Ash and Martock Nature - Phosphate Survey

Report 8

Parrett Load, January 2024

This is a short report on two recent studies carried out on the river Parrett and its tributaries. The studies were designed to throw light on two observations emerging from the work done last year. These were:

1 Why do we see so little phosphate in the Parrett that is agricultural in origin?

2 Why does the phosphate concentration in the Parrett not vary with water flow?

The two studies are:

1 A study of the river Parrett phosphate load at Chiselborough over the last seven months.

2 A study of phosphate concentrations in different water sources around Martock during the recent flood season.

Data associated with both are attached in an appendix. Both studies are ongoing and yielding useful reproducible patterns.

Parrett Load Study

This entailed a weekly measurement of phosphate concentration at Chiselborough Bridge where there is an EA monitoring station measuring the Parrett flow rate. This enabled the phosphate load to be studied over time.

Here are some significant observations

1 The Parrett system summer flow is mainly from sewage works plus a few small springs under the limestone scarpland to the east (see report 6). Phosphate load is relatively constant at around 40kg/day past Chiselborough. This is almost entirely from sewage. It forms a baseline; anything in excess can presumably be attributed to oter sources

2 The phosphate load very closely follows the river flow. Phosphate load is therefore very weather dependent.

3 The total 3-month winter phosphate load (Dec-Feb) exceeds the 9-month summer load (Mar-Nov) by several times. (The load is represented by the area under the curve in the Appendix graph; this is greater in the winter months than in all the others combined).

4 The excess winter phosphate load must come from legacy phosphate and/or from agricultural run-off.

Phosphate distribution during the flood season

1 This is the season of maximum soluble phosphate generally because of decomposing plant material. A few water sources are still very low but water courses known for their low phosphate concentrations most of the year can be up to 0.3ppm[1] during flooding.

2 Land drains and deep drainage rhynes with raised banks are usually low/very low in phosphate suggesting strong absorption by the soil. This is supported anecdotally by farmers.

3 Surface flood water is universally high in phosphate; typically higher than river concentrations. When flooding occurs considerable additional excess phosphate comes from surface run-

1 All measurements refer to ppm active phosphate (PO_4), not phosphorus (P)

off. It is not clear how much of this subsequently enters the main rivers directly. Much appears to soak into the ground, presumably losing its phosphate on the way. How the volume of this compares with that carried in the rivers is unknown.

4 Where river and tributaries are contained within banks even during raised flow any significant excess phosphate must come mainly from disturbed river sediment. This is strongly evident in the main rivers (Parrett and Yeo) where phosphate concentrations have remained remarkably constant at around 0.5-0.6 ppm during the winter.

5 Winter surface floodwater is universally high in phosphate; typically higher than river concentrations. When flooding occurs, considerable additional phosphate comes from surface run-off. This suggests phosphate is held in the top few centimetres of soil with little penetrating much further. Surface run-off phosphate seems to be largely independent of how the land is cultivated (though former potato fields seem particularly high). The volume of surface run-off was greatly dependent on farming practice, particularly cover-cropping and attention to the state of ditches.

Some implications for phosphate offsetting

1 The winter phosphate load entering the Levels area does not normally enter the Moor rhynes (except for those few moors, like Curry Moor, set aside for balancing flood waters and which are flooded deliberately). Moor flooding is cause d mainly by over-topping drains when the rivers are too full to allow drains to be fully pumped; the main sources of flood water are therefore the streams feeding each Moor and not the main rivers.

2 The inlets from the Parrett and Yeo down onto the Moors are all closed in the winter period.

3 Considerably less than a third of the annual Parrett/Yeo catchment flow passes through the Levels in the months when the inlets are open (roughly April-Oct). Less than 0.1 % of this April-Oct flow passes onto the Moors through each inlet (there are typically around two feeding each Moor) which are typically not opened particularly wide, maintaining a small flow that does not erode the rhynes..

4 Only about 0.03% of annual river phosphate load enters the Moors through inlets (follows from the above points)

5 Offsetting one new house prevents about 100g phosphorus entering the Levels area in the main rivers annually. Offsetting one house therefore will prevent 30 mg or less of phosphate per year entering the Moors (0.03% of 100g) though inlets. 30mg is roughly what can be held between thumb and forefinger (a ‘pinch’). The remaining 99.97g would otherwise go directly with the main rivers to Bridgewater Bay; it would not enter the Levels catchment.

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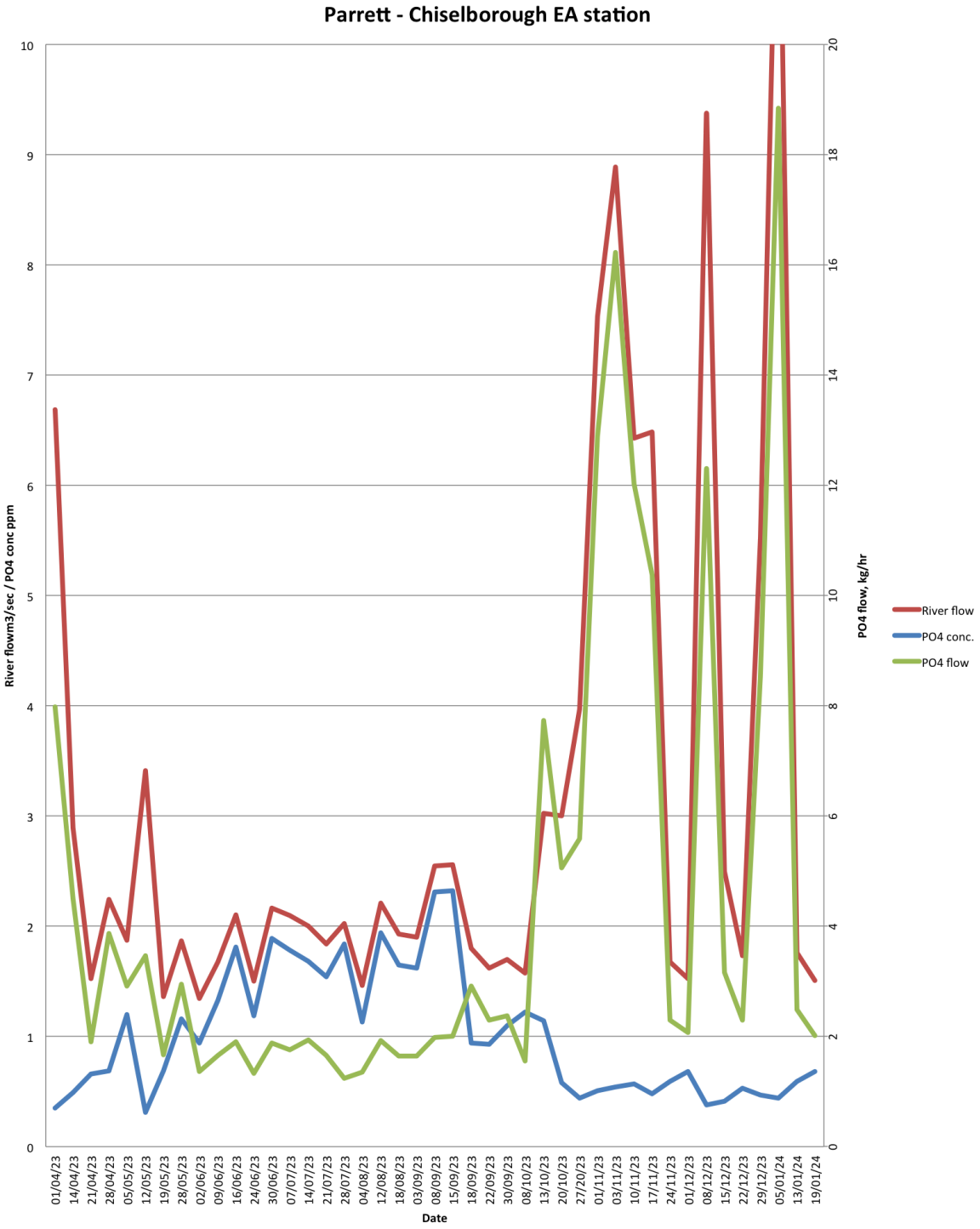
Appendix - Experimental

Parrett Load Study

The graph shows the Parrett Flow, phosphate concentration and phosphate load (kg/hr) for the



river Parrett at the Chiselborough monitoring station over a period of around 9 months. Samples were taken weekly.

Note the relative stability of the phosphate concentration over time, in contrast to the consider-

able variation in both river flow and load. Note that the load mirrors the flow rate, suggesting rapid equilibration between phosphate in solution and phosphate bound to disturbed sediment minerals.

Note also that much more phosphate flowed through the catchment in winter than in summer.

Phosphate distribution during the flood season

This study looked at a variety of different watercourses in or near Martock Parish during two periods of flooding. These were:

- Surface flood water and ditches receiving it
- Deep rhynes taking mainly water that had percolated through the soil
- A land drain
- Artificial retention ponds forming part of the parish flood protection system and/or irrigation ponds
- The main rivers Parrett and Yeo.

Watercourse	Location	Description	Flood 1 1-2Nov23 (ppm)	Flood 2 5-13 Dec23 (ppm)	EA classification	Agricultural data (recent crop)
Norton spring	Little Norton	Spring water at source	0.00	0.00	High	Woodland
Land train	Bower Hinton farm	Maize field	0.00	0.06	High	Maize
Pond	Bower Hinton farm	Retention/irrigation pond	0.00	0.04	High	Mainly maize
Stream	Bower Hinton	Deep stream	0.01	0.32	High/moderate	Mainly grass
Stream	Norton centre	Confluence	0.06		High	
Stream	Norton church		0.26		Good	
Stream	Norton, main road	Confluence with Parrett	0.32	0.35	Moderate	Grassland
Flood water	Bower Hinton farm	Maize field	0.34		Moderate	Hillside
Stream	Cartgate	Exit stream	0.36	0.39	Moderate	Maize, potato, grass
Stream	Lambrook Brook	Outflow from South Petherton STW	0.40		Moderate	Grass hay/silage
Stream	Lambrook Brook	Overtopping in field	0.43	0.55	Moderate	Grassland
River Parrett	Chiselborough	Main River	0.51	0.44	Moderate	
River Parrett	Chiselborough	Main River	0.54	0.59	Moderate	
River Parrett	Gawbridge	Main River		0.56	Moderate	
River Yeo	Long Load	Main River		0.57	Moderate	
River Parrett	Bower Hinton farm	Main River		0.51	Moderate	
Pond	Cartgate	Retention pond overtopped	0.60	0.62	Moderate	Nature area. Potato upstream
Flood water	Gawbridge	from Parrett	0.70		Poor	Grassland
Flood water	Gawbridge	Field run-off	0.71	0.81	Poor	Maize
Flood water	Stoke road	stream and field run-off	0.72		Poor	Grassland and maize
Flood water	Long Load field	Witcombe Min drain overtopping		0.72	Poor	Grassland (dairy farm)
Flood water	Chiselborough	Parrett overtopping	0.87	0.73	Poor	Riding stables
Ditch	Cartgate	field run-off	0.98		Poor	Potato

A striking feature is table is that although it has been deliberately arranged according to column 4 (increasing phosphate concentration in flood 1), it has automatically arranged itself by watercourse (col 1) - with standing floodwater the most polluted by phosphate.

The lowest phosphate concentrations of found in watercourses fed largely by water that has been filtered through the soil. Note, once again the almost constant concentration of phosphate in the main rivers even though their volumes and flow rates varied very considerably when these measurements were taken.

Note the consistancy between the results for the two flood periods (cols 4 and 5)

Measurement units

All measurements recorded active phosphate as PO_4, not as P. (To convert to P, divide by 3) The EA category boundaries (as PO_4) used in the table relate to the River Parrett below Langport and are as follows (in ppm)

High	<0.15
Good	0.15 to 0.27
Moderate	0.28 to 0.66
Poor	0.67 to 3.33
Bad	>3.33