# The Citizen Crane Project
# Year One Interim Report

## August 2015

## Summary

The purpose of this report is to capture the development of the Citizen Crane project, set out the key findings of the project over the first year of data collection and record how the project is likely to develop through 2015/16 during its 2nd full year of funding. The project started with a feasibility study in 2013 and the main data collection exercise commenced in April 2014. All stages have been supported by the Thames Water Fund.

A summary of the key outcomes is given below:

- Twenty two (22) Trained Citizen Scientists are managing 11 monitoring sites throughout the catchment, undertaking Riverfly Monitoring Initiative (RMI) sampling and collecting monthly water samples for analysis of phosphorus (total, dissolved and soluble reactive), ammoniacal nitrogen and sulphate.
- The project has a steering group with membership from Crane Valley Partnership (CVP), Thames Water, Environment Agency (EA), The Zoological Society of London (ZSL), Friends of River Crane Environment (FORCE) and frog environmental Ltd (frog)
- The monitoring sites extend from the river headwaters to the lower reaches, providing a view over the entire catchment
- The number of RMI trigger level breaches in the first year of the project suggests that sites upstream of Cranford Park have been most impacted by point source pollution events. Newton Park, at the top of Yeading Brook East, has demonstrated signs of chronic pollution issues throughout the period of monitoring
- Methodologies for both the RMI and water quality analysis are EA approved. In addition the methodology for water sample collection, storage and processing in a UKAS accredited laboratory ensures the data produced are accurate and reliable
- Information collected by Citizen Scientists has been used to help direct and prioritise Thames Water resources in their misconnections programme
- In its first year Citizen Crane has detected three pollution events. This has allowed the EA to take early action and, in the case of the Mill Stream event of October 2014, mitigation measures were instigated within 48 hours of pollution being detected
- The project has engaged local academic institutions in the collection and analysis of the data. There are now, as a result, strong collaborations developing with St Mary's University, Kingston University, Brunel University, Harrow College and Royal Holloway
- These institutions are already bringing analytical and academic resources to the Crane catchment and several undergraduate and post-graduate research studies are in progress. It is anticipated these relationships will develop as the project continues and this resource will be of value, both to this project and the wider work of the Crane Valley Partnership (CVP)
- There is considerable public interest in the project. Through a separate funding stream (Heathrow Communities Fund) each monitoring team has been provided with equipment and information so as to better engage the public during the monitoring sessions. This will help educate local people on the importance and value of the river, as well as giving practical information on issues such as domestic misconnections and pollution reporting
- The project has recently been extended to include a pilot study monitoring surface water outfalls using a standard proforma developed by Thames Water and adapted by the project team. This will be reported on separately
- The project is now providing evidence that the catchment partnership can use to support and target investment in the river as it moves towards improved Water Framework Directive(WFD) status

## Acknowledgments

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# 1. Introduction

## 1.1 Overview

Citizen Crane (CC) is the synthesis of two citizen science projects; the Riverfly Partnership's Riverfly Monitoring Initiative (RMI), coordinated locally by the Zoological Society of London (ZSL); and a Phosphorus Monitoring Project devised and led by Friends of the River Crane Environment (FORCE) and Frog Environmental (frog). The CC project, now in its second year, is supported by the Thames Water (TW) Fund, provided to the Crane following the major pollution event of October 2011 and administered by the Crane Valley Partnership (CVP).

The RMI has existing project protocols, which are being replicated nationally, whilst the phosphorus monitoring project is an approach designed specifically for the Crane catchment. Both projects are managed and coordinated by a steering group with representatives from the CVP, the Environment Agency (EA), TW, FORCE, Frog and ZSL.

The River Crane is a largely urban tributary of the River Thames, with a catchment area of approximately 125 $km^2$ and river length of 38 km, running through five boroughs of west London (starting in its headwaters as the Yeading Brook). The river corridor is a valuable asset for the half million people who live within the catchment. The river itself can support a good population of coarse fish alongside kingfishers and water voles, and has been a valued resource for local anglers. It has though also been subject to major pollution events, as well as chronic pollution problems, in recent years. A major pollution event in October 2011 wiped out the entire fish population downstream of Cranford Park, numbering around 10,000 in total, then a second major event in October 2013 greatly affected the river ecology in its early recovery phase. As a result, public interest and concern was focused on the condition of the river, and this project was created in response.

The two projects commenced with feasibility studies before they were brought together in early 2014, with the main stage of monitoring started in April 2014. This document is an interim report on the first 12 months of monitoring up until April 2015.

This is the final version of the report and has been reviewed internally by the steering group and other interested parties. The project team welcomes all comments on the findings of this report and these can be incorporated into an updated report following the second year of monitoring. Funding is currently in place for monitoring to continue until March 2016.

## 1.2 The monitoring network

Twenty two volunteers have been trained onto the project. Figure 1 shows the 11 monitoring sites (including one on the Upper Duke of Northumberland's River at Donkey Wood). Monitoring takes place on the third Saturday of each month. Partnership organisations that have adopted sites include:

The Harrow Nature Conservation Forum, Arocha, Thames 21 with Friends of Cranford Park, Friends of Yeading Brook and River Pinn, The London Wildlife Trust, Thames Anglers' Conservancy, Friends of Ickenham Marshes and the Friends of River Crane Environment.


**Figure 1: The monitoring teams and sites**

## 2. Background

### 2.1 The Riverfly Monitoring Initiative

The Citizen Crane project uses the nationally recognised Riverfly Monitoring Initiative (RMI) methodology as a biotic indicator of river health. The RMI was developed by the Riverfly Partnership (RP) (www.riverflies.org) and launched nationally in 2007. It is now employed on over 80 catchments and 1000 sites across the UK, engaging an estimated 1,200 volunteers.

The aims of the RMI are:

- Increased catchment wide monitoring
- Pollution detection and a more timely response to identify sources of pollution
- Mapping of key problem areas that should be targeted for improvement
- A network of volunteers and groups that can link to other projects
- Outreach, awareness raising and empowerment of local groups

This report sets out how these aims have been applied in the Crane catchment.

### 2.2 The phosphorus project

A phosphorus monitoring network is a natural component to build onto the infrastructure provided by RMI for a number of reasons. Phosphorus (P) is a key factor preventing many catchments in the UK, including the Crane, from reaching 'good' status under the WFD. By having a catchment wide phosphorus monitoring programme in the Crane catchment, a detailed understanding of the behaviour of phosphorus over time and space can be developed and used to inform effective remedial action. This can in turn benefit the wider ecology of the river.

The feasibility report (November 2013 - the executive summary of which is included as Appendix A), indicated that all necessary resources and capabilities were in place within the Crane Catchment to implement a phosphorus-monitoring programme, producing data to inform decision making at a catchment level.

The project has been designed to record and monitor the loading of soluble reactive phosphorus (SRP) in addition to concentration. Simple flow monitoring stations were set up and used at each monitoring point, such that the throughput of phosphorus in each part of the river system, in terms of $kgh^{-1}$ for example, can be evaluated. The methodology for this is provided in section 3.2.

## 3. Method

### 3.1 Criteria for site selection for the RMI

The RMI site selection was undertaken first, and the phosphorous project used the same sites for sampling, with nearby reaches used for flow monitoring. The following criteria informed the selection of RMI monitoring sites:

- Safe access to the river
- Permission from landowner
- Proximity to a source of volunteers or to a volunteer group
- Suitable river substrate i.e. not deep silt.

The resulting network of sites, as shown on Figure 1, provides a reasonable distribution across the catchment, with spacing at between 3 and 6 km, and all of the tributaries and confluences monitored. The project is currently reviewing the potential to add two further sites, such that the base of the River Crane and the Lower DNR are also monitored.

### 3.2 Site set up for phosphorus project

A simple gauging station was set up at each monitoring site to enable loadings to be calculated from the concentration data. The recording form for sampling is shown in Appendix B.

The gauging stations were set up by identifying a reach of 3 to 5 metres in length with relatively linear features and installing posts to demarcate the reach. A representative transect was then taken from bank to bank within the reach, measuring depth every 0.5 metres. A depth gauge was installed into the bank on this transect, easily accessible to Citizen Scientists, and a reading taken on each site visit, from which the river cross sectional area (A) can be calculated.

A piece of floating material is used to measure flow rate between the two markers, allowing a surface flow velocity (V, $ms^{-1}$) to be calculated. A factor of 0.8 is used to relate surface velocity to the bulk flow velocity, such that the flow rate (Q, $m^3 s^{-1}$) can be calculated as follows:

$Q = 0.8 V \times A$

By combining concentration data and flow (Q), loading can be calculated. The loading represents the amount of phosphate in the river at the point of measurement.

### 3.3 Training for the RMI

Two separate RMI training events have been held, one at Crane Park Island and the other at Minet Country Park, and a total of 22 volunteers attended the training sessions. Topics covered in the training included:

- The theory of biotic assessment of river health
- Taking and scoring an RMI kick sample
- Invertebrate identification
- Trigger levels and what to do in the event of a trigger level breach
- Health and safety
- Biosecurity

### 3.4 Training for Phosphorus sampling

A training morning took place at Crane Park Island for Citizen Scientists collecting P data and attended by 14 volunteers from sample sites across the catchment. The training session was also used as an opportunity to demonstrate use of and distribute sampling kits and equipment.

The day itself involved classroom and field elements with the EA also in attendance to support delivery of key topic areas. The following points were covered:

- Consistent water sample collection
- Sample transfer and storage
- Consistent measurement of flow (recording form and instructions in Appendix B)
- Recording and communicating site measurements
- Health & Safety
- Water quality and identifying pollution types

In addition, there have been introductions to the phosphorus monitoring at each of the RMI training sessions.

### 3.5 Health & Safety

The health and safety of citizen scientists is the most important part of the project. Having the RMI framework on which to build further monitoring proved very useful as the methodology involves entering the river, therefore Health & Safety (H&S) protocols are more stringent then the methodologies developed for water sampling and flow monitoring.

In addition, new risk assessments were put in place for water sampling and flow monitoring, and volunteer safety was emphasised during the training day.

A protocol was also put in place to ensure transparency on all matters concerning H&S, with the topic having a place on the agenda for each Steering Group meeting.

To date, one incident has been reported to the steering group. This involved a volunteer falling into the water. No injury was sustained but the importance of following risk assessments and method statements was re-iterated to all Citizen Scientists. This includes a safety first approach to any sample and data collection. This resulted in one weekend when a number of samples were not taken due to excess river levels.

### 3.6 RMI sample collection and analysis

Samples are taken in a standardised three minute kick/sweep sample using a standard kick net, followed by a one minute manual search. This method allows comparable samples to be taken over time.

The RMI uses the presence and abundance of eight target groups of invertebrates as indicators of river health. Once a sample has been taken it is analysed on the river bank. Invertebrates relevant to the RMI are separated from the sample using pipettes and small sectioned trays. The relative abundance figures for the RMI invertebrate groups are converted into a score for the sample, as shown in Table 1 below.

**Table 1: RMI scores for the 4 abundance categories**

| Abundance | Score | Estimate Numbers |
|---|---|---|
| 1 to 9 | 1 | Quick Count |
| 10 to 99 | 2 | Nearest 10 |
| 99 to 1000 | 3 | Nearest 100 |
| over 1000 | 4 | Nearest 1000 |

A score below a pre agreed 'trigger level' indicates that the river may be polluted. Table 2 below shows trigger levels for the CC sites set with the EA's Monitoring Officer for the Crane:

**Table 2: Environment Agency trigger levels for the 11 CC sites**

| Site | Trigger Level |
|---|---|
| Headstone Manor | 3 |
| Spider Park | 3 |
| Ickenham Marshes | 3 |
| Newton Park West | 3 |
| Yeading Brook Meadows | 4 |
| Minet Country Park | 3 |
| Cranford Park | 3 |
| DNR - Donkey Wood | 7 |
| Crane -Donkey Wood | 3 |
| Crane Park Island | 6 |
| Mill Road | 8 |

### 3.7 Phosphate sample collection and analysis

There are six main steps to the collection, analysis and communication of water sample data collected by volunteers, as outlined below:

**Step 1: Citizen Scientist collects water samples**
Water samples can be collected at any point over a sampling weekend. All Citizen Scientists are equipped with cool bags and cooling kit, critical for spring and summer, as the samples have to be kept at +5 ± 3 °C.

**Step 2: Samples collected from Citizen Scientists**
On the Sunday evening of the sampling weekend samples are picked up from across the catchment. Samples are kept in cool storage at all times. New sampling bottles are dropped off at the same time as full bottles are collected.

**Step 3: Samples delivered to Thames Water**
Samples are kept cool overnight and delivered to Thames Water at Mogden Sewage Treatment Works (STW) where they are labelled and transferred to a fridge.

**Step 4: Samples transferred to Reading Laboratory for analysis**
A refrigerated courier van picks up the samples from Mogden on Monday morning and takes them to the Thames Water UKAS accredited laboratory in Reading.

**Step 5: Results of analysis returned to project team**
A concentration data report is typically issued within two weeks of sample receipt. These results allow calculation of phosphorus loading using data collected from site as set out in section 3.2 above.

**Step 6: Results uploaded to CVP website**
Results are freely available to Citizen Scientists and members of the public via a dedicated webpage on the Crane Valley Partnership website.

## 4. Results

### 4.1 RMI results

A total of 111 samples have been taken across 11 sites out of a possible total of 132 during the first 12 months of the project. Gaps in the record have been caused by factors such as the occasional unavailability of volunteers and high water levels causing unacceptable risks with water entry. The resulting data are presented in Table 3 and Figures 2 and 3 below.

**Table 3: Average RMI scores and numbers of RMI animal groups at the 11 monitoring sites over the first 12 months of the project**

| Site | Average RMI score | Number of RMI invertebrate groups found |
|---|---|---|
| Headstone Manor | 3.3 | 3 |
| Spider Park | 1.8 | 1 |
| Ickenham Marshes | 3.8 | 2 |
| Newton Park West | 3.6 | 3 |
| Yeading Brook Meadows | 4.3 | 5 |
| Minet Country Park | 2.5 | 1 |
| Cranford Park | 3.0 | 4 |
| DNR - Donkey Wood | 7.3 | 5 |
| Crane -Donkey Wood | 5.5 | 4 |
| Crane Park Island | 8.8 | 5 |
| Mill Road | 8.8 | 5 |

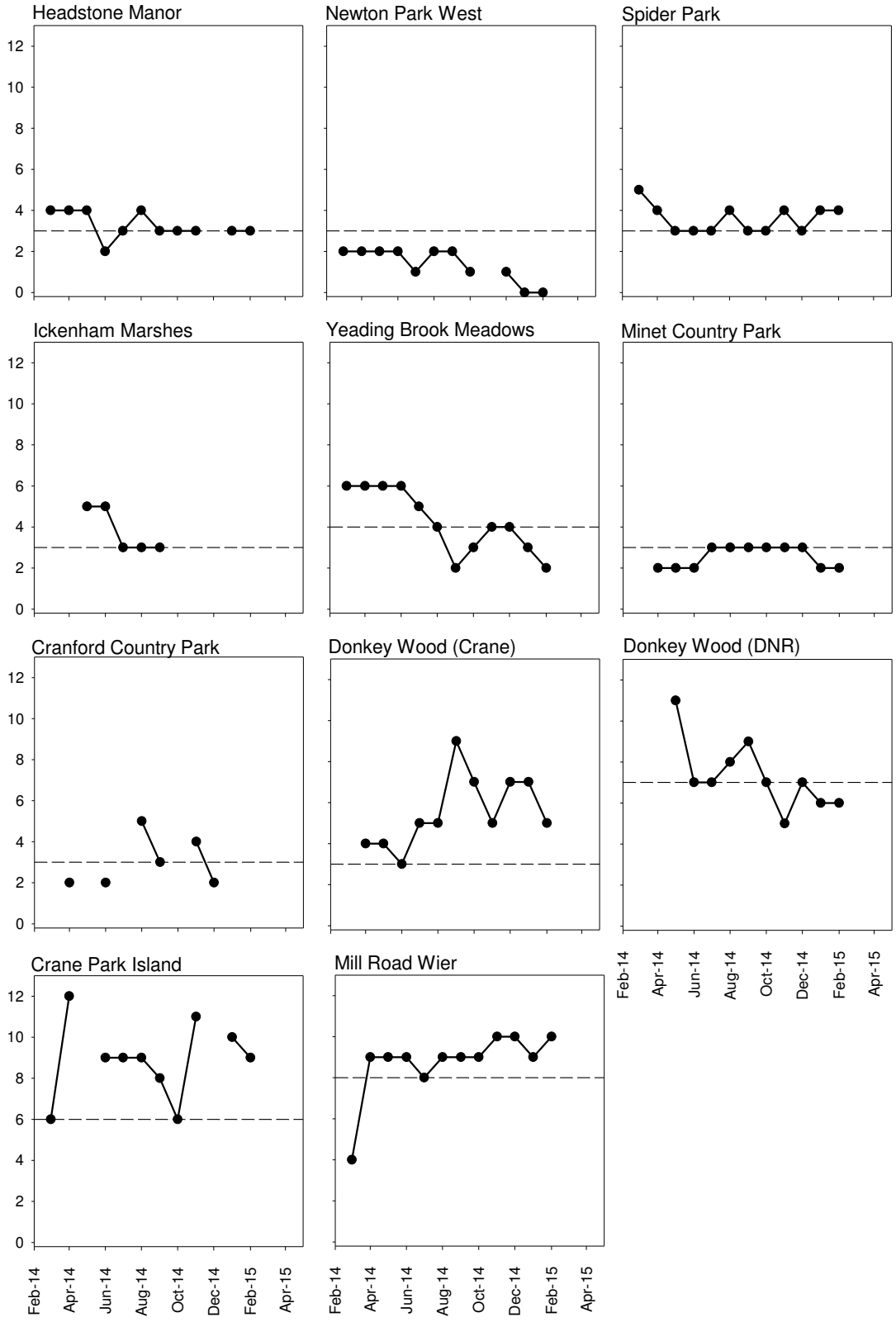


**Figure 2: RMI record at the 11 monitoring sites over the first year of the project. (1) Trigger level as dotted line (2) no sample was taken when a blank is shown**

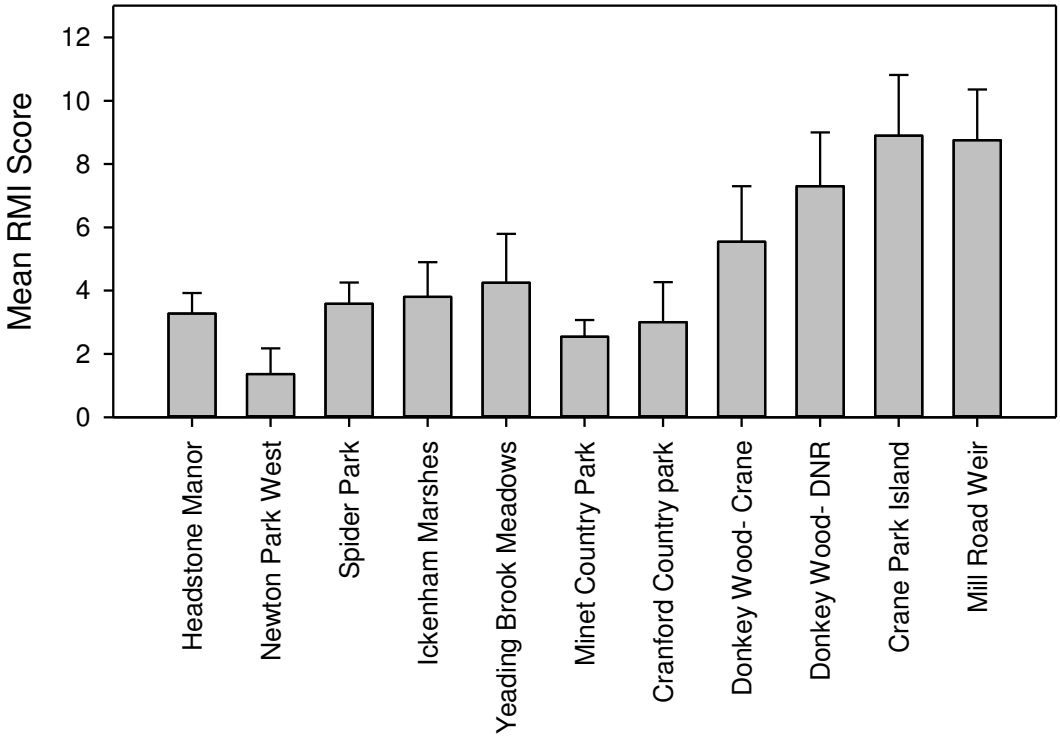


**Figure 3: mean RMI scores (with standard deviation bars) at the 11 sites**

Figure 2 shows a total of 28 RMI trigger level breaches over the first 12 months of monitoring. The majority of these were in sites upstream of where the upper DNR joins the Crane. The Newton Park site, near to the top of the Roxbourne Brook, never achieved a score above its trigger level, and in January and February 2015 failed to record any RMI invertebrates in the river.

Seasonal variations can be seen in most invertebrate groups. For example freshwater shrimp (*Gammarus sp.)* numbers are lower in the winter samples and a reduction in mayflies (olives) is apparent after the April/May hatching at sites where they are recorded.

Figure 3 shows average RMI scores generally increasing with distance from the source. One exception to this is the Minet Country Park site – and there may be site specific water quality issues to investigate further here. The Cranford park site also has a fairly low result, and this may be due to habitat deficiencies at this site. It is notable that the abundance and diversity of RMI invertebrates increase at sites downstream of Donkey Wood and this may be a result of the beneficial effects of inflow from the upper DNR.

These preliminary conclusions are subject to review and change as the project continues. It should be noted for example that, although sites with the best possible range of habitats were selected in each area, in some places these are significantly limited. An assessment of the habitat value of each site, using the Urban River Survey (URS) method, is being undertaken in summer 2015 and can be used to assess the influence of habitat on these results.

## 4.2 Water quality analysis results

### Historical context

Long-term concentration data for SRP have been made available by the EA and these data are valuable to set the project data in the context of the long term trend. Data from the Northcote Road site, near the base of the River Crane, extend back to 1978 and are set out in Figure 4 below.

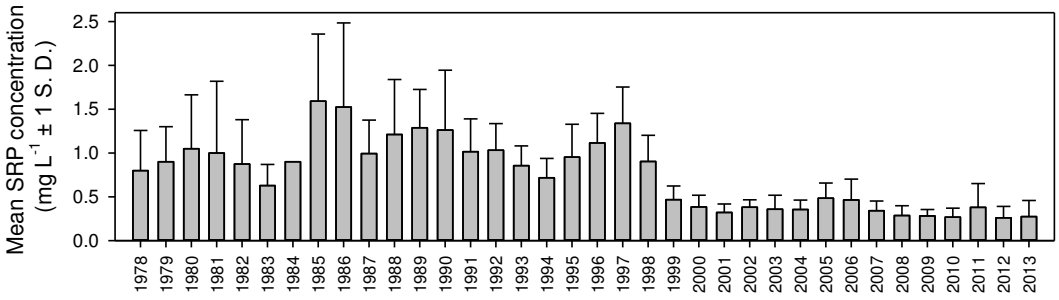


**Figure 4: SRP concentrations (mg $L^{-1}$) from 1978 to 2013**

These long term data reveal two distinct sub-sets. Up until 1998 concentrations were averaging 0.5 mg.$l^{-1}$ and above and regularly reaching above 1mg.$l^{-1}$. From 1999 onwards concentrations have been generally at or below 0.5mg.$l^{-1}$. The reason for this reduction is believed to be due to the installation of phosphorus stripping at sewage works in the upper Colne catchment, with the impact being due to the transfer of water into the middle Crane along the Upper Duke of Northumberland's River (Upper DNR). Concentrations have been considerably lower over the last 15 years.

### Overview of phosphate data set

Concentration data are set out in Table 4a below. The concentration levels have been colour coded to the WFD standard for SRP for each site, which vary slightly depending on altitude and alkalinity.

**Table 4a: SRP threshold levels for each Citizen Crane monitoring site**

| Site Number | Site Name | Easting | Northing | Altitude (m) | Mean observed Alkalinity (mgCaCO3/l | High | Good | Moderate | Poor |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Headstone Manor | 514100 | 189463 | 51 | 214 | 0.044 | 0.081 | 0.196 | 1.057 |
| 2 | Bridgewater Fields/ Roxbourne park | 512330 | 187520 | 46 | 214 | 0.045 | 0.082 | 0.199 | 1.063 |
| 4 | Newton Park West | 512939 | 186659 | 39 | 213 | 0.046 | 0.084 | 0.202 | 1.069 |
| 6 | Yeading brook meadows | 510259 | 182849 | 30 | 190 | 0.045 | 0.083 | 0.2 | 1.066 |
| 8 | Cranford park | 510174 | 177510 | 23 | 188 | 0.046 | 0.085 | 0.203 | 1.072 |
| 9 | Donkey wood (Crane) | 511167 | 174696 | 22 | 188 | 0.046 | 0.085 | 0.204 | 1.073 |
| 10 | Donkey wood (DNR*) | 511062 | 174625 | 22 | 221 | 0.05 | 0.09 | 0.213 | 1.093 |
| 11 | Crane Park Islands | 512742 | 172895 | 16 | 221 | 0.051 | 0.092 | 0.216 | 1.1 |
| 12 | Kneller Gardens/ Mill Road | 514793 | 173223 | 14 | 183 | 0.047 | 0.086 | 0.206 | 1.079 |

Table 4b provides the site name and number reference from the top to the bottom of the catchment with SRP concentration levels in mg/$l^{-1}$. Colour coding in table 4b relates to boundary limit as defined in table 4a.

**Table 4b: Citizen Science SRP concentrations by site from May 2014 to April 2015**

| site | Location | May | June | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | April |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | Headstone Manor | 0.41 | 0.86 | 0.43 | 0.44 | | 0.4 | 0.25 | 0.14 | 0.16 | 0.16 | 0.37 | |
| **2** | Roxbourne park | 0.57 | 0.64 | 0.58 | | 0.54 | 0.25 | <0.07 * | 0.18 | 0.22 | 0.18 | 0.47 | 0.55 |
| **3** | Ickenham Marshes | | | | | | | | | | | | 0.54 |
| **4** | Newton Park West | 0.71 | | 0.22 | 0.36 | 0.54 | 0.26 | 0.29 | 0.32 | 0.23 | 0.25 | 0.61 | 0.72 |
| **5** | Yeading brook East (not used) | | | | | | | | | | | | |
| **6** | YB meadows | 0.34 | 0.55 | 0.22 | 0.25 | 0.54 | 0.2 | 0.14 | 0.15 | 0.11 | 0.09 | 0.31 | 0.46 |
| **7** | Minet park | | | | | | | | | | 0.12 | 0.29 | 0.39 |
| **8** | Cranford park | 0.21 | 0.17 | 0.99 | 0.2 | 0.29 | 0.18 | 0.11 | | 0.12 | 0.13 | 0.16 | 0.2 |
| **9** | Donkey wood | 0.16 | 0.16 | 0.23 | 0.14 | 0.17 | 0.12 | 0.13 | 0.1 | 0.1 | 0.11 | 0.12 | 0.15 |
| **10** | Donkey wood DNR | 0.33 | 0.38 | 0.33 | 0.42 | 0.32 | 0.2 | 0.17 | 0.15 | 0.18 | 0.17 | 0.14 | 0.16 |
| **11** | Crane Park Island | 0.28 | 0.3 | 0.31 | 0.32 | 0.28 | 0.17 | 0.12 | 0.11 | 0.15 | 0.12 | 0.12 | 0.14 |
| **12a** | Mill Road | 0.26 | 0.3 | 0.25 | 0.26 | 0.18 | 0.18 | 0.14 | 0.11 | 0.12 | 0.12 | 0.14 | 0.13 |
| **12b** | As per 12a | | | | | | | | | | | | |

The following general points are made on the nature of the data presented:

- The percentage data collection is high, with only five missing data points over the 12 months. These data are missing for a variety of reasons such as safety concerns and lack of cover during holidays
- Site 3 and Site 7 have come on line during the course of the first year
- Site 5 is not an active CC monitoring site. This site code has been used on occasion for water quality monitoring of specific outfalls entering the Crane
- Site 9 is on the main Crane just above the confluence with the DNR and Site 10 is on the upper DNR above this same confluence
- A single water sample is taken at Site 12, a few hundred metres upstream of where the lower DNR (12a) and lower Crane (12b) split. This sample, along with flow records from both arms, is then used to calculate the P loading on both arms of the river

The following initial comments are made by review of these data:

- SRP concentrations are generally higher in the upstream part of the catchment
- There is a general reduction in SRP concentration in the winter months, shown by a higher frequency of yellow from October through to March
- Whilst official classification uses the mean SRP level, results indicate that no Citizen Crane sites have scored 'high' level at any point during the monitoring and only one site, Minet Park has registered a 'good' level, in 2014. In this case it should be noted that this sample had an SRP level below the limit of detection and may therefore be considered incorrect.

Further analysis of these data is presented in the sections below

## Flow data for each site

The flow data, as monitored at each of the monitoring sites, are presented in Figure 5 below. These data are presented spatially from upstream to downstream

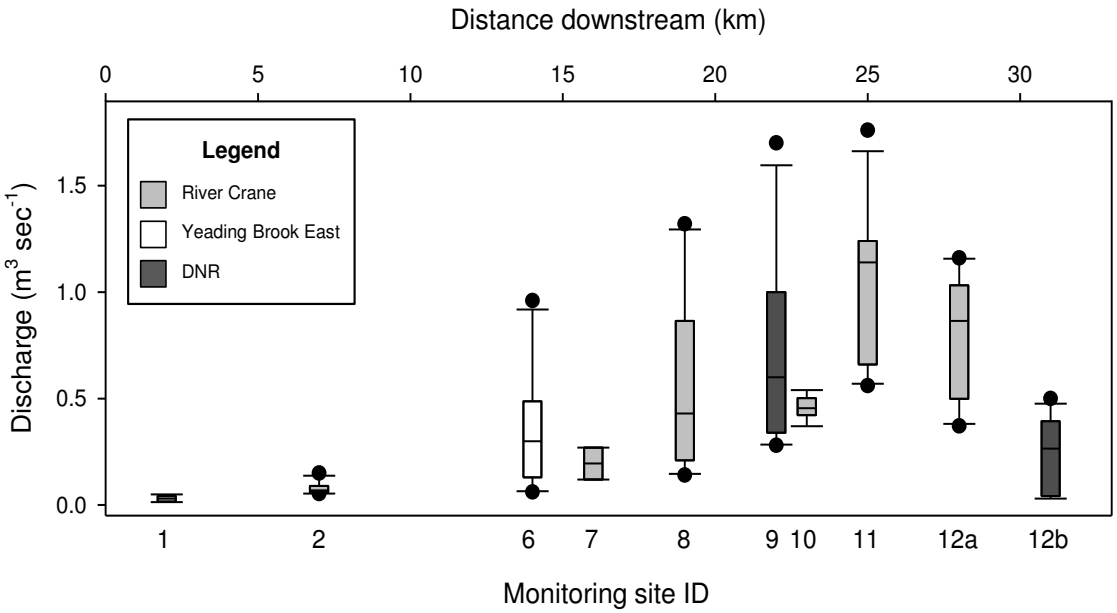


**Figure 5: Flow data for each monitoring site from upstream to downstream**

The following general points are made on the data presented:

- Site 3 is not included as the gauging station was only set up in March 2015
- Site 4 is not included as there have been problems with the data set from this station
- Site 5 is not a fixed CC site. It has been used to sample water from outfalls on 2 occasions.
- Site 7 is included although there are only three data points and no higher winter flows
- Site 9 is the flow in the Crane immediately upstream of the DNR
- Site 10 is the flow in the DNR as it joins the Crane
- Site 12a shows the flow into the lower DNR and 12b is the flow into the Crane below the lower DNR

## Seasonal variations in flow rates

Flow data from all the sites are collated in Figure 6 below to give an indication of the seasonal variations in flow rate:

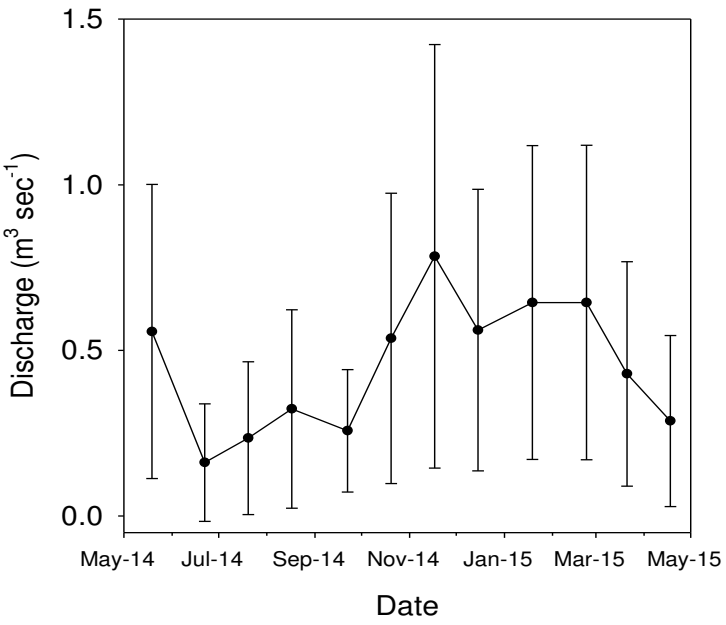


**Figure 6: mean discharge rates (± 1 S. D.) across all sites for each month of the monitoring period**

These data indicate that flows in the winter months of the year 2014/15 were typically several times higher than in the summer months.

## Phosphate concentration data for each site

Figure 7 below summarises all the SRP concentration data by monitoring site and displays these data spatially from upstream to downstream.

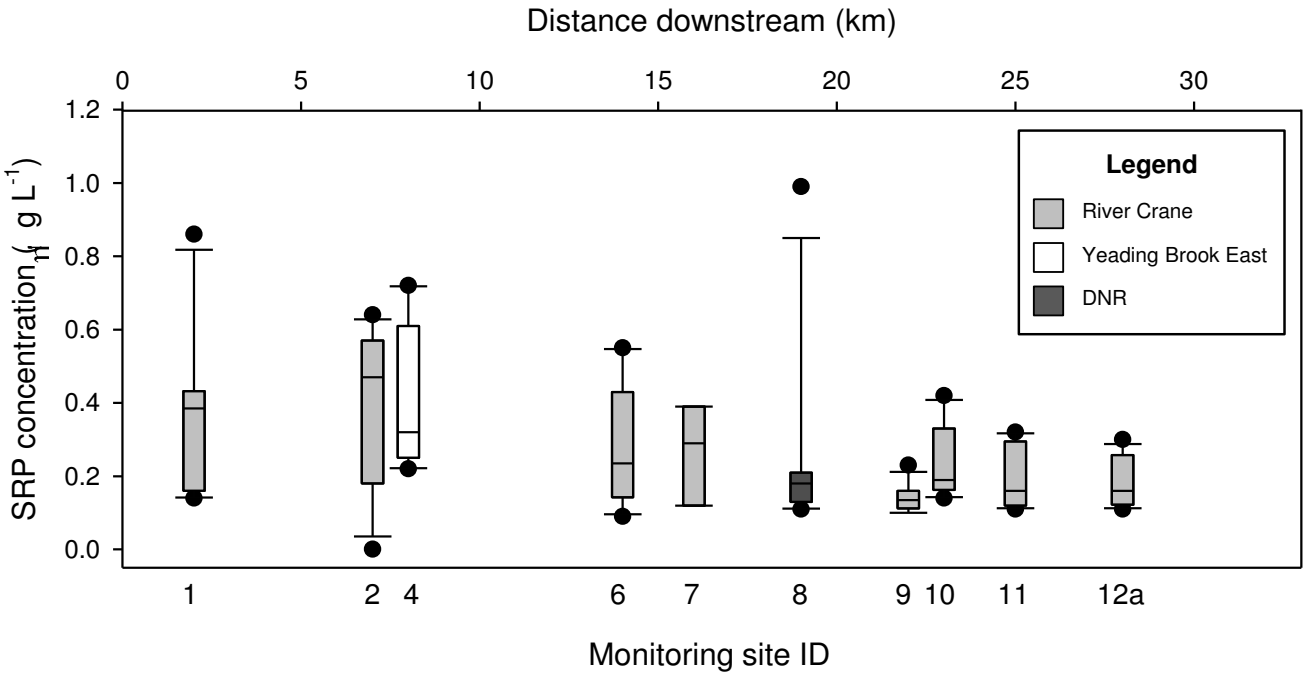


**Figure 7: SRP concentration by monitoring site**

The following preliminary conclusions can be drawn from these data:

- The higher concentrations are predominantly in the upper parts of both tributaries (Yeading Brook and Roxbourne Brook) and concentrations steadily reduce with distance downstream to the confluence with the upper DNR
- There is a single major outlier to this general trend at Site 8 – with a concentration in excess of 1 mg $l^{-1}$ - and this is believed to be due to a particular pollution incident
- The inflow from the upper DNR (Site 10) has a higher SRP concentration than from the Crane above it and yet RMI scores below this confluence are higher than those above. This indicates that the diversity and abundance of RMI invertebrate taxa is not in this location affected by the concentrations of SRP detected during this study. Other factors such as wash-down of invertebrates from sources upstream on the Upper DNR, habitat, sediment and flow may play a more significant role than SRP concentrations on the RMI of the lower Crane
- The overall concentrations continue to fall downstream of this confluence – both in mean concentration and in the upper limits - though not to the levels found above the Upper DNR confluence

These preliminary conclusions will be tested and developed in year two of the project.

### Seasonal variations in phosphate concentration

The mean concentration levels for SRP across the 12 month monitoring period are plotted in Figure 8 below.

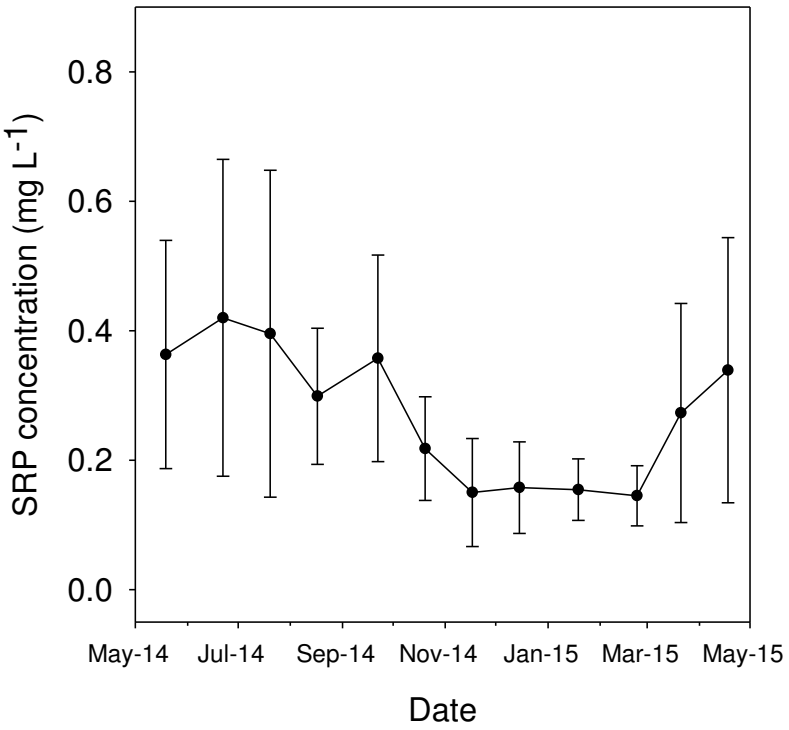


**Figure 8: Mean SRP concentration (± 1 S. D.) for each month of the monitoring period**

These data confirm the pattern seen in Table 4 whereby SRP concentrations across the catchment reduce during the winter. Mean concentrations across the catchment are closer to 0.4 mg $l^{-1}$ during the summer, with mean concentration typically below 0.2 mg $l^{-1}$ in the winter. This response appears to be an inverse function of the flow variations over the year (as set out in Figure 6), indicating a dilution response to flow.

## Phosphate loading data for each site

Figure 9 below summarises all the SRP loading data by monitoring site and displays these data spatially from upstream to downstream.

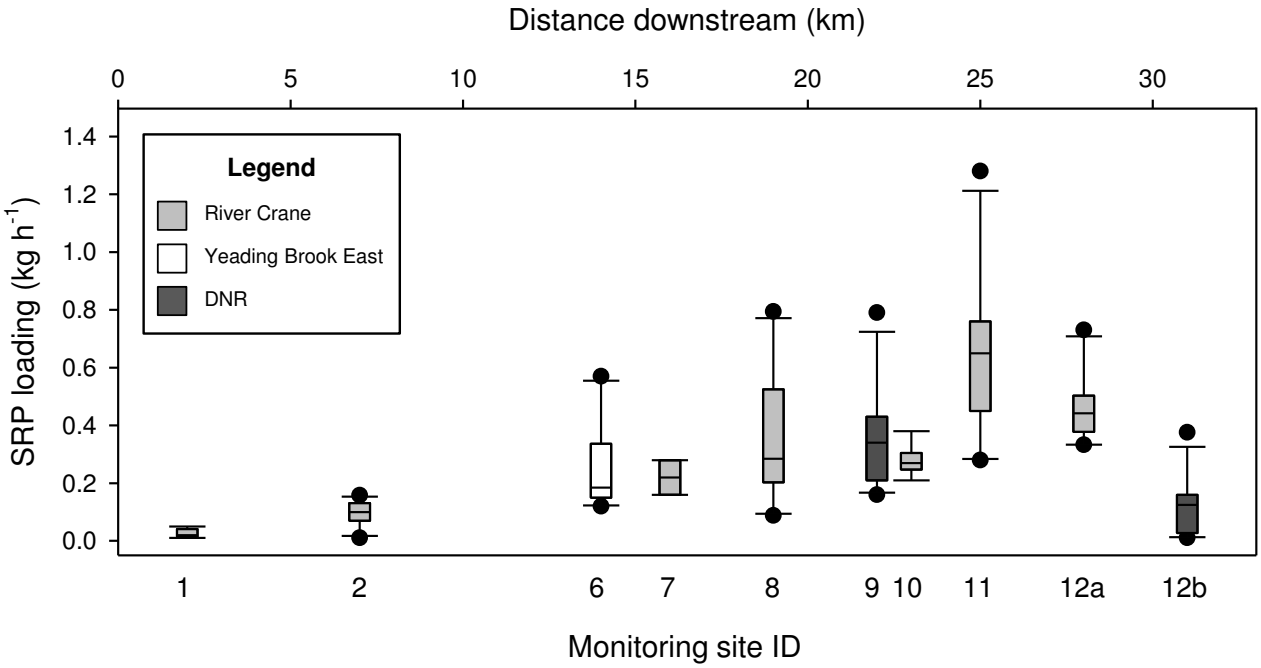


**Figure 9: SRP loading by monitoring site**

The following preliminary conclusions can be drawn from these data:

- There are significant SRP loadings into the top of the catchment, in the order of 250g.$hr^{-1}$ above site 6
- Mean SRP loadings remain fairly stable through the middle reaches of the catchment, between sites 7 and 9, in the order of 300gm.$hr^{-1}$
- There is a further 200 gm.$hr^{-1}$ coming into the river from the Upper DNR (site 10 data) on a fairly consistent basis, giving around 500 gm.$hr^{-1}$ in total
- The loading remains fairly constant along the downstream reach to Mill Road, indicating that any inputs and take up of SRP along this reach are generally in balance
- The mean loading recorded at site 12 suggests an annual P load into the catchment to this point of around 5000 kg
- The inflow from the upper DNR has a higher SRP loading than from the Crane above it. This indicates that, whilst in general terms the inflow from the upper DNR has a sweetening effect on the quality in the main river, this is not the case with respect to phosphate

These preliminary conclusions will be tested and developed in year two of the project.

## Seasonal variations in phosphate loading

Phosphate loadings have been calculated by combining discharge and concentration data, using the method set out in Section 3.2 above. The mean loadings (in kg $hr^{-1}$) for SRP across the 12 month monitoring period are plotted in Figure 10 below:

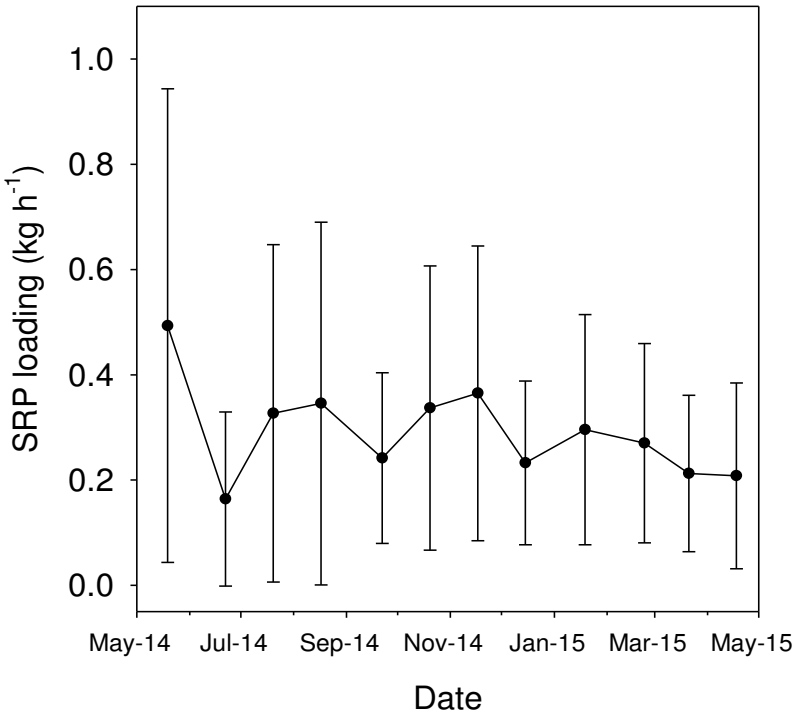


**Figure 10: Mean SRP loading data (± 1 S. D.) for each month of the monitoring period**

These data show little or no seasonality of response with respect to the SRP load in the river.

## SRP data on a site by site basis

SRP loading has also been plotted on a site-by-site basis, to show loading over time at various monitoring points, in Figure 11 below. It should be noted that some data points are missing due to incomplete data from site.

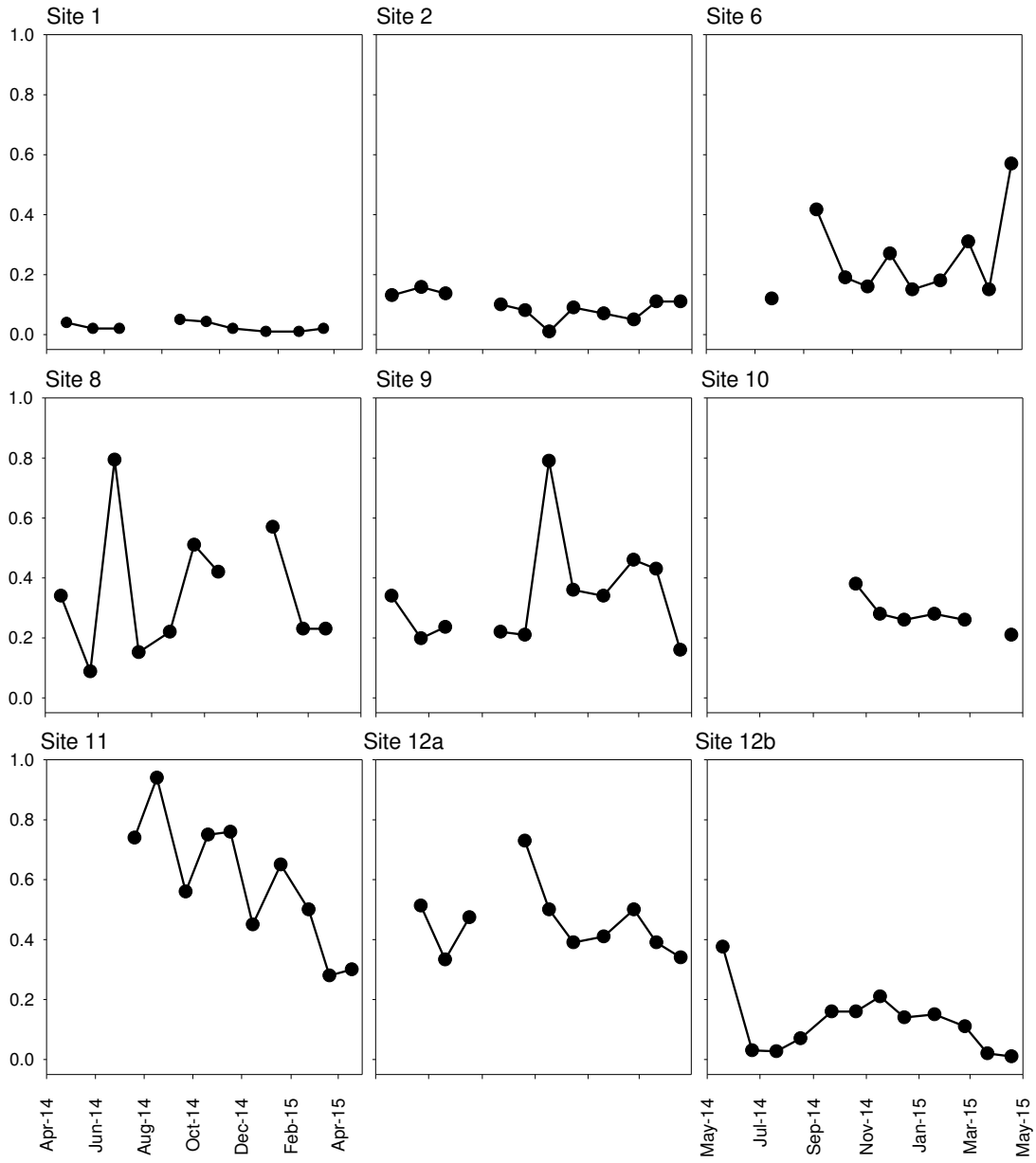


**Figure 11: SRP loading by site for the monitoring period to date**

At this stage in the project it is considered too early to draw out any firm conclusions from the site specific data. However, it is hoped that further conclusions can be drawn as the project progresses and data analyses become more statistically valid.

## 5. Discussion

### 5.1 RMI

Several hundred volunteer hours have been spent monitoring the river during the first year of the project. The data collected provide a valuable baseline on which to build an increasingly detailed picture of the ecological condition of the river. The RMI data will also provide an insight into changes in habitats and water quality in the catchment, as invertebrate diversity and abundance are not just dependent on water quality: flow regimes, sediment quantity and quality, shading, morphology and habitat diversity are also key factors influencing invertebrate populations.
The data have resulted in the early detection of specific pollution events and pollution reports from CC volunteers have allowed the EA to respond quickly to problems. For instance in the case of the Mill Stream event of October 2014, CC reports allowed mitigation measures to be instigated within 48 hours of the pollution being detected and EA investigations led eventually to the changing of polluting and potentially polluting practices at several commercial operations. RMI data remains a key part of the synergy between citizen scientists and the EA's catchment management.

Following six months of data collection RMI trigger levels were set by the EA. For the Crane no sites currently have a trigger level below 3, despite Newton Park West consistently scoring 2, with underlying chronic water quality issues affecting this site. The RMI data records have supported the prioritisation of the upstream drainage catchments for TW investigation of misconnections. As and when TW misconnections works remediate some of the issues there is the potential for improvement in invertebrate communities.

Trigger levels will be reviewed now that a full year of sampling has taken place.

### 5.2 Phosphorus

Classification under WFD is calculated over 3 years of data collection. However, the samples collected as part of CC show every site breaching the threshold between 'moderate' and 'poor' on more than one occasion.

Longer-term EA data indicate that the concentrations have nevertheless reduced considerably, from a time up until 1998 when concentrations at the base of the catchment were regularly exceeding 1 mg $l^{-1}$.

The concentration data indicate an inverse relationship with river flow, which suggests that concentrations of phosphate are a function of dilution.

Given the length of the data set it is not possible to draw a clear link between season and P concentration.

The upper reaches of the catchment (on both the Yeading Brook and Roxbourne Brook arms) have the highest phosphate concentrations - and also the lowest RMI scores. This indicates that, all other factors being equal, these would be priority areas for investigation of potential phosphate sources. Tackling the 250g.$hr^{-1}$ that is entering the upper reaches of the river would also obviously help to reduce the phosphate loading of the entire river.

There is a significant additional phosphate loading entering the river along the upper DNR and this input does have a negative impact on phosphate concentrations in the lower part of the river. It has however been generally assumed that the inflow from the upper DNR has a beneficial impact on the ecology of the Crane – and this is supported by the RMI data set. It is evident for example that the DNR will dilute

pollutants in the Crane during pollution incidents, and add to the flow during dry spells. Increased. RMI scores below the confluence may also be partly attributable to drift of some species down the DNR from the Colne. One clear conclusion from this is that there is no direct relation between RMI and P in the catchment.

One further conclusion from the Upper DNR data is that any improvements in phosphate loadings to the upper and middle reaches of the Colne – believed to be significantly due to inputs at sewage works in the upper Colne - would benefit P loadings in both the Colne and the Crane.

The data indicate an annual loading of SRP to the catchment in 2014/15 of around 5000 kg. Around 1500 kg of this originated (via the upper DNR) from the River Colne with the remaining 3500kg having a Crane catchment origin.

There are several likely key sources of SRP within the catchment:

- Domestic foul water sources that are misconnected into the surface water drainage system. Note that (a) maybe 3 to 5 per cent of London's houses contain such misconnections and (b) there are at least 150 surface water outfalls into the river system
- Shared man-holes that contain pipes for both foul and surface water drainage systems and can cause crossover flows to the river following sewer blockages or storm events
- Conventional combined sewer overflows may also be a contributory factor. Although there are only three permitted CSOs in the catchment, there may be others that are unknown and unpermitted

There are not as yet sufficient SRP data points to establish whether a disproportionate increase in SRP is being recorded between 2 monitoring sites. The analysis undertaken by the project team is however to be extended by the EA who will input these data to their Source Apportionment GIS (SAGIS) modeling tool to further understand contributions of P to the river loading.

Concentrations of ammoniacal N and sulphate have also been recorded in all water samples collected by Citizen Scientists. These data have not been included in this interim report for the sake of brevity. The data have though already been used to identify specific pollution spikes and it is anticipated that – as the data sets increase and academic inputs develop – further findings will be derived from these data.

Unlike the RMI methodology there are no trigger levels set within the framework of this project element. The formation of a steering group has provided open channels of communication between the project team and key stakeholders in the EA and TW and salient information picked up during preliminary data analysis has been passed on for further investigation. As an example, consistently high concentrations of ammoniacal N at site 4 have been recorded, leading to Thames Water investigating and identifying misconnections in the area. The same site also shows very low RMI scores, with no invertebrates being recorded on one occasion.

### 5.3 Public engagement and outreach

Public engagement is a key theme of Citizen Crane. Members of the public often stop and talk to the teams as they collect their data during the weekend. Young children are particularly interested in the invertebrate samples. To this end promotional materials have been produced, including banners for sites when volunteers are at work and a publicity leaflet –included as Appendix C. Around 1000 of these have been distributed to date.

Members of the public often show an interest in the project and appreciate the value of monitoring the

river's water quality. There is a particular interest in whether fish are going to return to the river. Teams have also recruited additional team members through this engagement process. It has also allowed wider messages regarding pollution reporting and misconnections to be disseminated.

The demographic of Citizen Scientists includes:

- Long-term volunteers with an environmental interest( see list of partnership organisations involved)
- Those with a specific fishing interest (Thames Anglers' Conservancy)
- Employees and volunteers with several third sector organisations (and in two cases council employees)
- Students and others with an academic interest
- New volunteers attracted through local publicity

A total of 22 citizen scientists had been through the training programme by May 2015 (with a further course provided on 30th May). The actual numbers within the programme exceed this however, with between three and seven volunteers supporting each site. The cross fertilisation between these volunteers, and the exchange of information and ideas about the river, are further benefits of the project.

### 5.4 University links

Strong links with the local academic community have played a key role in the project since the start of the feasibility study in late 2013. Table 5 below shows how locally based academic institutes have been contributing to the project.

**Table 5: academic involvement in the project**

| Institute | Contribution |
|---|---|
| St Mary's University | Plotting phosphorus data and contributing to the analysis and interpretation of results |
| St Mary's University | Project development and development of papers around Citizen Crane project |
| St Mary's University | Contribution of scientific equipment to help support detailed and accurate data collection at monitoring sites |
| St Mary's University | Co-ordination of academic steering group based on research in the Crane catchment. |
| St Mary's University | Inclusion of Citizen Crane in funding bid for monitoring equipment |
| St Mary's University | Several students working with the data |
| Kingston University | Project development, contribution to discussion of results |
| Kingston University | Prospective PhD project based on the chemical analysis of effluent from outfalls in the Crane Catchment |
| Kingston University | At least two students working with and adding to the data set |
| Brunel University | Development of at least two projects focused on pollutant footprint in sediment from outfalls. |
| Brunel University | Contribution and development of academic steering group |

There is also interest and support for the project at Royal Holloway and Harrow College.

### 5.5 Research work

The development of a strong coordinated research led academic partnership on the Crane is a key potential area of benefit. Peer-reviewed papers are anticipated from this project data set, focused on the Crane, and with outcomes transferable to other urban catchments. It is anticipated that these academic

institutions can also play a key role in developing and coordinating wider research activities in the Crane catchment.

## 6. Future Plans

Both RMI and phosphorus monitoring are moving into their second year of sampling across the catchment. During year 2, and as the data set grows, the Citizen Crane project team and key stakeholders will seek to gain more from the analysis and interpretation of results linked to the phosphate and RMI projects as well as expanding the project in the following ways:

- **Additional monitoring sites:** Brazil Mill is the latest addition to the Citizen Crane monitoring sites and will be undertaking RMI methodology from June 2015. Investigations are also in hand to add further sites at the base of the lower DNR and the River Crane
- **Outfall monitoring:** a pilot project to review the viability of an outfall monitoring programme across the catchment is currently underway. The methodology is being tested at 3 monitoring sites with a total of around 30 outfalls being monitored
- **Urban River Survey:** a 2 day training course was undertaken on the Crane involving academia and the CC monitoring network. There are now Citizen Scientists trained in assessing geomorphology according to the URS framework. A catchment wide URS is currently being undertaken through the CVP and this could play an important role in evaluating any geomorphological influences on RMI for each site
- **Diatom Analysis:** Diatoms are key indicators of aquatic health and as such are a key assessment criterion under WFD. Collecting information on diatoms involves professional and academic expertise and provides an opportunity for volunteers to become involved in a different type of sampling. Initial work has started on this aspect
- **Detailed temporal SRP monitoring:** the Citizen Crane project is currently in discussions with a supplier and the EA to deploy a monitoring device capable of taking an SRP reading at 15-minute intervals for several days/weeks. The deployment will identify any short-term variations in SRP levels that current temporal resolution of sampling may not be recording

## 7. Conclusions

This report sets out the findings of the first year of a Citizen Science project on the River Crane in west London.

The development of a network of volunteers to monitor 11 sites across the catchment has proceeded very successfully with 22 citizen scientists trained to May 2015.

The data sets appear to be of good quality and robust nature. The citizen science teams are enthusiastic and supportive of the project. The project has helped to foster a greater sense of ownership and interest in the river within the network and, through public engagement, with the wider community.

The active support of TW and the EA, plus the engagement through the CVP, has been essential to the successful delivery of the project.

The project has already enabled the identification of three specific pollution incidents and reported these to the EA and TW such that remedial actions have been undertaken.

The project has developed good relations with several local academic institutions and these are generating benefits for this project and the wider objectives of the CVP.

There is an increased understanding of the temporal and spatial variations in RMI invertebrates and phosphorus across the catchment. This is likely to develop further with a second year of monitoring scheduled. It is anticipated that this improved understanding of the catchment workings will greatly aid the optimisation of catchment improvement measures as the project moves forwards.

The project has helped to spawn investigations into related issues such as: outfall monitoring; diatom monitoring; Urban River Surveys; and short term variations in P concentration at a site.

Locally focused decision making and positive community action are at the heart of the WFD. Well designed citizen science projects can help provide the evidence needed to underpin local decision making and will strengthen relationships between the statutory agencies and trained volunteer groups within catchment partnerships.

With proper encouragement and support, this network of citizen scientists can be a major long-term asset for the Crane Valley Partnership and the River Crane.

Appendix A: **Stage 1 Phosphorus report, Executive Summary - key findings**

- A Citizen Science approach to the Phosphorus Project is both practical & feasible and will bring an increased value to the outcomes of the project.
- Creating a well-resourced water quality monitoring network on the River Crane that combines Citizen Scientists, Academia, Volunteer Groups, and Professional Services, key Stakeholders from the Private Sector and the Regulator is of practical benefit to meeting targets set out under the Water Framework Directive (WFD).
- There is willingness on the part of a wide range of stakeholders covering all sectors to devote time and resources to the success of the project (as summarised in appendix 1).
- Stage 2 of the project cannot be delivered without the support of the private sector to assist with coordination and delivery during the first 12 months.
- Costs in the first 12 months of the project (phase two) include a considerable input to develop and test the methodology and set up and train the large volunteer and academic project team. The annual costs of ongoing monitoring have not been calculated as yet, but are likely to be substantially lower. Long-term partnerships and funding are being planned that will ensure the longevity of the project.
- Data review has shown that a typical phosphate concentration in the Crane, from Environment Agency (EA) data, is between 0.3 and 0.5mg/l and that a major historic source of phosphate loading is likely to be from the River Colne via the DNR.
- Positive Engagement with the Zoological Society of London (ZSL) and third sector organisations such as Thames21 has revealed opportunities to share resources and to cross-pollinate and promote projects. The prospect of joint Citizen Scientist training days and sharing of sampling points on the River Crane is also a practical benefit. This should lead directly to resource efficiencies being found and a more joined up approach to water quality investigation on the River Crane. The Phosphorus Project is open to new partnerships being formed with other organisations in the quest for delivering value and efficiency with the resources available.

**Appendix B: Recording form for water sample collection and flow monitoring**

**Citizen Science, River Crane Water Quality Monitoring**

*Thank you for taking part in this Citizen Scientist programme to measure and monitor water quality in the River Crane.*
*The Health & Safety of Citizen Scientists when they are working in the field is of primary importance to this project. Before commencing any fieldwork it is important that you are familiar with the main risks associated with working around water, and how to manage your personal safety appropriately.*
*All Citizen Scientists will receive risk assessments and method statements for the tasks at hand. The success of the project depends upon these being followed, both for the accuracy of the data to be collected and the personal safety of all those involved with collecting it.*
*Thank you once again for taking part in this project, your contribution as a Citizen Scientist will help us to improve the River Crane for local communities and native wildlife.*
*Yours sincerely,*

**Rob Gray**
**Chair**
**Friends of River Crane Environment**

**Key project contact:**
**crane.monitoring@gmail.com**

**Items contained in kit**

- **blue nitrile gloves (to be used when taking water samples)**
- **Small bucket with rope attached (for collecting samples)**
- **A clipboard**
- **2 Marker Pens (for marking sample containers)**
- **Spare pens (biros)**
- **A cool bag and freezer pack (for keeping water samples cool)**
- **Thames Water sample bottles**
- **Hand sanitizer**
- **Tape measure**

**Documents contained in kit**

- **Method statement A 'collecting and storing water samples'**
- **Method statement B 'recording depth and flow rate'**
- **Risk assessment**
- **Site number and sample numbering protocol**
- **Copies of site recording form**
- **Environment Agency on missed connections, invasive species and pollution types**
- **Environment Agency notes on collecting samples**

**If any items or documents need replacing please contact project admin: crane.monitoring@gmail.com**

**Site numbering protocol**

**The samples that you collect as a Citizen Scientist will be analysed by professional technicians working in an accredited laboratory.**

**Each monitoring site has been given a number, this must be written onto every sample bottle to ensure the laboratory can return the correct results to the project administrator.**

**It is very important to clearly write the site number on the sample container with the marker pen provided.**

**The table below assigns a number to each site. Please note this clearly on every sample bottle taken from that site.**

| Site number | Site name | Organisation lead |
|---|---|---|
| **1** | Headstone Manor | Harrow Nature Conservation Forum |
| **2** | Bridgewater Fields/ Roxbourne park | Friends of Yeading Brook |
| **3** | Ickenham Marshes | Friends of Ickenham Marshes (TBC) |
| **4** | Newton Park West | Harrow Nature Conservation Forum |
| **5** | Yeading brook East | Environment Agency |
| **6** | Yeading brook meadows | London Wildlife Trust |
| **7** | Minet park | LB Hillingdon (TBC) |
| **8** | Cranford park | Friends of Cranford Park & Thames 21 |
| **9** | Donkey wood (Crane) | Thames Angling Conservancy |
| **10** | Donkey wood (DNR*) | Thames Angling Conservancy |
| **11** | Crane Park Island | LWT - Ian Mckinnon |
| **12** | Kneller Gardens/ Mill Road | FORCE & St Marys University |
| **13** | Lower DNR | TBC |
| **14** | Lower Crane (below A316) | TBC |

***Duke of Northumberland River**

**Sample pick up and sample bottle replacement**

Samples will be collected at predetermined address on the Sunday evening or Monday morning following sampling. Samples can be left outside in an agreed location. The project administrator will contact each lead organisation to confirm a pick up location.

**Method Statement A – Collecting and Storing Water Samples**

*Collecting and storing water samples correctly prior to analysis is important for recording accurate results for the project. Samples must be kept cool in the cool bag provided using the freezer pack, also provided.*

***Before leaving to your designated monitoring site ensure you have with you, or a fellow citizen scientist is bringing the following items:***

- ***Frozen freezer pack & cool bag***
- ***3 sample containers***
  - ***250ml plastic x 2***
  - ***250ml opaque plastic x 1***

- ***marker pen***
- ***disposable nitrile gloves***
- ***sample collection bucket***
- ***Point of work risk assessment***
- ***Hand sanitizer***

**step by step method**

1. **Refer to the risk assessment, is the job safe to proceed?**
2. **Fill in site assessment form**
3. **Write the site reference number onto each sample bottle**
4. **Swill the collection bucket with river water**
5. **Collect water sample using bucket and then move away from waters edge to decant the sample into containers**
6. **Fill up each of the 3 sample containers (2 x clear & 1 x opaque), collecting more water if necessary.**
7. **Place full sample containers in cool bag along with the freezer pack**
8. **Text project admin (number to be confirmed via email) when the sample is ready for collection**

*Please note: A project administrator will collect the water samples from an agreed location on Sunday evening or Monday morning following sampling. The pick up location will be agreed between the project administrator and lead organisation for each site.*

**Method Statement B - Recording depth & flow**

*Recording the height of the river & flow rate of river at the time of sampling is important as it allows this data to be combined with water quality data to calculate the nutrient loading.*
*2 orange marker posts have been set out at each monitoring site, you will use these to measure the flow rate of the river by recording the time it takes for a stick to pass between the 2 posts.*
*1 marker will also have an arrow painted in orange. You will use this to record the height of the river in relation to the top of this marker.*

*This information will then be used to calculate the volume of water flowing in cubic metres per second (cumecs).*

***Before leaving for your designated monitoring site ensure that you have the following:***

- ***Means of recording time such as a stop watch***
- ***Data collection sheet***
- ***Tape measure***

**Step by step method**

1. **Refer to the Risk Assessment, is the job safe to proceed?**
2. **Find a small stick to time between marker posts**
3. **Throw the stick into the river upstream of the upstream marker post**
4. **Record the time taken between the 2 orange marker posts**
5. **Repeat this at different distances from the bank, recording each result**
6. **Record the distance from the top of the depth marker to the water level using the tape measure provided.**
7. **Transcribe the data you collect on site and send via email to the project administrator: Crane.monitoring@gmail.com**

**River Crane water quality monitoring project**
**Site assessment Form**

*All data that is recorded on this form must be passed to the Project Administrator via email at Crane.monitoring@gmail.com*

*Please fill in the following information for every site visit:*

**1. Site name and number:**
**2. Date:**
**3. Time taken:**

**4. Table to record time taken between marker posts:**

| **Test** | **Time (seconds)** |
|---|---|
| A | |
| B | |
| C | |
| D | |
| E | |

**5. Distance from top of gauging board to water level:**

**6. Any pollution noted in water?**

**……**
**……**
**……**

**6. Any invasive species recorded?**
**…….**
**…….**

**Appendix C: Citizen Crane public leaflet**

## You can support our project as follows:

Find out more about the project
See the data collected so far at
www.cranevalley.org.uk/projects/citizen-crane.html

Offer help to your local citizen scientist team
See the map below to find them and find out what else they are doing to help the river.
Contact crane.monitoring@gmail.com with your name and interest, and noting your local site.

Find out if your house is properly connected
Pledge your support for the "Only Rain in Rivers" campaign at
www.thames21.org.uk/onlyraininrivers
Information on misconnections
www.connectright.org.uk

**Report any pollution in the river on the Environment Agency hotline 0800 80 70 60**


Crane Valley Partnership
HARROW · EALING · HILLINGDON
HOUNSLOW · RICHMOND

# The Citizen Crane Project

Volunteers on this Citizen Science project are collecting monthly information on the health and quality of the River Crane at 10 sites across the catchment. This information is being used to monitor the health of the river, identify particular pollution events and try to reduce the level of chronic pollution.

We are doing this by recording the types and numbers of key invertebrates at each river location under a national programme called the Riverfly Monitoring Initiative. These small creatures are near the base of a river's food chain and sensitive indicators of pollution. If and when the invertebrate samples show a significant reduction in numbers, this is reported as indicative of a pollution incident.

The Citizen Science team for Ickenham Marshes

A drain flowing into the River Crane, with grey staining, typical of misconnections

We are also sampling the river for phosphate pollution. Phosphate is recognised as a key pollutant in urban rivers like the Crane – and a major source of phosphate is poorly connected plumbing in domestic houses.

A large number of homes (up to 5% of the total) in the Crane catchment have misconnected plumbing, meaning that the outflow from the washing machine, shower (and even lavatory) goes into the surface water drain rather than the foul sewer, and from there straight into the river.