# Staveley Wastewater Treatment Works

## Report on the year-long monitoring of discharges undertaken by Staveley with Ings Parish Council: February 2022 to February 2023






### Introduction

Since 2017, following the aftermath of Storm Desmond, Staveley with Ings Parish Council has been working with other agencies and organisations to resolve the problem of unpermitted sewage discharge, particularly in heavy and persistent rain, both on to village streets and into its rivers, the Kent and Gowan.

Over this period the circumstances have been clearly identified as:

- Public waste water manholes have discharged sewage on to village roads 50 times
- All discharges are within a few metres of our two SSI and SAC rivers
- Wet wipes and nappy liners cling to the manholes during discharges
- One discharge is across a route to school; another blocks the approach to a village footbridge
- The cause is a restriction in the pipe size as it passes beneath the River Kent, causing a back-up of sewage in heavy rain

During this time, concern about the adequacy of the WwTW began to surface with the possibility of a link between its capacity to cope with high inflow levels and the pipe restriction upstream. As evidence of excessive amounts of untreated sewage emerged, entering the River Kent from the WwTW, the Council undertook a programme of year-long observations of the site to monitor these discharges. As a result of these evidence recorded, it is clear that:

- Excessive amounts of surface/ground water enter the combined waste system (foul and surface water) at all times but especially during only moderate rainfall.
- Only small increases in rainfall cause the WwTW to discharge untreated sewage, rendering it inadequate
- Following research by the Clean River Kent Campaign, the water quality in the Kent is poor, especially so downstream of the WwTW

## Location of Staveley WwTW

The site lies approximately half a mile downstream from Staveley in a beautiful location immediately adjacent to the River Kent. It is fed by a 40cm diameter pipe across farmland. As it leaves the village this is initially across a flood plain which is under water in heavy and persistent rain. The Dales Way, a national footpath regularly used by walkers, follows the river on the opposite bank. The protected designation of the river extends throughout its route from Staveley to the WwTW and beyond.

The site is operated by United Utilities. Both the Dump Pipe and the Treated Pipe discharge directly into the river from the site. The Dump Pipe is used to discharge untreated sewage in emergency storm conditions when the WwTW is unable to store or cope with the inflow of foul water. It is also used to discharge sewage that has undergone some settlement in holding tanks, when these have reached capacity. As far as it is known, there is no check on the concentration of pollution that the liquid contains at this point. The Treated Pipe discharges the run-off of water after treatment. This is self-monitored by an 'independent' unit working within UU. All discharges are subject to an Environment Agency permit.

## Methodology

Between February 25th 2022 and February 27th 2023, 186 observations of the WwTW were made, on 154 separate days. Observers completed a common grid to record the outflow from both the Dump and Treated Pipes, the extent of flow and any visual contamination. (See appendix 1.) Weather conditions and the precise timing of each observation were also noted. On 173 visits the river levels of the Gowan at Staveley (normal range 0.26m to 1.0m as identified by EA), and the Kent at Bowston (normal range 0.13m to 1.2m) were also recorded at the precise time of the visit. These were taken from the measurements available on the Government river level website at Staveley - Find river, sea, groundwater and rainfall levels - GOV.UK (check-for-flooding.service.gov.uk).

Photographs were taken as further evidence of the discharging pipes on 102 of the 186 observations. As the observations progressed, attention focused more particularly on the Dump Pipe; the recording of the Treated Pipe was done on a less frequent basis.

Nine volunteers carried out the observations, using agreed guidelines (see appendix 4), which were then recorded on a central database under the headings shown below. This use ensured consistency of approach and reliability of the process. Occasionally, it proved difficult to assess the Dump Pipe overflow, particularly when it was underwater but as the results were compiled, the discharge pattern in relation to rainfall and subsequently river levels became clear enabling observations to be confirmed. As the Treated Pipe is positioned lower in the water, although less subject to rainfall variations, observations were not always possible.

| Date (x.x.xx) | Time (24 hrs) | Weather conditions Eg: Dry/ Showery/ Recent heavy rain/ Flood | Discharge evidence Upper pipe (concrete surrounding structure) DUMP PIPE Record: Yes for discharging No: Not discharging | If yes, flow evidence: Discoloured: Yes/No Approx. length of plume in river: Eg: 1m; 2m; half way (across river), | Discharge evidence Lower pipe (no surrounding structure) TREATED PIPE Record: Yes for discharging No: Not discharging | If yes, flow evidence: Discoloured: Yes/No Approx. length of plume in river: Eg: 1m; 2m; half way (across river) | River level: Gowan at Staveley | River level: Kent at Bowston | Photo attached: Yes/No<br><br>Other: Eg: Tanker discharging |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

A full set of recorded observations is available in appendix 1.

The visits were made at random to suit volunteer availability. On a few occasions this resulted in duplication on a particular day but rather than proving unnecessary, this helped to validate observations and also provided a more complete check should discharge change. This unscheduled approach taken over a full year is considered to provide a fair reflection of the WwTW performance. However, as more visits are likely to have been made in reasonable weather conditions, which as is now clear, significantly influence discharge, it is possible that the frequency of these is under-recorded.

The greatest difficulty volunteers faced was in estimating the extent of any plume of discolouration, which would indicate the presence of pollution. However, with the emphasis on the Dump Pipe, while the concentration of sewage will vary depending on whether it is storm dumping or an overflowing settlement tank, it is all untreated.

Rainfall data from Meteorological Site 585177, situated at the west end of Staveley, was made available for every day across the survey period to enable the correlation with river levels to be analysed. (See appendix 2.) As expected, river levels are shown to be generally consistent with rainfall although differences in timing occur. Both the Gowan and Kent rivers are known to rise and fall quickly but there will always be an impact delay on river levels, depending on a number of factors including how localised the rainfall is, its intensity and land conditions at the time. Occasionally, although unusually, melting snow will add to the variations.

## General Findings and Data Analysis

- **Sewage Discharges:** There is an excessive amount of untreated sewage discharging into the River Kent from the WwTW.
    - **98 of the 186 observations recorded sewage discharging into the River Kent; 53% of the visits**.
    - Further information from United Utilities would be needed to determine the proportion that was emergency (storm) discharge but it is clear from an analysis of associated rainfall over the survey period that the vast majority of this is dumped in 'normal' weather conditions

- **As a result, it is concluded that the WwTW is incapable of operating adequately to treat the current, regular amount of foul water in the combined system.**

- **River Level Rise linked to Discharges:** The levels of both rivers, Kent and Gowan, were recorded at the precise time when 173 of the observations were made. The discharges observed show a high correlation with rainfall and subsequently river levels, clearly demonstrating that significant amounts of surface and ground water are entering the combined sewerage system.
  - **Consequently, using river level data, it is possible to predict, with 90% accuracy, the level at which the Dump Pipe will discharge. In this report, this is termed the river's 'threshold' value.**
  - Modelling different threshold values showed that the best fit for the Kent to begin discharging was at a river level of 0.27m. **When the Kent was at or above this level, discharges occurred 90% of the time from the Dump Pipe.**
  - The lowest (base) level observed for the Kent during the visits, as recorded at the Bowston measuring station, was 0.12m. **Hence, a rise of just 0.15m (15cm) is 90% certain to result in discharge at the WwTW.**
  - For the Gowan, the best fit threshold level for discharge to occur was shown to be 0.38m. **At or above this level discharge occurred 90% of the time.**
  - The lowest (base) level recorded by the Gowan river gauge in Staveley for the whole survey period was 0.27m. **Consequently, a rise of 0.11m (or 11cm) in the level of the Gowan will likely cause discharge from the Dump Pipe at the WwTW.**

- **In summary, moderate rainfall and subsequent small increases in river levels result in Dump Pipe WwTW discharges, indicating that the site is operating close to or beyond capacity at all times.**

- **Rivers Levels Follow Similar Rhythms:** Both rivers (Kent and Gowan) respond to weather conditions in a similar rhythm although, as explained previously, the precise impact on river levels may vary.
  - When discharging occurred, in 84% of the observations both rivers were at or above their threshold value. In only 10% were both below, while in 6% of the time only the Gowan was above
  - When no discharging occurred, both rivers were below threshold in 92% of the observations, while in 3% of visits both were at or above their threshold level. In 4.5% of the time only the Kent was under its threshold.
  - **This evidence demonstrates that during the year-long observation period the two river levels rose and fell consistently together and with a similar impact on the Dump Pipe discharge for 95% of the time.**

- **Annual Rate of Discharges:** Using both observational evidence and Gowan river level records, compiled by the Environment Agency, the total duration of discharges occurring at or above threshold levels was assessed. **Across the year-long survey period this amounted to 3616 hours (or over 150 days) of untreated sewage being dumped in the River Kent. (See appendix 3).**

- **Longest Continuous Discharge: This occurred from 30.9.22 to 4.12.22 for a total of 1558 hours (or almost 65 days) as shown in appendix 3.**

- **Predicting Annual Discharge Rate using Daily Counts:** The correlation between river level and Dump Pipe discharges also enables predictions to be made on the frequency of discharges across a longer period. As the Gowan follows a course through Staveley that is more likely to interact with the combined sewerage network, the river's rainfall gauge, upstream of the WwTW, was used as a predictor. A**cross the 154 observation days, the threshold level of 0.38m was breached on 72 (47%) of these. It follows that in a full year, Dump Pipe discharging is likely on 172days.**
    - **Applying a similar calculation to the Kent, its threshold was breached 66 days out of the 154 on which recordings were taken, a frequency of 43%. For a full year this equates to 157 days**
    - **These predictions resemble those for the actual discharges observed, as described above.**

- **No Discharges Recorded in Storm Conditions:** Using the designated low, normal and high river level values for the River Gowan monitoring station in Staveley, only on one occasion, and then just for eleven hours on 10th January 2023, was the river level in the 'high' range. **This demonstrates clearly that the discharges were not caused by 'STORM' conditions.** (As this reading did not coincide with an observation visit, all the recordings of the WwTW actually took place when the Gowan river level was within its 'normal' range.)
    - Using the designated levels for the River Kent (as recorded at Bowston), with the exception of one observation when the level dropped into the 'low' category, all others were also within its 'normal' range.
    - **Consequently, the discharges are shown to be occurring routinely when NORMAL river level conditions pertain in both rivers.**

- While variations in rainfall affect the timing of river level movement, one conclusion is startlingly clear: **The WwTW Dump Pipe discharges increase as a consequence of rainfall and continue beyond such times when dry conditions prevail until the river levels reduce to below their threshold value.**

- **Treated Pipe Discharges:** The Treated Pipe never stopped discharging throughout the observations. Given the extent of excess surface and ground water in the system, it is likely that this continues on a 24 hour basis. This requires further investigation.

## Recommended Actions

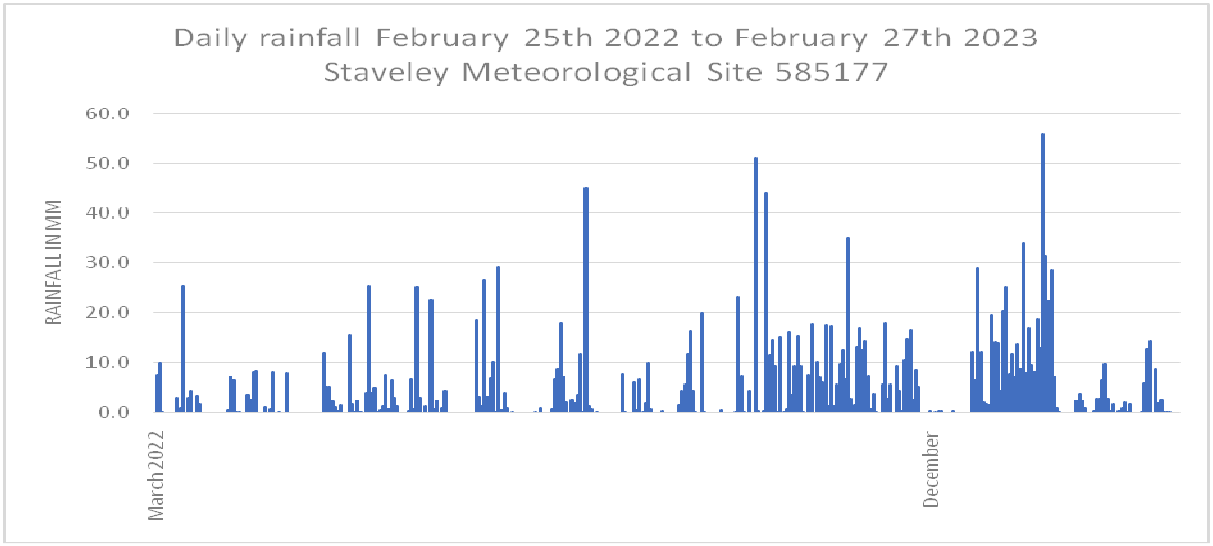
- The quantity of foul water in the system needs to be assessed and measured against the current population of Staveley and take into account year-round visitor and business use.
- The proportion of household and business related sewage in the foul water needs to be assessed to determine the amount of excess surface and groundwater entering the system.
- Urgent measures need to be determined to identify and quantify the extent of surface and ground water entering the combined sewerage system from inflowing culverts, village infrastructure and across the flood plain
- Detailed plans need to be drawn up to resolve this and analyse its impact on both the village sewerage infrastructure and the WwTW
- In the light of this analysis, early consideration should be given to the further resources needed to resolve the problem to be implemented no later than 2030

- United Utilities will possess detailed information of the WwTW performance in relation to the findings outlined in this report. These need to be made openly available and solutions sought on a locality basis to address the current, regular, unpermitted discharges
- Future analysis should include discharge flow rate and duration from the Treated Pipe
- The Environment Agency should be informed of the report findings so that it can regulate the performance of Staveley WwTW more effectively
- The Lake District National Park Planning Authority should be made aware of the report findings, particularly the lack of capacity at the WwTW

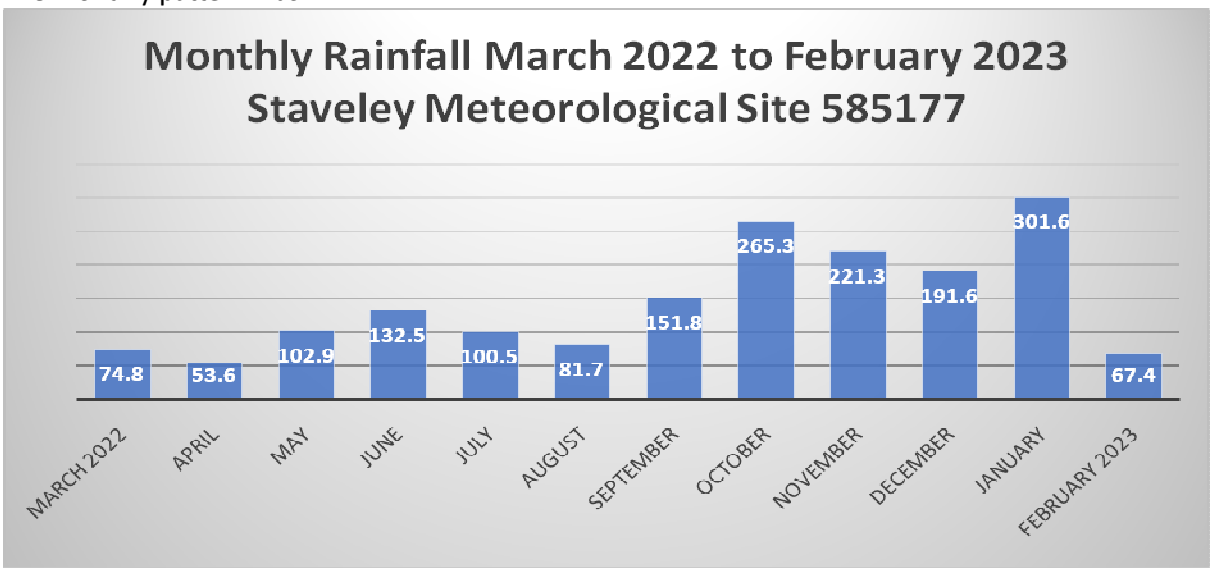
**Appendix 1: Grid showing WwTW Observations, 25.2.22 to 27.2.23** (see separate accompanying document)

**Appendix 2: Rainfall Patterns and River Levels**

For the observed period the daily rainfall pattern, as recorded at the Meteorological Site 585177 in Staveley, is shown below:

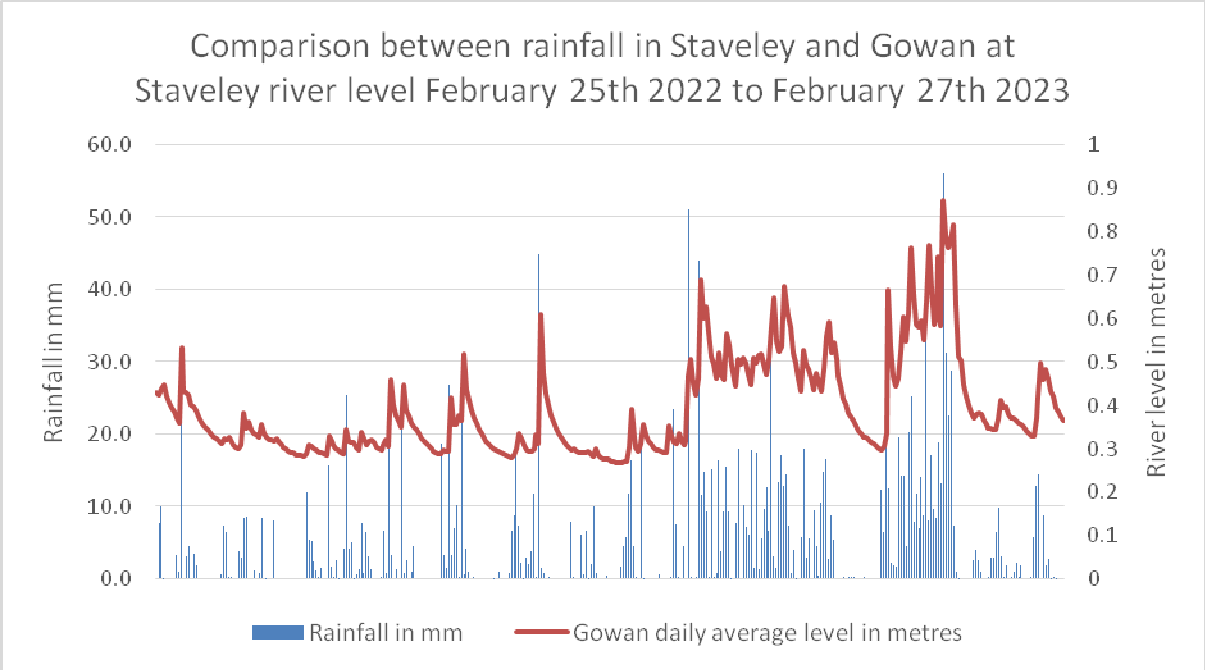



The monthly pattern was:

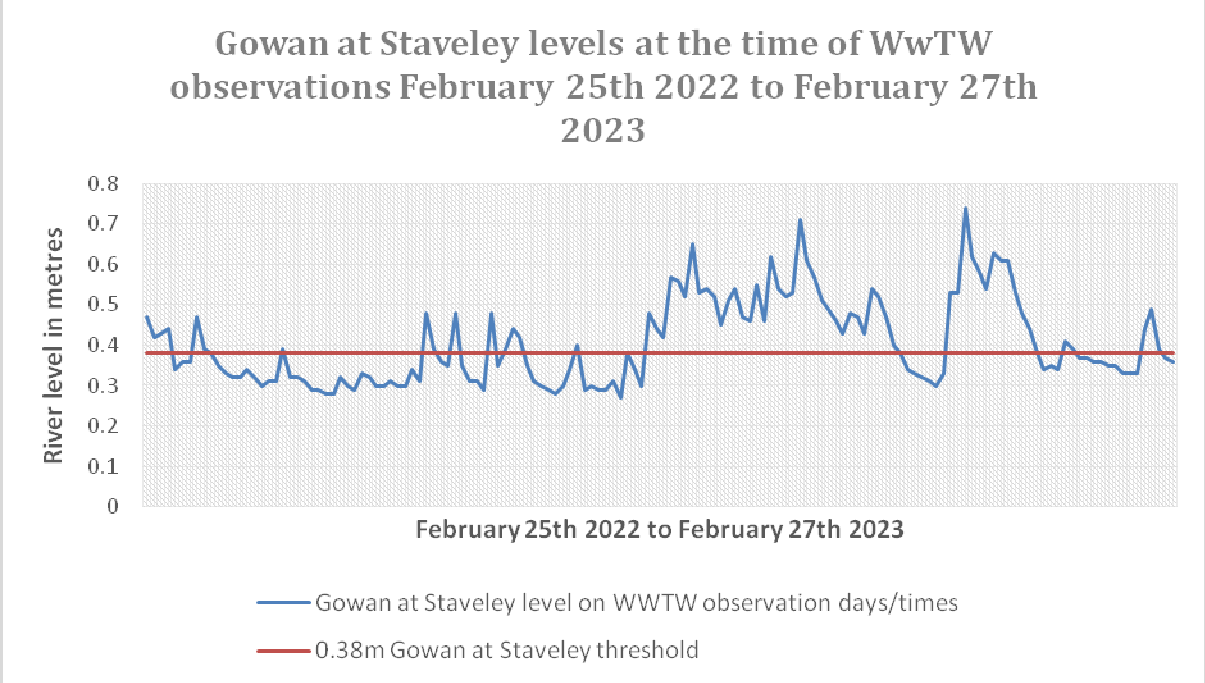


## Correlation between rainfall and recorded river level

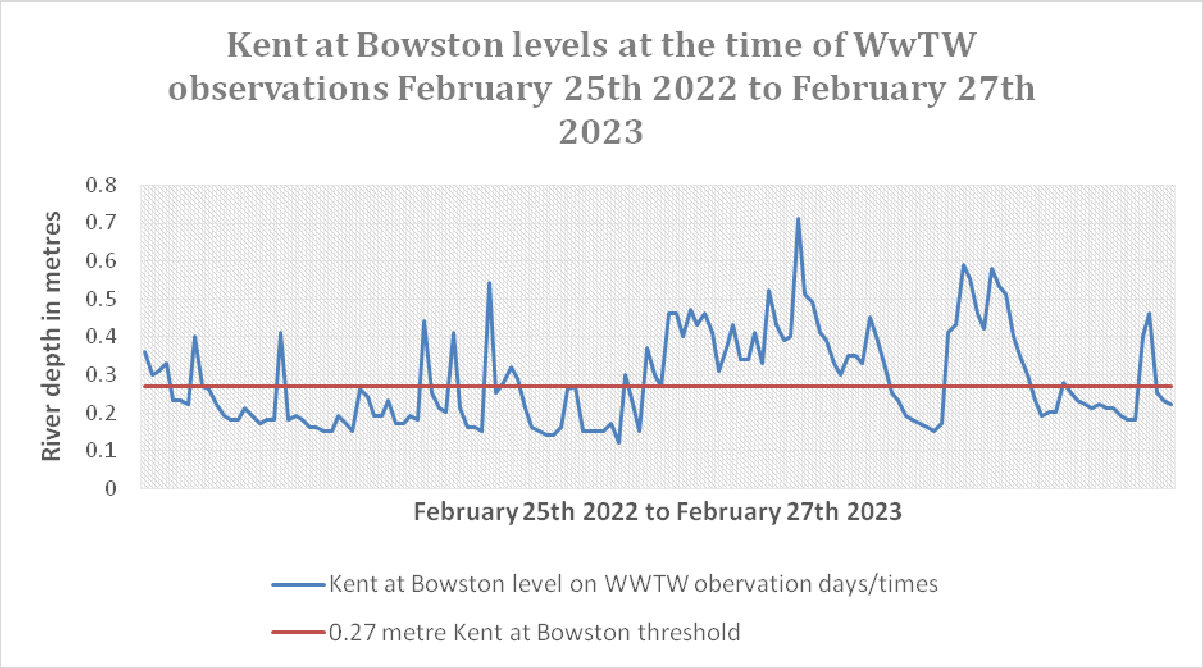
The following graph shows daily rainfall together with the river levels at the time the Dump Pipe was observed on the 154 observation days when river level data was recorded. There is a broad correlation but some variances. It should be noted that the rainfall data is a record of a 24 hour total whereas the river level data is a single point observation.




## Correlation between river level and Dump pipe discharging




In 90% of the observations the Dump Pipe was discharging once the Gowan at Staveley was 0.38m or above.




In 90% of the observations the Dump Pipe was discharging once the Kent at Bowston was 0.27m or above.

**Appendix 3: Discharge Record** (dates and durations)

Data collated from survey record and river level threshold breached as shown by Gowan measuring station in Staveley

| Start Date | Start Time | End Date | End Time | Duration (Hrs) |
|---|---|---|---|---|
| 25.2.22 | 1500 | 8.3.22 | 2100 | 270 |
| 11.3.22 | 1900 | 18.3.22 | 2000 | 169 |
| 3.6.22 | 0300 | 6.6.22 | 0900 | 78 |
| 8.6.22 | 0300 | 10.6.22 | 1400 | 59 |
| 27.6.22 | 0400 | 27.6.22 | 2200 | 18 |
| 30.6.22 | 0600 | 30.6.22 | 1600 | 10 |
| 1.7.22 | 2100 | 6.7.22 | 0400 | 103 |
| 2.8.22 | 0000 | 6.8.22 | 1500 | 111 |
| 7.9.22 | 2100 | 8.9.22 | 0100 | 4 |
| 12.9.22 | 0300 | 12.9.22 | 1400 | 11 |
| 22.9.22 | 1600 | 23.9.22 | 0300 | 11 |
| 30.9.22 | 1400 | 4.12.22 | 1200 | 1558 |
| 18.12.22 | 2200 | 22.1.23 | 0100 | 819 |
| 23.1.23 | 1500 | 25.1.23 | 2000 | 53 |
| 1.2.23 | 1300 | 6.2.23 | 0800 | 115 |
| 16.2.23 | 2300 | 26.2.23 | 1000 | 227 |
| | | | **Total** | **3616 hours (150.7 days)** |

## Appendix 4: Guidelines for the Monitoring Visits:

### Monitoring Outflows from Staveley WWTW: Notes for Volunteers

**Location**

The WWTW is located about half a mile down the Dales Way footpath from the main road on the Staveley side of the level crossing. The two discharge pipes can be viewed from the path, from which you should make your observation. It is not a requirement to go closer to the river bank but if you choose to do this please take great care – the ground is uneven and the stones can be slippery. Under no circumstances should you enter the water at the site.

The first (upstream) discharge pipe is the DUMP pipe, out of which untreated sewage emerges when the WWTW is unable to cope with the quantity of waste water in the system. It is easy to spot towards the left hand side of the site (as viewed from across the river) and is encased in a concrete structure.

The second (lower downstream) pipe is for TREATED waste water. It is towards the right of the site and is less easy to spot emerging from the river bank, although you will soon get used to it.

**Your Task**

You are asked to simply complete the accompanying grid, keeping to the guidance and responses requested so that comparisons made can be as accurate as possible. You should then send it to me at arthurcapstick@btinternet.com within two days of a visit. This is to allow me to check the water level data for your visit, which is only readily available for a few days, if you have not completed that column yourself. (Please note the email address is not my usual one but it is correct. I plan to keep the WWTW data in this separate file). You may also choose to attach up to two photos (max per visit). This to add additional information but it is suggested that this is only necessary when discharge is occurring. Taking your photo at an angle will show the discharge better. Depending on the light, you may find it tricky to capture a good visual image of the water which is why your observational record is so important.

**My Task**

I will then extract your data by copying and pasting to an overall grid which will build the complete picture. Once I've done this, I will delete your grid until you send your next observations, which should be added to your previous record. In this way we have a back up should one be needed.

**Monitoring Grid**

Weather conditions: Please keep to the four descriptions. We can agree more if needed once we have all made a few visits

Discharge pipes and flow evidence: Again only use the responses shown: Yes, No, 1m, 2m, Half way

River levels, Gowan and Kent: These can be found as follows but if you are not familiar with this site I will complete it, hence the need for a quick return. Use the address https://check-for-flooding.service.gov.uk/river-and-sea-levels In the search location window put in 'River Gowan'. This will bring up 'Staveley Village' for the Gowan and 'Bowston' for the Kent. You can then record the level from the graph for the time of your visit.

Rainfall: I will complete this column as I have not asked for this data to be made more generally available

Photo/Other: Only record Yes or No. Name and date each photo: WWTW, x xx xx, 1 (or 2). For 'Other' only complete this if you notice something unusual, such as the example given.

Disclaimer: Finally the Parish Council is unable to accept responsibility for any accidents or injuries that occur while undertaking monitoring.

On behalf of the Parish Council, many thanks for helping in this way. It really is appreciated.

Report compiled by Arthur Capstick and Mike Cambray on behalf of Staveley with Ings Parish Council March 2023