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The use of onsite wastewater treatment systems in Northern Ireland

1 Overview

There has been a legal requirement to obtain consent to discharge, in order to operate an on-site waste water treatment system (OSWWTS), such as a septic tank, in Northern Ireland since 1973. According to the Northern Ireland Environment Agency (NIEA) 113,254 consents to discharge have been issued while there are approximately 16,000 unconsented systems.[1]

Many of the unconsented systems are over 40 years old and therefore nothing is known about their condition or suitability for local conditions. The implications of poorly maintained OSWWTS are discussed through analysis of a number of studies that have been conducted on the island of Ireland. These show there are implications for the environment and public health.

Aside from the environmental and public health risks posed by poorly maintained septic tanks, their impact on water quality has the potential to lead to Infraction proceedings if water quality targets established by the Water Framework Directive (WFT) are not met. This paper discusses how this threat of infraction prompted the Irish Government to legislate for the regulation of OSWWTSs in 2012 and to introduce an inspection and replacement scheme. The initial outcomes of this work are also discussed.

[1] NIEA (2015) Domestic Consents: Northern Ireland Environment Agency (NIEA) Position Statement – April 2015

2 Background

When businesses, private housing developments or single dwellings are unable to connect to the public sewerage infrastructure, onsite waste water treatment systems (OSWWTS), such as septic tanks or treatment systems with soakaways, are required to treat sewage. There is a degree of acceptance that OWWSTS can have an impact on water quality. However, the extent of this is uncertain for the following reasons:

- Lack of information about the location, number and condition of OSWWTSs;
- The difficulty, and general lack, of monitoring of the effects of OSWWTS discharges to surface water and groundwater;
- The increasing need – driven by European Regulation – to consider a wide range of potential pollutants; and
- The role/significance of OSWWTS pollutants compared to other sources such as agricultural activity.

The purpose of this paper is to assess the potential implications from the use of OSWWTS in Northern Ireland. This will be achieved by:

- Looking at the laws pertaining to the use of OSWTSs in Northern Ireland;
- Detailing the prevalence of OSWWTS in Northern Ireland;
- An examination of the current literature on the impacts of OSWWTSs; and
- A review of measures employed to mitigate the impact of OSWWTS.

3 Legislative context

The Water (Northern Ireland) Order 1999 is the primary legislation dealing with discharges to water requiring those with, or installing, an OSWWTS to obtain consent to discharge. This legislation makes it an offence to knowingly or otherwise permit trade or sewage effluent to enter surface waters or groundwater without the permission of the Department of the Environment (DoE).

The Water Framework Directive (WFD) is the primary piece of water legislation in the European Union (EU); its aim is to improve and integrate the way water bodies are managed and to improve and maintain water quality at ‘good status’ across the EU. The WFD was transposed into Northern Ireland law via the Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2003. This legislation appointed the Northern Ireland Environment Agency (NIEA) as the ‘competent authority’ with responsibility for implementing the WFD in Northern Ireland.

The Groundwater Directive (2006/118/EC) is a 'daughter' of the WFD and its purpose is to clarify certain objectives for groundwater quality in the WFD. The Directive includes criteria for the assessment of good chemical status and for identifying and reversing

upward trends in pollution. It also details measures to prevent or limit pollutants into groundwater.

The Groundwater Directive is transposed in Northern Ireland through the Groundwater Regulations (Northern Ireland) 2009. These Regulations came into operation on 10th August 2009 while a number of amendments were made through the Groundwater (Amendment) Regulations (Northern Ireland) 2014.

4 Onsite waste water treatment systems in Northern Ireland

The Northern Ireland Environment Agency (NIEA) has estimated that some 130,000 properties are served by OSWWTS in Northern Ireland.[2] Under the Water (Northern Ireland) Order 1999, owners of these treatment systems are required to have the consent of the Department of the Environment (DoE) to discharge effluent to a waterway or underground stratum (a soakaway) (article 9).

According to the NIEA there are 113,254 OSWWTS across Northern Ireland on behalf of the DoE[3] while it processes an average of 218 domestic consent applications each month.[4]

4.1 Unconsented systems

The NIEA estimates that there are over 16,000 un-consented OSWWTSs in Northern Ireland. There are two issues here; firstly there is uncertainty with regards the exact figure and ultimately the location of these OSWWTS. May et al. (2014) have pointed out that *"the number of* [OSWWTS] *across the UK has been significantly underestimated in the past",*[5] therefore given the problems associated with high densities of septic tanks it would be prudent to have a more accurate account of these.

The fact that such a large number of OSWWTSs are un-consented means nothing is known about their condition. This is a concern as there has been a legal requirement to obtain consent to discharge since 1973, under the Water Act (NI) 1973; therefore, many of the unconsented systems will be over 40 years old. There will also, therefore, be nothing known about the suitability of these unconsented systems for local conditions; Rail (2000) notes:

> *"Their [septic tanks] impact on water quality is variable. The rate of ground water quality change is affected by factors that are site specific in response to quantity and chemical quality of the septic tank effluent, soil properties,*

[2] NIEA (2015) Domestic Consents: Northern Ireland Environment Agency (NIEA) Position Statement – April 2015
[3] As of April 2015
[4] NIEA (2015) Domestic Consents: Northern Ireland Environment Agency (NIEA) Position Statement – April 2015
[5] May, L., Withers, P., Jordan, P., May, L. (2014) Impact of onsite sewage treatment systems on river water quality in UK catchments. A report for Natural England [online] available from: http://nia1.me/2re

water table location, subsurface geology, climate and vegetation, and its management over and around the leachfield".[6]

A study conducted in Ireland (Gill et al. 2007) found only 4 of 74 sites (5.4%) were suitable for the installation of a septic tank.[7]

This is why under current regulations applicants for discharge consent must arrange for soil percolation tests to be carried out. The results are submitted to NIEA to determine if the ground is suitable and also the length of the soakaway that will be required to operate an efficient soakaway.[8]

It should also be noted that apart from the legal requirement for consent to discharge, most lenders require proof of consent before they will release monies to home-builders. Therefore, almost anyone building on a mortgage or on borrowed money will in the majority of cases have to obtain consent. Houses built before 1973 therefore account for the bulk of the presently un-consented systems.[9]

4.2 Monitoring of consented systems

After a consent to discharge has been issued there are no routine inspections of septic tanks. It is NIEA policy to initiate enforcement action only where a pollution incident is of high or medium severity. If the seriousness of the incident warrants it, or pollution continues to occur, NIEA will initiate appropriate enforcement action.

5 Pollution threat

It is generally accepted that an OSWWTS that is well constructed, sited and maintained to approved standards poses a 'relatively small' pollution risk[10]. However, a high density of OSWWTS, particularly those that are poorly maintained has been shown to increase the risk of pollution.[11] [12] The key pollutants from sewage discharges are:

- Nutrients (Nitrogen and Phosphorus);
- organic matter – ammonia and faecal pathogens;
- toxic substances – from industrial effluent, household chemicals and road run-off; and

[6] Rail, C.D. (2000) Groundwater Contamination: Volume 1. CPC PRESS. Page 36
[7] Gill, L.W., O'Sulleabhain, C., Miisstear, B.D.R. and Johnston, P.J. (2007) The treatment performance of different subsoils in Ireland receiving on-site wastewater effluent. Journal of Environmental Quality. Volume 36 pp. 1843-1855
[8] NIEA (2013) Restructuring and revision of application process and fees for discharge consent under the Water (Northern Ireland) Order 1999 for single domestic dwellings October 2011[online] available from: http://nia1.me/2rk
[9] DOE DALO
[10] SNIFFER (2009) Review of the Legislative Requirements and Responsibilities Relating to On-site Wastewater Treatment Systems and Their Impact on Water Quality [online] available from: http://nia1.me/2rd PAGE 26
[11] Arnscheidt, J., Jordan, P., Li, S., McCormick, S., McFaul, R., McGrogan, H.J., Neal, M. and Sims, J.T. (2007) Defining the sources of low-flow phosphorus transfers in complex catchments. Science of the Total Environment vol. 382 pp. 1-13 [online] available from: http://nia1.me/2rc (subscription required)
[12] NIEA [online] River Basin Management Plans: Programme of measures. Available from: http://nia1.me/2ri

- sewage-related debris.[13]

The release of nutrients into sensitive waterbodies is a particularly important issue as this can lead to eutrophication and ultimately, failure to comply with water quality standards established for the Water Framework Directive (WFD).

5.1 High Density of OSWWTS

Morrissey et al. (2015)[14] have assessed the impact of high density clusters of houses using OSWWTS. Four separate cluster development sites were selected, each representative of different aquifer[15] vulnerability categories,

> *"Vulnerability is determined and mapped by the Geological Survey of Ireland by a combination of factors such as the leaching characteristics of the topsoil, the permeability and thickness of the subsoil, the thickness and properties of the unsaturated zone, the type of aquifer and the amount and nature of groundwater recharge."*

The four sites were: Naul, Co. Dublin; Rhode, Co. Offaly; Carrigeen, Co. Kilkenny and Faha, Co. Limerick. The number and density of OSWWTS in the study area is set out in table one:

Table 1: Catchment and Cluster Characteristics

Location	Naul, Co. Dublin	Rhode, Co. Offaly	Carrigeen, Co. Kilkenny	Faha, Co. Limerick
Vulnerability	Low	Moderate	High	Extreme
No. of OSWWTS	21	11	17	20
Av. Plot size (ha)	0.35	0.30	0.18	0.20
Density (units/ha)	1.82	1.04	2.44	2.04

Morrissey et al. (2015)

The results showed that *"…expected plumes of contaminants from clusters of OSWWTSs tend to be very localised, with most not spreading significantly further than 250m downstream".*[16] They also carried out simulations to assess the impact of increasing cluster densities up to a density of 6 units/ha, finding that:

> *"In general these simulations at each of the study areas all indicated the same findings; whilst increasing the density of OSWWTSs does increase the concentrations of pollutants within the localised plumes, the effects further downstream are significantly muted and have dissipated within 250–500 m downstream."*[17]

[13] Ibid.
[14] Morrisey, P.J., Johnston, P.M. and Gill, L.W. (2015) The impact of on-site wastewater from high density cluster developments on groundwater quality. *Journal of Contaminant Hydrology*. Vol. 182
[15] Aquifer is a body of permeable rock which can contain or transmit groundwater
[16] Morrisey, P.J., Johnston, P.M. and Gill, L.W. (2015) The impact of on-site wastewater from high density cluster developments on groundwater quality. *Journal of Contaminant Hydrology*. Vol. 182 (2015) 36–50 p.48
[17] Ibid. p.48

There was a degree or variation in the sites with the extreme vulnerability site showing the highest impact on groundwater with pollution levels spreading ~150m further downstream. On the basis of these findings the authors recommend a maximum density of between 5 and 4 units/ha. Consideration was also given to typical 'ribbon' style of development prevalent across the island of Ireland. They suggest a minimum plot size of 0.17 ha would be satisfactory to protect groundwater (a density of 6/ha); for all groundwater vulnerabilities with the exception of Extreme; in this case they suggest a larger plot size of up to 0.28 ha (or a density of 3.5/ha).

5.1.1 Discussion

The focus of this study was very much on the site i.e. it examined the impact of OSWWTS on groundwater across areas with varying soil conditions and system densities. While it showed that pollution from septic tanks, even in high density areas, remains fairly localised it did not look at factors such as the age and condition of individual OSWWTS, for example would a high number of poorly maintained systems alter the findings?

5.2 Blackwater River Study

Arnscheidt et al. (2007)[18] noted a series of studies that have shown that rural rivers in Ireland are maintained in a eutrophic state (this would normally only be the case during heavy rain), similar to streams and rivers in larger catchments that are persistently impacted by urban centres and waste-water treatment discharges. Acknowledging that most Phosphorus (P) discharges emanate from heavily fertilised soil (largely through agriculture), they also suspected that rural catchments were being subjected to low-level but chronic P inputs from OSWWTS.

This phenomenon of nutrient enriched rivers was especially prevalent in the border region therefore this study was conducted in three rural tributaries of the Blackwater River in counties Tyrone, Armagh and Monaghan. The results showed that nutrient levels exceeded acceptable levels more frequently in catchments with higher densities of OSWWTS than those with lower densities.

Arnscheidt et al. (2007)[19] link OSWWTS density to impaired water quality for two reasons. Firstly,

- the cumulative discharges of all systems (effluent discharge that is net of soil retention), whether operating correctly or not, in a sub-catchment with a high density

[18] Arnscheidt, J., Jordan, P., Li, S., McCormick, S., McFaul, R., McGrogan, H.J., Neal, M. and Sims, J.T. (2007) Defining the sources of low-flow phosphorus transfers in complex catchments. Science of the Total Environment vol. 382 pp. 1-13 [online] available from: http://nia1.me/2rc (subscription required)

[19] Arnscheidt, J., Jordan, P., Li, S., McCormick, S., McFaul, R., McGrogan, H.J., Neal, M. and Sims, J.T. (2007) Defining the sources of low-flow phosphorus transfers in complex catchments. Science of the Total Environment vol. 382 pp. 1-13 [online] available from: http://nia1.me/2rc (subscription required)

of rural housing may be enough to eventually elevate nutrient and other water quality parameters to high concentrations during low flow; secondly,

- the increasing probability, as population density increases, that one or several septic systems will be discharging effluent due to poor maintenance and/or inappropriate placement or exfiltration as water tables rise.

5.3 Condition of OSWWTS

A further dimension to this study was a comprehensive catchment survey that recorded the state of OSWWTS infrastructure. 113 OSWWTSs were surveyed and the results showed that over 35% were at a high risk of having a negative impact on water quality due to the condition of the system, while 73% were assessed as a medium risk (see table one).

Table 1: Septic tank system scores and densities for the three catchments

Septic tank score range	Priority	Tyrone		Armagh		Monaghan	
%		*n*	%	*n*	%	*n*	%
< 30	Low	1	7	2	7	4	6
30–45	Low–medium	1	7	11	38	10	14
46–50	Medium	1	7	3	10	12	17
50–60	Medium–High	5	27	4	14	17	25
> 60	High	5	27	9	31	26	38
Total		15	100	29	100	69	100
Density, systems km^2		2.6		9.7		13.8	

Source: Arnscheidt et al. (2007)

5.4 Rural England Study (3 sites)

Withers, et al. (2013)[20] provide further evidence that, despite a perception that OSWWTSs contribute negligible amounts of nutrients relative to agricultural land, they still pose a significant risk to water quality in certain conditions. They comment:

> *"Failure to take account of nutrient emissions from septic tanks may undermine current attempts to improve the ecological status of freshwaters through controls over major sewage treatment works and agriculture […] the widespread distribution of these (mini) point sources suggest there is a need to raise awareness of the potential environmental problems associated with septic tanks amongst rural communities in the UK."*[21]

[20] Withers, P.J.A., Jordan, P., May, L., Jarvie, H.P. and Deal, N.E. (2013). Do septic tanks pose a hidden threat to water quality? Frontiers in Ecology and the Environment (In press). Available from: http://nia1.me/2rj

[21] Ibid. p.18

5.5 Lough Neagh and Lough Erne

Research conducted by AFBI on behalf of the Department for Agriculture and Rural Development (DARD) found that between 1989 and 1999 the level of phosphates in both Lough Erne and Lough Neagh increased by 50 per cent. Agriculture was the main source accounting for 62 and 73 per cent in Lough Neagh and Lough Erne respectively. However, septic tanks were the next largest contributor at 14 (Lough Neagh) and 12 per cent (Lough Erne).[22]

It should be noted that this research predates the adoption of the Water Framework Directive in 2000. This Directive has brought about significant efforts to improve water quality in Northern Ireland and while Northern Ireland is largely compliant at present there are pressures to maintain good status in certain areas while there is a significant distance to go to achieve good status in other areas. EU Fresh Water Policy and the Northern Ireland's compliance with regards the WFD is discussed in some detail in RaISe publication *306-12 EU freshwater policy.*

6 Mitigating the impact of poorly maintained OSWWTSs

A significant proportion of the homes in Northern Ireland rely on an OSWWTS as they live in an area where it is not possible to connect to the public sewer. Arguably the biggest threat, discussed in section 3.1 of this paper, is the high number of unconsented systems in NI; nothing is known about the age or condition of neither these systems nor their suitability for the area in which they operate – all factors which have been shown to have a significant bearing on the level of pollution from OSWWTS. Another factor is that no routine maintenance is conducted by the NIEA, therefore, there is very little, if anything known about consented systems some of which may be almost 40 years old.

Even when a system is consented there is no monitoring of how these are maintained with the only figures available suggesting this is at the very least conducted piecemeal. For example, every owner of a consented OSWWTS is entitled to have their septic tank desludged by NI Water once per year. An Assembly question in February 2015 has, however, revealed that despite there being 113,735 consented systems NI Water only desludges an average of 29,000 per year.[23]

6.1 Replacement

The possibility of a grant scheme to help with replacement of non-compliant OSWWTSs was put to the Minister of the Environment in 2011. The Minister confirmed there was no such grant scheme in place. However, he did not rule it out.

[22] AFBI [online] eutrophication-phosphorus-inputs-to-lough-neagh. Available from: http://nia1.me/2s2
[23] AQW 41724/11-15

> *"I am not ruling it in or out, but a scheme to replace septic tanks in the North would require a capital budget of around £12 million. We have about 108,000 septic tanks, as well as at least 15,000 to 20,000 that are not yet registered. I am not closing the door on that opportunity, but that is the scale of the finance required were we to introduce a grant scheme."*[24]

The Minister went on to state that *"…there is very good compliance in the North of Ireland when it comes to septic tanks."* While he acknowledged problems associated with ground water quality in the Republic of Ireland may lead to infraction proceedings *"That is not the situation here [in Northern Ireland]".* [25]

6.2 Inspection and Replacement Scheme in Ireland

The problems in the Republic of Ireland, alluded to by the Minister of the Environment, pre-empted the introduction of a new registration and inspection regime for OSWWTSs in Ireland.[26] The aim is to protect ground and surface water quality from the risks posed by systems that are not working properly. It was introduced under the Water Services (Amendment) Act 2012.[27]

Having registered, local authorities then arrange for inspections to be carried out. The inspectors are appointed and approved by the Environmental Protection Agency. Inspections started in 2013 in areas with high risk to the environment and public health – where drinking water sources or habitats are at risk from waste water discharges. They are also being carried out in areas of lower risk, but at a lower rate.

Advisory notices are issued by the local authority when systems are not functioning correctly. These advise owners what the next step is i.e. they may need to simply improve the maintenance of the system, carry out repairs or ultimately replace it entirely. Any remediation work required will be based on factors such as the nature of the problem, the extent of risk to public health or the environment, existing site size and the hydrological and geological conditions present.

6.2.1 Grant Scheme

A grant scheme was also introduced under the Water Services (Amendment) Act 2012. The principal features of the grants scheme are as follows:

- Grants are available for the carrying out of remediation, repair or upgrading works to, or replacement of, a domestic waste water treatment system, where such remediation, repair, upgrading or replacement arises directly from an inspection and subsequent issue of an advisory notice under the Water Services (Amendment) Act 2012.

[24] AQO 662/11-15
[25] Ibid.
[26] Environmental Protection Agency [online] National Inspection Plan. Available from: http://nia1.me/2ry
[27] Water Services (Amendment) Act 2012 [online] available from: http://nia1.me/2rx

- The treatment system requiring remediation must have been registered by the owner of the premises connected to it by the prescribed date of 1 February 2013.
- Grants are means tested; households with income of up to €50,000 per annum will be eligible to apply for a grant of 80% of approved costs with a maximum grant payable of €4,000. Households with incomes between €50,001 and €75,000 will be eligible for a grant of 50% of approved costs with a maximum grant payable of €2,500.
- Grants will not be paid towards the costs of maintaining, servicing or de-sludging a domestic waste water treatment system as these are costs which owners should be incurring as a matter of course to ensure that their systems are functioning properly.
- Applicants for grant aid must submit supporting documentation including evidence of household income, itemised receipts for the work carried out and a copy of the contractor's tax clearance certificate.[28]

6.2.2 Responsibility of owners

The Water Services (Amendment) Act 2012 places general duties on owners of premises connected to ensure that their treatment system is operated and maintained properly so that it does not pose a risk to human health or the environment. Owners must comply with the advisory notice if their system fails an inspection. [29]

6.2.3 Outcomes of Inspection Programme

The EPA aim to carry out a minimum of 1,000 inspections per year. In the first year (1st July 2013 – 30th June 2014):

- 987 inspections were carried out;
- 476 systems failed the inspection and received an advisory notice;
- Almost 50% of the systems inspected failed - most common reason for failure was lack of de-sludging;
- 52% of sites with private wells failed the inspection;
- 79% of inspected systems > 50 years old, failed the inspection; and
- 79% of the inspected systems are now compliant with the regulations.[30]

These initial statistics indicate that the lack of general maintenance is a major cause of system failure with a lack of desludging the most common cause of system failure. In the review, the EPA highlighted that a lack of awareness of operation and maintenance requirements was evident among homeowners.[31] This could very well be a problem in

[28] Environment, Community and Local Government [online] Hogan announces septic tank grants scheme of up to €4,000 to help protect water quality. Available from: http://nia1.me/2ru
[29] Clause 70C — (1) Water Services (Amendment) Act 2012 [online] available from: http://nia1.me/2rx
[30] Environmental Protection Agency (2015) National Inspection Plan 2015-2017 Domestic Waste Water Treatment Systems [online] available from: http://nia1.me/2rz
[31] Ibid. p.11

Northern Ireland; the lack of desludging relative to the number of OSWWTS in NI (discussed in section 5) suggests homeowners are not carrying out the required maintenance, while there is no research to indicate a reason for this, there may be a general lack of awareness.

These statistics also suggest that old systems are much more likely to fail and this could be a significant problem here. The majority of unconsented systems in Northern Ireland, are > 40 years old, therefore given that 79% of > 50 years old systems in Ireland failed it is reasonable to assume similar results will be found here.

Table 2: Total inspections and outcomes from 1st July 2013 to the 31st December 2014

Total Submitted Inspections	1559
Total No. Compliant Inspections	842
Total No. Non-Compliant Inspections	717
Total No. Open Advisory Notices	240
Total No. Closed Advisory Notices	477

Source: http://nia1.me/2s0