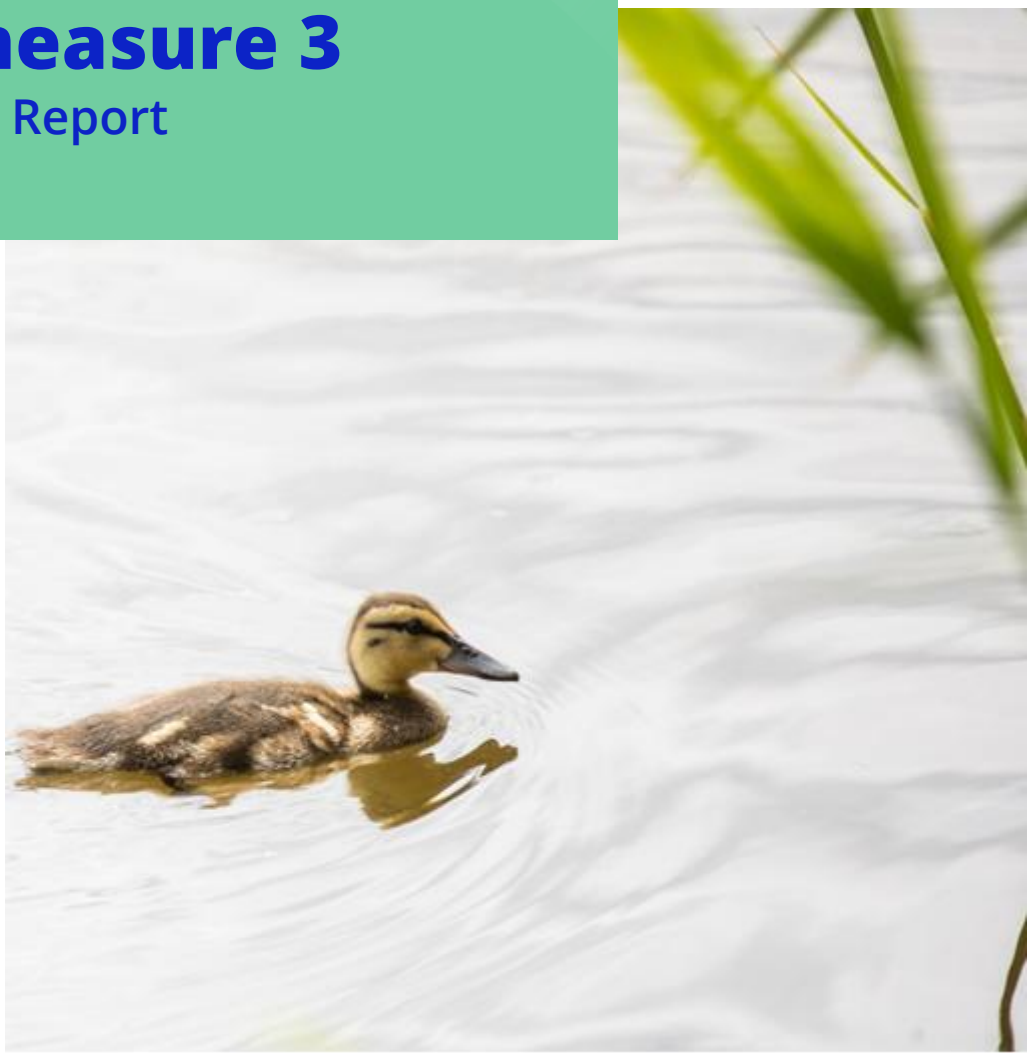
September 2025

Uisce Éireann
Irish Water

Report

# Uisce Éireann National Recovery and Resilience Plan – Sub-measure 3

## Summary Report



UÉ /FF/LDB/0323

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# Abbreviations

| Abbreviation | Description |
|---|---|
| AFA | Area for Action |
| BOD | Biological Oxygen Demand |
| cBOD | Carbonaceous Biological Oxygen Demand |
| COD | Chemical Oxygen Demand |
| CSMU | Catchment Science and Management Unit |
| DO | Dissolved Oxygen |
| ELV | Emission Limit Value |
| EPA | Environmental Protection Agency |
| EQS | Environmental Quality Standard |
| EU | European Union |
| HSO | High Status Objective |
| PE | Population Equivalent |
| RBMP | River Basin Management Plan |
| TN | Total Nitrogen |
| TSS | Total Suspended Solids |
| UÉ | Uisce Éireann |
| WAC | Wastewater Assimilative Capacity |
| WFD | Water Framework Directive |
| WWDL | Waste Water Discharge Licence |

| Abbreviation | Description |
|---|---|
| WWTP | Wastewater Treatment Plant |

# 1 Introduction

## I. Purpose of report

This document is the final report for sub-measure 3 under the NRRP Project 1.7: River Basin Management Plan – Enhanced Ambition Programme.

**Milestone 42: Final Report**

| Sequence | Measure | Name | Completion Date |
|---|---|---|---|
| 42. | Sub-measure 3 | Final Report | Q3 2025 |

## II. Background

Uisce Éireann's River Basin Management Plan Enhanced Ambition Programme is funded by the European Union under Ireland's National Recovery and Resilience Plan (NRRP). This will support the objectives of Ireland's River Basin Management Plans (RBMPs) and improve water quality in receiving waters by ensuring that Uisce Éireann assets are not impacting on the ability of receiving waters to achieve their water quality objectives under three sub-measures:

a) Sub-measure 1 – The upgrade of at least 10 Wastewater Treatment Plants (WWTPs);
b) Sub-measure 2 - completing feasibility studies for 20 WWTPs; and
c) Sub-measure 3 - undertaking effluent and water quality assessments to quantify improvements needed at these WWTPs

The three sub-measures in the Uisce Éireann proposal align with RBMP priorities, including:

d) High status objective (HSO) water bodies;
e) Area for Action (AFA) water bodies;
f) Water bodies with water-related protected area objectives; and
g) Urban wastewater significant pressures in 'at risk' water bodies.

## III. Sub-measure 3 objectives

Sub-measure 3 involves investigation and assessment work in relation to the impact of Uisce Éireann assets on receiving water bodies. This work included:

- Collation and collection of high-quality baseline data
  - Collation and gap analysis of available data.
  - Sampling and analysis of effluent quality and ambient quality and flow.
- Modelling and assessment
  - Developing a bespoke Uisce Éireann online assimilative capacity calculation tool (the Environmental Capacity Calculator (ECC) tool) to:
    - Capture available effluent and ambient data;
    - Simulate the impact of discharges on receiving waters using a modelling approach;
    - Assess available assimilative capacity in receiving waters using a risk-based approach;
    - Use the above analysis to identify appropriate WWTP Emission Limit Values (ELVs).

The information and analysis produced by the Sub-measure 3 informs both Sub-measure 1 and Sub-measure 2; and supports the achievement of RBMP objectives generally through defining and developing approaches, methodologies and capabilities around the assessment of assimilative capacity in receiving waters and the identification of appropriate emission limit values for WWTP discharges.

# IV. WWTPs

The WWTPs included in Sub-measure 1 and 2 are included in the Sub-measure 3 monitoring programme. These are listed in Table 1.

Table 1 WWTP site locations selected for effluent and ambient quality and flow sampling.

| WWTP Name | License code | WWTP Name | License code |
|---|---|---|---|
| Abbeydorney | D0417-02 | Granard | D0187-01 |
| Balla | D0216-01 | Granard | D0187-02 |
| Ballindine | D0355-01 | Kildavin | A0097-01 |
| Ballingeary | D0431-01 | Kilcoole | D0087-01 |
| Ballintra | A0294-01 | Kilcormac | D0225-01 |
| Ballitore | A0129-01 | Kilmaganny | A0155-01 |
| Ballycanew | D0402-01 | Kilkelly | D0357-01 |
| Ballymoe | A0105-01 | Killygordon | D0518-01 |
| Blacklion | D0498-01 | Millview (Milltownpass) | A0527-01 |
| Clonea Power | A0377-01 | Kilpedder | D0416-01 |
| Borrisokane | D0326-01 | Lisdoonvarna | D0077-01 |
| Castlecomer | D0149-01 | Mohill | D0277-01 |
| Cloneygowan | A0167-01 | Moycullen | D0191-01 |
| Coill Dubh | D0242-01 | Pettigo | A0461-01 |
| Colecot Cottages | A0107-01 | Mullinahone | D0456-01 |
| Dunleer | D0111-01 | Nurney | A0080-01 |
| Galbally | A0208-01 | Rathdowney | D0288-01 |
| Grangemockler | A0416-01 | Shercock | D0495-01 |

# 2 Site suitability assessment

Pre-survey site suitability assessments were undertaken to establish the suitability of ambient monitoring locations upstream and downstream of the WWTPs. This included existing and proposed monitoring locations, where multiple discharge locations were being considered in relation to a discharge. The assessments considered site suitability for both ambient and spot flow measurements, with the process including a preliminary desktop assessment in addition to site surveys.

An example of the reporting following a site suitability survey for the Kilkelly WWTP is included in Appendix 2.

Table 2 lists the ambient sites that have had site suitability assessments undertaken.

Table 2 Locations where site suitability assessment was undertaken.

| WWTP Name | Licence code | Easting | Northing | U/S & D/S of new/existing discharge point |
|---|---|---|---|---|
| Abbeydorney | D0417-02 | 86421 | 123622 | Proposed new |
| Abbeydorney | D0417-02 | 85398 | 124320 | Proposed new |
| Balla | D0216-01 | 125313 | 284386 | Existing |
| Balla | D0216-01 | 121325 | 288610 | Proposed new |
| Balla | D0216-01 | 131799 | 287931 | Proposed new |
| Ballindine | D0355-01 | 136037 | 270010 | Existing |
| Ballindine | D0355-01 | 135775 | 271566 | Proposed new |
| Ballingeary | D0431-01 | 114470 | 66712 | Proposed new |
| Ballingeary | D0431-01 | 115346 | 66791 | Proposed new |
| Ballintra | A0294-01 | 191182 | 369813 | Existing |
| Ballitore | A0129-01 | 279848 | 195717 | Existing |
| Ballycanew | D0402-01 | 315038 | 152238 | Existing |
| Ballycanew | D0402-01 | 315069 | 154958 | Proposed new |
| Ballycanew | D0402-01 | 316244 | 156222 | Proposed new |
| Ballymoe | A0105-01 | 169483 | 271734 | Existing |
| Blacklion | D0498-01 | 208309 | 338365 | Proposed new |
| Clonea Power | A0377-01 | 238469 | 114197 | Existing |
| Borrisokane | D0326-01 | 190993 | 194135 | Existing |
| Borrisokane | D0326-01 | 189533 | 193705 | Proposed new |
| Castlecomer | D0149-01 | 253593 | 171608 | Existing |
| Cloneygowan | A0167-01 | 248070 | 216205 | Existing |
| Coill Dubh | D0242-01 | 279440 | 226989 | Existing |
| Colecot Cottages | A0107-01 | 318875 | 254401 | NA |

| WWTP Name | Licence code | Easting | Northing | U/S & D/S of new/existing discharge point |
|---|---|---|---|---|
| Dunleer | D0111-01 | 305609 | 288522 | Existing |
| Dunleer | D0111-01 | 305866 | 289711 | Proposed new |
| Dunleer | D0111-01 | 306569 | 291102 | Proposed new |
| Galbally | A0208-01 | 180784 | 127758 | Existing |
| Grangemockler | A0416-01 | 235947 | 132588 | Existing |
| Granard | D0187-01 | 233374 | 279501 | Existing |
| Granard | D0187-02 | 230548 | 279685 | Proposed new |
| Granard | D0187-02 | 229485 | 280547 | Proposed new |
| Kildavin | A0097-01 | 289030 | 159747 | Existing |
| Kildavin | A0097-01 | 289902 | 159695 | Proposed new |
| Kilcoole | D0087-01 | 330757 | 207430 | Existing |
| Kilcoole | D0087-01 | 329566 | 206257 | Proposed new |
| Kilcoole | D0087-01 | 329723 | 210538 | Proposed new |
| Kilcormac | D0225-01 | 218088 | 214314 | Existing |
| Kilcormac | D0225-01 | 214976 | 214480 | Proposed new |
| Kilcormac | D0225-01 | 213542 | 218804 | Proposed new |
| Kilmaganny | A0155-01 | 245832 | 135204 | Existing |
| Kilkelly | D0357-01 | 143828 | 291491 | Existing |
| Killygordon | D0518-01 | 220271 | 394146 | Existing |
| Millview (Milltownpass) | A0527-01 | 249750 | 243889 | Existing |
| Kilpedder | D0416-01 | 326740 | 208929 | Existing |
| Kilpedder | D0416-01 | 326914 | 210391 | Proposed new |
| Kilpedder | D0416-01 | 326601 | 206531 | Proposed new |
| Lisdoonvarna | D0077-01 | 112207 | 197725 | Existing |
| Mohill | D0277-01 | 209065 | 296333 | Existing |
| Mohill | D0277-01 | 211291 | 296078 | Proposed new |
| Mohill | D0277-02 | 210246 | 293707 | Proposed new |
| Moycullen | D0191-01 | 122243 | 232874 | Existing |
| Moycullen | D0191-01 | 124586 | 229464 | Proposed new |
| Moycullen | D0191-01 | 128073 | 228078 | Proposed new |
| Pettigo | A0461-01 | 211315 | 366542 | Existing |
| Mullinahone | D0456-01 | 233649 | 139609 | Existing |
| Mullinahone | D0456-01 | 232907 | 136366 | Proposed new |
| Mullinahone | D0456-01 | 233017 | 137328 | Proposed new |
| Mullinahone | D0456-01 | 226687 | 135192 | Proposed new |
| Nurney | A0080-01 | 273339 | 167640 | Existing |
| Rathdowney | D0288-01 | 228492 | 178811 | Existing |
| Rathdowney | D0288-01 | 230022 | 177735 | Proposed new |
| Rathdowney | D0288-01 | 231684 | 177865 | Proposed new |
| Shercock | D0495-01 | 267400 | 310088 | Proposed new |

# 3 Summary of monitoring

The monitoring programme incorporates one year of monthly effluent quality and ambient quality and flow data sampling and analysis. Table 3 lists the parameters that were tested for as part of the monitoring programme. Appendix 1 provides a simplified summary example of the effluent results for the Abbeydorney WWTP.

Table 3 Effluent and ambient parameters

| Effluent parameters | Ambient parameters |
|---|---|
| pH | pH |
| Biochemical oxygen demand ($BOD_5$) | Dissolved oxygen |
| Chemical oxygen demand (COD) | Temperature |
| Total Ammonia ($NH_3$-N) | Conductivity |
| Suspended solids | Biochemical oxygen demand ($BOD_5$) |
| Orthophosphate ($PO_4$-P) | Chemical oxygen demand (COD) |
| | Total Ammonia ($NH_3$-N) |
| | Suspended solids |
| | Orthophosphate ($PO_4$-P) |

The monitoring programme was completed at all sites in Q4 2024.

## I. Effluent data

Table 4 below highlights the total number of samples taken within the monitoring programme.

Table 4 Summary of the total number of effluent samples taken for each WWTP.

| WWTP | Number of samples taken at present | WWTP | Number of samples taken at present |
|---|---|---|---|
| Abbeydorney | 12 | Kilcoole | 12 |
| Balla | 11 | Moycullen | 11 |
| Ballindine | 11 | Kilcormac | 12 |
| Ballingeary | 12 | Kildavin | 12 |
| Ballintra | 12 | Kilkelly | 12 |
| Ballitore | 12 | Kill | 12 |
| Ballycanew | 12 | Mohill | 11 |
| Ballymoe | 11 | Killygordan | 11 |
| Ballynoe | 12 | Kilmaganny | 12 |
| Blacklion | 9 | Kilpedder | 12 |
| Borrisokane | 12 | Lisdoonvarna | 12 |
| Castlecomer | 12 | Millview | 12 |
| Clonea Power | 12 | Mullagh | 12 |
| Cloneygowan | 12 | Mullinahone | 12 |
| Coill Dubh | 12 | Nurney | 12 |
| Colecott Cottages | 12 | Pettigo | 12 |
| Dunleer | 12 | Portlaoise | 12 |
| Emyvale | 12 | Shercock | 12 |
| Galbally | 12 | Skibbereen | 12 |
| Granard | 12 | Tinahely | 12 |
| Grangemockler | 12 | Rathdowney | 12 |

| WWTP | Number of samples taken at present | WWTP | Number of samples taken at present |
|---|---|---|---|
| Tulla | 12 | | |

# II. Ambient data

Table 5 below highlights the total number of samples taken within the monitoring programme.

Table 5 Summary of the total number of ambient samples taken for each WWTP.

| WWTP | Number of samples taken | WWTP | Number of samples taken |
|---|---|---|---|
| Abbeydorney | 42 | Kilcoole | 64 |
| Balla | 66 | Kilcormac | 68 |
| Ballindine | 44 | Kildavin | 51 |
| Ballingeary | 42 | Kilkelly | 24 |
| Ballintra | 24 | Kill | 24 |
| Ballitore | 24 | Killygordan | 24 |
| Ballycanew | 64 | Kilmaganny | 24 |
| Ballymoe | 22 | Kilpedder | 64 |
| Ballynoe | 24 | Lisdoonvarna | 24 |
| Blacklion | 20 | Millview | 24 |
| Borrisokane | 48 | Mohill | 46 |
| Castlecomer | 24 | Moycullen | 54 |
| Clonea Power | 24 | Mullagh | 24 |
| Cloneygowan | 24 | Mullinahone | 86 |
| Coill Dubh | 24 | Nurney | 22 |

| WWTP | Number of samples taken | WWTP | Number of samples taken |
|---|---|---|---|
| Colecott Cottages | 24 | Pettigo | 24 |
| Dunleer | 66 | Portlaoise | 24 |
| Emyvale | 22 | Shercock | 24 |
| Galbally | 24 | Skibbereen | 22 |
| Granard | 69 | Tinahely | 24 |
| Grangemockler | 22 | Rathdowney | 64 |
| Tulla | 24 | | |

# 4 ECC tool

Uisce Éireann has statutory obligations to assess the impact of its wastewater discharges on the receiving water environment to support its activities including investment planning, regulatory compliance, wastewater licencing, and river basin management planning.

Uisce Éireann routinely undertakes assessments of the impact of wastewater discharges on the receiving water environment, in line with its statutory obligations.

The introduction of standardised tools to apply existing methodologies would significantly improve the consistency and transparency of these assessments. The ECC tool offers a scalable, systematic approach that can be rapidly applied across multiple sites. Its development helps different parts of the business to work from the same reliable and consistent evidence base when evaluating the impact of wastewater discharges on the receiving water environment. This leads to better decision-making and reduces duplication of effort; which supports improved alignment across programmes and enables more targeted and effective investment.

The tasks involved in the delivery of the ECC Tool are outlined in Table 6.

Screengrabs illustrating the form and function of the tool are presented in Appendix 3.

An example output report, including the results of the calculations, is included in Appendix 4.

Table 6 ECC Tool delivery tasks

| | Task | Description |
|---|---|---|
| 1 | Procurement of technical support | Procurement of external technical support to develop a bespoke Uisce Éireann tool to calculate simple mass balance and Monte-Carlo analysis. |

| | Task | Description |
|---|---|---|
| 2 | Scoping workshops | Establishment of a core project team internally. Undertake scoping workshops to outline the data, IT systems, and end-user requirements and limitations with respect to tool development and the gathering of data to populate the tool. |
| 3 | Tool development | Development of a bespoke Uisce Éireann Monte-Carlo simulation tool with the capability of assessing the impact of discharges on river receiving water bodies using both simple mass balance and Monte-Carlo approaches, determining available assimilative capacities in receiving river water bodies and facilitating determination (in accordance with Uisce Éireann's interim Water Quality Impact Assessment (WQIA) Guidelines) of appropriate emission limit values for primary discharges to rivers. Screengrabs from the tool are presented in Appendix 3. |
| 4 | Data ingestion | Identification of gaps in the data (effluent data, ambient data, and riverine flows) required to undertake tool simulations. Preparation of a scope of works required to fill the data gaps, including publication of sites selected for sampling and analysis. Establishment of data mart on UÉ cloud where data for the tool is held and updated weekly and from where the data can be ingested into the tool. |
| 5 | Run simulations | Application of the tool to, at a minimum, the WWTPs identified in Sub-measures 1 and 2; and production of outcome reports for each WWTP outlining the resultant concentrations downstream of the primary discharges for a range of scenarios (e.g. current conditions, notionally clean, ELVs). An example output report is included in Appendix 4 of this report. |
| 6 | Final reporting and tool handover | Final report to include results of monitoring and tool simulations. Final handover of tool to include training materials and sessions for relevant Uisce Éireann staff. |
| 7 | Promotion and publicity | Internal and external promotion and awareness-raising in relation to the tool. |

Note: all necessary internal governance steps are being completed as required throughout the process.

These tasks have all been completed and the tool was launched to end-users in December 2024.

# 5 Summary

This report has demonstrated the achievement of the milestone through presenting:

- An overview of the monitoring programme and summary of results;
- Details of the ECC Tool development and outputs, which demonstrate massive gains in UÉ's capability around establishing required treatment standards to support RBMP objectives.

# Appendix 1

Example of site suitability report for Kilkelly WWTP

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**PRE-SURVEY SITE SUITABILITY ASSESSMENT**

**KILKELLY (D0357-01), Co. MAYO**

Report Ref: 32010-1

31 August 2023

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Reviewed by: Dr Imelda Shanahan

# CONTENTS



| **Document Revision** | | **TMS Approval** | **Uisce Éireann Approval** | |
|---|---|---|---|---|
| | | | **Approver** | **Date** |
| 01 August 2023 | Draft | IS | | |
| 16 August 2023 | Draft #2 | IS | KS | 31 August 2023 |
| | | | | |
| | | | | |

## 1.0 INTRODUCTION

A survey of the site was undertaken to establish the suitability of ambient monitoring locations upstream and downstream of the waste water treatment plant (WWTP) at Kilkelly, Co Mayo (D0357-01). The assessment was carried out in accordance with the following reference documents:

(i) 21/041-001 Multi Party Framework for the provision of Laboratory Services RFMT for the provision of Effluent and Ambient Monitoring Services; Annex 2 Scope.

(ii) Uisce Éireann Ambient Monitoring Guidelines; UE-ER-GL-008 Rev.1.0

(iii) Uisce Éireann BioSecurity-Aquatic sampling; IW-AMT-GL-007 Rev.1.0

(iv) Uisce Éireann BioSecurity standard operating procedure for Aquatic sampling; IW-AO-SOP-010 Rev.1.0

(v) WHO UNEP Water Quality Monitoring Guidelines, 1996

(vi) ISO5667 Water Quality

(vii) IS EN ISO 18365: 2013. Hydrometry – Selection, establishment and operation of gauging station.

This report presents a summary of the findings of the assessment in respect of the identification of, and assessment of the suitability of, monitoring locations upstream and downstream of the WWTP. The purpose of the assessment was to assess the suitability of the existing monitoring points for the ambient monitoring.

## 2.0 IDENTIFICATION OF MONITORING POINTS

A preliminary desktop assessment was carried out in advance of visiting the site using available resources which included the following:

- Information on the treatment capacity of the WWTP;
- License information on WWTP;
- Channel width and depth;
- Local hydrometric data;
- Discharge characteristics.

Following review of the available data a preliminary assessment of the mixing zone was completed including a calculation of mixing length as shown in Appendix I. The mixing zone calculations were then compared with the approximate estimates taken from the Uisce Éireann Guidance (UE-ER-GL-008 Rev.1.0) as presented in Appendix II. The calculated mixing length falls within the range quoted in the Uisce Éireann guidance for this site.

An estimate of dilution factors which considers the discharge flow rate and receiving water body flow rate was also carried out for existing and proposed discharge locations and is summarised in Appendix II. The dilution ratios are large relative to the discharge rate and support a working assumption that the discharge flow rates are generally insignificant in determining mixing length. Specifically for Kilkelly, the dilution ratio is large and the discharge rate is not the dominant factor determining mixing length.

A summary of the mixing length estimates using the different approaches is shown in Table 1.

**Table 1** Summary of mixing length estimates

| | **Calculated mixing length, m Appendix I** | **UÉ Guidance Mixing length, m Appendix II** | **Dilution Ratio Appendix II** |
|---|---|---|---|
| Existing discharge location | 80 | None, <5 | 444 |

A site survey was carried out on 26th July 2023 and the following factors were considered in the assessment of suitable locations for monitoring.

- The proposed monitoring locations provided by Uisce Éireann;
- The guidance provided by Uisce Éireann as noted in section 1.0;
- The findings of the preliminary desktop assessment;
- The discharge rate of the WWTP i.e. the collected load;
- The discharge site, i.e. mid-channel or alongside the bank;
- Incoming streams/tributaries between the discharge sites and the u/s and d/s ambient monitoring sites;

- Influences from other sources of pollution between the discharge and upstream and downstream monitoring sites;
- Health and safety issues and site accessibility. The monitoring sites should provide safe, and relatively easy, access to sampling personnel at all times, and should consider factors such as:
    - Bank profiles;
    - Seasonal variation in flow rates and conditions that might affect access e.g. vegetation cover, soil conditions;
    - Land ownership and the ability to access to private lands;
    - Safe car parking;
    - Distance to be walked.
    - The suitability of the site for spot flow measurement

This ambient site suitability report includes the following:

- Coordinates of existing and proposed new ambient monitoring site(s);
- Weather conditions on the day as well as preceding weather conditions;
- Photographs of all sites;
- Details of access and any other relevant issues;
- Details of safe parking and distance from parking to sites;
- Details of immediate local land use on each riverbank;
- Details of any evidence of agricultural access to river (evidence of poaching or cattle tracks to river, lack of fencing, animal faeces in river/riverbanks);
- Details of any evidence of abstraction (permanent/temporary) from surface waters;
- Details of any evidence of point/diffuse inputs to surface waters;
- Details of any evidence of any other pressures acting on surface waters;
- Assessment of whether *in-situ* works, such as sampling platforms, would be desirable.

Following the assessment of all these factors, the existing downstream monitoring location was deemed suitable for this project. For the upstream location, the proposed monitoring point is not significantly different from the existing location. It is moved slightly to allow for greater access to the river for spot flow measurements, as the current site is not suitable.

## 3.0 MONITORING LOCATION DETAILS

Details of the Upstream and downstream monitoring locations are presented in Table 2 and Table 3. Photographs of the monitoring locations are included at Appendix III.

## 4.0 CONCLUSIONS

The existing downstream monitoring location was found to be suitable for the project. A new upstream monitoring location is proposed due to unsuitability of the existing location.

**Table 2** Upstream monitoring location details

| | |
|---|---|
| **Location** | Kilkelly (D0357-01) Co Mayo<br>Upstream. |
| **Monitoring Location coordinates and distance from discharge** | 144355E 291588N<br>-551m upstream of discharge<br>-115m upstream of existing location<br>Better channel section for flow measurements. |
| **Existing monitoring location coordinates and distance from discharge** | 144244E 291575N<br>-436m upstream of discharge<br>Site inaccessible due to excess vegetation. |
| **Weather** | Heavy rain and overcast on day of assessment, showers on days preceding assessment. |
| **Discharge location** | 143828E 291491N – Bank discharge – visual observation. |
| **Access to location for spot flow measurements and ambient sampling** | Park in hard shoulder adjacent to unnamed bridge at 144340E 291599N, short walk to sampling location (approximately 20-25m). Step over small fence and walk down to river bank on right hand side facing upstream, approximately 10m upstream of the bridge. |
| **Land use** | Land either side is used for agriculture, no signs of animals entering river. River banks are steep, but little vegetation (grass). Little weed growth in channel. Channel substrate is cobbles / sand and silt. |
| **Pressures** | No evidence of abstraction, inputs to surface waters or any other pressures between proposed location and discharge. |
| **Suitability assessment** | Suitable for installation of permanent gauging station. |
| **Channel dimensions** | 2.9m wide, 1.1m depth (max) |
| **Recommended method of spot flow measurement** | Current meter, wading. |
| **Recommended method of water sampling** | Direct (by hand) |
| **Recommended works** | None specific. |

**Table 3** Downstream monitoring location details

| | |
|---|---|
| **Location** | Kilkelly (D0357-01) Co Mayo Downstream. |
| **Proposed Location coordinates and distance from discharge** | 143777E 291440N<br>-82m downstream of discharge<br>Better channel cross section for flow measurements than existing site. |
| **Existing monitoring location coordinates and distance from discharge** | 143767E 291432N<br>-95m downstream of discharge. |
| **Weather** | Heavy rain and overcast on day of assessment, showers on days preceding assessment. |
| **Discharge location** | 143828E 291491N – Bank discharge – visual observation. |
| **Access to location for spot flow measurements and ambient sampling** | Park in layby adjacent to river, short walk to site (10-15m). Gentle slope into river bank, approximately 5m upstream of the unnamed bridge at 143762E 291428N |
| **Land use** | Land either side is used for agriculture, no signs of animals entering river. River banks are steep, but little vegetation (grass). No weed growth in channel. Channel substrate is cobbles / sand and silt. |
| **Pressures** | No evidence of abstraction, inputs to surface waters or any other pressures. |
| **Suitability assessment** | Suitable for installation of permanent gauging station, but area is very accessible – vandalism could be an issue. |
| **Channel dimensions** | 3.7m wide, 0.5m depth (max) |
| **Recommended method of spot flow measurement** | Current meter, wading. |
| **Recommended method of water sampling** | Direct (by hand) |
| **Recommended works** | None specified. |
| **Estimated mixing length** | 80m. |
| **Estimated distance downstream of discharge** | 82m. |

## Kilkelly WWTP - Proposed Discharge Location 1 (143828 291491)

USGS (1985), 'Techniques of Water Resources, Book 3, Measurement of Discharge Using Tracers'

**Equation:**

$$L_m = K\frac{vB^2}{E_z}$$

**Where:**

| | | Units |
|---|---|---|
| $L_m$ | Mixing length | ft |
| K | Coefficient (varies, see Tabl | - |
| v | Mean stream velocity | ft/s |
| B | Mean stream width | ft |
| $E_z$ | Transverse mixing coefficie | - |
| d | Mean stream depth | ft |
| s | Water surface slope | - |

**Transverse mixing coefficient:**

$$E_z = 1.13 d^{3/2} s^{1/2}$$

**Coefficient K:**

| Number and location of injection points | Coefficient, K Percentage mixing 90 | 95 | 98 |
|---|---|---|---|
| One center injection | 0.070 | 0.100 | 0.140 |
| Two injection points [a] | 0.018 | 0.025 | 0.035 |
| Three injection points [b] | 0.008 | 0.011 | 0.016 |
| One side injection point | 0.280 | 0.400 | 0.560 |

**Assumptions:**

1. Straight uniform channel
2. Rectangular cross-section with uniform velocity
3. Laminar flow
4. Continuous injection at uniform rate
5. No other inputs or outputs in reach

**Manning Equation:**

**Manning's Equation**

$$V = \frac{R^{2/3} S^{1/2}}{n}$$

V is average velocity (m/s)
R = hydraulic radius (m)
S = energy slope (m/m)
n = Manning's roughness coefficient

**Calculation of depth & velocity:**

| | | | Units |
|---|---|---|---|
| b | Mean stream width | 2.9 | m |
| d | Mean stream depth | 0.307 | m |
| A | Wetted area | 0.8903 | $m^2$ |
| P | Wetted perimeter | 3.514 | m |
| R | Hydraulic radius | 0.253357997 | m |
| S | Energy slope | 0.002 | - |
| n | tanning roughness coefficie | 0.04 | - |
| V | Mean stream velocity | 0.451772564 | m/s |
| Q | Mean stream flow | 0.402213114 | $m^3/s$ |

**Inputs for Mixing Calculation:**

| | | Units | | Units | Source |
|---|---|---|---|---|---|
| Mean stream width (representative rectang | 2.9 | m | 9.5149 | ft | Estimated from OSI map/aerial photos |
| Mean stream depth (representative rectang | 0.307 | m | 1.007267 | ft | Calculated from Manning Equation |
| Mean stream flow (=Q65%ile) | 0.402 | m3/s | 14.19651 | ft3/s | Estimated from EPA Hydrotool |
| Mean stream velocity | 0.451 | m/s | 1.479731 | ft/s | Calculated from Manning Equation |
| Water surface slope | 0.002 | - | 0.002 | - | Estimated from OSI map |

**Calculation of Mixing Length (Average Conditions):**

| | | |
|---|---|---|
| K | 0.1 | - |
| v | 1.479731 | ft/s |
| B | 9.5149 | ft |
| $E_z$ | 0.051087 | - |
| $L_m$ | 262.2291 | ft |
| $L_m$ | 80 | m |

| UniqueID | Channel width (m) | UE Guidance on mixing length | PE | Discharge Rate (m3/d) | Discharge Rate (l/s) | Average Channel flow m3/s | Average Channel flow l/s | Dilution Ratio (No.:1) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Kilkelly D0357 | 2.9 | None, <5 | 433.3052 | 77.994936 | 0.90 | 0.402 | 402 | 445 |
| | | | | | | | | |
| | | | | | | | | |

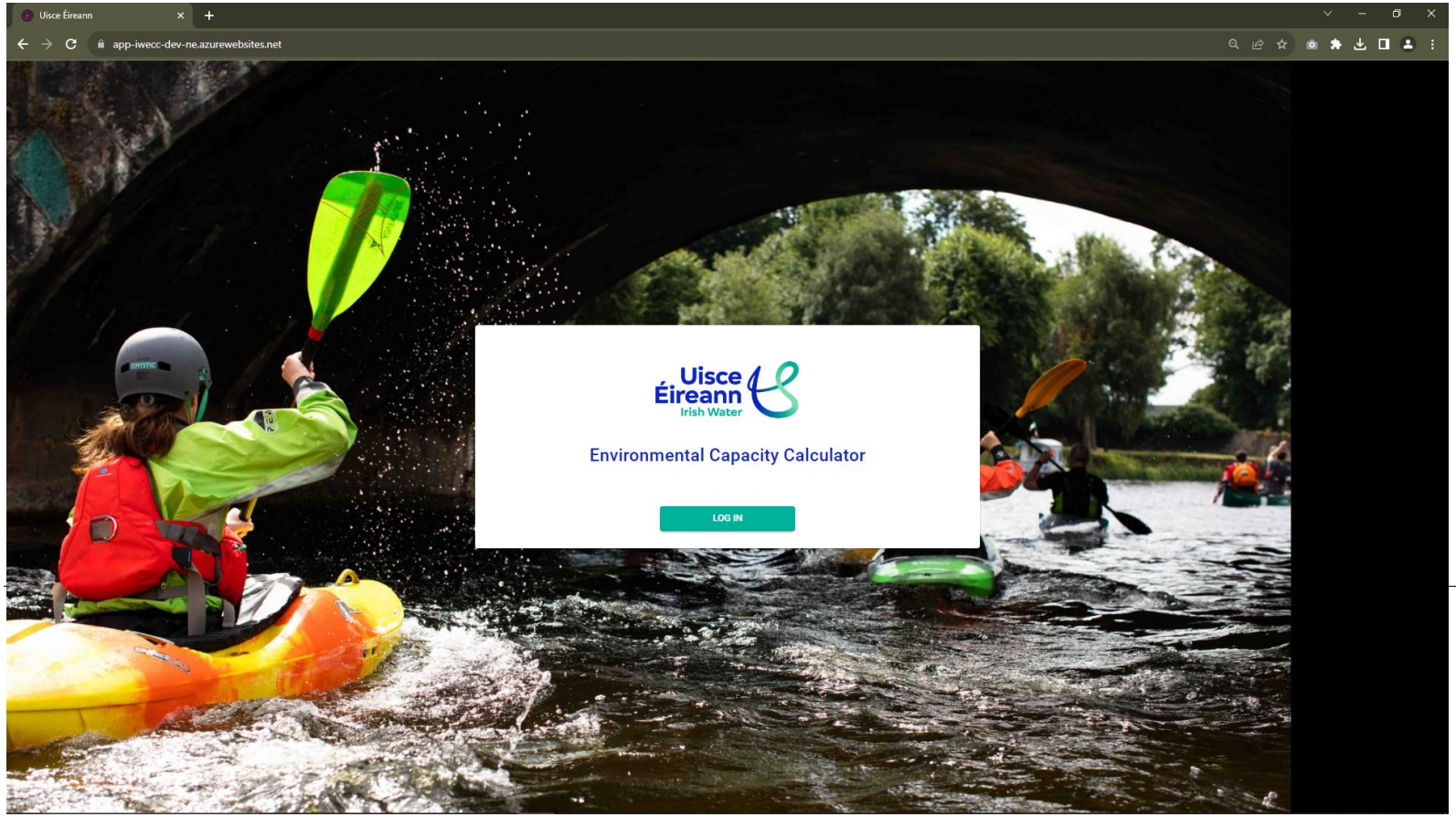
**Figure 1** Upstream monitoring location

**Figure 2** Downstream monitoring location

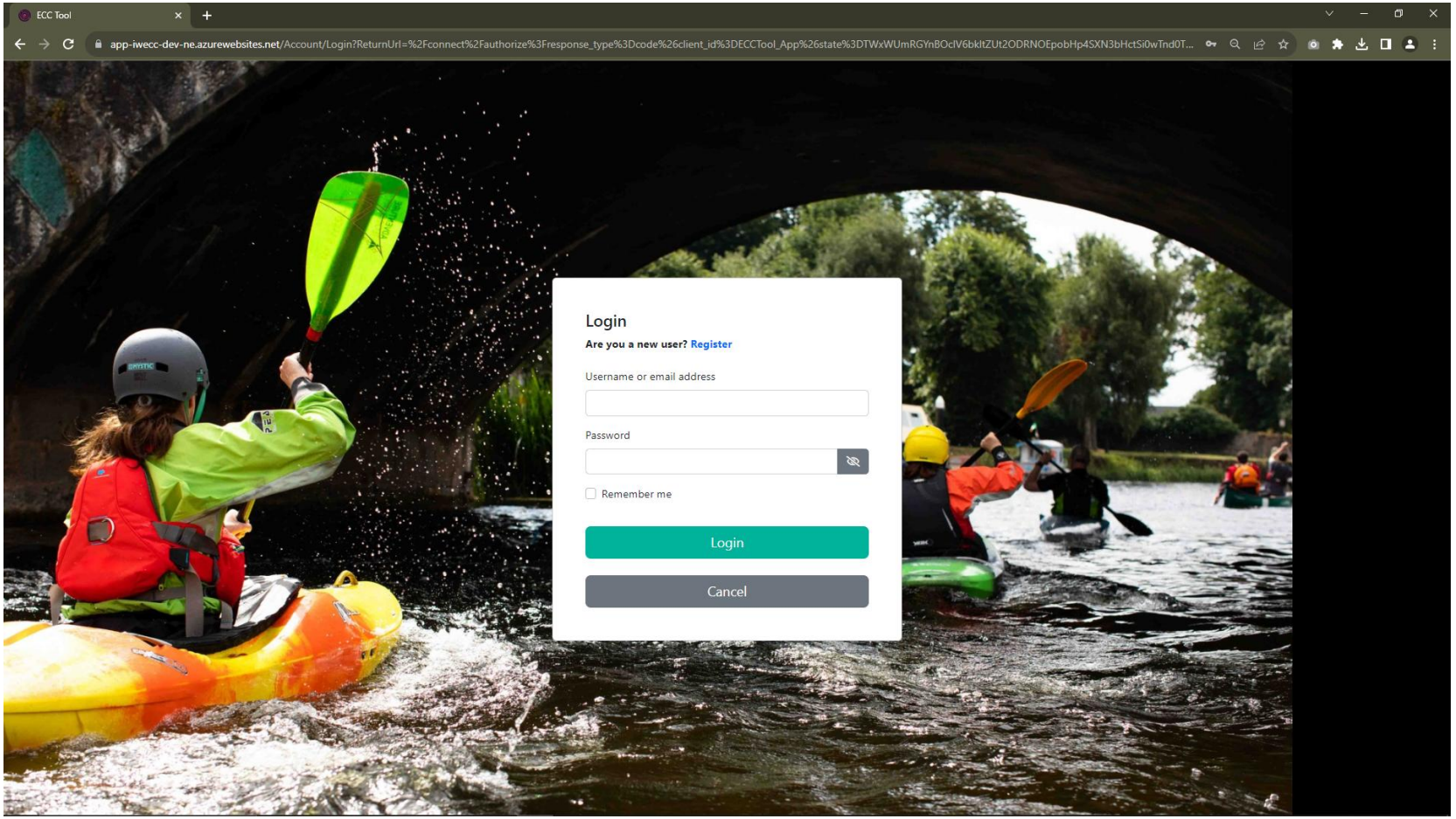
# Appendix 2

Screengrabs illustrating the form and function of the Environmental Capacity Calculation tool.

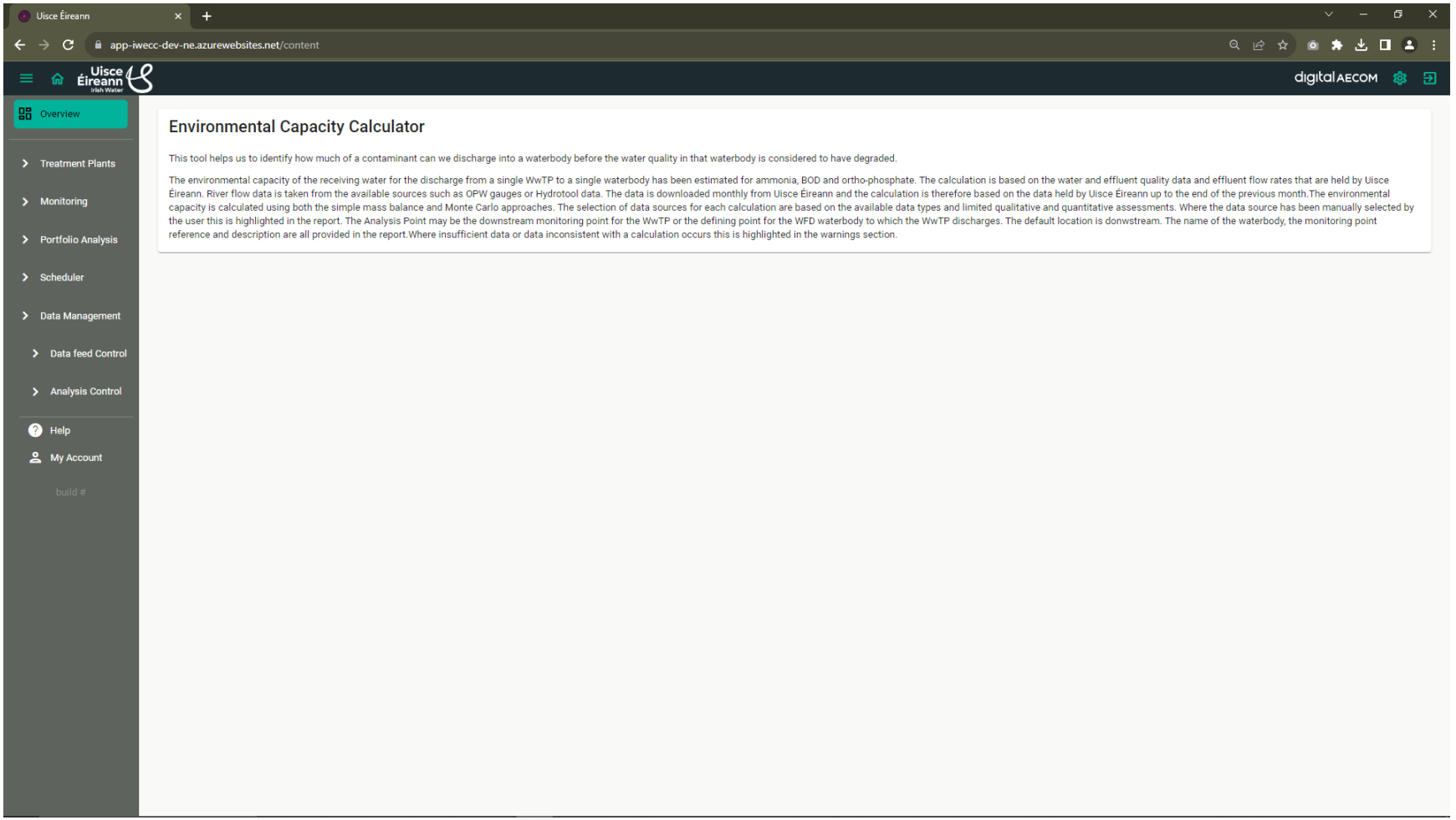
Landing page



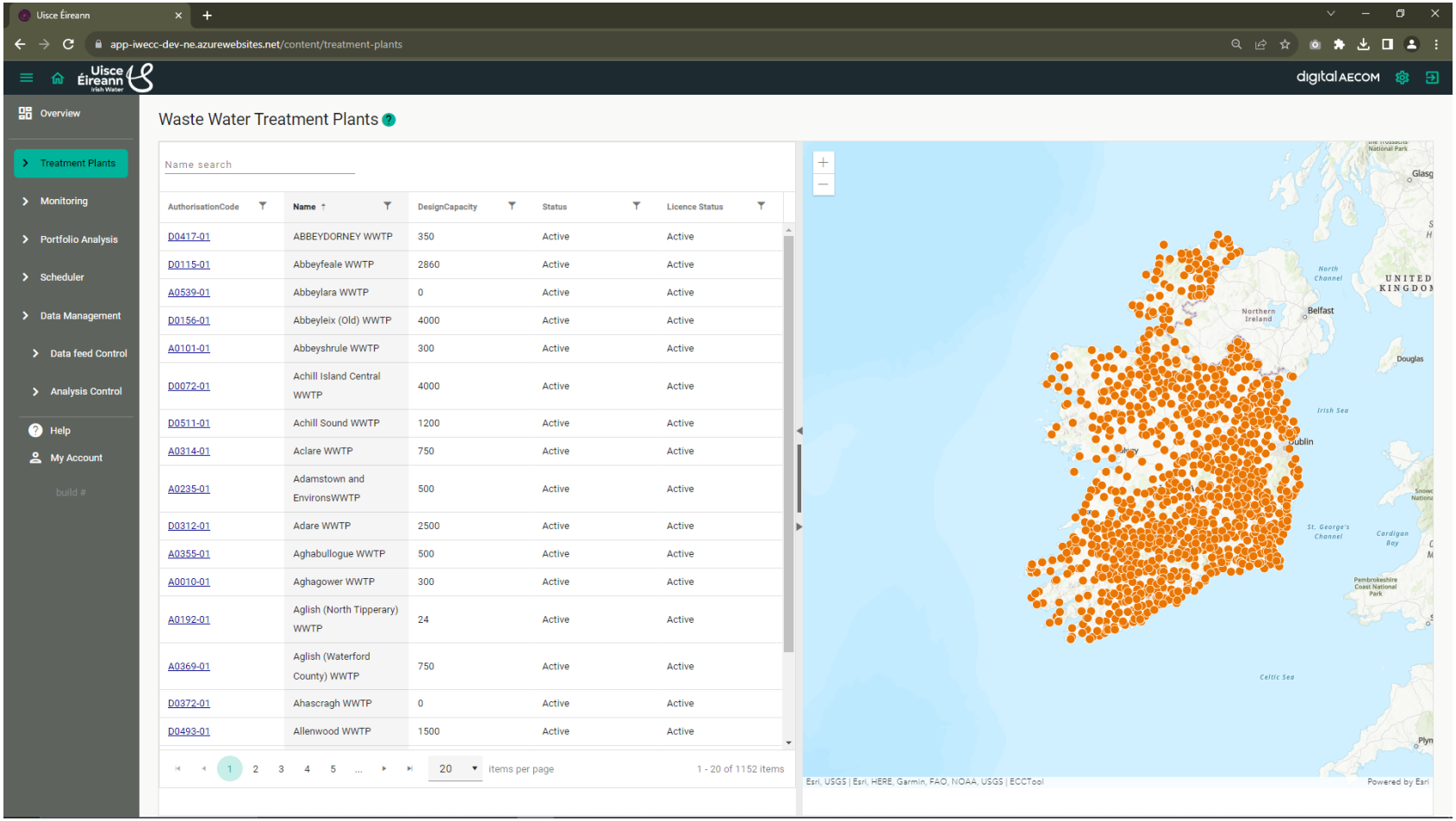
## Login Page


ECC Tool
app-iwecc-dev-ne.azurewebsites.net/Account/Login?ReturnUrl=%2Fconnect%2Fauthorize%3Fresponse_type%3Dcode%26client_id%3DECCTool_App%26state%3DTWxWUmRGYnBOclV6bkltZUt2ODRNOEpobHp4SXN3bHctSi0wTnd0T...
Login
Are you a new user? Register
Username or email address
Password
Remember me
Login
Cancel

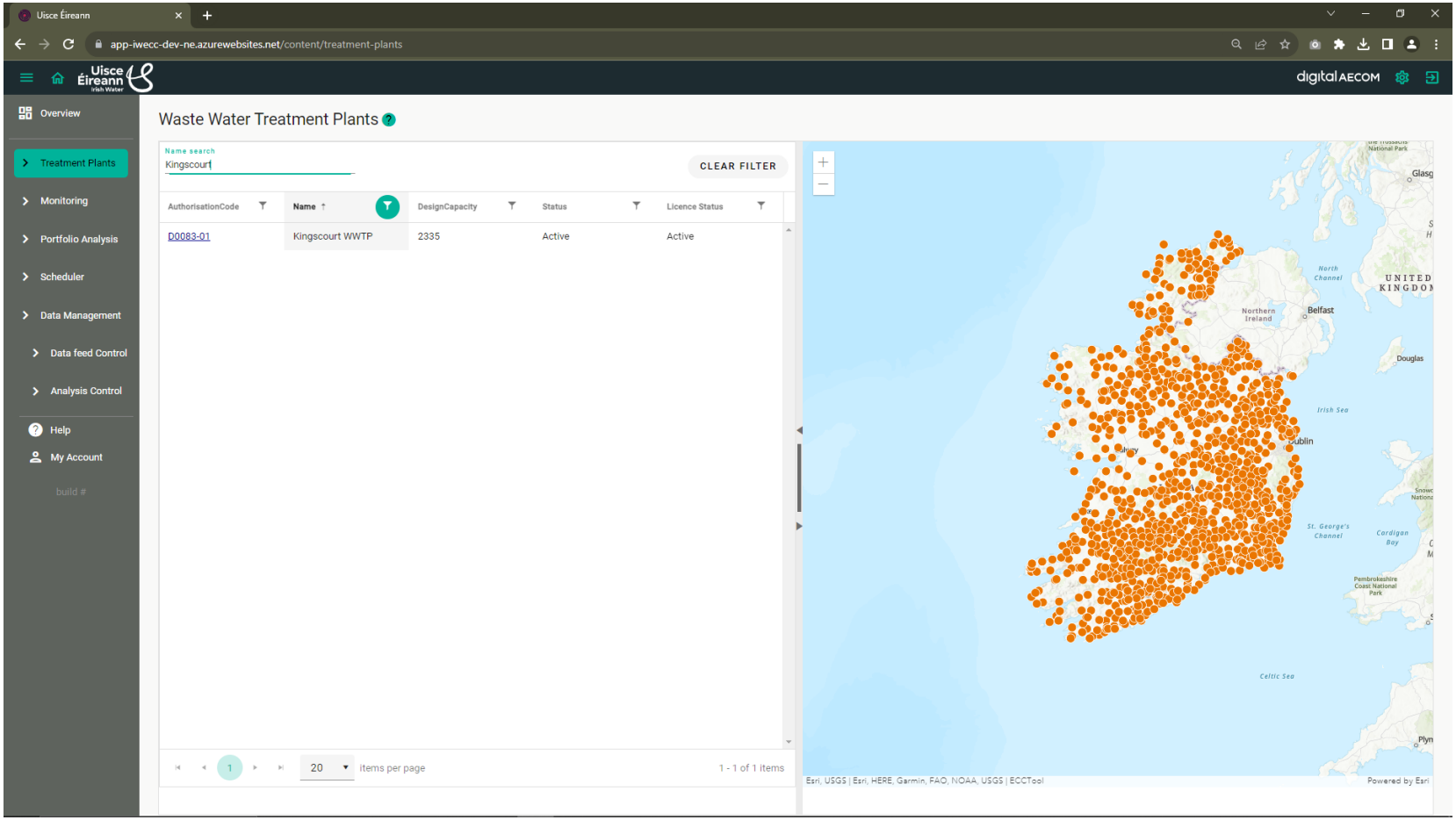
## Overview


Uisce Éireann
app-iwecc-dev-ne.azurewebsites.net/content
Uisce Éireann
Irish Water
digital AECOM
Overview
Treatment Plants
Monitoring
Portfolio Analysis
Scheduler
Data Management
Data feed Control
Analysis Control
Help
My Account
build #
Environmental Capacity Calculator
This tool helps us to identify how much of a contaminant can we discharge into a waterbody before the water quality in that waterbody is considered to have degraded.
The environmental capacity of the receiving water for the discharge from a single WwTP to a single waterbody has been estimated for ammonia, BOD and ortho-phosphate. The calculation is based on the water and effluent quality data and effluent flow rates that are held by Uisce Éireann. River flow data is taken from the available sources such as OPW gauges or Hydrotool data. The data is downloaded monthly from Uisce Éireann and the calculation is therefore based on the data held by Uisce Éireann up to the end of the previous month.The environmental capacity is calculated using both the simple mass balance and Monte Carlo approaches. The selection of data sources for each calculation are based on the available data types and limited qualitative and quantitative assessments. Where the data source has been manually selected by the user this is highlighted in the report. The Analysis Point may be the downstream monitoring point for the WwTP or the defining point for the WFD waterbody to which the WwTP discharges. The default location is donwstream. The name of the waterbody, the monitoring point reference and description are all provided in the report.Where insufficient data or data inconsistent with a calculation occurs this is highlighted in the warnings section.

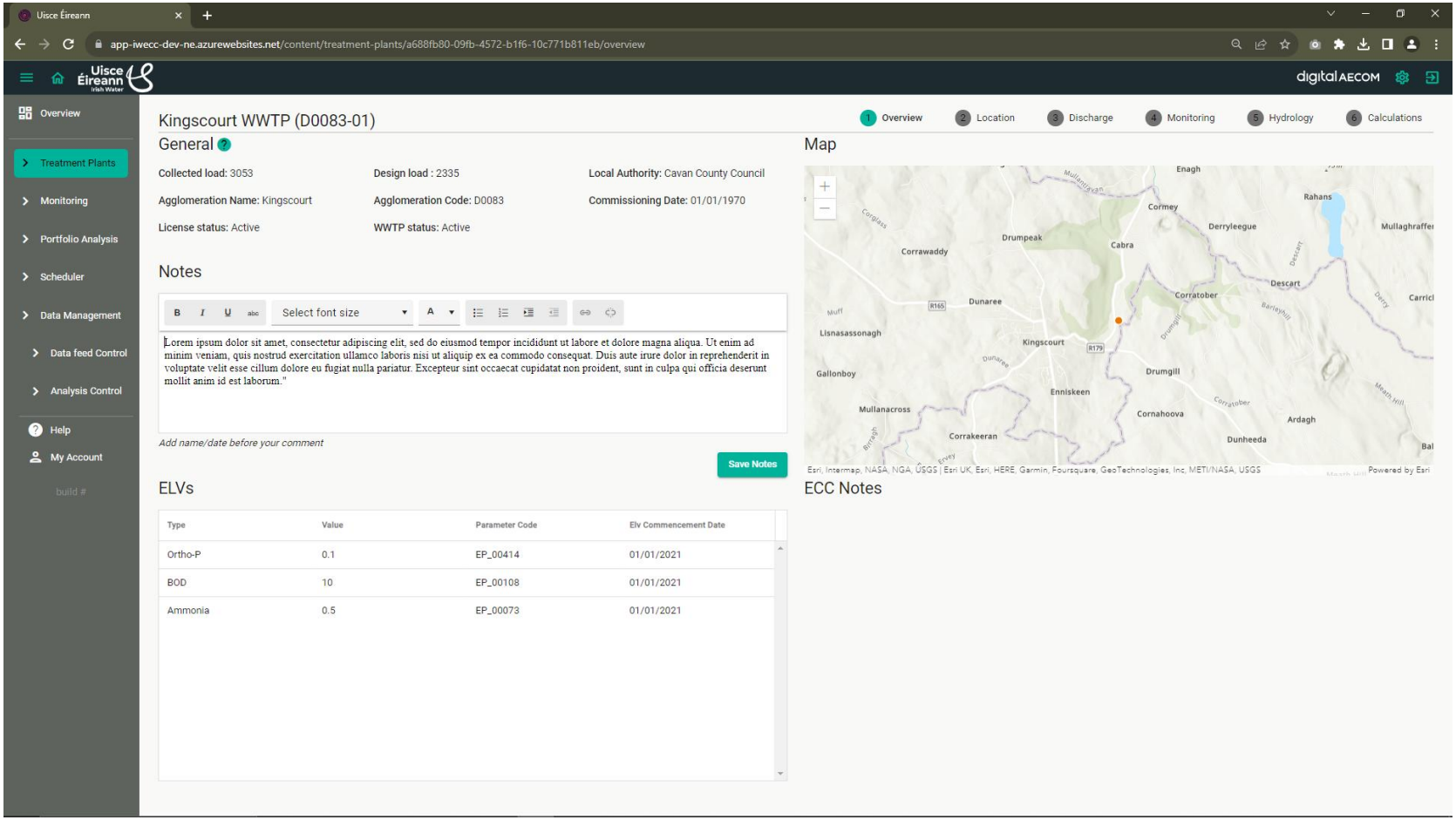
## Waste Water Treatment Plants



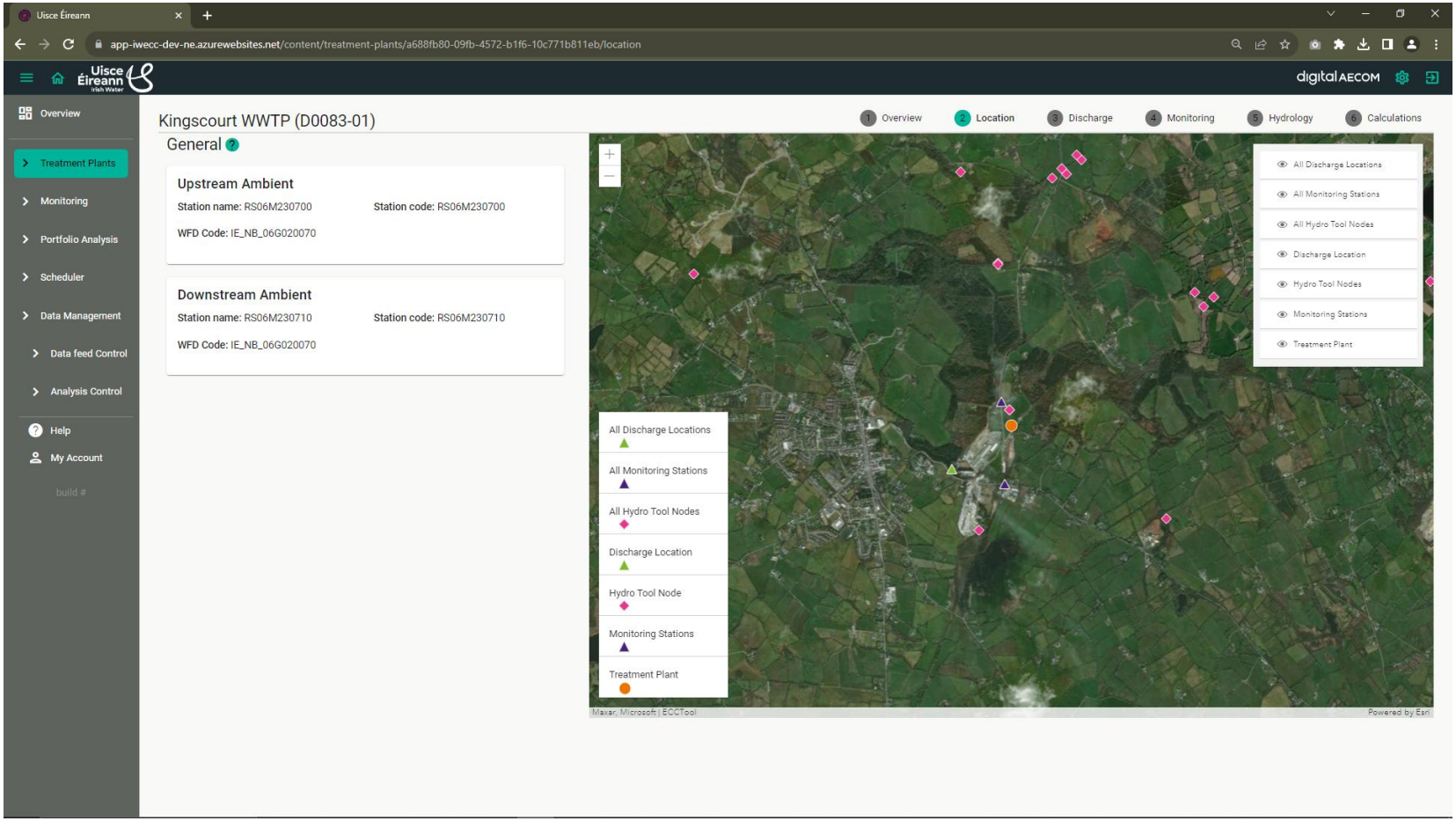
Filtering on Waste Water Treatment Plants



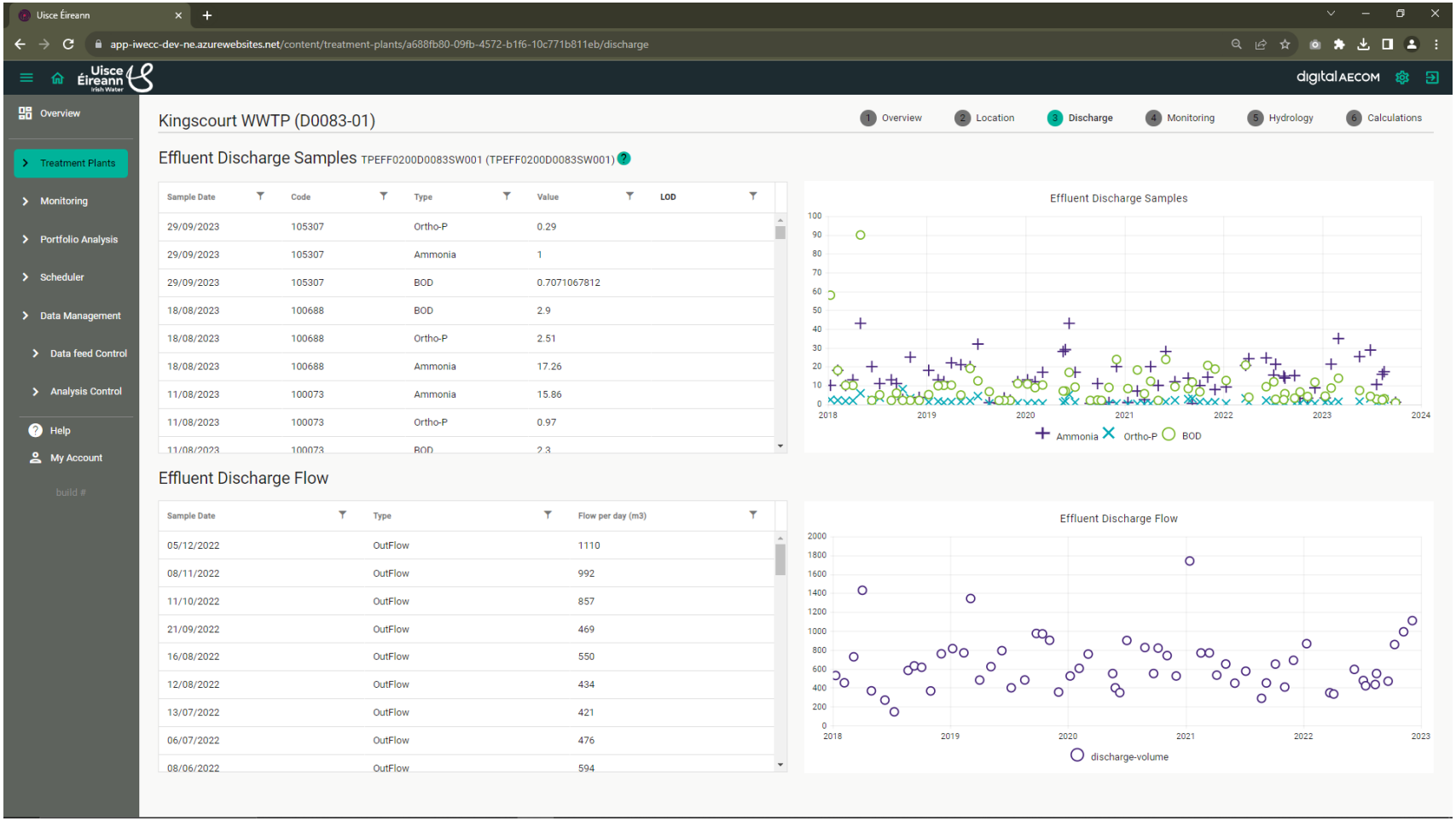
## Waste Water Plant Overview



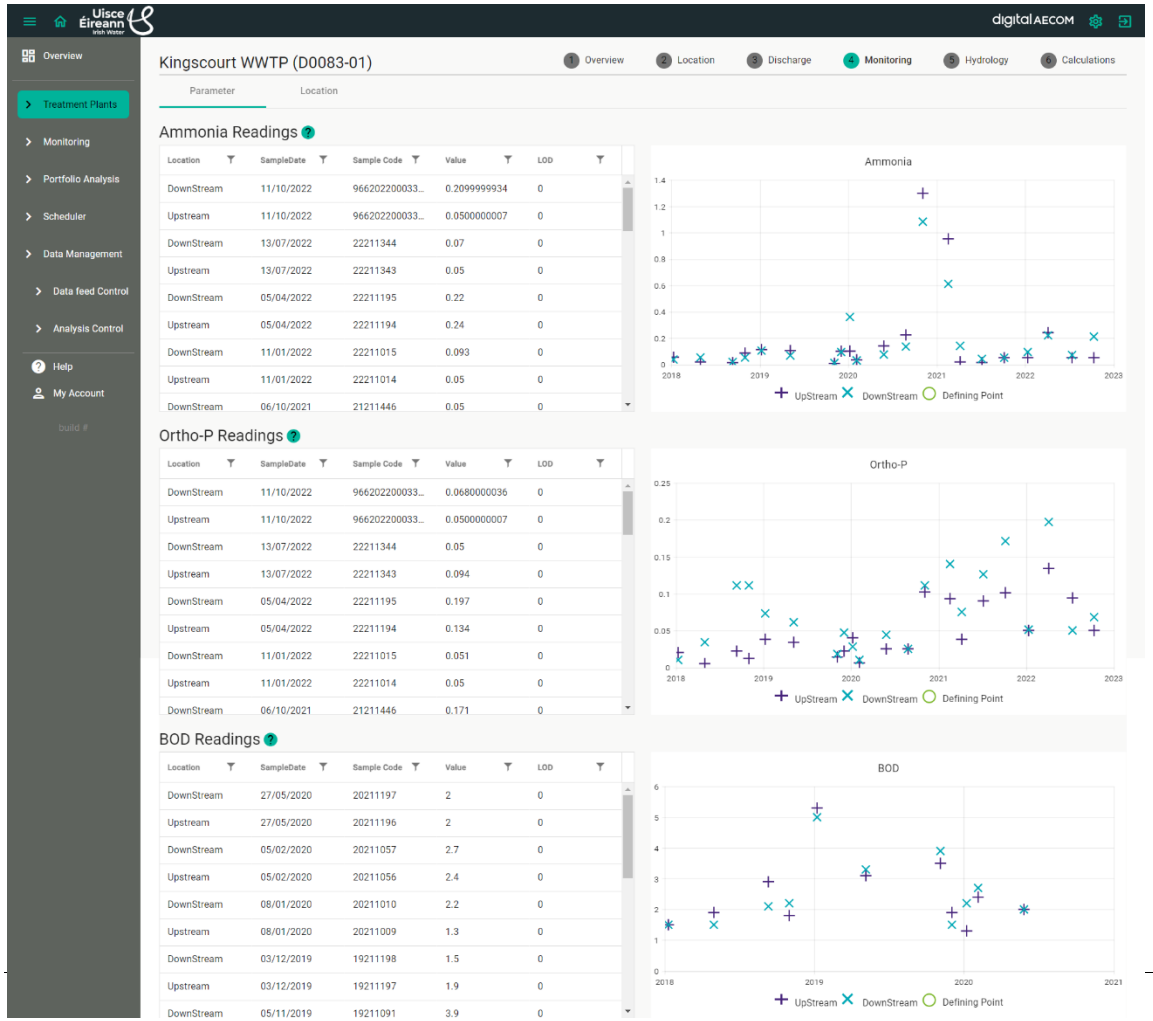
## Waste Water Plant Location



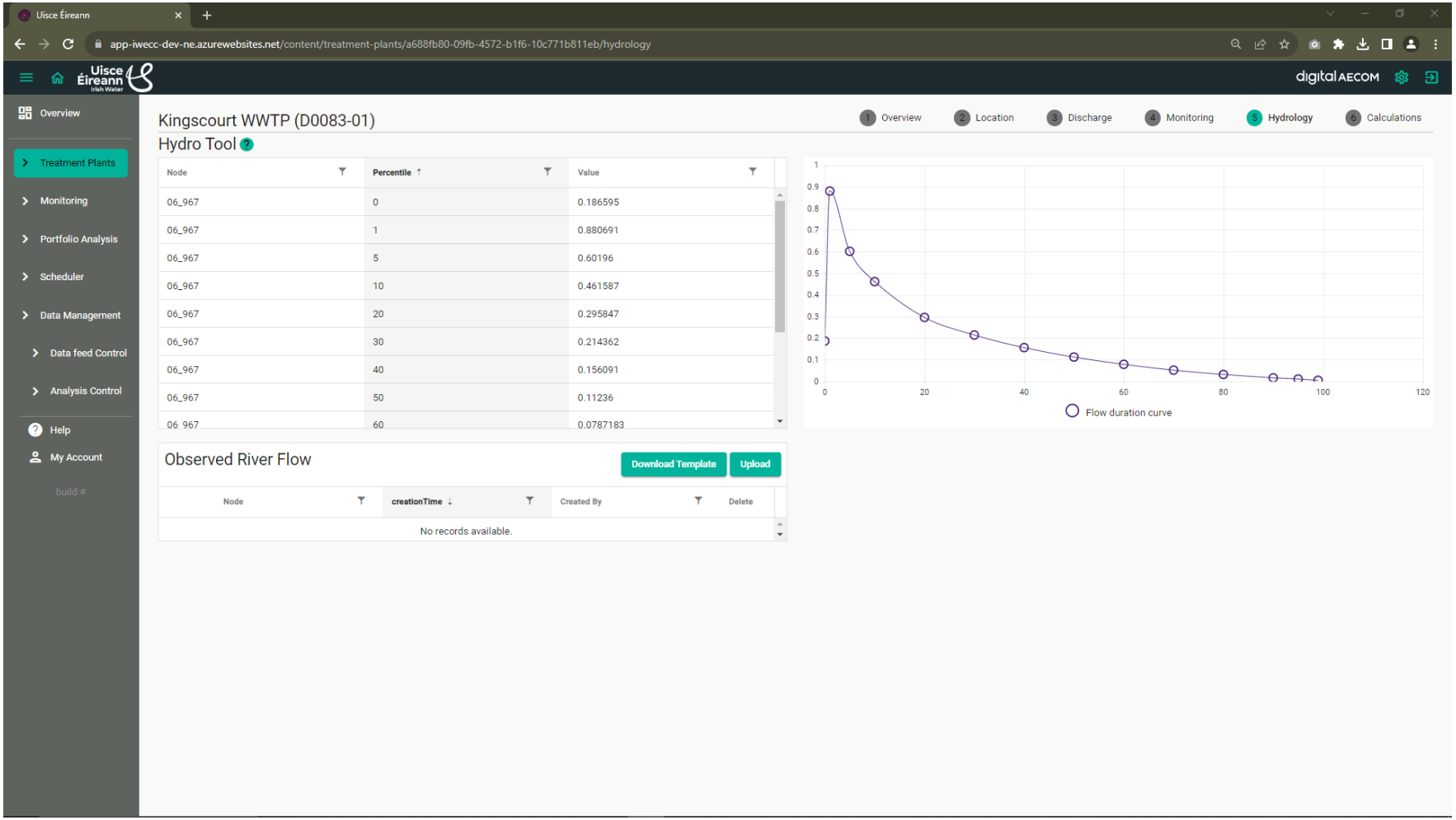
# Waste Water Plant Discharge



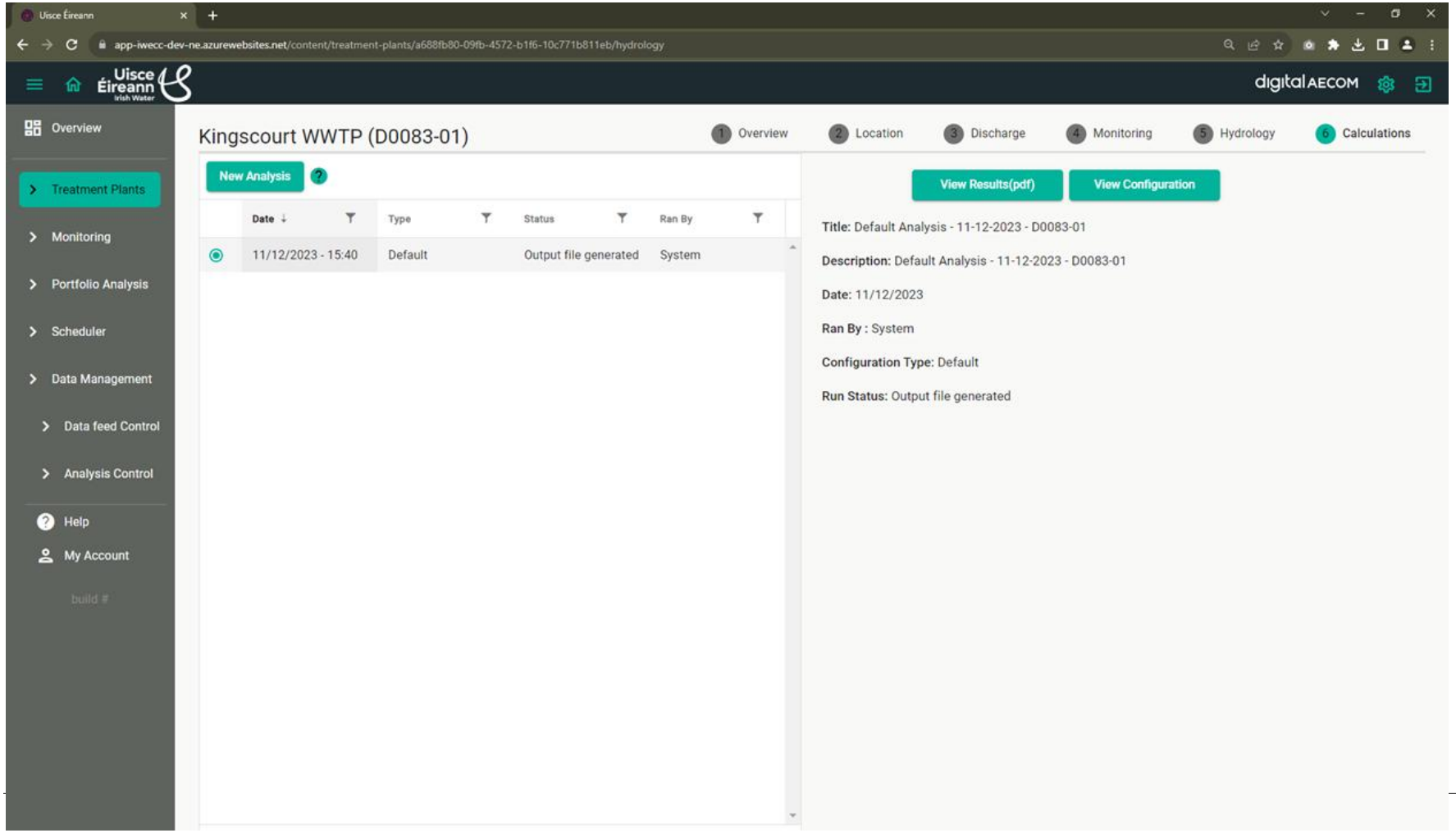
# Waste Water Plant Monitoring



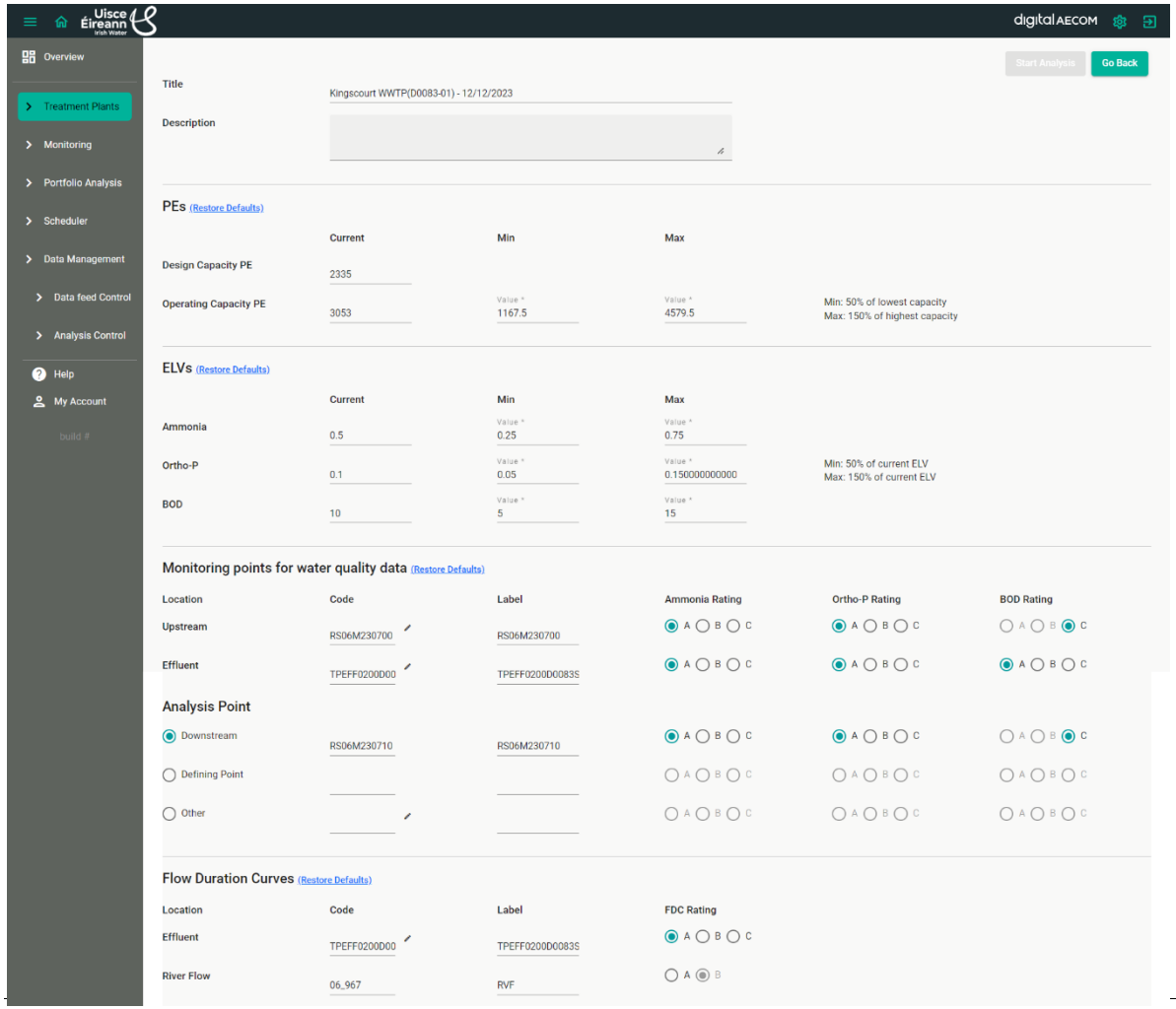
# Waste Water Plant Hydrology



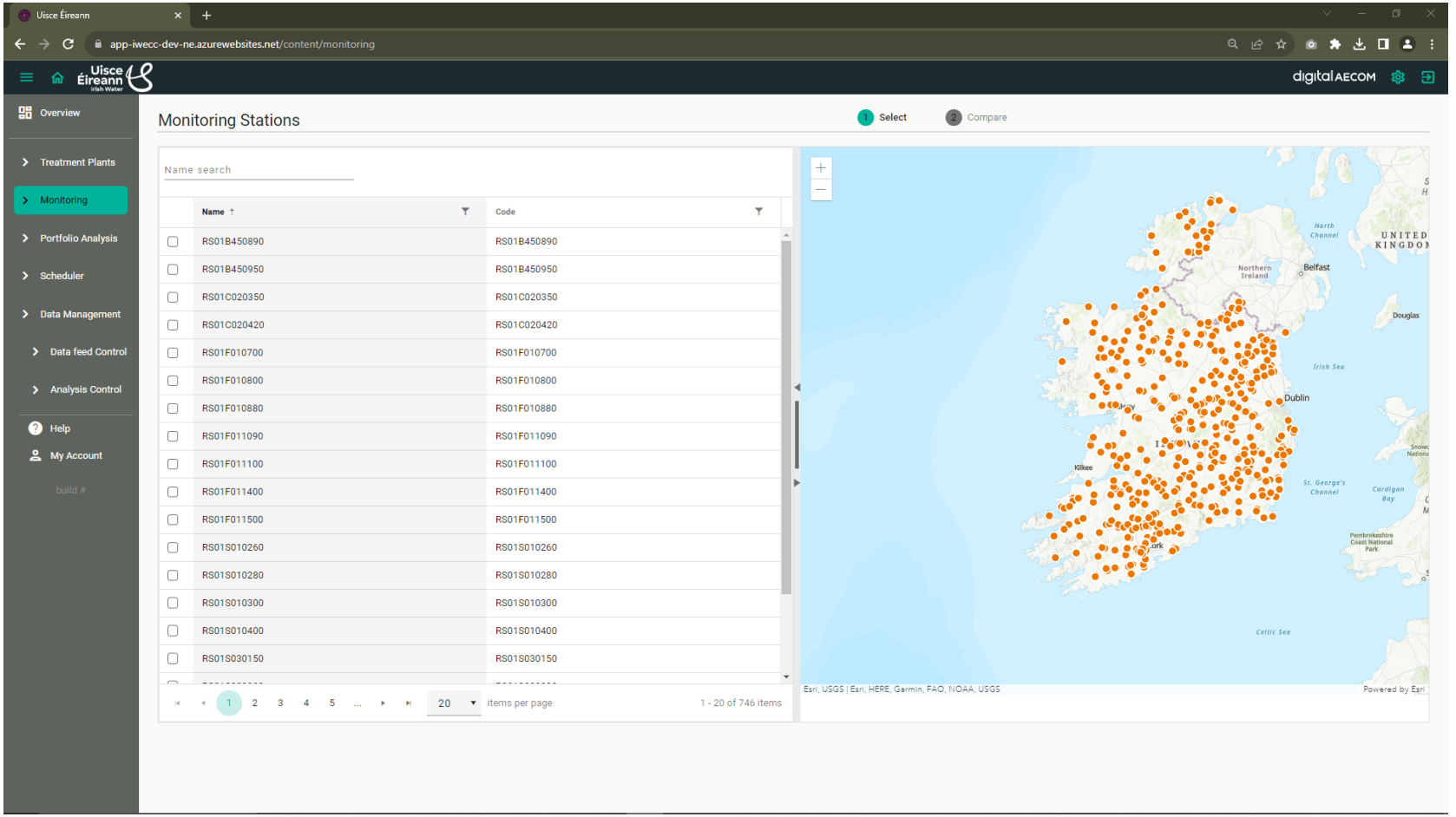
Waste Water Plant Calculations – Overview



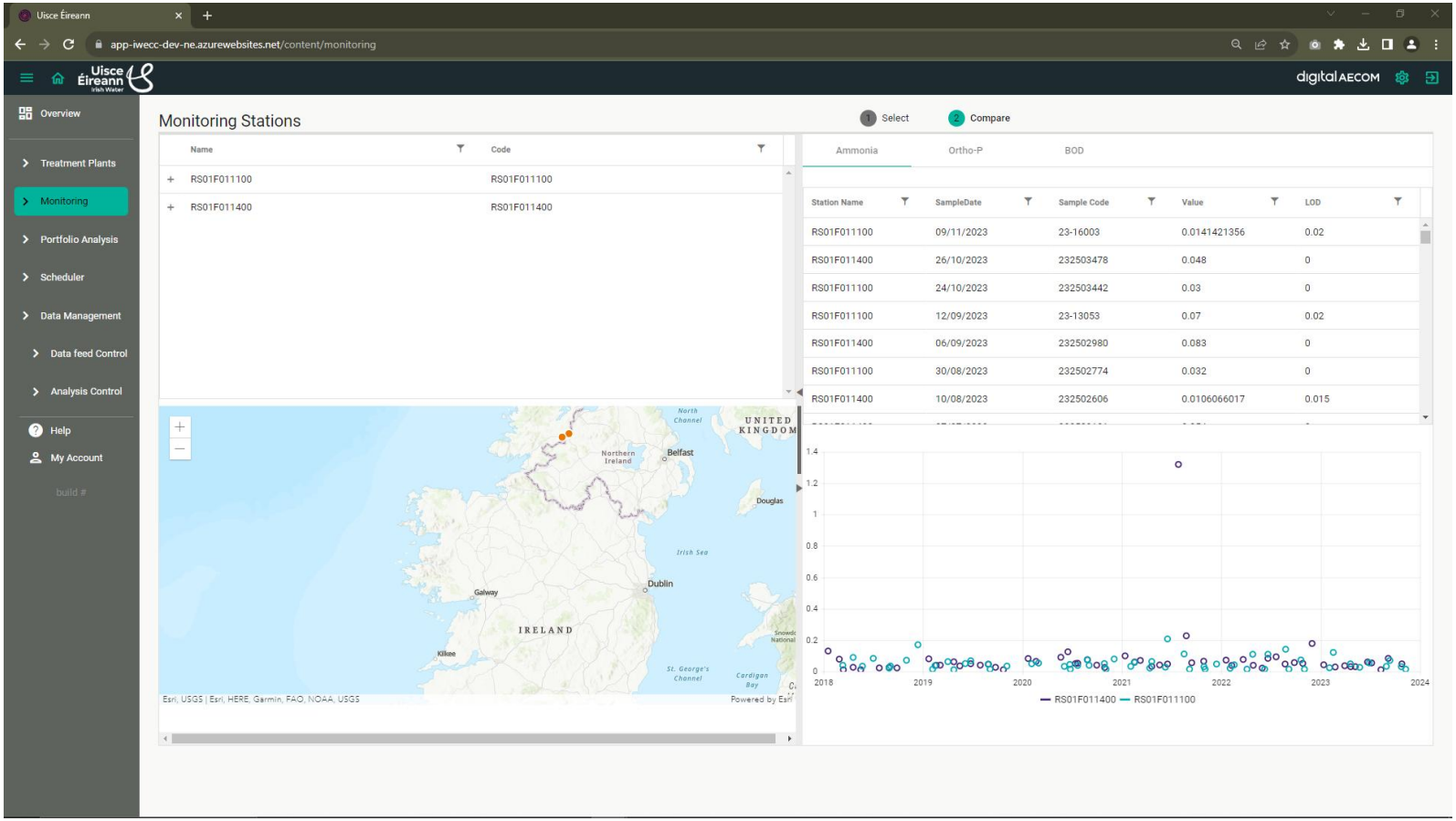
# Waste Water Plant Calculations – Configuration



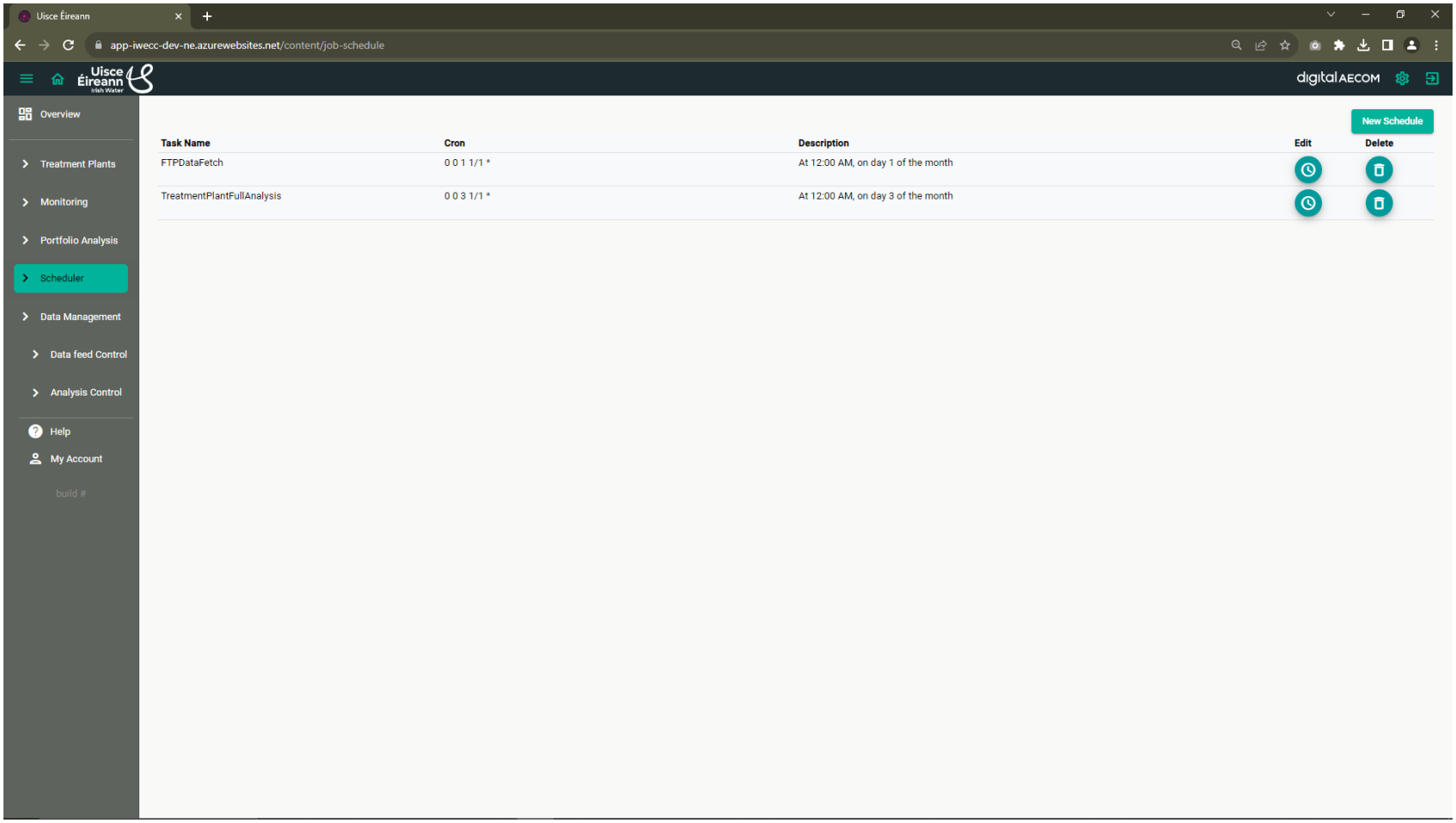
## Monitoring Stations



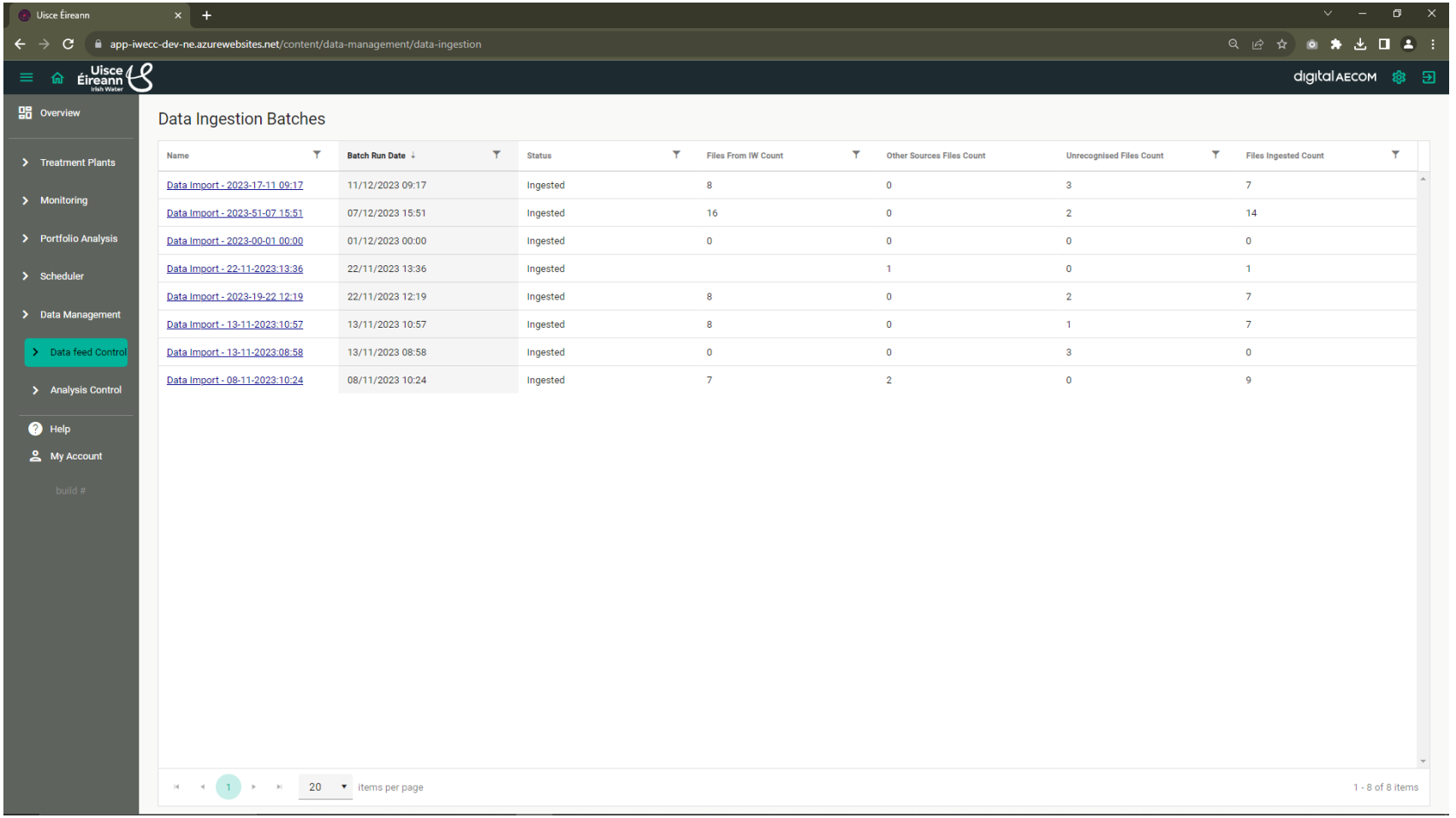
## Monitoring Stations - Compare Stations



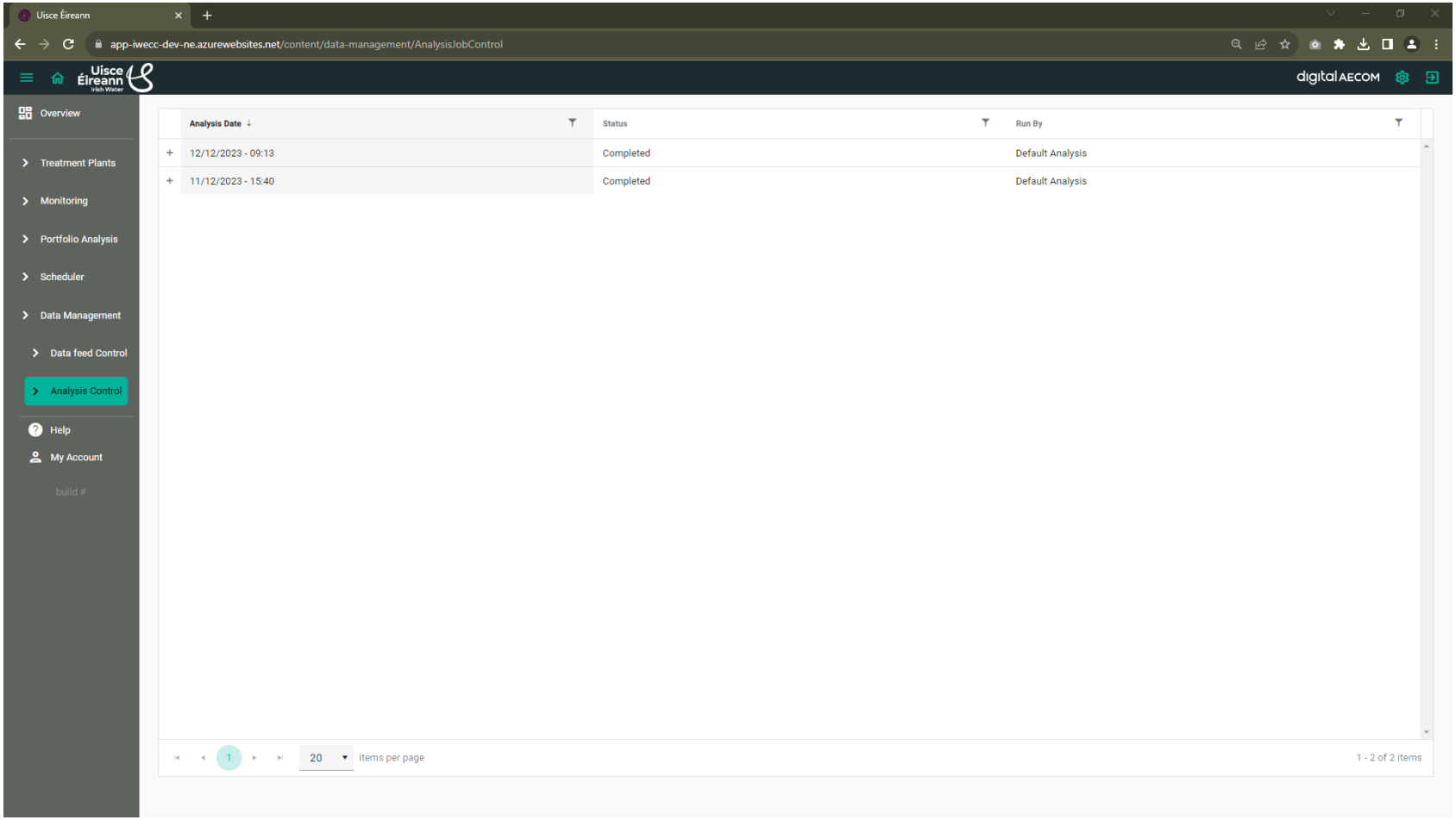
# Scheduler


Uisce Éireann
app-iwecc-dev-ne.azurewebsites.net/content/job-schedule
Uisce Éireann
digital AECOM
Overview
Treatment Plants
Monitoring
Portfolio Analysis
Scheduler
Data Management
Data feed Control
Analysis Control
Help
My Account
build #
New Schedule
Task Name
Cron
Description
Edit
Delete
FTPDataFetch
0 0 1 1/1 *
At 12:00 AM, on day 1 of the month
TreatmentPlantFullAnalysis
0 0 3 1/1 *
At 12:00 AM, on day 3 of the month

# Data Ingestion



# Analysis Control



# Appendix 3

Example of an Environmental Capacity Calculation output report. **Note: The data presented below is illustrative and is for purposes of demonstrating the ECC Tool, it does not constitute a site assessment.**

Uisce Éireann
Irish Water

## Environmental Capacity Calculation

**D0083-01**
**Kingscourt WWTP**
Report produced : 12/12/2023


Pdf version: v0.11

## Table of Contents

# 1. Introduction

## 1.1 Introduction

The environmental capacity of the receiving water for the discharge from a single WwTP to a single waterbody has been estimated for ammonia, BOD and ortho-phosphate. The calculation is based on the water and effluent quality data and effluent flow rates that are held by Uisce Éireann. River flow data is taken from the available sources such as OPW gauges or Hydrotool data. The data is downloaded monthly from Uisce Éireann and the calculation is therefore based on the data held by Uisce Éireann up to the end of the previous month.The environmental capacity is calculated using both the simple mass balance and Monte Carlo approaches. The selection of data sources for each calculation are based on the available data types and limited qualitative and quantitative assessments. Where the data source has been manually selected by the user this is highlighted in the report. The Analysis Point may be the downstream monitoring point for the WwTP or the defining point for the WFD waterbody to which the WwTP discharges. The default location is donwstream. The name of the waterbody, the monitoring point reference and description are all provided in the report.Where insufficient data or data inconsistent with a calculation occurs this is highlighted in the warnings section.Appendix A provides a Glossary of terms used in this report. The methodology for the calculation is described in Appendix B.

## 1.2 Wastewater Treatment Plant (WwTP) Information



| | |
|---|---|
| **Analysis date and time** | 12/12/2023 |
| **WwTP Number** | D0083-01 |
| **WwTP Name** | Kingscourt WWTP |
| **Analysis Point** | Downstream |
| **Monitoring Station Name** | RS06M230710 |
| **Discharge Points** | Primary (TPEFF0200D0083SW001) |
| **Analysis Type** | Placeholder: Default or custom analysis |
| **Description** | User generated analysis: Kingscourt analysis |
| **Notes** | User generated analysis: Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. |

| | Design | Operating | Headroom | Headroom Available |
|---|---|---|---|---|
| **WwTP Capacity [PE]** | 2,335 | 3,053 | -718 | Negative headroom |
| **Mean Effluent Flow Rate [m3/d]** | | 0.007 | | |

| | Ammonia 95th percentile | BOD 95th percentile | Ortho-P Mean |
|---|---|---|---|
| **ELV [mg/l]** | 0.50 | 10.00 | 0.10 |
| **Effluent Concentration [mg/l]** | 28.12 | 21.25 | 0.66 |

More detailed analysis of the effluent quality is provided in section 4.

## 1.3 Scenario Description

| | Description |
|---|---|
| **Scenario 1 - Current Operations** | Simulate the impact of a change in effluent flow rate with effluent concentration the same as current operations. All other parameters constant. |
| **Scenario 2 - ELV** | Simulate the impact of a change in effluent flow rate with the effluent quality at the ELV. All other parameters constant. |
| **Scenario 3 - Notionally Clean** | Simulate the impact of a change in the effluent flow rate with effluent concentration the same as current operations. River water quality set at 20% of the High/Good threshold. |
| **Scenario 4 - Treatment Level** | Simulate the impact of higher and lower effluent concentration for the current operating flow rate. All other parameters constant. |

## 1.4 Water Quality (Based on Current Operating Concentrations)

Concentration is the 50th percentile for ortho-P and the 95th percentile for ammonia and BOD.

| | Ammonia | BOD | Ortho-P | Monitoring Station |
|---|---|---|---|---|
| **Upstream [mg/l]** | 1.142 | 2.200 | 0.091 | RS06M230700 |
| **Upstream Indicative Quality** | Moderate | High | Poor | |
| **Downstream [mg/l]** | 0.870 | 2.200 | 0.093 | RS06M230710 |
| **Downstream Indicative Quality** | Moderate | High | Poor | |

## 1.5 Waterbody Capacity Calculation (Based on Current Operating PE = 3,053)

| | SMBA | | | MCA | | |
|---|---|---|---|---|---|---|
| | Ammonia | BOD | Ortho-P | Ammonia | BOD | Ortho-P |
| **Scenario 1 [PE]** | >4,580 | >4,580 | 3,858 | >4,580 | >4,580 | <1,160 |
| **Scenario 2 [PE]** | >4,580 | >4,580 | >4,580 | >4,580 | >4,580 | <1,160 |
| **Scenario 3 [PE]** | >4,580 | >4,580 | 3,286 | >4,580 | >4,580 | 1,360 |
| **Scenario 4 [PE]** | Placeholder | Placeholder | Placeholder | Placeholder | Placeholder | Placeholder |

## 1.6 Data Sources

| Location | Ammonia | BOD | Ortho-P |
|---|---|---|---|
| **Upstream** | A (10 records) | C (0 records) | A (10 records) |
| **Effluent** | A (38 records) | A (38 records) | A (38 records) |
| **Downstream** | A (10 records) | C (0 records) | A (10 records) |

| Location | Data Source |
|---|---|
| **Effluent Flow** | A (29 records) |
| **River Flow** | B (14 records) |



### Data Source Description

| Input Parameter | A | B | C |
|---|---|---|---|
| River Flow | Flow duration curve from detailed site-specific analysis. | Flow duration curve using a Hydrotool point close to the WWTP discharge point. | Flow duration curve using a Hydrotool point distant from outfall scaled by catchment area. |
| Upstream Water Quality | Cumulative distribution function generated from EPA and Uisce Éireann observed data. | Probability distribution calculated from statistics from observed data. | Probability distribution based on Notionally Clean mean and 95%ile conditions (20% of High Status EQS limits). |
| Downstream Water Quality | | | |
| Analysis Defining Point Water Quality | | | |
| Effluent Flow | Cumulative distribution function generated from Uisce Éireann monitoring data. | | Probability distribution generated using mean and standard deviation approximated from population equivalent |
| Effluent Quality | | | Probability distribution based on treatment type (primary, secondary, tertiary).* |

* Not implemented in the current version; awaiting agreement of values with Uisce Eireann.

## 1.7 Analysis Statements

- Placeholder: Increasing x by y we see z
- Placeholder: Increasing x by y we see z
- Placeholder: Increasing x by y we see z

## 1.8 Warning Messages

The river water data for the DownStream point is assumed to be notionally clean - BOD

The river water data for the Upstream point is assumed to be notionally clean - BOD

## 2. Mass Balance Calculation Results

### 2.1: Scenario 1 - Current Operations

| Calculation Code | PE | Effl. Flow [m3/s] | Ammonia Concentrations [mg/l] | | | | BOD Concentrations [mg/l] | | | | Ortho-P Concentrations [mg/l] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Effluent | River | Defining Point | | Effluent | River | Defining Point | | Effluent | River | Defining Point | |
| | | | | | MCA | SMBA | | | MCA | SMBA | | | MCA | SMBA |
| **Operating** | 3,053 | 0.007 | 28.117 | 1.129 | 0.836 | 0.836 | 21.225 | 0.406 | 0.406 | 0.406 | 0.659 | 0.091 | 0.091 | 0.091 |
| **Design** | 2,335 | 0.005 | 28.117 | 1.129 | 0.728 | 0.728 | 21.225 | 0.406 | 0.339 | 0.339 | 0.659 | 0.091 | 0.086 | 0.086 |
| **Calc. 0** | 1,160 | 0.003 | 28.117 | 1.129 | 0.546 | 0.546 | 21.225 | 0.406 | 0.224 | 0.224 | 0.659 | 0.091 | 0.077 | 0.077 |
| **Calc. 1** | 1,502 | 0.003 | 28.117 | 1.129 | 0.600 | 0.600 | 21.225 | 0.406 | 0.258 | 0.258 | 0.659 | 0.091 | 0.080 | 0.080 |
| **Calc. 2** | 1,844 | 0.004 | 28.117 | 1.129 | 0.653 | 0.653 | 21.225 | 0.406 | 0.291 | 0.291 | 0.659 | 0.091 | 0.082 | 0.082 |
| **Calc. 3** | 2,186 | 0.005 | 28.117 | 1.129 | 0.706 | 0.706 | 21.225 | 0.406 | 0.324 | 0.324 | 0.659 | 0.091 | 0.085 | 0.085 |
| **Calc. 4** | 2,528 | 0.006 | 28.117 | 1.129 | 0.758 | 0.758 | 21.225 | 0.406 | 0.357 | 0.357 | 0.659 | 0.091 | 0.087 | 0.087 |
| **Calc. 5** | 2,870 | 0.006 | 28.117 | 1.129 | 0.809 | 0.809 | 21.225 | 0.406 | 0.389 | 0.389 | 0.659 | 0.091 | 0.090 | 0.090 |
| **Calc. 6** | 3,212 | 0.007 | 28.117 | 1.129 | 0.859 | 0.859 | 21.225 | 0.406 | 0.421 | 0.421 | 0.659 | 0.091 | 0.092 | 0.092 |
| **Calc. 7** | 3,554 | 0.008 | 28.117 | 1.129 | 0.909 | 0.909 | 21.225 | 0.406 | 0.453 | 0.453 | 0.659 | 0.091 | 0.095 | 0.095 |
| **Calc. 8** | 3,896 | 0.008 | 28.117 | 1.129 | 0.959 | 0.959 | 21.225 | 0.406 | 0.484 | 0.484 | 0.659 | 0.091 | 0.097 | 0.097 |
| **Calc. 9** | 4,238 | 0.009 | 28.117 | 1.129 | 1.008 | 1.008 | 21.225 | 0.406 | 0.514 | 0.514 | 0.659 | 0.091 | 0.100 | 0.100 |
| **Calc. 10** | 4,580 | 0.010 | 28.117 | 1.129 | 1.056 | 1.056 | 21.225 | 0.406 | 0.545 | 0.545 | 0.659 | 0.091 | 0.102 | 0.102 |



### 2.2: Scenario 2 - ELV

| Calculation Code | PE | Effl. Flow [m3/s] | Ammonia Concentrations [mg/l] | | | | BOD Concentrations [mg/l] | | | | Ortho-P Concentrations [mg/l] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Effluent | River | Defining Point | | Effluent | River | Defining Point | | Effluent | River | Defining Point | |
| | | | | | MCA | SMBA | | | MCA | SMBA | | | MCA | SMBA |
| **Operating** | 3,053 | 0.007 | 0.500 | 1.129 | 0.836 | 0.836 | 10.000 | 0.406 | 0.406 | 0.406 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Design** | 2,335 | 0.005 | 0.500 | 1.129 | 0.842 | 0.842 | 10.000 | 0.406 | 0.354 | 0.354 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Calc. 0** | 1,160 | 0.003 | 0.500 | 1.129 | 0.852 | 0.852 | 10.000 | 0.406 | 0.266 | 0.266 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Calc. 1** | 1,502 | 0.003 | 0.500 | 1.129 | 0.849 | 0.849 | 10.000 | 0.406 | 0.292 | 0.292 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Calc. 2** | 1,844 | 0.004 | 0.500 | 1.129 | 0.846 | 0.846 | 10.000 | 0.406 | 0.318 | 0.318 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Calc. 3** | 2,186 | 0.005 | 0.500 | 1.129 | 0.843 | 0.843 | 10.000 | 0.406 | 0.343 | 0.343 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Calc. 4** | 2,528 | 0.006 | 0.500 | 1.129 | 0.840 | 0.840 | 10.000 | 0.406 | 0.368 | 0.368 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Calc. 5** | 2,870 | 0.006 | 0.500 | 1.129 | 0.838 | 0.838 | 10.000 | 0.406 | 0.393 | 0.393 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Calc. 6** | 3,212 | 0.007 | 0.500 | 1.129 | 0.835 | 0.835 | 10.000 | 0.406 | 0.418 | 0.418 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Calc. 7** | 3,554 | 0.008 | 0.500 | 1.129 | 0.832 | 0.832 | 10.000 | 0.406 | 0.442 | 0.442 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Calc. 8** | 3,896 | 0.008 | 0.500 | 1.129 | 0.829 | 0.829 | 10.000 | 0.406 | 0.466 | 0.466 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Calc. 9** | 4,238 | 0.009 | 0.500 | 1.129 | 0.826 | 0.826 | 10.000 | 0.406 | 0.489 | 0.489 | 0.100 | 0.091 | 0.091 | 0.091 |
| **Calc. 10** | 4,580 | 0.010 | 0.500 | 1.129 | 0.824 | 0.824 | 10.000 | 0.406 | 0.513 | 0.513 | 0.100 | 0.091 | 0.091 | 0.091 |

## 2.3: Scenario 3 - Notionally Clean

| Calculation Code | PE | Effl. Flow [m3/s] | Ammonia Concentrations [mg/l] | | | | BOD Concentrations [mg/l] | | | | Ortho-P Concentrations [mg/l] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Defining Point | | | | Defining Point | | | | Defining Point | |
| | | | Effluent | River | MCA | SMBA | Effluent | River | MCA | SMBA | Effluent | River | MCA | SMBA |
| **Operating** | 3,053 | 0.007 | 28.117 | 0.018 | 0.836 | 0.836 | 21.225 | 0.440 | 0.406 | 0.406 | 0.659 | 0.005 | 0.091 | 0.091 |
| **Design** | 2,335 | 0.005 | 28.117 | 0.018 | 0.650 | 0.650 | 21.225 | 0.440 | 0.340 | 0.340 | 0.659 | 0.005 | 0.073 | 0.073 |
| **Calc. 0** | 1,160 | 0.003 | 28.117 | 0.018 | 0.335 | 0.335 | 21.225 | 0.440 | 0.228 | 0.228 | 0.659 | 0.005 | 0.043 | 0.043 |
| **Calc. 1** | 1,502 | 0.003 | 28.117 | 0.018 | 0.428 | 0.428 | 21.225 | 0.440 | 0.261 | 0.261 | 0.659 | 0.005 | 0.052 | 0.052 |
| **Calc. 2** | 1,844 | 0.004 | 28.117 | 0.018 | 0.520 | 0.520 | 21.225 | 0.440 | 0.294 | 0.294 | 0.659 | 0.005 | 0.061 | 0.061 |
| **Calc. 3** | 2,186 | 0.005 | 28.117 | 0.018 | 0.611 | 0.611 | 21.225 | 0.440 | 0.326 | 0.326 | 0.659 | 0.005 | 0.069 | 0.069 |
| **Calc. 4** | 2,528 | 0.006 | 28.117 | 0.018 | 0.701 | 0.701 | 21.225 | 0.440 | 0.358 | 0.358 | 0.659 | 0.005 | 0.078 | 0.078 |
| **Calc. 5** | 2,870 | 0.006 | 28.117 | 0.018 | 0.789 | 0.789 | 21.225 | 0.440 | 0.390 | 0.390 | 0.659 | 0.005 | 0.087 | 0.087 |
| **Calc. 6** | 3,212 | 0.007 | 28.117 | 0.018 | 0.877 | 0.877 | 21.225 | 0.440 | 0.421 | 0.421 | 0.659 | 0.005 | 0.095 | 0.095 |
| **Calc. 7** | 3,554 | 0.008 | 28.117 | 0.018 | 0.963 | 0.963 | 21.225 | 0.440 | 0.452 | 0.452 | 0.659 | 0.005 | 0.104 | 0.104 |
| **Calc. 8** | 3,896 | 0.008 | 28.117 | 0.018 | 1.048 | 1.048 | 21.225 | 0.440 | 0.482 | 0.482 | 0.659 | 0.005 | 0.112 | 0.112 |
| **Calc. 9** | 4,238 | 0.009 | 28.117 | 0.018 | 1.132 | 1.132 | 21.225 | 0.440 | 0.512 | 0.512 | 0.659 | 0.005 | 0.120 | 0.120 |
| **Calc. 10** | 4,580 | 0.010 | 28.117 | 0.018 | 1.216 | 1.216 | 21.225 | 0.440 | 0.542 | 0.542 | 0.659 | 0.005 | 0.128 | 0.128 |



## 2.4: Scenario 4 - Treatment Level

| Calculation Code | PE | Effl. Flow [m3/s] | Ammonia Concentrations [mg/l] | | | | BOD Concentrations [mg/l] | | | | Ortho-P Concentrations [mg/l] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Defining Point | | | | Defining Point | | | | Defining Point | |
| | | | Effluent | River | MCA | SMBA | Effluent | River | MCA | SMBA | Effluent | River | MCA | SMBA |
| **Operating** | 3,053 | 0.007 | 28.117 | 1.129 | 0.836 | 0.836 | 21.225 | 0.406 | 0.406 | 0.406 | 0.659 | 0.091 | 0.091 | 0.091 |
| **Design** | 3,053 | 0.007 | 0.500 | 1.129 | 0.347 | 0.347 | 10.000 | 0.406 | 0.244 | 0.244 | 0.100 | 0.091 | 0.068 | 0.068 |
| **Calc. 0** | 3,053 | 0.007 | 0.250 | 1.129 | 0.342 | 0.342 | 5.000 | 0.406 | 0.172 | 0.172 | 0.050 | 0.091 | 0.066 | 0.066 |
| **Calc. 1** | 3,053 | 0.007 | 0.300 | 1.129 | 0.343 | 0.343 | 6.000 | 0.406 | 0.186 | 0.186 | 0.060 | 0.091 | 0.066 | 0.066 |
| **Calc. 2** | 3,053 | 0.007 | 0.350 | 1.129 | 0.344 | 0.344 | 7.000 | 0.406 | 0.201 | 0.201 | 0.070 | 0.091 | 0.067 | 0.067 |
| **Calc. 3** | 3,053 | 0.007 | 0.400 | 1.129 | 0.345 | 0.345 | 8.000 | 0.406 | 0.215 | 0.215 | 0.080 | 0.091 | 0.067 | 0.067 |
| **Calc. 4** | 3,053 | 0.007 | 0.450 | 1.129 | 0.346 | 0.346 | 9.000 | 0.406 | 0.229 | 0.229 | 0.090 | 0.091 | 0.068 | 0.068 |
| **Calc. 5** | 3,053 | 0.007 | 0.500 | 1.129 | 0.347 | 0.347 | 10.000 | 0.406 | 0.244 | 0.244 | 0.100 | 0.091 | 0.068 | 0.068 |
| **Calc. 6** | 3,053 | 0.007 | 0.550 | 1.129 | 0.348 | 0.348 | 11.000 | 0.406 | 0.258 | 0.258 | 0.110 | 0.091 | 0.069 | 0.069 |
| **Calc. 7** | 3,053 | 0.007 | 0.600 | 1.129 | 0.348 | 0.348 | 12.000 | 0.406 | 0.273 | 0.273 | 0.120 | 0.091 | 0.069 | 0.069 |
| **Calc. 8** | 3,053 | 0.007 | 0.650 | 1.129 | 0.349 | 0.349 | 13.000 | 0.406 | 0.287 | 0.287 | 0.130 | 0.091 | 0.069 | 0.069 |
| **Calc. 9** | 3,053 | 0.007 | 0.700 | 1.129 | 0.350 | 0.350 | 14.000 | 0.406 | 0.302 | 0.302 | 0.140 | 0.091 | 0.070 | 0.070 |
| **Calc. 10** | 3,053 | 0.007 | 0.750 | 1.129 | 0.351 | 0.351 | 15.000 | 0.406 | 0.316 | 0.316 | 0.150 | 0.091 | 0.070 | 0.070 |

## 3. Capacity Calculation Results

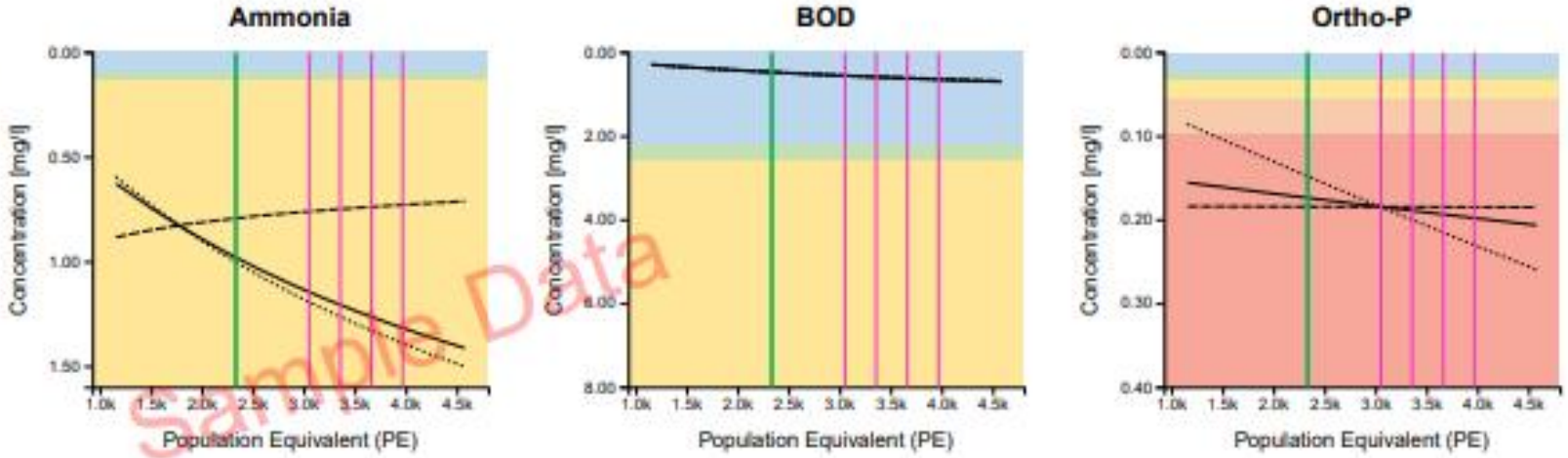
### 3.1 Effects of Population on Concentration for Scenarios 1 to 3 - MCA

Bad | Poor (P only) | Moderate | Good | High | Scenario 1: Current Operations | Scenario 2: ELV | Scenario 3: Notionally Clean

Graphs show estimated concentration at the monitoring point for each quality parameter for a range of PE loadings on the WwTP for each.

Scenario:
1. Current Operation
2. Discharge at ELV concentrations
3. Discharge to Notionally Clean River

Green vertical line shows current Design Capacity.
Pink vertical lines show Operation Load +0%, +10%, +20% and +30% loading.





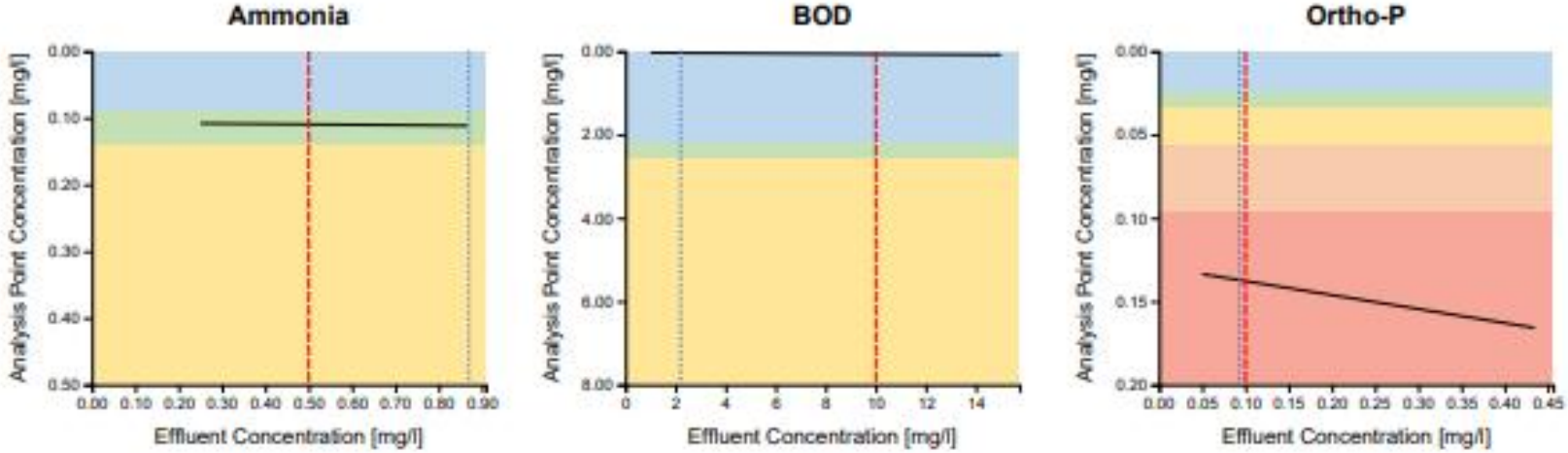

### 3.2 Effect of Effluent Discharge Concentration on Downstream Analysis Point for Scenario 4 - MCA

Bad | Poor (P only) | Moderate | Good | High | Scenario 4: Treatment Level | ELV | Current Operation

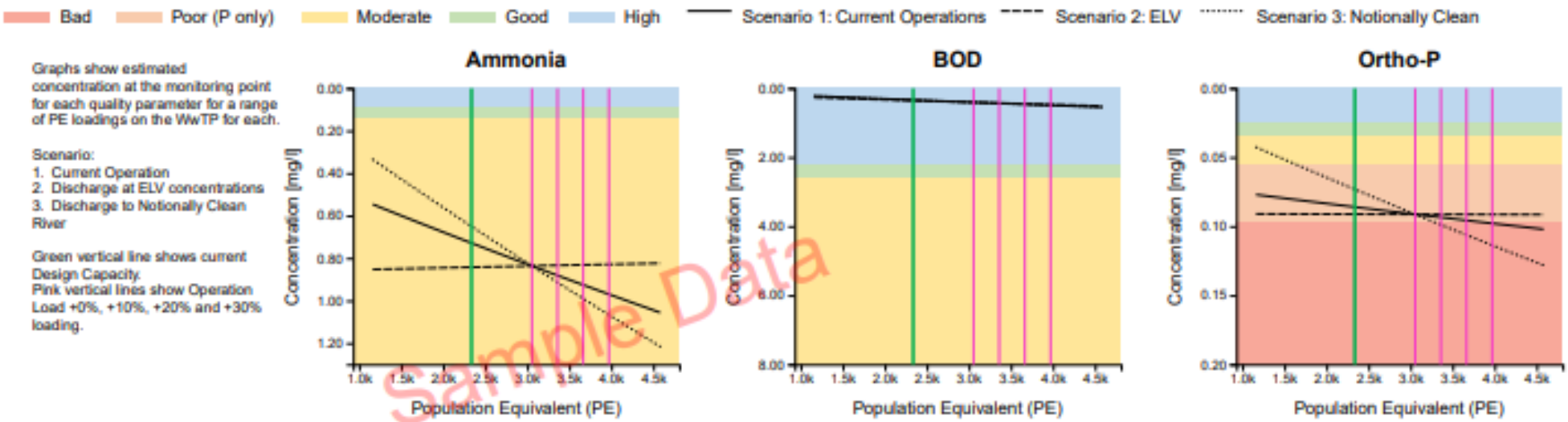
Graphs show estimated concentration at the monitoring point for each quality parameter for a range of concentrations of the effluent.

Scenario 4: Change in treatment efficiency

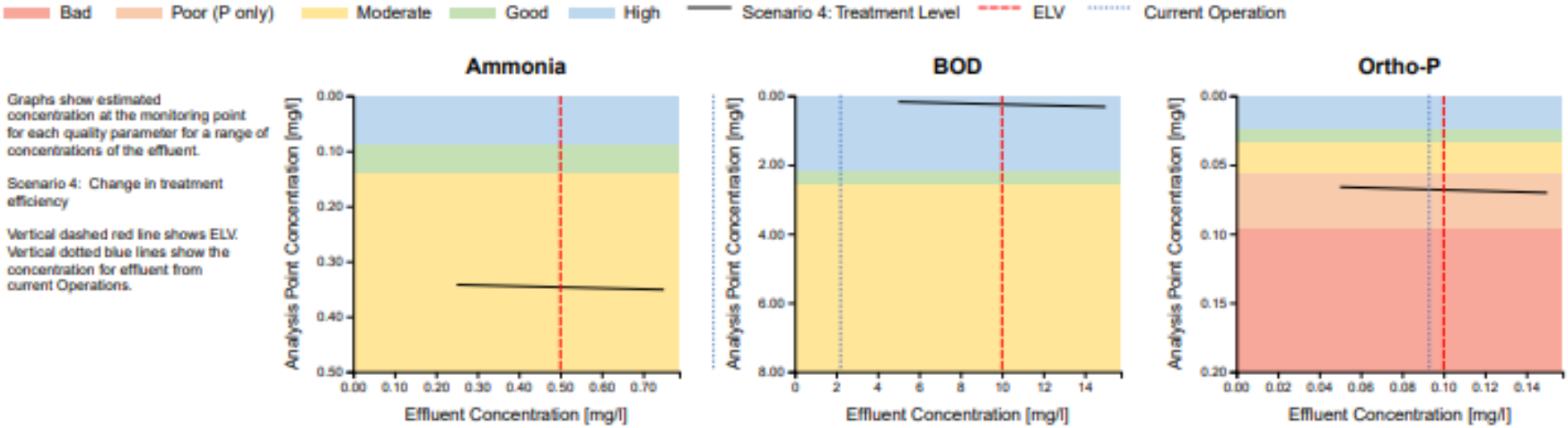
Vertical dashed red line shows ELV.
Vertical dotted blue lines show the concentration for effluent from current Operations.



## 3.3 Effects of Population on Concentration for Scenarios 1 to 3 - SMBA



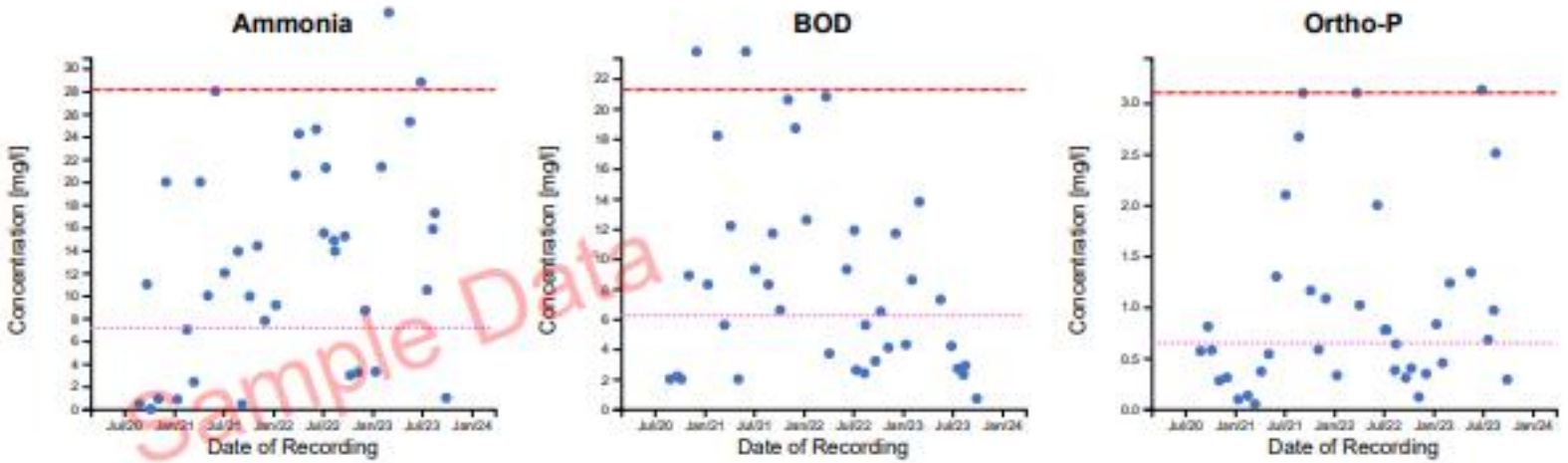

## 3.4 Effect of Effluent Discharge Concentration on Downstream Analysis Point for Scenario 4 - SMBA



## 4. Effluent Quality

Observed data  Mean  95th percentile

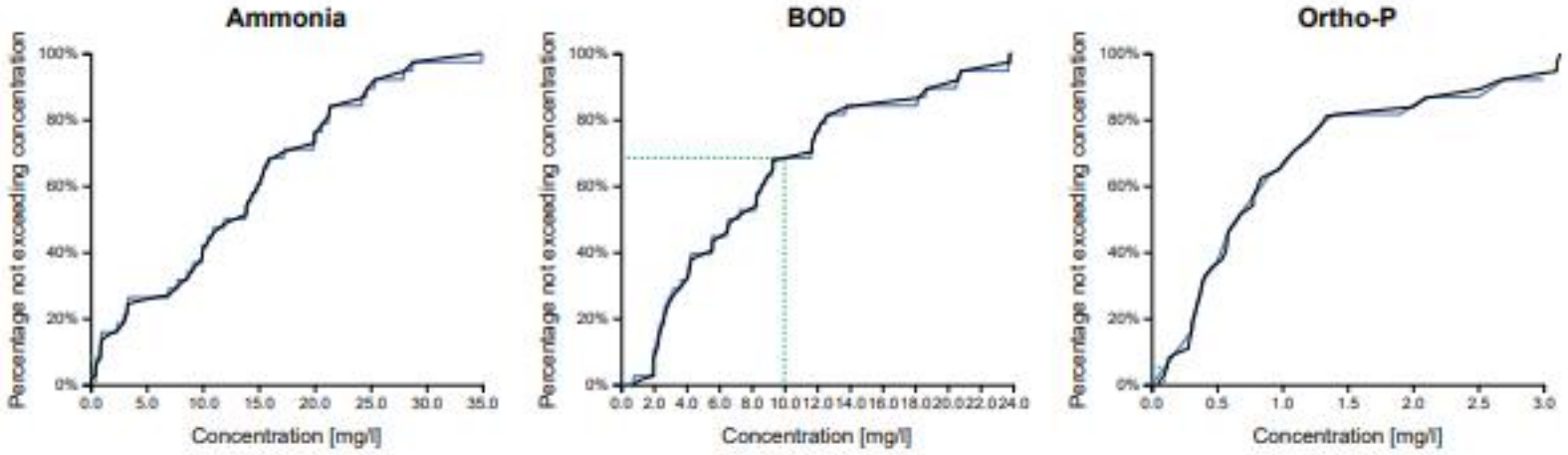
Graphs show the observed concentrations at the primary effluent discharge point for each quality parameter.






Observed cumulative %  Standardised line  Proportion of compliant records

Graphs show the proportion of compliant observed data at the primary effluent discharge point for each quality parameter.

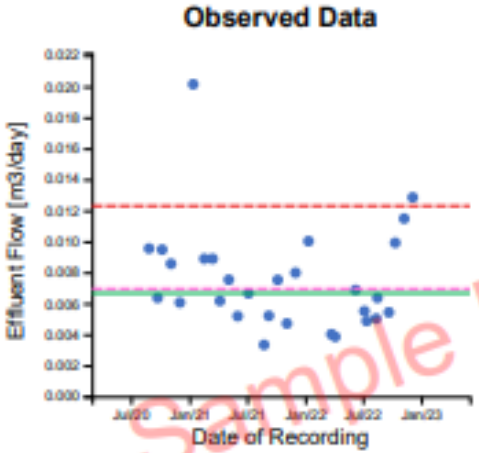


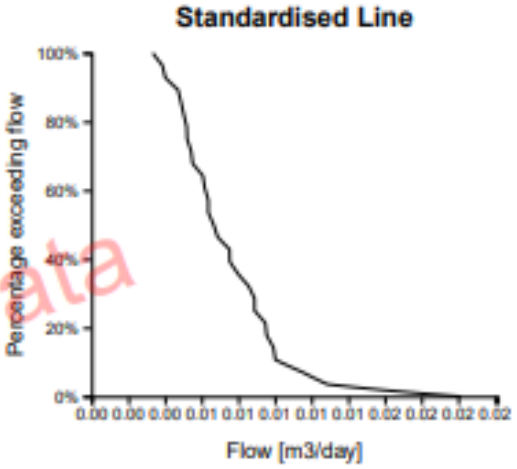
## 5. Effluent Flow Rates

Observed data — Median — Mean — 95th percentile — Standardised line

The first graphs show the observed effluent flow rates estimated from daily flow rate for a range of concentrations.

The second plot shows a standardised line.






| Statistic | Value [m3/day] |
|---|---|
| **Median** | 0.01 |
| **Mean** | 0.01 |
| **95th Percentile** | 0.0123 |
| **Standard Deviation** | 1.48 |
| **Samples** | 29 |

| Percentile | Value [m3/day] |
|---|---|
| **1** | 0.0035 |
| **5** | 0.0039 |
| **10** | 0.0046 |
| **20** | 0.0051 |
| **30** | 0.0055 |
| **40** | 0.0062 |
| **50** | 0.0067 |
| **60** | 0.0075 |
| **70** | 0.0088 |
| **80** | 0.0095 |
| **90** | 0.0103 |
| **95** | 0.0123 |
| **99** | 0.0181 |

| Year | Max Value [m3/day] |
|---|---|
| **2023** | Insuff. data |
| **2022** | Insuff. data |
| **2021** | Insuff. data |
| **2020** | Insuff. data |

# 7. River Water Quality at the Upstream and Analysis Points

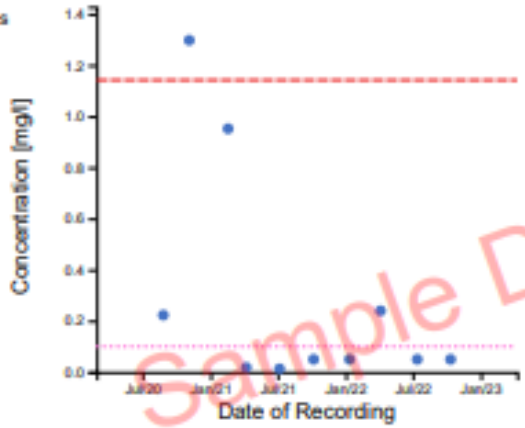
## 7.1 Water Quality at Upstream

Observed data  Mean  95th percentile

Graphs show the observed concentrations at upstream location for each quality parameter.

Blue points show observed data.
Vertical dashed red line shows 95th percentile.
Vertical dashed pink line shows mean.

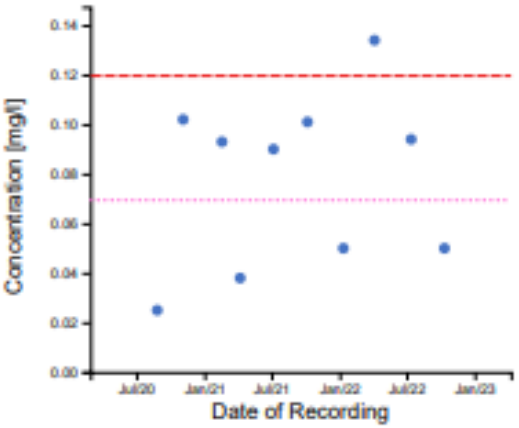
### Ammonia




### BOD

Insufficient data

### Ortho-P






| Statistic | Ammonia [mg/l] | BOD [mg/l] | Ortho-P [mg/l] |
|---|---|---|---|
| **Min** | 0.01 | Insuff. data | 0.03 |
| **Median** | 0.05 | 0.26 | 0.09 |
| **Mean** | 0.10 | 1.30 | 0.07 |
| **95th Percentile** | 1.14 | 2.20 | 0.12 |
| **Max** | 1.30 | Insuff. data | 0.13 |
| **Standard Deviation** | 4.79 | 0.13 | 1.71 |
| **Samples** | 10 | 0 | 10 |

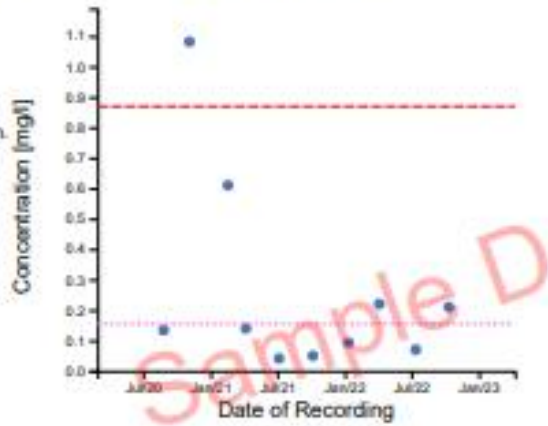
## 7.2 Water Quality at Analysis Point (Downstream)

Observed data  Mean  95th percentile

Graphs show the observed concentrations at downstream location for each quality parameter.

Blue points show observed data.
Vertical dashed red line shows 95th percentile.
Vertical dashed pink line shows mean.

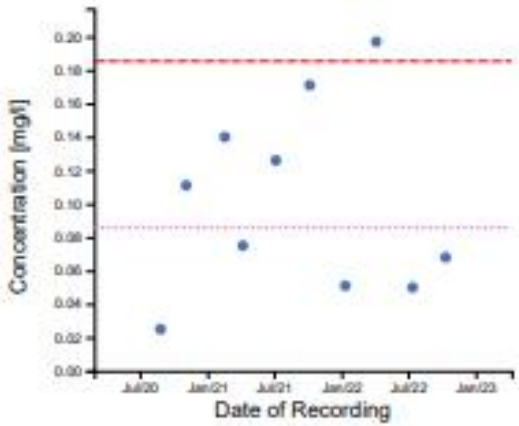
### Ammonia




### BOD

Insufficient data

### Ortho-P






| Statistic | Ammonia [mg/l] | BOD [mg/l] | Ortho-P [mg/l] |
|---|---|---|---|
| **Min** | 0.04 | Insuff. data | 0.03 |
| **Median** | 0.14 | 0.26 | 0.09 |
| **Mean** | 0.15 | 1.30 | 0.09 |
| **95th Percentile** | 0.87 | 2.20 | 0.19 |
| **Max** | 1.08 | Insuff. data | 0.20 |
| **Standard Deviation** | 2.85 | 0.13 | 1.91 |
| **Samples** | 10 | 0 | 10 |