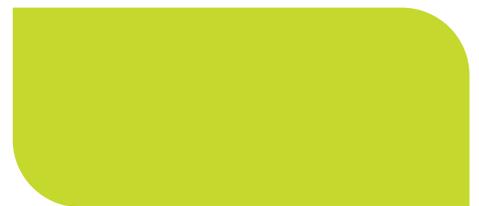
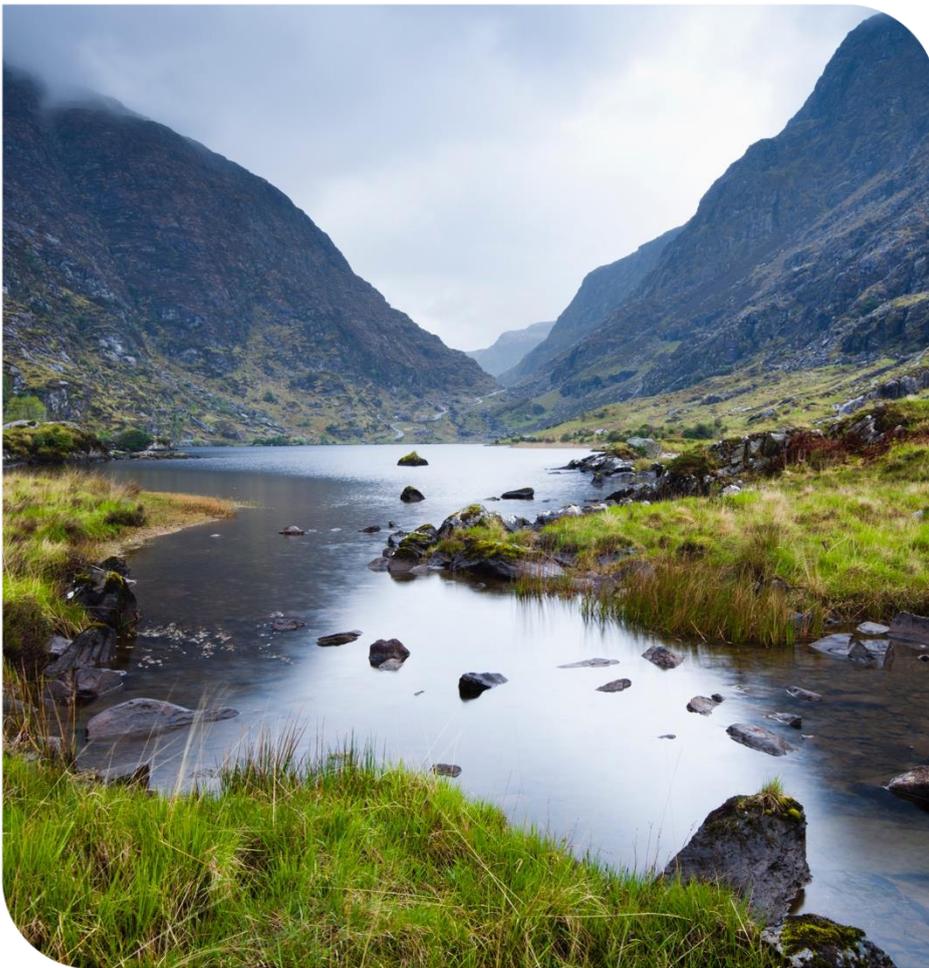


26 November 2021



Irish Water Top 26 Water Treatment Plants - Assessment Report



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1 – Executive Summary

In response to two separate incidents that occurred at Ballymore Eustace and Gorey Water Treatment Plants (WTPs) in August 2021, Irish Water undertook an assessment of 26 Water Treatment Plants – of which the population served accounts for 65% of Irish Water’s customer base. The purpose of these assessments was to ensure the necessary processes were in place to deal with and escalate incidents which may arise. The assessments focussed on determining the compliance status of each plant and carrying out an Alarm and Inhibit (A&I) review of the disinfection and filtration processes (both of which are critical water treatment processes). In parallel to these assessments, Irish Water provided training to the management and operators of the Top 26 WTPs. This training provided clear guidelines on the water quality and water treatment standards applicable to the WTP in question and identified what constitutes a reportable incident as relevant to the plant.

Disinfection system compliance and alarms

In relation to the disinfection processes, the findings confirmed that 25 out of 26 plants are 100% compliant with regulatory microbiological parameters, all plants have a functioning disinfection system, and all plants now have chlorine monitors and alarms in place and set at the correct levels. 1 plant requires some additional UV alarm works (Srowland WTP) which are underway and expected to be complete before year end.

Filtration system compliance and alarms

In relation to the filtration processes, the findings confirmed that protozoa monitoring (i.e. for Cryptosporidium and Giardia) was in place at 18 plants, and 14 of these had zero detections from Jan 2020 to date. Some low-level detections were identified in 4 plants in 2020-2021, however long-term solutions to address these issues are now in place at 3 of these plants and monitoring is no longer required. Interim measures are in place at the 4th location until the longer-term solution is in place. The remaining plants do not require Cryptosporidium monitoring as they have a validated barrier in place. All plants have a functioning filtration system, and all plants except 1 (Drumcliffe) have the required set of turbidity monitors in place. Turbidity monitors and alarms at this plant are expected to be in place by the end of February 2022. With the exception of 3 remaining plants, all have the required turbidity alarms and set points in place. These 3 remaining plants (which already have the required monitors in place) will have the necessary alarms and set points in place before the end of the year.

Automatic WTP shutdown capability

In relation to automatic plant shut down, 20 out of 26 plants have automatic shutdown capabilities if a critical chlorine alarm is activated. Of the plants with UV disinfection, 8 out of 11 plants will automatically shut down following a critical UV alarm. In terms of the Filtration process, 19 out of 26 plants have automatic shutdown capabilities if Turbidity levels exceed acceptable levels. The plants that do not have automatic shut down in place on either / both disinfection and filtration processes rely on manual responses to alarms, incident management and notification requirements to ensure water quality and public health is protected. Measures to facilitate auto shut down can vary from small to significant interventions and careful consideration is required to ensure there are no unintended negative consequences to new measures introduced. Improvement Programmes (AIPs) have been identified to determine the required measures. AIPs are either complete or underway for 8 plants, plans for 6 plants will be complete before the end of Q1 2022 and a new plant will be provided at Lee Road in Q2 2022. Necessary measures identified to enable automatic shutdowns will be prioritised for delivery by Irish Water.

Incident Management

Incident Management and notification training was provided to the management and operators of all 26 WTPs. In some cases, plant managers cascaded the training to all plant operatives. Training was also provided to all 31 LA staff nationally for onward cascading to plant operating staff. Cascading is now complete by 27 Local Authorities. 4 Local Authorities are required to have all have all training cascaded by the end of December 2021.

2 – Introduction and Background

In August 2021, two separate incidents occurred at the Ballymore Eustace (BME) and Gorey WTPs. These incidents highlighted the need for improved operational oversight by Irish Water of critical treatment processes, and for key controls such as alarms, automatic shutdowns, and telemetry to be in place and effective.

In response to these incidents, the Environmental Protection Agency (EPA) instructed Irish Water to undertake immediate corrective actions to ensure that the plants in question produced safe and secure drinking water. Irish Water committed to immediately commence assessments of our Top 20 water treatment plants to help ensure the likelihood of similar incidents occurring at these WTPs would be minimised.

On the 18th September 2021, Minister O'Brien met with Irish Water and Local Authority senior management to discuss the events at BME and Gorey. Following this meeting the Minister reinforced the EPA's request, instructing that Irish Water "*prioritise the largest 20 treatment plants, visiting each of them, meeting with caretakers of each plant to ensure that proper processes are in place in terms of dealing with and escalating any incidents which may arise*". He also asked that Irish Water provide training to plant operators on incident reporting, and to place technicians on site to ensure the safety of water treatment plants.

This report details the water treatment plants assessed, the findings of the assessments and outlines Irish Water's actions to address identified issues. The report also describes the training provided by Irish Water to WTP operators and management staff.

Top 26 Water Treatment Plants (WTPs) assessed

Irish Water identified 25 WTPs for assessment to ensure the Top 20 treatment plants were covered by both production volume and population served. The Gorey plant, which serves a much smaller population was added to the scope of the Minister's request, bringing the total number of WTPs to be assessed to 26 (referred hereafter and listed further below as the **Top 26**). These top 26 WTPs (listed in Table 1 below) serve approx. 65% of Irish Water's customer base.

Table 1 – Top 26 Water Treatment Plants

| WTP Name | Local Authority | Population Served |
|------------------------------|-----------------------------------|--------------------------|
| Ballymore Eustace WTP | Dublin City Council | 808,277 |
| Leixlip WTP | Fingal County Council | 622,070 |
| Inniscarra WTP | Cork County Council | 145,304 |
| Vartry WTP | Dublin City Council | 129,808 |
| Clareville WTP | Limerick City and County Council | 125,857 |
| Terryland WTP | Galway City Council | 90,754 |
| Lee Road WTP | Cork City Council | 97,176 |
| Lough Guitane WTP | Kerry County Council | 65,648 |
| Tourmakeady WTP | Mayo County Council | 47,160 |
| Tuam Luimnagh WTP | Galway County Council | 42,323 |
| East Waterford Adamstown WTP | Waterford City and County Council | 66,046 |
| Staleen WTP | Louth County Council | 74,986 |
| Glashaboy WTP | Cork County Council | 24,602 |
| Srowland WTP | Kildare County Council | 69,454 |
| Foynes Shannon Estuary WTP | Limerick City and County Council | 7,242 |
| Portloman WTP | Westmeath County Council | 50,817 |
| Cavanhill WTP | Louth County Council | 49,589 |
| Castle Lake WTP | Clare County Council | 24,030 |
| New Doolough WTP | Clare County Council | 11,587 |
| Drumcliffe WTP | Clare County Council | 29,642 |
| Ballyboden WTP | Dublin City Council | 53,778 |
| Illies WTP | Donegal County Council | 20,121 |

| WTP Name | Local Authority | Population Served |
|----------------------------|--------------------------|-------------------|
| Letterkenny WTP Goldrum | Donegal County Council | 31,556 |
| Liscartan WTP | Meath County Council | 31,979 |
| Athlone WTP | Westmeath County Council | 23,467 |
| Gorey WTP | Wexford County Council | 7,241 |
| | TOTAL: | 2,750,514 |

Scope of the Assessments

The disinfection and filtration processes in drinking water treatment plants are the two primary means of ensuring drinking water provided to the public is safe to drink.

Disinfection

One of the most important steps in the water treatment process is disinfection. The most widely used method of disinfecting treated water is through the addition of chlorine.

Chlorination of treated drinking water is an extremely effective means of killing harmful bacteria that can cause illness. If this process fails, is not operating correctly, or doesn't have the required controls in place, the risk of harmful bacteria surviving the treatment process and ending up at the customer tap increases.

In addition to chlorination, some treatment plants also utilise Ultraviolet (UV) disinfection. This involves exposing treated water to high intensity UV light, which breaks up the DNA of harmful pathogens, rendering them unable to infect humans. The primary benefit of UV disinfection is for the inactivation of *Cryptosporidium* (a parasite which can cause a disease called Cryptosporidiosis). UV treatment is only installed where it is required, i.e. where the filtration system on its own does not have the capability to filter out every potential *Cryptosporidium Oocyst*¹.

Filtration

The majority of the Top 26 WTPs abstract raw water from either a river or lake source. Water from rivers and lakes is easily prone to contamination and can contain dangerous parasites such as *Cryptosporidium* (in addition varying levels of colour and dirt particles). These contaminants must be filtered out of the water and this process requires careful management and control.

If this process is not correctly sized, is not operated correctly or has inadequate controls, the risk of harmful pathogens such as *Cryptosporidium* evading the process increases. The clarity of water after filtration is determined by measuring its **Turbidity**. The lower the turbidity, the clearer (and cleaner) the water.

Irish Water measures the effectiveness of the filtration process by continuously measuring the Turbidity of water as it is being filtered and rates the process in terms of what percentage reduction it can achieve. For example, a filter that can

¹ *Cryptosporidium* survives in the environment inside an **Oocyst** (hard shell). One Oocyst contains 4 Sporozoites. One Oocyst can potentially cause illness.

continuously achieve Turbidity levels of less than 0.3 is rated as providing 99.9% removal capability for Protozoa such as Cryptosporidium and Giardia. This method of assessing filter performance is called the Log Credit approach and is a standard that exceeds that applied by water utilities across the world.

The scope of the assessments focused on the disinfection and filtration systems and in particular determining:

- the compliance status of each plant
- the robustness of the disinfection and filtration processes

Compliance

The compliance status was determined by reviewing the regulatory monitoring results for microbiological parameters such as E. coli and Enterococci, and for protozoan parameters such as Cryptosporidium and Giardia for 2020 and 2021².

Robustness

The robustness of the disinfection and filtration processes was assessed by undertaking a detailed **Alarm & Inhibit (A&I)** review at each of the 26 WTPs.

This review is also a very important component of the World Health Organisation's "Drinking Water Safety Plan" approach, which is recognised internationally³ as the most appropriate method of assessing risk for Drinking Water supplies. Irish Water has formally adopted and embedded this approach as a key risk management tool⁴.

The A&I Review undertaken at the Top 26 WTPs specifically focused on determining the presence of appropriate alarms and automatic shutdown capabilities at critical control points within the treatment process. An automatic shut-down is the last line of defence in the event of an unexpected mechanical failure. These 'reactive barriers' prevent water entering distribution that is potentially unsafe to consume. This is particularly important at WTPs which do not have personnel present 24/7 to consistently monitor treatment performance.

Alarm and Inhibit Review – methodology applied

The A&I review undertaken at the Top 26 WTPs consisted of two stages:

² January 2020 to October 2021

³ <https://www.euro.who.int/en/health-topics/environment-and-health/water-and-sanitation/water-safety-plans>

⁴ DWSP Hazard assessments and associated identification of failure modes is an involved assessment. In recognition of the immediate need to assess the Top 26 WTPs, Irish Water undertook a review of plant controls irrespective of the potential DWSP hazard level, and in alignment to Irish Water design standards.

The first stage was to determine what critical alarms should be in place at each WTP and what levels they should be configured at to inhibit (i.e. automatically shut down) the plant.

The second stage looked at the actual alarm set points and determined if they were set at an appropriate level for the WTP in question that ensured water quality performance targets were being met.

The A&I review was supported by a standardised assessment form to ensure a consistent approach was applied at each of the 26 WTPs.

Stage 1:

This involved an assessment of whether the WTP in question possessed the relevant alarms and inhibits required to conform with IWs **Log Credit Approach** and the IWs **Chlorine Contact time** (C_t) standards (explained further below).

This stage required the collection of site-specific information on water source conditions, treatment process stages, storage volumes and how chlorine monitoring instruments were configured.

- a. **Log Credit Approach:** this approach assesses if the treatment standard at the WTP in question is sufficient to address the risk presented by the source water, in particular from harmful parasites such as *Cryptosporidium*. It also assesses if the treatment process can meet this standard **all the time**. For example, if a source presents a 3 Log risk for *Cryptosporidium*, the treatment plant must be able to provide 3 Log treatment to meet / negate this risk. In terms of the filtration process, Turbidity is used to monitor filter performance. For an individual filter to provide 3 Log treatment (i.e. 99.9% removal) it must consistently achieve Turbidity levels of less than 0.3NTU. Also, the alarm set-point for the Turbidity monitor must be set to align with this specific performance standard.

- b. **Contact Time (C_t) Standard:** IWs C_t standard seeks to verify that primary disinfection is being achieved in accordance with the World Health Organisation's (WHO) contact time standard for chlorination of drinking water. This requires the calculation of a site-specific minimum "**Target Ct**" value. The WTP must operate at an "**Effective Ct**" that is always above this level. For each of the Top 26 WTPs⁵, a standard calculation method was applied to determine the minimum chlorine concentration at which an

⁵ Four of the Top 26 WTPs assessed were configured to automatically calculate Target Ct and Effective Ct on a live basis with the critical alarm set point changing dynamically with the live calculated value. This is called **Real Time Ct** and is built into IWs disinfection standard.

alarm and inhibit must be set to ensure the Effective C_t remains above the Target C_t .

Stage 2:

Following the assessments described in Stage 1 above, Irish Water determined if existing alarms & shutdown set points were set at the required level to comply with site-specific compliance targets. This involved reviewing the information on the WTPs telemetry system in liaison with the WTP Operator to check if the following critical alarm signals (see below) existed, if they were enabled, and if the alarm signals were set at the correct level;

1. Free chlorine (high & low alarms/inhibits),
2. pH (high & low alarms/inhibits),
3. Settled Turbidity (high alarm),
4. Individual Filter turbidity (high alarm/inhibit)
5. Final water turbidity (high alarm/inhibit)
6. UV system (alarms/inhibits)

The assessment also determined if these critical alarms generated either an automatic shutdown of the WTP or would run the water to waste, and if the levels that triggered these responses were set at the correct level.

3 – General Findings

Disinfection

Irish Water compiled a compliance status review and undertook a detailed technical assessment of the chlorination process at all Top 26 WTPs in terms of how it was configured, how it was controlled and managed day to day, what alarms were in place to warn of potential issues, and what fail-safes (such as automatic shut-down) were in place to protect water quality.

Compliance

In relation to the compliance status of the Top 26 WTPs, all samples taken from Jan 2020 to Oct 2021 in supplies served by 25 out of 26 plants were 100% compliant⁶ for microbiological parameters. There was 1 detection for E. coli from a sample taken within the Cork City Water Supply (served by Lee Road WTP). Subsequent investigative samples were fully clear (following completion of network flushing) and the associated enforcement file was closed. The compliance figures for each of the 26 WTPs are provided in Appendix 1.

Robustness

In relation to the alarm and inhibit review of the disinfection systems at the Top 26 WTPs, the following points summarise the system performance on the date of assessment, and the current status (where applicable) following implementation of immediate corrective actions.

- All plants had a functioning disinfection system in place
- 25 out of 26 plants had a chlorine alarm enabled. The remaining plant (Cavanhill WTP) now also has a chlorine alarm enabled.
- 20 plants had a chlorine alarm that initiated an automatic shutdown of the treatment plant
- The other 6 (Ballymore Eustace, Lee Road, Castlelake, Drumcliffe, Ballyboden, and Creagh) rely on a manual response following activation of the chlorine alarm
- 11 plants had a UV system in addition to a chlorination system. Of those 11 UV systems;

⁶ Compliance was determined from reviewing the results of the regulatory monitoring programme. For the Gorey WTP, investigative samples (non-regulatory) taken in response to the incident were all 100% compliant for microbiological parameters. It should be noted however that there were no samples scheduled during the time of the incident where undisinfecting water went into distribution. At Ballymore Eustace WTP there is daily operational (non-regulatory) monitoring in place. Results from this monitoring were 100% compliant during the incident that occurred in August 2021.

The Galway City Water Supply (served by Terryland WTP) recorded an E. coli failure from a non-regulatory sample. This resulted in a localised BWN in the Salthill area which was lifted after 7 days following completion of remedial actions.

- 10 out of 11 had the required alarms in place and the alarms for these 10 systems were set at the correct level (Srowland WTP had some but not all the required UV alarms in place for validation purposes).
- 8 out of 11 had alarms that generated an automatic shutdown of the treatment plant
- The remaining 3 (Vartry, Lee Road, and Srowland) rely on a manual response following activation of the UV alarm

Filtration

Irish Water undertook a detailed technical assessment of how the filtration systems were performing at the Top 26 WTPs. The general findings from these assessments are described below.

Compliance

In relation to the compliance status of the Top 26 WTPs, protozoan monitoring was in place at 14 WTPs with none of the monitoring showing any detections from Jan 2020 to date. A further three WTPs had low level intermittent detections however these sites now have a validated barrier and Crypto monitoring is no longer required. Low level detections were recorded at the Lee Road plant in Cork following which emergency UV was installed and is now operational. Crypto monitoring is continuing at this WTP until UV disinfection is installed at the Churchfield reservoir. The remaining 8 plants do not require Cryptosporidium monitoring as they have a validated barrier in place. The compliance figures for each of the 26 WTPs are provided in Appendix 2

Robustness

In relation to the alarm and inhibit review of the disinfection systems at the Top 26 WTPs, the following points summarise the system performance on the date of assessment, and the current status (where applicable) following implementation of immediate corrective actions.

- All plants had a functioning filtration system in place
- 25 of the 26 plants had a Turbidity monitor in place on each of the filters. The remaining WTP (Drumcliffe) had a Turbidity monitor on the combined filtered water. Plans are in place to install monitors on each individual filter at Drumcliffe.
- 23 of the 26 plants had alarms generated by each of the Turbidity monitors (exceptions were Luimnagh & New Doolough WTPs). Works were undertaken at Foynes to put appropriate alarms in place, which are now complete.

- 20 of the 23 plants (with Turbidity alarms) had the alarms set at the correct level (exceptions were Portloman, Castlelake, and Illies WTPs). Works were undertaken at all 3 plants to ensure alarms were set at the correct level.
- 19 of the 26 plants had alarms on either each individual filter, or on the combined filtered water that resulted in an automatic shutdown if the Turbidity exceeds acceptable levels (refer to Appendix 2 for breakdown).

4 – Incident training

Irish Water is the Water Services Authority for public supplies and therefore has responsibility and accountability for the provision of safe and secure drinking water. A main concern arising from the BME and Gorey incidents was in the area of incident awareness and notification requirements. Timely notification of incidents to Irish Water allows for a situation to be risk assessed and enables informed decisions to be made promptly thereafter. Under the Drinking Water Regulations, Irish Water has a legal responsibility to consult with the HSE where we consider the supply of water potentially poses a risk to public health. We are also required to notify such incidents to the EPA in accordance with timeframes set out in the legislation.

Irish Water provided training to the management and operators of the Top 26 WTPs from the 24th of September to the 7th of October. In most instances this was provided on the same day as the A&I site assessment. This training provided clear guidelines on the water quality and water treatment standards applicable to the WTP in question and identified what constitutes a reportable incident with practical examples provided as relevant to the site.

As many of the Top 26 WTPs are staffed on a 24/7/365 basis this meant that training for some sites had to be cascaded to any WTP staff who were not on duty / available on the day. This cascaded training was delivered by the plant management staff. Irish Water can confirm that training has been delivered / cascaded to all staff in the Top 26 WTPs. The Training material provided is available on each WTP and training records are being maintained.

Irish Water also provided refresher training to relevant Engineering, Scientific, and Technical staff within all 31 Local Authorities over a three-week period. This training covered the same areas as that provided to the Top 26 WTPs. The Local Authorities in question were requested to cascade this training to all remaining WTP operators and their supervisors. We have received confirmation from 27 out of 31 Local Authorities that this is now complete, with the remainder expected by the end of Q4 2021.

5 – Corrective Actions and Timelines

Corrective actions were identified in response to the findings from Irish Water’s assessment of the disinfection and filtration processes, and control and management systems of the Top 26 WTPs. These were categorised into:

- **immediate to short term** (e.g. critical interventions and quick fixes) and
- **medium term** (e.g. installations which require detailed planning).

Immediate to Short Term Measures

Immediate priority items which are being progressed in the short term are those required to ensure that as a minimum there is sufficient instrumentation on site, linked up to local control systems to generate alarms for the following conditions:

- Where filtered water Turbidity exceeds an allowable limit
- Where final water Chlorine levels drop below a critical low limit
- Where final water Chlorine levels exceed a critical high limit
- Where UV disinfection operates outside its validated range (i.e. not delivering the required level of disinfection)
- Where the pH of the final water drops below a critical low limit
- Where the pH of the final water exceeds a critical high limit
- Where the Settled Water Turbidity exceeds an allowable limit
- Where the Final Water Turbidity exceeds an allowable limit

The following table details the immediate priority items identified for the Top 26 WTPs⁷.

Table 2 – Immediate priority items for the Top 26 WTPs

| WTP Name | Immediate Priority Items to be delivered | Progress Status* | Time frame for Completion |
|-----------|---|------------------|---------------------------|
| Vартy WTP | Switch from emergency temporary UV system at Callowhill to permanent UV system at Vартy which has all alarms and shutdown in place. | | Q4 2021 |

⁷ DWSP Hazard assessments and associated identification of failure modes is an involved assessment. In recognition of the immediate need to assess the Top 26 WTPs, Irish Water undertook a review of plant controls irrespective of the potential DWSP hazard level, and in alignment to Irish Water design standards

| WTP Name | Immediate Priority Items to be delivered | Progress Status* | Time frame for Completion |
|----------------------------|---|------------------|---------------------------|
| Terryland WTP | Adjust setpoints and time delay settings on filter and final water turbidity alarms. | Complete | Complete |
| Tuam Luimnagh WTP | Relocation of Individual Turbidity Monitors to allow associated alarms to be enabled. | Yellow | Q4 2021 |
| Inniscarra WTP | Enable Final Water Turbidity Alarm. | Yellow | Q4 2021 |
| Adamstown WTP | Amend pH alarm set points to the correct level. | Complete | Complete |
| Srowland WTP | Install a continuous UVT monitor on the UV Disinfection system to verify that the UV system operates within its validated range at all times. | Yellow | Q4 2021 |
| Foynes Shannon Estuary WTP | Enable Individual Filter Alarms (complete). Enable pH alarms (planned). | Yellow | Complete |
| Portloman WTP | Amend Individual Filter Turbidity alarm set points to the correct level. | Complete | Complete |
| Cavanhill WTP | Enable chlorine alarm (Note: automatic shutdown already exists). | Complete | Complete |
| Castle Lake WTP | Amend Individual Filter Turbidity alarm set points to the correct level. | Complete | Complete |
| New Doolough WTP | Enable Individual Filter Turbidity alarms. | Yellow | Q4 2021 |
| Drumcliffe WTP | Install Turbidity monitors on each Membrane filter. | Yellow | End of Feb 2022 |
| Illies WTP | Amend Individual Filter Turbidity alarm set points to the correct level. | Complete | Complete |
| Athlone WTP | Amend Alarm set point on Individual Filter Turbidity Monitor to the correct level. | Yellow | End of Nov 2021 |

| WTP Name | Immediate Priority Items to be delivered | Progress Status* | Time frame for Completion |
|-----------|---|------------------|--------------------------------|
| Gorey WTP | Install automatic shutdown (inhibit) where Filtered water Turbidity is > 0.3NTU. Further work to optimise the WTP with inclusion of a run to waste facility | | Automatic shutdown is Complete |

* **Green** = alarm gaps resolved; **Amber** = alarms gaps yet to be resolved but works underway; **Red** = alarm gaps yet to be resolved and no plan in place

Medium Term Measures

Medium term measures are measures that require additional assessment and planning before works can progress to address a particular risk.

Where gaps have been identified in terms of fail-safes such as automatic-shutdowns, determining the necessary work generally requires more detailed analysis and risk assessment of the plant to fully assess any unintended consequences or knock-ons, including infrastructural issues that need to be addressed first.

Irish Water has an established risk assessment process in place for progressing such deficits referred to as the '*Drinking Water Safety Plan Risk Assessment (DWSP-RA) and Asset Improvement Programme workshop process*'. This approach is recommended by the World Health Organisation as a risk management tool for water suppliers and has been advocated for many years by the EPA in their annual reports.

DWSP-RAs have already been completed for all Top 26 WTPs. Follow-on Asset Improvement Programme (AIP) workshops are being rolled out, The timeline and the status for these is set out in **Table 3** below.

The outcomes of the DWSP-RA and Asset Improvement Programme process determines the required corrective actions (e.g. including actions that require capital expenditure) and associated timeframes for delivery. Irish Water will prioritise these works, having regard to risk ranking and competing priorities. Highest risk items identified within the AIP such as measures needed to install automatic shutdowns (inhibits) will be prioritised for delivery as quickly as possible.

Interim measures

In the interim, and pending implementation of the medium term corrective actions following the AIP process, the implementation of immediate to short term measures (identified in Table 2) together with incident response training,

implementation of relevant WTP procedures⁸, enhanced on-site presence and oversight will help manage / mitigate potential risks.

Table 3 – Asset Improvement Programme – status and timeframe for completion for the Top 26 WTPs

| WTP Name | Priority* | Timeframe for AIP Conclusion | AIP Workshop Status |
|------------------------------|-----------|------------------------------|-----------------------|
| Ballymore Eustace WTP | | Complete | Complete |
| Leixlip WTP | | Q1 2022 | Planned |
| Inniscarra WTP | | Q1 2022 | Planned |
| Vartry WTP | | Q1 2022 | Planned |
| Clareville WTP | | Complete | Complete |
| Terryland WTP | | Complete | Complete |
| Lee Road WTP | | Q2 2022 | Awaiting new WTP 2022 |
| Lough Guitane WTP | | Q1 2022 | Planned |
| Tourmakeady WTP | | Q4 2021 | On-going |
| Tuam Luimnagh WTP | | Complete | Complete |
| East Waterford Adamstown WTP | | Complete | Complete |
| Staleen WTP | | Q2 2022 | Planned |
| Glashaboy WTP | | Q1 2022 | Planned |
| Srowland WTP | | Q1 2022 | On-going |
| Foynes Shannon Estuary WTP | | Q1 2022 | Planned |
| Portloman WTP | | End of Nov 2021 | On-going |

⁸ Site procedures are currently under review to ensure they are fit for purpose. Updated SOPs will issue in Q4 2021.

| WTP Name | Priority* | Timeframe for AIP Conclusion | AIP Workshop Status |
|----------------------------|-----------|------------------------------|---------------------------|
| Cavanhill WTP | Green | Q2 2022 | Planned |
| Castle Lake WTP | Amber | End of Jan 2022 | Planned |
| New Doolough WTP | Amber | Q1 2022 | Post upgrade project 2022 |
| Drumcliffe WTP | Amber | End of Nov 2021 | On-going |
| Ballyboden WTP | Amber | Complete | Complete |
| Illies WTP | Green | Complete | Complete |
| Letterkenny WTP Goldrum | Green | Complete | Complete |
| Liscartan WTP | Green | Q2 2022 | Planned |
| Athlone WTP | Amber | Q1 2022 | Planned |
| Gorey WTP | Amber | N/A | Complete |

***Green** = AIP complete, or planned for 2022, and the required automatic shutdowns are in place; **Amber** = AIP complete, underway, or planned for 2022, and the required automatic shutdowns are not yet in place;

Red = AIP not planned, and the required automatic shutdowns are not yet in place

Appendix 1 – Current Status of the Top 26 WTPs – Disinfection

| No. | Water Treatment Plant | Disinfection System Performance Information | | | Disinfection Controls Required | | | | | | | |
|-----|----------------------------|---|--|---|---|--|---|---|---|---|--|--|
| | | Percentage of samples that passed Microbiological standards (2020-2021) | Does the treatment plant have a disinfection system in place? (Yes/No) | Are additional Disinfection controls required? (Yes/No) | Does the chlorine dosing have an alarm in place? (Yes/No) | Is the Chlorine Alarm set at the correct level? (Yes/No) | Does the chlorine alarm initiate an automatic shut-down? (Yes/No) | Will the WTP automatically shut down if Turbidity levels exceed 1 NTU ⁹ (Yes/No) | Is UV in place as an additional disinfection system? (Yes/No) | Does the UV disinfection system have all the required alarms in place? (Yes/No) | Are the UV alarms set at the correct level? (Yes/No) | Do the UV alarms initiate an automatic shut-down? (Yes/No) |
| 1 | Ballymore Eustace WTP | 100.00% | Yes | Yes ¹⁰ | Yes | Yes | No | No | No | N/A | N/A | N/A |
| 2 | Leixlip WTP | 100.00% | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 3 | Inniscarra WTP | 100.00% | Yes | Yes | Yes | Yes | Yes | No | No | N/A | N/A | N/A |
| 4 | Vartry WTP | 100.00% | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No |
| 5 | Clareville WTP | 100.00% | Yes | No | Yes | Yes | Yes | Yes | No | N/A | N/A | N/A |
| 6 | Terryland WTP | 100.00% | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 7 | Lee Road WTP | 99.55% | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | No |
| 8 | Lough Guitane WTP | 100.00% | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 9 | Lough Mask WTP | 100.00% | Yes | Yes | Yes | Yes | Yes | No | No | N/A | N/A | N/A |
| 10 | Luimnagh WTP | 100.00% | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 11 | Adamstown WTP | 100.00% | Yes | No | Yes | Yes | Yes | Yes | No | N/A | N/A | N/A |
| 12 | Staleen | 100.00% | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 13 | Glashaboy WTP | 100.00% | Yes | Yes ¹⁰ | Yes | Yes | Yes | No | No | N/A | N/A | N/A |
| 14 | Srowland | 100.00% | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | No |
| 15 | Foynes Shannon Estuary WTP | 100.00% | Yes | Yes ¹¹ | Yes | Yes | Yes | Yes | No | N/A | N/A | N/A |
| 16 | Portloman WTP | 100.00% | Yes | Yes ¹¹ | Yes | Yes | Yes | Yes | No | N/A | N/A | N/A |
| 17 | Cavanhill | 100.00% | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 18 | Castle Lake WTP | 100.00% | Yes | Yes | Yes | Yes | No | No | No | N/A | N/A | N/A |
| 19 | New Doolough WTP | 100.00% | Yes | Yes | Yes | Yes | Yes | No | No | N/A | N/A | N/A |
| 20 | Drumcliffe WTP | 100.00% | Yes | Yes | Yes | Yes | No | No | No | N/A | N/A | N/A |
| 21 | Ballyboden WTP | 100.00% | Yes | Yes | Yes | Yes | No | No | No | N/A | N/A | N/A |
| 22 | Illies WTP | 100.00% | Yes | No | Yes | Yes | Yes | Yes | No | N/A | N/A | N/A |
| 23 | Letterkenny WTP | 100.00% | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 24 | Liscartan WTP | 100.00% | Yes | No | Yes | Yes | Yes | Yes | No | N/A | N/A | N/A |
| 25 | Athlone WTP | 100.00% | Yes | Yes ¹¹ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 26 | Creagh WTP | 100.00% | Yes | Yes | Yes | Yes | No | Yes | No | N/A | N/A | N/A |

⁹ This is a critical control point to ensure the primary disinfection stage is effective.

¹⁰ Site requires an additional chlorine monitor due to more than one distribution line from the WTP.

¹¹ All controls are in place for Disinfection however additional controls in relation to final water pH alarms and automatic shutdowns are required.

Appendix 2 – Detailed Audit findings of the Top 26 WTPs – Filtration

| No. | Water Treatment Plant | Filtration Performance Information | | | Filtration Controls Required | | | |
|-----|----------------------------|---|--|---|---|---|---|--|
| | | Percentage of samples that had no detections for Crypto and Giardia (2020-2021) | Does the treatment plant have a filtration system in place? (Yes/No) | Are additional Filtration controls required? (Yes/No) | Does each individual filter have a Turbidity monitor installed and operational? | Does each Turbidity monitor generate an alarm? (Yes/No) | Is the Turbidity alarm for each individual monitor set at the correct level? (Yes/No) | Will an automatic shutdown occur on each filter if Turbidity levels exceed acceptable levels? (Yes/No) |
| 1 | Ballymore Eustace WTP | 100% | Yes | Yes | Yes | Yes | Yes | No |
| 2 | Leixlip WTP | 99.7% ¹² | Yes | No | Yes | Yes | Yes | Yes |
| 3 | Inniscarra WTP | 100% | Yes | No | Yes | Yes | Yes | Yes |
| 4 | Vartry WTP | 98.9% ¹² | Yes | No | Yes | Yes | Yes | Yes |
| 5 | Clareville WTP | 100% | Yes | No | Yes | Yes | Yes | Yes |
| 6 | Terryland WTP | N/A ¹³ | Yes | No | Yes | Yes | Yes | Yes |
| 7 | Lee Road WTP | 98.9% ¹⁴ | Yes | Yes | Yes | Yes | Yes | No |
| 8 | Lough Guitane WTP | N/A ¹³ | Yes | No | Yes | Yes | Yes | Yes |
| 9 | Lough Mask WTP | 100% | Yes | No | Yes | Yes | Yes | Yes |
| 10 | Luimnagh WTP | N/A ¹³ | Yes | Yes | Yes | No | N/A | No |
| 11 | Adamstown WTP | 100% | Yes | Yes | Yes | Yes | Yes | No |
| 12 | Staleen | 100% | Yes | No | Yes | Yes | Yes | Yes |
| 13 | Glashaboy WTP | 100% | Yes | Yes | Yes | Yes | Yes | No |
| 14 | Srowland | N/A ¹³ | Yes | No | Yes | Yes | Yes | Yes |
| 15 | Foynes Shannon Estuary WTP | 100% | Yes | Yes | Yes | Yes | Yes | No |
| 16 | Portloman WTP | 100% | Yes | No | Yes | Yes | Yes | Yes |
| 17 | Cavanhill | 96% ¹² | Yes | No | Yes | Yes | Yes | Yes |
| 18 | Castle Lake WTP | 100% | Yes | Yes | Yes | Yes | Yes | No |
| 19 | New Doolough WTP | 100% | Yes | Yes | Yes | No | N/A | No |
| 20 | Drumcliffe WTP | 100% | Yes | Yes | No | N/A | Yes | No |
| 21 | Ballyboden WTP | 100% | Yes | Yes | Yes | Yes | Yes | No |
| 22 | Illies WTP | N/A ¹³ | Yes | No | Yes | Yes | Yes | Yes |
| 23 | Letterkenny WTP | N/A ¹³ | Yes | No | Yes | Yes | Yes | Yes |
| 24 | Liscartan WTP | N/A ¹³ | Yes | No | Yes | Yes | Yes | Yes |
| 25 | Athlone WTP | N/A ¹³ | Yes | Yes | Yes | Yes | No | Yes |
| 26 | Creagh WTP | 100% | Yes | No | Yes | Yes | Yes | Yes |

¹² Monitoring for Crypto and Giardia no longer required as a validated barrier is now in place (e.g. following installation of UV, filter upgrades etc.)

¹³ Monitoring for Crypto and Giardia not required as a validated barrier is in place

¹⁴ UV disinfection is in place at the treatment plant however Crypto and Giardia monitoring will continue until UV disinfection is installed at the Churchfield reservoir site

Appendix 3 – Detailed Audit findings of the Top 26 WTP – Training Requirements

| No. | Water Treatment Plant | Status of Incident Notification Training | | |
|-----|----------------------------|--|---|--|
| | | Has incident notification training been delivered to WTP management? | Has this training been cascaded to all WTP operators? | Projected date for full cascading of training to all WTP operators |
| 1 | Ballymore Eustace WTP | Yes | Yes | Complete |
| 2 | Leixlip WTP | Yes | Yes | Complete |
| 3 | Inniscarra WTP | Yes | Yes | Complete |
| 4 | Vartry WTP | Yes | Yes | Complete |
| 5 | Clareville WTP | Yes | Yes | Complete |
| 6 | Terryland WTP | Yes | Yes | Complete |
| 7 | Lee Road WTP | Yes | Yes | Complete |
| 8 | Lough Guitane WTP | Yes | Yes | Complete |
| 9 | Lough Mask WTP | Yes | Yes | Complete |
| 10 | Luimnagh WTP | Yes | Yes | Complete |
| 11 | Adamstown WTP | Yes | Yes | Complete |
| 12 | Staleen | Yes | Yes | Complete |
| 13 | Glashaboy WTP | Yes | Yes | Complete |
| 14 | Srowland | Yes | Yes | Complete |
| 15 | Foynes Shannon Estuary WTP | Yes | Yes | Complete |
| 16 | Portloman WTP | Yes | Yes | Complete |
| 17 | Cavanhill | Yes | Yes | Complete |
| 18 | Castle Lake WTP | Yes | Yes | Complete |
| 19 | New Doolough WTP | Yes | Yes | Complete |
| 20 | Drumcliffe WTP | Yes | Yes | Complete |
| 21 | Ballyboden WTP | Yes | Yes | Complete |
| 22 | Pollan Dam WTP | Yes | Yes | Complete |
| 23 | Letterkenny WTP | Yes | Yes | Complete |
| 24 | Liscartan WTP | Yes | Yes | Complete |
| 25 | Athlone WTP | Yes | Yes | Complete |
| 26 | Creagh WTP | Yes | Yes | Complete |

Acknowledgements

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