen:	1980-present

- Mainly monthly sampling intervals

Data records: flow

Arle:	1975-present
Candover:	1970-present
Cheriton:	1970-present
Itchen:	1984-present

- Daily values (cumecs; m^3s^{-1})

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Phosphate concentrations

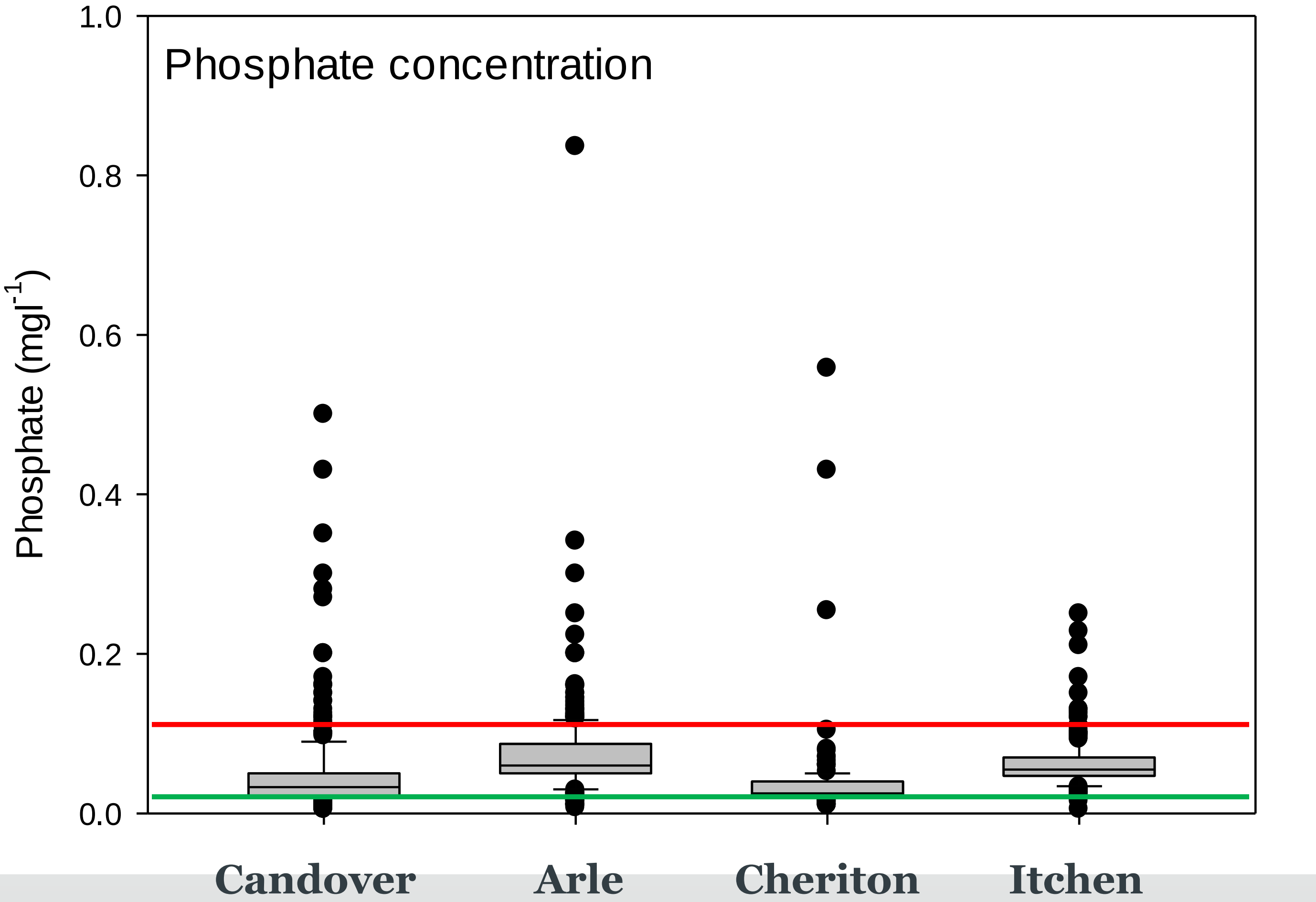
Interpreting phosphate concentrations

0-0.02 mgl^{-1} "is the estimate in the absence of anthropogenic activity."

… could "equate to a mid point in High Status under the Water Framework Directive."

UK Environmental Standards and Conditions, Final report. UK WFD Technical Advisory Group, 2008

Phosphate concentration



"Natural"
(mid to high)
0-0.02 mg P l^{-1}

"Guideline"
(mid to good)
0.02-0.06 mg P l^{-1}

"Threshold"
(just moderate)
0.04-0.10 mg P l^{-1}

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Phosphate concentrations exceeding 0.02 mgl^{-1}

Arle:	**95%** of all samples
Candover:	**72%** of all samples
Cheriton:	**62%** of all samples
Itchen:	**98%** of all samples

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Phosphate as a function of flow

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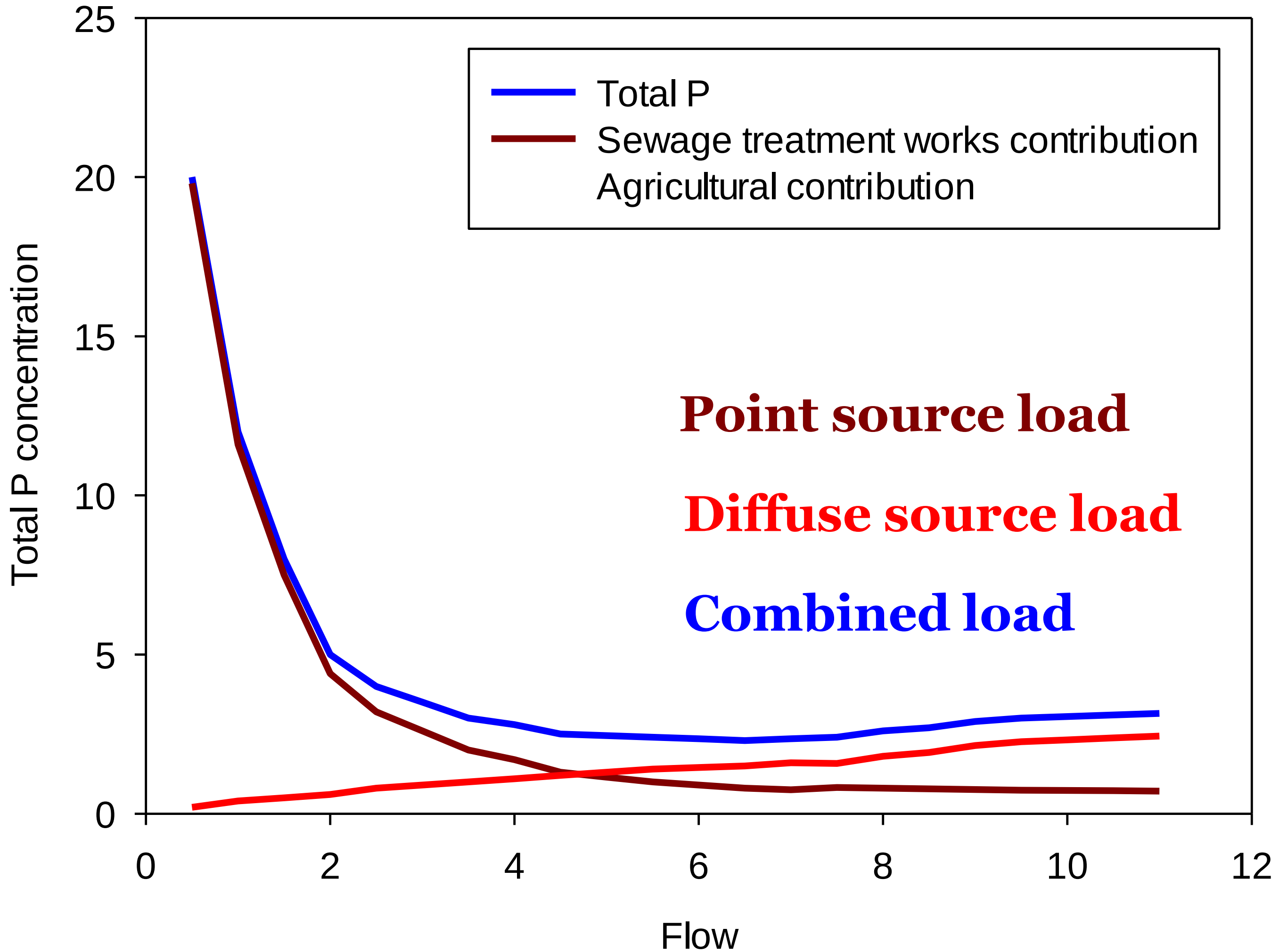
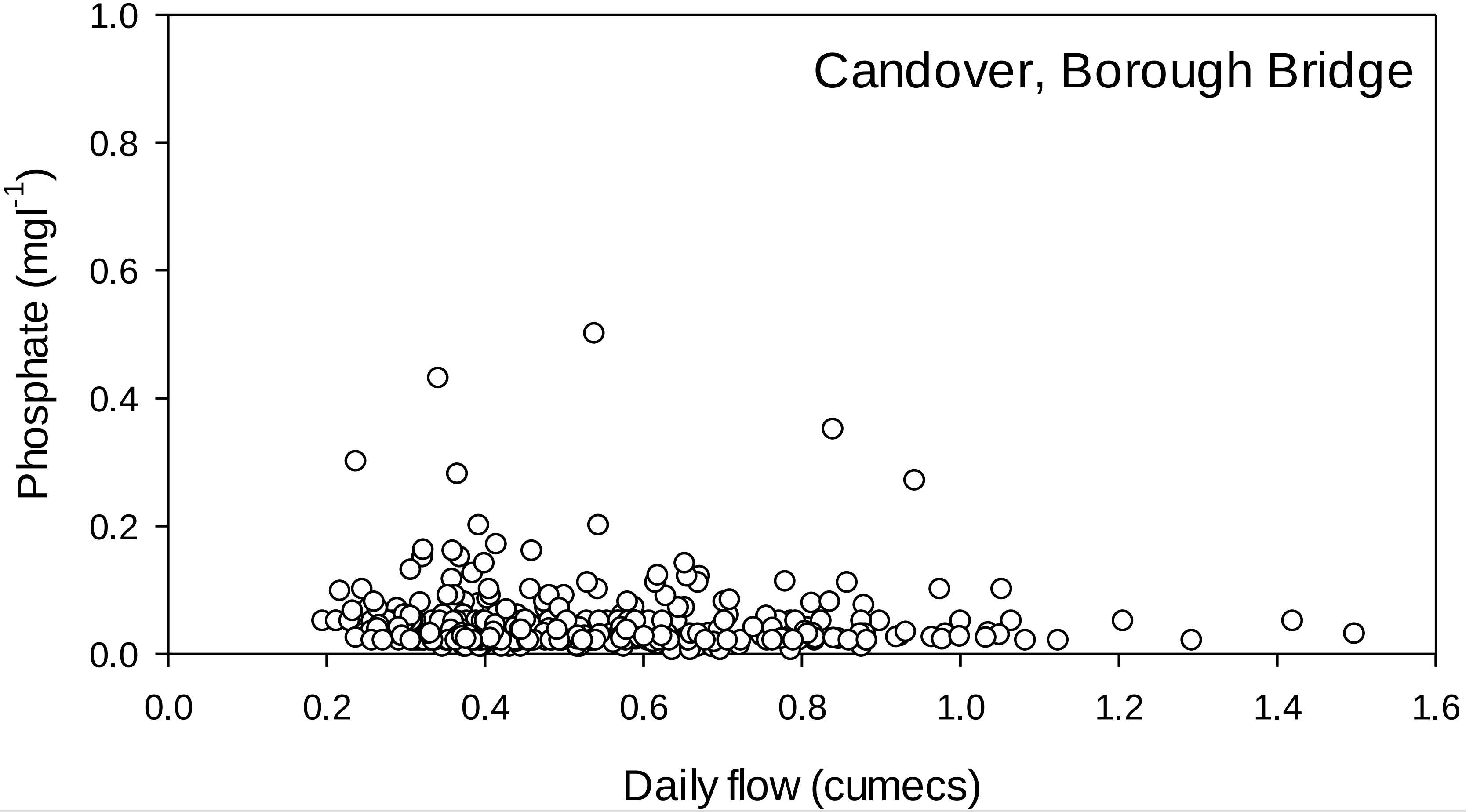
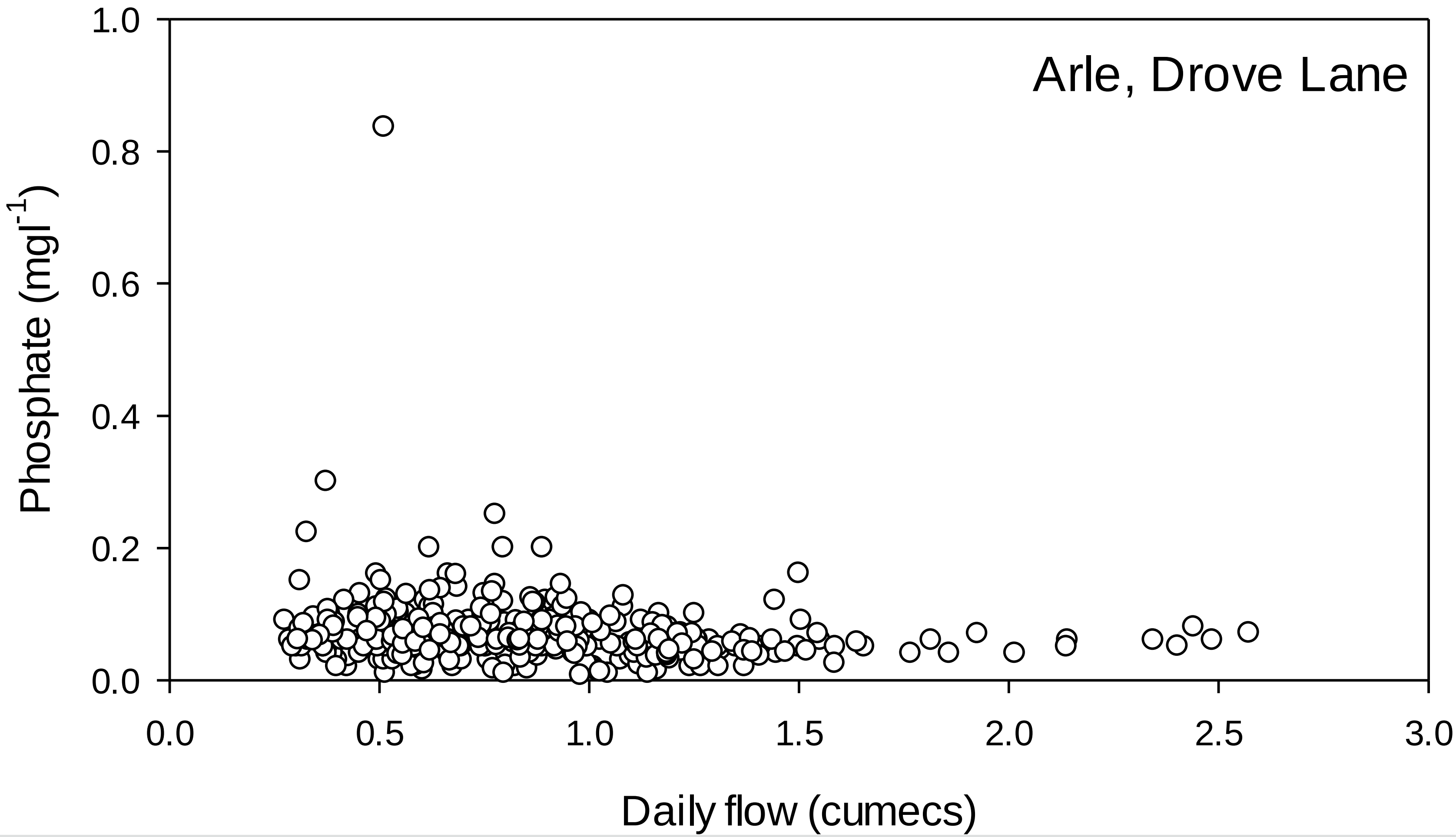
Phosphorus load apportionment



Candover

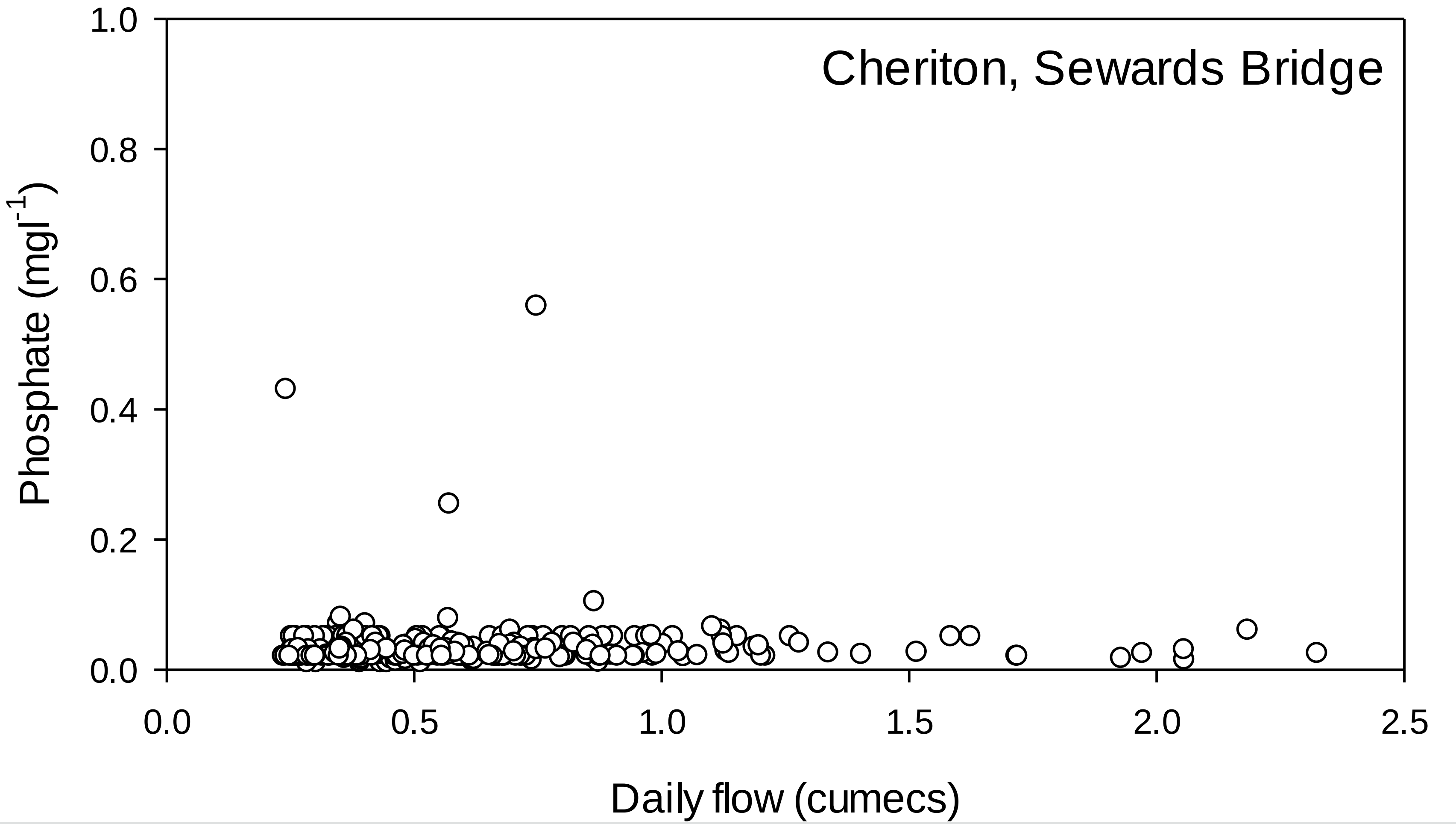

Candover, Borough Bridge
Phosphate (mgl-1)
Daily flow (cumecs)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0.0
0.2
0.4
0.6
0.8
1.0

Arle

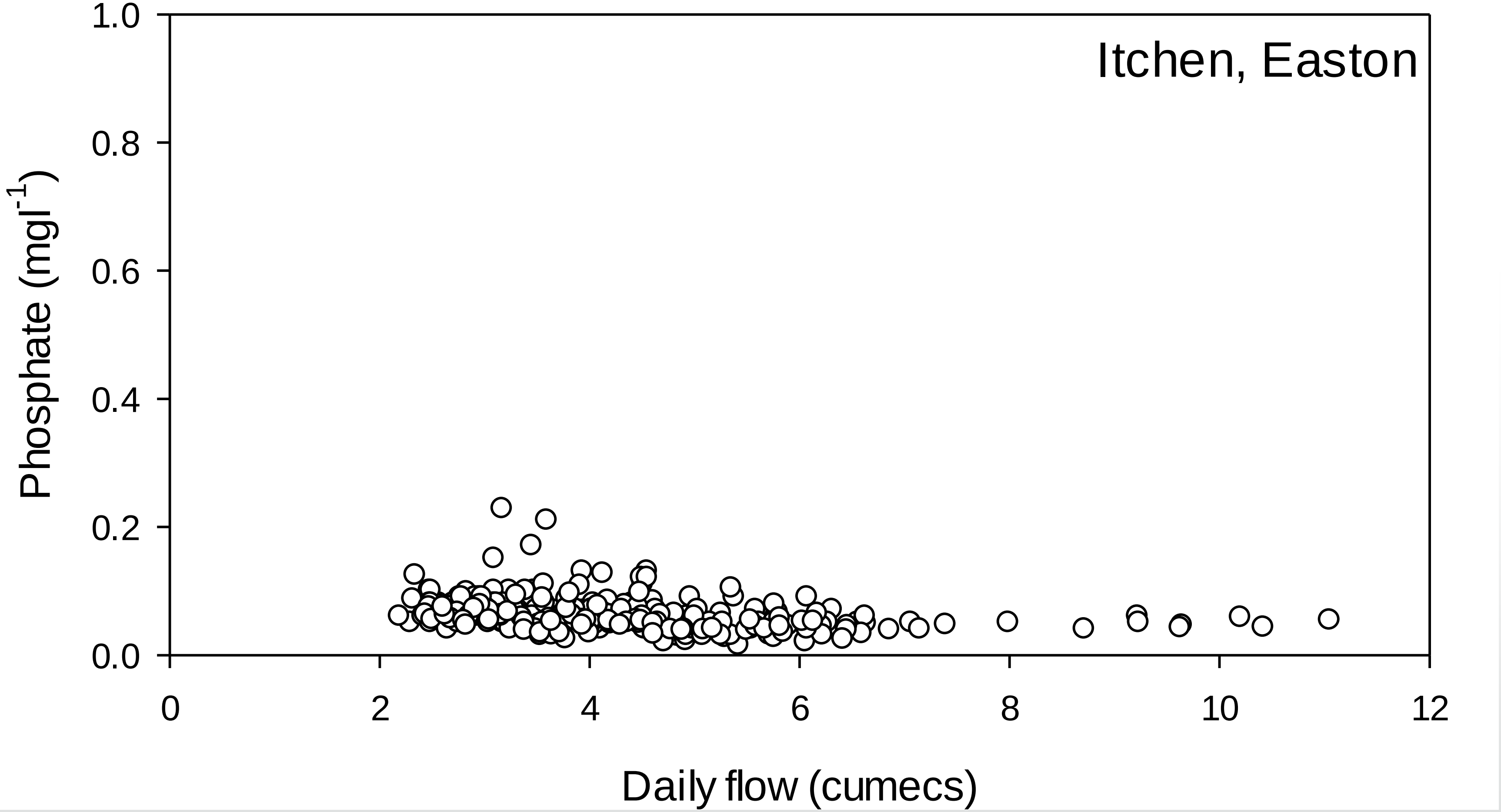


Arle, Drove Lane
Phosphate (mgl-1)
Daily flow (cumecs)
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0

Cheriton

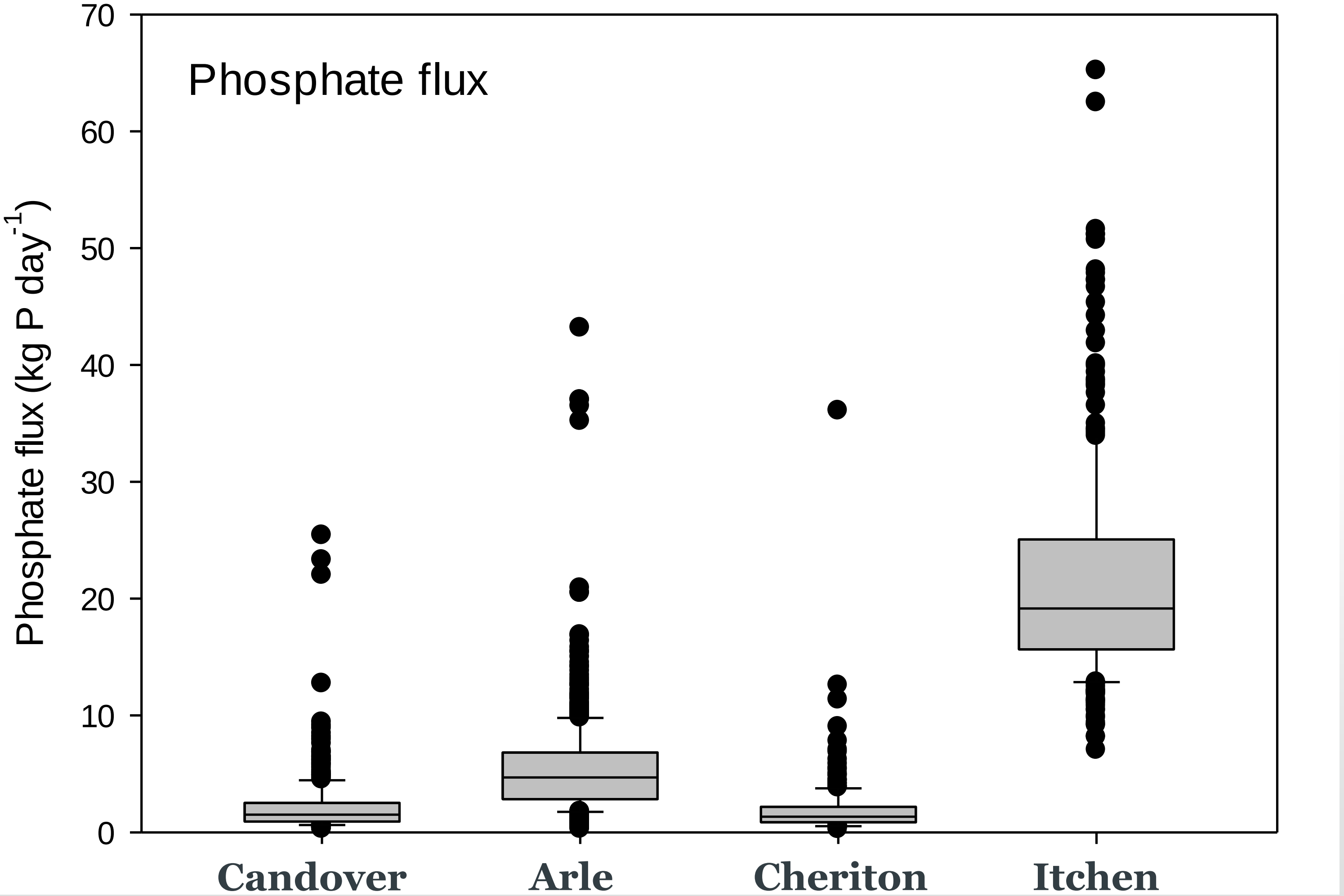

Cheriton, Sewards Bridge
Phosphate (mgl^{-1})
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
2.5
Daily flow (cumecs)

River Itchen



Phosphate fluxes

Phosphate flux estimates



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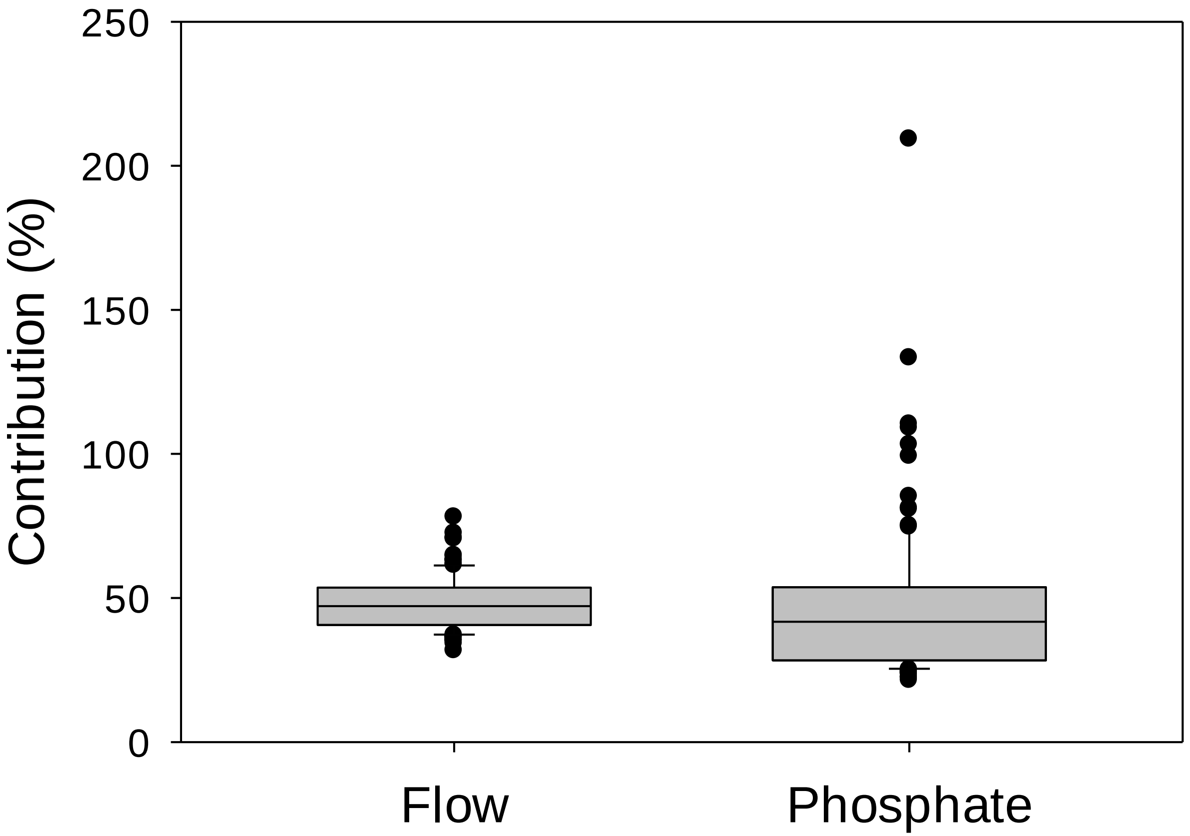
Contributions of the three main tributaries to flow and phosphate fluxes at Easton



Flow

ca. 48% from the three main tributaries

Phosphate

ca. 47% from the three main tributaries

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Contributions of the three main tributaries to flow and phosphate fluxes at Easton

Candover	12% of flow 10% of phosphate flux
Arle	22% of flow 26% of phosphate flux
Cheriton	14% of flow 11% of phosphate flux
Other sources	52% of flow 53% of phosphate flux

Summary and closing remarks

Summary

Phosphate levels are high at all sampling sites considered; the Arle and Itchen are highest.

Relationships between phosphate concentration and flow are inconclusive.

The Arle contributes more to the phosphate flux than other tributaries.

The three main tributaries only account for about half of the flow and phosphate flux at Easton.

Remarks

This initial analysis gives insight to the problem but not answers to key questions:

Where does most phosphorus come from and when?

What are the priority targets and potential mechanisms to reduce phosphorus inputs?

“When” needs higher resolution.

“Where” needs higher resolution.

Phosphorus speciation needs to be considered.

Research objectives

1. Define the relative contributions of different species of P from diffuse and point sources.
2. Investigate transport mechanisms and pathways of P (timing, rate and speciation).
3. Build a P mass balance model at sub-catchment level (fluxes, and physical, chemical, and biochemical mechanisms of storage and release).
4. Identify priority targets and potential mechanisms for intervention to reduce the supply of available phosphorus to the river.

Acknowledgement

Many thanks to colleagues at the Environment Agency for provision of data.

Phosphate concentration