JOINT POSITION PAPER
Nitrate & Nitrite in Drinking Water 2023

This joint position paper was developed by the Health Service Executive (HSE) and the Environmental Protection Agency (EPA). It provides a summary of the issues in relation to nitrate and nitrite in drinking water, including health, legislation and interventions.

1.1 Introduction

Nitrate is found naturally in the environment and is an important plant nutrient. It is present at varying concentrations in all plants and is a part of the nitrogen cycle (1). Nitrate is formed when nitrogenous waste in soil or water is decomposed by microbial action. Vegetable matter, human waste discharge and animal slurries are natural sources of nitrates.

Contamination of drinking water sources with nitrogen-containing fertilisers and animal or human organic wastes can raise the concentration of nitrate in public or private drinking water supplies above acceptable levels. Shallow, rural domestic wells may also be contaminated with nitrates, especially in areas where there are more intensive agricultural practices or, on occasion, poorly functioning septic tanks nearby. A major artificial source of nitrate in the environment is nitrogen-containing fertiliser. Nitrate in the soil is soluble and readily migrates into groundwater and surface water.

Nitrite is typically found in low amounts, except in environments with an absence of oxygen, because nitrate is the more stable chemical state.

Nitrite can also be formed chemically in galvanised steel water distribution pipes by *Nitrosomonas* bacteria during stagnation of nitrate-containing and oxygen-poor drinking water or if chloramination is used to provide a residual disinfectant. An excess of free ammonia entering the distribution system can lead to nitrification and the potential increase of nitrate and nitrite in drinking water. Nitrate and nitrite can also be produced as a result of nitrification in source water or distribution systems (1).

1. 2 Sources of Nitrates and Mechanism via which Nitrates can enter Drinking Water Sources

Eighty per cent of Ireland's drinking water is sourced from surface water (rivers and lakes), 13% is groundwater and 7% is sourced from springs (2).

The main sources of nitrogen in Irish groundwater and surface waters are from agriculture, with pasture being the dominant source overall. Nitrogen emissions from arable land are also important in crop-intensive areas in freely draining soils of the country in the East and South-East where there is less rainfall (3). Nitrates from agricultural activities may enter surface or groundwater bodies via either point sources, such as leakage from storage areas, or diffuse sources, such as landspreading of fertilisers and manures.

The proportion of nitrogen in Irish rivers from septic tank systems is low on average, with higher contributions in the north-west and west regions of Ireland reflecting the relative density of septic tanks in these areas. Contributions from wastewater are relatively low across all regions except for the east due to the high proportion of the population living in this region (3).

Surface water nitrate concentrations can change rapidly owing to surface runoff of fertiliser, uptake by phytoplankton and denitrification by bacteria, but groundwater concentrations generally show relatively slow changes (1).

Conventional treatment (coagulation, clarification, filtration and chlorination) of water in drinking water treatment plants in Ireland does not remove nitrates. As a result, nitrates

present in raw water sources such as groundwater, springs, rivers and lakes may pass through the treatment plant and into the drinking water distribution network.

2. Legislative Framework

2.1 Drinking Water Regulations and Limits

The recast EU Drinking Water Directive (2020/2184) is implemented by the *European Union (Drinking Water) Regulations 2023 (S.I. No. 99 of 2023)* (4) (5).

These regulations set out the parametric limits for nitrate and nitrite in drinking water as illustrated in Table 1. Both nitrate and nitrite are Group B chemical parameters. Under specific circumstances, nitrite (and ammonium) should be added to the Group A parameters if chloramination treatment is used.

Table 1: Parametric values for nitrate and nitrite in drinking water

Parameter	Parametric value
Nitrate	50 mg/l (at the tap)
Nitrite	0.50 mg/l (at the tap) 0.10 mg/l (ex water treatment works – i.e. final water after treatment)
Nitrate & nitrite	A water supplier shall ensure that the condition [nitrate]/50 + [nitrite]/3 < 1, where the square brackets signify the concentrations in mg/l for nitrate (NO_3) and nitrite (NO_2), is complied with and that the parametric value of 0.10 mg/l for nitrites is complied with ex water treatment works.

The World Health Organization guideline values are 50 mg/l for nitrate (as NO_3^-) and 3 mg/l for nitrite (as NO_2^-) based on short-term effects but protective for long-term effects (1).

The 2023 Drinking Water Regulations require risk assessment and risk management of catchment areas for drinking water sources. This will assist in identifying, managing and mitigating the risk from nitrate/nitrite contamination.

EU Nitrates Directive

The European Union Nitrates Directive (91/676/EEC) aims to protect water quality by reducing pollution from agricultural sources and by promoting the use of good agricultural practice (6). It forms an integral part of the Water Framework Directive (2000/60/EC) and is one of the key instruments in the protection of waters against pollution from agricultural practices (7) (8).

Ireland's Fifth Nitrates Action Programme runs from 2022 to 2025 and is given effect by the European Communities (Good Agricultural Practice for Protection of Waters) GAP Regulations 2022 as amended (9). The regulations contain specific measures to protect surface waters and groundwater from nutrient pollution arising from agricultural sources.

Article 17 of the Nitrates Regulations *inter alia* regulates the landspreading of organic fertilisers in the vicinity of drinking water abstraction points. Article 17(2) lays down exclusion zones from drinking water abstraction points within which the land application of organic fertiliser is not permitted. These distances vary from 200m to 25m depending on the daily

abstraction amount or the number of people served by the drinking water source. The regulations enable landspreading distances to be reduced or increased after a technical assessment or prior investigation under the regulations has been undertaken. The EPA's Drinking Water Advice Note No. 11: Technical Assessments and Prior Investigations provides further information (10).

2.2 Roles and Responsibilities

Environmental Protection Agency (EPA)

The Environmental Protection Agency (EPA) is defined as the supervisory authority for all public water supplies managed by Uisce Éireann under Regulation 2(1) of the Drinking Water Regulations 2023 (5). The EPA publishes regular reports on drinking water quality in public and private supplies and issues advice and guidance to Uisce Éireann and local authorities in relation to drinking water.

The EPA also monitors and reports on the quality of Ireland's surface waters and groundwaters under the Water Framework Directive. The monitoring of nitrate in surface waters and groundwaters is a key part of this assessment as nitrate is an indicator of nutrient enrichment and a potential human health indicator in drinking water (8).

Uisce Éireann

Uisce Éireann is the national water utility responsible for the provision of drinking water in all public water supplies in Ireland. It also provides drinking water from its treatment plants to public group schemes.

Local Authorities

Local Authorities are the supervisory authority for regulated private drinking water supplies providing more than 10 m^3/day on average or serving more than 50 persons, supplies that have a commercial or public activity regardless of the volume supplied or population served, and public group schemes (5). Local Authorities monitor compliance of these supplies with the standards set out by the Regulations and perform the same regulatory function over these supplies as the EPA does over public supplies. Regulated private water supplies include community-owned private rural water services, known as group water schemes. Group water schemes are represented and supported by the National Federation of Group Water Schemes (NFGWS).

Exempted supplies are private supplies serving less than 10 m^3/day on average or serving fewer than 50 persons, provided that those supplies are not used in a commercial or public activity (such as a hotel or similar commercial outlet). An example of an exempted supply is a well serving a household for domestic use only. There are 171,136 households supplied by private water sources (not including private group water schemes) in Ireland, which equates to 10% of households (11). Owners of these supplies are responsible for the monitoring and management of their own supplies. The Local Authorities have a role in providing advice and guidance to these unregulated (exempted) private water supplies.

Under the Nitrates Regulations, Local Authorities carry out farm inspections every year.

Health Service Executive (HSE)

The Health Service Executive (HSE) is the single national body with statutory responsibility for the management and delivery of health and personal social services to the population of Ireland. The objective of the HSE is to use the resources available to it in the most beneficial, effective and efficient manner to improve, promote and protect the health and welfare of the public. The role of the HSE includes protecting the health of the public from potential chemical threats, such as nitrate or nitrite. When a nitrate or nitrite exceedance is detected in a supply, the water supplier should notify the relevant supervisory authority (5).

Where a water supplier or a Local Authority considers that a supply of water intended for human consumption constitutes a potential danger to human health, the water supplier or the local authority, as the case may be, should consult with the HSE and should ensure that agreed actions regarding the protection of consumers' health are followed.

The **Department of Housing, Local Government and Heritage** determines policy and funding in relation to public and private water supplies and is also the lead authority for the Nitrates (or GAP) Regulations.

The **Department of Agriculture, Food and the Marine** implements and operates the nitrates derogation including inspections of participant farms and imposition of penalties for non-compliance (8).

The **Commission for Regulation of Utilities** is the economic regulator for public water services, responsible for ensuring that Uisce Éireann operates in an economic and efficient manner.

The primary role of the **World Health Organization** (**WHO)** is to direct and coordinate health promotion internationally, within the United Nations system. The WHO strives to attain health objectives by supporting national health policies and strategies. The establishment of guideline values and health-based values for nitrate and nitrite is one example of the WHO's supporting initiatives.

3. Nitrate and Nitrite Monitoring in Ireland

Uisce Éireann is responsible for the monitoring of nitrate and nitrite in public drinking water supplies in Ireland to determine that the quality standards set by the Regulations are met. The Drinking Water Regulations categorise nitrate and nitrite as Group B (chemical) parameters that must be monitored in all public water supplies unless a derogation is granted in accordance with Regulation 18 of the Drinking Water Regulations 2023. The monitoring frequency is based on the volume of water distributed or produced each day within a supply zone.

Under specific circumstances, nitrite (and ammonium) should be added to the Group A parameters if chloramination treatment is used. Chloramination is a water treatment process that involves adding ammonia to drinking water along with chlorine to disinfect it.

Local Authorities are responsible for the monitoring of nitrate and nitrite in regulated private water supplies, including public and private group water schemes and regulated small private supplies in their functional areas.

Private supplies providing <10 m^3/day or serving fewer than 50 people, such as private wells, are not covered by the Drinking Water Regulations, except where they supply water as part of a public or commercial activity. It is not the responsibility of Uisce Éireann or of the Local Authorities to monitor these exempt private supplies. The onus is on private supply owners to get their own supply tested. Private wells in Ireland are at risk of contamination from nitrate and other hazards which can pose a significant risk to human health. For this reason, it is very important that owners of unregulated private supplies ensure their water supply is protected from contamination and has appropriate treatment, and that they monitor their water supply. The relevant Local Authority can provide guidance on how to protect their well water source.

Overall, compliance with the nitrate and nitrite parametric values is very high in public supplies, public group schemes and private group schemes, with greater than 98.8% of supplies compliant for both parameters in 2021 (12). Compliance with the nitrate standard was a little lower for small private supplies, with 97.8% compliant for nitrate in 2021 (13).

Failures of the nitrate and nitrite parametric values in public supplies were very low for the years 2017 to 2021 inclusive, with three or fewer supplies per year notified to the EPA as having failed the nitrate standard and two or fewer supplies per year notified to the EPA as having failed the nitrite standard (14) (15) (16) (2) (12).

Occasional water restrictions are put in place due to nitrate or nitrite contamination of drinking water supplies. These incidents show the importance of protecting the sources of supplies from contamination.

While there is no legal requirement to monitor unregulated private supplies such as private householder wells, it is recommended that the well is tested regularly to ensure that it is safe for drinking. More information is available at Household Wells | Environmental Protection Agency (epa.ie) (17).

3.1 Monitoring of Surface Water and Groundwater

The EPA monitors surface water and groundwater, some of which is used as drinking water sources, for a range of substances including nitrate under the Water Framework Directive Surveillance Programme.

Groundwater flows through spaces or fractures in the subsoil or bedrock to streams, rivers, lakes and estuaries. It can be an important contributor of nitrate from pollution sources into surface water bodies. During periods when there is little or no rain, almost all of the water flowing in streams and rivers originates from groundwater.

The South and South-East of the country continues to have the greatest proportion of groundwater monitoring sites with elevated nitrate concentrations. This region has also seen the greatest increase in nitrate concentrations since 2016 (18).

The appendix contains a map of average nitrate concentrations in groundwater from 2016 to 2021 (18).

Forty-three per cent of river sites have high nitrate concentrations and 39% of river sites have increased concentrations, mostly in the South and South-East of the country.

Appendix A shows that nitrate concentrations are highest in rivers in the South and South-East, where there is more intensive farming coupled with free-draining soils. Recent analysis by the EPA shows that more than 85% of nitrogen in rivers in some catchments in the South and South-East comes from agricultural sources. Parts of the East of the country have higher nitrate concentrations associated with urban waste water discharges (18).

4: PUBLIC HEALTH IMPLICATIONS/HEALTH EFFECTS

4.1: WHO guideline values, health-based values, tolerable and acceptable daily intakes

The WHO defines guideline values, health-based values, tolerable daily intakes (TDIs) and acceptable daily intakes (ADIs) for some drinking-water contaminants (19).

- Guideline values are derived for many chemical constituents of drinking water, including nitrate and nitrite. A guideline value normally represents the concentration of a constituent that does not result in any significant risk to health over a lifetime of consumption.
- In cases where a chemical constituent occurs in drinking water at concentrations well below health concern, the WHO does not calculate a formal guideline value. This is to dissuade Member States from incorporating a value into their national standards when this may be unnecessary for the protection of human health. In cases where a guideline value is not calculated, the WHO may determine a 'health-based value' to provide guidance to Member States when there is reason for local concern.
- The TDI is an estimate of the amount of a substance in food and drinking water, expressed on a body weight basis (milligram or microgram per kilogram of body weight), that can be ingested over a lifetime without appreciable health risk and with a margin of safety.
- ADIs are established for food additives and pesticide residues that occur in food for necessary technological purposes or plant protection reasons.

Acceptable Daily Intake Nitrate

Nitrates are a natural constituent of a normal mixed diet. The main dietary sources are green vegetables and cured meats, but in some areas drinking water may make a major contribution. The ADI for nitrate is 3.7 mg/kg of body weight (20) (21). A 60 kg individual consuming 2 litres of drinking water per day, at the parametric limit value of 50 mg of nitrate per litre, would result in a nitrate intake of 1.67 mg/kg of body weight/day from drinking water. This would be equivalent to 45% of the ADI. Further nitrate will be obtained from food.

Acceptable Daily Intake Nitrite

The current ADIs for nitrite set by the European Commission's former Scientific Committee for Food (SCF) in 1997 and the Joint FAO/WHO Expert Committee on Food Additives (JECFA) in 2002 and re-evaluated by the European Food Safety Authority in 2017, are 0.06 mg/kg of body weight and 0.07 mg/kg of body weight respectively (20) (21). A 60 kg individual consuming 2 litres of drinking water per day, at the parametric limit value of 0.5 mg of nitrite per litre, would result in a nitrite intake of 0.017 mg/kg of body weight/day from drinking water. This would be equivalent to 28% of the SCF ADI (or 24% of the JECFA ADI). Further nitrite will be obtained from food.

Public Health Implications of Nitrates and Nitrites in Drinking Water

Methaemoglobinaemia

The drinking water standard of 50 mg/l nitrate, originally set by the WHO in 1958, aims to protect bottle-fed infants from methaemoglobinaemia, a condition first reported by Comly in 1945 (22). The link between nitrate concentration in drinking water and infantile methaemoglobinaemia (IM) is complex and there are several other causes of IM, including genetic causes and exposure to other oxidising agents. However, infants are particularly susceptible to IM and drinking water standards which protect them will protect the rest of the population.

IM occurs when bacteria, either in the soil or in the immature infant gut, convert nitrates to nitrites. Nitrites easily combine with foetal haemoglobin to form methaemoglobin, which cannot carry oxygen around the body. The infant presents with central cyanosis (blue baby syndrome), which fails to respond to oxygen. The infant is treated by replacing nitrate-contaminated water in the preparation of feeds. Severe cases are treated with methylene blue. Breastfeeding protects babies from IM and boiling water does not remove nitrate. Simultaneous exposure to microbial contaminants resulting in gastrointestinal infections may increase the risk of IM (22). After the age of 4 months the gut flora changes, foetal haemoglobin is replaced by adult haemoglobin and reducing enzymes, which convert methaemoglobin back to normal haemoglobin, become more active. As a result infants gradually become less susceptible to IM.

There is no reliable estimate of the incidence of methaemoglobinaemia associated with drinking water worldwide (23). It is rare in Western Europe, although occasional cases have been reported from rural areas in Eastern Europe (24). A report in the literature in 1998 described methaemoglobinaemia in three Irish siblings which occurred as a result of accidental poisoning with sodium nitrate – commonly known as saltpetre and used for curing meat (25). Cases have also been described in Ireland more recently in connection with use of amyl nitrate (26) (27). From 2012 to 2021 fewer than five cases of methaemoglobinaemia in an infant were documented on HIPE (Hospital In Patient Enquiry) discharge data* (28). Clinical details including the cause and nature of methaemoglobinaemia are not available.

Other Adverse Health Effects

* It is not permitted to publish data cells from HIPE system containing five or fewer cases, to protect patient confidentiality

Associations between nitrates and other adverse health effects such as thyroid function alteration, pregnancy complications and cancer have been studied in the scientific literature.

There is evidence to suggest that exposure to nitrate in drinking water may alter human thyroid gland function (29) (30). While studies found that exposure to nitrate concentrations greater than 50 mg/L are weakly associated with altered thyroid function, the evidence is limited, conflicting and based on studies with important methodological limitations (29). Mode of action data suggests that pregnant women and infants are the sensitive population, due primarily to the importance of adequate thyroid hormone for normal neurodevelopment in the foetus and infant, but also due to increased thyroidal turnover in foetal and early life (29).

Evidence of an association between nitrate and foetal mortality, growth restriction or birth defects is weak. However, there are critical data gaps in individual exposure assessment, co-exposure to other contaminants and exposure to nitrate from food sources, which is likely more relevant than exposure from drinking water (30).

Because of the biological plausibility of endogenous nitrosation of ingested nitrate and nitrite, there is a possibility that a cancer risk may exist. IARC (2010) has classified 'ingested nitrate or nitrite under conditions that result in endogenous nitrosation' as probably carcinogenic to humans (Group 2A) (31).

Although numerous epidemiological studies have investigated the relationship between exposure to nitrate or nitrite in drinking water and cancer occurrence, the weight of evidence does not clearly support an association between cancer and exposure to nitrate or nitrite per se (30).

5: INTERVENTIONS

Protecting the drinking water supply is paramount. The most appropriate means of controlling nitrate concentrations, particularly in groundwater, is the prevention of contamination. This may take the form of appropriate management of agricultural practices and sanitation practices (1).

Where trends show an increasing concentration of nitrate in raw water or where nitrate or nitrite levels exceed recommended values in drinking water, intervention is required. Potential interventions include the following.

- **Actions by Water Suppliers:** When a nitrate or nitrite exceedance is detected in a supply, the water supplier should notify the relevant supervisory authority. The water supplier or the local authority, as the case may be, should consult with the HSE in accordance with the EU Drinking Water Regulations and undertake agreed actions necessary to protect human health. A water supplier should immediately undertake an investigation in order to identify the cause of the failure. The investigation should include undertaking a phase of increased monitoring in the immediate aftermath of the exceedance. The locality of the intake for the supply should be inspected for evidence of nearby fertiliser use. If use is identified that may be linked to the exceedance, the landowner should be consulted through the appropriate channels to make them aware of the potential implications of the

activity on drinking water quality. Inspections for other sources of nitrogen such as sewage or wastewater discharges should also be undertaken. Regular monitoring should continue until compliance has been confirmed.

- **Water Restrictions**: Where nitrate and/or nitrite level in a drinking-water supply is found to exceed the parametric limit value(s), an informed risk-based decision must be made as to whether there is an ongoing or likely ongoing potential danger to health (32).

In considering raised levels of nitrate/nitrite in a supply, the overall ratio of nitrate to nitrite must also be considered (see Table 1).

For nitrate, it is not recommended that people regularly consume water above the drinking water standard of 50 mg/l (1) (29) (32)**.**

For nitrite, any exceedance of the drinking water standard of 0.5 mg/l should prompt an investigation into the supply (32)**.** As a precaution, it is not recommended that anyone should drink water with nitrite concentrations above the drinking water standard of 0.5 mg/l on a regular basis because the additional intake from the diet means that it is likely that the EFSA ADI for nitrite could also be exceeded. Both the WHO and Health Canada guideline values for nitrite in drinking water are higher at 3 mg/l. This value is widely considered to be protective against the acute effect of methaemoglobinaemia induced by nitrite in bottle-fed infants and for the general population.

Therefore, it is recommended that people immediately stop using the supply if nitrite levels are above the WHO guideline value of 3 mg/l, which is protective against acute health effects (32)**.**

This advice applies to the whole population and is protective against methaemoglobinaemia and thyroid effects in the most sensitive subpopulation, bottle-fed infants and pregnant women, and consequently other population subgroups.

Where a 'do not consume' notice applies to the drinking water supply, an alternative water supply or bottled water should be used to prepare infant feeds for non-breastfed infants. All bottled water, with the exception of natural mineral water, is regulated to the same standard as drinking water (33) (34). It is best not to use bottled water labelled as 'natural mineral water' as it can have high levels of sodium and other minerals, although it rarely does. 'Natural mineral water' can be used if no other water is available, for as short a time as possible, as it is important to keep babies hydrated (33). Tap water, tankered water and bottled water are not sterile and should be boiled once and cooled for making up infant feeds. Ready-to-use formula that does not require reconstitution with water can also be used.

- **Actions by Private Householder Wells**

The EPA recommends that all household wells are tested at least once every year to check for contamination. The best time to test your well is after heavy rainfall, as this is when contamination is likely to be at its highest. If your well water changes in smell, taste or colour, it is a strong indication that contamination has taken place.

Repeat sampling should be undertaken as soon as possible if there is an exceedance of the nitrate or nitrite parametric value. Wells that are located in agricultural areas are more susceptible to nitrate and nitrite contamination, particularly shallow wells. Private well water containing levels of nitrate and/or nitrite above the parametric values should not be consumed on a regular basis and shall be subject to the same restrictions as outlined above.

Homeowners that have nitrate or nitrite test results consistently above the parametric values should consider installing a drinking water treatment device, blending with another supply or using an alternative drinking water supply (35). Users of the affected well should contact their Local Authority for further advice and guidance. The Local Authority may consult the HSE for health advice.

- **Treatment for the Removal of Nitrates/Nitrites**

  Possible solutions for the removal of nitrates or nitrites in the drinking water are as follows:

  - Source substitution (if feasible);
  - Blending/dilution with another low nitrate supply (if feasible);
  - Nitrate removal – Effective treatment technologies involve the physical/chemical and biological removal of nitrate and include ion exchange, reverse osmosis, biological denitrification and electrodialysis, which are capable of removing over 80% of nitrate from water.

    Reverse osmosis forces water under pressure through a membrane to filter out contaminants. Ion exchange involves replacing nitrate with chloride ions as it passes through an ion exchange resin. Ongoing nitrate monitoring will be required to demonstrate that the nitrate treatment unit is operating satisfactorily. Backwashed water should be disposed of in an appropriate manner so that it does not cause contamination of the environment.

    Conventional treatment (coagulation, flocculation, filtration, disinfection) of water is not effective in removing nitrate, as nitrate is a stable and highly soluble ion with low potential for co-precipitation and adsorption (1).

Treatment usually focuses on nitrate, because nitrite is readily converted to nitrate by many disinfectants (1).

It should be noted that excessive boiling of water to ensure microbiological safety can concentrate levels of nitrate in the water, so care should be taken to ensure that water is heated only until it reaches a rolling boil (1).

- **EPA enforcement actions:** When any breach of the regulatory limits is detected, the EPA requires that Uisce Éireann undertake an investigation into the cause of the exceedance and take corrective action, if necessary, to ensure compliance with the nitrate or nitrite

parametric value. Furthermore, the EPA may pursue enforcement actions under the 2023 Drinking Water Regulations, such as issuing legally binding Directions to Uisce Éireann.

- **Local Authority enforcement actions:** As the supervisory authority over regulated private supplies, Local Authorities ensure that any failure to meet parametric value is immediately investigated to determine its cause and that corrective actions, if necessary, are taken to ensure compliance with the nitrate or nitrite parametric value. Local authorities can pursue other enforcement actions such as issuing legally binding Directions to regulated private water suppliers requiring completion of actions to achieve compliance. Local Authorities also play an important role in enforcing the Nitrates Regulations and investigating any perceived breaches within their areas.

- **Water Safety Plans:** The 2023 Drinking Water Regulations require that the supply, treatment and distribution of water intended for human consumption is subject to the application of a risk-based approach that covers the whole supply chain from the catchment area, abstraction, treatment storage and distribution of water to the consumer's tap (5).
  The risk assessment and risk management of the catchment areas for abstraction points of water intended for human consumption should be carried out by the water supplier by 12 July 2027 and reviewed and updated at regular intervals of not greater than six years.
  The risk assessment and risk management of each supply system should be carried out by the water supplier by 12 January 2029 and reviewed and updated at regular intervals of not greater than six years.

  The WHO has published updated guidance on the implementation of the Water Safety Plan approach to the management of drinking water supplies (36). The approach involves the 'source-to-tap' risk assessment of a supply, the identification of potential hazards to water quality, assessment of the level of risk associated with each hazard and identification of appropriate control measures. The presence of nitrates in the catchment and the risk it poses to drinking water is included in the approach. The focus is on preventative action (37).

6: SUMMARY AND CONCLUSIONS

Agriculture is the greatest source of nitrate in groundwater and surface water in Ireland. Protecting drinking water supplies by focusing on reducing nitrate from entering sources is of critical importance. Implementation and enforcement of the Nitrates Directive and associated regulations by Local Authorities is key to reducing nitrate emissions to the environment. Proper management and treatment of sewage and waste water discharges is also of importance, as well as focusing on any other localised sources of nitrates near a drinking water source.

Overall compliance with the nitrate and nitrite parametric values is very high in both public and private supplies in Ireland. However, monitoring of supplies has demonstrated occasional exceedances of the parametric values for nitrate and nitrite and a small number of supplies

have had water restrictions imposed on them as a result. In some cases, sources have been switched off if there is gross contamination with nitrate.

Where trends show an increasing concentration of nitrate in raw water, action may be necessary by the supplier. Where nitrate levels repeatedly exceed recommended values in drinking water, intervention is required such as additional treatment at the plant, blending or dilution or, in some cases, shutting down of a source. Simple household treatment procedures such as boiling, filtration, disinfection and water softening do not remove nitrate from water. Boiling may increase the nitrate concentration of the remaining water.

Where Uisce Éireann (for public water supplies) and the Local Authority (for all other water supplies) consider there is a potential danger to human health they shall consult with the HSE and, with the agreement of the HSE, decide what action to take. Actions may include advisory notice issued to the consumers.

All exceedances of the nitrate or nitrite parametric value in public water supplies must be notified by Uisce Éireann to the EPA.

This is the joint position of the EPA and HSE regarding nitrate and nitrite in drinking water.

www.hse.ie
www.epa.ie

References & Further Reading

1. Guidelines for drinking-water quality: fourth edition incorporating the first and second addenda. Geneva: World Health Organization; 2022. Licence: CC BY-NC-SA 3.0 IGO. https://www.who.int/publications/i/item/9789240045064

2. Drinking Water Report for Public Supplies 2019. https://www.epa.ie/pubs/reports/water/drinking/DW%20Quality%20in%20Public%20Supplies%202019_web.pdf

3. Mockler, E.M. et al., 2017. Sources of nitrogen and phosphorus emissions to Irish rivers and coastal water: Estimates from a nutrient load apportionment framework. *Science of the Total Environment* 601–602 (2017) 326–339.

4. Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 20202 on the quality of water intended for human consumption (recast) https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020L2184&from=EN

5. European Union (Drinking Water Regulations, 2023 (S.I. 99 of 2023). S.I. No. 99/2023 - European Union (Drinking Water) Regulations 2023 (irishstatutebook.ie)

6. The Nitrates Directive (91/676/EEC). 1991. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01991L0676-20081211&from=EN

7. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. https://eurlex.europa.eu/legalcontent/EN/TXT/HTML/?uri=CELEX:32000L0060&from=EN

8. EPA, 2020. Ireland's Environment. An Integrated Assessment, 2020. http://www.epa.ie/pubs/reports/indicators/irelandsenvironment2020.html

9. European Communities (Good Agricultural Practice for Protection of Waters) Regulations (S.I. No. 113 of 2022), as amended. https://www.irishstatutebook.ie/eli/2022/si/113/made/en/print

10. EPA, 2011. EPA Drinking Water Advice Note No. 11: Technical Assessments and Prior Investigations. Advice-Note-No11.pdf (epa.ie)

11. CSO, 2019. The Census of Population from an Environment Perspective 2011 and 2016. https://www.cso.ie/en/releasesandpublications/ep/p-sdg6/irelandsunsdgs2019-reportonindicatorsforgoal6cleanwaterandsanitation/cleanandsafewater/

12. EPA, 2022. Drinking Water Quality in Public Supplies 2021. https://www.epa.ie/publications/compliance--enforcement/drinking-water/annual-drinking-water-reports/drinking-water-quality-in-public-supplies-2021.php

13. EPA, 2022 Drinking Water Quality in Private Group Schemes and Small Private Supplies – 2021 https://www.epa.ie/publications/compliance--enforcement/drinking-

water/annual-drinking-water-reports/Drinking-Water-Quality-in-Private-Group-Schemes-and-Small-Private-Supplies-2021---post-changes-Dec-2022.pdf

14. EPA, 2018. Drinking Water Report for Public Supplies 2017. https://www.epa.ie/pubs/reports/water/drinking/drinkingwaterreport2017.html

15. EPA, 2019. Drinking Water Report for Public Supplies 2018. https://www.epa.ie/pubs/reports/water/drinking/EPA%20DW%20Public%20Supplies_web.pdf

16. EPA, 2021. Drinking Water Quality in Public Supplies 2020. https://www.epa.ie/publications/compliance--enforcement/drinking-water/annual-drinking-water-reports/drinking-water-quality-in-public-supplies-2020-.php

17. EPA. Household Wells. https://www.epa.ie/environment-and-you/drinking-water/household-wells/

18. EPA, 2022. Water Quality in Ireland, 2016–2021. Monitoring & Assessment: Freshwater & Marine Publications | Environmental Protection Agency (epa.ie)

19. WHO, 2009. WHO Guidelines for Drinking Water Quality Policies and Procedures used in updating the WHO Guidelines for Drinking Water Quality.

20. Food and Agriculture Organization/World Health Organization, 2002. Evaluation of certain food additives. Fifty-ninth report of the Joint FAO/WHO Expert Committee on Food Additives. WHO Technical Report Series No. 913. Geneva: WHO.

21. European Food Safety Authority, 2017. Factsheet: EFSA explains risk assessment. Nitrites and nitrates added to food. https://www.efsa.europa.eu/sites/default/files/corporate_publications/files/nitrates-nitrites-170614.pdf

22. Comly, H.H., 1987. Landmark article Sept 8, 1945: Cyanosis in infants caused by nitrates in well-water. *Journal of the American Medical Association* 257 (20) 2788–2792.

23. Fewtrell, L. 2004. Drinking-water nitrate, methemoglobinemia, and global burden of disease: a discussion. *Environmental Health Perspectives* 112 (14) 1371–1374.

24. European Parliament. Parliamentary questions 1 April 2004 E-0562/2004. Answer given by Mrs Wallström on behalf of the Commission. https://www.europarl.europa.eu/sides/getAllAnswers.do?reference=E-2004-0562&language=EN

25. Finan, A. et al., 1998). Methaemoglobinaemia associated with sodium nitrite in three siblings. *British Medical Journal* 317 (7166) 1138–1139.

26. Nee, R. and Fitzgerald, M., 2014. Two cases of methaemoglobinaemia secondary to amyl nitrate use. *Irish Medical Journal* 107 (2) 48, 50.

27. Uí Bhroin, S. et al., 2018. Methaemoglobinaemia: a blue light emergency. *Irish Medical Journal* 111 (3), https://imj.ie/methaemoglobinaemia-a-blue-light-emergency/

28. Healthcare Pricing Office, 2023. Hospital Inpatient Enquiry (HIPE). https://www.hiqa.ie/areas-we-work/health-information/data-collections/hospital-patient-enquiry-hipe

29. Health Canada, 2013. Guidelines for Canadian Drinking Water Quality Guideline Technical Document – Nitrate and Nitrite. Pub. Number: 130471 Cat.: H144-13/2-2013E-PDF ISBN: 978-1-100-22999-7

30. World Health Organization, 2016. Nitrate and Nitrite in Drinking-water: Background document for development of WHO Guidelines for Drinking-water Quality. WHO/FWC/WSH/16.52

31. IARC, 2010. Ingested nitrate and nitrite and cyanobacterial peptide toxins. Lyon: International Agency for Research on Cancer; 1–464 (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 94).

32. Kibble, A. UKHSA. Written communication. August 2022

33. FSAI Scientific Committee Recommendations of Sodium Content of Bottled Water suitable for Infant Feeding: Corrigendum: Section 4.8.3 Scientific Recommendations for a National Infant Feeding Policy, 2nd Edition. https://www.fsai.ie/uploadedFiles/Resouces_and_Publications/Corrigendum_Infant_Feeding_Report_2015.pdf

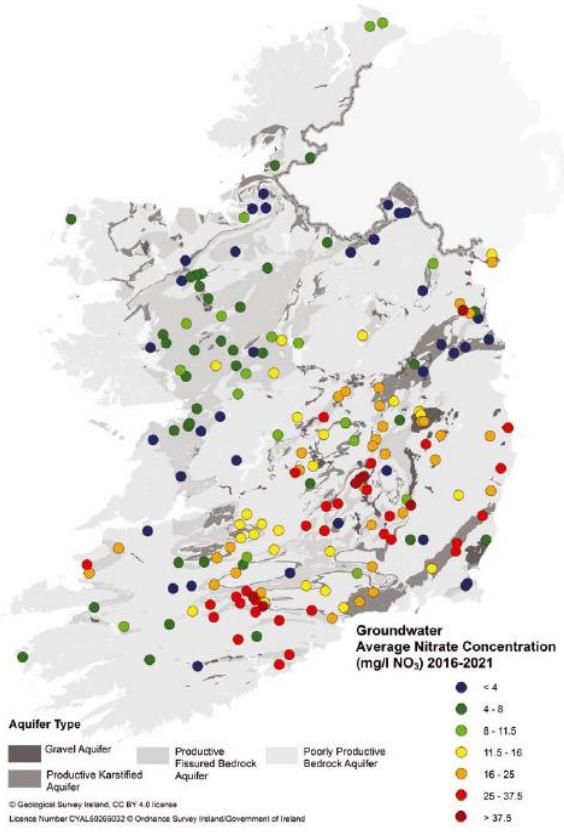
34. Health Service Executive, 2020. Management of initial notification of a drinking water issue of potential danger to human health 2020. https://www.hse.ie/eng/services/list/1/environ/water/management-of-initial-notification-of-a-drinking-water-issue-of-potential-danger-to-human-health.pdf

35. UK Drinking Water Inspectorate, 2020. Nitrate and Private Water Supplies – Version 5, 16 March 2020.

36. Water safety plan manual: step-by-step risk management for drinking-water suppliers, second edition. Geneva: World Health Organization, 2023. https://www.who.int/publications/i/item/9789240067691

37. EPA, 2011. EPA Drinking Water Advice Note No. 8: Developing Drinking Water Safety Plans. https://www.epa.ie/publications/compliance--enforcement/drinking-water/advice--guidance/Advice-Note-No8.pdf

Appendix



Map 6.2 Average nitrate concentrations in groundwater 2016-2021

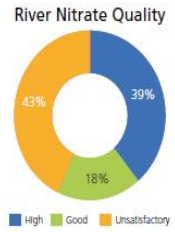
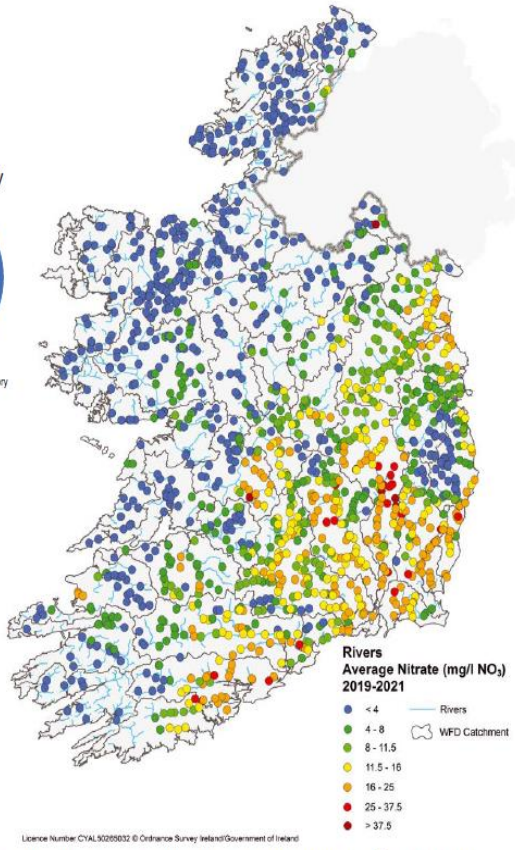


Figure 2.10 River nitrate quality



Map 2.5 Average nitrate concentration at WFD river sites for 2019-2021