Drinking Water Audit Report

County:	Galway	**Date of Audit:**	14 March 2019
Plant(s) visited:	Ballinasloe Water Treatment Plant	**Date of issue of Audit Report:**	05 April 2019
		File Reference:	DW2009/175
		Auditors:	Ms Derval Devaney
Audit Criteria:	• The *European Union (Drinking Water) Regulations 2014 (S.I. 122 of 2014), as amended*. • *The EPA Handbook on the Implementation of the Regulations for Water Services Authorities for Public Water Supplies (ISBN: 978-1-84095-349-7).* • The recommendations specified in the EPA *Drinking Water Report*. • EPA Drinking Water Advice Notes No.s 1 to 15. • The recommendations in any previous audit reports.		

MAIN FINDINGS

i. **The purpose of the audit was to assess the suitability of Ballinasloe Public Water Supply for removal from the EPA's Remedial Action List (RAL). Ballinasloe PWS is on the EPA's RAL since 2008 for persistent THM failures. Plant upgrade works have resulted in compliant THMs results in the network since December 2018.**
ii. **A UVT warning alarm has been placed on the plant's final water to ensure THMs compliance at network extremities.**
iii. **Ballinasloe Public Water Supply will be removed from the EPA's Remedial Action List when the Q1 2019 RAL update is published.**

1. INTRODUCTION

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. Ballinasloe public water supply has been on the EPA's Remedial Action List (RAL) since 2008 due to elevated levels of trihalomethanes (THMs) in the treated water. This audit was carried out to verify the effectiveness of remedial works undertaken to address persistent THMs exceedances in the network and to determine if the supply can be removed from the RAL.

The source of Ballinasloe public water supply is taken from the Bunowen River about 30m north of its' confluence with the River Suck. In times of flood the source is a mix of the two rivers.

Treatment at the plant consists of coagulation, flocculation, clarification (CFC), pressure filtration and disinfection (by UV and chlorination) and fluoridation. The plant operates 24 hours/day and produces 190 m^3/hour serving 8, 525 people. It also serves three public water group schemes (pGWS); Kiltomer No. 3 pGWS (Scheme Code 1200PRI0677 serving 76m^3/day to 380 persons), Clontuskert pGWS (Scheme Code 1200PRI0752 serving 108 m^3/day to 539 persons) and Moher pGWS (Scheme Code

1200PRI0448 serving 13 m^3/day to 64 persons). These pGWSs are suppled from the Ballinasloe PWS via Sheepwalk Reservoir, although part of Clontuskert is also supplied from Garbally Reservoir.

An upgrade to the water treatment plant commenced in November 2017 and was completed in December 2018. Works included optimisation and upgrade of the CFC process, filtration and disinfection treatment systems and process control/SCADA.

The opening meeting commenced at 10.30 am at Ballinasloe Water Treatment Plant. The scope and purpose of the audit were outlined at the opening meeting. The audit process consisted of interviews with staff, review of records and observations made during an inspection of the treatment plant. The audits observations and recommendations are listed in Section 2 and 4 of this report. Photographs taken by Derval Devaney during the audit are attached to this report and are referred to in the text where relevant. The audits observations and recommendations are listed in Section 2 and 4 of this report. The following were in attendance during the audit.

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Representing Irish Water:

Pat O'Sullivan, Drinking Water Compliance Specialist
Thomas Gibbons, Drinking Water Compliance Analyst
Pat Collins, Drinking Water Compliance Analyst
Eoin Hughes, Process Optimisation Specialist

Representing Galway County Council:

Tom Doherty, Project Manager
Diarmuid Croghan, Engineer
Paul Leonard, GSS
Tara Meehan, Technician
Ollie Sweeney, Caretaker
Adrian Raftery, Area Engineer

Representing Glan Agua Ltd.:

Kevin Blake, Engineer

Representing the Environmental Protection Agency:

Derval Devaney, Inspector

2. AUDIT OBSERVATIONS

The audit process is a random sample on a particular day of a facility's operation. Where an observation or recommendation against a particular issue has not been reported, this should not be construed to mean that this issue is fully addressed.

1.	**Source Protection** a. The source of Ballinasloe public water supply is taken from the Bunowen River about 30m north of its' confluence with the River Suck. In times of high rainfall, the surrounding area of land floods. During drought periods, such as summer 2018, supplementary pumps are installed into the main channel of the River Suck to secure raw water supply, thus the source is essentially a mix of the two rivers. b. On the day of the audit the River Suck had overflowed its banks and water flooded the low-lying land which surrounded the perimeter of the water treatment plant' grounds (see Photo 1). c. Raw water is gravity fed to a raw water sump at the plant. There are three forward feed water pumps on the raw water sump. Plant operation is controlled by the off-site reservoir level.

	d. Continuous raw water monitors were installed as part of the upgrade to measure UVT, turbidity, pH, ammonia and alkalinity. The monitors read a UVT of 25.27 %, turbidity of 1.934 NTU, pH of 7.82 and ammonia concentration of 2.9 mg/l on the day of the audit. e. Daily tests are also completed for temperature, colour and pH of the raw water and recorded in the daily log book. The log book entry at 8 am on the morning of the audit read a turbidity of 1.95 NTU, pH of 8.09 and a temperature of 8.8 ^{0}C. f. The river sources at Ballinasloe are classified as S3 and have been defined as needing a 5-log protozoal credit. The upgraded plant affords 6-log credit for protozoal treatment. g. The flashy nature of the river source also has a high level of dissolved organics with UVT's of 20% and below being experienced at the raw water intake.
2.	**Coagulation, Flocculation and Clarification** a. The provision for alkalinity boosting of the raw water using sodium hydroxide (caustic soda) was included in the upgrade in the event of the alkalinity monitor detecting low alkalinity levels in the raw water. The boosting station was not in operation during the audit and it was stated it is used infrequently (usually 4 times / year). The control on the use of caustic is manual, but it is planned to automate this process within the next 12 months with the installation of a streaming current monitor to enhance the coagulation process. b. The upgrade included the provision of a duty/standby sulphuric acid carrier/dilution water dosing arrangement to supress the raw water pH for optimum coagulation. c. Sulphuric acid is dosed to achieve a target coagulation pH of 5.8 to 6.1. The dose rate is automatically controlled by a feedback signal from a triple validated pH monitor located in the flocculation tank. The pH monitor read 5.89, 5.85 and 5.91 on the day of the audit. The monitor alarms via a text to personnel which is set at a low pH of 5 and at a high pH of 6.5. d. The aluminium sulphate (coagulant) dose point was relocated as part of the upgrade and is now dosed prior to water entering the flocculation tank. The dose rate is automatically controlled by a feed forward signal from the raw water UVT monitor. Three UVT bands are used to determine the aluminium dose rate (see Photo 2). On the day of the audit the UVT monitor read 25.27 % which signalled a coagulant dose of 400 mg/l. There is a duty and standby dosing arrangement from the alum day tank which alternates automatically every 12 hours. The raw water is mixed post dosing via an inline static mixing element. e. The chamber housing the aluminium injection point had filled with rainwater and the pipe was submerged in water (see Photo 3). f. With the installation of a streaming current monitor it is planned to increase the UVT bands from three to five. The narrower UVT ranges will enhance dose response to variations in raw water quality. g. Hydraulic mixing in the flocculation tank is achieved via baffle walls with top entry/bottom exit to encourage floc formation. Water enters a flow split chamber where a coagulant aid (a poly dose of 0.27 mg/l at 0.1% strength) is introduced with a duty and standby dosing arrangement. h. Water then enters one of two up-flow clarifiers via a new stainless steel weir (see Photo 4). The auditor was of the opinion that this weir post poly dosing introduced a turbulent flow which may pose a risk of breaking up the floc already formed. i. Pulse valves are present on the pipework entering each clarifier. They are fully open at present but there is the ability to adjust the valves to cause a pulsation of the inflow to the clarifiers to further improve flocculation if necessary. j. Both clarifiers were structurally and mechanically assessed and cleaned as part of the upgrade during 2018. Tube settlers were installed within the settling tanks and turbidity meters were installed on each tank outlet. The settled water decanting troughs were also levelled to ensure a linear flow within the clarifiers. Sludge blanket detectors were also installed. Sludge bleeds are based on time and occur every 8 minutes lasting for 30 seconds. The sludge bleed draw off points were relocated on each clarifier and pipework replaced as part of the upgrade. k. The up-flow rate on the clarifiers in 0.7 m/hr which is well within their design rate of 3.5 m/hr. During the audit, strong winds had an effect on the clarifiers water surface. A surface current was evident, pushing the water in the direction of the wind. The wind was also blowing water out of the decanting channels in the clarifiers (see Photo 5). It was stated during the audit that the wind was exceptionally strong and that windy conditions have not been known to affect the clarification process. l. Jar testing is initiated when raw water conditions deteriorate by 10% (signalled by a lowering of UVT levels). There are jar testing capabilities on-site. Jar tests were also carried out by an external laboratory during the commissioning phase of the plant on 27/09/18, 03/10/18 and

	03/12/18 and these test results were presented during the audit. m. The turbidity monitors on the outlet of Clarifiers 1 and 2 are trending on SCADA and were reading 0.61 NTU and 0.53 NTU respectively. These are to be used to determine the frequency of clarifier proactive maintenance and cleaning. Irish Water has stated in previous written correspondence that each clarifier will be cleaned every quarter (one clarifier will be cleaned every 6 weeks). n. The clarified water is injected with caustic (sodium hydroxide) prior to entry into a settled water tank to achieve a target final water pH. The pH of the final water is monitored continuously. If the pH goes outside the pH band on the HMI it will signal an increase or decrease in the caustic dosing pump speed as required. The pH monitor alarms via text when the pH reaches 5.7 (low level alarm) or 8.5 (high level alarm) in the final water. As an additional safeguard, to avoid over or under dosing, there is a minimum pump speed reference and a maximum pump speed reference. o. The settled water tank was covered during the upgrade works to afford protection from contamination by vermin, animals and algal growth. The settled water is also monitored on a daily basis by the caretaker for pH and aluminium and was 7.34 and 192 ug/l respectively on the day of the audit.
3.	**Filtration** a. There are seven pressure filters in service. Filters 1-5 were installed in 2008 and filters 6 & 7 as part of the recent upgrade. All filters had their media replaced as part of the upgrade with 700 mm of 065 ES silica sand (UC of 1.3 – 1.7) and 400 mm of Grade 2 anthracite. All nozzles within the filters and valves were also replaced. Turbidity monitor were installed on each of the filters rinse lines and on the outlet from each pressure filter in addition to there being two combined water turbidity monitors. Head loss is also monitored on all filters. b. The maximum filtration rate is 10 m/hour. A filter backwash is initiated by time, turbidity (at 0.3 NTU for 500 seconds) or headloss. The plant is using treated water from the rising main to backwash the filters. A backwash occurs every 36 hours if it is not triggered by turbidity or headloss first. When a backwash commences the filtered water valve shuts and the waste wash water valve opens to allow the water (i.e. the "dump volume") to run to waste. After backwash, water continues to run to waste for 25 minutes at which point the water should be below 1 NTU. A turbidity check on the run to rinse turbidity monitor must be satisfied to be not greater than 1 NTU before each pressure filter is brought back into service. c. The readings on the turbidity monitors Filters 1 – 7 during the audit were as follows; 0.084 NTU, 0.043 NTU, 0.046 NTU, 0.116 NTU, 0.052 NTU, 0.091 NTU and 0.070 NTU. The calibration of the turbidity monitor on Filter No 1 was checked and found to be due a calibration in March 2019. d. The final water turbidity was 0.035 NTU on the day of the audit. The plant shutdown alarm is set at 1 NTU for a period of 15 minutes on the common final water turbidity monitor.
4.	**Disinfection - UV** a. The water undergoes protozoan deactivation via UV treatment in duty/standby ATG UV SX 425 -10 medium pressure units. The validation protocol used was USEPA UV-DVGM 2006. The validated operating range of the UV system was provided to the EPA in advance of the audit, however the UV validation certificate on-site did not contain the validated dose and UV plates outlining the validated criteria were not displayed on the unit. b. The UV unit was found to be operating within its validated ranges during the audit; flow of 22 - 705 m^3/hr at a % UVT of 68.8 – 94.6 and a power of 50 – 100% and a dose of 12 mJ/ cm^2. c. The plant will shutdown at a high turbidity of 1 NTU, a low low UVT of 70 %, a minimum power of 50%, and a dose of < 12 mJ/ cm^2. The units automatically change over every 16 hours. There is no alarm on flow as it was stated during the audit that the plant cannot achieve flows greater than 705 m^3/hr or less than 80 m^3/hr. **Disinfection - Chlorination** d. Primary disinfection for the treatment of bacteria and viruses is provided via chlorination post UV disinfection using sodium hypochlorite 14 %. A day tank is made up from a bulk tank on-site.

	e. The chlorination injection points were upgraded and meets the EPA criteria for dosing arrangements. A contact time loop arrangement was provided on the sample line as part of the upgrade so the chorine monitor can measure chlorine residual post contact time. The chlorine residual monitor was reading 1.57 mg/l on the day of the audit. The target residual is 1.5 – 1.7 mg/l in the final water. f. The final water chlorine alarm at the plant initiates a text alert and a plant shutdown at a low chlorine residual of 0.5 mg/l and a high chlorine residual of 3 mg/l in the treated water. The chlorine monitor on the reservoir outlet also has a low chlorine alarm at 0.4 mg/l and a high chlorine alarm at 1 mg/l and alarms by sending an alert by text. There is a cascade system in place to respond to alarms that are sent by text. g. Records for delivery of sodium hypochlorite to the bulk tank were not provided during the audit. Details of the sodium hypochlorite batch in use were however provided after the audit as follows: Delivery date: 21/02/2019, Batch Number: 17902121, Date of manufacture: Feb 19, Expiry date: 12/05/2019, Manufacturer: Chemifloc.
5.	**Treated Water Storage and Distribution Network** a. There are three reservoirs on the network (Garbally, Sheepwalk and Redmount Hill Reservoir). Chorine booster stations are present at the inlet of Sheepwalk Reservoir and outlet of Redmount Hill Reservoir. Garbally reservoir is 1.5 miles from the plant. There are no customers served on the rising main to Garbally reservoir. b. All three reservoirs were cleaned in 2018 and the networks flushed.
6.	**Monitoring and Sampling Programme for treated water** a. There is a continuous monitor for pH (6.79), turbidity (0.035 NTU), UVT (86.80 %) and chlorine residual (1.57 mg/l) on the final water at the plant. Aluminium, turbidity, colour, free chlorine and temperature is also manually monitored daily in the final water and fluoride at the Garbally Reservoir. The daily manual records, which are entered into the daily log book, were inspected during the audit and found to be satisfactory. b. Chlorine residuals are monitored in the network 2-3 times per week. Residuals were available for Ballinasloe town but another caretaker undertakes the monitoring at the extremities and these results were not available on the day of the audit. Chlorine residual results taken in the networks extremities were submitted after the audit for January - March 2019 and were satisfactory.
7.	**Exceedances of the Parametric Values** a. THMs have shown to be compliant with the parametric value of 100 ug/l since the last failure on 23/11/18 (111 ug/l). The chlorine residual in the samples taken since November 2018 were also satisfactory (above 0.1 mg/l). Better controls are now in place as part of the upgrade works to limit THMs formation potential in the network.
8.	**Management and Control** a. Irish Water stated that a treated water UVT of 84.5 % and above leaving the plant is required in order to achieve THM compliance at the extremities of the network. In order to ensure plant performance is maintained and to provide a disinfection by-product barrier to limit THM formation, a final water UVT monitor and alarm was installed at the plant. The UVT monitor is set at to alarm by text alert at 84.5 % UVT to give early warning on potential breach of the THMs parametric value in the network and afford time to react to a decrease in UVT. b. A map was produced during the audit which listed the "Cloonlahan GWS" in its legend. When questioned if this was a group water scheme that was connected to the Ballinasloe PWS, there appeared to be a lack of clarity on whether there were group water schemes connected to the Ballinasloe PWS. After the audit the auditor discovered that EDEN lists three group water schemes as being served from the Ballinasloe PWS: Kiltomer No. 3 - Scheme Code 1200PRI0677 serving 380 persons; Clontuskert - Scheme Code 1200PRI0752 serving 539 persons and Moher – Scheme Code 1200PRI0448 serving 64 persons. These schemes existence was confirmed by Irish Water in writing following the audit.

3. AUDITORS COMMENTS

The upgrade of Ballinasloe water treatment plant has improved the operation and control of its treatment processes, resulting in drinking water that is in compliance with the THMs parametric value of the Drinking Water Regulations. Further enhancement of the coagulation process is planned for completion within the next 12 months and should allow for a more informed response to deteriorating raw water quality.

To ensure ongoing THMs compliance, it is imperative that procedures are in place for proactive maintenance of the clarifiers and a programme for network flushing and reservoir cleaning. Once further enhancements of the coagulation process are complete, the alarm settings for the final water UVT monitor should be reviewed downwards to add further protection to the water supply and provide additional response time should the final water quality deteriorate.

Ballinasloe Public Water Supply will be removed from the EPA's Remedial Action List when the Q1 2019 RAL update is published.

RECOMMENDATIONS

Coagulation, Flocculation and Clarification

1. Irish Water should confirm that the weir post the addition of coagulant aid does not give rise to turbulent flows that interfere and break up floc already formed during the coagulation/flocculation process. In this respect, please refer to the EPA's Drinking Water Advice Note No. 15: Optimisation of Chemical Coagulant Dosing at Water Treatment Works which states weirs should not have a greater fall than 0.5 m, and water velocities should be less than 0.3 m/s, in order to ensure that floc are not broken.

2. Irish Water should investigate, and if necessary take action, to ensure that strong winds do not lead to operational difficulties with the two open clarifiers (e.g. creating a circulating current leading to short circuiting, scouring of settled particles from the sludge zone, wind-induced turbulence, density currents, etc.) resulting in reduced settled water quality.

3. Irish Water should develop a preventative maintenance programme for the clarifiers to ensure continued satisfactory operation of the treatment process as recommended by the EPA's publication "*Water Treatment Manual: Coagulation, Flocculation and Clarification*". This should include scheduled or routine maintenance of tanks, pipelines, valves and associated pumps and specify that each clarifier will be cleaned every quarter (one clarifier will be cleaned every 6 weeks) as per Irish Water's previous written correspondence.

4. Irish Water should ensure the 0.1 µg/l drinking water parametric value for acrylamide is complied with by ensuring:

   (a) the dose averages no more than 0.25 mg/l and never exceeds 0.50 mg/l of the active polymer;
   (b) no batch contains more than 0.020% (by weight) of free acrylamide monomer, based on the active polymer content;
   (c) the polyacrylamide in use is a DWI approved product (http://www.dwi.gov.uk/drinking-water-products/approved-products/soslistcurrent.pdf)

   Irish Water should confirm the status of points (a)-(c) above for the plant and submit the calculations for determining the maximum allowable concentration of active polyacrylamide product dosed to drinking water supply.

5. Irish Water should investigate the feasibility of reducing the UVT alarm setting on the final water downward from 84.5% once the coagulation process is enhanced further (i.e. the streaming current system is in place and additional UVT bands are introduced).

Disinfection

6. Irish Water should ensure the validated operating ranges for the UV disinfection system are displayed on a plate on the UV unit or next to the online UV monitor at the plant.

Distribution System

7. Irish Water should put in place a programme for regular flushing and souring of the mains and cleaning the reservoirs to ensure the distribution networks are proactively maintained to ensure that organic material does not build up and the potential for the generation of disinfection by-products (THMs) is kept under control and free residual chlorine levels at the end of the distribution network are maintained at 0.1mg/l or greater.

Hygiene and Housekeeping

8. Irish Water should ensure that water does not collect in the chamber housing the aluminium dose injection point.

Management and Control

9. Irish Water should ensure that there are adequate flood control measures in place to reduce or prevent detrimental effects of flood waters or high water levels on the water treatment plant.

10. Irish Water should confirm that the filter's turbidity monitors were calibrated during March 2019 as required.

11. Irish Water should update the Ballinasloe PWS & Associated Public GpWS map to reflect network connections from the PWS to these group water schemes and display the map at the water treatment works. Irish Water should ensure a communications procedure is in place setting out how the private supplies are informed in the event of an exceedance of a parametric value in the public water supply or water outage, which may have the potential to affect the group water schemes water quality or quantity.

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 by Irish Water to address the issues raised. This report has been reviewed and approved by Ms Aoife Loughnane, Drinking Water Team Leader.

Irish Water should submit a report to the Agency within one month of the date of this audit report detailing how it has dealt with the issues of concern identified during this audit. The report should include details on the action taken and planned to address the various recommendations, including timeframe for commencement and completion of any planned work.

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.

Please quote the File Reference Number in any future correspondence in relation to this Report.

Report prepared by: Derval Devaney **Date:**

Derval Devaney — 5th April 2019

Inspector

Photo 1 River Suck and Bunowen River burst its banks - water surrounds perimeter of water treatment plant due to flooding

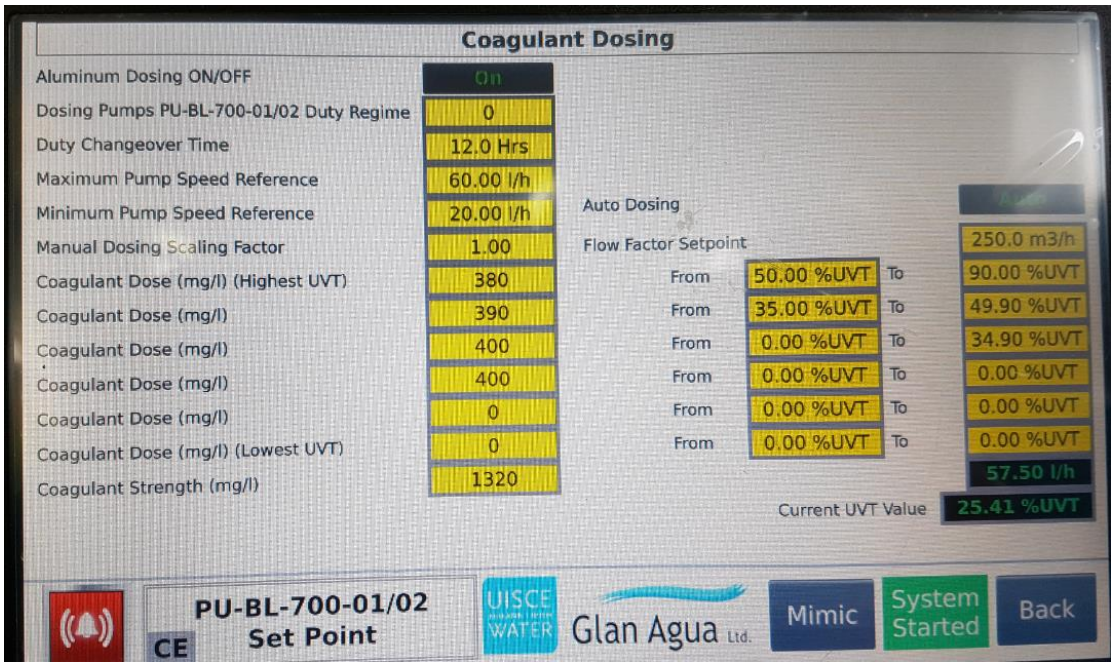

Photo 2 Three UVT Bands used currently to determine coagulant dose

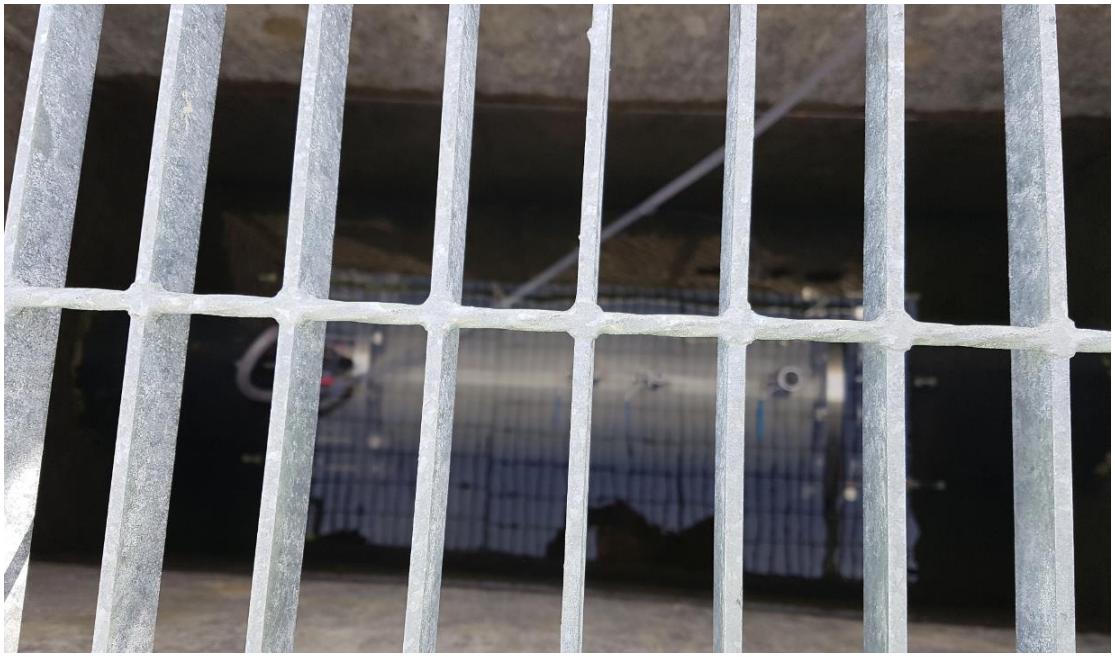

Photo 3 Rainwater has collected in the aluminium dosing point chamber and submerges the transfer pipe

Photo 4 Weir post poly dose prior to entry to clarifiers

Photo 5 Strong winds producing surface water currents in the clarifier and affecting settled water entering decanting troughs