

## APPENDIX GA36d

### LEVEL 7 ASSESSMENT SPECIFICATION

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                      |                                                                                    |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------------------|
| Student name:                   | Alex Haddow                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Student ID number:                                   | 2006950                                                                            |
| Programme:                      | MSc Programme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                      |                                                                                    |
| Module:                         | Postgraduate Research Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                      |                                                                                    |
| Module code:                    | ACFA 7004<br>20 CREDITS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Contribution to Overall Module Assessment (%):       | 100%                                                                               |
| Lecturer:                       | Chris House                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Internal Verifier:                                   | REJ                                                                                |
| Assignment Title:               | Research Proposal & presentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Word count (or equivalent):                          | 12 min presentation plus A4 summary sheet (30%) 4,000 word Research Proposal (70%) |
| Submission deadline:            | 29 <sup>th</sup> March 2022<br>(PRESENTATION)<br>Tuesday 29 <sup>th</sup> March 2022<br>(Research Proposal Report and Ethics form)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Return date of provisional marks & written feedback: | 20/04/22                                                                           |
| Submission method:              | <p>All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.)</p> <p><b>Alternative submission method (if applicable):</b></p> <p><b>Late submission of the assessment will result in a late penalty mark.</b> Penalties for late submission: Up to one week late, maximum mark of 50%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.</p> |                                                      |                                                                                    |
| Academic honesty / referencing: | <p>Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.</p>                                                                                                                                                                                                                                                                                              |                                                      |                                                                                    |

## Table of Contents

|               |                                                              |           |
|---------------|--------------------------------------------------------------|-----------|
| <b>1.0.</b>   | <b>Introduction</b>                                          | <b>4</b>  |
| <b>2.0.</b>   | <b>Literature Review</b>                                     | <b>5</b>  |
| <b>2.1.</b>   | <b>Phosphates</b>                                            | <b>5</b>  |
| <b>2.2.</b>   | <b>Why do phosphates affect rivers?</b>                      | <b>6</b>  |
| <b>2.3.</b>   | <b>Where are phosphates coming from?</b>                     | <b>7</b>  |
| <b>2.4.</b>   | <b>Current Guidance Review</b>                               | <b>8</b>  |
| <b>2.4.1.</b> | <b>Determining if a development will increase phosphorus</b> | <b>8</b>  |
| <b>2.4.2</b>  | <b>Connecting to a public Wastewater Treatment Plant</b>     | <b>10</b> |
| <b>2.4.3</b>  | <b>Private Sewage Treatment Systems</b>                      | <b>10</b> |
| <b>2.5.</b>   | <b>The consequence to developers</b>                         | <b>10</b> |
| <b>2.6.</b>   | <b>The future of phosphates</b>                              | <b>11</b> |
| <b>2.7.</b>   | <b>Innovation</b>                                            | <b>11</b> |
| <b>2.8.</b>   | <b>Improving Sustainability</b>                              | <b>11</b> |
| <b>3.0.</b>   | <b>Methodology</b>                                           | <b>11</b> |
| <b>3.1.</b>   | <b>Study Design</b>                                          | <b>11</b> |
| <b>3.1.1.</b> | <b>Knowledge Contribution and Research Aim</b>               | <b>12</b> |
| <b>3.1.2.</b> | <b>Research Data</b>                                         | <b>12</b> |
| <b>3.1.3.</b> | <b>Sampling, Timescales and Location</b>                     | <b>13</b> |
| <b>3.2.</b>   | <b>Data Gathering Framework</b>                              | <b>14</b> |
| <b>3.3.</b>   | <b>Methods of Analysis</b>                                   | <b>15</b> |
| <b>3.4.</b>   | <b>Data Collection Procedures</b>                            | <b>16</b> |
| <b>4.0.</b>   | <b>Results</b>                                               | <b>17</b> |
| <b>4.1.</b>   | <b>Introduction</b>                                          | <b>17</b> |
| <b>4.2.</b>   | <b>Body</b>                                                  | <b>17</b> |
| <b>4.3.</b>   | <b>Concluding Summary</b>                                    | <b>17</b> |
| <b>5.0.</b>   | <b>Evaluation</b>                                            | <b>18</b> |
| <b>5.1.</b>   | <b>Impacts</b>                                               | <b>18</b> |
| <b>5.2.</b>   | <b>Limitations</b>                                           | <b>18</b> |
| <b>5.3.</b>   | <b>Weaknesses</b>                                            | <b>18</b> |
| <b>6.0.</b>   | <b>Project Timeline</b>                                      | <b>18</b> |
| <b>7.0.</b>   | <b>References</b>                                            | <b>19</b> |
| <b>8.0.</b>   | <b>Appendices</b>                                            | <b>22</b> |
| <b>8.1.</b>   | <b>Appendix 1</b>                                            | <b>22</b> |

**Title**

Phosphates in UK rivers: the impacts of phosphates within the UK river systems and how tighter phosphate targets are impacting developments and the planning process throughout the Wales.

**A Research Proposal Submitted by**

**Alex Haddow**

**Student Number: 2006950**

**Email: alex.haddow9@gmail.com**

**Proposed Supervisor: TBC**

**University of South Wales Trinity St David**

**March 2022**

## 1.0. Introduction

Guidance provided by the Joint Nature Conservation Committee has resulted in Natural Resources Wales (NRW) further investigating its conservation objectives. NRW has subsequently investigated nine rivers in Wales, utilising three years of water quality data, which was drawn from the NRW database. The rivers investigated were all within special areas of conservation (SAC).

During the testing phase it was discovered that 61% of samples taken failed the water body assessment. A table of sampling has been provided within appendix 1. The concerning data sparked a reaction from NRW and led them to subsequently update their phosphorus targets for Welsh SACs Hatton-Ellis TW (2021).

Phosphates are an anion made up of oxygen and phosphorus and can be expelled both by fertilisers and wastewater. As phosphates enter the watercourse and increase the level of nutrients, plant and animal life can be hindered. Smith (2009) states that this over-enrichment of rivers with nutrients is known as Eutrophication. Eutrophication can lead to algal bloom, oxygen depletion and dead zones Wallingford (2022).

With household foul waste being a large contributing factor to the increase of phosphates within rivers, new build projects are currently at a stand still with the stalling of planning applications seen throughout Wales Loader (2021). This problem is directly linked to the current restrictions on new developments that were implemented by NRW back in May 2021.

At present the recently implemented guidance has been published with little to no guidance or solution for new developments. Councils such as Carmarthenshire County Council (2021) have stated that until further guidance is received, they are unable to determine many planning applications. Carmarthenshire Council are not alone with this problem with many Welsh local authorities seeing similar issues.

As stated above with the current guidance being recently implemented, little to no guidance by NRW has been published to assist developers to find a solution that mitigates the

increasing phosphates within welsh rivers. This is causing direct implications to clients, contractors and developers throughout wales.

### **Aim**

The aim of the research is to utilise the knowledge and experience of professionals within the built environment to provide available options to mitigate the impacts of phosphates in UK rivers.

### **Objectives**

The research will fully investigate current literature and investigate the situation and issues faced by key stakeholders within the built environment. The literature review will provide a background to the current phosphate issue and why the current guidance has been implemented. Alongside this the challenges that the guidance has caused to new build projects across Wales. A research methodology will also be implemented to source primary data from individuals working within the constraints of the guidance. The primary data will be used to understand the various challenges faced within the industry and provide potential mitigation option by professionals within their field.

The research will assist with the key decision-making process for developers and clients to overcome the current planning stoppages and alleviate the pressures local councils. The objective of the research is to provide an overview of the potential options that are currently available and to scrutinise the functionality and suitability for developers and clients.

## **2.0. Literature Review**

### **2.1. Phosphates**

Phosphates are a chemical compound formed from the chemical element phosphorus. Phosphorus is a naturally forming element that is found on earth in many compound forms. Phosphorus is a very important nutrient for all animals and plants and is primarily found within plants and animal DNA. Phosphorus naturally moves through a cycle within the environment. Starting within rocks and released through rainfall, the element finds its way into soil which are consumed by animals and released when the animal dies and decays. The

element is then mineralised by the soil and can subsequently find its way into the watercourse and eventually oceans. Sciencelearning.org (2013), PFA (2020), OCP Group (2021). Phosphates are the most common mineral within the Phosphorus family and is found within the natural environment. Phosphates can be found in igneous, metamorphic and sedimentary rocks and in soils Jones (2021).

The global phosphorus cycle is made up of four major factors. Firstly, tectonic uplift. Secondly, physical erosion and chemical weathering. Thirdly, the transportation of phosphorus to lakes and oceans via river systems and lastly the burial of phosphorus back into the ocean floor Ruttenberg (2001). This cycle has been continuously active for millions of years and provides natural nutrients for plant and animal growth throughout the world.

## 2.2. Why do phosphates affect rivers?

Excessive phosphorus enrichment within rivers can have detrimental affects on plant life. The over enrichment can lead to an unbalance ecosystem for plants and can eventually lead to degrading of rivers. To minimise to long term affects, concentrations of phosphorus need to be reduced. Mainstone (2002).

The above concerns were raised by Mainstone as far back as 2002. This would suggest that the rivers within the UK have suffered with Eutrophication for 20 years. Questions must be raised to why it has taken NRW this long to implement changes to their guidance. Alongside this why the guidance has caused so much disruption to developments within the Wales. Suggestions may be raised that the action was reactive rather than proactive.

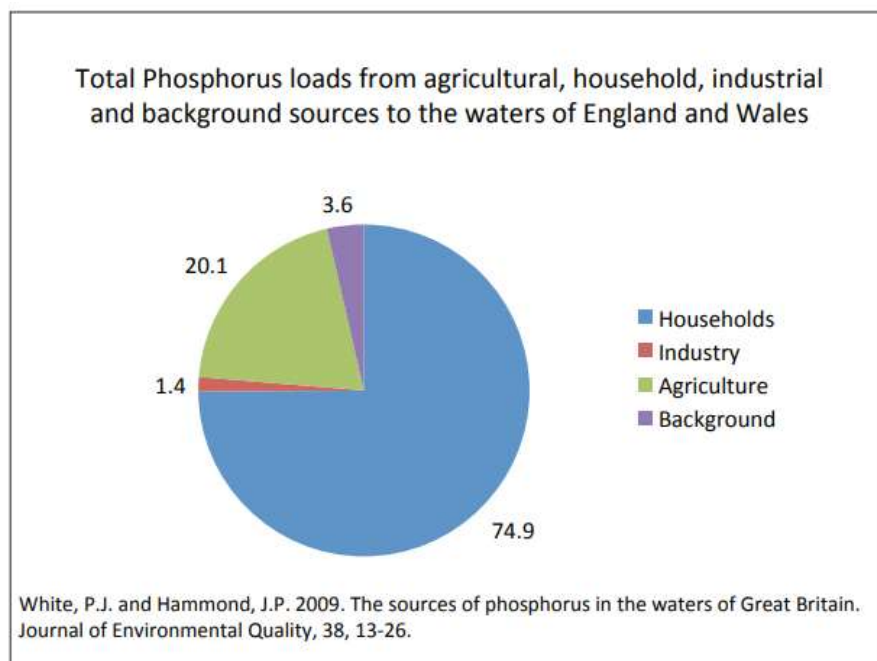
The Department for Environmental Food and Rural Affairs (2020) suggests that Eutrophication occurs when excessive nutrients are delivered to an ecosystem via pollution. This increase can result in decreased biodiversity. The above statement was initially describing air pollution, but the principles of Eutrophication remains the same for air and water.

The increase of phosphorus in rivers is directly linked to human activities with a projected annual production of phosphates hitting 53 million tonnes in 2012 alone Cederberg (2012). Much of the phosphorus produced finds its way into fertilisers and animal feed. Cederberg (2012) states that the production and consumption of food is thereby almost certainly responsible for the phosphorus problem.

As stated above the increasing phosphate issue within rivers has been identified for many years via several sources. Although NRW must act to provide a viable framework to reduce phosphates their rushed approach has caused significant issues for local planning authorities and developers across the UK.

### 2.3. Where are phosphates coming from?

A recent study carried out by the Environmental Agency and the NFU (2019) suggests that 5% of phosphate deposition occurs naturally. But the majority share coming from human activity. The below chart indicates that 74.9% comes directly from households and 20.1% from agricultural activities.



With the above chart in mind it is easy to see why NRW have implemented the recent guidance to minimise phosphate deposition from new build projects within Wales. The main issue

not being the guidance but the lack of direction for new developers to fulfil the requirements of the guidance.

## 2.4. Current Guidance Review

### 2.4.1. Determining if a development will increase phosphorus

The current guidance provided by NRW is directed at planning authorities and affects planning applications that have the potential to affect river SAC's, in particular rivers with poor phosphorus water quality. It is suggested that planning applications should be considered on a case by case basis NRW (2021).

The NRW (2020) also suggests that developments are screened to determine if they are likely to have a significant impact. Developments with the below criteria will be deemed to not influence phosphorus levels: -

- Developments that do not increase the volume of foul water.
- Developments that improves the existing water quality discharged.
- Provides sewage treatment with a maximum discharge rate of two cubic meters per day based on BS 6297:2007. Developments should also be located more than 40m from any surface water feature and located more than 50m from a SAC boundary.

Many if not all new developments will inevitably increase the volume of foul water. Reading into the guidance it is believed that the developments that improve the existing water quality is directed at refurbishment projects whereby the water production is reduced by installing more water efficient systems within the building thus improving water quality.

It is believed that the two cubic meters is derived from the 'General Binding Rules: small sewage discharge to the ground' guidance published by the Environmental Agency (2021). This has not been confirmed by NRW. Two cubic meters equates to roughly 2000 litres of water per day that can be discharged to ground via a septic tank or small sewage treatment plant.

The above information is provided for local authorities, but no information has been given to developers that fall outside of the above criteria. This is causing a backlog of planning applications as both the planning authorities and developers are stuck with no solution.

Other calculations provided by alternative published documents highlight a varying degree of measurements that can be used to provide estimates of usage.

British Water Flows and Loads suggests that a five-bed house equates to 1.05 cubic meters of water discharge per household (max 7 persons). British Water Flows and Loads (2013). This would suggest that a development over two five bed properties will fall outside of the target and will be unable to obtain satisfactory planning permission. Within the same code for office / factory units without a canteen are deemed to expel 50 litres per person per day and with a canteen 100 litres per person per day.

Without a canteen – 40 staff X 50 litres = 2000 litres per day (2.0 cubic meters)

With a canteen – 20 staff X 100 litres = 2000 litres per day (2.0 cubic meters)

The above calculations suggest that many newly developed office blocks and factory units will also fall outside of the NRW phosphate target.

Building Regulations Part H (2010) suggests that for a single dwelling, a flow rate of 2.5 litre per second. This would equate to 216 cubic meters of discharge per day. As can be seen by the above calculation there is a large disparity between calculations and methodology behind the analysis of water volumes.

BS EN 10256-2:2000 Gravity drainage systems inside buildings takes the flow from the various items within the system and determines the overall discharge rate. This option provides a more scientific method for calculating projected flow rates for new developments.

The disparity in methods for flow rate calculations is a real concern to developers and clients. NRW need to provide clarity on the method to ensure continuity within all planning applications being provided to local authorities.

### 2.4.2 Connecting to a public Wastewater Treatment Plant

For developments that have the capability to connect to a public wastewater treatment plant it is suggested that the treatment plant is assessed to determine if the additional wastewater load can be effectively treated. If deemed sufficient it is suggested that the development will be unlikely to increase phosphorus loads. NRW (2021).

Developments that plan to connect to a public wastewater treatment plant that does not have adequate phosphate cleaning capabilities will also not be considered by planning and will fall outside of the NRW targets.

### 2.4.3 Private Sewage Treatment Systems

For developments that are prohibited by cost or practicality, a sewage treatment plant may be adopted. Developments should first consider connecting to a public sewer but if this is not feasibly a package sewage treatment plant can be considered. Where this is also not feasible a septic tank option should be adopted as the last consideration. NRW (2021).

For developments considering private sewage treatment plant a further Habitat Regulation Appraisal is needed to determine if a development is likely to significantly affect a site of European habitat Importance. The appraisal is also used to provide planning authorities with a statement of phosphate loads and a future guarantee that the development will not contribute to further phosphate increases in the local area. This assessment is to be carried out in line with planning applications NatureScot (2021), Turner (2021). This additional assessment has caused significant delays to planning applications across the UK.

## 2.5. The consequence to developers

With over 60% of welsh waterbodies falling within the tighter targets its clear that the majority if not all planning authorities will be experiencing issues with planning applications. Carmarthenshire County Council (2022) have stated that until further guidance has been published, they are unable to determine some applications. This is due to the ambiguity surrounding the measuring and mitigating techniques that are deemed acceptable.

## 2.6. The future of phosphates

Outside of Wales the environmental agency has produced a paper outlining potential future solutions for phosphates and rivers.

## 2.7. Innovation

Through the National Environmental Programme (2014) water companies investigated applications of new methods for the removal of phosphates within wastewater. These tests are helping to determine which technologies are suitable for the UK. Focus has turned to new technologies whilst also making best use of existing technologies. Environmental Agency (2019).

## 2.8. Improving Sustainability

Consideration should be given to the source of the phosphates that are being expelled by humans via wastewater. A more sustainable approach to fertiliser use and phosphate use in human food will elevate pressures of over enrichment. The Environmental Agency (2019) stated that it wishes would explore this further with government, sector groups and other stakeholders in managing Phosphates for the future.

## 3.0. Methodology

This section will outline the specific procedure that will be undertaken to collect the topic specific data. Also outlining the various options available and the full justification for the chosen approach.

## 3.1. Study Design

This section will cover the study design. The study design is seen to be very important to the success of the project. This section will cover the process whereby the trial methodology and statistical analysis is organised to ensure that the null hypothesis is either accepted or rejected Parab (2010).

### 3.1.1. Knowledge Contribution and Research Aim

The aim of the research is to utilise the knowledge and experience of professionals within the built environment to provide available options to mitigate the impacts of phosphates in UK rivers. The below section will investigate the various study design options to provide a systematic approach to gathering the relevant data.

#### **Basic vs Applied**

Basic research is the process of developing knowledge, theories and predictions. Whereby applied research aims to develop techniques, products and procedures Scribd (2021).

#### **Exploratory vs Explanatory**

Exploratory research aims to explore the main aspects of an under-researched problem, while explanatory research aims to explain the cause and consequence of a well-defined problem Scribd (2021).

#### **Indicative vs Deductive**

Indicative research aims to develop and theory whereby deductive research aims to test a theory Scribd (2021).

The research will aim to develop further knowledge whilst also exploring the main aspect of what is the under researched problem of the recently published NRW phosphate targets. For this reason, the research will generally adopt a basic exploratory aim.

### 3.1.2. Research Data

**Primary Data vs Secondary Data** - Primary data refers to the first hand gathering of data by the researcher. Whereas secondary data is utilising other research gathered by others to inform the study Wagh (2015).

**Qualitative Data** is defined as information gathering via observations or questions to individuals or groups. This form of data gathering typically can't be measured in any meaningful way via numbers Study.com (2021).

**Quantitative Data** is any set of information that can be numerically recognised and analysed. Data sets are typically in the form of graphs, charts or statistics Hiter (2021).

The research method option that will be utilised for this paper will be primary qualitative data. The research relies upon the opinions of specialists within their field to provide primary data of their thoughts and challenges faced whilst also providing potential mitigation options to the current issue.

### 3.1.3. Sampling, Timescales and Location

**Non-probability sampling** will be utilised for this study. This will eliminate the random selection of interviewees and allow for individuals to be considered based on their knowledge and understanding of the subject matter. This is opposed to probability sampling which allows for random selection of subjects Howard (2019)

**Cross-sectional** sampling will be utilised to gather data at a single point in time. Interviews will take place over a period of two weeks and will reflect the knowledge and understanding of the subjects to date. This is opposed to longitudinal sampling which gathers data at certain points in time Scribd (2021).

**Fixed** design research will be used to ensure the design study is fixed prior to the gathering of data. Interview questions will be set and tested prior to undertaking the interviews. This is opposed to flexible research which allows for more fluidity during the data gathering exercise Scribd (2021).

### 3.2. Data Gathering Framework

With the research method following a qualitative process the data gathering framework will reflect the route to best suite the project deliverables and outcomes.

The process that will be followed will include but not limited to: -

- Interview Style

Semi-structured Interviews will be used to collect the data. This will allow for open ended discussions that allows participant to provide an in-depth insight into the problem but within a structured pre-existing plan. British Government (2020).

- Subject Selection

Subject selection will be based upon their link to the subject matter for example project developers, planning consultants, local planning authorities, client and NRW representatives. By including multiple participants, the data should provide an overview from multiple viewpoints within the industry.

- Question Preparation and Testing

To ensure the relevant questions are selected for the final interview stage a three-phase process will be adopted: -

- Phase One – Draw up draft questions (no limit)
- Phase two – Shortlist 10-15 questions. Shortlisted questions to be tested for suitability via a mock interview.
- Phase three – Final selection of question. Max 10 questions.

- Subject Interview Brief

A full interview agenda and briefing pack will be delivered to each participant via email. This pack will give a background and context to the study allowing participants time to consider their response ahead of the interviews.

- Physical Interviews with Subjects

Where possible interviews will be carried out via Microsoft Teams. This will reduce the impacts to participants. The interviews will all be carried out within a 2-week timeframe that will be decided based on the completed project timeline.

### 3.3. Methods of Analysis

**Content Analysis** is the systematic approach of analysing qualitative data in the form of communicative messages. The messages are analysed for content and meaning to provide definition, process and limitations of the research Allan (2017).

**Narrative Analysis** refers to the cluster of analytical methods for deciphering texts of the storied kind. The aim of the activity is to analyse the interviewees responses in a variety of contexts which are supported by their varying experiences Pedamkar (2021).

**Discourse Analysis** is a field of research composed of multiple heterogeneous, largely qualitative, approaches to the study of relationships between language-in-use and the social world Johnson (2020).

**Framework Analysis** is the process of setting out analysis parameters either prior or during the data collection phase. In the analysis stage the gathered data is sifted, charted and sorted in accordance with key issues and themes Srivastava (2009).

This involves a five-step process:

- 1.0. Familiarisation
- 2.0. Identifying a thematic framework
- 3.0. Indexing
- 4.0. Charting
- 5.0. Mapping and interpretation

**Grounded theory** is a research method concerned with the generation of theory, which is 'grounded' in data that has been systematically collected and analysed. It is used to uncover

such things as social relationships and behaviours of groups, known as social processes. Noble (2016)

The chosen method of analysis for the predicted research is narrative analysis. By utilising narrative analysis, the captured data will be deciphered for commonality, themes and limitations, also utilising the knowledge and experience of professionals within their field to provide a rounded approach to the data. This approach refers to the cluster of analytical methods for deciphering texts of the storied kind. The aim of the activity is to analyse the interviewees responses in a variety of contexts which are supported by their varying experiences Pedamkar (2021).

### **3.4. Data Collection Procedures**

In order to fully capture the required qualitative data, a full recording procedure will be implemented for both online and face to face interviews. All interviews will be transcribed for analysis purposes.

#### **Location**

Option 1 – Online via Microsoft Teams

Online interviews will be scheduled via an online booking platform to ensure attendees are fully briefed on the required date and time.

Option 2 – Face to Face Interviews

Careful consideration will be given to the location of all face to face interviews. A private location will be selected that minimises disturbance.

#### **Equipment**

Option 1 – Online via Microsoft Teams

This process will include utilising Microsoft Teams recording and transcript features.

Transcripts will be checked and amended if required.

Option 2 – Face to Face Interviews

This process will include utilising a Dictaphone to record the full interview. Transcripts will then be collated at a later date.

## **Preparation**

It is imperative that the recording equipment used is tested for both location suitability and functionality prior to the interview starting. Backup recording equipment will also be used during the interviews. A full meeting agenda will be provided to all attendees prior to the meeting to provide a structure.

## **4.0. Results**

### **4.1. Introduction**

As can be seen within the literature review above, it is well known that UK rivers have an historical and ongoing problem with over enrichment of nutrients such as phosphates. The NRW has implemented targets with very limited advice. These targets have been set to ultimately lower phosphate loadings from new developments. Although the lack of guidance for both developers and local planning authorities has caused many planning applications to fall outside of the targets. This has caused a backlog in planning applications throughout the UK.

### **4.2. Body**

The purpose of this research is to fully investigate the current issue and to utilise the opinions and advice of professionals within the built environment to provide options to mitigate the current planning obstacles.

By utilising the data gathering framework mentioned above and the data capturing procedures, all data will be presented in the form of recordings and transcripts. These transcripts will be used to analyse the data for themes and commonalities. Also, through the use of semi-structured interview questions any mitigating options provided by the subjects will be analysed for suitability and functionality.

### **4.3. Concluding Summary**

The concluding summary section will be used to provide the reader with an overview of the project findings and outcomes. This section will be well isolated and provide a full concise breakdown of deliverables and future learning objectives or further research questions.

## 5.0. Evaluation

The evaluation section will investigate the potential impacts of the research, also investigating any limitations and weaknesses.

### 5.1. Impacts

The potential projected impacts are as followed but not limited to: -

- Prompting NRW to publish guidance to assist developers to correctly measure their phosphate loads.
- Provide guidance to clients and developers currently experiencing the current problem.

### 5.2. Limitations

The potential projected limitations are as followed but not limited to: -

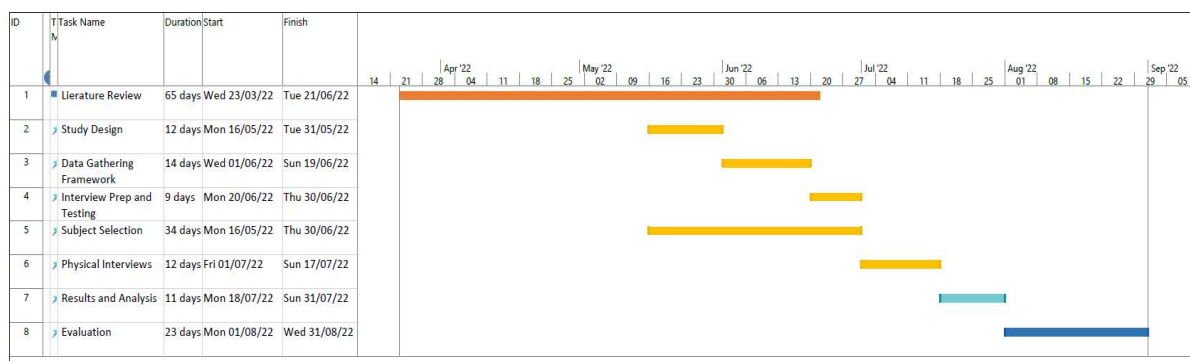
- With the NRW targets being relatively new published literature may be limited.
- Accessing professional subjects for data collection.

### 5.3. Weaknesses

The potential projected weaknesses are as followed but not limited to: -

- NRW publishing their interim guidance document prior to the completion of the study.

## 6.0. Project Timeline



## 7.0. References

A Parab and S Bhalerao. Study Design. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2924977/24977/>. Accessed on: 27<sup>th</sup> March 2022.

A Srivastava & S.B. Thomson (2009). Framework Analysis: A Qualitative Methodology for Applied Research Note Policy Research. JOAAG, Vol. 4. No. 2

British Government (2020) Interview study: qualitative studies. Available at: <https://www.gov.uk/guidance/interview-study-qualitative-studies?msclkid=53732bf8a1fa11ecb6a8b6eabfb1b0d>. Accessed on: 12<sup>th</sup> March 2022.

British Water Flows and Loads (2013). British Water Expertise Worldwide. Flows and Loads. Vol 5. PP4.

BS EN 12056-1:2000 Gravity Drainage System Inside Buildings – Part 1 & Part 2.

Building Regulations (2010) Approved Document H, Drainage and Wastewater. Vol 2. PP27.

C Howard (2019) Understanding Probability vs. Non-Probability Sampling: Definitive Guide. Available at: <https://www.cvent.com/en/blog/hospitality/understanding-probability-vs-non-probability-sampling>. Accessed on: 27<sup>th</sup> March 2022.

C Mainstone, W Parr (2002) Phosphorus in rivers ecology and management. The science and the total environment. 282. PP1-3.

Carmarthenshire County Council (2022) How new phosphate targets may impact on your development. Available at: <https://www.carmarthenshire.gov.wales/home/council-services/planning/ecology-advice/new-phosphate-targets/#.Yh9a7pLP02w>. Accessed on: 19<sup>th</sup> February 2022.

Cederberg (2012) Environmental Assessment and Management in the Food Industry. Improving nutrient management in agriculture to reduce eutrophication, acidification and climate change. Vol 1. PP2.

Department for Environmental Food and Rural Affairs (2020) Impacts of air pollution on ecosystems. Vol 1. PP 5.

E Jones (2021) Encyclopaedia of Geology. Phosphates. Vol 2. PP1.

Environmental Agency (2019) Phosphorus and Freshwater Eutrophication Pressure. Vol 1. PP4.

Environmental Agency (2021) General binding rules: small sewage discharge to the ground. Available at: <https://www.gov.uk/guidance/general-binding-rules-small-sewage-discharge-to-the-ground>. Accessed on: 19<sup>th</sup> February 2022.

Environmental Agency, NFU (2019) Tackling our Phosphate Problem. Vol 1. PP4.  
G Loader (2021) New builds in Wales 'at standstill' due to pollution targets. BBC. Available at: New builds in Wales 'at standstill' due to pollution targets - BBC News. Accessed on: 19<sup>th</sup> February 2022.

H Noble & G Mitchell (2016). What is grounded theory? Available at: <https://ebn.bmj.com/content/19/2/34>. Accessed on: 27<sup>th</sup> March 2022.

Hatton-Ellis TW, Jones TG. (2021) Compliance Assessment of Welsh River SACs against Phosphorus Targets. NRW Evidence Report No: 489, 66pp, Natural Resources Wales, Bangor.

Hiter (2021) What is Quantitative Data? Available at: <https://www.datamation.com/big-data/what-is-quantitative-data/?msclkid=48d20f5da1f311ecb4c588896eadd035>. Accessed on: 12<sup>th</sup> March 2022.

K.C. Ruttenberg (2001) Encyclopaedia of Ocean Science. Phosphorus Cycle. Vol 1. PP4.  
L Turner (2021) The trouble with phosphates in planning. Available at: <https://www.boyerplanning.co.uk/news/trouble-phosphates-planning>. Accessed on: 19<sup>th</sup> February 2022.

M Allan (2017) Content Analysis, Definition of. Sage. PP1.

M Johnson, E McLean. Disclosure Analysis. Science Direct, International Encyclopaedia of Human Geography Vol 2. PP1. Narrative. Vol 1. PP24.

NatureScot (2021) Habitat Regulation Appraisal (HRA). Available at: <https://www.nature.scot/professional-advice/planning-and-development/environmental-assessment/habitats-regulations-appraisal-hra#:~:text=Help%20and%20advice.%20Under%20the%20Habitats%20Regulations%2C%20all,that%20the%20plan%20or%20project%20will%20not%20>. Accessed on: 19<sup>th</sup> February 2022.

OCP Group (2021) What is phosphate? Available at: What is phosphate and how is it used? | OCP Group. Accessed on: 19<sup>th</sup> February 2022.

P.J. White, J.P. Hammond (2009) The source of phosphorus in the water of Great Briton, Journal of Environmental Quality, Vol 38, PP13-26.

Pedamkar (2021) What is Qualitative Data Analysis. Available at: <https://www.educba.com/what-is-qualitative-data-analysis/>. Accessed on: 12<sup>th</sup> March 2022.  
PFA (2020) What are phosphates. Available at: WHAT ARE PHOSPHATES | PhosphateFacts (phosphatesfacts.org). Accessed on: 19<sup>th</sup> February 2022.

Sciencelearn.org (2013) The phosphorus cycle. Available at: <https://www.sciencelearn.org.nz/resources/961-the-phosphorus-cycle>. Accessed on: 19<sup>th</sup> February 2022.

Scribd (2021). Understanding Types of Research. Available at: <https://www.scribbr.com/methodology/types-of-research/#:~:text=Types%20of%20research%20data%20%20%20Type,Do%20you%20want%20to%20identify%20characteristics%2C%20...%20>. Accessed on: 27<sup>th</sup> March 2022.

Study.com (2021) Qualitative Data: Meaning and Examples. Available at: <https://study.com/learn/lesson/what-is-qualitative-data-examples.html?msclkid=e70221a3a1f111ec95fe115e6cf22083>. Accessed on: 12<sup>th</sup> March 2022.

V.H Smith (2009) Eutrophication. Science Direct. Available at: Eutrophication - an overview | ScienceDirect Topics. Accessed on: 19<sup>th</sup> February 2022.

Wagh (2015) Public Health Research Guide: Primary & Secondary Data Definitions. Available at: <https://researchguides.ben.edu/c.php?g=282050&p=4036581>. Accessed on: 12<sup>th</sup> March 2022.

Wallingford (2022) Focussing of Phosphates. Available at: Focusing on phosphates - WHS (hydrosolutions.co.uk). Accessed on: 19<sup>th</sup> February 2022.

## 8.0. Appendices

### 8.1. Appendix 1

| <b>SAC Name</b>                   | <b>Passing</b> | <b>Failing<br/>(Episodic)</b> | <b>Failing<br/>(Consistent)</b> | <b>Not<br/>Assessed</b> |
|-----------------------------------|----------------|-------------------------------|---------------------------------|-------------------------|
| River Dee & Llyn Tegid            | 5              | 2                             | 1                               | 1                       |
| Afon Gwyrfai a Llyn Cwellyn       | 2              | 0                             | 0                               | 0                       |
| Meirionnydd Oakwoods              | 3              | 0                             | 0                               | 0                       |
| Afon Eden – Cors Goch Trawsfynydd | 3              | 0                             | 0                               | 1                       |
| Afon Teifi                        | 8              | 8                             | 0                               | 2                       |
| Afonydd Cleddau                   | 5              | 5                             | 5                               | 4                       |
| Afon Tywi                         | 2              | 0                             | 0                               | 1                       |
| River Usk                         | 2              | 7                             | 8                               | 6                       |
| River Wye                         | 14             | 11                            | 17                              | 3                       |
| <b>Total</b>                      | <b>42</b>      | <b>33</b>                     | <b>31</b>                       | <b>18</b>               |

Table 1: Summary of the overall status of Welsh SACs in relation to phosphorus targets, as number of water bodies. Hatton-Ellis TW, Jones TG. (2021)