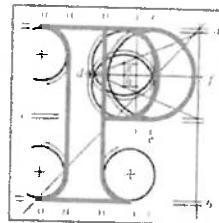


Our Case Number: ACP-324584-26



**An
Coimisiún
Pleanála**

River Shannon Environmental Protection Alliance
c/o Séamus Morris
Rathnaleen
Nenagh
Co. Tipperary

Date: 16 October 2026

Re: Proposed Limerick Wastewater Treatment Plant Upgrade & Regional Bioresource Centre
off Dock Road, Ballykeeffe, Corkanree and Courtbrack (townlands), Limerick

Dear Sir / Madam,

An Coimisiún Pleanála has received your recent submission in relation to the above mentioned proposed development and will take it into consideration in its determination of the matter. Please accept this letter as a receipt for the fee of €50 that you have paid.

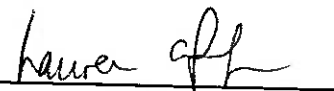
The Commission will revert to you in due course with regard to the matter.

Please be advised that copies of all submissions / observations received in relation to the application will be made available for inspection on the Commission's website at the following link:
<https://www.pleanala.ie/en-ie/case/324584>

More detailed information in relation to strategic infrastructure development can be viewed on the Commission's website: www.pleanala.ie.

If you have any queries in the meantime please contact the undersigned officer of the Commission. Please quote the above mentioned An Coimisiún Pleanála reference number in any correspondence or telephone contact with the Commission.

Yours faithfully,


Lauren Griffin
Executive Officer
Direct Line: 01-8737244

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SID Online Observation

Online Reference
SID-OBS-006165

Online Observation Details

Contact Name
Laura Kavanagh

Lodgement Date
15/10/2026 17:25:55

Case Number / Description
324584

Payment Details

Payment Method
Online Payment

Cardholder Name
Laura Kavanagh

Payment Amount
€50.00

Fee Refund Requisition

Please Arrange a Refund of Fee of

€

Lodgement No

LDG—

Reason for Refund

Documents Returned to Observer

☐ Yes ☐ No

Request Emailed to Senior Executive Officer for Approval

☐ Yes ☐ No

Signed

EO

Date

Finance Section

Payment Reference

ch_3UQrTbB1CW0EN5FC1tJl1OxN

Checked Against Fee Income Online

EO/AA (Accounts Section)

Amount

€

Refund Date

Authorised By (1)

SEO (Finance)

Authorised By (2)

Chief Officer/Director of Corporate Affairs/SAO/Board Member

Date

Date

An Coimisiún Pleanála

Planning Reference: PA91.324584

Proposed Limerick Wastewater Treatment Plant Upgrade and Regional Bioresource Centre

Submission / Observation

Submitted by: River Shannon Environmental Protection Alliance (RSEPA)

Date: 13 October 2026

1. Introduction and Scope of Submission

1.1 This submission is made by the River Shannon Environmental Protection Alliance (RSEPA) in relation to the proposed upgrade of Limerick Wastewater Treatment Plant (WWTP) at Bunlicky and the development of the associated Regional Bioresource Centre. The submission raises concerns regarding the potential consequences of increased nitrogen discharges to the Shannon Estuary and the adequacy of the environmental assessments accompanying the application.

1.2 The receiving environment is already under significant ecological pressure. The Natura Impact Statement (NIS) confirms that Limerick Dock, into which the WWTP discharges, and the downstream Upper Shannon Estuary are both classified as having Poor Water Framework Directive (WFD) status and are identified as “At Risk” of failing to achieve their environmental objectives. The existing WWTP discharged approximately 312.8 tonnes of total nitrogen (TN) in 2024, while the Environmental Impact Assessment Report (EIAR) predicts increases in dissolved inorganic nitrogen (DIN) concentrations following the proposed upgrade. These findings raise important questions regarding the potential for additional nutrient enrichment in waterbodies that are already failing to achieve good ecological status.

1.3 RSEPA welcomes improvements to wastewater treatment capacity, phosphorus removal and stormwater management. However, these improvements must be accompanied by adequate controls on nitrogen discharges and a robust assessment of their potential environmental effects. This submission therefore examines the proposed nitrogen removal arrangements, the assumptions underpinning the discharge modelling, cumulative nitrogen loading and the implications for WFD environmental objectives and the conservation objectives of the affected European sites. It identifies matters requiring further scientific evidence before the Commission can be satisfied that the proposed development meets the applicable environmental protection requirements.

2. Nitrogen Removal and Predicted Increases in Dissolved Inorganic Nitrogen (DIN)

2.1 The 2024 Annual Environmental Report (AER) for Limerick WWTP identifies the existing treatment process as providing tertiary nitrogen removal. However, Section 2.1.4.1 (Treatment Efficiency Report) records a TN removal efficiency of just 38%, with a reported influent nitrogen load of 508,011 kg/year and an effluent mass emission of 312,839 kg/year (approximately 312.8 tonnes of TN discharged to the Shannon Estuary). This indicates that approximately 62% of the incoming nitrogen load remained in the treated effluent. The mean effluent TN concentration was 17.67 mg/L. Despite these substantial nitrogen emissions, no TN emission limit value (ELV) is specified in the existing discharge licence.

2.2 Section 2.2.2.1 of the NIS confirms that the proposed development will introduce a new 157,000 population equivalent (PE) Aerobic Granular Sludge (AGS) treatment stream operating in parallel with the existing Conventional Activated Sludge (CAS) system, with a proposed 50:50 flow split. The existing treatment system will therefore remain operational, despite its reported total nitrogen removal efficiency of just 38% in 2024. The description of the proposed works does not identify specific upgrades to improve nitrogen removal within the existing CAS system, nor does it demonstrate how the combined operation of both treatment streams will achieve improved nitrogen removal or reduce overall nitrogen emissions to the Shannon Estuary.

2.3 Section 16.2.1.3 and Table 16-2 of the Environmental Impact Assessment Report (EIAR) apply an assumed future effluent DIN concentration of 30 mg/L. This is particularly concerning given that the 2024 AER recorded a mean effluent TN concentration of 17.67 mg/L. As DIN constitutes a component of TN, the assumed future DIN concentration exceeds the existing reported mean TN concentration. While these figures represent different assessment conditions, the discrepancy raises questions regarding the anticipated nitrogen removal performance of the upgraded facility and the basis for the assumed future concentration. The assessment should explain how the assumed future DIN concentration of 30 mg/L was determined, whether it reflects the anticipated nitrogen removal performance of the combined AGS and CAS treatment systems, and whether residual nitrogen from the Regional Bioresource Centre has been included. It should also distinguish between concentrations adopted for conservative environmental modelling and the nitrogen concentrations and mass loads actually expected from the upgraded facility.

2.4 Section 16.6.3.2 of the EIAR predicts increases in receiving water DIN concentrations of approximately 0.35–0.55 mg/L further from the outfall under the proposed upgrade scenarios. The assessment also identifies a localised mixing zone in which the non-regulatory indicative DIN threshold for Good status is exceeded. Notwithstanding these predicted increases, the EIAR concludes that there will be no adverse effects on waterbody status or the conservation objectives of designated European sites. The absence of a statutory DIN

environmental quality standard (EQS) for transitional waters does not remove the requirement to assess the ecological implications of increased nitrogen enrichment, particularly within designated European sites. Given the substantial existing nitrogen emissions from Limerick WWTP and the proposed increase in treatment capacity and discharge volumes, it is unclear whether the assessment adequately considers the potential effects of increased nitrogen loading on nutrient enrichment, ecological conditions and the conservation objectives of the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA. Reliance on a non-regulatory indicative threshold, without clearly demonstrating how the predicted increases in DIN relate to the ecological sensitivities and conservation objectives of these sites, raises concerns regarding the robustness of the assessment's conclusions.

2.5 The proposed development will substantially increase wastewater treatment capacity and treated effluent discharge volumes while retaining the existing CAS treatment stream, which achieved a reported TN removal efficiency of only 38% in 2024. Section 3.9.6.7 of the EIAR identifies a proposed side-stream liquor treatment process using anammox bacteria, designed to remove approximately 85% of ammonia from nitrogen rich liquors generated by the Regional Bioresource Centre. However, the assessment does not clearly quantify the residual nitrogen loads returned to the existing treatment stream or demonstrate how these will affect the combined plant's nitrogen removal performance. Given the existing reported annual TN discharge of approximately 312.8 tonnes, a comprehensive nitrogen mass balance is required to establish whether the proposed development will reduce or increase total nitrogen emissions to the Shannon Estuary.

2.6 It is submitted that the applicant should be required to provide a comprehensive nitrogen mass balance for the proposed development, including the anticipated nitrogen-removal efficiency of the retained CAS system, the new AGS treatment stream and the proposed side-stream liquor treatment process. This should quantify projected TN and DIN concentrations and annual mass loads in the combined final effluent, including residual nitrogen contributions from the Regional Bioresource Centre, and provide a direct comparison with existing discharge loads. The applicant should also clarify what legally binding nitrogen emission limits, monitoring requirements and operational performance standards will apply to the upgraded facility, and how these will be secured through the wastewater discharge authorisation process, having regard to its increased treatment capacity, the requirements of the recast Urban Waste Water Treatment Directive (EU) 2024/3019 and the ecological sensitivities of the receiving Shannon Estuary.

2.7 Appendix 16.3 of the EIAR confirms that the water quality modelling applies Q95 river flows for summer conditions and Q30 flows for winter conditions. While the summer scenario is described as representing critical conditions for effluent dispersion, it is unclear whether the assessment adequately accounts for more severe or prolonged low-flow events, such as those experienced in the Shannon catchment during summer 2026. Given the Poor WFD status of Limerick Dock and the Upper Shannon Estuary, and the predicted increases in DIN

following the proposed upgrade, it is submitted that the applicant should demonstrate whether the conclusions of the assessment remain valid under exceptional drought conditions, when dilution capacity may be further reduced.

3. Water Framework Directive: Environmental Objectives and Non-Deterioration

3.1 Article 4 of Directive 2000/60/EC (Water Framework Directive) establishes obligations to prevent deterioration in the status of surface water bodies and to protect, enhance and restore those waters with the objective of achieving good ecological and chemical status, subject to the provisions and exemptions of the Directive. Section 3 and Table 3-1 of the NIS confirm that both Limerick Dock, which receives the WWTP discharge, and the downstream Upper Shannon Estuary were classified as having Poor WFD status for the 2019–2024 assessment period, with both waterbodies identified as “At Risk” of failing to achieve their environmental objectives. These existing conditions are particularly relevant given the approximately 312.8 tonnes of TN discharged from Limerick WWTP in 2024 and the predicted increases in DIN concentrations associated with the proposed expansion. The assessment must therefore demonstrate that the additional nitrogen loading will not cause deterioration or compromise the achievement of good ecological status in these already impacted waterbodies.

3.2 The predicted increases in DIN concentrations must be assessed in the context of existing nutrient pressures and cumulative wastewater discharges throughout the Shannon catchment. A preliminary assessment of 12 wastewater treatment plants upstream of Parteen identified approximately 174.3 tonnes of TN discharged annually (*Preliminary Assessment of Wastewater Nitrogen Loading in the Lower River Shannon Catchment*, September 2026; Appendix A). Castletroy WWTP, which was not included in that assessment, reported an additional 30.9 tonnes of TN discharged in 2024 (2024 Annual Environmental Report, Section 2.1.4.1), while Limerick WWTP at Bunlicky reported approximately 312.8 tonnes in the same year. Together, these 14 facilities account for approximately 518 tonnes of reported annual TN discharges. This represents only a proportion of the wastewater-derived nitrogen entering the Shannon system and excludes additional wastewater discharges and diffuse nutrient sources. Although the reported loads do not establish the quantity of nitrogen ultimately reaching the estuary, they demonstrate the scale of cumulative wastewater derived nitrogen emissions that must be considered when assessing the potential ecological effects of the proposed development and compliance with Water Framework Directive environmental objectives.

3.3 Appendix 16.3 of the EIAR (Sections 1.3 and 2.6.1) confirms that the modelling incorporates existing upstream DIN concentrations derived from EPA monitoring data for 2013–2020 and includes cumulative scenarios for the proposed upgrades at Castletroy and Shannon Town WWTPs. However, it is unclear whether the assessment adequately considers

potential changes in upstream nitrogen loading over the operational lifetime of the proposed development. Given the existing Poor WFD status of Limerick Dock and the Upper Shannon Estuary, the applicant should demonstrate whether the conclusions remain valid under reasonably foreseeable changes in cumulative nutrient pressures, including those associated with future wastewater discharges and catchment development.

3.4 Castletroy WWTP's 2024 AER (Section 2.1.3) identifies a deterioration in ambient water quality downstream of the discharge, with annual mean ammonia-N concentrations increasing from 0.034 mg/L upstream to 0.036 mg/L downstream and orthophosphate-P increasing from 0.020 mg/L to 0.022 mg/L. The report acknowledges that the cause of this deterioration has not been established and that other potential sources remain unknown. It also records non-compliance with the plant's ammonia emission limit during 2024. This reinforces the importance of assessing cumulative wastewater discharges alongside other nutrient inputs when evaluating the potential ecological effects of the proposed Bunlicky upgrade.

3.5 The EPA's *Water Quality in 2025: An Indicators Report* (p. 17) identifies the ecological risks associated with elevated DIN concentrations in transitional and coastal waters, including increased algal growth, reduced dissolved oxygen and adverse effects on aquatic ecosystems. The EPA also identifies winter DIN concentrations as an important indicator of nitrogen enrichment because biological uptake is reduced during this period. Although the EIAR includes both summer and winter modelling scenarios (Section 16.2.1.3, Table 16-3), its assessment of the final future-development scenario (C06) focuses on summer conditions. The assessment should therefore clarify whether the predicted DIN increases and conclusions regarding ecological effects remain valid under winter conditions, particularly at the proposed 325,000 PE design capacity.

3.6 Appendix 16.3 of the EIAR presents a detailed assessment of effluent dispersion and predicted changes in DIN concentrations within the Shannon Estuary. However, the modelling primarily evaluates the distribution of pollutants and the extent of the resulting mixing zones. It does not demonstrate how the predicted increases in DIN have been assessed in terms of their potential effects on algal growth, dissolved oxygen conditions or other relevant ecological quality elements. This is particularly important given the existing Poor WFD status of Limerick Dock and the Upper Shannon Estuary. The applicant should therefore explain how the predicted changes in nitrogen concentrations support the conclusion that the proposed development will not cause ecological deterioration or hinder the achievement of WFD environmental objectives.

4. Habitats Directive: Adequacy of the Natura Impact Statement

4.1 Article 6(3) of Directive 92/43/EEC (Habitats Directive) requires the competent authority to ascertain, following an appropriate assessment and in view of the relevant conservation

objectives, that a proposed development will not adversely affect the integrity of any European site concerned, either individually or in combination with other plans or projects. Authorisation may only be granted under Article 6(3) where the competent authority has established, beyond reasonable scientific doubt, that no such adverse effects will occur.

4.2 The NIS concludes that the proposed development will not adversely affect the integrity of the Lower River Shannon SAC or the River Shannon and River Fergus Estuaries SPA. However, Section 5 identifies potential indirect adverse effects arising from water quality deterioration on several qualifying interests, including Atlantic salmon and lamprey species. Section 6.2.1.2.4 subsequently concludes that no residual adverse effects will occur, relying substantially on the limited spatial extent of the predicted mixing zone and the absence of deterioration in wider estuary water quality status. Given the predicted increases in DIN concentrations, the substantial existing TN discharge from Limerick WWTP and the cumulative upstream nutrient pressures identified in Appendix A, it is unclear whether the assessment adequately demonstrates, beyond reasonable scientific doubt, that the proposed development will not adversely affect the conservation objectives of the European sites concerned.

4.3 Section 6.2.1.2.4 of the NIS acknowledges that the existing benthic communities are dominated by species tolerant of organic enrichment and that substantial upstream nutrient inputs may limit ecological recovery. However, the conclusion that the proposed development will not adversely affect the qualifying interests and special conservation interests of the European sites relies substantially on the limited extent of the modelled mixing zone. It is unclear whether the predicted increases in DIN have been adequately assessed in relation to their potential effects on algal growth, dissolved oxygen conditions, supporting habitats and the conservation objectives of the affected European sites. This is particularly relevant given that Section 5 of the NIS identifies potential indirect adverse effects from water quality deterioration on Atlantic salmon and lamprey species. The applicant should therefore demonstrate how these ecological pathways have been assessed and how the predicted nitrogen increases support the conclusion that no adverse effects on site integrity will occur.

4.4 The Commission must be satisfied that the Appropriate Assessment is supported by complete, precise and definitive scientific findings and conclusions capable of removing all reasonable scientific doubt as to the absence of adverse effects on the integrity of the European sites concerned, having regard to their conservation objectives.

5. Regional Bioresource Centre and Cumulative Nitrogen Loading

5.1 The proposed Regional Bioresource Centre introduces an additional source of nitrogen-rich liquors generated through sludge treatment and dewatering, including the processing of imported sludge from Counties Limerick, Clare and Tipperary. These liquors will undergo

dedicated side-stream treatment before being returned to the main wastewater treatment process. The potential contribution of residual nitrogen from these return flows to the combined final effluent must therefore be considered when assessing the overall nitrogen loading associated with the proposed development.

5.2 Section 6.2.1.2.3 of the NIS concludes that the Regional Bioresource Centre will have no additional impacts on water quality because its return liquors will undergo dedicated treatment. However, this conclusion is not supported in that section by quantified residual nitrogen loads. The applicant should provide the anticipated volumes and nitrogen concentrations of these return liquors, the expected nitrogen removal efficiency of the side stream treatment process and the residual nitrogen loads returned to the main WWTP. It should also demonstrate how these loads have been incorporated into the projected nitrogen concentrations and mass loads of the combined final effluent.

5.3 The cumulative modelling presented in Appendix 16.3 of the EIAR includes future discharge scenarios for Castletroy and Shannon Town WWTPs. However, the assumptions underlying these projected discharges require further clarification. In particular, Castletroy WWTP's 2024 Annual Environmental Report (Licence D0019-01) records non-compliance with its ammonia emission limit, a TN discharge of approximately 30.9 tonnes annually and a TN removal efficiency of 66%. The Bunlicky modelling assumes a future DIN concentration of 7 mg/L and a discharge flow of 15,866 m³/day for Castletroy. Given the proposed increase in Castletroy's treatment capacity, the applicant should demonstrate how these assumptions were derived, whether they reflect the nitrogen removal performance of the upgraded facility and whether the cumulative assessment remains valid under reasonably foreseeable variations in future nitrogen loading.

6. Conclusion and Information Required

6.1 The proposed upgrade has the potential to improve wastewater treatment and reduce stormwater overflows. However, the EIAR predicts increases in DIN concentrations in the Shannon Estuary following the upgrade, while uncertainty remains regarding the nitrogen removal performance of the proposed treatment processes and the absence of specific nitrogen emission limits. These concerns must be considered in the context of existing nutrient pressures, including approximately 518 tonnes of combined reported annual TN discharges from the 14 wastewater treatment plants identified in this submission. It is therefore submitted that the applicant should be required to demonstrate, through a robust cumulative and ecological assessment, that the proposed development will not cause deterioration in the receiving waters, compromise the achievement of Water Framework Directive objectives or adversely affect the integrity of the relevant European sites.

6.2 Accordingly, it is submitted that the Commission should require the applicant to provide clear, verifiable evidence addressing the following:

- i. The expected nitrogen removal performance of the retained CAS system and how its performance, together with the new AGS treatment stream, will affect the nitrogen content of the combined final effluent.
- ii. The predicted TN and DIN concentrations and annual discharge loads under normal operating conditions and scenarios representing the highest anticipated nitrogen loading.
- iii. The expected nitrogen removal performance of the proposed side-stream liquor treatment process, the quantity of residual nitrogen returned to the main WWTP and how this has been accounted for in the overall nitrogen balance.
- iv. The potential ecological effects of the predicted increases in DIN, including implications for WFD environmental objectives and the conservation objectives of the affected European sites.
- v. The proposed nitrogen monitoring arrangements, enforceable emission limits and operational measures needed to ensure that the upgraded WWTP achieves its stated treatment performance.

6.3 Until these matters have been adequately addressed, it is submitted that the Commission cannot be satisfied that the proposed development will not compromise the environmental objectives of the receiving waterbody or adversely affect the integrity of the European sites concerned. The applicant should therefore be required to provide the necessary scientific evidence before any decision is made to grant permission.

Submitted on behalf of: River Shannon Environmental Protection Alliance (RSEPA)

Contact: Séamus Morris

Postal address: Rathnaleen, Nenagh, Co. Tipperary

Appendix A – Preliminary Assessment of Wastewater Nitrogen Loading in the Lower River Shannon Catchment

Preliminary Assessment of Wastewater Nitrogen Loading in the Lower Shannon Catchment

1. Introduction

A preliminary assessment was undertaken to quantify wastewater discharge and associated nitrogen loading from urban wastewater treatment plants (UWWTPs) within the Lower Shannon study area of Catchment 25C.

Catchment 25C contains 75 UWWTPs, together with 44 EPA-licensed facilities and 57 facilities operating under Section 4 discharge licences. The present assessment focuses specifically on a subset of 58 UWWTPs located between Mullingar and Parteen. Nitrogen inputs associated with the remaining UWWTPs, EPA-licensed facilities and Section 4 discharges have not been quantified as part of this assessment. The results therefore represent a partial assessment of point-source nitrogen inputs to the catchment rather than the total nitrogen load entering the Lower Shannon.

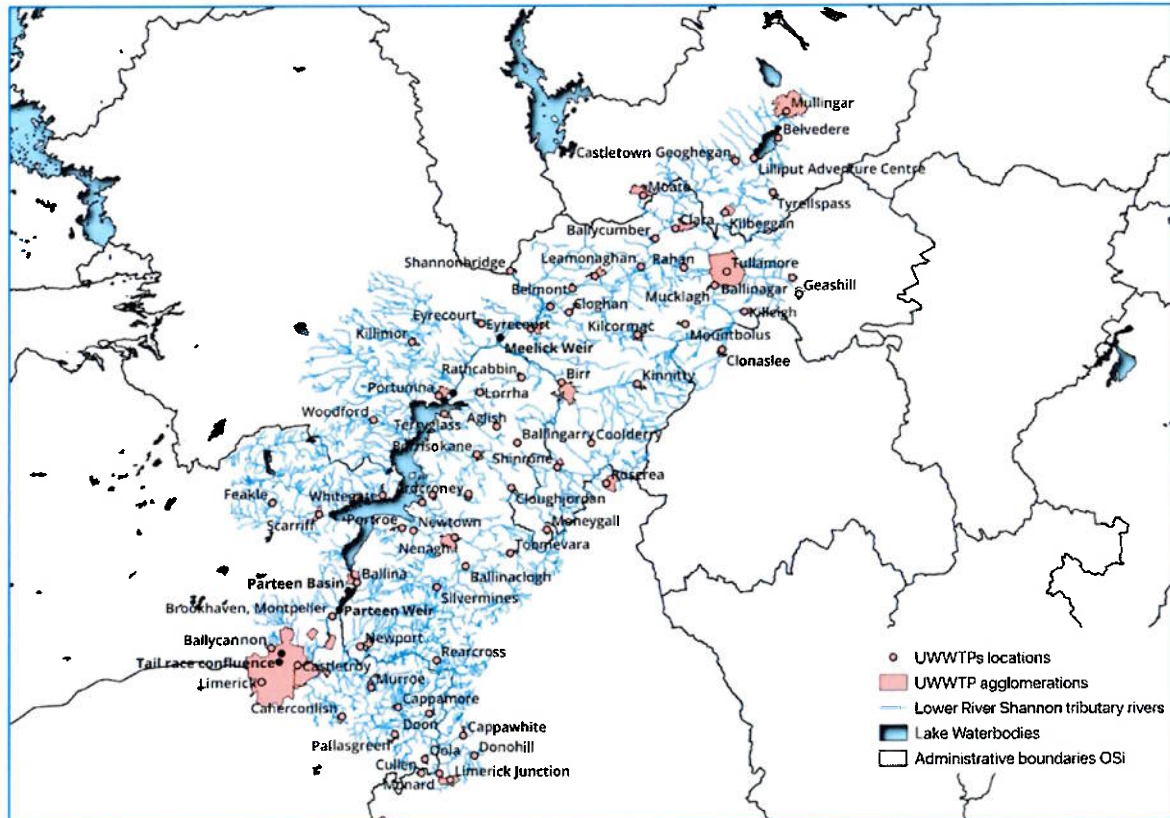


Figure 1. UWWTPs within Catchment 25C and the Lower Shannon river network.

The purpose of this initial analysis was to:

- quantify the volume of treated wastewater discharged where hydraulic data were available;
- estimate total nitrogen (TN), nitrate-N and ammonia-N loads from available effluent monitoring data;
- examine the composition of measured nitrogen loads;
- examine the relationship between ammonia-N loading and recorded ammonia emission limit value (ELV) exceedances; and
- place the quantified wastewater discharge and nitrogen loads in the context of the very low river flows recorded during 2026.

The assessment is based on available UWWTP monitoring data and does not include diffuse nitrogen inputs or other potential point sources that have not been quantified.

2. Data availability and methodology

Of the 58 UWWTPs identified within the study area, average hydraulic loading data were available for 19 plants (Appendix 1). These 19 UWWTPs represented a combined population equivalent (PE) of 115,015, accounting for 90.55% of the total PE (127,020) represented by the 58 plants. Their combined average hydraulic loading was 38,612.87 m³/day, equivalent to 0.4469 m³/s.

Wastewater treatment, hydraulic loading and effluent monitoring data used in the assessment were obtained from the latest available Annual Environmental Report (AER) for each UWWTP, accessed through the EPA LEAP portal. As the latest available reporting year varied between UWWTPs, the dataset represents the most recent reported conditions available for each plant rather than a single contemporaneous monitoring period. The complete list of the 58 UWWTPs, together with the availability of hydraulic and nitrogen monitoring data for each plant, is provided in Appendix 1.

Nitrogen loads were estimated using the reported annual mean effluent concentration for each nitrogen parameter and the corresponding average hydraulic loading:

$$\text{Load (kg N/day)} = \frac{\text{Concentration (mg N/L)} \times \text{Hydraulic loading (m}^3\text{/day)}}{1000}$$

Annual loads were subsequently estimated by multiplying the calculated daily load by 365 and converting kilograms to tonnes. Loads were calculated only where both hydraulic loading and monitoring data for the relevant nitrogen parameter were available; no values were extrapolated for UWWTPs with missing data.

3. Hydraulic loading

The 19 UWWTPs with available hydraulic data discharged an average combined volume of approximately 38,613 m³/day (0.447 m³/s).

The five largest hydraulic discharges were Mullingar, Nenagh, Tullamore, Birr and Roscrea. Together these accounted for 71.83% of the quantified wastewater flow, while Mullingar, Nenagh and Tullamore alone accounted for 56.88%.

Average hydraulic discharge by WWTP

Lower Shannon catchment | 19 WWTPs with hydraulic data

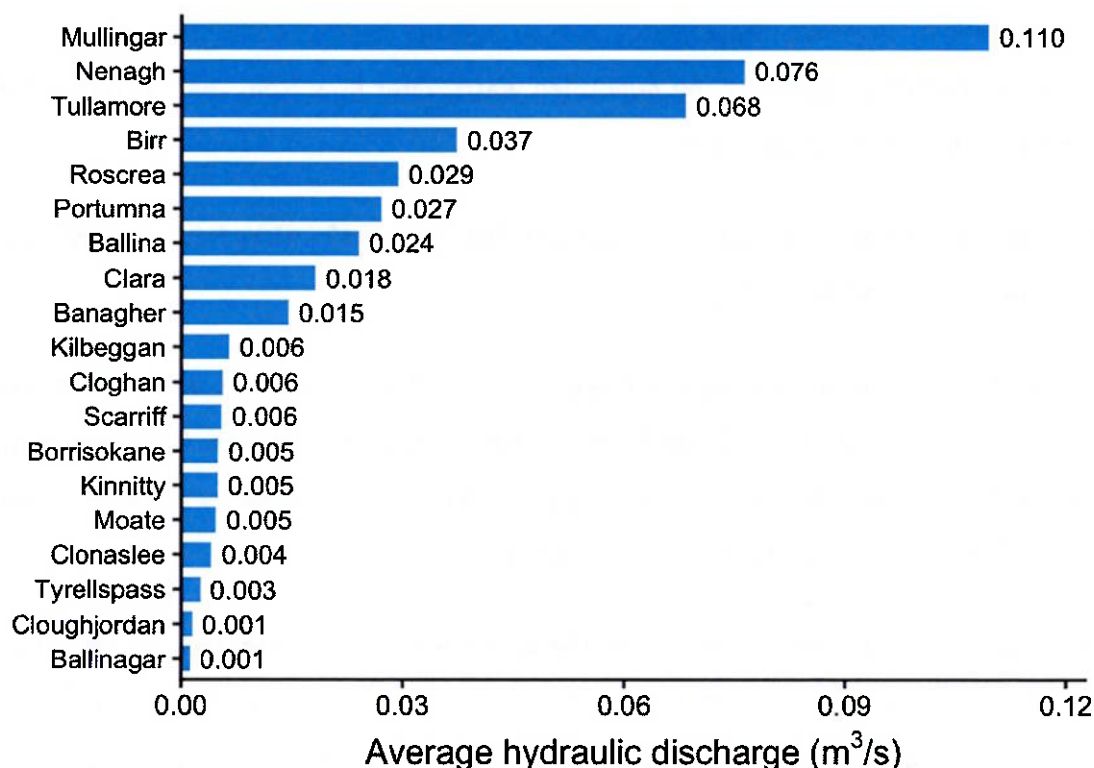


Figure 2. Average hydraulic discharge from the 19 UWWTPs with available hydraulic loading data.

During the 2026 low-flow period, combined Parteen flow fell to approximately 11 m³/s. For comparison, the combined average hydraulic discharge from the 19 UWWTPs (0.447 m³/s) was equivalent in magnitude to approximately 4.06% of this low-flow rate:

$$\frac{0.447}{11} \times 100 = 4.06\%$$

This comparison provides an indication of the relative magnitude of treated wastewater discharge under very low-flow conditions. It should not be interpreted as demonstrating that 4.06% of the water at any particular location comprised wastewater effluent, as the UWWTPs are distributed throughout the study area and the calculation does not account for the spatial distribution of discharges, tributary inflows, water travel times or other hydrological processes.

4. Total nitrogen loading

Effluent total nitrogen (TN) concentrations and average hydraulic loading data were available for 12 UWWTPs. Together, these plants had an average hydraulic discharge of 31,976.87 m³/day, representing 82.81% of the quantified wastewater flow from the 19 UWWTPs for which hydraulic data were available.

The combined estimated TN load from these 12 UWWTPs was 477.41 kg N/day, equivalent to approximately 174.26 tonnes N/year.

The largest estimated TN load was associated with Tullamore UWWTP, at 71.10 t N/year, accounting for approximately 40.8% of the combined calculated TN load. Other substantial estimated loads were associated with Nenagh (22.93 t N/year), Roscrea (22.29 t N/year), Mullingar (18.42 t N/year) and Birr (17.67 t N/year).

The estimated 174.26 t N/year represents the quantified TN load from the 12 UWWTPs for which both average hydraulic loading and effluent TN monitoring data were available. No TN load was assigned to UWWTPs for which TN monitoring data were unavailable. As reported annual mean TN concentrations varied substantially between plants, from 3.81 to 42 mg N/L, extrapolation to unmonitored UWWTPs was not considered appropriate.

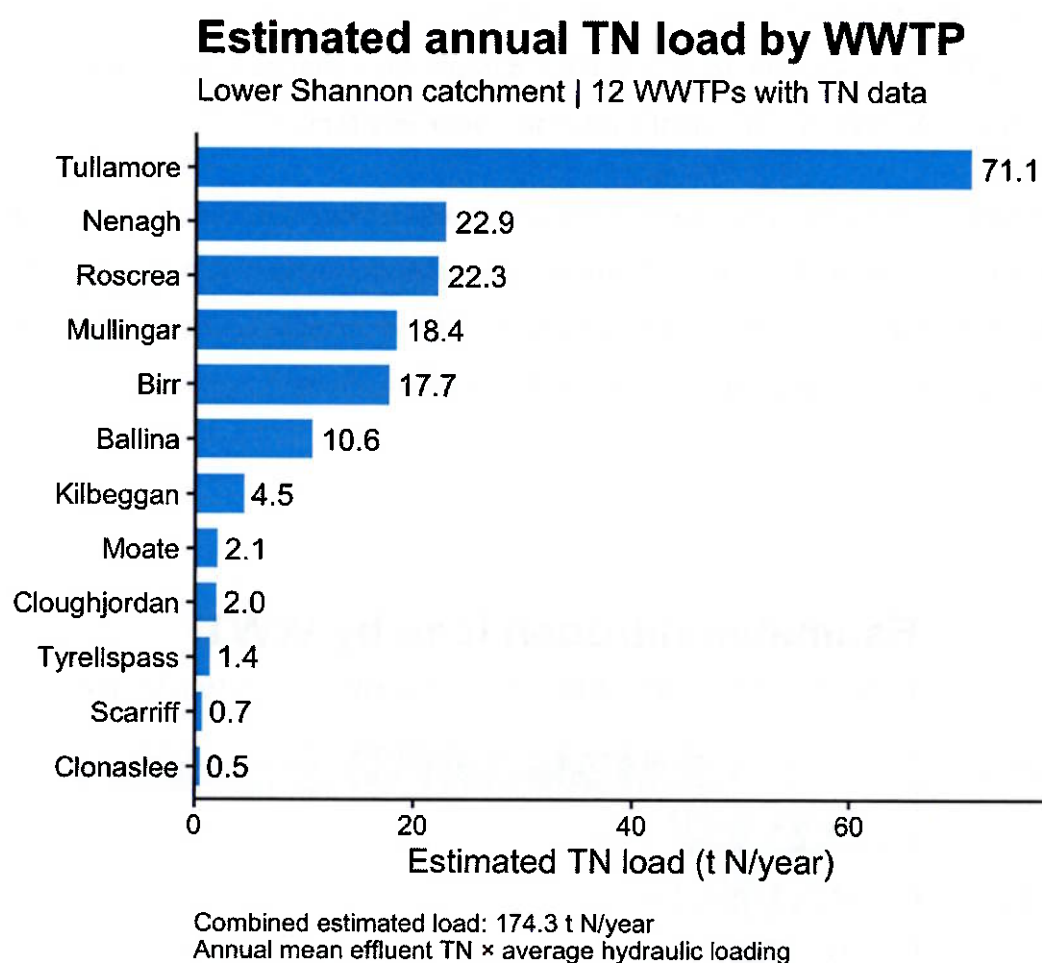


Figure 3. Estimated annual total nitrogen (TN) load from the 12 UWWTPs with sufficient hydraulic loading and effluent TN data.

5. Nitrogen composition

Ten UWWTPs had complete data for total nitrogen (TN), nitrate-N and ammonia-N, allowing nitrogen composition to be examined on a like-for-like basis.

Together, these plants had an average hydraulic discharge of 29,421.4 m³/day and an estimated TN load of 162.89 t N/year. Of this, 127.24 t N/year (78.11%) was nitrate-N, while 9.62 t N/year (5.90%) was ammonia-N. The remaining approximately 16% of the estimated TN load comprised nitrogen not represented by the nitrate-N and ammonia-N estimates, together with differences arising from the use of separately reported annual mean concentrations.

The results show that nitrate-N was the dominant measured nitrogen fraction discharged by these UWWTPs. Across the matched ten-plant dataset, the estimated nitrate-N mass was approximately 13 times greater than the estimated ammonia-N mass.

This distinction is important when considering wastewater nitrogen pressure based primarily on ammonia monitoring. Wastewater treatment processes can convert ammonia to oxidised forms of nitrogen through nitrification; consequently, a low ammonia-N concentration or load does not necessarily indicate a low total nitrogen load where nitrate-N remains in the treated effluent.

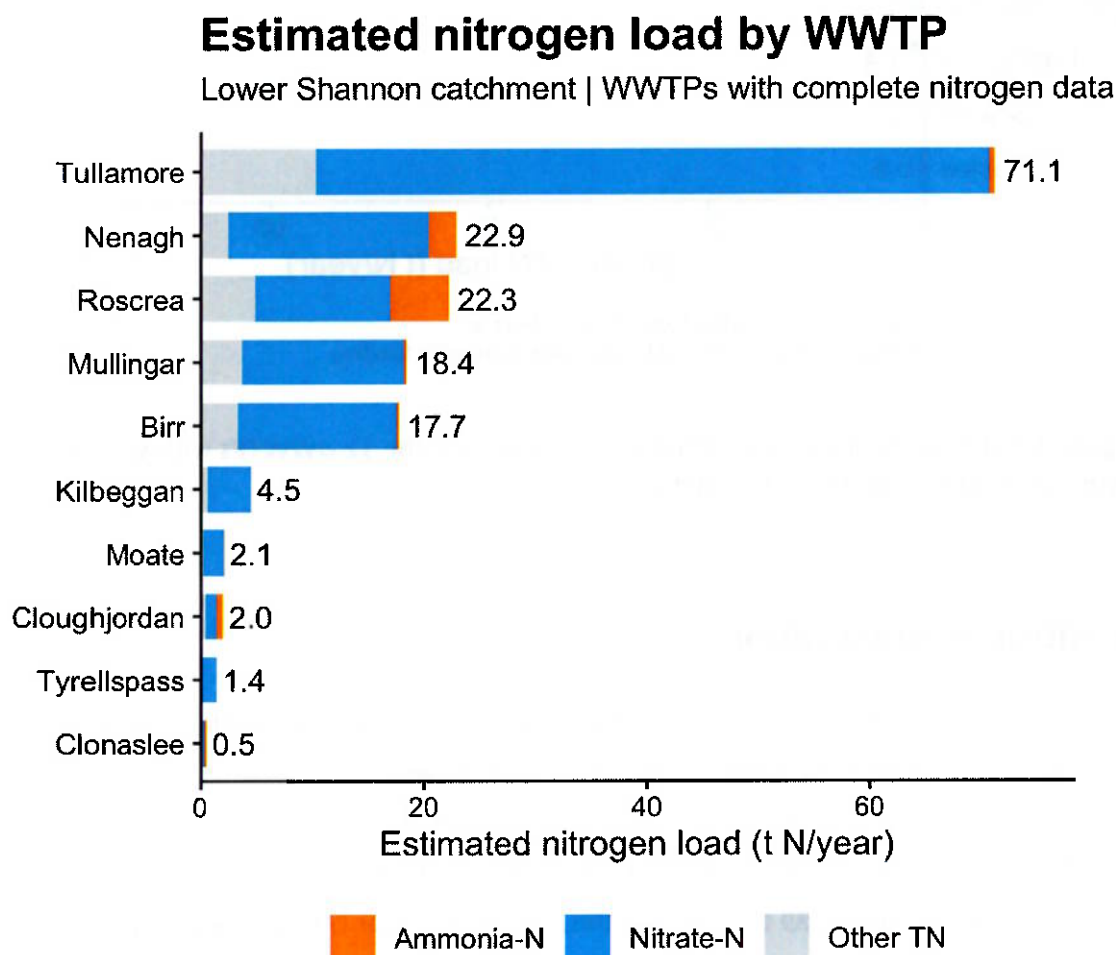
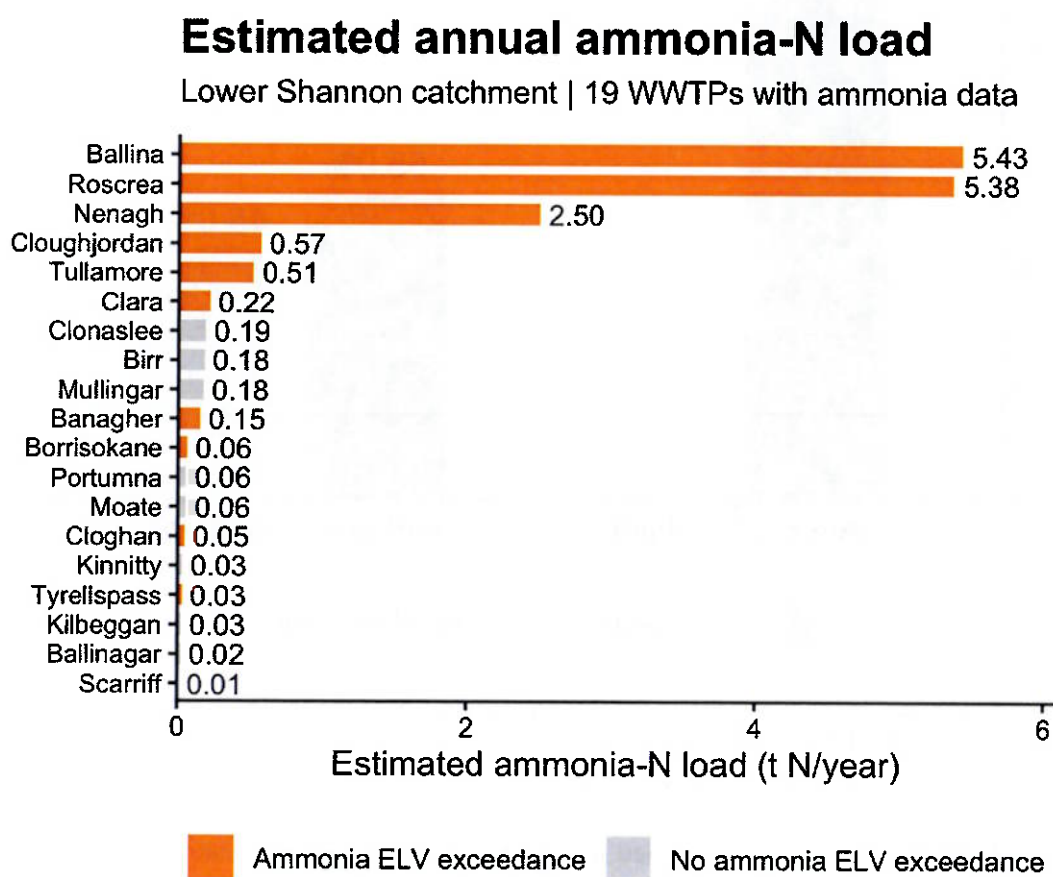


Figure 4. Estimated nitrogen load by UWWTP and nitrogen fraction.

6. Ammonia-N loading and ELV exceedances

Annual mean effluent ammonia-N concentrations were available for all 19 UWWTPs for which average hydraulic loading data were available.

The combined estimated ammonia-N load from these plants was 42.89 kg N/day, equivalent to approximately 15.65 t N/year. The distribution of this load was strongly concentrated among a small number of plants. Ballina and Roscrea together accounted for approximately 69% of the calculated ammonia-N load, despite representing only approximately 12% of the quantified hydraulic discharge.



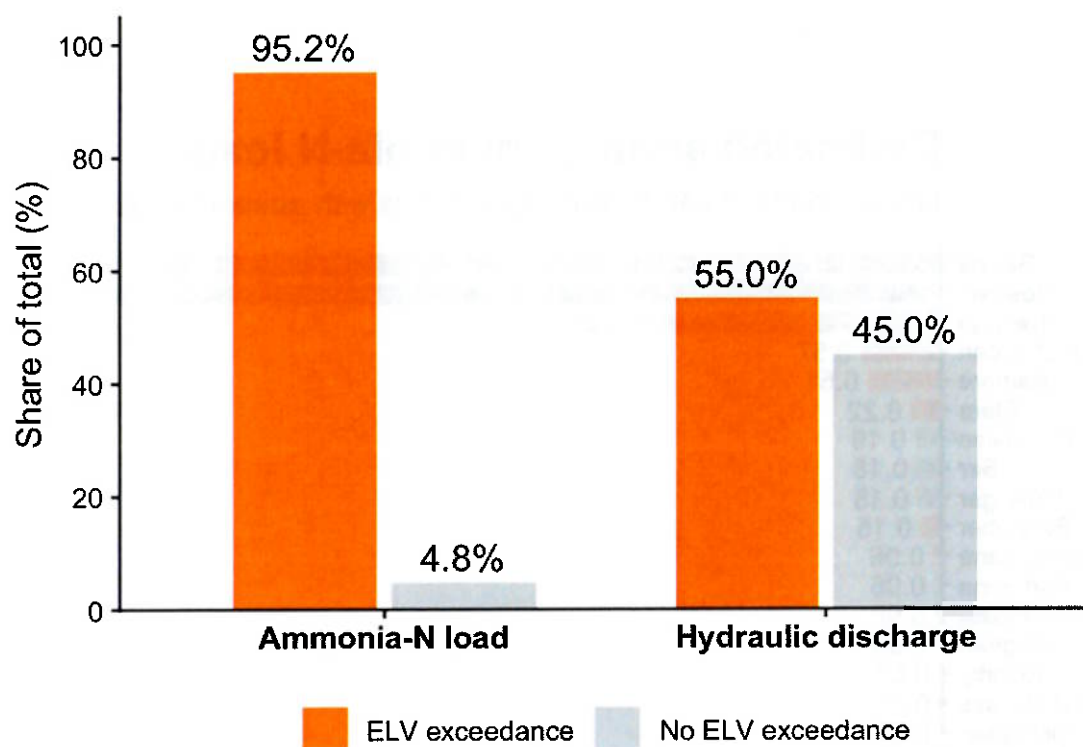
Loads estimated from annual mean effluent ammonia-N concentration and average hydraulic loading.

Figure 5. Estimated annual ammonia-N load by UWWTP.

Ten of the 19 UWWTPs had at least one documented ammonia-N ELV exceedance during the relevant reporting period. Collectively, these plants represented 55.0% of quantified hydraulic discharge but 95.2% of the estimated ammonia-N load. In contrast, the nine UWWTPs without a documented ammonia-N ELV exceedance represented 45.0% of quantified hydraulic discharge but only 4.8% of the estimated ammonia-N load.

Ammonia load and hydraulic discharge

Lower Shannon catchment | 19 WWTs with ammonia data



ELV exceedance = at least one recorded ammonia-N exceedance during the reporting period.

Figure 6. Proportion of ammonia-N load and hydraulic discharge associated with UWWTPs with and without recorded ammonia-N ELV exceedances.

This comparison demonstrates that the estimated ammonia-N load was strongly concentrated among UWWTPs with recorded ammonia-N ELV exceedances. However, it does not indicate that 95.2% of wastewater discharge was non-compliant. ELV exceedance status

indicates that at least one ammonia-N compliance sample exceeded the applicable ELV during the reporting period, whereas the ammonia-N loads presented here were independently estimated using reported annual mean effluent concentrations and average hydraulic loading.

7. Low-flow nitrogen context

The relative influence of a continuous wastewater nitrogen load on receiving waters increases as river discharge declines, as the same mass load is subject to a smaller volume of receiving water.

To examine the potential magnitude of the quantified UWWTP nitrogen loads under very low-flow conditions, a simple screening calculation was undertaken using a combined Parteen flow of 11 m³/s, recorded during the 2026 low-flow period. At this flow, the calculated UWWTP loads correspond to the following concentration-equivalents:

Nitrogen parameter Quantified UWWTP load Concentration-equivalent at 11 m³/s

Total nitrogen (TN)	477.41 kg N/day	0.502 mg N/L
Nitrate-N	355.14 kg N/day	0.374 mg N/L
Ammonia-N	42.89 kg N/day	0.045 mg N/L

These values are concentration-equivalents and should not be interpreted as predicted or measured river concentrations. The calculation assumes the quantified UWWTP load is considered against the stated river flow and does not account for the spatial distribution of individual discharges, travel time, tributary inflows, dilution upstream or downstream of individual discharge points, biological uptake, transformation or loss of nitrogen, retention within lakes and river reaches, or temporal variation in UWWTP discharge and effluent concentrations.

The calculation nevertheless illustrates the increasing relative magnitude of a given wastewater nitrogen load as receiving-water flow declines. Using the estimated TN load of 477.41 kg N/day, the corresponding concentration-equivalent would increase from approximately 0.055 mg N/L at 100 m³/s to 0.502 mg N/L at 11 m³/s, an approximately nine-fold increase.

The TN and nitrate-N screening values are themselves partial estimates, as the relevant monitoring data were not available for all 19 UWWTPs with hydraulic data, or for the wider set of UWWTPs and other potential point-source discharges within Catchment 25C.

8. Preliminary findings

The analysis identified a measurable wastewater nitrogen load within the Lower Shannon study area. The 12 UWWTPs for which both hydraulic loading and TN monitoring data were available had a combined estimated load of 174.3 t N/year. This represents a partial estimate, as TN could not be quantified for UWWTPs without the necessary monitoring data and other potential point-source nitrogen inputs within Catchment 25C were not included.

The composition of the quantified nitrogen load is particularly notable. Within the matched ten-plant dataset, nitrate-N represented 78.1% of estimated TN mass, compared with 5.9% as ammonia-N. Nitrate-N was therefore the dominant measured nitrogen fraction within this dataset, indicating that assessment based primarily on ammonia-N would not characterise the majority of the measured nitrogen mass discharged by these UWWTPs.

Ammonia-N nevertheless represented a distinct pressure. UWWTPs with at least one recorded ammonia-N ELV exceedance accounted for 95.2% of the estimated ammonia-N load, despite representing 55.0% of quantified hydraulic discharge. This indicates that estimated ammonia-N loading was strongly concentrated among plants with recorded ammonia-N ELV exceedances during the relevant reporting periods.

The relative magnitude of the quantified wastewater discharge and associated nitrogen loads increased markedly under the very low river-flow conditions recorded during 2026. At a combined Parteen flow of 11 m³/s, the quantified UWWTP TN and nitrate-N loads

corresponded to concentration-equivalents of approximately 0.50 mg N/L and 0.37 mg N/L, respectively. These values are screening estimates rather than predicted receiving-water concentrations, but demonstrate the increased relative magnitude of a given wastewater nitrogen load as receiving-water flow declines.

Appendix 1. UWWTPs included in the Lower Shannon study area and availability of hydraulic and nitrogen monitoring data

Reg Code	Plant Name	Agglomeration PE	Urban area PE	ELV Ammonia as N (mg l)	ELV TN (mg l)	AER Year	TN (mg l) Annual Mean	Nitrate as N (mg l) Annual Mean	Ammonia Total as N (mg l) Annual mean	ELV Compliance Status	Average Hydraulic Loading m3 day
A0526	Belvedere	59	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0529	Lilliput Adventure Centre	53	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0077	Whitegate	89	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0163	Killeigh	343	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0164	Ballycumber	256	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0165	Belmont	250	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0166	Coolderry	135	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0169	Moneygall	422	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0170	Mountbolus	330	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0171	Shannonbridge	317	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0173	Rahan	82	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0174	Leamonaghan	209	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0177	Geashill	476	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0178	Silvermines	388	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0179	Ballinaclogh	22	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0182	Portroe	400	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0183	Ballingarry	39	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0184	Ardcroney	34	<500	NA	NA	NA	NA	NA	NA	NA	NA
D0008	Mullingar	25468	29,019	NA	10	2025	5.33	4.21	0.051	Compliant	9466.4
D0097	Moate	3692	4,296	1	NA	2024	14	12.35	0.38	Compliant	410
D0147	Ferbane	1502	1,765	3	NA	2025	NA	NA	0.914	Compliant	NA
D0025	Roscrea	19309	7,286	10	15	2024	24	13	5.79	Non-compliant	2544
D0027	Nenagh	12628	12,749	3	15	2024	9.53	7.48	1.04	Non-compliant	6593
D0039	Tullamore	21771	28,209	0.5		2024	33	28	0.239	Non-compliant	5903
D0375	Eyrecourt	297	NA	NA	NA	NA	NA	NA	NA	NA	NA
D0319	Scarriff	987	1,133	0.5	NA	2024	4.23	NA	0.059	Compliant	476
A0436	Feakle	380	<500	NA	NA	NA	NA	NA	NA	NA	NA
D0225	Kilcormac	1130	1,334	7.5	NA	2025	NA	NA	3.84	Non-compliant	NA
A0162	Shannon Harbour	64	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0111	Woodford	370	<500	NA	NA	NA	NA	NA	NA	NA	NA
D0189	Ballina	5178	6,040	4	NA	2024	14	NA	7.16	Non-compliant	2079.47

D0196	Portumna	2161	2,504	NA	NA	2024	NA	NA	0.068	Compliant	2346
D0099	Tyrellspass	542	581	1	NA	2024	16.86	15.63	0.35	Non-compliant	229
A0517	Killimor	414	<500	NA	NA	NA	NA	NA	NA	NA	NA
D0103	Kilbeggan	1740	2,178	1	NA	2024	22	19	0.13	Non-compliant	561
D0326	Borrisokane	1325	1,684	0.8	NA	2024	NA	15	0.4	Non-compliant	436
D0362	Ballinagar	443	491	2.6	NA	2025	NA	NA	0.558	Compliant	105
D0363	Kinnitty	381	420	5	NA	2025	NA	NA	0.214	Compliant	431
D0364	Mucklagh	814	920	5	NA	2025	NA	NA	1.6	Non-compliant	NA
D0365	Shinrone	650	784	3	NA	2024	NA	NA	2.52	Non-compliant	NA
D0369	Cloghan	746	806	1	NA	2025	NA	NA	0.272	Non-compliant	488
D0109	Birr	10847	7,913	5	NA	2024	15	12	0.152	Compliant	3228
D0475	Cloughjordan	650	794	3	NA	2024	42	20	12	Non-compliant	129
A0064	Mountshannon	169	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0066	Castletown Geoghegan	182	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0186	Dromineer	162	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0187	Toomevara	380	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0191	Lorrha	200	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0192	Aglish	11	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0194	Terryglass	200	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0195	Newtown	300	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0199	Lachtacarn	22	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0200	Puckane	300	<500	NA	NA	NA	NA	NA	NA	NA	NA
A0203	Rathcabbin	250	<500	NA	NA	NA	NA	NA	NA	NA	NA
D0386	Clonaslee	603	658	4	NA	2025	3.81	1.28	1.44	Compliant	358
D0141	Banagher	2260	2,497	2	NA	2025	NA	NA	0.331	Non-compliant	1255
D0142	Clara	4284	4,397	1.5	NA	2025	NA	NA	0.377	Non-compliant	1575
A0554	Eyrecourt	304	<500	NA	NA	NA	NA	NA	NA	NA	NA