Clean River Kent Campaign

Freshwater Watch (FWW)
citizen science project
1 September 2023 - 31 August 2024

Summary of results

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Abstract

- This report summarises a CRKC citizen science project within the Freshwater Watch (FWW) framework (www.freshwaterwatch.org).

- CRKC's aim was to establish an overview of the health of the River Kent and its main tributaries including the levels of phosphate-P and nitrate-N, turbidity and systematic observations about the general state of the local environment.

- Following a pilot study, samples were taken between 1 September 2023 and 31 August 2024 at 19 locations on the River Kent and its main tributaries – the Gowan, the Mint, the Sprint, and Lambrigg (Flodder) Beck, and at Underbarrow Pool.

- The results appear to show a number of locations with potentially harmful levels of phosphate-P in the river Kent. This is potentially significant given the river's status as a Site of Special Scientific Interest (SSSI) and a Special Area of Conservation (SAC).

- This intensive 12-month citizen science study brought together a team of 46 volunteers who analysed a total of 246 river water samples along the river Kent and its tributaries.

- The results of the CRKC Citizen Science Programme continue to contribute to the national campaign to clean up our inland waterways.

Thank you to all the citizen science volunteers who took part in the programme, and to our funders.

Introduction to the River Kent

The River Kent is a fast flowing, oliotrophic (low in plant nutrients such as phosphate-P and nitrate-N), upland river with significant and rapid variations in river levels in response to high rainfall.

The river is much loved by local people, who enjoy walking along the riverbanks, as well as paddling and swimming, kayaking and angling.

The River Kent is designated as a Site of Special Scientific Interest (SSSI) and a Special Area of Conservation (SAC) due to the presence of several critically endangered species. Yet the most recent published data from Natural England raise concerns about the quality of the river water.

The Clean River Kent Campaign (CRKC) was established in 2021 as a coalition of communities living along the River Kent, including Staveley, Burneside, Kendal, Sedgwick and Levens. Our aim is to make the River Kent clean for all types of water-based recreation and to protect the ecology and wildlife in the river by working with local communities. Link for more info

CRKC has an active citizen science programme which has included monitoring levels of E. coli and Enterococcus spp (faecal bacteria) and the sources of the E. coli. Link for more info

This report presents the findings of the FWW project to assess the health of the River Kent and its main tributaries.

The River Kent and tributaries FWW project
1 September 2023 to 31 August 2024

This report summarises a CRKC citizen science project within the Freshwater Watch (FWW) framework (www.freshwaterwatch.org). FWW is a global organisation which supports local groups to monitor their local water course, including recording the levels of Phosphorus-phosphate-P [PO_4^{3-}-P] (“phosphate-P”) and Nitrogen-nitrate-N [NO_3^--N] (“nitrate-N”). FWW provides a structured approach to recording and uploading data. They also deliver the reagents, are available for technical advice, and provide an annual report.

phosphate-P and nitrate-N cause a process known as eutrophication, acting as harmful nutrients by promoting algal growth which deprives other aquatic plants and animals of oxygen. The main sources of phosphate-P is sewage effluent (primarily from WwTW but also from septic tanks) and losses from agricultural land. nitrate-N is associated primarily with nitrification of soil organic matter, inorganic fertiliser, manure, and to a lesser extent sewage.

CRKC’s aim was to establish an overview of the health of the River Kent and its main tributaries including the levels of phosphate-P and nitrate-N. This information will provide a baseline against which changes to water quality, either good or bad, can be measured. It will also inform the next stage of the CRKC citizen science programme, for example by identifying “hot spots” or “gaps” which require further investigation.

Following a pilot study, samples were taken between 1 September 2023 and 31 August 2024 at 19 locations on the River Kent and its main tributaries – the Gowan, the Mint, the Sprint, and Lambrigg (Flodder) Beck, and at Underbarrow Pool. Additional results, collected by National Trust volunteers at Sizergh, have also been included. Volunteers also measured water turbidity and made systematic observations at each location. In total 246 samples were collected by 46 CRKC volunteers at a total cost of slightly less than £2,000.

Summary of sampling locations

River Kent - sampling locations

K05 Scroggs Bridge Staveley

K15 Stock Bridge Farm

K20 Downstream from Staveley WwTW

K30 Bowston Bridge

K35 Ford Bridge Burneside

K45 Dockray Bridge

K50 Upstream from K Shoes Factory

K65 Scroggs Wood

K70 Below Scroggs Weir

K75 Grassy Banks

K80 Low Sizergh Suspension Bridge

K85 Nannypie Lane

K90 River Kent Levens Bridge

River Kent tributaries - sampling locations

G20 Gowan Deeps
L05 Lambrigg Beck above WwTW
L10 Lower Lambrigg Beck
M05 River Mint Main River
M10 Mint Bridge
S05 Sprint Bridge
U05 Underbarrow Pool

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Map showing sampling locations - North

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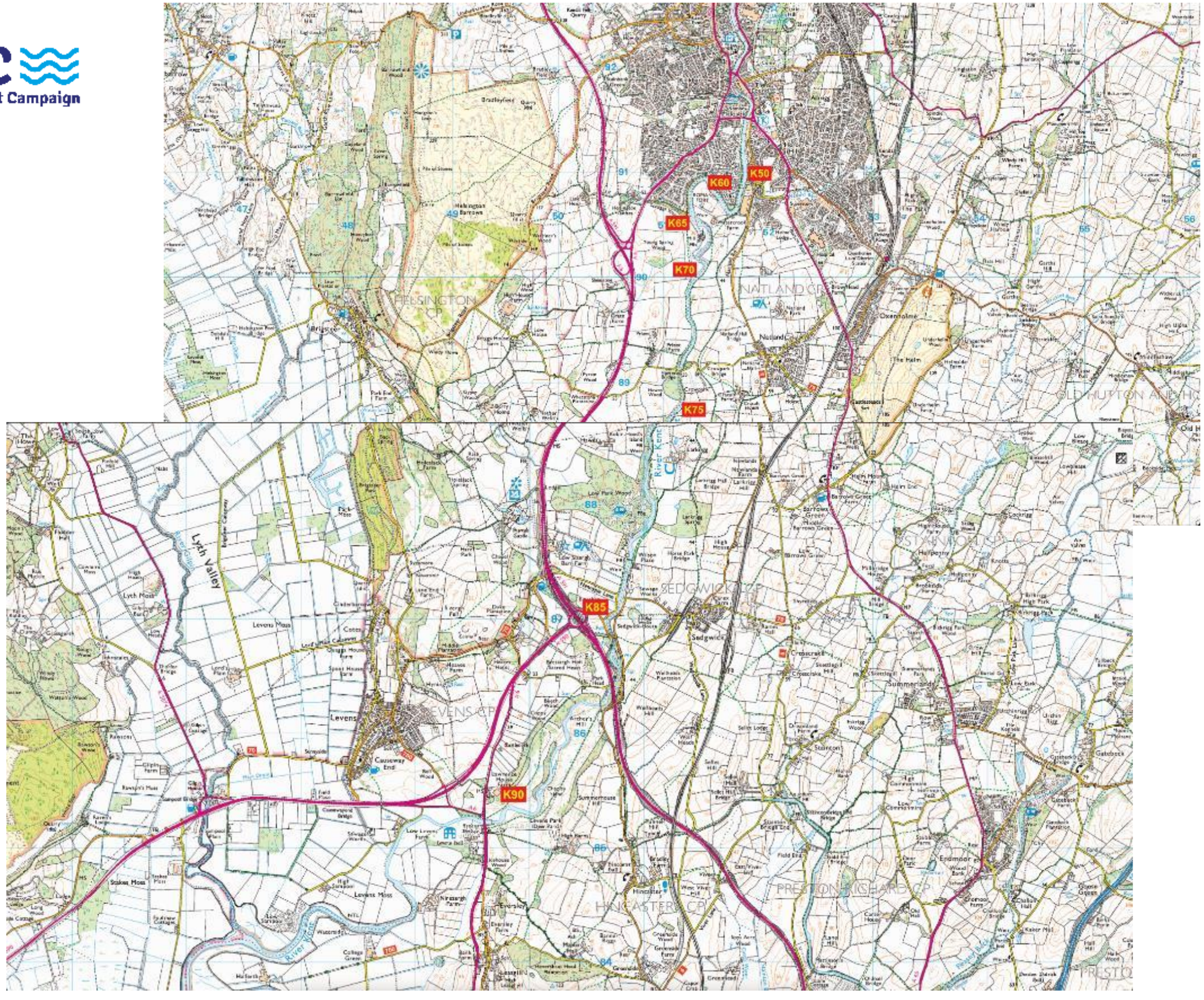

Map showing sampling locations - South

Map showing sampling locations - East

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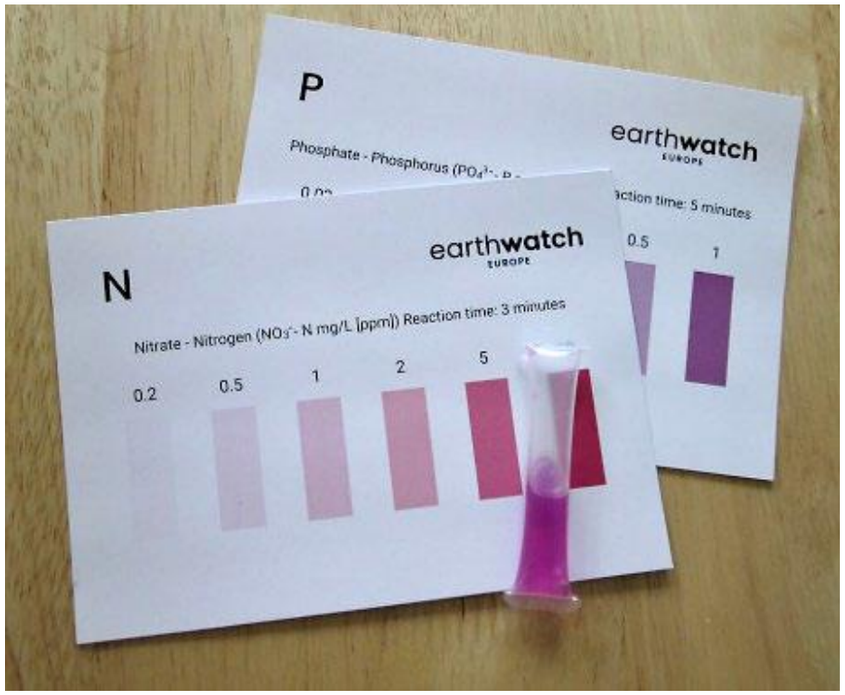
How nutrient testing is undertaken

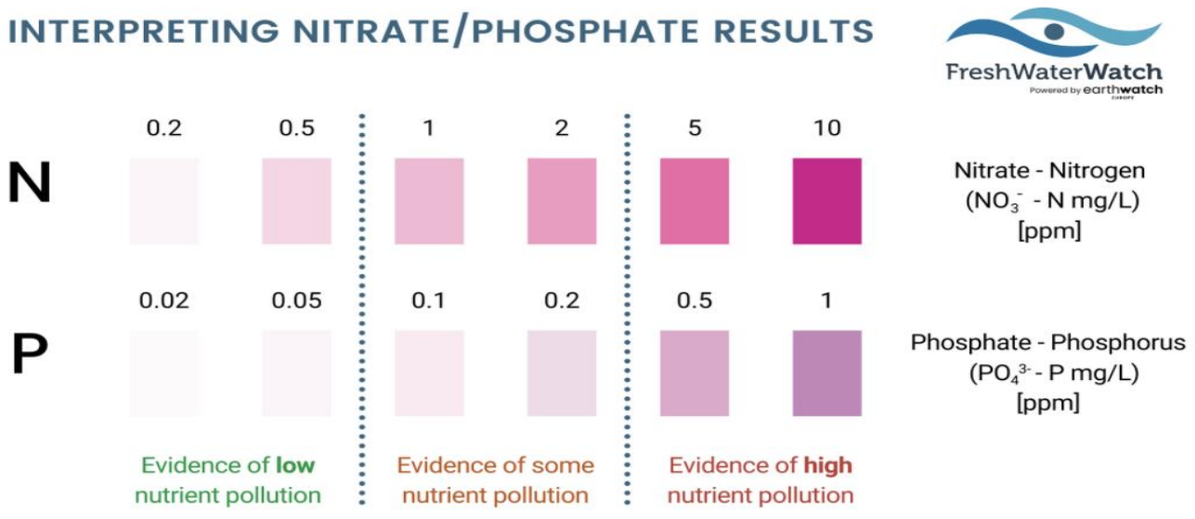


A measured volume of river water is placed in two small ampoules each containing an indicator chemical – one for phosphate-P and the other for nitrate-N. After a prescribed time, the resulting colour density is compared to a chart to identify a concentration range using the chart below.

- phosphate-P is measured as milligrams PO_4^{3-}-P per litre water (mg/l)
- nitrate-N is measured as milligrams NO_3^--N per litre water (mg/l)

Values are recorded for each sample as one of these six bands for nitrate-N and for phosphate-P and compared with the FWW thresholds:

P	N
0 - 0.02	0 - 0.2
0.02 - 0.05	0.2 - 0.5
0.05 - 0.1	0.5 - 1.0
0.1 - 0.2	1.0 - 2.0
0.2 - 0.5	2.0 - 5.0
0.5 - 1.0	5.0 - 10



Good ecological status may result from low nutrient concentrations - nitrate **<1** and phosphate **<0.1**.
Poor ecological status may result from high nutrient concentrations - nitrate **>1** and phosphate **>0.1**.

Notations and Water Quality Targets

- Although in lay terms we talk of testing for phosphates and for nitrates, the FWW test kits actually measure:

    - Phosphorus *as* PO_4^{3-}-P per litre water (mg/l or µg/l) – phosphate-P
    - Nitrogen *as* NO_3^--N per litre water (mg/l or µg/l) – nitrate-N

- These are key indicators of the availability of inorganic phosphorus and nitrogen respectively in a form that can be taken up by algae and other organisms, and that can influence the balance of plant species in a freshwater environment.

- Nutrient concentrations are expressed as either **milligrams** per litre of water (mg/l) or **micrograms** per litre of water (µg/l). These notations are used interchangeably in this report, because of the way notations are used by the organisations involved. FWW use milligrams per litre, whereas Natural England and Environment Agency use micrograms per litre.

- The measurements are compared with the FWW targets that indicate compromised water quality:

    FWW threshold for Phosphate-P: 0.1 mg/l PO_4^{3-}-P = 100 µg/l PO_4^{3-}-P

    FWW threshold for Nitrate-N: 1.0 mg/l NO_3^--N = 1000 µg/l NO_3^--N

Overview of results

- CRKC has analysed the levels of phosphate-P and nitrate-N in each river water sample and compared these with the thresholds used by FWW. Tables 1 and 2 show the monthly results for the River Kent itself (Table 1) and its tributaries (Table 2).

- Overall, the levels of phosphate-P do not appear to have varied by the season. Levels above the FWW threshold are found in relatively few locations. The levels of nitrate-N were more likely to exceed the FWW threshold in the winter and spring months, though not exclusively so. Increased levels of nitrate-N and phosphate-P seem to occur independently of each other.

- High phosphate-P levels appear to occur at locations along the length of the river and its tributaries. The results at Lambrigg Beck (both United Utilities and Natural England have expressed concerns about phosphorus levels at nearby Flodder Beck), were particularly high.

- nitrate-N exceedance was more likely downstream of Kendal than upstream.

- On only three occasions did the levels of both nitrate-N and phosphate-P exceed FWW thresholds on the same day:

    - Below Scroggs Weir (K70) on 24 Dec 23
    - Lambrigg Beck above the WwTW (L05) on 28 Jan 24
    - Lower Lambrigg Beck (L10) on 30 Jan 24

    But volunteer observations indicate that the 3 occasions had nothing in common in terms of rainfall, river level or river water flow.

- The detailed results for each location (2 pages per location) are presented in **Annex 1.** The detailed observational data is also summarised along with a photograph of the location.

Table 1: River Kent Annual Summary
Maximum values by month (red=exceeds FWW threshold)

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RIVER KENT

PHOSPHATE mg/l

	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24
K05 Scroggs Bridge Staveley	0.00	0.01	0.01	0.01		0.01	0.01	0.04	0.01	0.01	0.01	0.04
K15 Stock Bridge Farm	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
K20 Downstream from Staveley WwTW	0.15	0.04	0.01	0.01	0.04	0.15	0.04		0.04	0.08	0.01	
K30 Bowston Bridge	0.01	0.04	0.01	0.01	0.01		0.01	0.01	0.01		0.01	0.04
K35 Ford Bridge Burneside	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.50	0.08	0.01		0.01
K45 Dockray Bridge	0.04	0.01	0.01	0.01	0.04	0.01	0.04	0.01	0.01	0.01	0.01	0.01
K50 Upstream from K Shoes Factory	0.04	0.04	0.04			0.01	0.04	0.01	0.04	0.08	0.01	0.01
K65 Scroggs Wood	0.08	0.08	0.04		0.04	0.08	0.04	0.01	0.01	0.01	0.01	0.01
K70 Below Scroggs Weir				0.75	0.04	0.08	0.08	0.04	0.04	0.01	0.01	0.04
K75 Grassy Banks	0.04	0.04	0.04	0.08	0.04	0.01	0.08	0.08	0.08	0.04	0.01	0.01
K80 Low Sizergh Suspension Bridge		0.08	0.01	0.08	0.08	0.01	0.01	0.04	0.08	0.08	0.01	0.01
K85 Nannypie Lane	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.04	0.04	0.15	0.01	0.01
K90 Levens Bridge	0.04	0.04	0.01	0.04		0.08	0.04	0.01	0.04	0.01	0.04	0.01

NITRATE mg/l

	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24
K05 Scroggs Bridge Staveley	0.35	0.35	0.10	0.35		0.75	0.10	0.10	0.10	0.10	0.10	0.35
K15 Stock Bridge Farm	0.35	0.35	0.10	0.35	0.75	0.35	0.35	0.35	0.35	0.10	0.10	0.35
K20 Downstream from Staveley WwTW	0.75	0.35	0.35	0.75	0.75	0.75	0.75		0.35	0.35	0.10	
K30 Bowston Bridge	0.35	0.75	0.10	0.35	0.75		0.35	0.35	0.35		0.10	0.10
K35 Ford Bridge Burneside	0.75	0.75	0.75	0.75	0.35	0.75	0.35	0.75	0.35	0.10		1.50
K45 Dockray Bridge	0.75	0.35	0.75	1.50	0.75	0.75	0.35	0.75	0.75	0.75	0.35	0.10
K50 Upstream from K Shoes Factory	0.35	1.50	1.50			1.50	0.75	0.75	0.75	0.75	0.35	0.35
K65 Scroggs Wood	0.75	0.75	0.75		1.50	0.75	0.75	1.50	0.35	0.10	0.35	0.35
K70 Below Scroggs Weir				1.50	1.50	1.50	0.75	0.75	0.35	0.75	0.35	0.10
K75 Grassy Banks	0.35	0.75	0.75	0.75	0.75	0.35	0.75	1.50	0.75	1.50	0.35	0.35
K80 Low Sizergh Suspension Bridge		0.75	0.75	1.50	1.50	1.50	0.35	0.35	1.50	0.35	0.35	0.35
K85 Nannypie Lane	0.35	0.75	0.75	0.75	0.75	1.50	0.75	1.50	0.75	0.10	0.35	0.75
K90 Levens Bridge	0.75	0.75	0.35	0.75		0.75	1.50	0.75	0.35	0.75	0.75	0.35

Table 2: River Kent Tributaries Annual Summary
Maximum values by month (red=exceeds FWW threshold)

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KENT TRIBUTARIES

PHOSPHATE mg/l

	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24
G20 Gowan Deeps	0.35		0.01	0.01				0.01		0.04	0.01	0.01
L05 Lambrigg Beck above WwTW	0.04	0.01	0.04	0.04	0.35				0.01		0.01	
L10 Lower Lambrigg Beck		0.08	0.35	0.75	0.75	0.04		0.01	0.01	0.08	0.04	
M05 River Mint (Main River)		0.01	0.04	0.01		0.04		0.08	0.01	0.04	0.01	
M10 Mint Bridge		0.04	0.01	0.04		0.35	0.01	0.01	0.01	0.01	0.01	0.01
S05 Sprint Bridge	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.01

NITRATE mg/l

	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24
G20 Gowan Deeps	0.35		0.35	1.50				0.35		0.35	0.10	0.10
L05 Lambrigg Beck above WwTW	0.75	0.35	0.75	0.75	1.50				0.10		0.10	
L10 Lower Lambrigg Beck		0.35	0.35	0.35	1.50	1.50		1.50	0.10	1.50	0.75	
M05 River Mint (Main River)		1.50	1.50	0.75		0.75		0.35	0.10	0.75	0.75	
M10 Mint Bridge		1.50	0.75	0.35		1.50	0.75	0.75	0.35	0.75	0.10	0.35
S05 Sprint Bridge	0.35	0.35	0.75	0.35	0.75	1.50	0.75	0.10	0.10	0.10	0.10	0.10

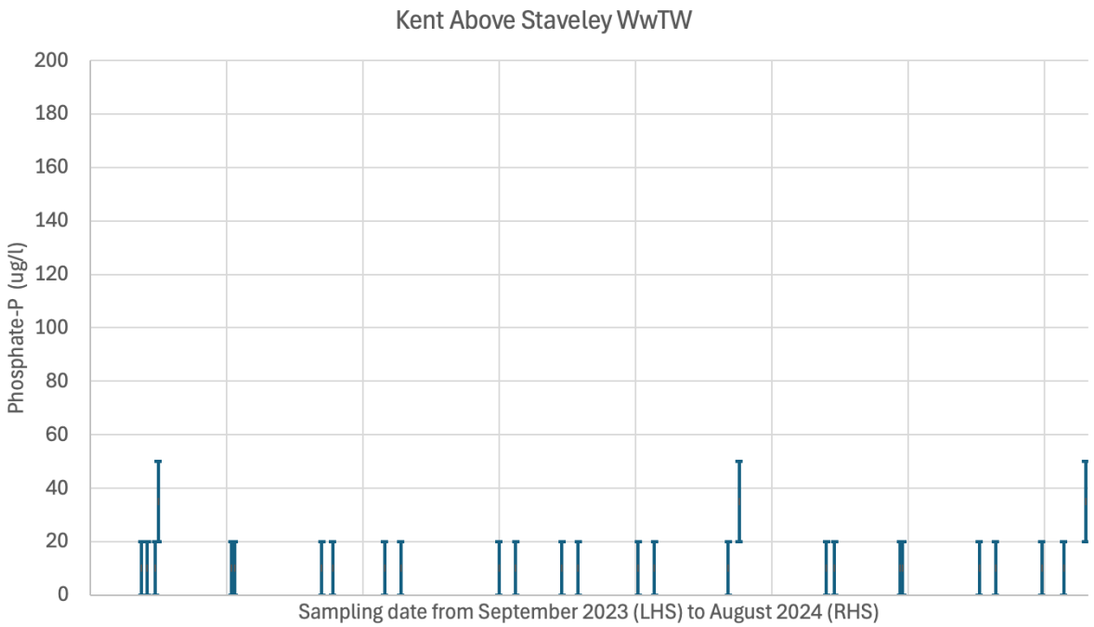
A comparison of 3 stretches of the River Kent

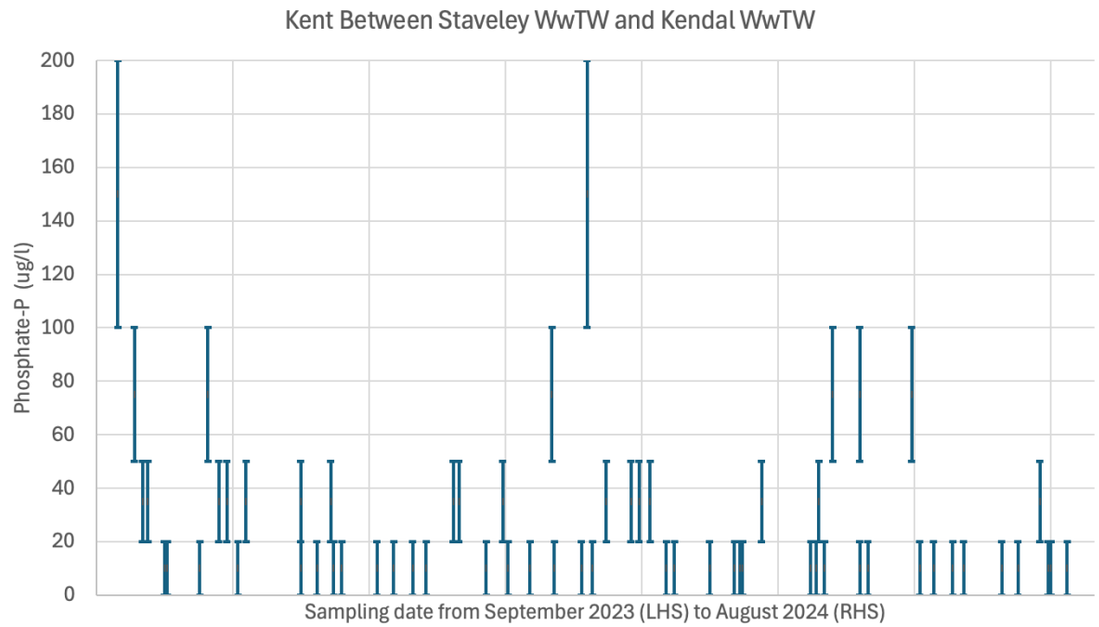
- Figure 1 on the following page groups the results for phosphate-P for three stretches of water:

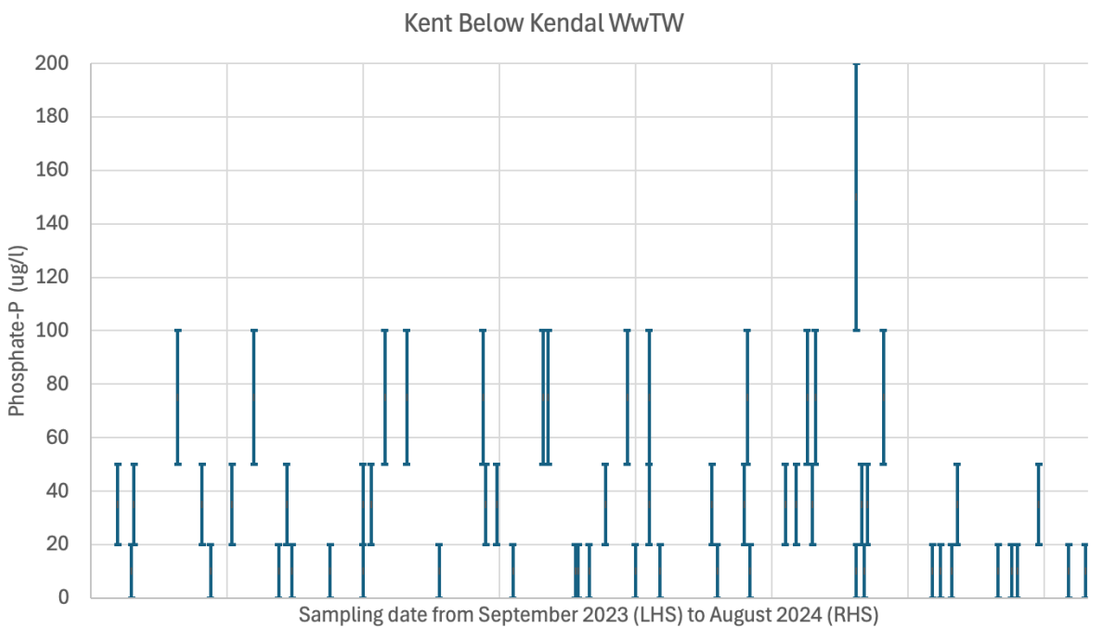
    - Upstream of Staveley WwTW
    - Between Staveley and Kendal WwTW
    - Downstream of Kendal WwTW

- This shows that the level of phosphate-P is low above Staveley WwTW, increases between the two WwTWs and is highest below Kendal WwTW. That is, phosphate-P nutrient pollution increases along the length of the river as it passes through habitation and farmland.

Figure 1: phosphate-P results upstream of Staveley WwTW, between Staveley and Kendal WwTWs, and downstream of Kendal WwTW







A comparison of Freshwater Watch and Natural England Water Quality Targets - overview

- The river Kent catchment (including its main tributaries) comprises a Site of Special Scientific Interest (SSSI) and a Special Area of Conservation (SAC). This means that more exacting quality standards and thus lower thresholds or targets are required for phosphate-P [PO_4^{3-}-P]. These are set by Natural England and the Environment Agency within the Common Standards Monitoring Guidance (CSMG).

- CSMG targets are expressed as annual averages for each stretch of the River Kent and its tributaries. These are one element of the assessment of water quality. The targets are set in the context of other factors including river flow, habitat structure, and local ecology.

- There is no equivalent CSMG target for nitrate-N, although a maximum annual average of 125 µg/l [NO_3^--N] is recommended. Again, this is significantly lower than the FWW threshold of1000 µg/l [NO_3^--N].

- **Table 3** compares the phosphate-P targets for each sample with the CSMG annual average target. The CSMG targets are significantly lower at every location.

- However, the FWW test method and its recording bands (**Table 3a**) is not designed to reliably measure the very low levels required by the CSMG targets. Therefore, our results are not reported relative to the CSMG targets, but only relative to FWW nutrient standards.

- This is illustrated for a selection of river Kent sampling locations in **Figure 2** on the following page, showing both FWW and CSMG targets. This issue will be discussed further with Natural England and the Environment Agency.

micrograms PO_4^{3-}-P per litre (µg/l)	FWW Target µg/l	CSMG Target µg/l
Dubbs Beck (Gowan headwater)	100	5
River Gowan	100	15
River Sprint	100	18
River Mint Upper	100	10
River Mint Lower	100	27
Grayrigg Beck (Lambrigg Beck)	100	10
Upper River Kent and in Kentmere	100	10
Kent: Gowan to Mint confluence	100	20
River Kent in Kendal & downstream of Kendal	100	30

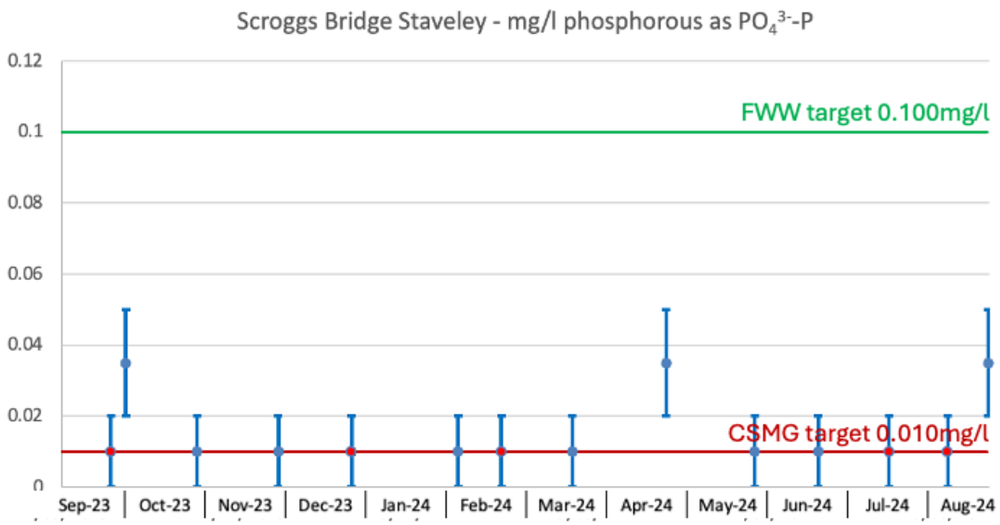
Table 3: Comparison of FWW and CSMG annual average Phosphate-P targets

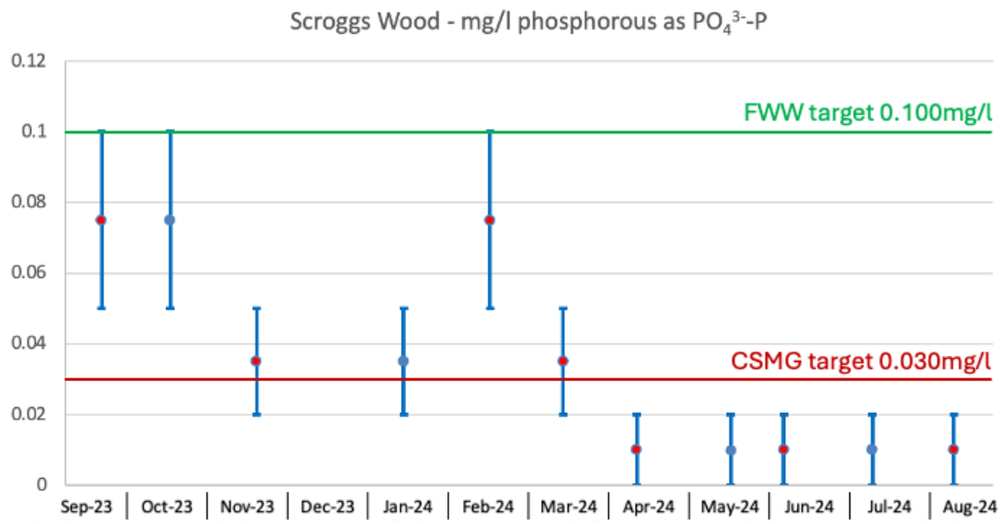
FWW phosphate-P measurement bands (µg/l)
0 - 20
20 - 50
50 - 100
100 - 200
200 - 500
500 - 1000

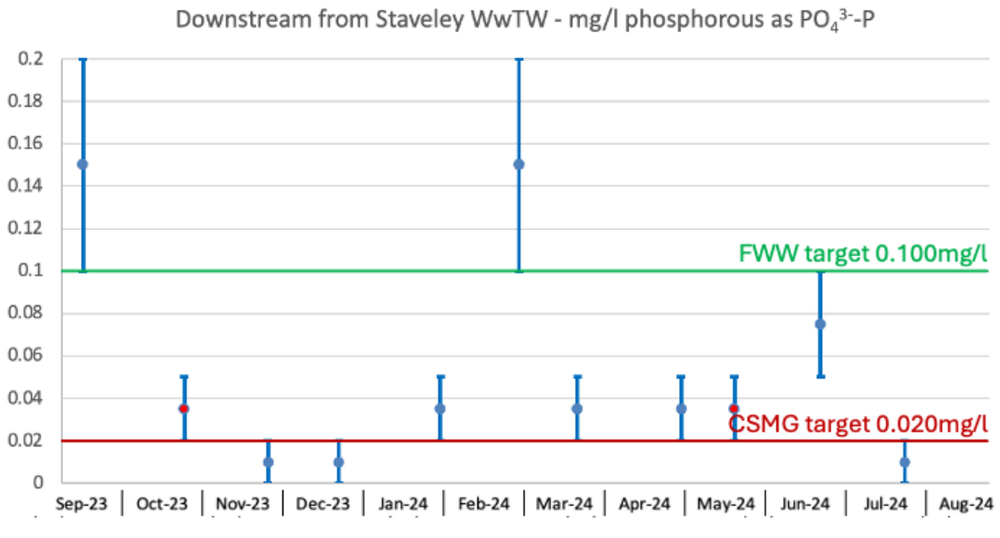
Table 3a: Freshwater Watch phosphate-P measurement bands

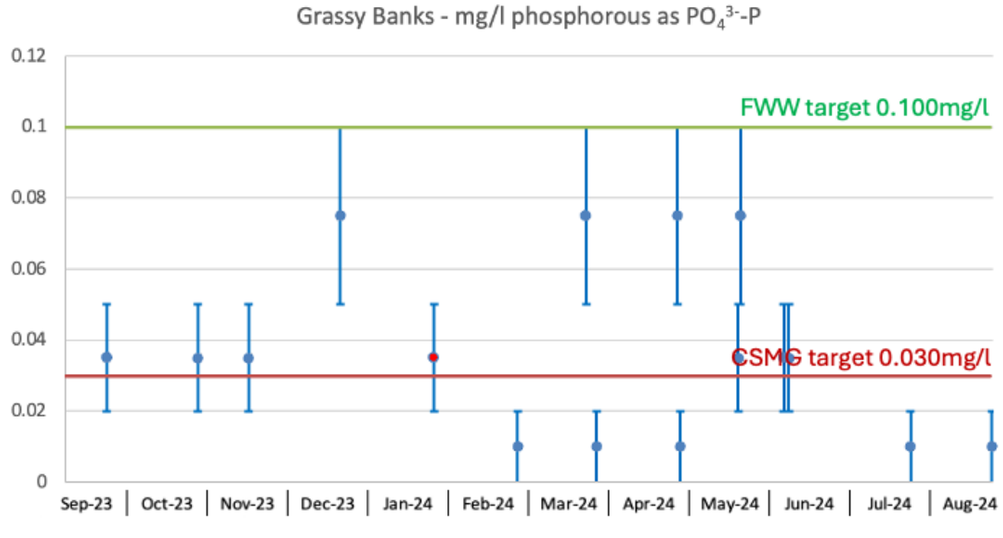
Figure 2: A comparison of Freshwater Watch and Natural England Water Quality Targets - examples

River Kent









Conclusions

- This study has achieved its primary aim of providing an overview of the health of the River Kent and its main tributaries. In total 246 samples were collected by 46 volunteers at 20 locations and at a total cost of slightly less than £2,000.

- The River Kent is an upland river, and CRKC therefore anticipated that the river and its tributaries would be in good general health. As measured against the FWW thresholds, this is broadly the case.

- However, high phosphate-P levels appear to occur along the length of the river and its tributaries. The results at Lambrigg Beck, where both United Utilities and Natural England have expressed concerns about phosphorus levels, were particularly high, and require further investigation.

- However, because the River Kent is an SSSI and SAC, the targets set by Natural England for phosphate-P are more rigorous than the thresholds set by FWW. When compared with the CSMG targets, the phosphate-P level at 8 locations are possibly above the CSMG target for that stretch of water.

- There is no target set by Natural England for nitrogen-N. The levels frequently exceeded the FWW threshold, more frequently below Kendal WwTW than above. However, as the main sources of nitrogen-N relate to farming practice, this could reflect the changing use of agricultural land as the river Kent flows south.

- The FWW results have been added to CRKC interactive map - www.russ-hore.co.uk/crkc/ for future reference and comparison against other data sets.

Next steps for CRKC citizen science

- CRKC will discuss the results of the FWW project with the Environment Agency (EA) and Natural England (NE) in the first instance. Both organisations have responsibilities for monitoring the water quality of the River Kent and its tributaries.

- The aims will be:
  - To raise CRKC concerns about the extent to which the levels of phosphate-P found in this study either possibly or definitely exceed the targets for that stretch of water
  - To understand the extent and the frequency of the monitoring programmes which are managed by the EA and NE
  - To ascertain whether, and if so how, CRKC can access the relevant databases
  - To determine whether CRKC needs to undertake further phosphate-P monitoring.

- If so, CRKC would need to select a method of testing which is sufficiently sensitive for the SSSI and SAC status of the river and its tributaries.

- In addition to the possibility of continuing to monitor phosphate-P, CRKC will consider testing ammonia levels (together with pH, an indicator of how acid or alkaline the water is). There is also the option of testing for E. coli, which was last done in 2022. This should be considered when the results of the CRKC microbial source tracking study are available.

- Finally, CRKC will consider which locations are the priority. Lambrigg Beck was identified as a “hot spot” in this study. In addition, United Utilities are planning investment at both Staveley and Kendal WwTWs, so perhaps these should also be considered as a focus.

- In discussion with CRKC supporters and volunteers, a decision will be made in early 2025.

Annex 1

Individual location results

River Kent K05 Scroggs Bridge Staveley - 1

13 samples, 23 Sep 23 – 15 Aug 24)

- Upland River, trees and shrubs
- Livestock in fenced fields with roads next to River
- Potential for urban road and agricultural run off
- Occasional foam seen on water
- No obvious filamentous algae seen
- No litter
- Dragonflies, damselflies, River fly larvae and white clawed crayfish

nitrate-N always < 1.0mg/L
phosphate-P always < 0.1mg/L

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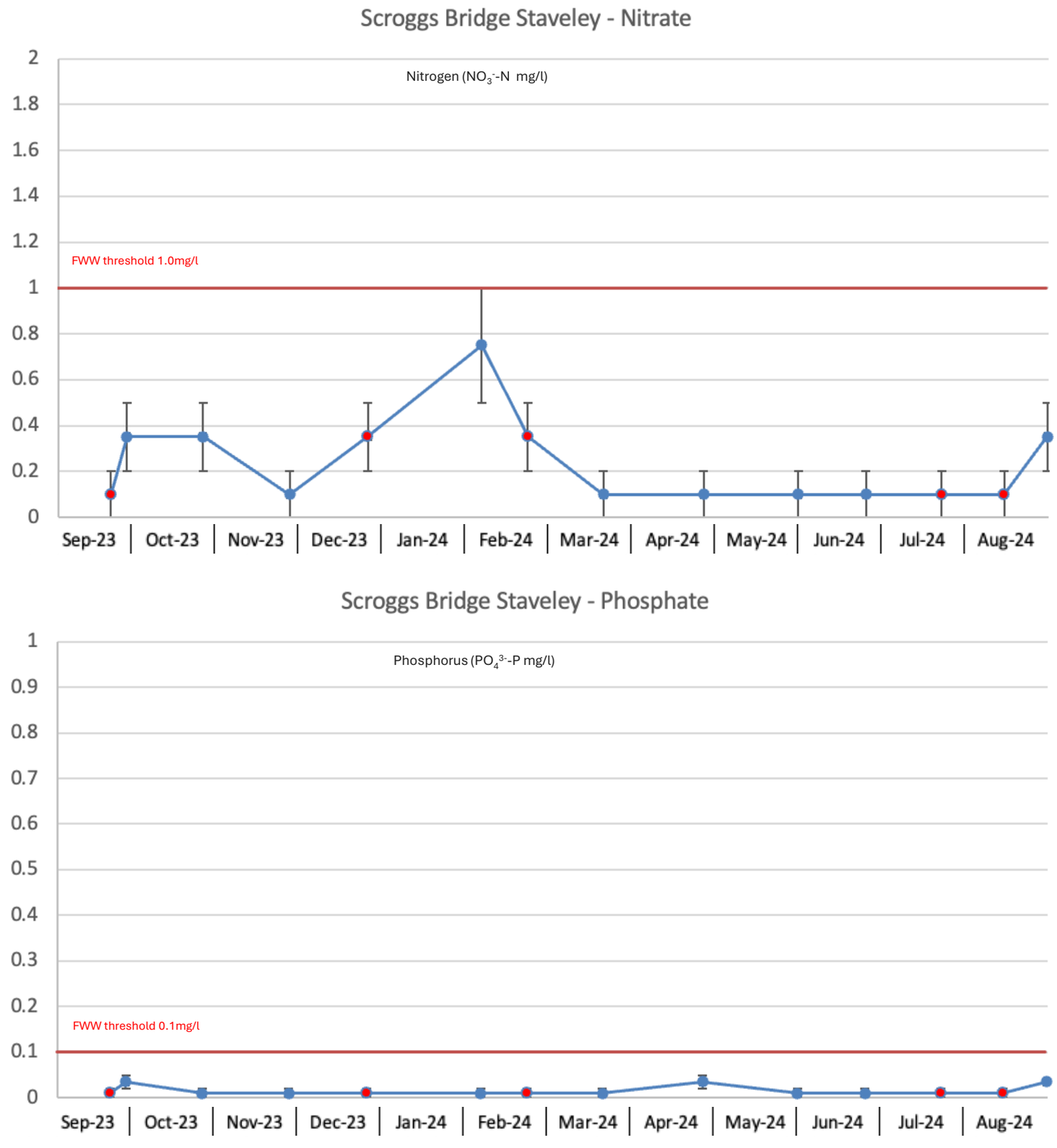
River Kent K05 Scroggs Bridge Staveley - 2



Red points indicate sampling preceded by heavy prolonged rain

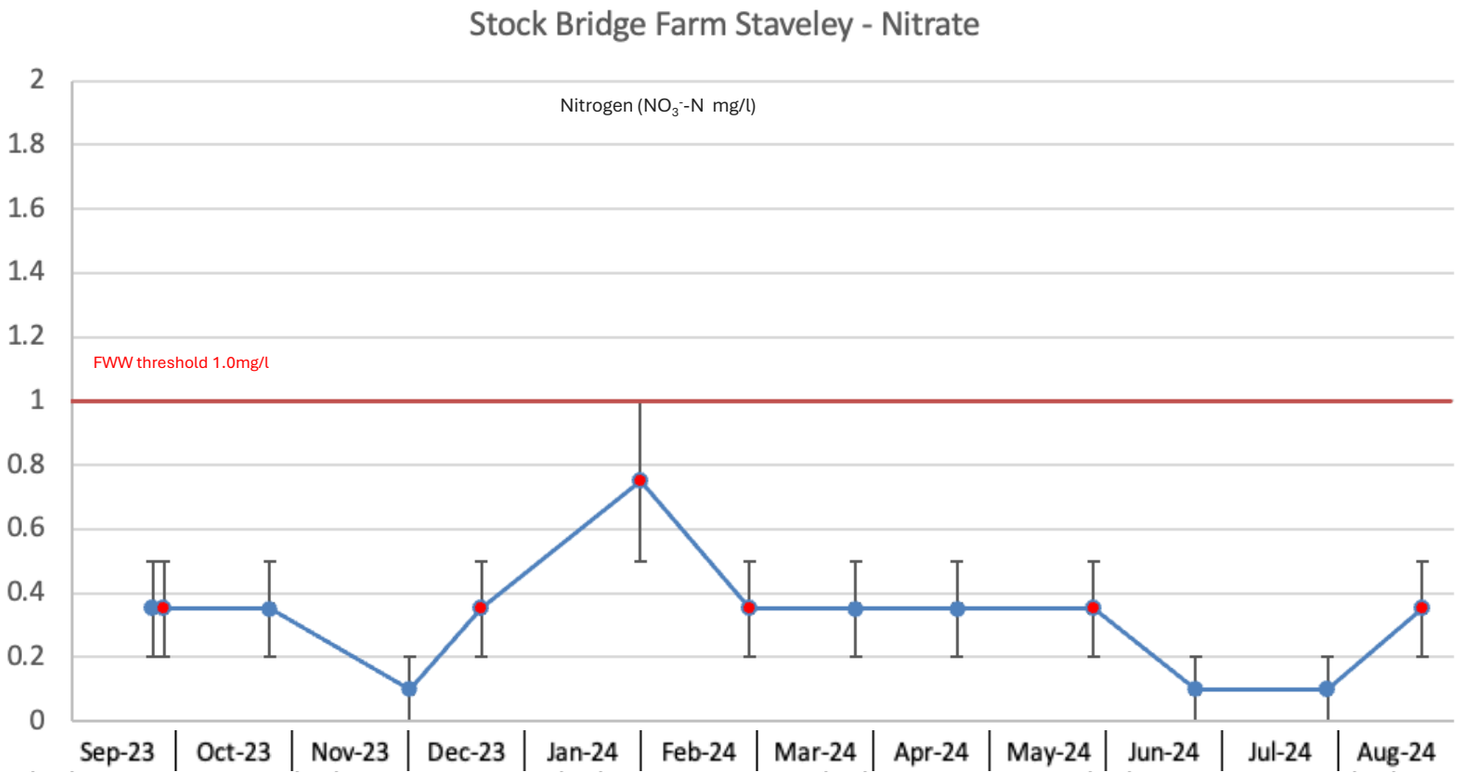
River Kent K15 Stock Bridge Farm, Staveley - 1

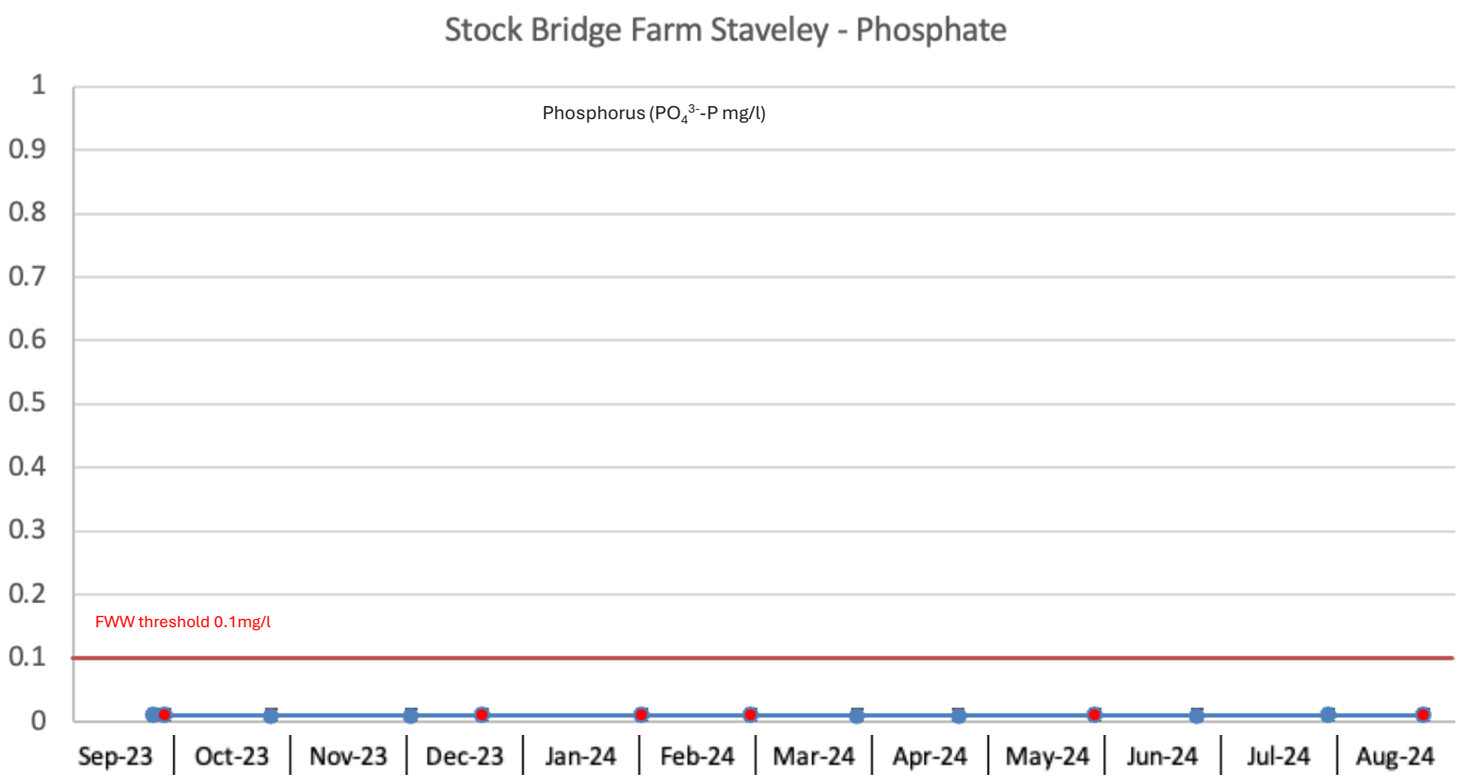
14 samples, 28 Sep 23 – 23 Aug 24

- Trees, shrubs, grass, small plants
- Mixed agricultural
- Potential for urban road and agricultural run off
- Foam seen on one occasion
- Filamentous algae seen on one occasion
- No litter
- Plants seen below surface and emerging from water

nitrate-N always < 1.0 mg/L
phosphate-P always < 0.1 mg/L

River Kent K15 Stock Bridge Farm, Staveley - 2





Red points indicate sampling preceded by heavy prolonged rain

River Kent K20 Downstream from Staveley WwTW - 1

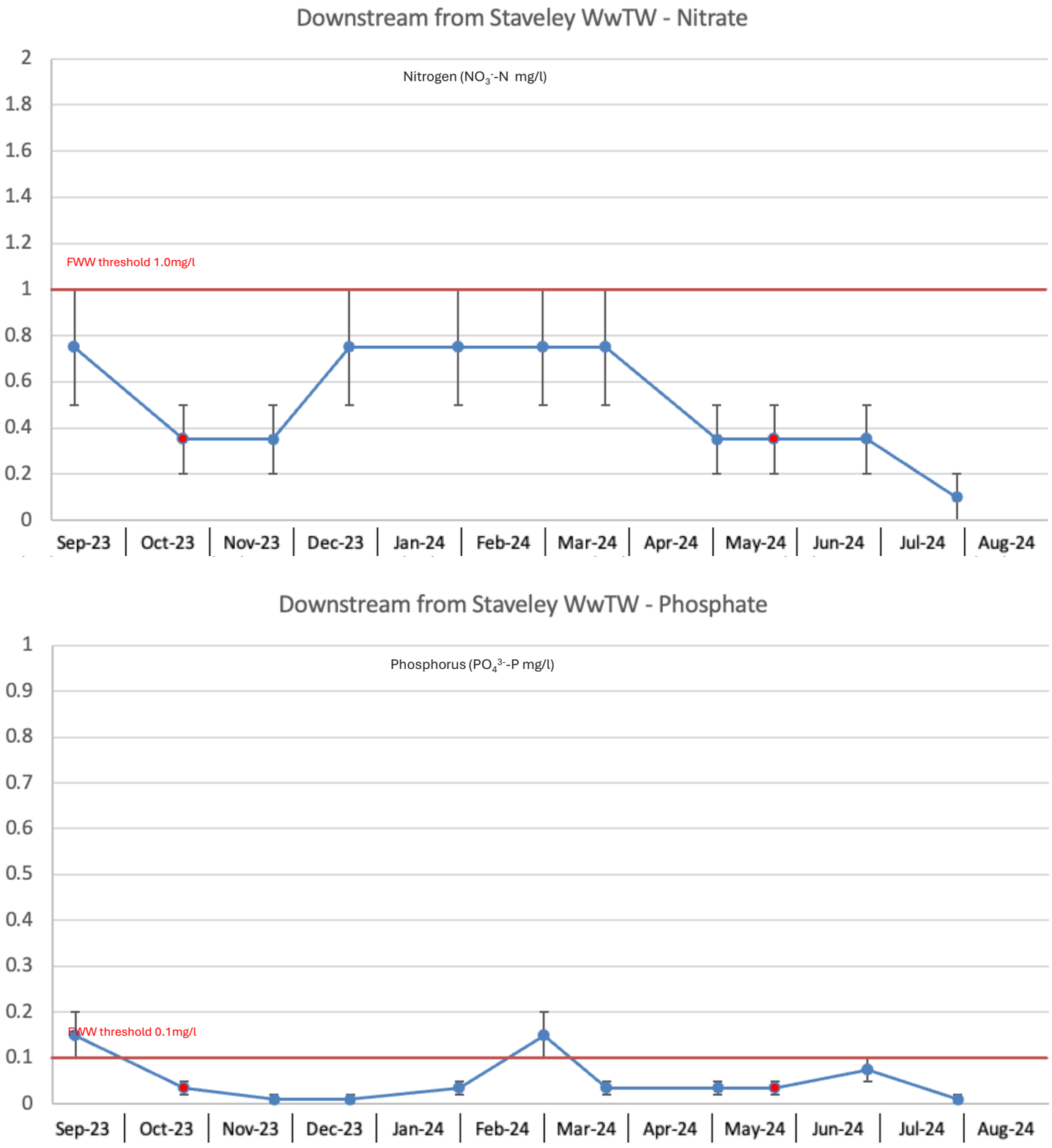
11 samples, 9 Sep 23 – 16 Aug 24

- Trees, shrubs, grass, small plants
- Livestock sometimes, with access to River and mixed agricultural
- Potential for agricultural run off
- No obvious foam or filamentous algae seen
- Recreational plastic on one occasion
- Just below Staveley WwTW outflow which was discharging on 5 occasions
- Public use of Riverbank
- Aquatic birds, mammals and plants

nitrate-N always < 1.0 mg/L
phosphate-P > 0.1 mg/L:

- 9 Sep 23 – no rain, River level low, water flow steady
- 28 Feb 24 – light showers, River level average, water flow steady

River Kent K20 Downstream from Staveley WwTW - 2



Red points indicate sampling preceded by heavy prolonged rain

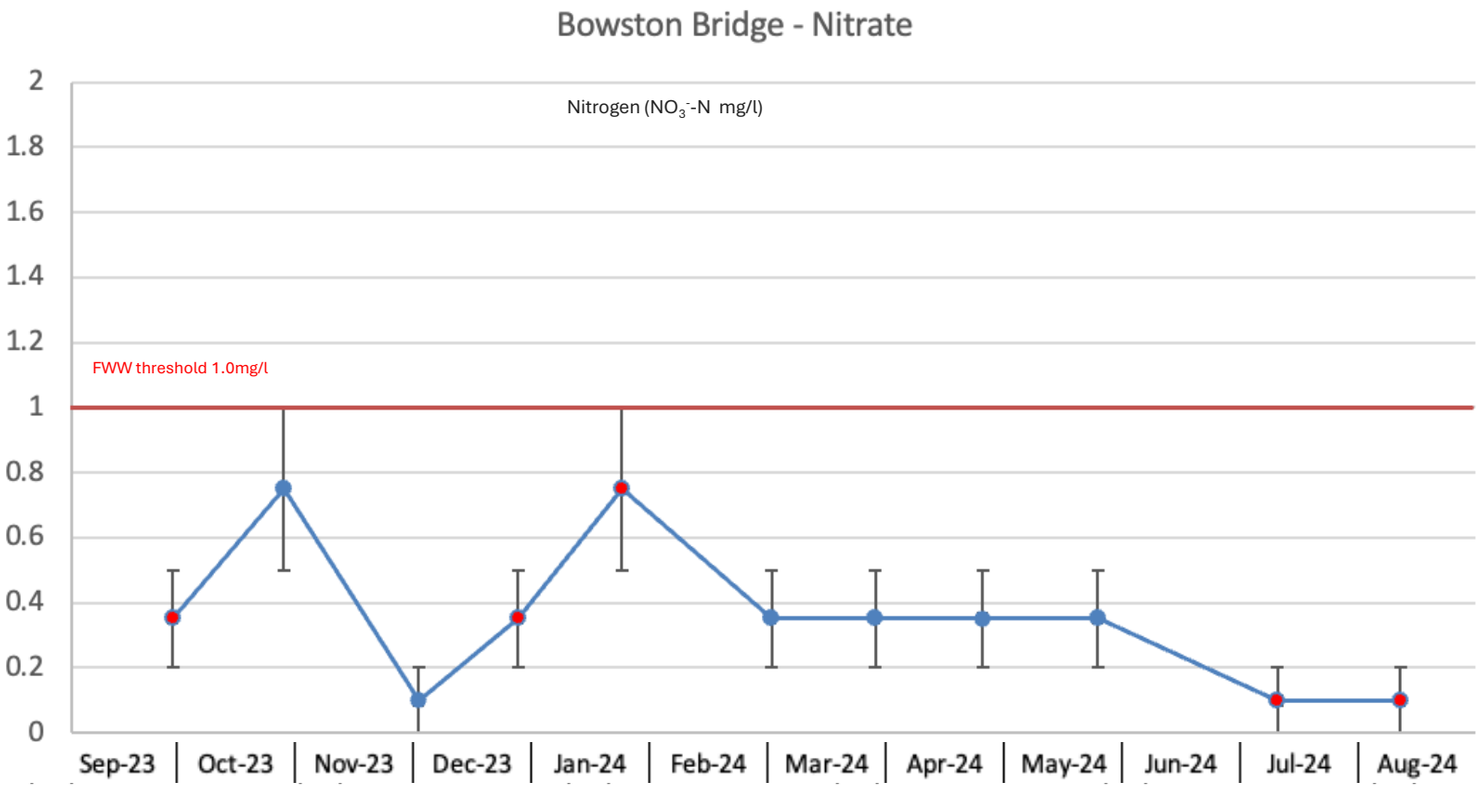
River Kent K30 Bowston Bridge - 1

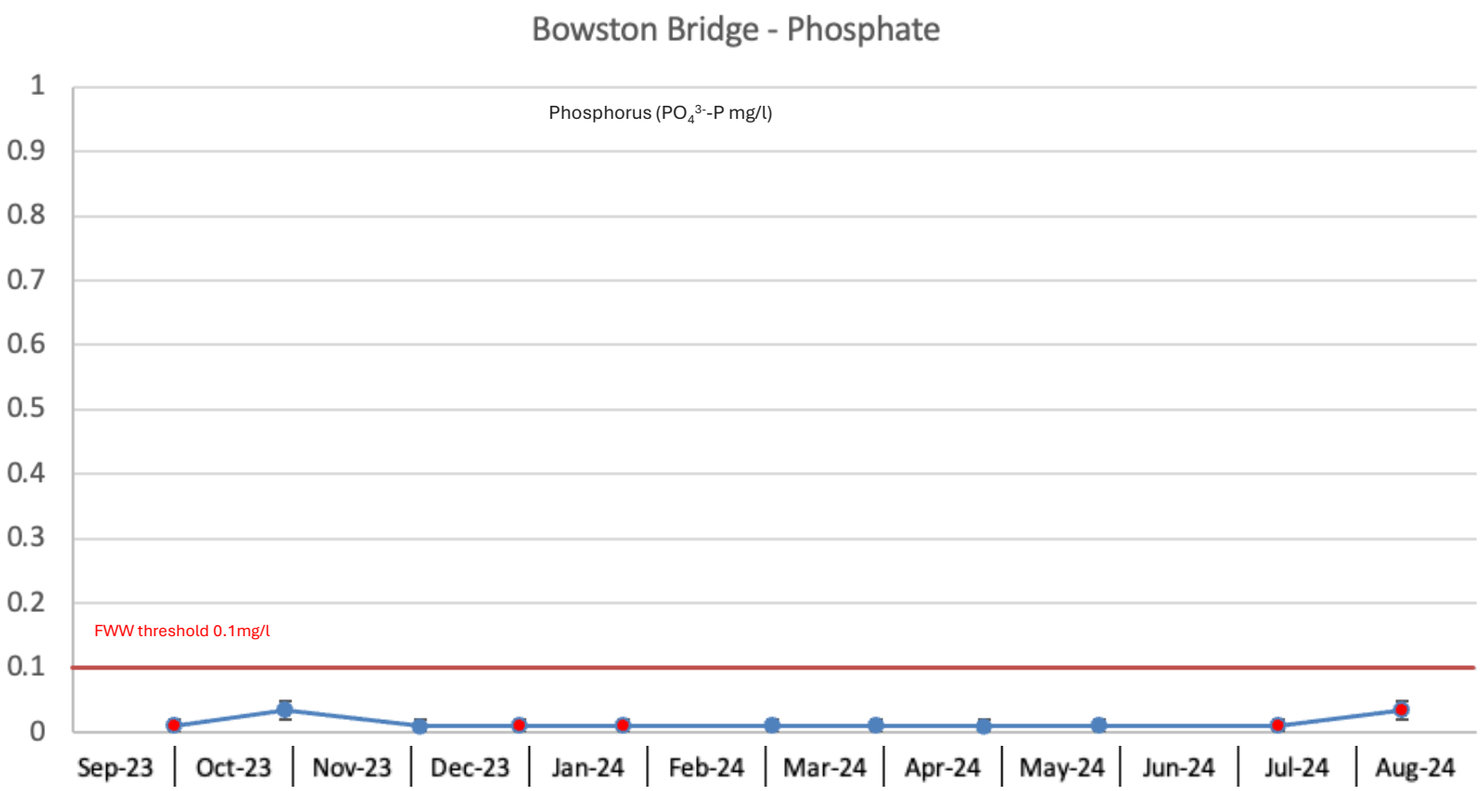
11 samples, 27 Sep 23 – 12 Aug 24

- Trees, shrubs, grass, small plants
- Livestock with access to River 50% of the time, rural/industrial/commercial
- Foam seen twice
- No obvious filamentous algae seen
- Litter seen twice in/on water
- Plants seen below surface and emerging from water

nitrate-N always < 1.0 mg/L
phosphate-P always < 0.1 mg/L

River Kent K30 Bowston Bridge - 2





Red points indicate sampling preceded by heavy prolonged rain

River Kent K35 Ford Bridge, Burneside - 1

11 samples, 26 Sep 23 – 4 Aug 24

- Trees, shrubs, grass, small plants, concrete/impermeable surface
- Rural/residential
- Foam and filamentous algae seen on some occasions
- Recreational litter seen in/on water
- Outfall pipe usually discharging
- Public use of Riverbank
- Plants seen below surface and emerging from water
- Aquatic birds

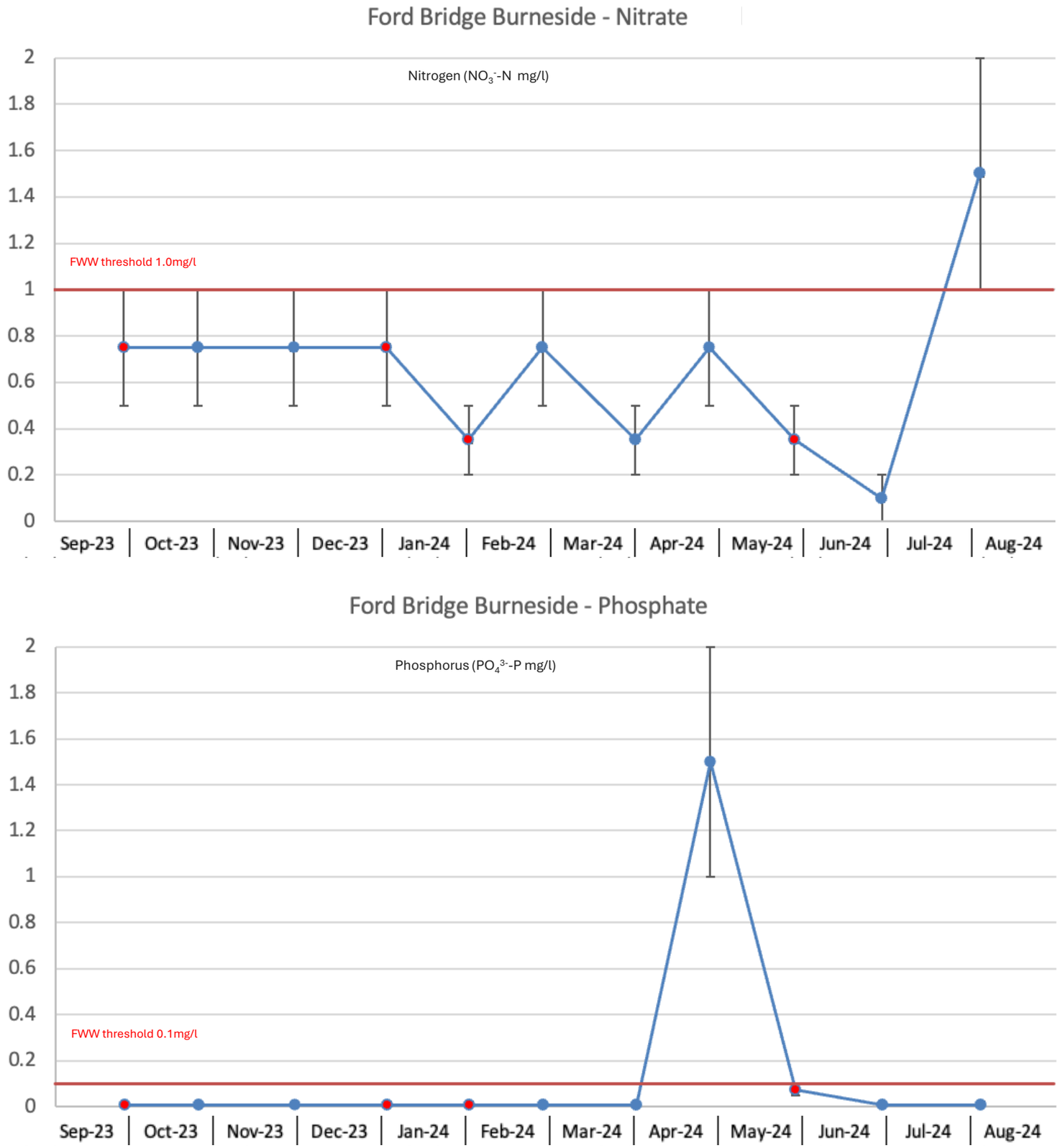
nitrate-N > 1.0mg/L

- 4 Aug 24 – light showers, River level low, water flow slow

phosphate-P > 0.1mg/L

- 27 Apr 24 – light showers, River level average, water flow slow

River Kent K35 Ford Bridge, Burneside - 2



Red points indicate sampling preceded by heavy prolonged rain

River Kent K45 Dockray Bridge - 1

12 samples, 18 Sep 23 – 15 Aug 24

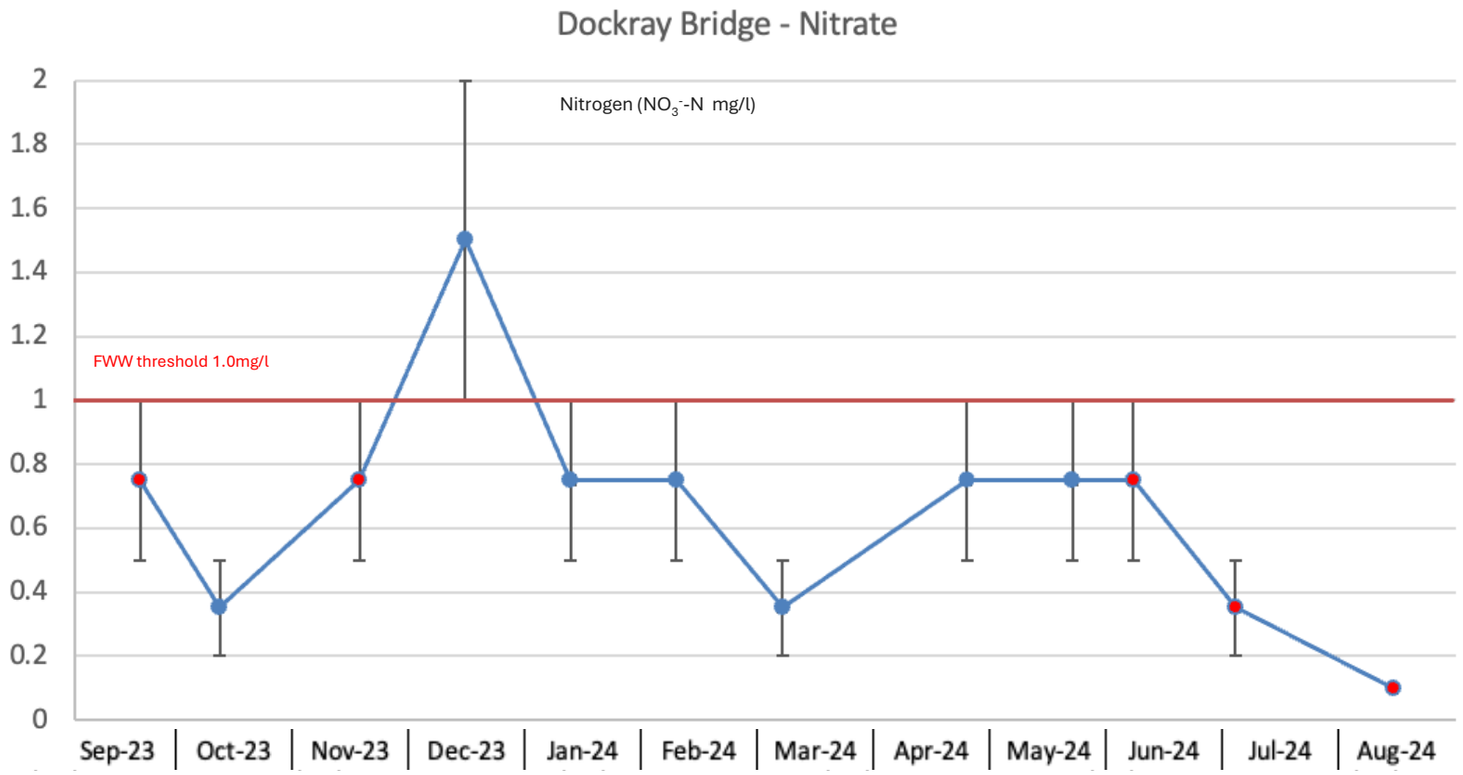
- Trees, shrubs, grass, small plants
- Industrial/commercial
- Potential for urban road run off
- Foam seen occasionally
- No obvious filamentous algae seen
- Recreational litter seen
- Public use of Riverbank
- Plants seen below surface and emerging from water
- Aquatic birds seen once

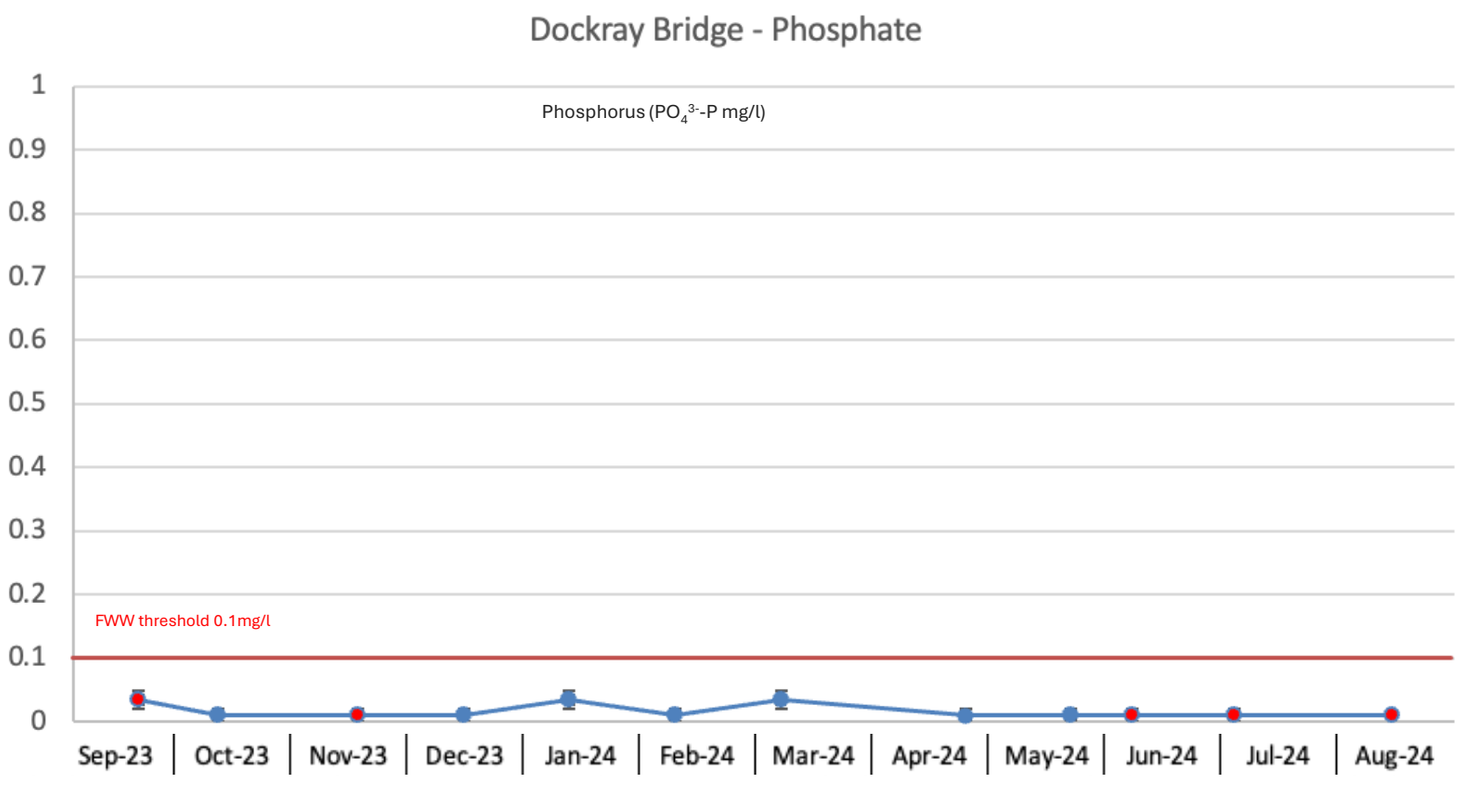
nitrate-N > 1.0mg/L

- 13 Dec 23 – light showers, River level average, water flow steady

phosphate-P always < 0.1 mg/L

River Kent K45 Dockray Bridge - 2





Red points indicate sampling preceded by heavy prolonged rain

River Kent K50 Upstream from K Shoes Factory - 1

10 samples, 20 Sep 23 – 22 Aug 24

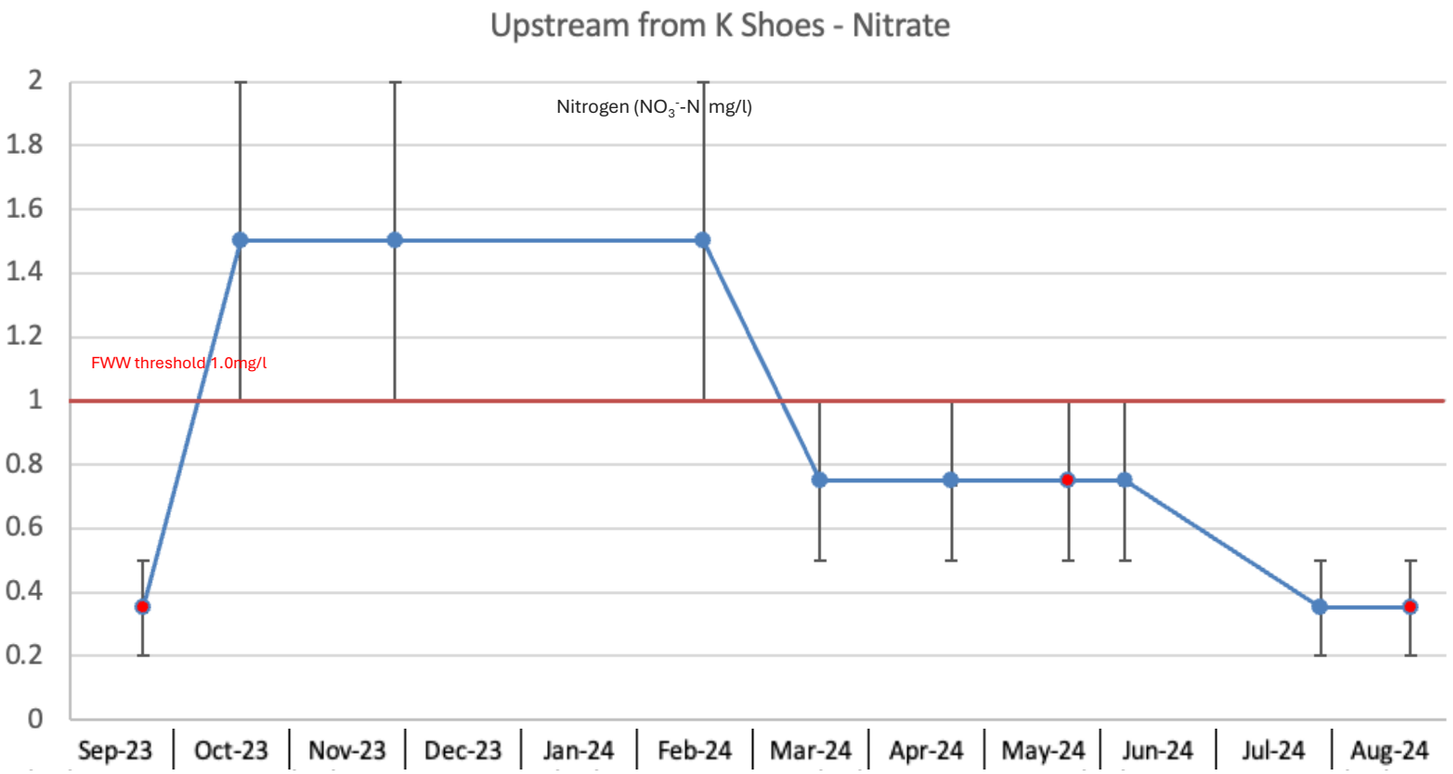
- Trees, shrubs, grass, small plants, bare soil, concrete/impermeable surface
- Urban residential and green space, industrial/commercial
- Potential for urban road run off
- No obvious foam or filamentous algae seen
- Outfall pipe discharging on 50% occasions
- Public use of Riverbank
- Plants below surface and emerging from water
- Fish and aquatic birds seen

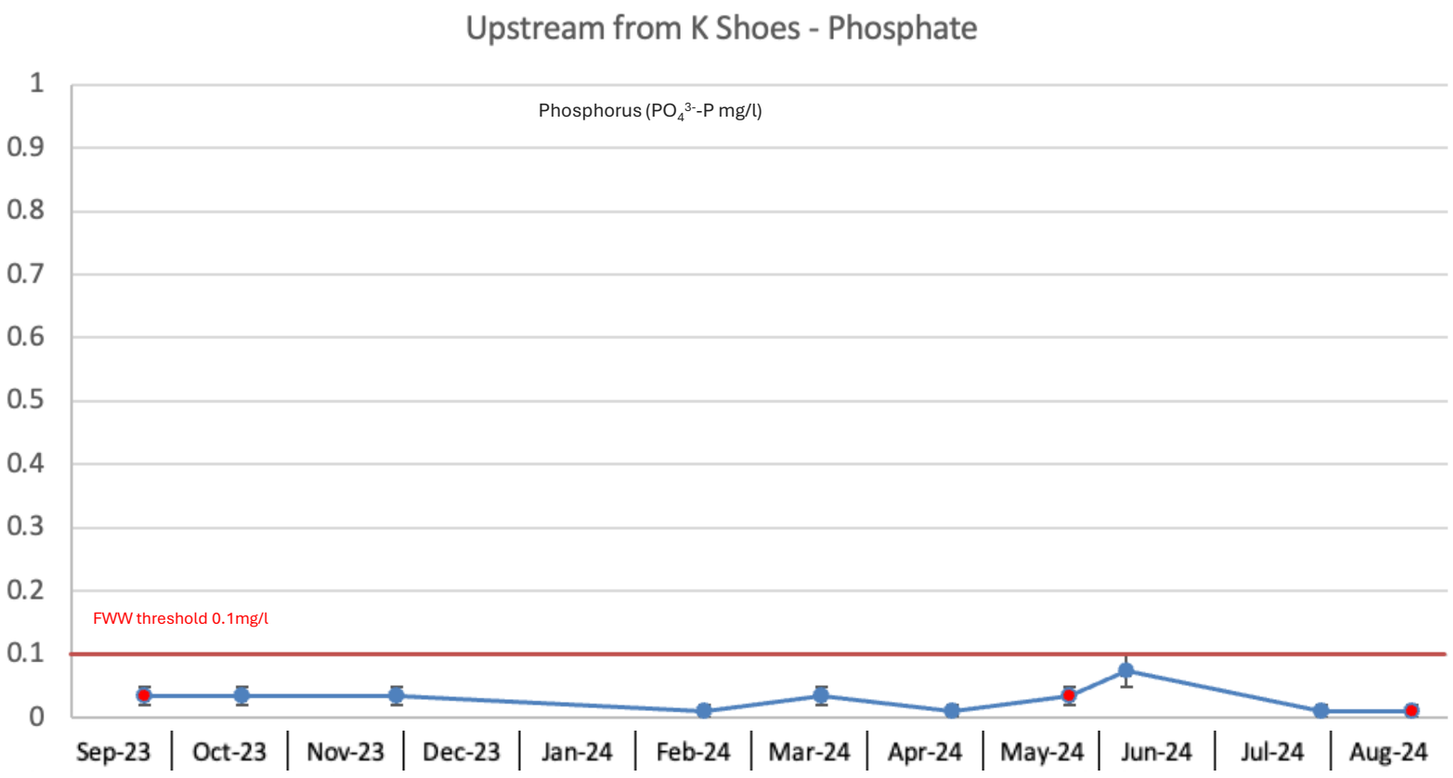
nitrate-N > 1.0mg/L

- 16 Oct 23 – no rain, River level average, water flow steady
- 26 Nov 23 – no rain, River level average, water flow steady
- 16 Feb 24 – light showers, River level average, water flow surging

phosphate-P always < 0.1 mg/L

River Kent K50 Upstream from K Shoes Factory - 2





Red points indicate sampling preceded by heavy prolonged rain

River Kent K65 Scroggs Wood - 1

11 samples, 15 Sep 23 – 16 Aug 24

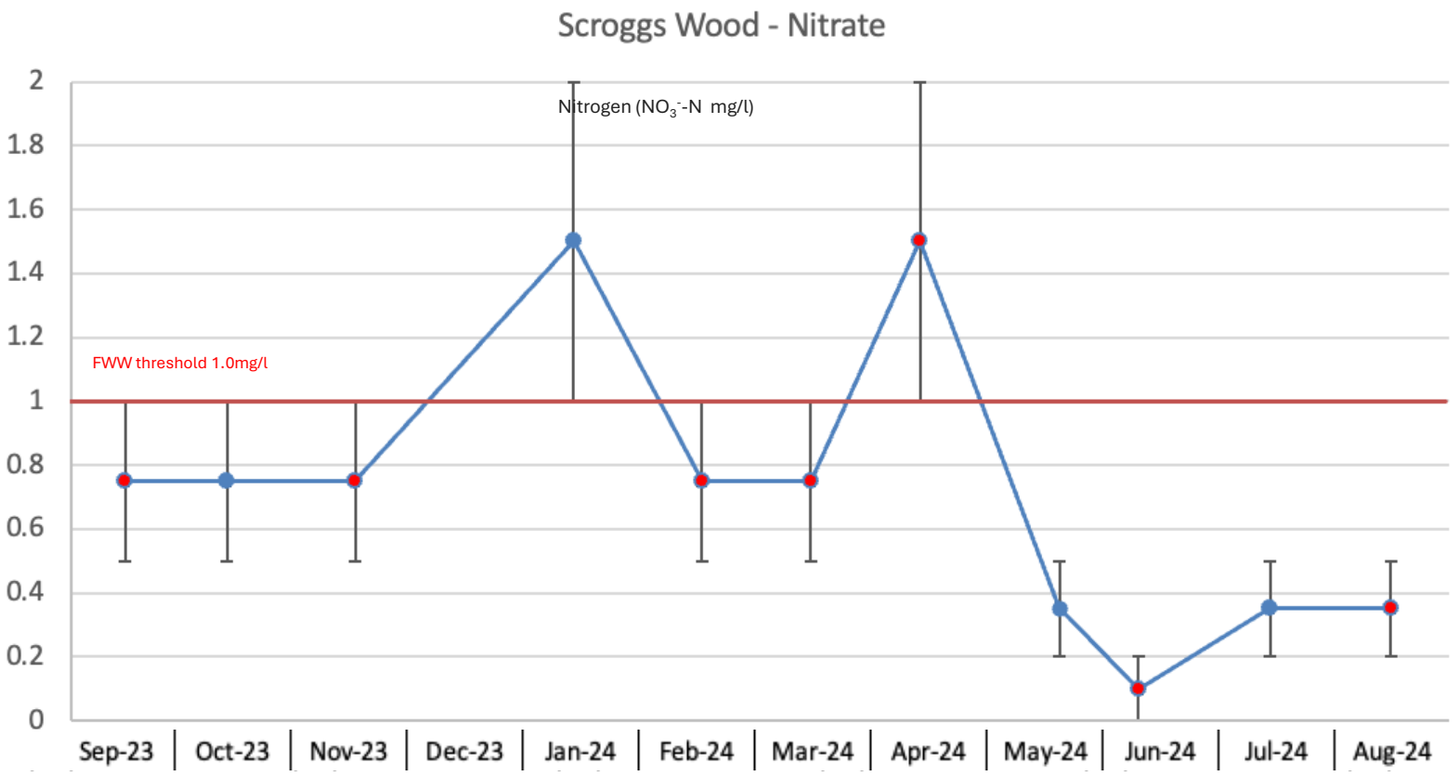
- Trees, shrubs, grass, small plants, bare soil
- Livestock with access to River for initial 7 samples, then rural/residential for remaining 7 samples
- Potential for agricultural run off
- No obvious foam or filamentous algae seen
- Recreational litter on Riverbank
- Public use of Riverbank
- Plants emerging from water, and aquatic birds seen on 5 occasions

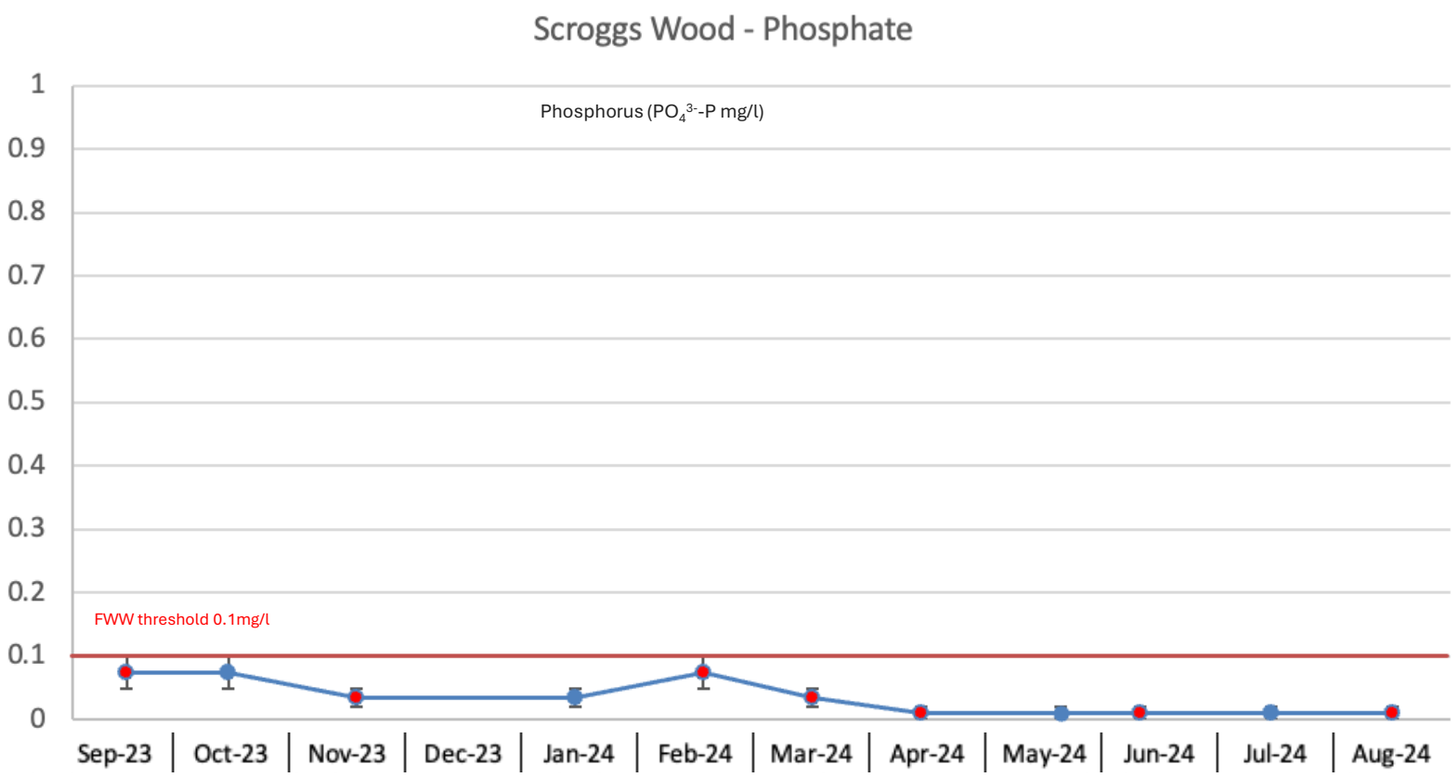
nitrate-N > 1.0mg/L

- 12 Jan 24 - no rain, River level average, water flow steady
- 13 Apr 24 – heavy rain, River level high, water flow surging

phosphate-P always < 0.1 mg/L

River Kent K65 Scroggs Wood - 2





Red points indicate sampling preceded by heavy prolonged rain

River Kent K70 Below Scroggs Weir - 1

10 samples, 13 Dec 23 – 14 Aug 24

- Tested in pilot phase, then stopped, restarted on 13 Dec 23 when Kendal WwTW outflow relocated
- Trees, shrubs, grass and small plants
- Rural/residential plus livestock and mixed agricultural
- No obvious foam or filamentous algae seen
- Recreational litter in water and on River edge
- Outfall discharging on 4 occasions
- Public use of Riverbank
- Aquatic plants and birds, emerging flies

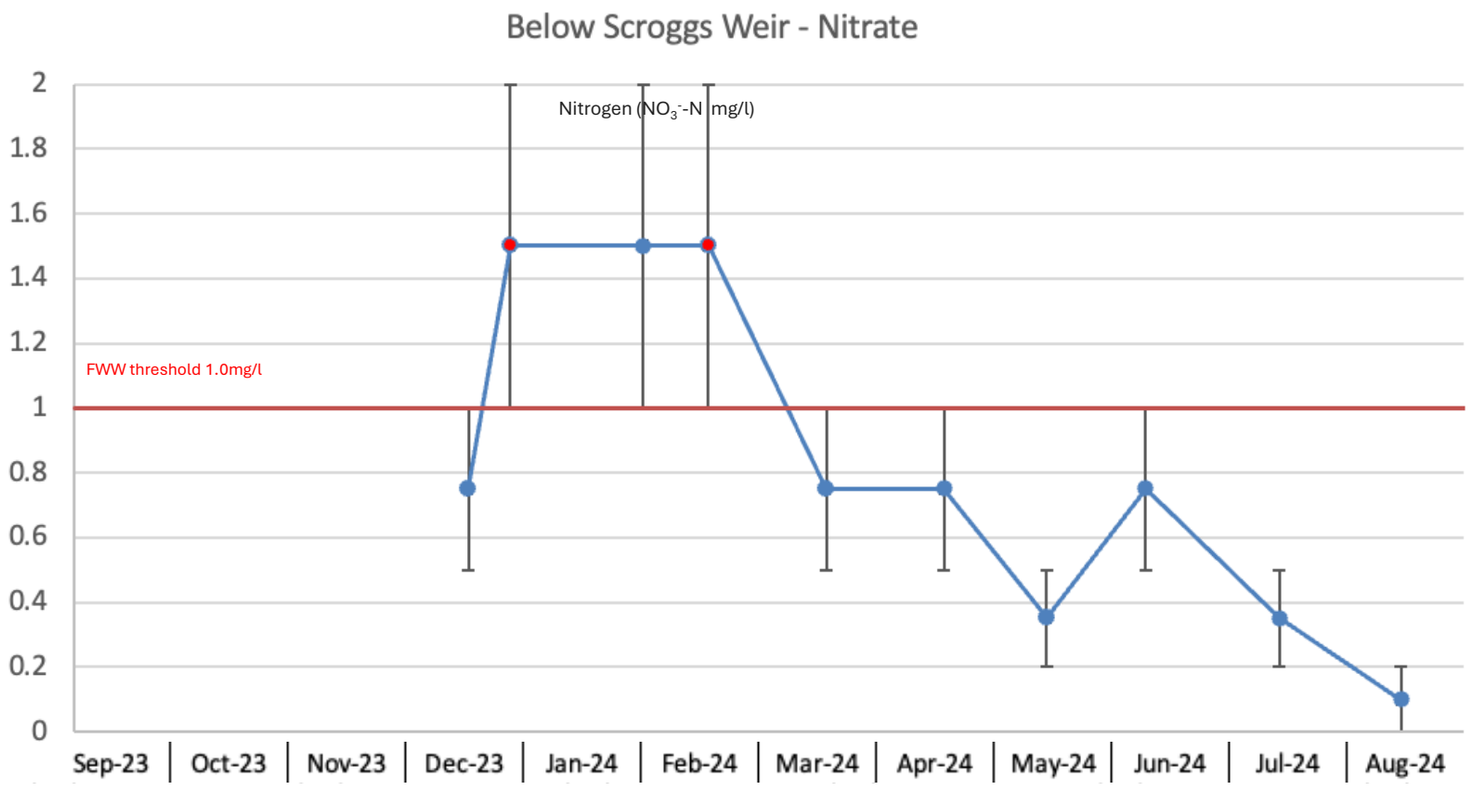
nitrate-N > 1.0 mg/L:

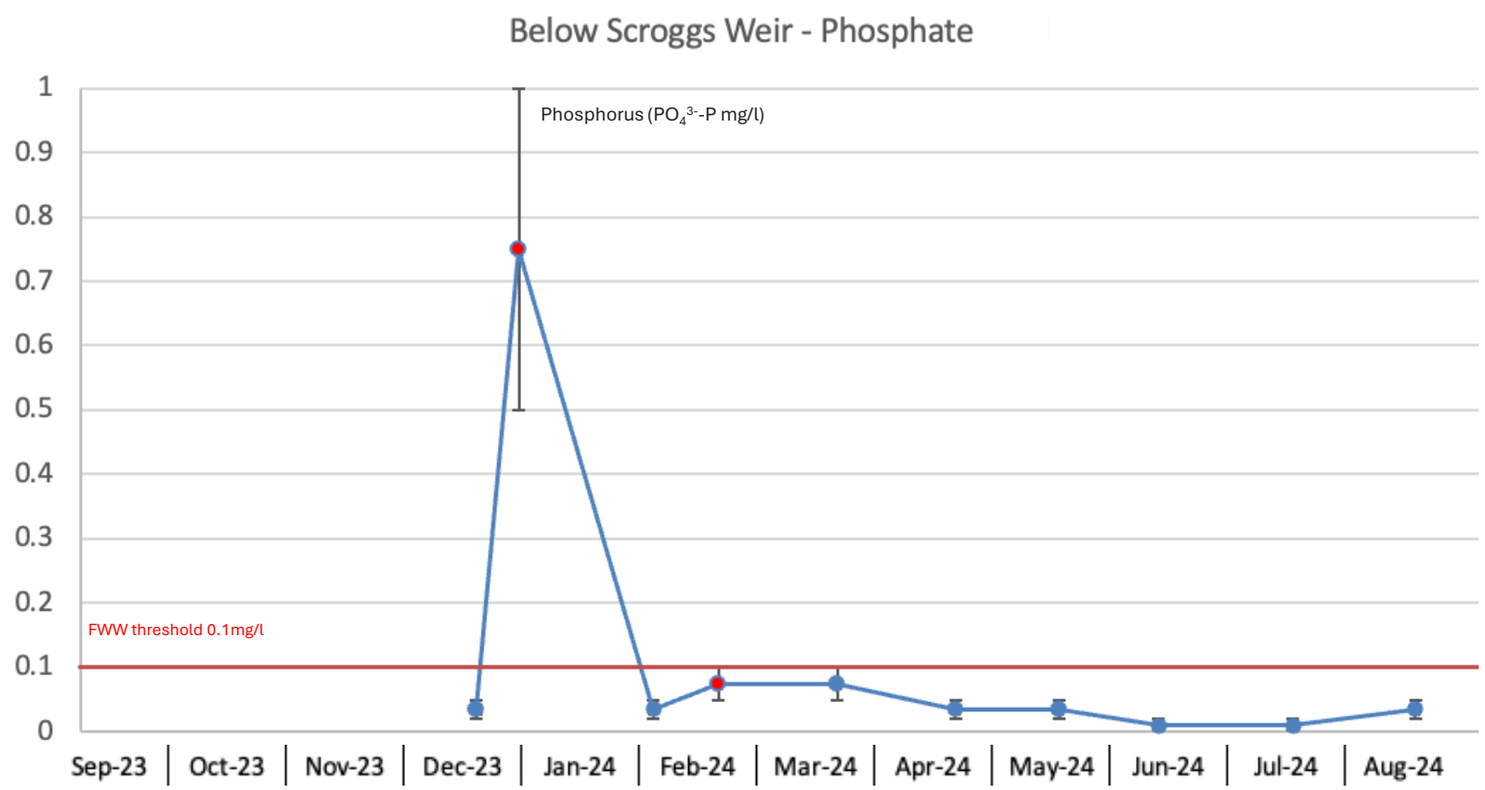
- 24 Dec 23 – heavy prolonged rain, River level high, water flow surging
- 28 Jan 24 – no rain, River level average, water flow steady
- 14 Feb 24 – heavy prolonged rain, River level high, water flow steady

phosphate-P > 0.1mg/L:

- 24 Dec 23 – heavy prolonged rain, River level high, water flow surging

River Kent K70 Below Scroggs Weir - 2





Red points indicate sampling preceded by heavy prolonged rain

River Kent K75 Grassy Banks - 1

15 samples, 17 Sep 23 – 31 Aug 24

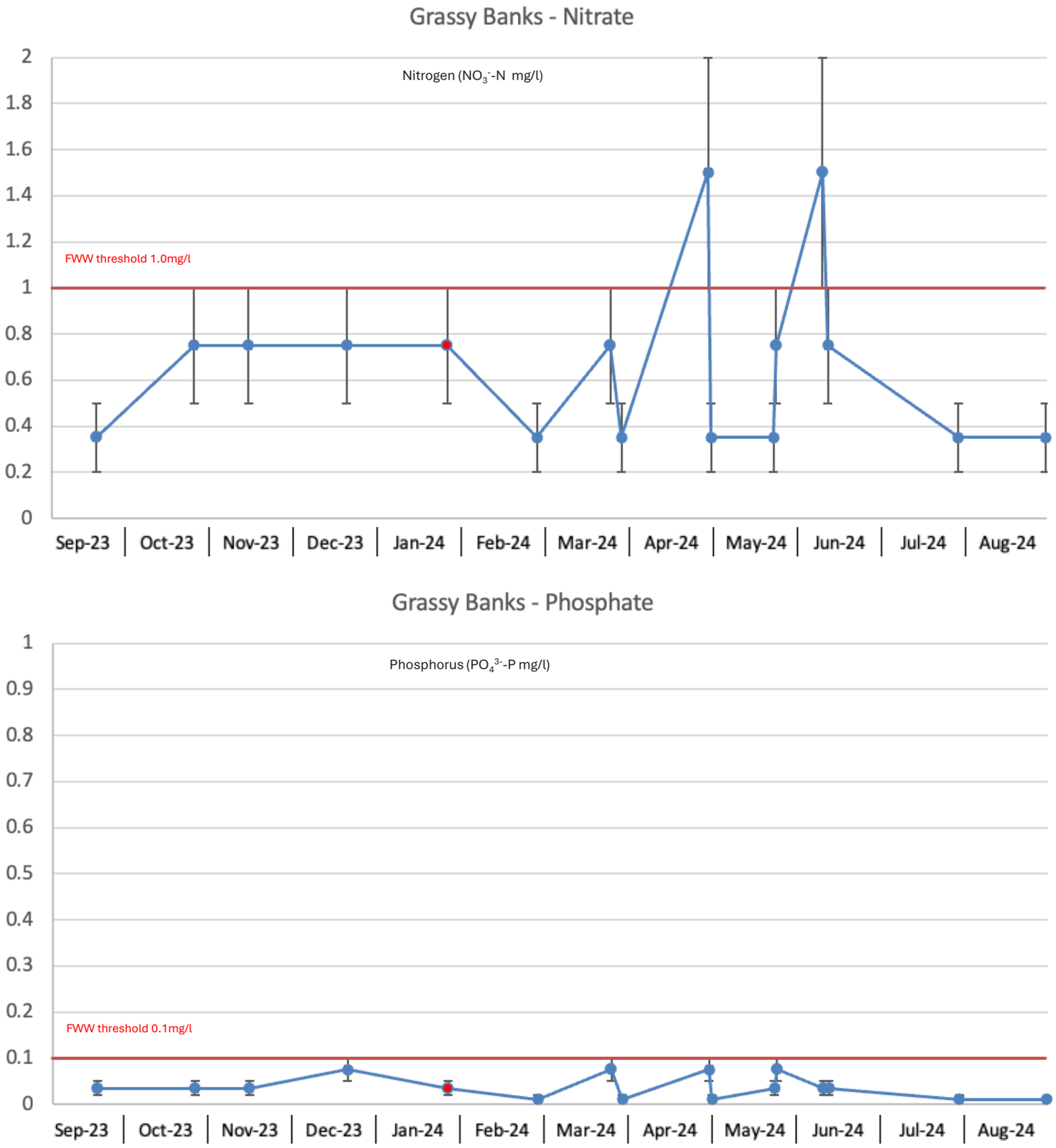
- Trees, shrubs, grass, small plants, limestone slabs
- Mixed agricultural, with livestock occasionally
- Potential for agricultural run off
- No obvious foam or filamentous algae seen
- Rubbish in/on water and on Riverbank
- Public use of Riverbank, plus fishing and boating
- Floating plants below surface
- Fish and aquatic birds, dragonflies and damselflies

nitrate-N > 1.0mg/L

- 29 Apr 24 – light showers, River level average, water flow steady
- 10 June 24 – light showers, River level average, water flow steady

phosphate-P always < 0.1 mg/L

River Kent K75 Grassy Banks - 2



Red points indicate sampling preceded by heavy prolonged rain

River Kent K80 Low Sizergh Suspension Bridge - 1

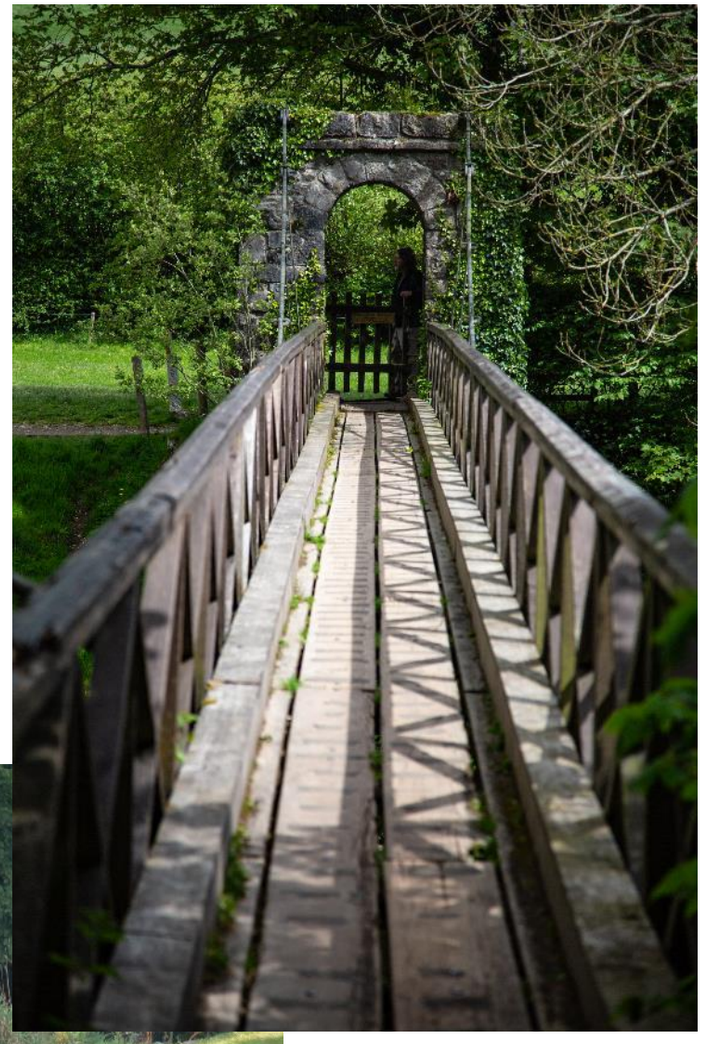
12 samples, 3 Oct 23 – 6 Aug 24

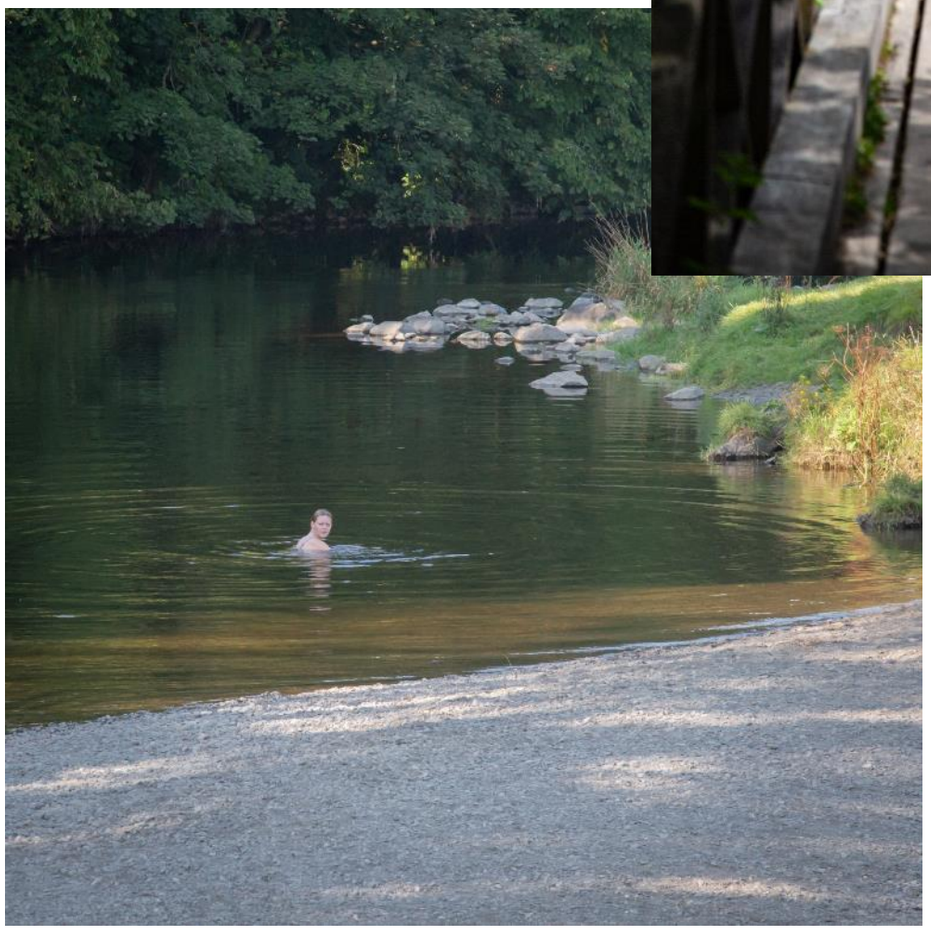
- Trees, shrubs, grass, small plants
- Livestock, mixed agricultural, grassland and shrub
- Potential for agricultural run off
- No obvious foam or filamentous algae seen
- Recreational plastic on several occasions
- Public use of Riverbank
- Plants below River surface and emerging

nitrate-N > 1.0mg/L

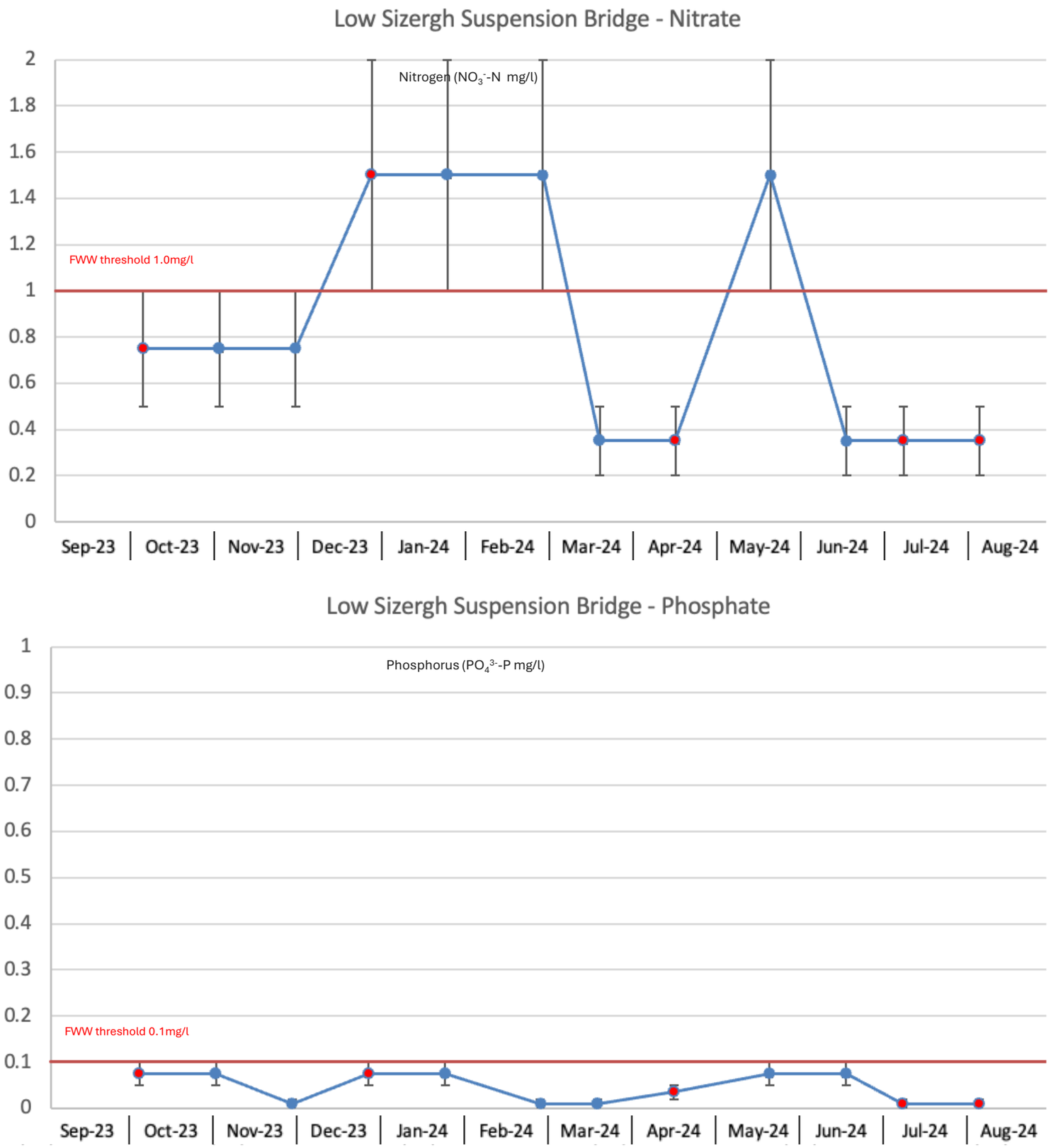
- 26 Dec 23 – heavy prolonged rain, River level average, water flow steady
- 23 Jan 24 – no record of weather, River level high, water flow surging
- 27 Feb 24 – light showers, River level average, water flow steady
- 18 Jun 24 – light showers, River level average, water flow steady

phosphate-P always < 0.1 mg/L





River Kent K80 Low Sizergh Suspension Bridge - 2



Red points indicate sampling preceded by heavy prolonged rain

River Kent K85 Nannypie Lane - 1

13 samples, 16 Sep 23 – 25 Aug 24

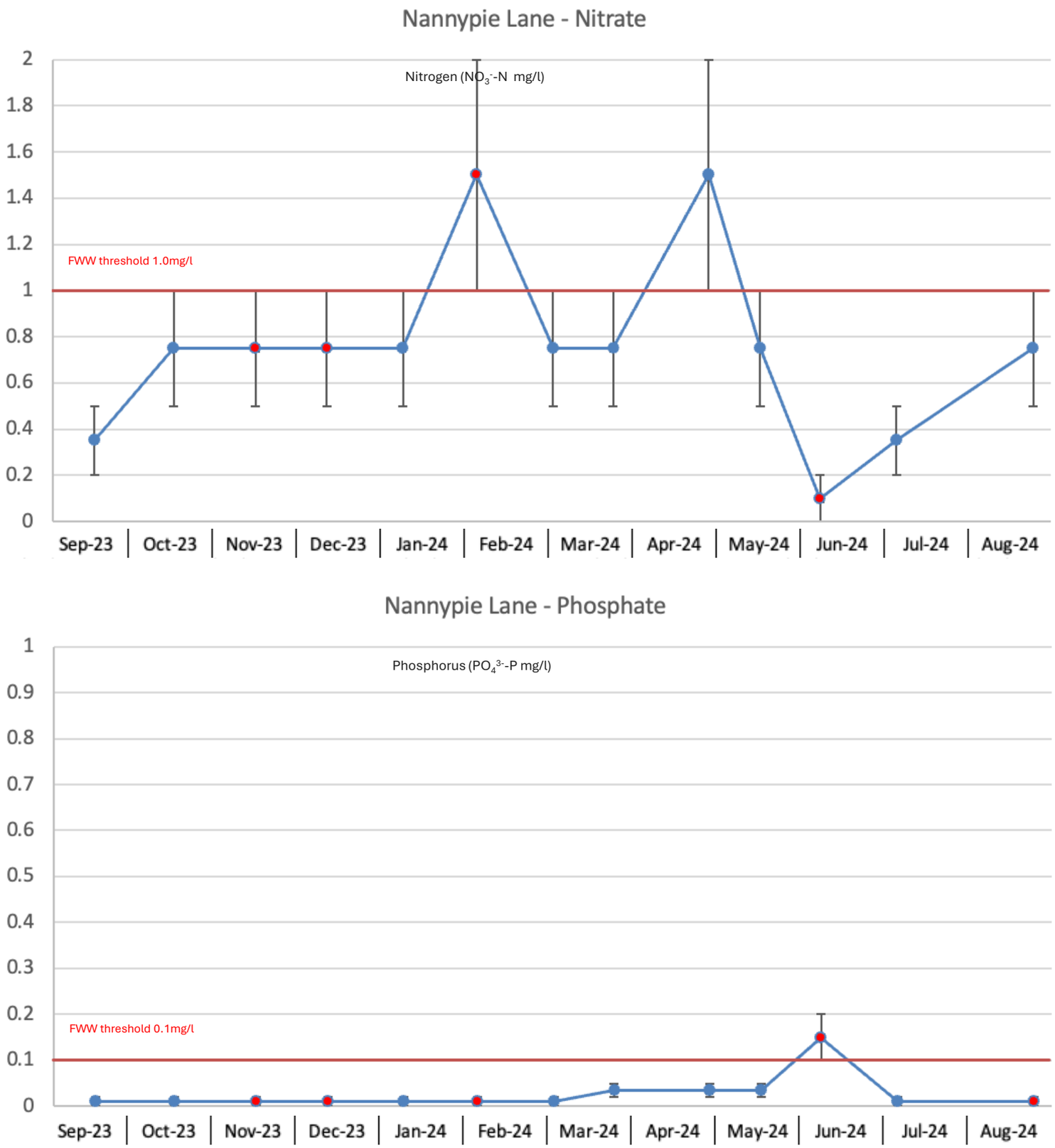
- Trees, shrubs, grass, small plants, bare soil
- Livestock
- Potential for urban road and agricultural run off
- Foam seen on the majority of occasions
- Attached filamentous algae seen on several occasions
- Recreational rubbish in/on water and on Riverbank
- Public use of Riverbank, plus fishing
- Floating plants below surface and emerging from water

nitrate-N > 1.0mg/L

- 3 Feb 24 – heavy prolonged rain, River level average, water flow surging
- 28 Apr 24 – No rain, River level low, water flow steady

phosphate-P always < 0.1 mg/L

River Kent K85 Nannypie Lane - 2



Red points indicate sampling preceded by heavy prolonged rain

River Kent K90 Levens Bridge - 1

11 samples, Sep 23 – Aug 24

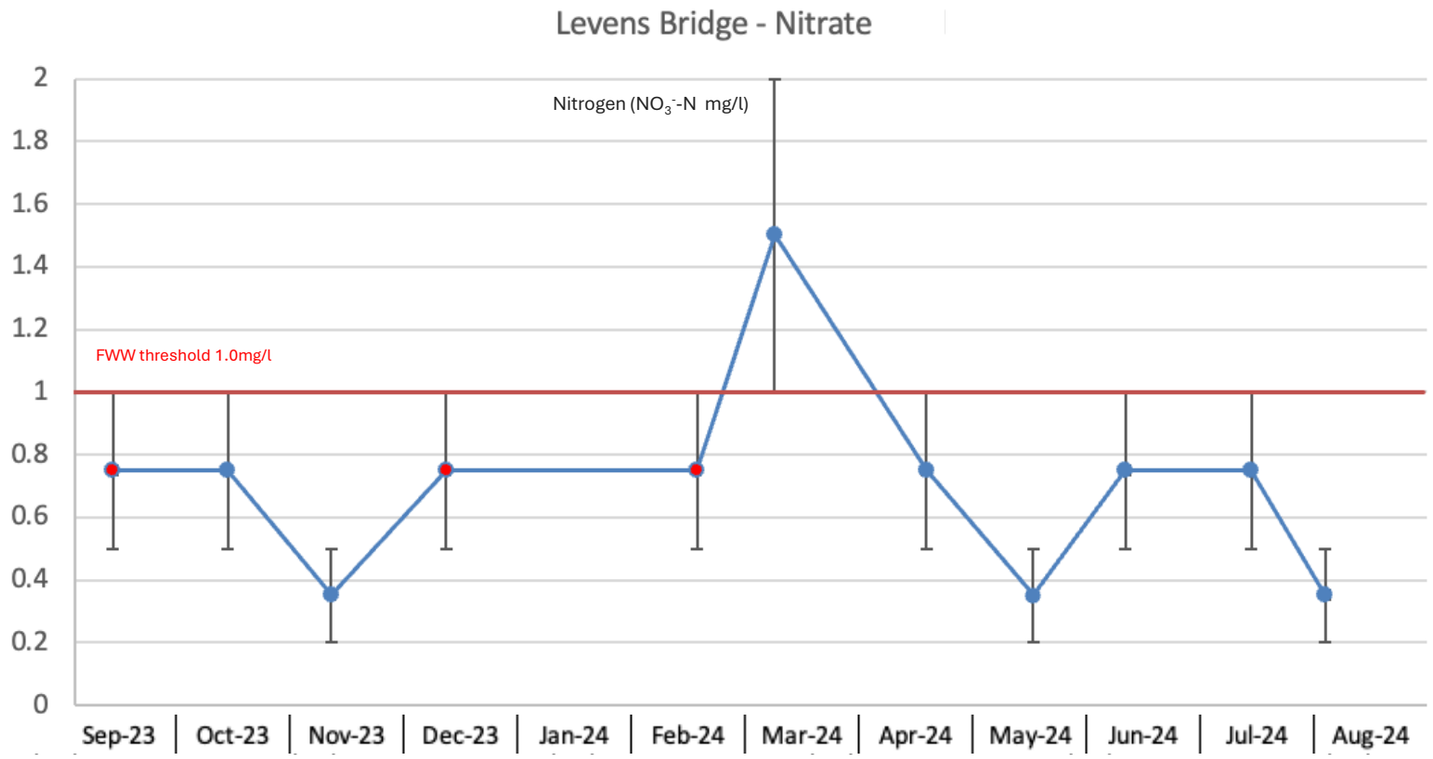
- Trees, shrubs, grass, small plants, bare soil
- Mixed agricultural – arable and livestock with access to River
- Potential for agricultural runoff
- Foam seen on some occasions, no obvious filamentous algae seen
- Some recreational litter
- Public use of Riverbank
- Plants below surface

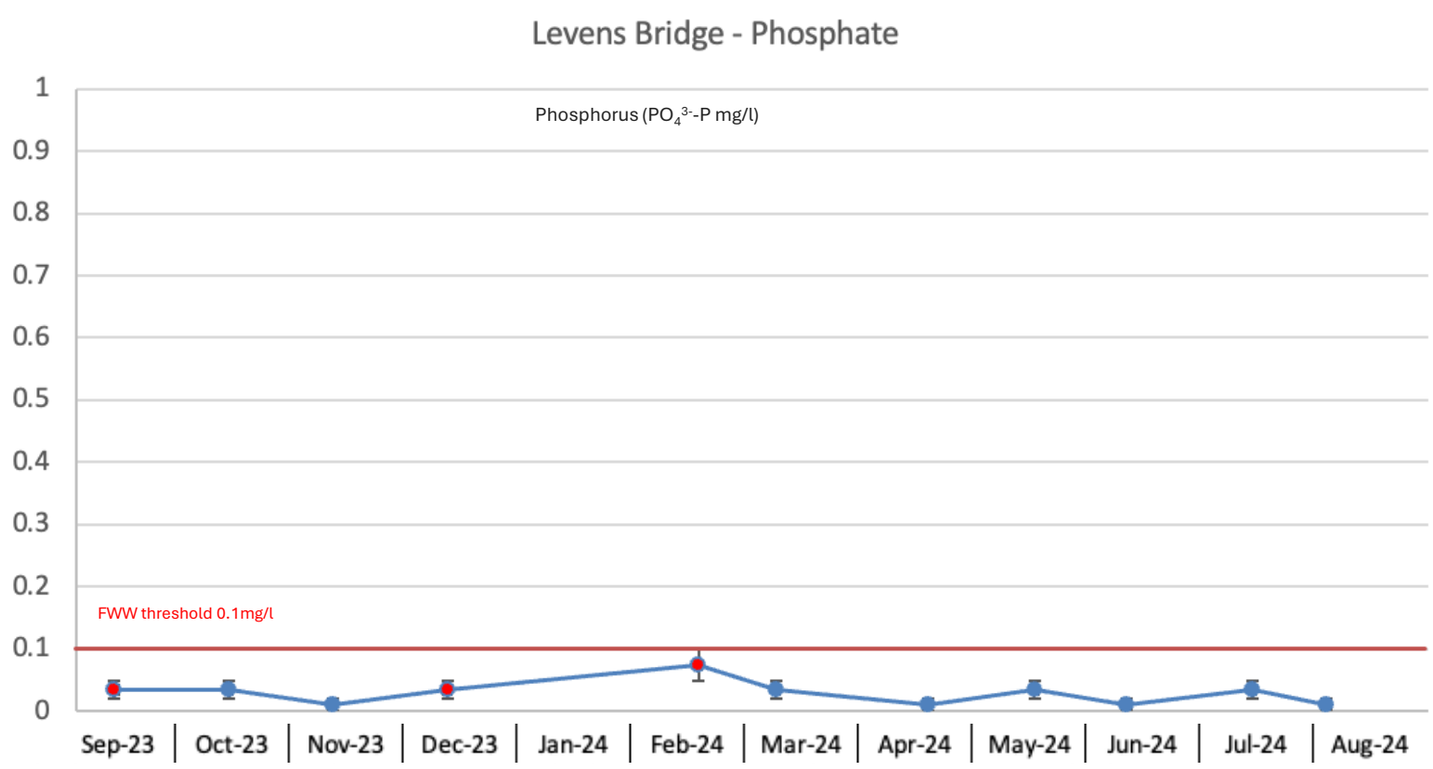
nitrate-N > 1.0mg/L

- 8 Mar 24 – no rain, River level average, water flow steady

phosphate-P always < 0.1 mg/L

River Kent K90 Levens Bridge - 2





Red points indicate sampling preceded by heavy prolonged rain

River Kent tributary: River Gowan – G20 Gowan Deeps - 1

11 samples, 1 Sep 23 – 20 Aug 24

- Trees, shrubs, grass, small plants, concrete/impermeable surface
- Livestock with access to River 6/12 times, grassland shrub, mixed agricultural
- Potential for agricultural run off
- No obvious foam or filamentous algae seen
- Recreational plastic pollution
- Outfall pipe running most times
- Plants seen below surface

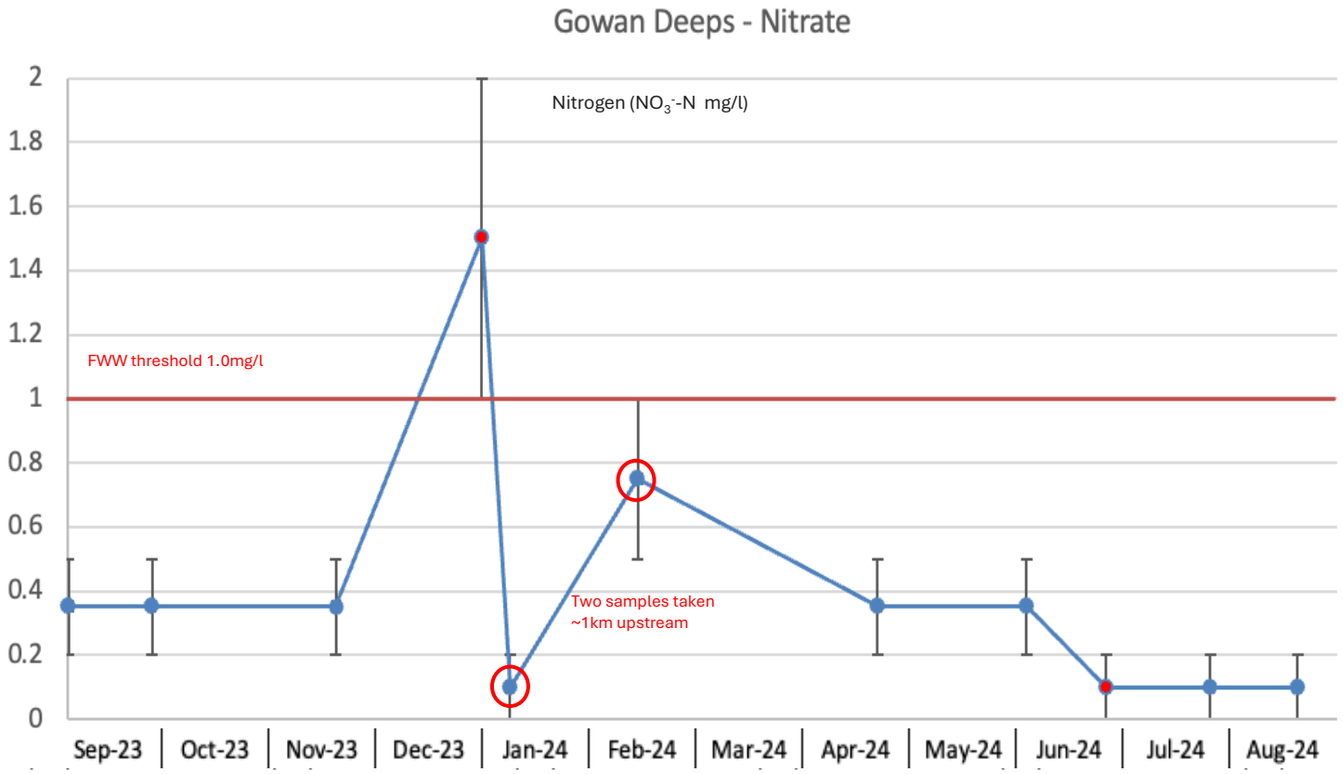
nitrate-N >1.0mg/L:

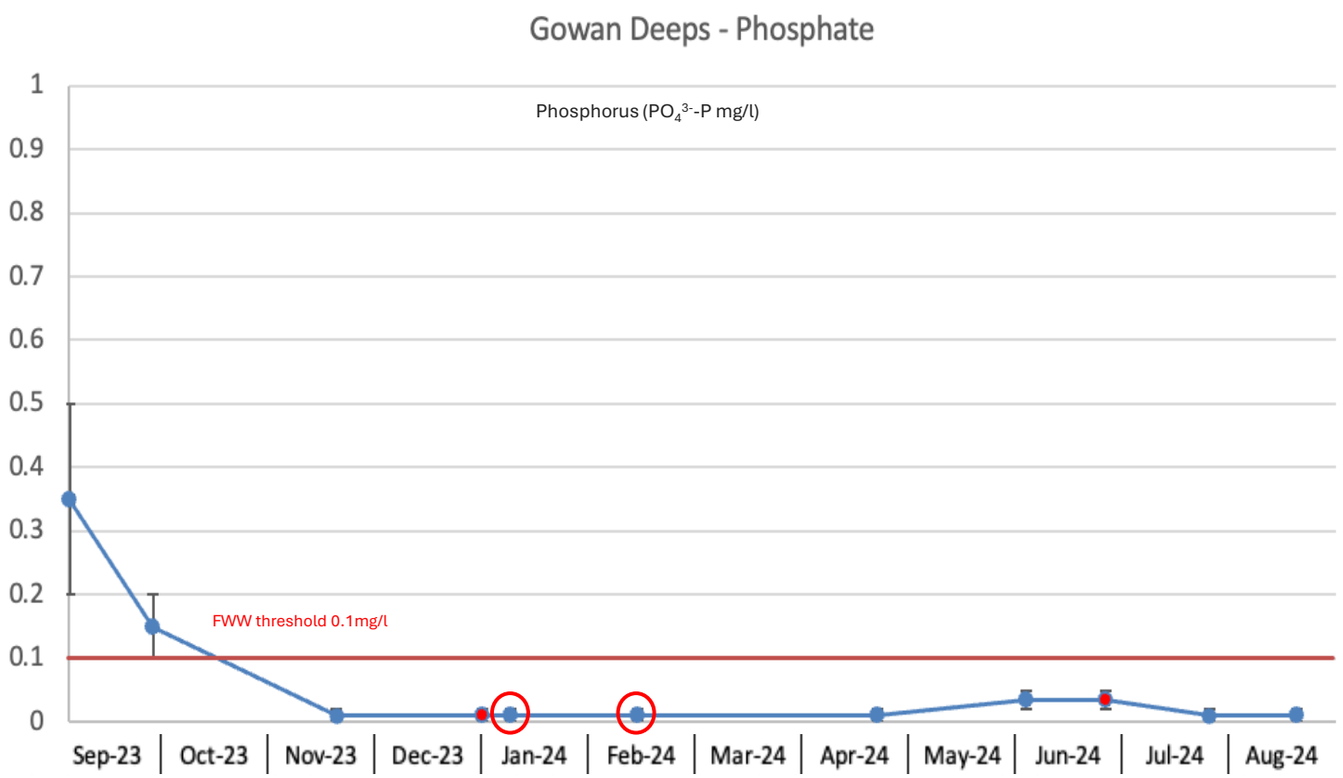
- 29 Dec 23 – heavy and prolonged rain, River level high, water flow steady

phosphate-P >0.1mg/L

- 1 Sep 23 – light showers, River level average, water still
- 25 Sep 23 - light showers, River level high, water flow steady

River Kent tributary: River Gowan – G20 Gowan Deeps - 2





Red points indicate sampling preceded by heavy prolonged rain

River Kent tributary: Lambrigg Beck – L05 Above WwTW - 1

7 samples, 12 Oct 23 – 4 Aug 24

- Trees, shrubs, grass, small plants, bare soil
- Livestock with access to River
- Potential for agricultural runoff
- Foam seen twice
- No obvious filamentous algae seen
- No litter
- Public use of Riverbank
- Plants below surface and emerging from water

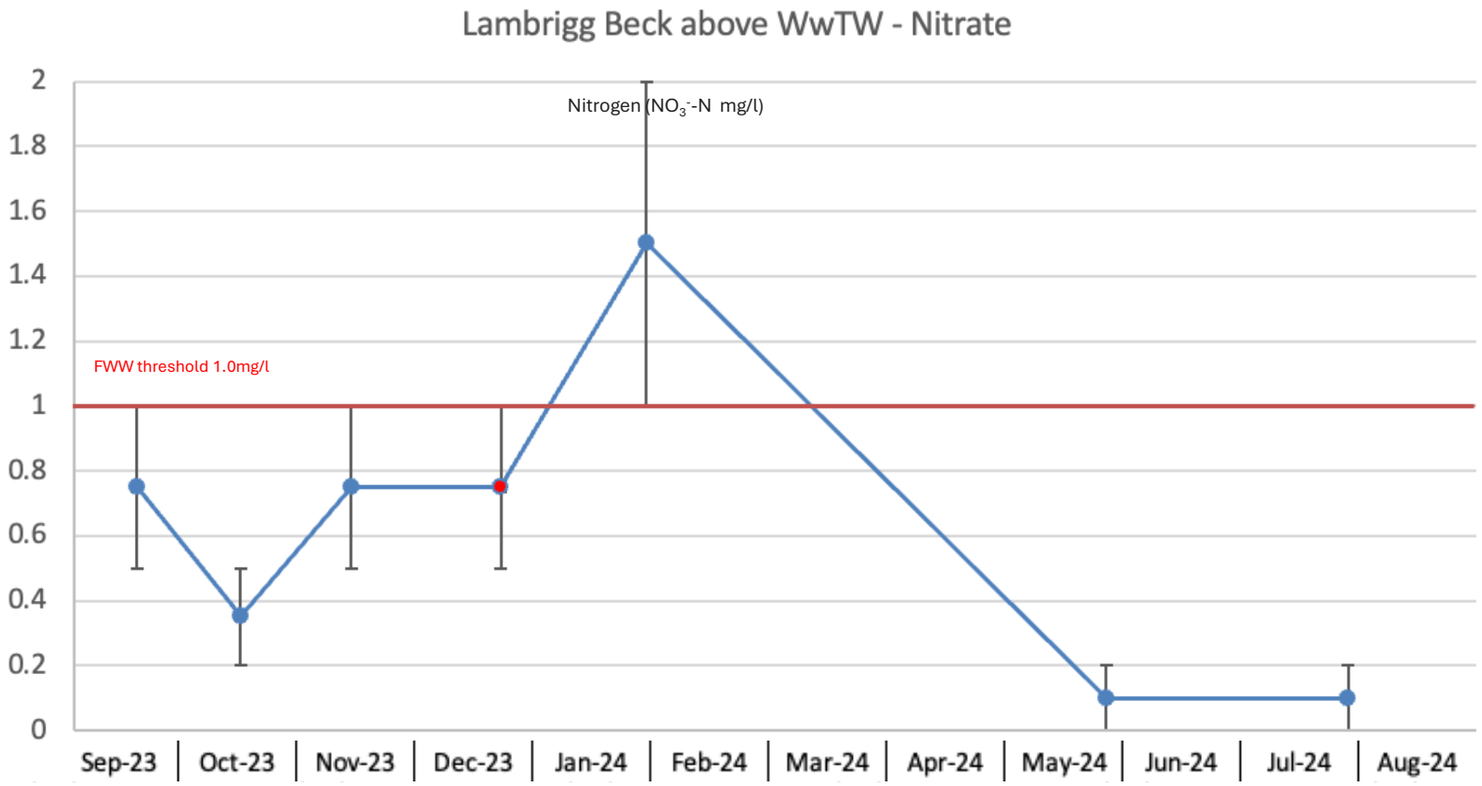
nitrate-N > 1.0mg/L

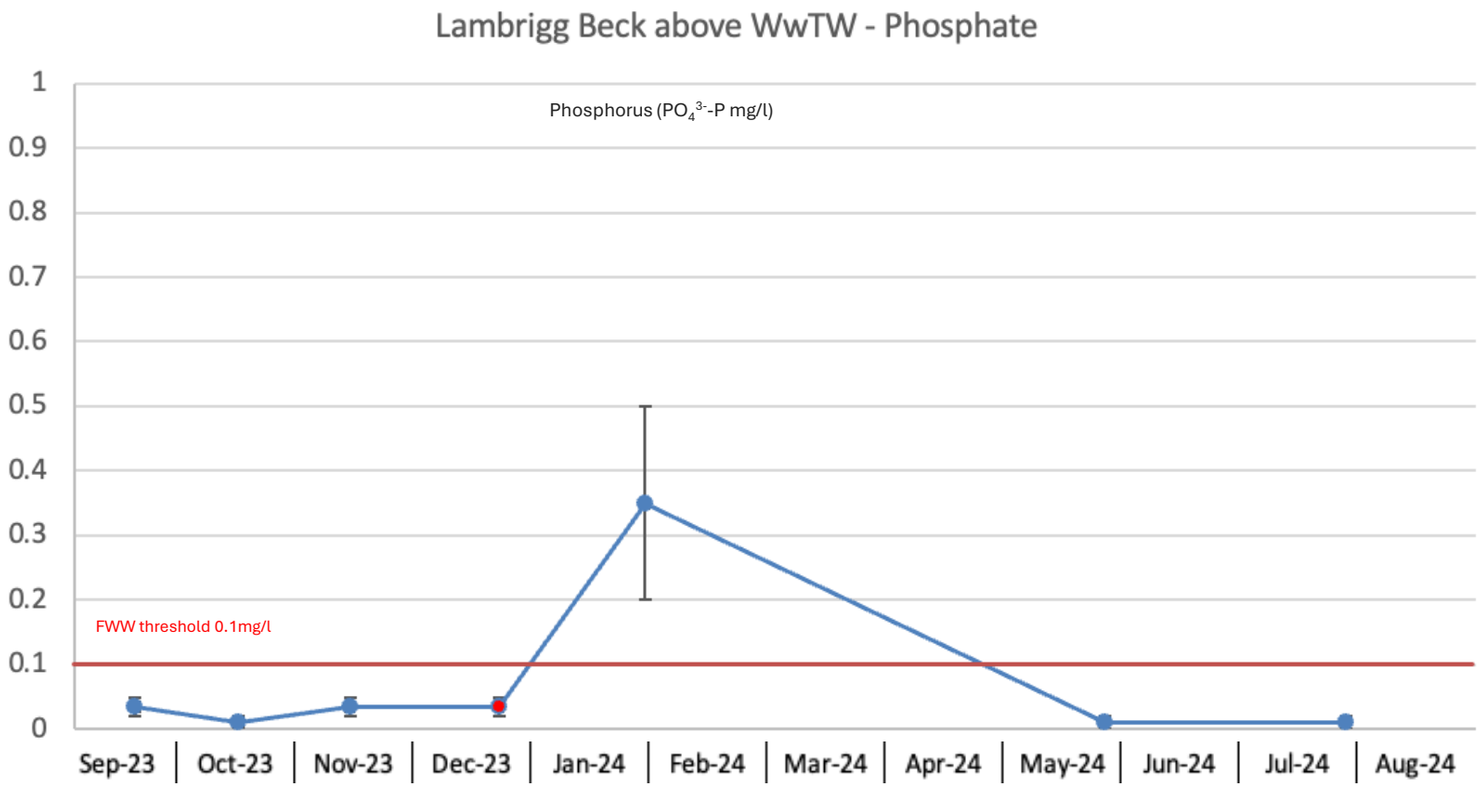
- 8 Mar 24 – no rain, River level average, water flow steady

phosphate-P > 0.1 mg/L

- 8 Mar 24 - no rain, River level average, water flow steady

River Kent tributary: Lambrigg Beck – L05 Above WwTW - 2





Red points indicate sampling preceded by heavy prolonged rain

River Kent tributary - L10 Lower Lambrigg Beck - 1

9 samples, 11 Oct 23 – 29 July 24

- Below Grayrigg WwTW above confluence with River Mint – UU has flagged requirement to reduce phosphorus below Grayrigg WwTW
- Trees, shrubs, grass, small plants, bare soil, concrete and impermeable surface
- Livestock with access to River
- Potential for agricultural run off
- Foam seen on 4 occasions, floating filamentous algae once
- No litter
- Public use of Riverbank
- Aquatic birds, mammals and plants

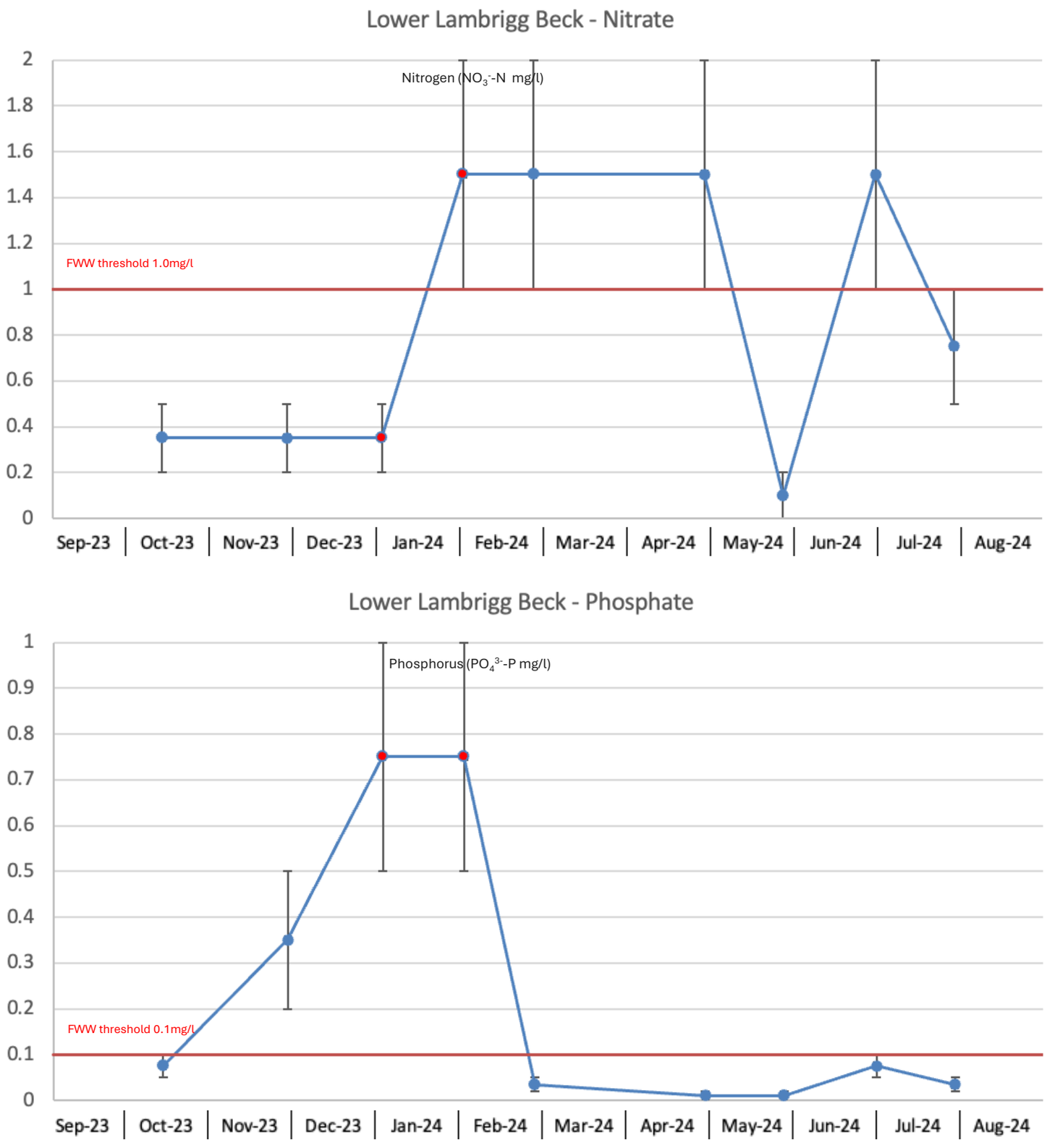
nitrate-N > 1.0 mg/L:

- 30 Jan 24 – heavy prolonged rain, River level high, water flow surging
- 25 Feb 24 – no rain, River level average, water flow steady
- 28 Apr 24 – no rain, River level low, water flow steady
- 30 Jun 24 – light showers, River level low, water flow slow

phosphate-P > 0.1 mg/L:

- 26 Nov 23 – no rain, River level low, water flow steady
- 31 Dec 23 – heavy, prolonged rain, River level high, water flow surging
- 30 Jan 24 – heavy prolonged rain, River level high, water flow surging

River Kent tributary - L10 Lower Lambrigg Beck - 2



Red points indicate sampling preceded by heavy prolonged rain

River Kent tributary: River Mint – M05 Main River - 1

8 samples, 11 Oct 23 – 29 Jul 24

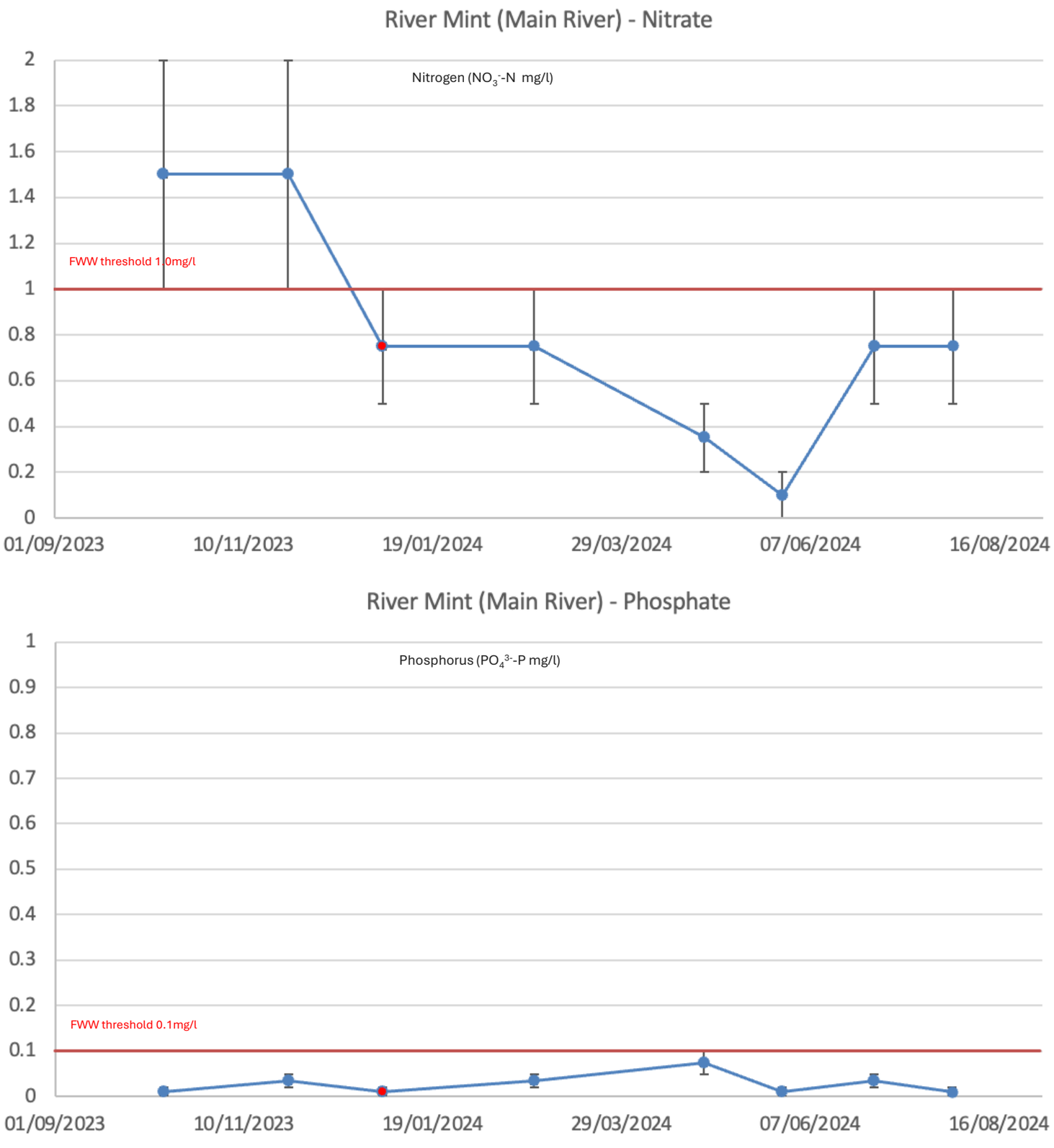
- Trees, shrubs, grass, small plants, bare soil, concrete/impermeable surface
- Livestock with access to River
- Potential for agricultural runoff
- No obvious foam seen
- Attached filamentous algae seen once
- No litter
- Public use of Riverbank and boating
- Plants below surface and emerging from water
- Aquatic birds

nitrate-N > 1.0mg/L

- 11 Oct 23 – light showers, River level average, water flow surging
- 26 Nov 23 – no rain, River level high, water flow steady

phosphate-P always < 0.1 mg/L

River Kent tributary: River Mint – M05 Main River - 2



Red points indicate sampling preceded by heavy prolonged rain

River Kent tributary: River Mint – M10 Mint Bridge - 1

12 samples, Sep 23 – Aug 24

- Trees, shrubs, grass, small plants, bare soil, concrete/impermeable surface
- Industrial/commercial, shops/business/rural
- Potential for urban road run off
- No obvious foam or filamentous algae seen
- Recreational litter on Riverbank
- Public use of Riverbank
- Plants below surface
- Aquatic birds, fish, evidence of crayfish

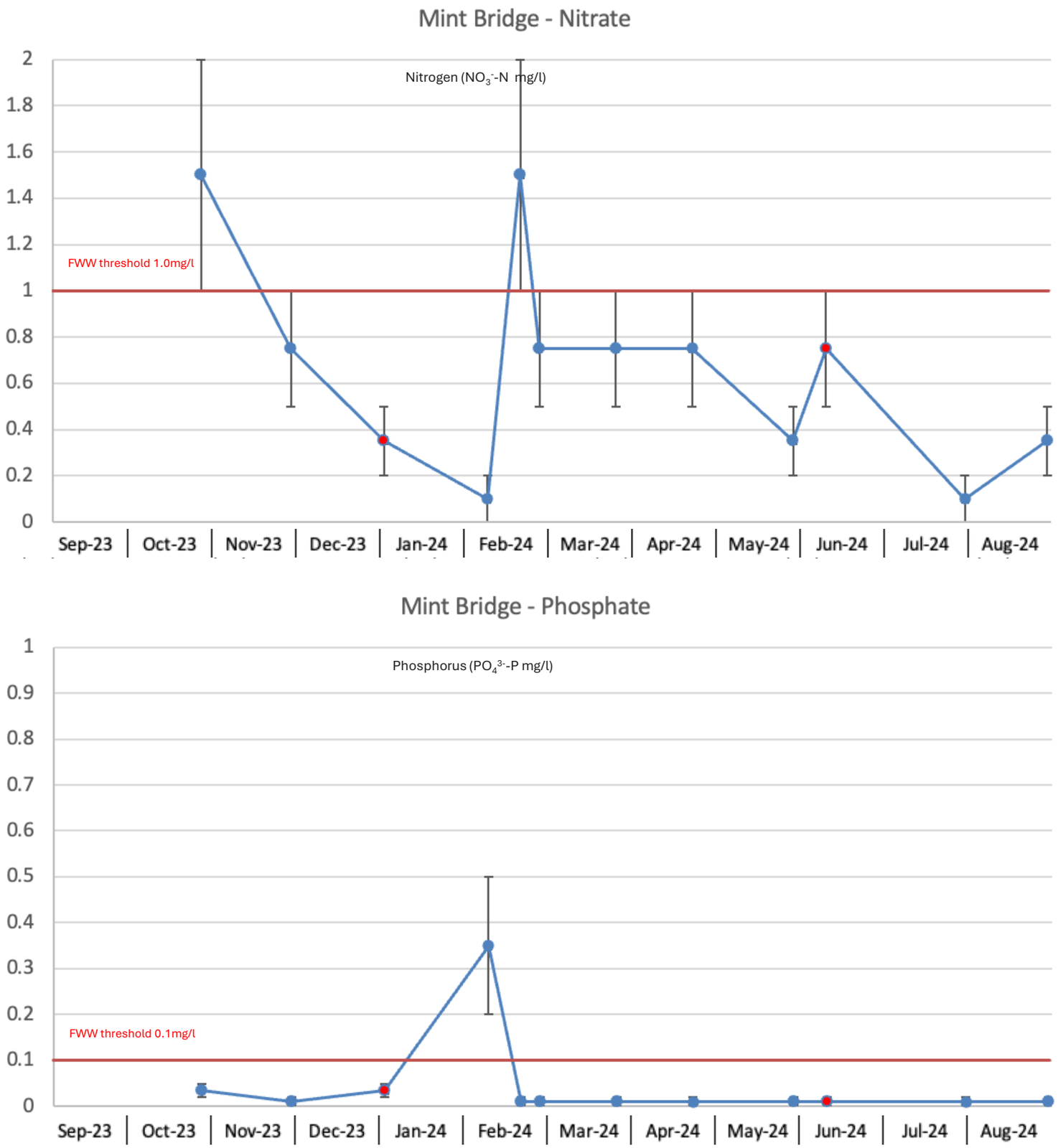
nitrate-N > 1.0mg/L

- 25 Oct 23 – no rain, River level average, water flow steady
- 19 Feb 24 – Light showers, River level average, water flow steady

phosphate-P > 0.1mg/L

- 7 Feb 24 – no rain, River level average, water flow steady

River Kent tributary: River Mint – M10 Mint Bridge - 2



Red points indicate sampling preceded by heavy prolonged rain

River Kent tributary: River Sprint – S05 Sprint Bridge - 1

12 samples, 13 Sep 23 – 21 Aug 24

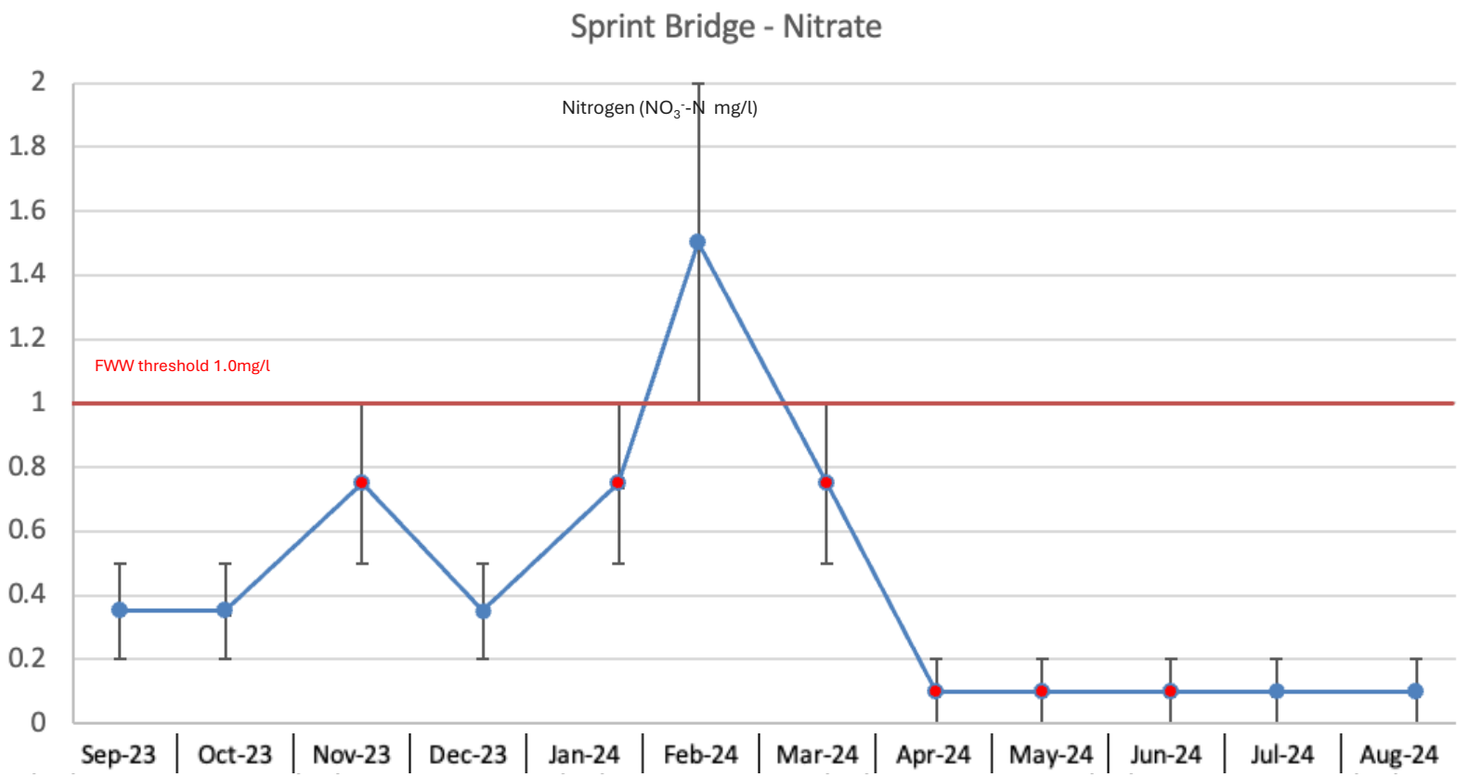
- Trees, shrubs, grass, small plants, bare soil
- Mixed agricultural, sometimes livestock with access to the River
- Potential for urban road and agricultural run off
- No obvious foam or filamentous algae seen
- Recreational litter occasionally seen on Riverbank
- Plants below surface and emerging from water

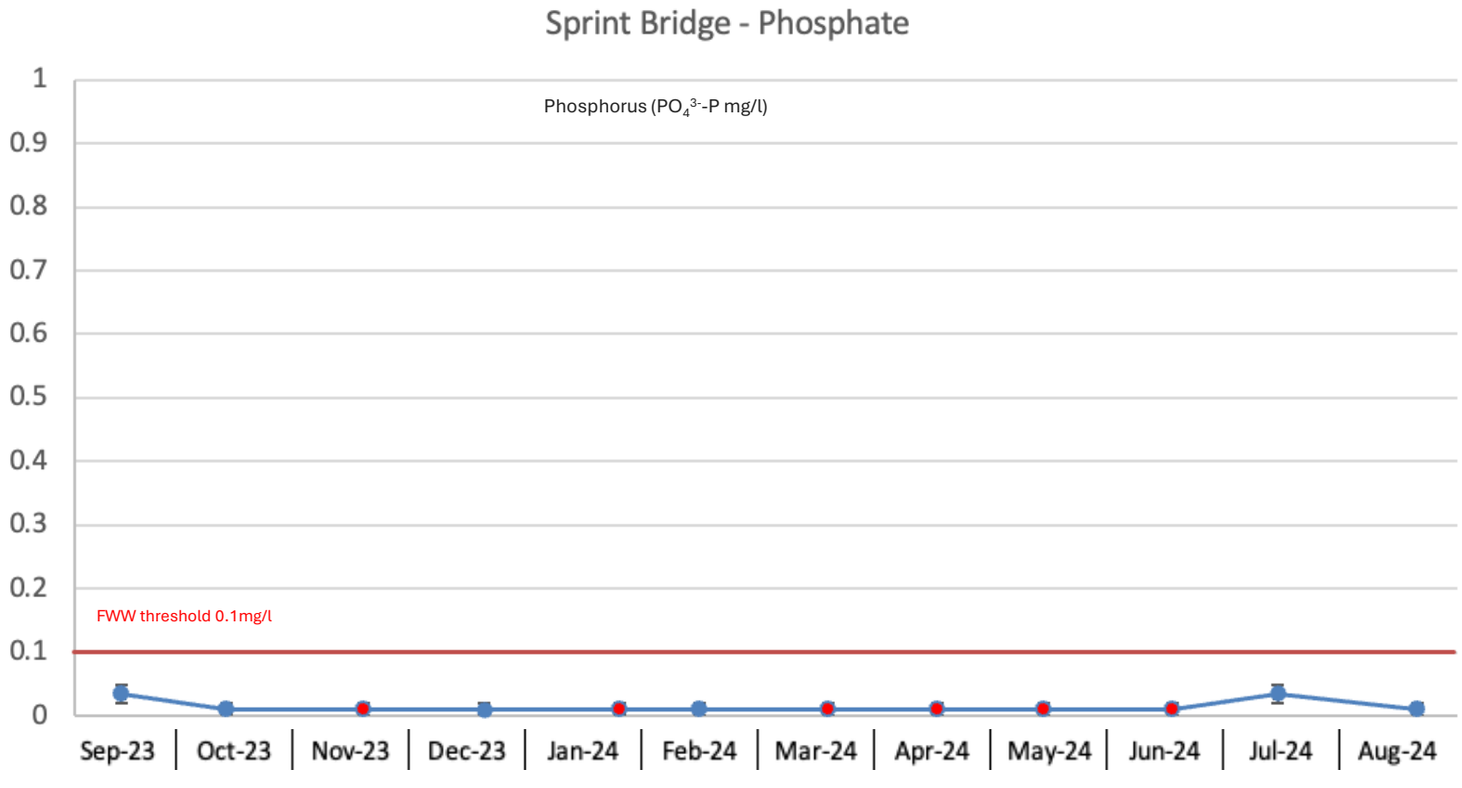
nitrate-N > 1.0mg/L

- 13 Feb 24 – light showers, River level average, water flow steady

phosphate-P always < 0.1mg/L

River Kent tributary: River Sprint – S05 Sprint Bridge - 2





Red points indicate sampling preceded by heavy prolonged rain

River Kent tributary: U05 Underbarrow Pool - 1

8 samples, Sep 23 – Aug 24

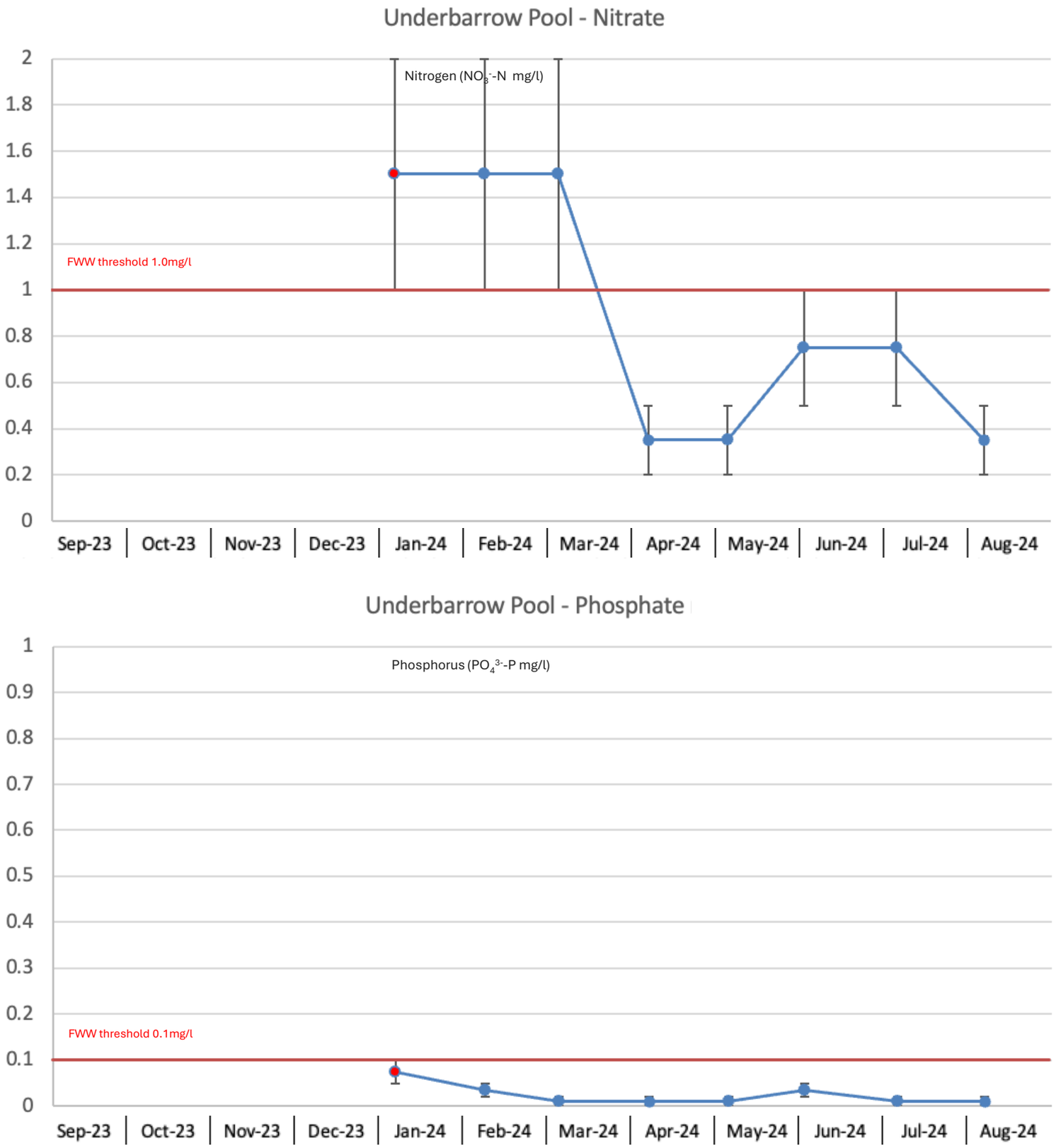
- Trees, shrubs
- Mixed agricultural
- Potential for urban road run off
- No obvious foam or filamentous algae seen
- No litter on Riverbank
- Public use of Riverbank
- Plants below surface and emerging from water
- Aquatic birds, fish, dragonflies and damselflies

nitrate-N > 1.0mg/L

- 4 Jan 24 – heavy prolonged rain, River level high, water flow steady
- 6 Feb 24 – no rain, River level average, water flow steady
- 4 Mar 24 – no rain, River level average, water flow steady

phosphate-P always < 0.1mg/L

River Kent tributary: U05 Underbarrow Pool - 2



Red points indicate sampling preceded by heavy prolonged rain