Site Visit Report

Under the European Union (Drinking Water) Regulations 2014 as amended, the Environmental Protection Agency is the supervisory authority in relation to Irish Water and its role in the provision of public water supplies. This Audit was carried out to assess the performance of Irish Water in providing clean and wholesome water to the visited public supply.

The audit process is a sample on a given date of the facility's operation. Where a finding against a particular issue has been reported this should not be construed to mean that this issue is fully addressed.

Water Supply Zone

Name of Installation	DCC Zone 1
Organisation	Irish Water
Scheme Code	0700PUB1001
County	Dublin
Site Visit Reference No.	SV22715

Report Detail

Issue Date	12/10/2021
Prepared By	Aoife Loughnane

Site Visit Detail

Date Of Inspection	09/09/2021	**Announced**	Yes
Time In	10:00	**Time Out**	14:15
EPA Inspector(s) **Additional Visitors**	Aoife Loughnane Michelle Minihan		
Company Personnel	Irish Water: Andrew Boylan, Joe O'Reilly Dublin City Council (operating under SLA to Irish Water): Eoin Walsh, Martin Hession, Jim O'Rourke HSE: Ruth McDermott, David Jordan. Helena Murray attended the opening & closing meetings by teleconference call.		

Summary of Key Findings

1. An incident associated with the alum dosing system occurred at Ballymore Eustace water treatment plant on 20/08/21 and went unreported for 12 days before the EPA and HSE were notified by Irish Water on 01/09/21. The alarms on the alum dosing system alerted the plant operators but the incident was not suitably escalated and managed in order to maintain water quality and protect public health. The delay in notifying the EPA & HSE meant that the critical period had passed in terms of issuing a boil water notice to protect consumers against the risk posed by the inadequately treated water.

2. The alum dosing incident caused operational difficulties in the water treatment processes whereby the reduction in coagulant dose caused the sludge blankets in the clarifiers to rise and floc carryover into the filters, which led to an increase in turbidity levels in final water. This meant the plant produced unsafe drinking water for a period of up to 10 hours on 20/08/21 to 21/08/21, due to the temporary loss of the *Cryptosporidium* treatment barrier compounded by inadequate disinfection.

3. During the audit, the EPA Inspectors discovered two further unreported incidents where the plant was producing potentially unsafe water for periods of time in August and September. The EPA requested Irish Water and Dublin City Council to undertake an immediate risk assessment of these incidents and consult with the HSE regarding the potential risk to public health.

4. The chlorine contact time calculations demonstrate that while the final treated water is achieving the WHO minimum recommended value of 15 mg.min/l, it fails to achieve Irish Water's site-specific target chlorine contact time of 29.25 mg.min/l, to ensure there is a margin of safety in verifying that primary disinfection is being achieved at the plant under all circumstances. Irish Water's National Disinfection Programme failed to identify this deficiency when the plant was surveyed and assessed in 2019.

5. The audit found significant failings in management oversight, operational control and responsiveness by Irish Water and Dublin City Council at Ballymore Eustace water treatment plant, in terms of their respective roles to deliver safe and secure drinking water.

Introduction

Ballymore Eustace Water Treatment Plant (WTP) is the largest water treatment plant in the country, which supplies water to approximately 877,000 people in Dublin City, South Dublin County, Dun Laoghaire Rathdown and Kildare. The plant currently produces approximately 320 ML/d and has a design capacity of 400 ML/d. Treatment consists of coagulation with alum and poly, clarification in 12 sedimentation tanks, rapid gravity filtration in 32 filters, disinfection using on-site electrolytic chlorination, lime addition for pH correction, and fluoridation. There is an on-site reservoir for storage of treated water with a capacity of approximately 100 ML, i.e. 8 hours storage.

This audit was carried out in response to the notification by Irish Water to the EPA on 01/09/21 of an alum dosing incident that occurred at the plant on 20/08/21.

Supply Zones Areas Inspected

The audit comprised of a site visit to Ballymore Eustace water treatment plant. The auditors inspected the water treatment processes, equipment and water quality data from the plant's SCADA system.

1. Incident Management

		Answer
1.1	Was the incident suitably alerted to the plant operators, escalated and managed in order to maintain water quality and protect public health?	No

Comment

1. On 01/09/21 the EPA was notified by Irish Water of an alum (coagulant) dosing incident at Ballymore Eustace water treatment plant which occurred on 20/08/21 but only came to light as part of Irish Water's investigations into the cause of a wastewater discharge exceedance to the River Liffey from the sludge treatment facilities at the plant.

2. From 20:30 on 20/08/21 until approximately 00:00 on 21/08/21 the correct alum dosing was not achieved for sedimentation tanks A & B which feed 16 filters (No. 21 to 36) at the plant. Sedimentation tank C was unaffected by the incident.

3. The root cause of the incident was a mechanical failure of the alum dosing system due to a suction issue which affected the dosing pumps by decreasing the dose rate by 20%.

4. The alum dosing flow alarm was activated at 20:30 hours on 20/08/21. The shift operator responded to the alarm and manually switched over to the standby dosing pump which subsequently air locked too. No mechanical fitters were available on the evening of 20/08/21 so an instrumentation technician was called to attend site. The dosing pumps were restarted a number of times but then failed again. Normal dosing levels were restored by approximately 00:00 on 21/08/21.

5. The reduction in coagulant dose impacted the sludge blankets in the clarifiers and resulted in floc carryover into the filters. An increase in turbidity levels was observed for each of the 16 filters affected. The turbidity across each affected filter began to rise above 0.3 NTU from approximately 23:00 on 20/08/21 until 04:00 on 21/08/21, reaching a turbidity of 1 NTU or higher for all filters during this approximate timeframe.

6. The impacts of this incident on plant performance were:

- The *Cryptosporidium* treatment barrier was compromised for up to 10 hours;
- There was ineffective disinfection due to a shielding effect, for the period of time when turbidity levels were above 1 NTU;
- There was inadequate disinfection (low chlorine levels in final water) for up to 6 hours;
- There was a plug of inadequately treated water in the distribution network for up to 4 days.

7. This incident went unreported for 12 days before the EPA and HSE were notified by Irish Water on 01/09/21. Irish Water stated that they only became aware of the incident on 31/08/21 during their investigations into a sludge discharge incident at the plant. The delay in notifying the EPA & HSE meant that the critical period had passed in terms of taking action to protect public health by issuing a boil water notice to protect consumers against the risk posed by the inadequately treated water.

8. Sampling for *Cryptosporidium* in treated water is carried out weekly at Ballymore Eustace water treatment plant. The sample results from 23/08/21 and 30/08/21 were clear, however these samples were taken outside the critical time period to assess the impact of the alum dosing incident on treated water quality.

9. The HSE representatives at the audit advised that if they had been consulted with in a timely manner, they would have recommended a boil water notice be issued for consumers of the Ballymore Eustace water supply, to protect public health. At the time of the audit, the HSE's surveillance monitoring programme for infectious diseases had not detected any significant increase in gastro-intestinal illness as a result of this incident, in the areas supplied by Ballymore Eustace water treatment plant. The HSE will continue to monitor for illness having regard to the longer incubation periods for illnesses such as *Cryptosporidiosis* and *Giardiasis*.

2. Disinfection

		Answer
2.1	Does the trend in chlorine residual at the treatment plant indicate adequate and stable levels of disinfection?	No

Comment

1. The water supply is disinfected using sodium hypochlorite (0.8% concentration) generated in two on-site electrolytic chlorination (OSEC) units. There is back-up liquid chlorine dosing at the plant in case of emergency.

2. The chlorine dose is flow proportional with feedback trim based on the chlorine monitor located at the end of the contact tank. During the audit, Dublin City Council representatives stated that the chlorine target is 0.66 mg/l in the contact tank. There is also a chlorine monitor at the outlet of the on-site reservoir.

3. At the audit, the following alarm set-points were identified for the chlorine monitor at the end of the contact tank;

- Low: 0.4 mg/l,
- Low-low: 0.3 mg/l and
- High: 1 mg/l.

These alarm settings are currently too low to allow the plant operators react in time when chlorine levels drop below the target level. During the audit the chlorine monitor at the end of the contact tank was reading 0.59 mg/l, which is below the target of 0.66 mg/l. Also, it is not clear if the low chlorine alarm set-points are based on the chlorine contact time calculations, to ensure the water leaving the plant has achieved primary disinfection.

4. The auditors review of final water chlorine levels from SCADA data found a very unstable trend, with chlorine levels dropping significantly below the target on 25th, 26th, 27th & 30th August and 7th September. Dublin City Council representatives confirmed there had been a fault with the OSEC west unit which resulted in sodium hypochlorite being dosed at a concentration below the required 0.8%. This fault had been occurring since the OSEC units were serviced on 26/08/21 by external specialised contractors, who are due to return to the plant during the week of 20/09/21. This equipment malfunction issue was not escalated by Dublin City Council to Irish Water prior to the audit.

5. The intermittent drops in chlorine levels in final water were not reported by the plant management to Irish Water, nor was the HSE consulted regarding the potential risk to public health of inadequately disinfected water being supplied from Ballymore Eustace water treatment plant.

6. A large proportion of the water from Ballymore Eustace water treatment plant receives secondary (booster) chlorination downstream in the distribution network, e.g. at Saggart and Stillorgan Reservoirs. However, there are areas where the water supply does not receive secondary chlorination downstream of Ballymore Eustace water treatment plant.

		Answer
2.2	Is there adequate chlorine contact time before the first connection?	No

Comment

1. Following the audit, at a meeting with the EPA on 29/09/21, Irish Water provided the following chlorine contact time (Ct) calculations for Ballymore Eustace WTP:

- Site-specific target Ct: 29.25 mg.min/l
- Scenario (a) Normal plant configuration: 22.17 mg.min/l
- Scenario (b) Enhanced production: 51.75 mg.min/l
- Scenario (c) Service water tower: 17.11 mg.min/l

These Ct calculations have been determined based on the following;

1. The raw water at Ballymore Eustace WTP can drop as low as 3ºC in winter, which adversely effects disinfection. If water temperature is above 5ºC (which it currently is) the target Ct drops to 23.4 mg.min/l.
2. A reservoir baffling capability factor of 0.35. Irish Water will undertake a hydraulic model in the coming weeks and the outcome of this may potentially improve the baffling capability factor to 0.5 resulting in the effective Ct on-site increasing to 30.82 mg.min/l.

The WHO minimum recommended Ct is 15 mg.min/l as a general rule, however a more considered site-specific approach to setting Ct values is recommended. Irish Water has identified a site-specific target Ct of 29.25 mg.min/l at Ballymore Eustace WTP. Therefore, the calculated Ct for scenarios (a) and (c) are less than the target Ct for the site. Irish Water needs to address this as a matter of urgency to ensure that the site-specific target Ct is being met, i.e. that there is a margin of safety in verifying that primary disinfection is being achieved at the plant under all circumstances, before final water leaves the plant.

2. Irish Water was not aware of the chlorine contact time issue at Ballymore Eustace WTP until the EPA raised the question at the audit. Irish Water's National Disinfection Programme failed to identify this deficiency when the plant was surveyed and assessed under that programme in 2019, and was not progressed further. This identifies a lack of management oversight by Irish Water in the operation of Ballymore Eustace WTP.

3. Management and Control

		Answer
3.1	Is the plant suitably managed and controlled to maintain the designed log credit on each treatment stage?	No

Comment

1. Ballymore Eustace WTP is manned 24/7 with 12 operators working a 3 shift basis. There are 2 shift operators on duty at any one time. While the shift operators responded swiftly to the alum dosing incident on 20/08/21, their focus was on fixing the mechanical issue and not on escalating the incident. There was a lack of awareness among operational and management staff within Dublin City Council as to the significance of such an incident and it's impact on drinking water quality.

2. The plant management staff were made aware of the alum dosing incident on Monday 23/08/21. However, it was not escalated to a senior management level within Dublin City Council or reported to Irish Water, and the HSE was not consulted in relation to the risk to public health.

3. During the audit, Dublin City Council representatives stated that the plant operators are not aware of the significance of the turbidity performance criteria of <0.3 NTU in filtered water to verify the performance of the *Cryptosporidium* treatment barrier at the plant.

4. During the audit, the EPA Inspectors discovered two further unreported incidents where the plant was producing potentially unsafe water for periods of time in August and September. The EPA requested Irish Water and Dublin City Council to undertake an immediate risk assessment of these two incidents and consult with the HSE regarding the potential risk to public health.

(i) Elevated turbidity levels on 24/08/21

- The auditors review of data trends found turbidity levels above 0.3 NTU in final water for a period of time on 24/08/21, which indicates that the *Cryptosporidium* barrier may have been compromised. During the audit, Irish Water and Dublin City Council could not explain the reason for this turbidity spike, but indicated that it could relate to works on the lime dosing system for pH correction.
- Following the audit, Irish Water confirmed that the elevated turbidity levels on 24/08/21 were related to an issue with lime dosing. Lime is added to treated water to ensure the final water pH is at optimal levels for delivery into the distribution network. In order to overcome the slow reaction time of the lime dosing arrangement to ensure water pH stays within the optimum band, an adjustment was made to the dose strength that resulted in an increase of lime entering the treated water. This in turn increased pH and turbidity levels. There is a pH inhibit in place set at 9.1 to control this process and ensure limits stay within the regulatory standards.

(ii) Low chlorine incident on 07/09/21

- The auditors review of disinfection trend data found that the chlorine residual in final water dropped below the target level from 13:15 to 15:30 on 07/09/21. Dublin City Council representatives stated that this was a result of the problems identified with the OSEC west unit which resulted in sodium hypochlorite being dosed at a concentration below the required 0.8% concentration.
- At the audit, the EPA asked Irish Water to identify how many times the chlorine levels in final water have dropped below the target level as a result of the problems identified with the OSEC west unit. Irish Water's review of chlorine trend data from 16/08/21 and 10/09/21 found 6 occasions when chlorine levels in final water dropped below 0.2 mg/l, which indicates that the water supply was not being adequately disinfected at all times. These incidents went undetected and unreported by operational and management staff at the plant.
- Since the audit, Irish Water confirmed that the intermittent chlorine drops have been completely resolved as of 10/09/21, and that both OSEC plants are now dosing sodium hypochlorite at the required 0.8% concentration following flushing of the system.

5. Irish Water is responsible for producing a safe and secure supply of water, and they should have sufficient management oversight of the operations at Ballymore Eustace WTP. At the audit, the EPA instructed Irish Water to put in place an increased and permanent staff presence at the plant to support Dublin City Council in operating the plant. Following the audit, Irish Water has increased its presence at the plant since 10/09/21 and are working in partnership with Dublin City Council to address the main findings outlined at the conclusion of the audit.

		Answer
3.2	Is there a documented alarm response procedure?	No

Comment

During the audit, Dublin City Council representatives confirmed that there is no documented incident response procedure, and the plant operators were unaware of what to do in terms of escalating incidents or the consultation procedure with the HSE to determine if the water supply presents a risk to public health.

		Answer
3.3	Are suitable plant shutdowns/inhibits in place to prevent the entry of inadequately treated water entering the distribution network?	No

Comment

There is no automatic shutdown of Ballymore Eustace WTP in the event that critical alarms are activated and not resolved by plant operators in a timely manner. The reliance on manual intervention to shutdown the plant presents a significant risk in the event of human error or unavailability to respond to critical alarms.

		Answer
3.4	Are suitable alarm settings in place to alert operators to deteriorating water quality and/or the failure of a critical treatment process?	No

Comment

1. During the audit, it could not be confirmed if there is a turbidity alarm on the filters to alert plant operators to any deviation from the normal operating range. Dublin City Council representatives confirmed that after a backwash, the filters run to waste until turbidity drops below 0.3 NTU and the filters are brought back into service.

2. It is not clear if the low chlorine alarm set-points are based on the chlorine contact time calculations, to ensure the water leaving the plant has achieved primary disinfection.

		Answer
3.5	Is the data obtained from sampling and monitoring used to actively inform the processes on site and in the distribution network?	No

Comment

1. During the audit, Dublin City Council representatives confirmed that the plant performance data trends (e.g. final water turbidity and chlorine levels) are not being assessed or used by the plant operators to manage the plant performance.

2. Irish Water confirmed that Ballymore Eustace water treatment plant is connected to Irish Water's National Control Centre, however Irish Water does not have direct control over the plant operations, as this responsibility remains with the operators at the plant.

3. Dublin City Council's Central Laboratory produces a monthly summary report of operational monitoring at water treatment plants in its functional area, including Ballymore Eustace. These reports are provided to the water treatment plant managers, as well as a wider circulation group of water services personnel in Dublin City Council and Irish Water. The monthly report for August 2021 identified low levels of chlorine in samples taken from contact tanks 1 and 2, compared to previous months. It appears that this monitoring data was not assessed by Dublin City Council or Irish Water to provide insight into operations at the plant, in particular the issue of intermittent drops in chlorine levels. This identifies a lack of oversight by management in Dublin City Council and Irish Water.

4. Site Specific Issues

		Answer
4.1	Are there any upgrade works currently underway or planned at Ballymore Eustace water treatment plant?	Yes

Comment

The following works are underway or planned at the plant:

1. Pre-treatment pH correction is currently being installed to address drops in raw water alkalinity levels after heavy rainfall.
2. New poly dosing pumps are due to be installed.
3. Connection works are underway to facilitate the delivery of up to 8 ML/d of treated water from Srowland water treatment plant into the on-site reservoir, as a contingency measure for drought conditions in the Greater Dublin Area.

The sand filter media in some of the 32 rapid gravity filters was installed 21 years ago. There are no immediate plans for filter refurbishment works at the plant. The filter turbidity levels were reading between 0.063 and 0.101 NTU during the audit, which demonstrates very good filter performance.

		Answer
4.2	Is there automatic switchover between the duty and standby dosing pumps for all water treatment chemicals used at Ballymore Eustace water treatment plant?	No

Comment

There is no automatic switchover between the duty and standby alum dosing pumps.

Recommendations

Subject	Ballymore Eustace WTP Audit Recommendations	Due Date	12/11/2021

Action Text

Recommendations

Irish Water is responsible for producing a safe and secure supply of drinking water. The audit findings highlight significant failings by Irish Water and Dublin City Council in relation to management oversight, operational control and responsiveness. To address these issues Irish Water should implement the following recommendations as a matter of urgency.

1. Irish Water is responsible for producing a safe and secure supply of water, and should have sufficient management oversight of operations at Ballymore Eustace water treatment plant.

2. Irish Water should ensure a permanent presence of suitably qualified and competent water services personnel at Ballymore Eustace water treatment plant, to support the plant operators and to ensure management oversight of plant performance.

3. Irish Water should notify the EPA and HSE without delay, if the water treatment plant does not meet the level of performance required to provide adequate treatment to ensure safe water.

4. Irish Water should install automatic shutdown at the plant in the event that critical plant alarms are not resolved by plant operators in a timely manner, as the ultimate failsafe to prevent inadequately treated water being supplied to consumers.

5. Irish Water should ensure there is a documented incident response procedure in place at the plant, and that plant operators and management are fully trained on responding to incidents, to ensure that incidents affecting drinking water quality are suitably escalated and managed in order to maintain water quality and protect public health.

6. Irish Water should undertake immediate works to ensure that the total effective chlorine contact time is sufficient to meet Irish Water's site-specific target of 29.25 mg.min/l for Ballymore Eustace water treatment plant under each flow scenario; (a) Normal plant configuration, (b) Enhanced production, and (c) Service water tower. Irish Water should ensure that the chlorine alarm set-points are based on the contact time calculations, to ensure the water leaving the plant has achieved primary disinfection.

7. Irish Water should maintain an operational performance level of < 0.3 NTU for the filtered water turbidity levels at the plant, to ensure the performance of the *Cryptosporidium* treatment barrier can be verified at all times.

8. Irish Water should assess the performance of each individual filter having regard to the age of filter media, to inform a phased programme of filter refurbishment works at the plant.

9. Irish Water should ensure that the following controls are in place at the plant:

(i) turbidity alarms on filters, to alert operators to any deviation from normal operating range;

(ii) automatic switchover between duty and standby dosing pumps for all water treatment chemicals used at the plant.

10. Irish Water should confirm when the following works have been completed at the plant:

(i) repair of the sodium hypochlorite tank at the on-site electrolytic chlorination system,

(ii) installation of pH correction on the raw water.

Follow-Up Actions required by Irish Water

During the audit, Irish Water representatives were advised of the audit findings and that action must be taken as a priority to address the issues raised. This report has been reviewed and approved by Dr. Michelle Minihan, Senior Inspector, Drinking Water Team.

Irish Water should submit a report to the EPA by 12/11/21 detailing how it has dealt with the issues of concern identified during this audit. The EPA also advises that the findings and recommendations from this audit report should, where relevant, be addressed at all other treatment plants operated and managed by Irish Water.