the Briefs
N°5 - April 2012

Nitrates directive Results of monitoring programmes

Twenty years after the Nitrates directive[1] became applicable and in compliance with European commission (EC) requirements, France has completed a series of five monitoring campaigns on nitrate concentrations in water. The campaigns evaluated the effects of action programmes and reviewed the boundaries of zones considered vulnerable to nonpoint-source pollution caused by nitrates from agricultural sources. In addition, to ensure monitoring continuity, a yearly report is also produced on nitrate measurements for surface waters and groundwater carried out in the water-quality monitoring networks.

The directive contributes to improve water quality

Nitrates are chemical substances naturally present in the environment, but which can become harmful for human health and the environment at high concentrations. Nitrates have many origins (agricultural, industrial, urban), however agriculture remains the primary source through the use of nitrogen fertiliser, synthetic fertiliser and via livestock effluents. The nitrogen not absorbed by plants remains in the soil and is then carried off by rain water to rivers, lakes, coastal waters and groundwater, particularly during groundwater recharging periods, generally over the winter.

The excess quantities of nitrates in aquatic environments make costly processing necessary to ensure the water is drinkable. Nitrates are also one of the main substances, with phosphorus, that result in eutrophication, i.e. the proliferation of algae and plants that disturb aquatic organisms and degrade water quality[2].

Confronted with the drop in water quality due to nitrates observed since the 1970s in a large number of Member States, the European commission adopted on 12 December 1991 the 91/676/EEC directive concerning the protection of waters against pollution caused by nitrates from agricultural sources, also known simply as the Nitrates directive. The goal of the directive is to reduce pollution in all water bodies (groundwater, rivers, lakes, coastal waters) caused by nitrates from agricultural sources and to reduce the extension of nitrate pollution.

The directive stipulates the means that must be implemented by each Member State to reach that goal :

> designate within two years special protection zones, called vulnerable zones, defined as those already polluted or

[1] The 91/676/EEC directive concerning the protection of waters against pollution caused by nitrates from agricultural sources.
[2] Action plan against green algae, Ecology ministry, February 2010.

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Public water information system

threatened with nitrate pollution from agricultural sources ;

> draft guidelines for agricultural good practices (use of nitrogen fertilisers and land management) implemented on a voluntary basis by farmers, in conjunction with training and information programmes ;

> set up mandatory action programmes (e.g. yearly schedules limiting or forbidding manure spreading, limits to the amounts of organic and/or mineral nitrogen used, management of periods between crop rotations, etc.) for farmers located in vulnerable zones. Launch of the first action programme was required within four years ;

> monitor over the long term the quality of surface waters and groundwater to check the effectiveness of the action programmes.

The European water framework directive[3] targets the good status of aquatic environments and bases its action on a number of other directives, including the Nitrates directive, which is one of the primary instruments in efforts to protect water from nitrates from agricultural sources.

Criteria defining water polluted or likely to be polluted by nitrates

Source: Nitrates directive

> For fresh water (rivers, lakes) and groundwater, a level higher than or that risks rising above 50 mg/l, or water threatened by pollution with a level of nitrates between 40 and 50 mg/l[4] and rising.

> For lakes and coastal waters, water subject to or at risk of eutrophication (rapid development of algae and plants).

How is the directive implemented in France?

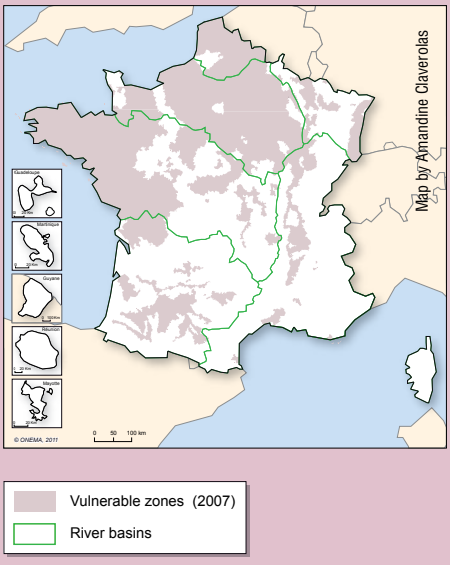
Implementation of the Nitrates directive was launched in France in 1992 with the first water-quality monitoring campaign which lasted from 1 September 1992 to 31 August 1993. The campaign, coordinated by the Ecology ministry, was carried out by the Water agencies and the local services of the Ecology and Health ministries[5]. Measurements of nitrate concentrations were carried out in 1 165 surface-water stations and 1 939 groundwater stations. The results served to identify the first vulnerable zones.

The initial work to set boundaries for vulnerable zones[6] was organised by the river-basin coordinating prefects, assisted by the departmental prefects, in collaboration with the professional agricultural organisations and representatives of water consumers, of towns, of environmental associations, etc. The Departmental and Regional councils, as well as the Chambers of agriculture, were all consulted and the project was finally adopted in 1997.

Vulnerable zones in 2007

Source: Sandre - WIS-FR[7] partners

To date, vulnerable zones are located in 74 departments in continental France. They cover a total of 244 000 square kilometers (44% of France) in 18 000 towns and almost half of all French farms representing 55% of useable farm land. Generally located north of a line from Bordeaux to Nancy, they correspond to mixed-crop and livestock farming (western France) and areas specialised in intensive plant production (Paris region and south-western France).



[3] 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.
[4] Threshold taken from the 75/440/EEC directive of 16 June 1975 concerning the quality required of surface water intended for the abstraction of drinking water.
[5] Initially by the Regional environmental agencies (DIREN) and the Regional health and social action agencies (DRASS), which have since been replaced by the Regional environmental, development and housing agencies (DREAL) and the Regional health agencies (ARS).
[6] Decree 93-1038 (27 August 1993) concerning the protection of waters against pollution caused by nitrates from agricultural sources stipulates the procedure to set boundaries for vulnerable zones and to revise them. It was modified by Decree 2005-634 (30 May 2005) and abrogated by Decree 2007-397 (22 March 2007) concerning the regulatory part of the Environmental code.
[7] Water information system for France (WIS-FR).

At the same time, a national good-practices code, containing technical advice on the spreading and storage of fertiliser, on land management and on irrigation, was drafted by the Guidance committee on environmentally friendly agricultural practices (CORPEN) and adopted in 1993[8].

The first action programmes for vulnerable zones were prepared by the departmental prefects in 1996[9] and implemented from 1997 to 2000. They contained mandatory measures dealing notably with limitations or interdictions on manure spreading and the storage of livestock effluents.

Since the initial efforts in this field:

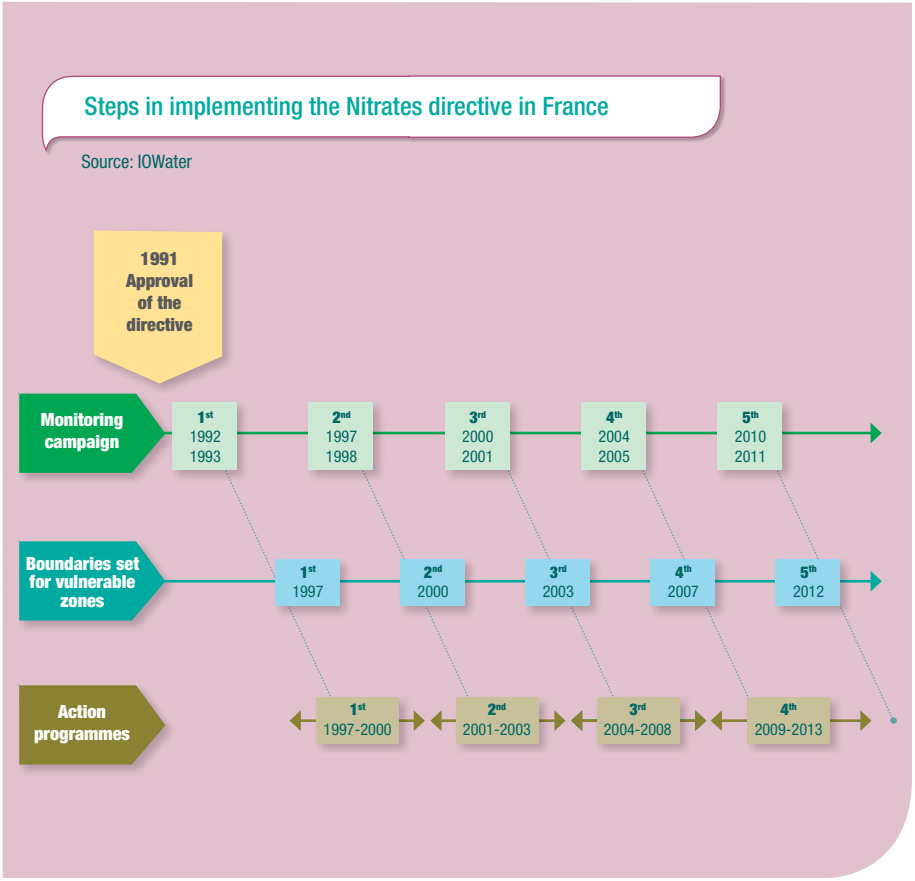
> four other water-quality monitoring campaigns have taken place in 1997-1998, 2000-2001, 2004-2005 and 2010-2011 (the results of the latest campaign are still being processed) ;

> the boundaries of vulnerable zones were revised in 2000, 2003 and 2007, and will be revised again at the end of 2012 ;

> three other action programmes were carried out in 2001-2003, 2004-2008 and 2009-2013.

Regulations have been updated in step[10].

In compliance with EC requirements, France has submitted evaluation reports every four years (1996, 2000, 2004 and 2008). The reports include a summary of the monitoring-campaign results, a map of vulnerable zones, a section on prevention efforts, plus a summary and evaluation of the measures implemented in the action programmes. The next report will be submitted later in 2012. Since 2008, the Member States must also provide the data from the monitoring campaigns.

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[8] Governmental order (22 November 1993) concerning good agricultural practices presented the national good-practices code containing stipulations on the spreading and storage of fertiliser, on land management and on irrigation. Application is voluntary outside of the vulnerable zones.

[9] Decree 96-163 (4 March 1996) concerning action programs to protect water against pollution caused by nitrates from agricultural sources (abrogated by Decree 2001-34 (10 January 2001)) and Governmental order (4 March 1996) concerning action programs for vulnerable zones to reduce water pollution caused by nitrates from agricultural sources (abrogated by Governmental order (6 March 2001)) define the technical framework for devising action programmes and mandatory measures for vulnerable zones (balanced use of fertilisers, periods when spreading is forbidden, storage of livestock effluents, suitable land management).

[10] Decree 2001-34 (10 January 2001) concerning action programmes to protect water against pollution caused by nitrates from agricultural sources (modified by Decree 2005-634 (30 May 2005) and abrogated by Decree 2007-397 (22 March 2007) concerning the regulatory part of the Environmental code).
Decree 2005-634 (30 May 2005) modifying Decree 2001-34 (10 January 2001) concerning action programmes to protect water against pollution caused by nitrates from agricultural sources.
Decree 2007-397 (22 March 2007) concerning the regulatory part of the Environmental code abrogated and replaced Decree 93-1038 (27 August 1993) and Decree 2001-34 (10 January 2001). Currently applicable texts are those in the Environmental code (articles R211-75 to R211-79 for setting the boundaries of vulnerable zones and articles R211-80 to R211-85 for the action programme).

Zones monitored in compliance with the directive

The purpose of the monitoring campaigns is to identify polluted zones (or likely to become polluted) by **nitrates from agricultural sources** in order to review the boundaries of vulnerable zones and evaluate the results of the action programmes. That is why nitrate measurement stations are located primarily in or near farming areas.

The last annual nitrate campaign took place from 1 October 2010 to 30 September 2011. The points below were drawn from the 2004-2005 annual campaign (1 October 2004 to 30 September 2005) :

> the campaign involved 1 775 surface-water stations (primarily on rivers) and 2 661 groundwater stations, located in continental France and the overseas departments (relatively few overseas due to the low concentrations of nitrates there) ;

> 62% of the stations used in the nitrate campaign were located in vulnerable zones ;

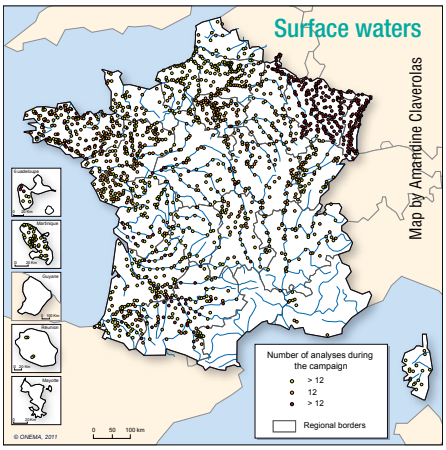
> the monitoring stations for surface waters were spread throughout France (including the overseas departments except Guiana), with a higher density in western France (mixed-crop and livestock farming) given the overall goals of the directive ;

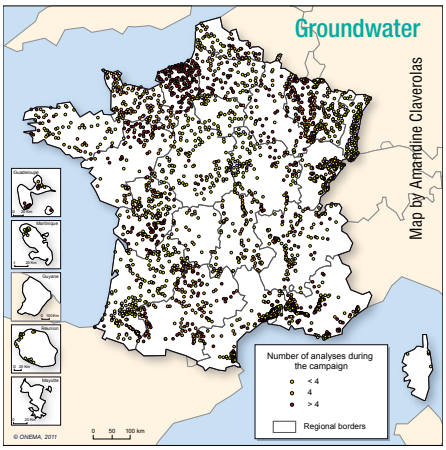
> the monitoring stations for groundwater were also spread throughout France (including the overseas departments except Guiana), with a much higher density in the Haute-Normandie, Alsace and Franche-Comté regions.

The analysis frequency recommended by the Nitrates directive is at least once per month (and more frequently during highwater periods) for surface waters. For groundwater, analyses must be carried out regularly, but no specific frequency is imposed by the directive. Generally speaking, higher frequencies are required for surface waters because their composition changes faster than groundwater.

Annual analysis frequency for nitrates in surface-water and groundwater stations in 2004-2005 (fourth annual campaign)

Source: Nitrates report (Ecology ministry) – Water agencies, DREAL, DEAL, ARS





The results presented below are drawn from two annual monitoring campaigns (campaign 1992-1993, from 1 September 1992 to 31 August 1993, and campaign 2004-2005, from 1 October 2004 to 30 September 2005) and from the additional annual report 2008-2009 covering the period from 1 October 2008 to 30 September 2009.

To evaluate water quality, the nitrate concentrations are compared to the thresholds below.

> 50 mg/l, the maximum permissible concentration for water intended for human consumption and for the quality standards applying to surface waters and groundwater. This value is applicable on both the European and national levels[11] :

> 40 mg/l, a warning threshold to launch preventive measures to restore the environment ;

> 25 mg/l, a warning threshold for surface waters used to select the best treatment for drinking water.

[11] Governmental order (11 January 2007) concerning quality standards and limits for untreated water and for water intended for human consumption, mentioned in articles R.1321-2, R.1321-3, R.1321-7 and R.1321-38 of the Public health code.
Governmental order (17 December 2008) setting evaluation criteria and procedures to determine the status of groundwater and significant, long-standing trends in the degradation of the chemical quality of groundwater.
Governmental order (25 January 2010) concerning the methods and criteria for evaluating the ecological status, the chemical status and the ecological potential of surface waters, in application of articles R. 212-10, R. 212-11 and R. 212-18 of the Environmental code.

Monitoring results for surface waters

For surface waters, the distribution of monitoring stations according to the average concentration classes has varied little over time :

> average concentration < 25 mg/l: 77% of all stations in 1992-1993 (900 stations), 81% in 2004-2005 (1 443 stations) and 81% in 2008-2009 (1 018 stations) ;

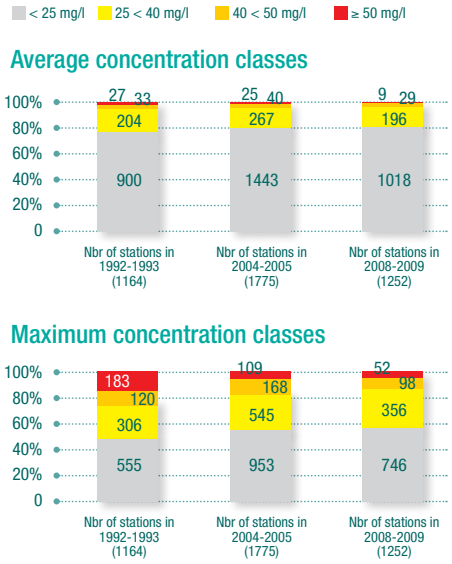
> average concentration 25 to 40 mg/l: 17.5% of all stations in 1992-1993 (204 stations), 15% in 2004-2005 (267 stations) and 16% in 2008-2009 (196 stations) ;

> average concentration 40 to 50 mg/l: 3% of all stations in 1992-1993 (33 stations), 2% in 2004-2005 (40 stations) and 2% in 2008-2009 (29 stations) ;

> average concentration > 50 mg/l: 2% of all stations in 1992-1993 (27 stations), 1% in 2004-2005 (25 stations) and 1% in 2008-2009 (9 stations).

Distribution of surface-water stations according to average and maximum concentration classes

Source: Nitrates report (Ecology ministry) – Water agencies, DREAL, DEAL, ARS



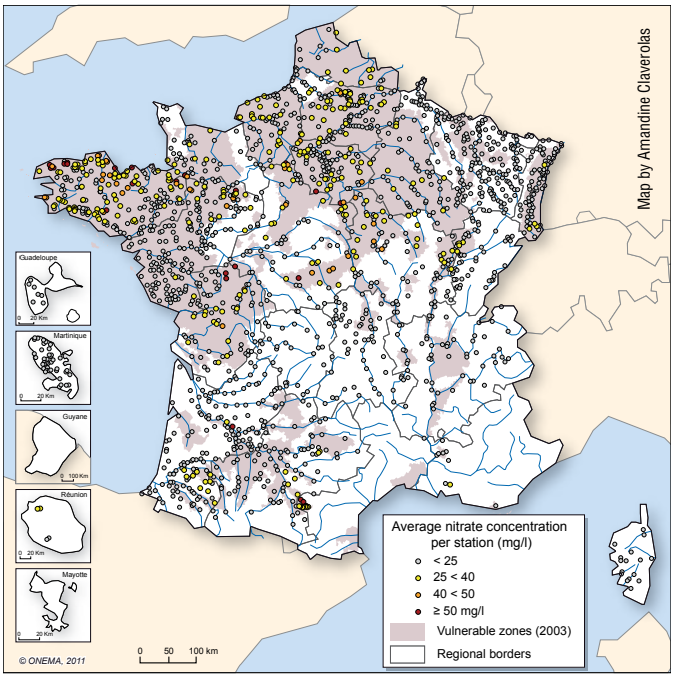
N.B. The 2004-2005 data is drawn from the fourth nitrate-monitoring campaign for the Nitrates directive. The 2008-2009 data is drawn from the water-quality monitoring networks set up for the Water framework directive. Note that the number of stations is not identical for the two periods (see the Note on methods, page 8), which may make data interpretation more difficult.

On the other hand, the distribution of monitoring stations among the maximum concentration classes has varied more significantly. For example, the percentage of stations measuring concentrations higher than 40 mg/l would appear to be dropping with 26% of all stations in 1992-1993 (303 stations), 15% in 2004-2005 (277 stations) and 12% in 2008-2009 (150 stations).

Stations measuring concentrations higher than 40 mg/l are located primarily in vulnerable zones, in western regions (Brittany, Pays de la Loire and Poitou -Charentes), as well as in Haute-Normandie, Ile-de-France and Centre.

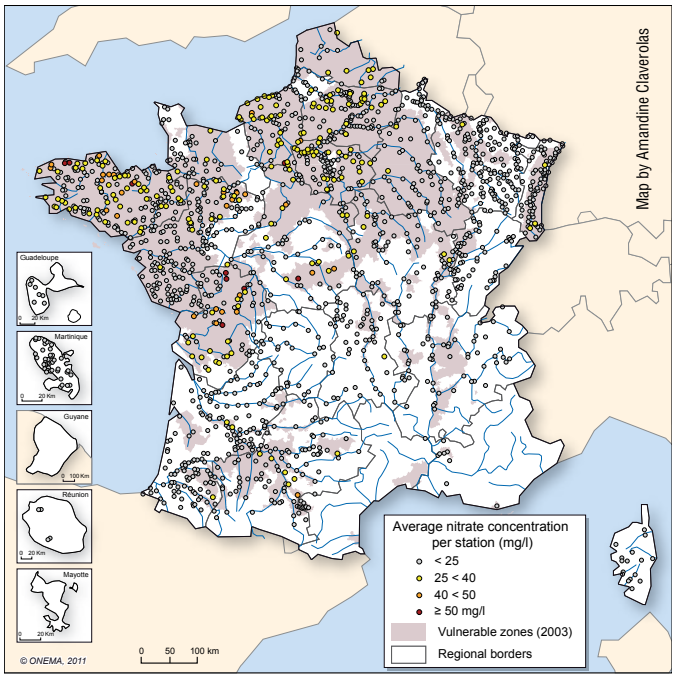
Average nitrate concentrations in surface-water stations in 2004-2005 (fourth annual campaign)

Source: Nitrates report (Ecology ministry) – Water agencies, DREAL, DEAL, ARS



Average nitrate concentrations in surface-water stations in 2008-2009 (additional study)

Source: Nitrates report (Ecology ministry) – Water agencies, DREAL, DEAL, ARS



Though the distribution of stations according to the average and maximum concentration classes varied little over the different periods, the comparison of the average concentrations between 1992-1993 and 2008-2009 in the stations used for all three campaigns (1992-1993 / 2004-2005 / 2008-2009, i.e. 783 stations) shows that :

> concentrations dropped or remained stable in 60% of the stations ;

> concentrations increased slightly in 27% of the stations ;

> concentrations increased significantly or very significantly in 13% of the stations.

Variations in average nitrate concentrations in surface waters between 1992-1993 and 2008-2009

Variation 1992-1993 to 2008-2009	Nbr of stations	% of stations
Major reduction (> -5 mg/l)	93	12
Minor reduction (≤ -5 mg/l)	179	23
Stability (± 0.99 mg/l)	199	25
Slight increase (1 < 5 mg/l)	215	27,5
Strong increase (5 to 10 mg/l)	74	9,5
Very strong increase (> 10 mg/l)	23	3
TOTAL	783	100

Source: Nitrates report (Ecology ministry) – Water agencies, DREAL, DEAL, ARS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Monitoring results for groundwater

For groundwater, the distribution of monitoring stations according to the average concentration classes has varied little over time :

> average concentration < 40 mg/l: 70% of all stations in 1992-1993 (1 357 stations), 76% in 2004-2005 (2 024 stations) and 76.5% in 2008-2009 (899 stations) ;

> average concentration 40 to 50 mg/l: 15% of all stations in 1992-1993 (283 stations), 10,5% in 2004-2005 (275 stations) and 11% in 2008-2009 (132 stations) ;

> average concentration > 50 mg/l: 15% of all stations in 1992-1993 (293 stations), 13.5% in 2004-2005 (362 stations) and 12.5% in 2008-2009 (146 stations).

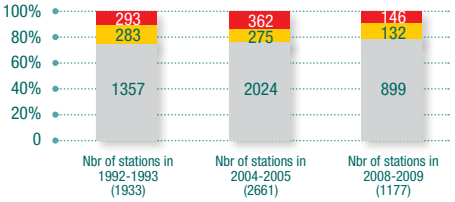
On the other hand, the distribution of monitoring stations among the maximum concentration classes has varied more significantly. For example, the percentage of stations measuring concentrations higher than 40 mg/l would appear to be dropping significantly with 48% of all stations in 1992-1993 (922 stations), 30% in 2004-2005 (795 stations) and 25% in 2008-2009 (328 stations).

Distribution of groundwater stations according to average and maximum concentration classes

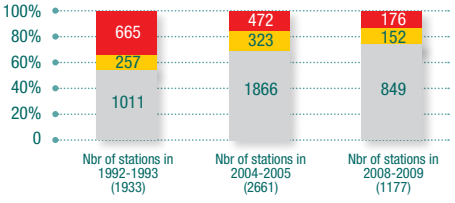
Source: Nitrates report (Ecology ministry) – Water agencies, DREAL, DEAL, ARS ; ADES (BRGM) – WIS-FR partners

< 40 mg/l 40 < 50 mg/l ≥ 50 mg/l

Average concentration classes



Maximum concentration classes



N.B. The 2004-2005 data is drawn from the fourth nitrate-monitoring campaign for the Nitrates directive. The 2008-2009 data is drawn from the water-quality monitoring networks set up for the Water framework directive. Note that the number of stations is not identical for the two periods (see the Note on methods, page 8), which may make data interpretation more difficult.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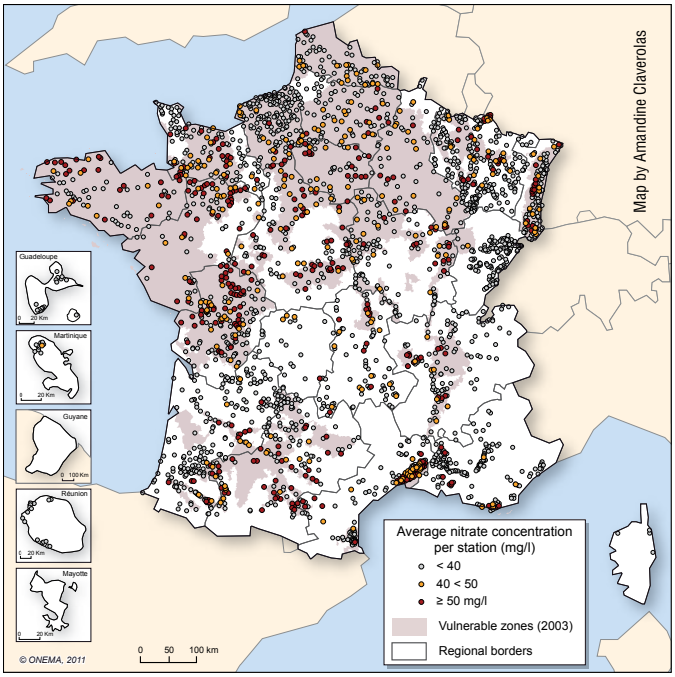
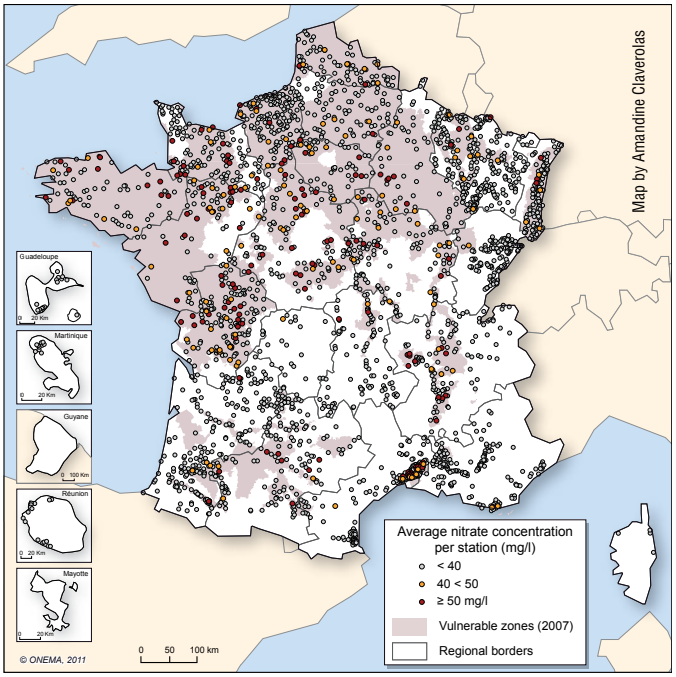
Average nitrate concentrations in groundwater stations in 2004-2005 (fourth annual campaign)

Source: Nitrates report (Ecology ministry) – Water agencies, DREAL, DEAL, ARS ; ADES (BRGM) - WIS-FR partners



Average nitrate concentrations in groundwater stations in 2008-2009 (additional study)

Source: Nitrates report (Ecology ministry) – Water agencies, DREAL, DEAL, ARS ; ADES (BRGM) - WIS-FR partners



Stations measuring concentrations above 40 mg/l are spread throughout most of continental France, with the exception of mountainous regions such as the Massif Central and the Alps.

Though the distribution of stations according to the average and maximum concentration classes varied little over the different periods, the comparison of the average concentrations between 1992-1993 and 2008-2009 in the stations used for all three campaigns (1992-1993 / 2004-2005 / 2008-2009, i.e. 634 stations) shows that:

> concentrations dropped or remained stable in 53% of the stations ;

> concentrations increased slightly in 13% of the stations ;

> concentrations increased significantly or very significantly in 34% of the stations.

Variations in average nitrate concentrations in groundwater between 1992-1993 and 2008-2009

Variation 1992-1993 to 2008-2009	Nbr of stations	% of stations
Major reduction (> -5 mg/l)	150	24
Minor reduction (≤ -5 mg/l)	104	16
Stability (± 0.99 mg/l)	80	13
Slight increase (1 < 5 mg/l)	84	13
Strong increase (5 to 10 mg/l)	114	18
Very strong increase (> 10 mg/l)	102	16
TOTAL	634	100

Source: Nitrates report (Ecology ministry) – Water agencies, DREAL, DEAL, ARS ; ADES (BRGM) – WIS-FR partners

Generally speaking, the distribution of monitoring stations according to the average concentration classes has varied little over time :

> for surface waters, three-quarters of all stations measured average concentrations less than 25 mg/l. Stations measuring maximum concentrations higher than 40 mg/l are located primarily in vulnerable zones, in western regions (Brittany, Pays de la Loire, Poitou-Charentes, Aquitaine, Midi-Pyrénées), as well as in the Paris region and northern France (Nord Pas-de-Calais and Picardie) ;

> for groundwater, three-quarters of all stations measured average concentrations less than 40 mg/l. Stations measuring maximum concentrations higher than 40 mg/l are located throughout continental France.

These results must, however, be interpreted with caution given that nitrate concentrations depend on the period. For surface waters, concentrations are higher in winter due to the higher probability of lesser plant cover to absorb the nitrates and weather conditions that favour run-off (drainage to rivers and groundwater).

It is necessary to take into account the hydrological conditions during each period and keep in mind that 1) the 1992-1993 campaign took place during a fairly pronounced low-water period interrupted by higher waters in December and January, 2) the 2004-2005 campaign was characterised by a significant water shortage that contributed to reducing river flow rates and aquifer levels, 3) the 2008-2009 campaign was more diverse with shortages in northern France and above average levels in the South.

Outlook for 2012-2013

In November 2009, the European commission sent an injunction (step prior to legal proceedings) to the French government concerning its action programmes and, in June 2011, a second injunction because the designation procedure for vulnerable zones was deemed insufficient. The EC then went one step further and turned the injunctions into a «reasoned opinion» in October 2011. The Commission concluded that certain measures in the action programmes were incomplete and insufficient to reach directive goals (insufficient periods banning spreading, insufficient obligations concerning effluent storage capacities, under-estimation of nitrogen quantities released by animals, etc.).

In response to the criticism, French public authorities launched a reform addressing two aspects :

> reorganisation of the action-programme architecture and revision of programme contents. The reform created a national action programme that will constitute a shared national regulatory basis for the 74 French departments concerned by the vulnerable zones. The departmental action programmes will be transformed into regional programmes indicating the additional efforts, adapted to the conditions in each zone, required to reach water-quality restoration and preservation goals in terms of pollution caused by nitrates ;

> revision of the designation procedure for zones vulnerable to pollution caused by nitrates from agricultural sources. The modifications will occur in 2012, based on the results of the water-quality monitoring campaign that ended in September 2011.

To ensure that the reform produces results, the concerned regulatory texts are now being rewritten. The changes will be implemented progressively starting in 2012 and the reform should be fully effective by 2013 when the fifth series of action programmes is launched.

Note on methods

The information briefly presented here is drawn from a research report that may be consulted on the Eaufrance web portal. The report is based on methods developed jointly by Onema, the Water and biodiversity department of the Ecology ministry (in charge of implementing the Nitrates directive) and IOWater.

In this document, the numerical data are drawn exclusively from the national database for nitrates reports (1992-1993, 1997-1998, 2001-2002, 2004-2005, 2010-2011 campaigns) and from additional information gathered from the Water agencies, Health ministry and the ADES site (www.ades.eaufrance.fr, data drawn on 20 September 2010). The 2008-2009 data were produced by the water-quality monitoring networks (surveillance-monitoring network, operational monitoring, other networks) set up in compliance with the Water framework directive[12]. The data were drawn from specific monitoring stations within those networks and assigned to the Nitrates directive. Not all stations were included because the water-quality monitoring networks do not pursue the same goals as the monitoring campaigns for the Nitrates directive and are not set up in the same manner :

> the water-quality monitoring networks are not necessarily located in or near farming areas. The subset of stations used for all three of the 1992-1993, 2004-2005 and 2008-2009 campaigns is therefore less numerous than the complete network of stations used for each of the campaigns (783 stations for all three campaigns for surface waters, 634 for groundwater) ;

> the frequency of nitrate measurements in the water-quality monitoring networks was lower in 2008-2009 than in 2004-2005. For surface waters, the average number per station fell from 11.5 to 9.8 and for groundwater, the average fell from 4.8 to 2.9. The lower number of measurements makes the averaged results less significant and increases the difficulty of analysing trends. The best solution would be to use longer data sets (series spanning more than ten years). This work will be carried out during the analysis of the results of the latest campaign (2010-2011) ;

> if an analysis produces a concentration result lower than the quantification minimum, the value recorded is the quantification minimum divided by two. The remainder of the calculation is based on an arithmetic mean.

[12] 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.

For more information…

See the information on the Nitrates directive:
http://www.rapportage.eaufrance.fr

Find this document on the internet at:
http://www.eaufrance.fr/IMG/PDF/nitrates_20082009_201204_synthese_EN.pdf
and www.documentation.eaufrance.fr

Find the complete study (in French) on the 2008-2009 results:
http://www.eaufrance.fr/IMG/PDF/nitrates_20082009_201111.pdf
and www.documentation.eaufrance.fr

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