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INSTITUTE FOR INLAND WATER MANAGEMENT AND WASTE WATER TREATMENT (RIZA)
NATIONAL INSTITUTE FOR COASTAL AND MARINE MANAGEMENT (RIKZ)
INSPECTORATE FOR HEALTH PROTECTION AND VETERINARY PUBLIC HEALTH

RIVM report 610056046

# Monitoring of radiation in the environment: Results in the Netherlands in 1999

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# Abstract

This report presents the results of radioactivity measurements in the environment in the Netherlands carried out by RIZA, RIKZ, Inspectorate for Health Protection and Veterinary Public Health and RIVM in 1999. Radioactivity was measured for airborne particulate, deposition, surface water, seawater and water for human consumption. Results for ambient dose equivalent rates were obtained from the National Radioactivity Monitoring Network. No measurements were done in milk and food. In 1999 there were no elevated levels of radioactivity found in the environment in the Netherlands.

# Preface

In this 1999 annual report results are presented of measurements on radioactivity in the Dutch environment. The following institutes have contributed to the report:

**The Institute for Inland Water Management and Waste Water Treatment (RIZA)**
Data on surface water from the main inland waters.
Ir. B. Parmet, Dr. A. Houben-Michalkova

**The National Institute for Coastal and Marine Management (RIKZ)**
Data on seawater.
Ir. O.C. Swertz

**The Inspectorate for Health Protection and Veterinary Public Health (KvW)**
Measurements on foodstuffs.
Drs. H. Nootenboom (†)

**The National Institute for Public Health and the Environment (RIVM)**
Data on air dust, deposition, ambient dose rates and drinking water.
J.E.M. Jacobs (editor), Dr. P.J.M. Kwakman, Dr. H.A.J.M. Reinen (RIVM/LSO),
Dr. ir. J.F.M. Versteegh (RIVM/LWD)

# Contents

# Samenvatting

In dit rapport worden de resultaten gegeven van radioactiviteitsmetingen in het milieu in Nederland verricht door RIZA, RIKZ, Keuringsdienst van Waren en RIVM in 1999. De jaargemiddelde totale α- en β-activiteitsconcentratie in luchtstof in Bilthoven was respectievelijk 0,1 en 0,4 $mBq \cdot m^{-3}$.
De jaargemiddelde activiteitsconcentratie in luchtstof van de nucliden $^{7}Be$, $^{137}Cs$ en $^{210}Pb$ was respectievelijk 3980, 1,1 en 377 $\mu Bq \cdot m^{-3}$.
De jaarlijkse totale α- en β-activiteit in depositie in Bilthoven bedroeg 26 en 84 $Bq \cdot m^{-2}$. De jaarlijkse totale activiteit van de nucliden $^{3}H$, $^{137}Cs$, $^{7}Be$, $^{210}Pb$ en $^{210}Po$ in depositie bedroeg respectievelijk 1530, 1,2, 1540, 158 en < 5,1 $Bq \cdot m^{-2}$.
Het omgevingsdosisequivalenttempo, gemiddeld over het jaar en over 159 meetlokaties, was 75,1 $nSv \cdot h^{-1}$.
De jaargemiddelde activiteitsconcentratie van $^{3}H$ in oppervlaktewater lag tussen 4,6 en 18,1 $Bq \cdot L^{-1}$ en van rest-β tussen 37 en 82 $mBq \cdot L^{-1}$ (3 meetlocaties). De jaargemiddelde activiteit van $^{137}Cs$ in zwevend stof in oppervlaktewater lag tussen 15 en 25 $Bq \cdot kg^{-1}$ (4 meetlokaties). De jaargemiddelde activiteitsconcentratie van $^{3}H$ in zeewater lag tussen 0,9 en 4,8 $Bq \cdot L^{-1}$ en van rest-β tussen 36 en 55 $mBq \cdot L^{-1}$ (3 meetlokaties ).
Typische waarden die in drinkwater gevonden worden zijn 1-10 $Bq \cdot L^{-1}$ voor $^{3}H$-activiteit en 0,1-1 $Bq \cdot L^{-1}$ voor totaal-β en rest-β activiteit. Uit het gelijk zijn van de bereiken voor totaal-β en rest-β blijkt dat in drinkwater weinig $^{40}K$, en dus kalium, aanwezig is. Al deze waarden zijn vergelijkbaar met de waarden gevonden in voorgaande jaren.
Er zijn in 1999 geen metingen verricht aan melk en aan voedsel.

# Summary

This report presents results of radioactivity measurements in the environment in the Netherlands carried out by RIZA, RIKZ, the Inspectorate for Health Protection and Veterinary Public Health and RIVM in 1999. The yearly averaged gross- α- and gross- β-activity concentrations in air dust in Bilthoven were 0.1 and 0.4 $mBq \cdot m^{-3}$, respectively. The yearly averaged activity concentrations in air dust for the nuclides $^{7}Be$, $^{137}Cs$ and $^{210}Pb$ were 3980, 1.1 and 377 $\mu Bq \cdot m^{-3}$, respectively. The yearly total gross-α- and gross-β-activities deposited in Bilthoven were 26 and 84 $Bq \cdot m^{-2}$, respectively. The yearly total activities of the nuclides $^{3}H$, $^{137}Cs$, $^{7}Be$, $^{210}Pb$ and $^{210}Po$ in deposition were 1530, 1.2, 1540, 158 and < 5.1 $Bq \cdot m^{-2}$, respectively. The ambient dose equivalent rate averaged for159 measurement locations over the year was 75.1 $nSv \cdot h^{-1}$. The yearly averaged activity concentration for $^{3}H$ in surface water was between 4.6 and 18.1 $Bq \cdot L^{-1}$, and for residual β between 37 and 82 $mBq \cdot L^{-1}$ (three measurement locations). The yearly averaged $^{137}Cs$ activity in suspended solids in surface water was between 15 and 25 $Bq \cdot kg^{-1}$ (four measurement locations). In seawater, yearly averages for $^{3}H$ varied between 0.9 and 4.8 $Bq \cdot L^{-1}$ and for residual-β, between 36 and 55 $mBq \cdot L^{-1}$ (three measurement locations).

Typical activities found in drinking water were 1-10 $Bq \cdot L^{-1}$ for $^{3}H$ activity and 0.1-1 $Bq \cdot L^{-1}$ for gross-β and residual-β activity. Because the range for gross-β activity is the same as for residual-β activity, it can be concluded that there is little $^{40}K$, and thus potassium, present in drinking water. All these values are comparable to those found in previous years. In 1999 no measurements were performed in milk and food.

# 1. Introduction

Levels of radioactive nuclides of natural origin, such as $^{40}K$ and daughters in the uranium and thorium series, can increase as a result of human activities, e.g. emissions from factories processing ores. Man-made radionuclides found in the environment are due to such factors as nuclear weapon tests and discharges from nuclear installations. It is advisable to monitor radiation in the environment to provide knowledge on levels of radiation under normal circumstances and to be able to look out for any abnormalities. The aim of the presentation here was threefold: (1) to provide, for the year 1999, an almost complete survey of measurements on radioactivity in the Dutch environment under normal circumstances; (2) to determine compliance of monitoring programmes in the Netherlands with the EU recommendation and to assess the programmes for omissions, and (3) to present the Dutch national report to the EU and other Member States.

The definition used in this report for the residual-β activity is the total-β activity (gross-β) minus the β activity of $^{40}K$. The results will, in general, be illustrated in graphs and tables, supported minimally by text. More detailed tables are presented in Appendix A.
Chapters 2 to 8 have been subdivided according to the structure of the ‘Recommendation on the Application of Article 36 of the Euratom Treaty’[1], presenting the results of measurements for various environmental compartments. Chapter 9 draws up general conclusions.

# 2. Airborne particles

The 1999 monitoring program for determining radioactive nuclides in air dust is given in *Table 2.1*. The sampling was done on the RIVM premises in Bilthoven. Air dust samples for the measurement of γ emitters, gross-α and gross-β were collected weekly with a High Volume Sampler (HVS). A detailed description of sampling, sample treatment and the analytical method is given in previous reports [2,3,4].

*Table 2.1: Monitoring program in 1999 for the determination of radioactive nuclides in air dust*

| Measurement | Location | Sample Period | Sample Volume | Analysis Frequency | Analysis |
|---|---|---|---|---|---|
| Air dust | Bilthoven | Week | ± 50000 $m^3$ | 1 per week | γ-em** |
| | Bilthoven | Week | ± 500 $m^3$ * | 1 per week | Gross-α, gross-β |

** γ-em: γ-spectroscopic analysis of specific γ-emitting nuclides
* A subsample of 1% from the filter through which about 50,000 $m^3$ is sampled

## 2.1 Gross-α/β activity

The weekly results of gross-α- and -β-activity concentrations in air dust are given in *Figure 2.1* and *Table A1* (see Appendix A). Due to large uncertainties caused by variations in dust thickness on the filters, gross-α-activity concentrations in air dust are given as indicative values [5]. The period between sampling and analysis is 5 to 10 days, which is long compared to the decay time of the short-lived decay products of $^{222}Rn$ and $^{220}Rn$. For this reason, these naturally occurring decay products do not contribute to the α- and β-activity concentrations.

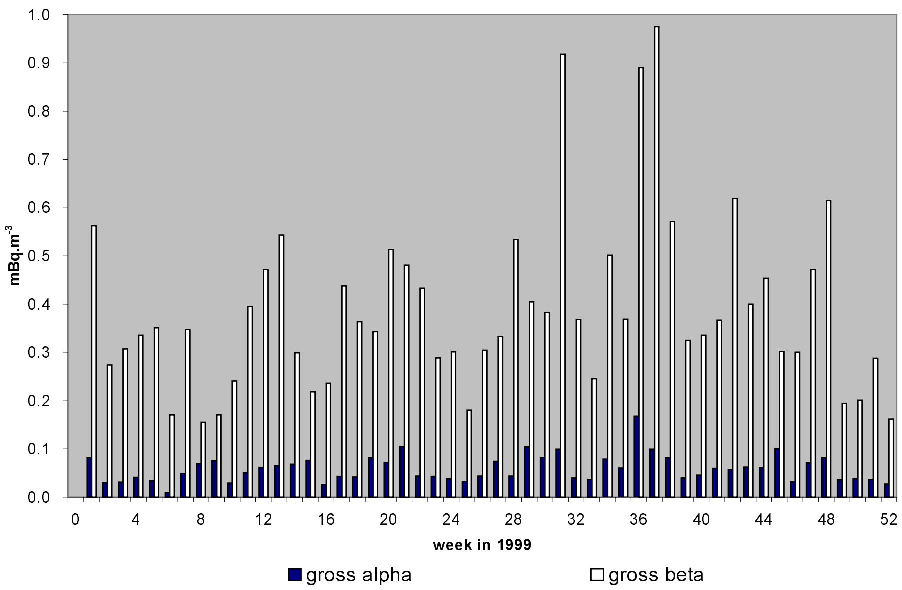



*Figure 2.1: Weekly results of gross-α- and -β-activity concentrations of long-lived nuclides in air dust sampled at the RIVM in Bilthoven (The Netherlands).*

The frequency distributions of gross-α- and gross-β-activity concentrations in air dust are given in *Figures 2.2* and *2.3*, respectively.

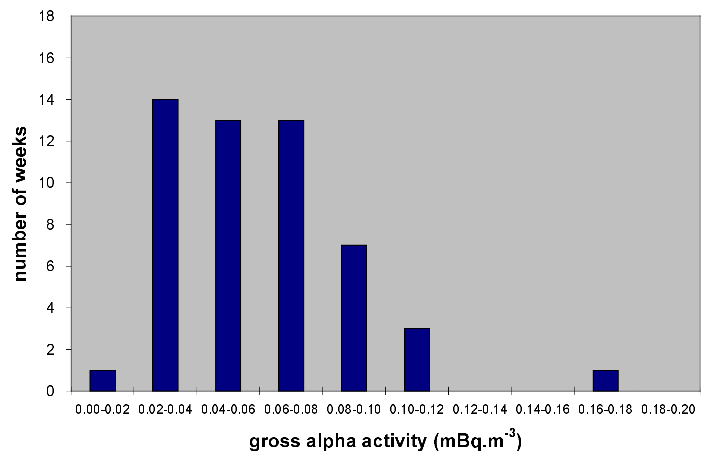



*Figure 2.2: Frequency distribution of gross-α-activity concentration of long-lived nuclides in air dust collected weekly at the RIVM, Bilthoven (The Netherlands) in 1999. Mean concentration is 0.06 (SD=0.03) mBq·m$^{-3}$ (SD is the standard deviation and illustrates the variation in weekly averages during the year).*

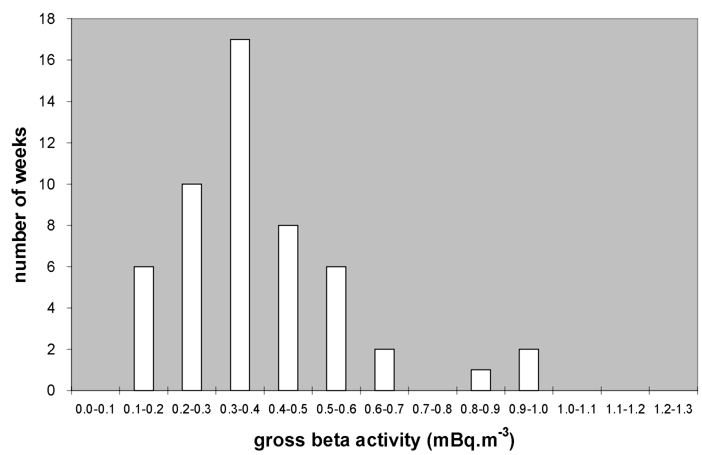



*Figure 2.3: Frequency distribution of gross- β-activity concentration of long-lived nuclides in air dust collected weekly at the RIVM, Bilthoven (The Netherlands) in 1999. Mean concentration is (0.389± 0.005) Bq·m$^{3}$ (SD=0.2 Bq·m$^{-3}$).*

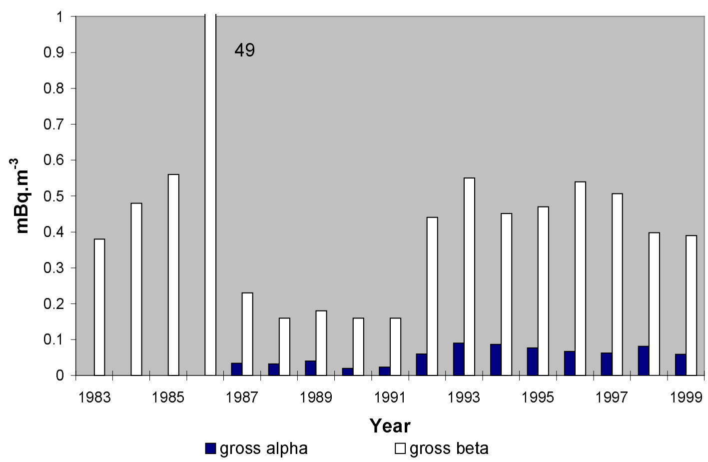



*Figure 2.4: Yearly averages of gross-α- and gross-β-activity concentration of long-lived nuclides in air dust from the outset of the respective monitoring campaigns. The '86 level was caused by the accident at the Chernobyl nuclear power plant.*

The change in the trend in 1987 is caused by a change in the measuring technique. The year 1992 marked the start of sampling air dust with a High Volume Sampler. The yearly averages of the gross-α- and β-activity concentrations of long-lived nuclides in 1999 amount to the same as the results in the 1992-1998 period [6] (see *Figure 2.4).*

## 2.2 γ-emitting nuclides

The detection limits for the nuclides considered in the gammaspectroscopic analysis of the HVS samples are given in *Table A2.* The nuclides $^{7}Be$, $^{137}Cs$ and $^{210}Pb$ are the only detectable nuclides (*Table A3*, *Figure 2.5, 2.6* and *2.7*).. The concentrations found for $^{7}Be$, $^{137}Cs$ and $^{210}Pb$ in 1999 are comparable to those found in 1992-1998 [6].

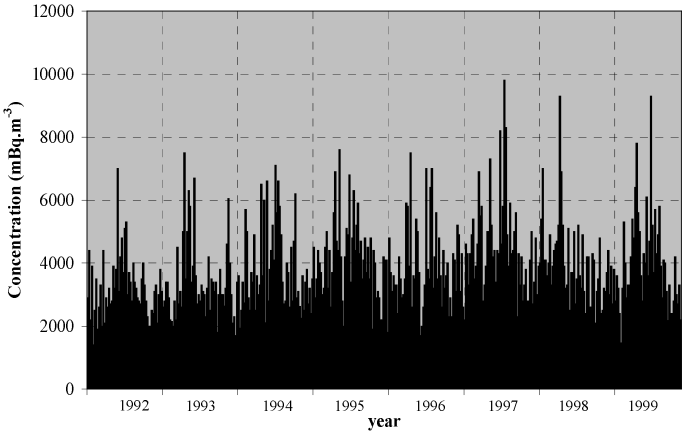



*Figure 2.5: Weekly averaged activity concentrations of $^{7}Be$ in air dust in Bilthoven in 1992-1999.*
*Yearly average for 1999 is 3980 ± 50 (SD=1500) μBq·m$^{-3}$.*

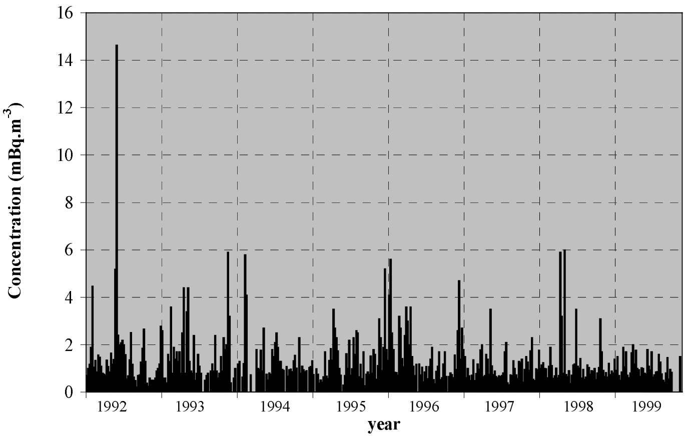



*Figure 2.6: Weekly averaged activity concentrations of $^{137}Cs$ in air dust in Bilthoven in 1992-1999.*
*Yearly average for 1999 is 1.06 ± 0.03 (SD=0.4) μBq·m$^{-3}$.*

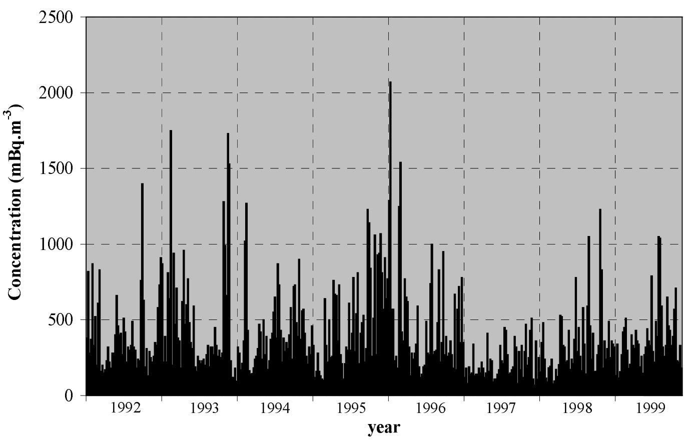



*Figure 2.7: Weekly averaged activity concentrations of $^{210}Pb$ in air dust in Bilthoven in 1992-1999.*
*Yearly average for 1999 is 377 ± 5 (SD=200) μBq·m$^{-3}$.*

# 3. Deposition

The 1999 monitoring program for determining radioactive nuclides in deposition is given in *Table 3.1*. Sampling was done on the RIVM premises in Bilthoven. Samples were collected weekly (γ-emitters) and monthly ($^{3}$H, gross- α, gross- β, $^{210}$Pb/$^{210}$Po). For the $^{210}$Pb/$^{210}$Po analysis, three monthly samples were combined into one sample, which was analysed quarterly.

*Table 3.1: The 1999 monitoring program for the determination of radioactive nuclides in deposition*

| Measurement | Location | Sample Period | Sample Volume | Analysis frequency | Analysis |
|---|---|---|---|---|---|
| Deposition | Bilthoven | Week | Variable | Once per week | γ-em ** |
| | Bilthoven | Month | Variable | Once per month | Gross- α, gross- β, $^{3}$H |
| | Bilthoven | Month | Variable | Once per quarter | $^{210}$Pb/$^{210}$Po |

** γ-em: γ-spectroscopic analysis of specific γ-emitting nuclides

## 3.1 Gross-α/β-activity

The monthly deposited gross-α- and gross-β-activities of long-lived nuclides are given in *Figure 3.1* and *Table A4*. The yearly total deposition of gross-α and gross- β was 25.5 ± 1.0 and 84 ± 2 Bq·m$^{-2}$, respectively, values comparable to those measured since 1987, as illustrated in *Figure 3.2* and *Table A5*.

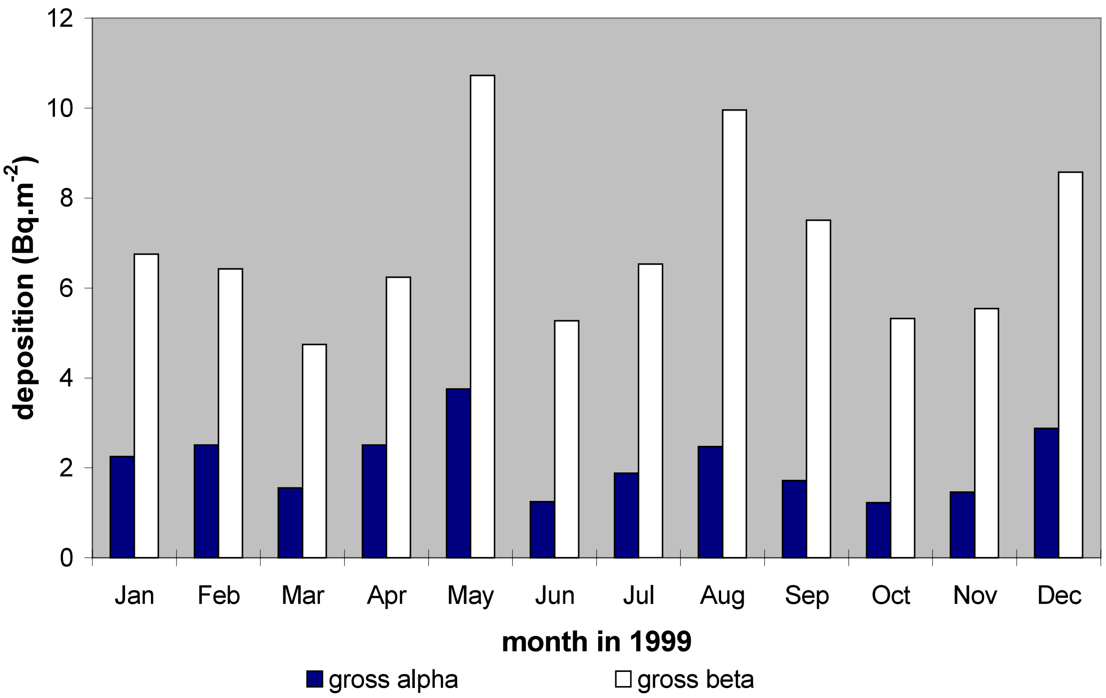



*Figure 3.1: Monthly deposited gross- α- and gross- β-activity of long-lived nuclides in 1999.*

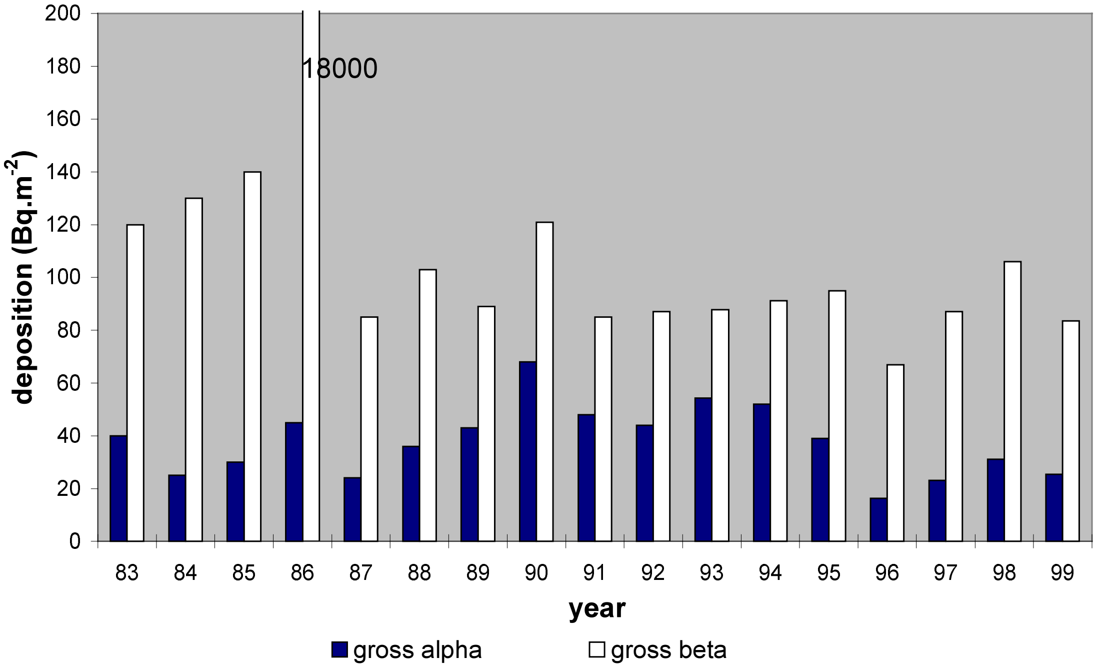



*Figure 3.2: Total gross-α- and gross- β-activity of long-lived nuclides deposited from 1983 to 1999 (see also Table A5). The 1986 level resulted from the accident at the Chernobyl nuclear power plant.*

The monthly deposition of $^3H$ is given in *Table A4*. In 1999 1530 ± 110 Bq·m$^{-2}$ was deposited. For the calculation of the yearly total, only months with depositions above the detection limit are used. This results in an extra uncertainty and implies that the maximum yearly total may be 1800 Bq·m$^{-2}$. *Figure 3.3* shows the exponential decay of $^3H$ after the end of the atmospheric nuclear weapons tests in the seventies.

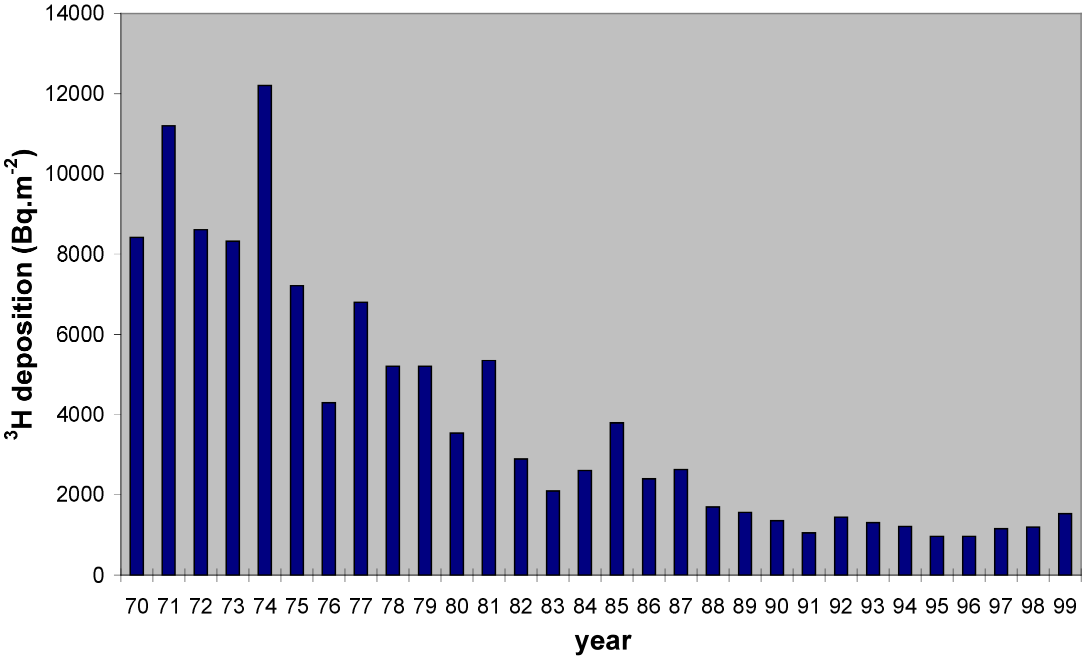



*Figure 3.3: Total deposition of $^3H$ in the period 1970-1999.*

*Figure 3.4* shows the deposition of $^{3}H$ to be proportional to the amount of precipitation

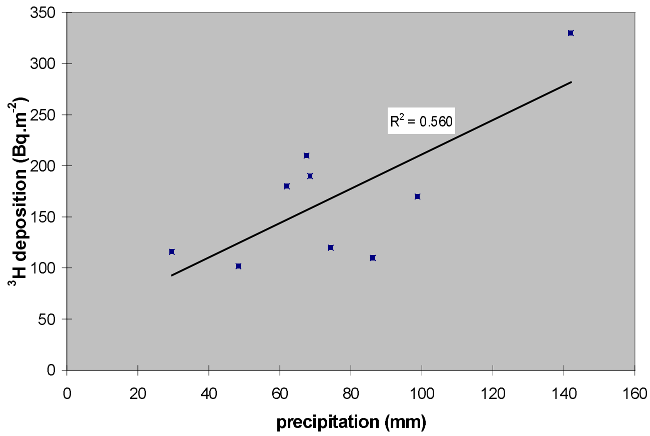



*Figure 3.4: The monthly deposition of $^{3}H$ in 1999 versus precipitation.*

The monthly α spectroscopy results for $^{210}Po$ are given in *Table A6*. The results for previous years are given in *Table A5*.

## 3.2 γ-emitting nuclides

Detectable quantities of the naturally occurring nuclides $^{7}Be$ and $^{210}Pb$ were found, with yearly depositions totalling1580 ± 30 and 158 ± 4 Bq·m$^{-2}$. Weekly depositions reaching a maximum of 0.106 ± 0.016 Bq·m$^{-2}$ (detection limit is about 0.005 Bq·m$^{-2}$) and a yearly total deposition of 1.22 ± 0.06 Bq·m$^{-2}$ were found for $^{137}Cs$ (*Table A*7). $^{134}Cs$ was not found (detection limit is about 0.2 Bq·m$^{-2}$).

The weekly depositions of $^{7}Be$, $^{137}Cs$ and $^{210}Pb$ are given in *Table A7. Figure 3.5* shows a correlation between the amount of precipitation and the deposition of $^{7}Be$. The correlation between the amount of precipitation and the deposition of $^{210}Pb$ is not as clear, as can be seen in *Figure 3.6.*

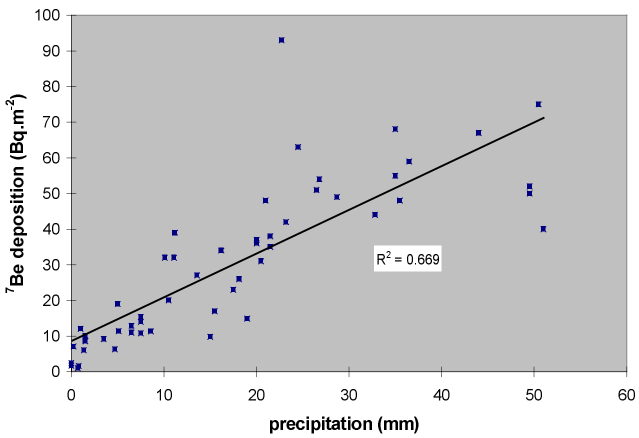



*Figure 3.5: The weekly deposition of $^{7}Be$ in 1999 versus precipitation.*

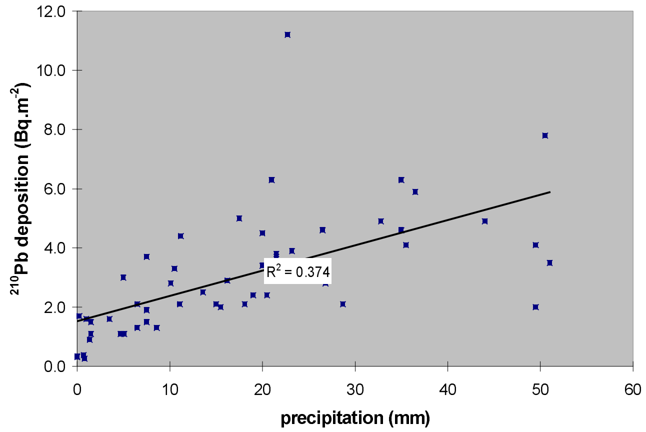



*Figure 3.6: The weekly deposition of $^{210}$Pb in 1999 versus precipitation.*

# 4. National Radioactivity Monitoring Network

This chapter presents data on ambient dose equivalent rates, ‘man-made’ gross-β-activity concentrations and gross-α-activity concentrations as measured by the NMR (National Radioactivity Monitoring Network ). The data on gross-α and gross-β differ in sample size, sampling frequency and analytical procedures from those given in the previous chapter.

In 1999 the NMR was reorganised from a network consisting of 280 dose equivalent rate monitors into a network consisting of 163 dose equivalent rate monitors and 14 aerosol monitors for determining gross-α and ‘man-made’ gross-β-activity concentrations [7]. Since 1996 the analysis of trends in the ambient dose equivalent rate has been based on this set of 163 stations. The 14 sites with an aerosol monitor are also equipped with a dose-equivalent rate monitor. These 14 dose equivalent rate monitors are not comparable with the 163 dose equivalent-rate monitors because of being differently placed (with respect to height and surface covering). The yearly averages before 1996 are calculated from data from the 58 stations of the former LMR [8].

The data presented in this chapter are based on averages over periods of ten minutes. averages over the year are calculated from these values (*Tables A8* and *A9).* These data on external radiation, expressed in ambient dose equivalent, contain a systematic error because of an overestimation of the cosmogenic dose rate and an underestimation of the terrestrial dose rate. For the correction of data from the LMR locations a conversion equation was used, as presented by Smetsers et al.[8]. This equation gives a correction of -10 $nSv.h^{-1}$ for the lowest dose rate encountered in the Netherlands and a correction of -5 $nS.h^{-1}$ for the highest dose rate in the Netherlands. No conversion formula has been determined for the 163 dose-equivalent rate monitors of the NMR, but the systematic error is expected to of the same magnitude.

In *Figures 4.1* and *4.3*, a tentative impression has been constructed of the spatial variation in the yearly averages of the NMR data using RIVM’s Geographical Information System (GIS). An interpolation algorithm was applied to calculate values in between NMR stations. *Figures 4.2* and *4.4* present the respective yearly averages of gross-α-activity concentration and ambient-dose equivalent rate from 1990 to 1999. The yearly averaged ambient dose-equivalent rate in 1999 is calculated using 159 stations. The remaining four stations were not operational for a large part of the year.

The 1999 yearly average of the gross-α-activity concentration is comparable to previous years. For the ambient dose equivalent rate, the average over the year and across the country in 1999 is also comparable to previous years. The yearly averages of the calculated ‘man-made’ gross- β-activity concentration do not deviate significantly from zero.

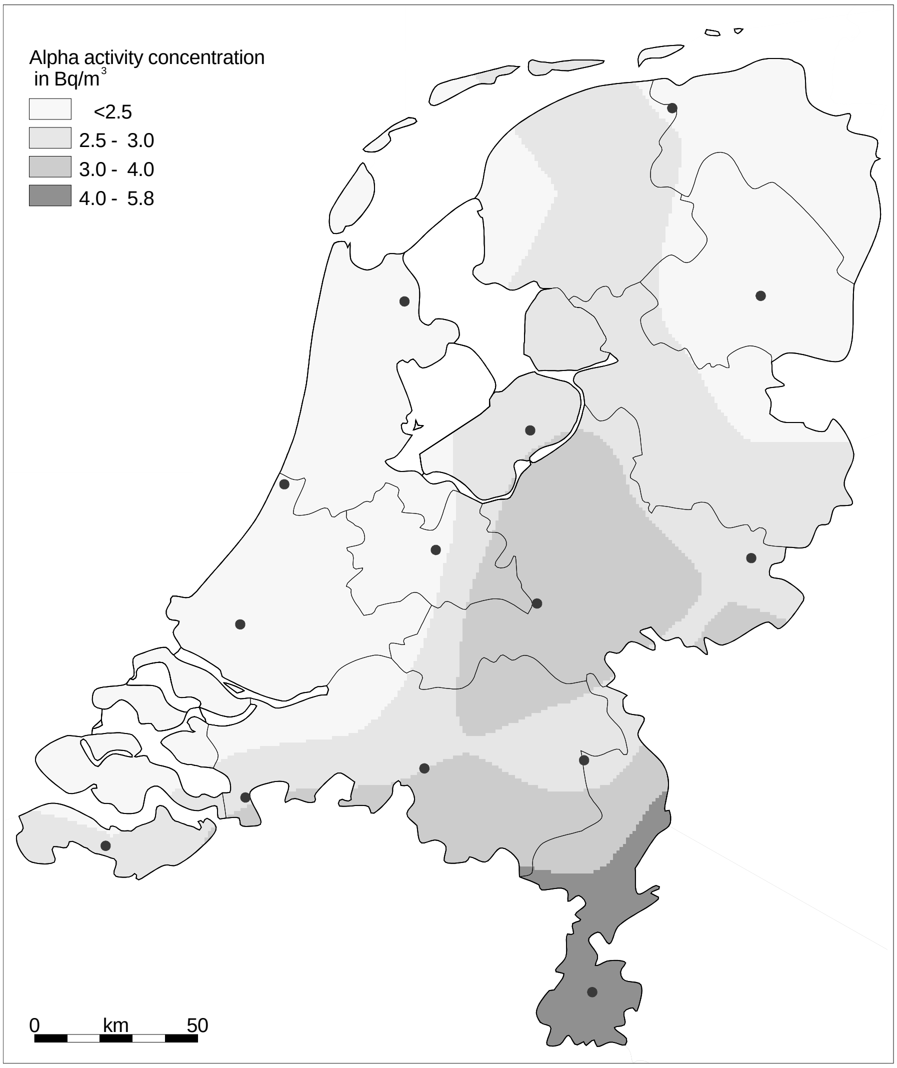



*Figure 4.1: Spatial variation in the average gross- α-activity concentration in air dust in 1999.*

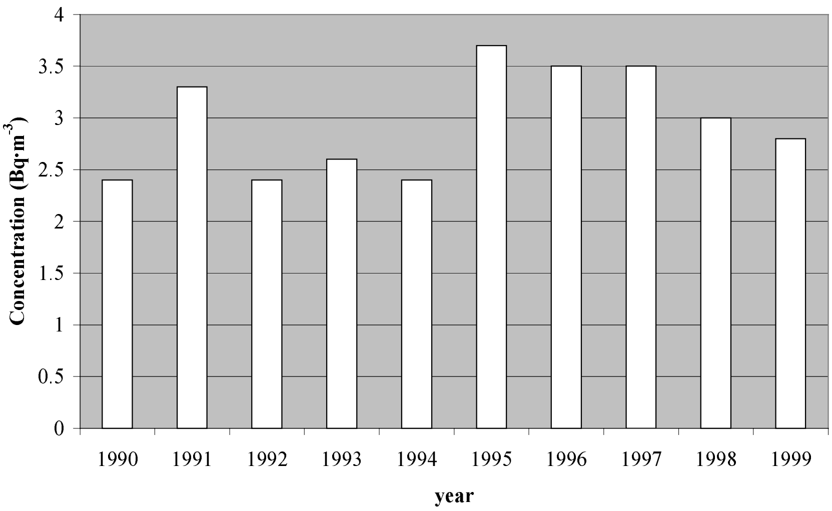



*Figure 4.2: The trend in the yearly averages for gross-α-activity concentration.*

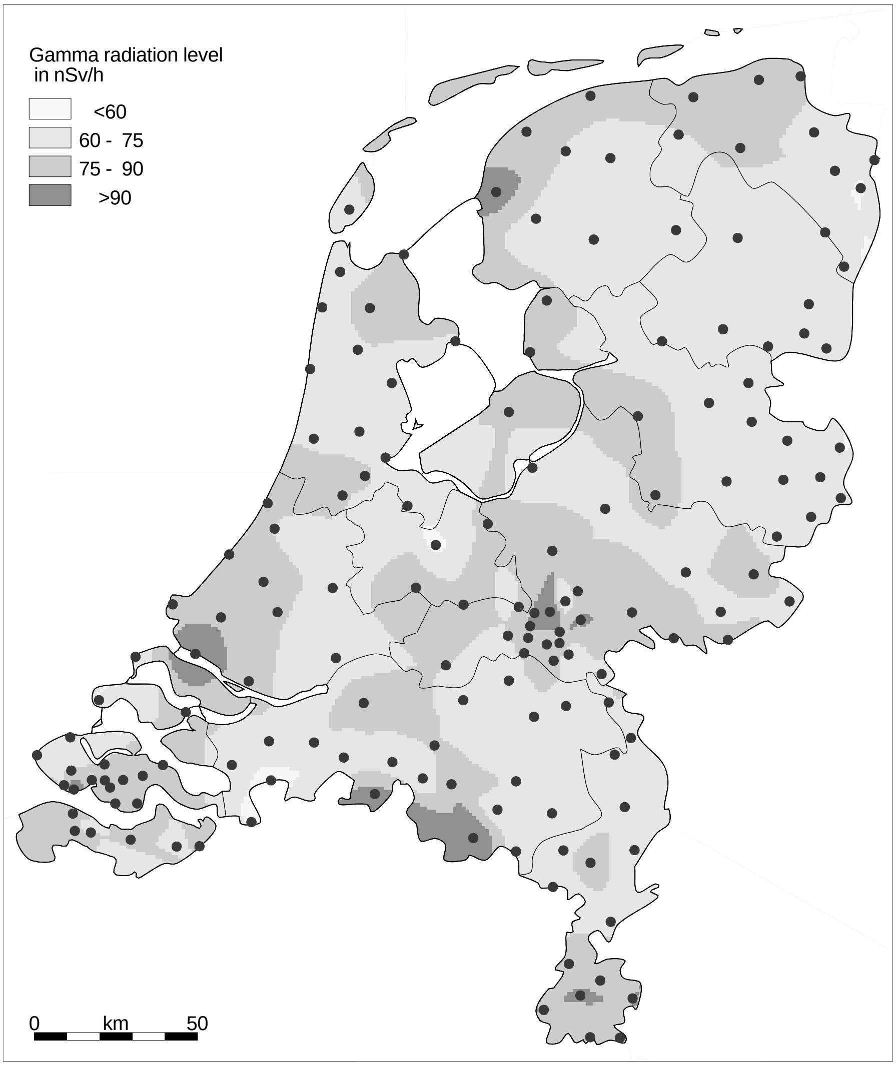



*Figure 4.3: Spatial variation in the average ambient- dose equivalent rate in 1999.*

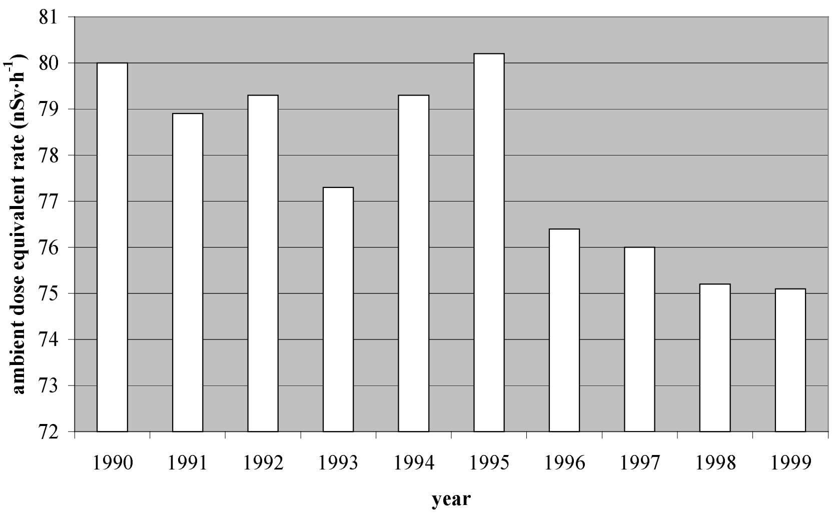



*Figure 4.4: The trend in the yearly averages of the ambient dose equivalent rate.*

# 5. Surface water and seawater

## 5.1 Introduction

The Institute for Inland Water Management and Waste Water Treatment (RIZA) and the National Institute for Coastal and Marine Management (RIKZ) regularly monitor the concentration of a number of radioactive nuclides in surface and seawater. The monitoring program presented here forms only part of the total monitoring program. The results presented in this report have been chosen to represent the major inland waters and seawater. More detailed results of measurements on radioactivity in Dutch waters are reported elsewhere [9]. The 1999 monitoring program is given in *Tables 5.1* and *5.2*. Radioactive nuclides were determined in water and suspended solids. The samples taken in Eijsden and in Lobith were collected for one week; the others were taken at random.

*Table 5.1: Monitoring program for the determination of radioactive nuclides in surface water in 1999*

| Location | Parameter | Compartment | Monitoring frequency (per year) |
|---|---|---|---|
| Meuse | Tritium | Water | 13 |
| (Eijsden) | Residual β | Water | 13 |
| | Cs-137 | Suspended solids | 52 |
| Rhine | Tritium | Water | 13 |
| (Lobith) | Residual β | Water | 13 |
| | Cs-137 | Suspended solids | 13 |
| Scheldt | Tritium | Water | 7 |
| (Schaar van Ouden Doel) | Residual β | Water | 13 |
| | Cs-137 | Suspended solids | 13 |
| Ketelmeer West | Cs-137 | Suspended solids | 6 |

*Table 5.2: Monitoring program for the determination of radioactive nuclides in seawater in 1999*

| Location | Parameter | Compartment | Monitoring frequency (per year) |
|---|---|---|---|
| Noordwijk 10 | Tritium | Water | 4 |
| | Residual β | Water | 4 |
| Noordwijk 70 | Tritium | Water | 4 |
| | Residual β | Water | 4 |
| Terschelling 235 | Tritium | Water | 2 |
| | Residual β | Water | 2 |

Noordwijk 10 is 10 km offshore, Noordwijk 70 is 70 km offshore and Terschelling 235 is 235 km northwest of Terschelling.

The data for inland waters are presented in *Tables A10* and *A11*, and the data for seawater in *Table A12*. The samples were analysed at the RIZA laboratory in Lelystad. The radioactive nuclides were determined according to standard procedures [10].

Target values for radioactive materials in surface water are used in the Netherlands, as given in the Fourth memorandum on water management (‘Vierde Nota waterhuishouding’) [11]. The yearly averages are compared with these target values. The results for surface water are presented in *Figures 5.1 to 5.6,* and the results for seawater in *Figures 5.7* to *5.10*.

## 5.2 Results for surface water

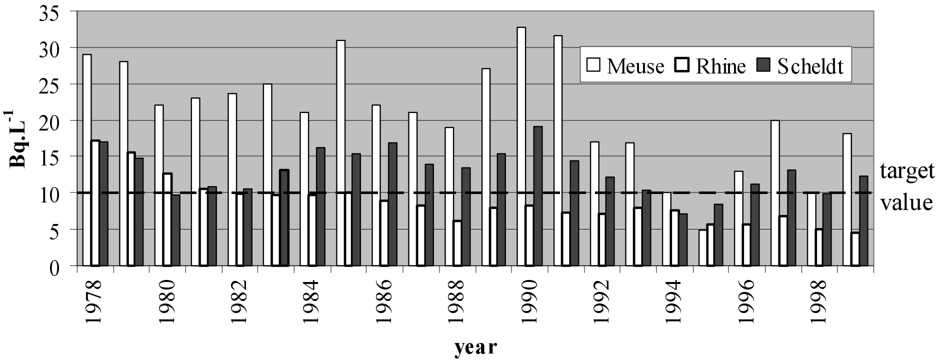



*Figure 5.1: Trend in the yearly averaged concentration of tritium.*

The yearly averaged concentrations of tritium in 1999 in the three rivers are comparable to those in previous years. The averaged tritium concentrations in the Meuse and the Scheldt are above the target value of 10 Bq·L$^{-1}$.

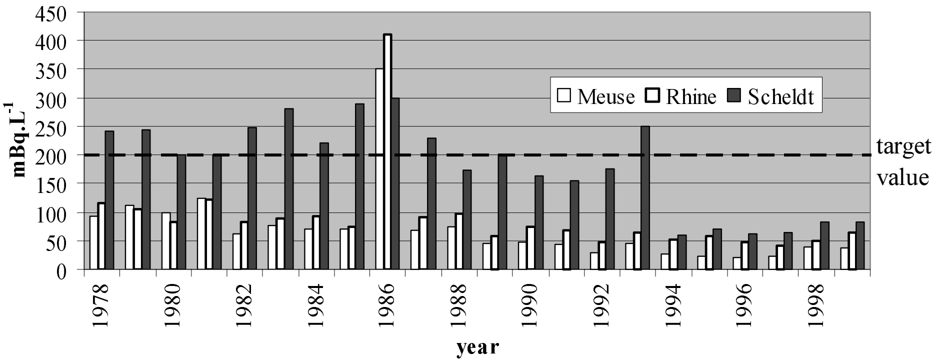



*Figure 5.2: Trend in the yearly averaged concentration of residual β.*

The yearly averaged concentrations of residual-β in 1999 for the three rivers are comparable to those in previous years. The averaged residual-β concentrations are below the target value of 200 mBq·L$^{-1}$.

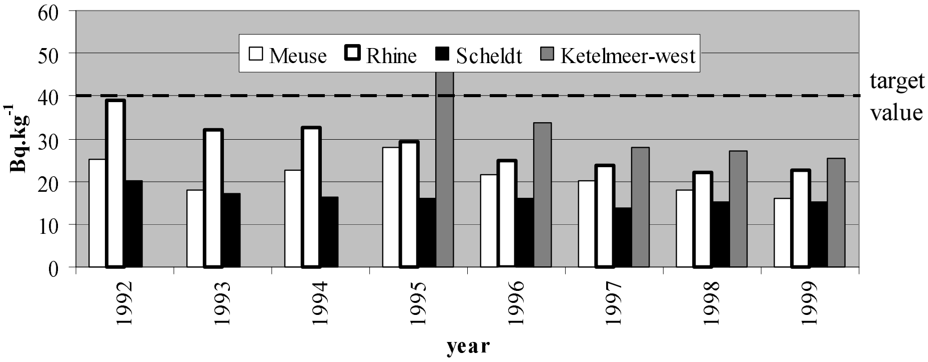



*Figure 5.3: Trend in the yearly averaged concentration of $^{137}$Cs.*

The yearly averaged concentrations of $^{137}$Cs in 1999 for the three rivers are comparable to those in previous years. The averaged $^{137}$Cs concentrations are below the target value of 40 Bq·kg$^{-1}$.

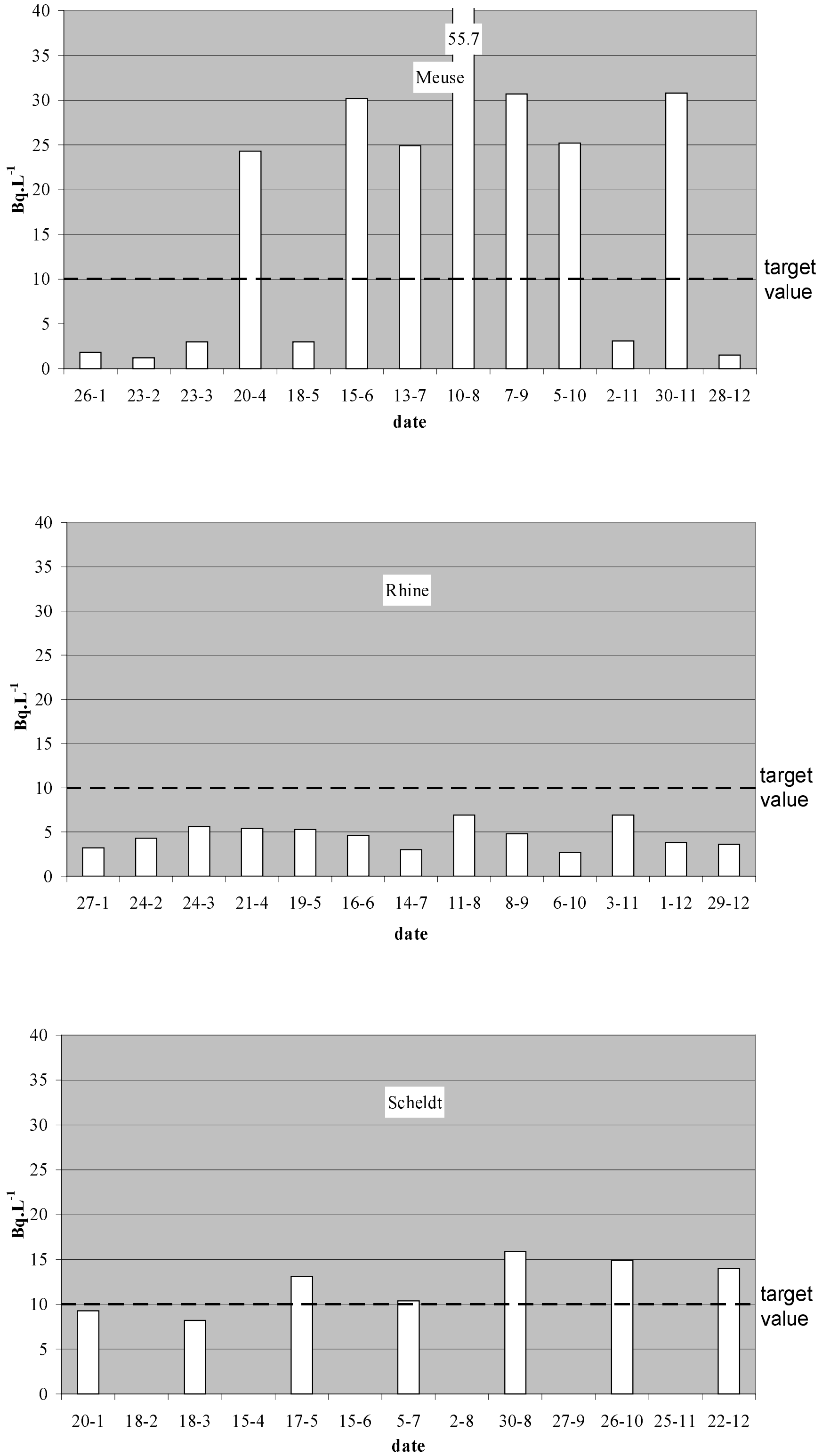



*Figure 5.4: The concentration of tritium in 1999 for the Meuse, Rhine and Scheldt, with respective averages of 18.1, 4.6 and 12.3 Bq.L$^{-1}$.*

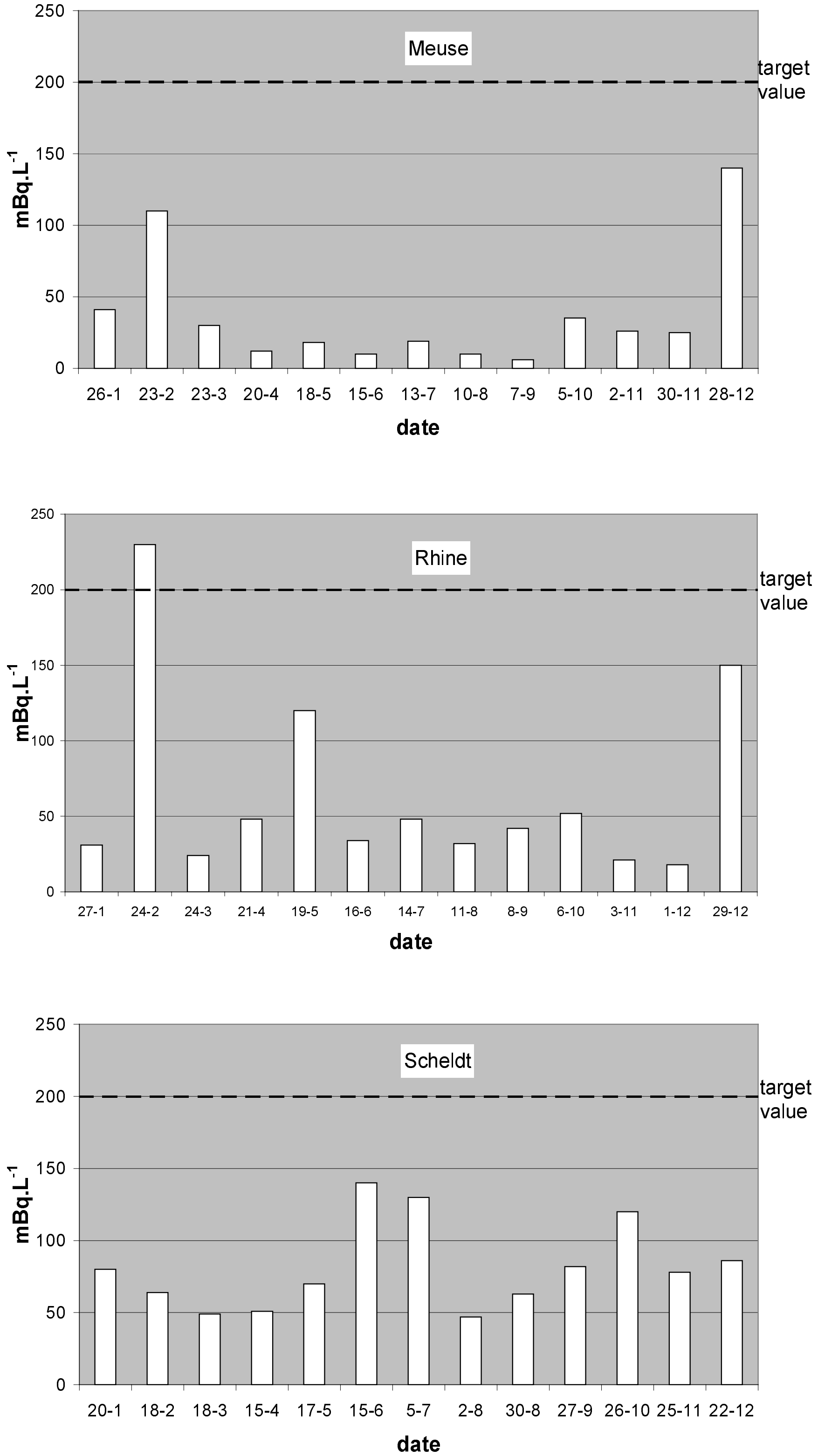



*Figure 5.5: The concentration of residual-β in 1999 for the Meuse, Rhine and Scheldt, with respective averages of 37, 65 and 82 mBq·L$^{-1}$.*

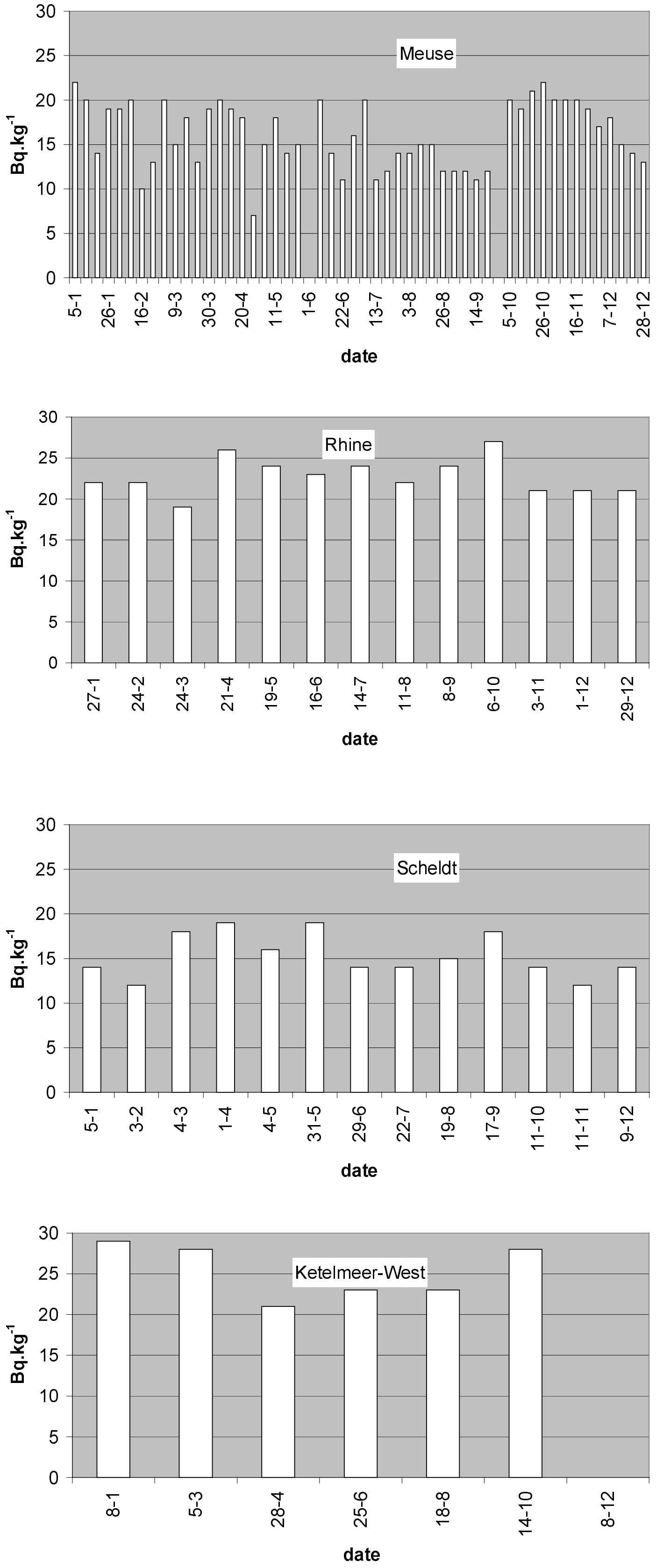



*Figure 5.6: The concentration of $^{137}Cs$ in 1999 for the Meuse, Rhine, Scheldt and Ketelmeer-West, with respective averages of 16, 23,15 and 25 Bq·kg$^{-1}$.*

## 5.3 Results for seawater

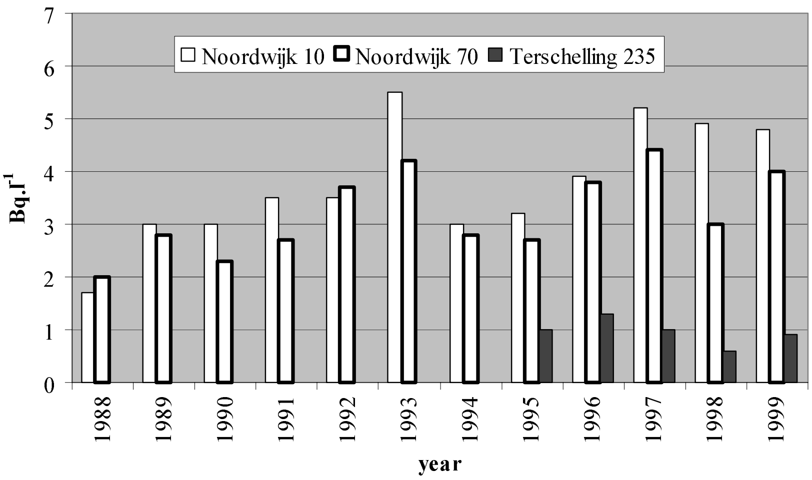



*Figure 5.7: Trend in the yearly averaged concentration of tritium.*

The yearly averaged concentrations of tritium in 1999 are comparable to those in previous years. The averages are below the target value of 10 Bq·L$^{-1}$.

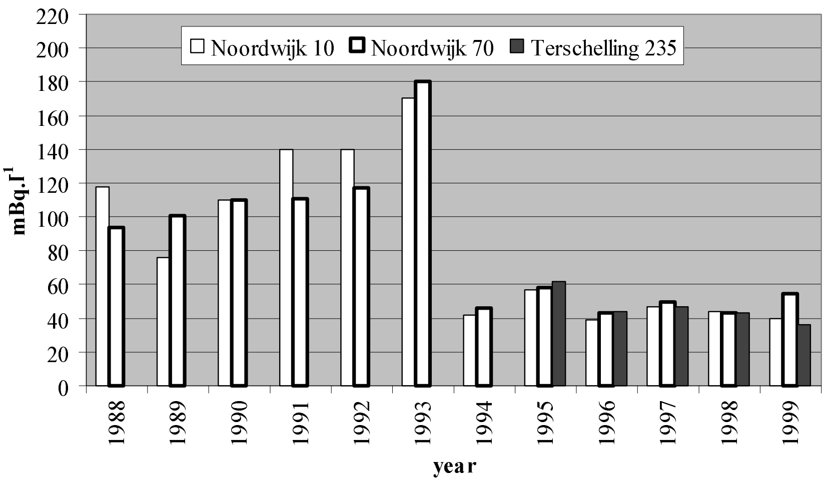
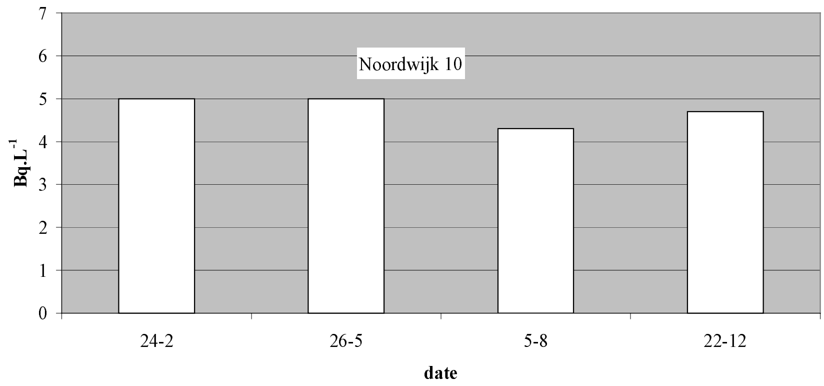
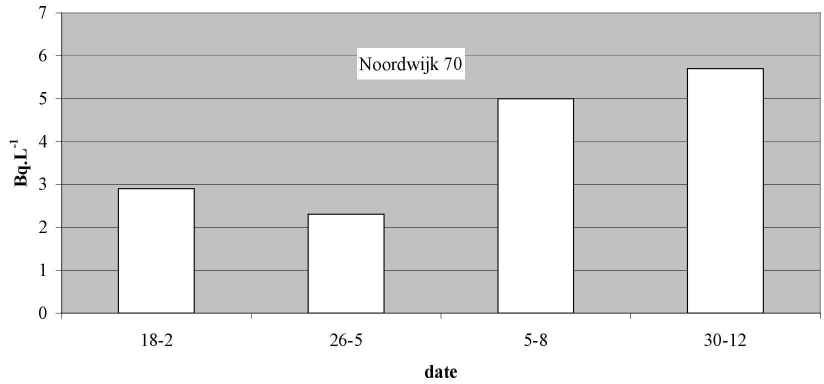



*Figure 5.8: Trend in the yearly averaged concentration of residual-β for 1988 to 1999.*

The yearly averaged concentrations of residual-β in 1999 are comparable to those in previous years. The averages are below the target value of 300 mBq·L$^{-1}$.



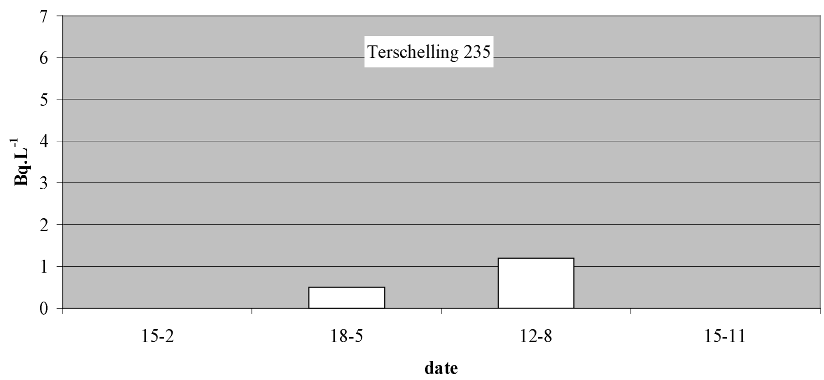




*Figure 5.9: The concentration of tritium in 1999 for three locations in the North Sea, with respective averages of 4.8, 4 and 0.9 Bq·L$^{-1}$.*

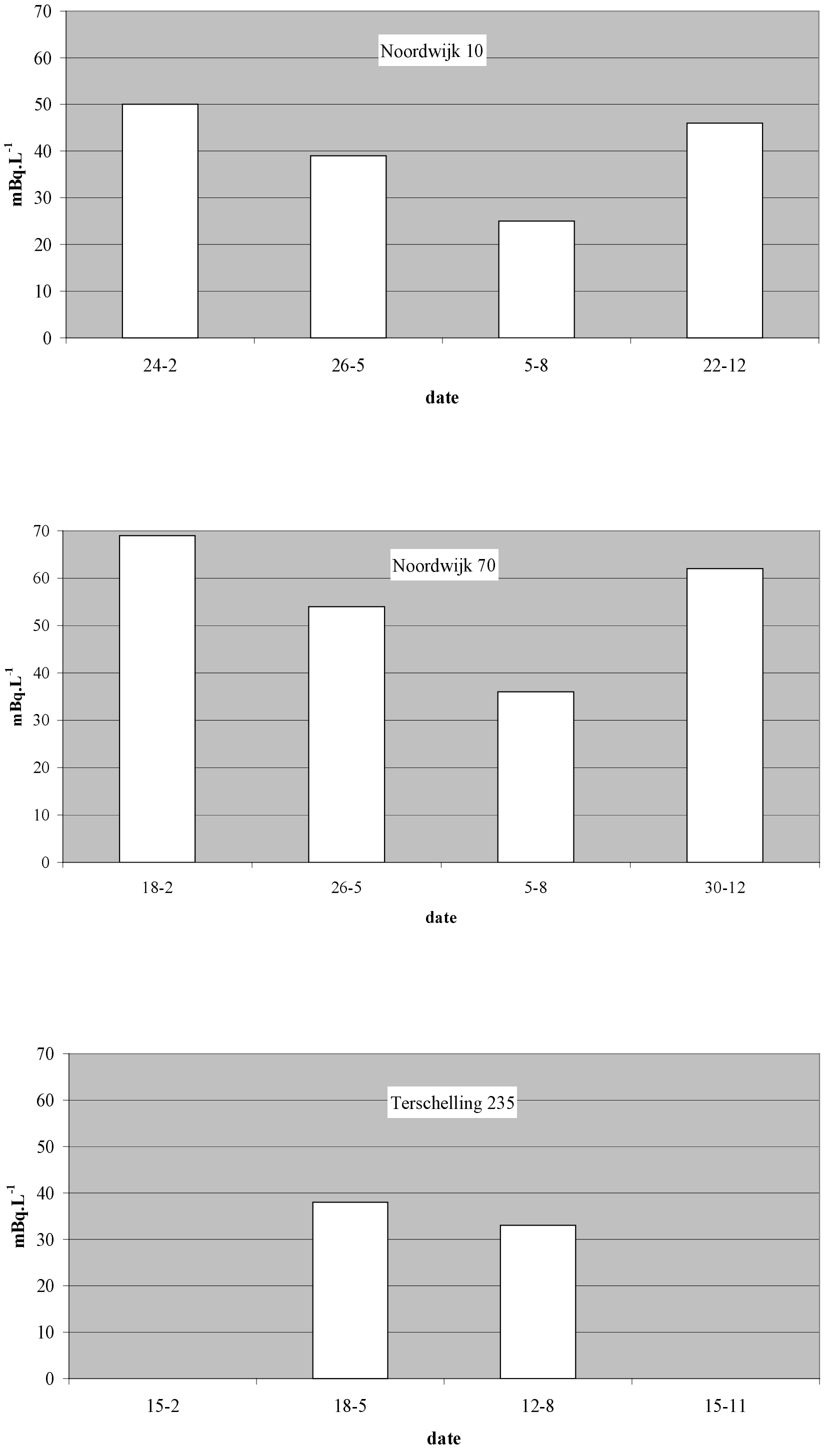



*Figure 5.10: The concentration of residual-β in 1999 for three locations in the North Sea, with respective averages of 40, 55 and 36 mBq·L$^{-1}$.*

# 6. Water for human consumption

In the Netherlands, water-pumping stations routinely monitor raw input water for tritium, gross-β and residual-β activity. The monitoring frequency is from 1 to 20 times per year, depending on the volume of water produced. Typical activities are 1-10 $Bq \cdot L^{-1}$ for tritium, and 0.1 – 1 $Bq \cdot L^{-1}$ for both gross-β and residual-β activity, which means there is almost no $^{40}K$ present.

The activity of natural nuclides, such as $^{226}Ra$ and $^{222}Rn$, in Dutch drinking water is very low. In 1994 a survey of Dutch water was carried out to determine the radon activity [12]. The average concentration found was 2.2 $Bq \cdot L^{-1}$.

# 7. Milk

Until 1997 RIVM measured radioactivity in milk samples under authority of the Chief of the Veterinary Inspectorate for Public Health of the Ministry of Health, Welfare and Sport. Because of the low levels of radioactivity found in the milk samples, the Chief Veterinary Inspectorate for Public Health decided to stop the monitoring program in 1998. Nevertheless Euratom holds the view that it is necessary to monitor gamma emitters and $^{90}Sr$ in milk samples taken from dairies.

# 8. Radioactivity in food

Radioactivity is measured in food suspected to contain more than the normal activity concentrations. The measurements are performed by the Inspectorate for Health Protection and Veterinary Public Health. No measurements on radioactivity in food were performed in 1999.

# 9. Conclusions

No elevated levels of radioactivity in the environment were found in 1999. The activity concentrations were back to the levels just before the Chernobyl accident. In 1999 no measurements were performed on milk and on foodstuffs, thereby departing from the Recommendation on the Application of Article 36 of the Euratom Treaty.

# References


[1] EC, 2000. Recommendation of the Commission of the European Communities on the Application of Article 36 of the Euratom Treaty. 2000/473/Euratom.

[2] Laboratory of Radiation Research, 1998. Monitoring of radiation in air dust, deposition and an overall country milk sample: Results in the Netherlands in 1996. RIVM, Bilthoven. Report no. 610056043.

[3] Laboratory of Radiation Research, 1996. Monitoring of radiation in the atmosphere and a food chain: Results in the Netherlands in 1995. RIVM, Bilthoven. Report no. 610056029.

[4] R.B. Tax, P.J.M. Kwakman, A.P.P.A. van Lunenburg and M.H. Tijsmans, 1994. Development of a High Volume Air Sampler for the sensitive detection of γ-emitting radionuclides attached to aerosols: Results obtained in the test period 1991-1992. RIVM, Bilthoven. Report no. 610056005.

[5] NVN 5636, 1991. Bepaling van de kunstmatige totale α-, kunstmatige totale β-activiteit en gammaspectrometrie van luchtfilters en berekening van de volumieke activiteit van de bemonsterde lucht, First printing, March.

[6] J.E.M. Jacobs, 1999. Monitoring of radiation in the environment: Results in the Netherlands in 1998. RIVM, Bilthoven. Report no. 610056045.

[7] Notulen beheerscommissie NMR,1998. Projectdossier NMR. RIVM, Bilthoven.

[8] R.C.G.M. Smetsers, L.J. de Vries, A.P.P.A. van Lunenburg and F.J. Aldenkamp, 1996. National Radioactivity Monitoring Network (LMR): Data report 1993–1995. RIVM, Bilthoven, Report no. 610056028.

[9] RIZA/RIKZ, 2000. Jaarboek Monitoring Rijkswateren 1999 (cd-rom.).

[10] E.J. de Jong, W. Lutthmer and B. Munster, 1995. Onderzoek naar radioactieve stoffen in Rijkswateren. Resultaten 1992. RIZA, Lelystad.

[11] Vierde Nota waterhuishouding, 1998. Minister of Transport, Public Works and Water Management (V&W), The Hague.

[12] F.M. Versteegh, F.W. van Gaalen, B.A. Baumann, E. Smit and L. Vaas, 1995. Resultaten van het meetprogramma drinkwater-1994 voor parameters uit het Waterleidingbesluit en enkele aanvullende parameters. RIVM, Bilthoven. Report no. 731011009.

[13] Letter to the State Health Inspectorate of the Ministry of Housing, Spatial Planning and Environment, 1997 (January 13). Onderzoek naar de slechte resultaten in 1995 van de bepaling van $^{210}$Po en $^{210}$Pb in natte en droge depostie. Reference no. 23/97 LSO Le/Ald/jdk..

# Appendix A

*Table A1: Weekly results of gross-$\alpha$ and gross-$\beta$ activities* in air dust sampled with a HVS on the RIVM premises in Bilthoven (The Netherlands) in 1999*

| Week number | Gross-α mBq.m$^{-3}$ | Gross-β mBq.m$^{-3}$ | | | Week number | Gross-α mBq.m$^{-3}$ | Gross-β mBq.m$^{-3}$ | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.081 | 0.563 | ± | 0.046 | 27 | 0.074 | 0.333 | ± | 0.028 |
| 2 | 0.030 | 0.27 | ± | 0.02 | 28 | 0.043 | 0.534 | ± | 0.044 |
| 3 | 0.031 | 0.307 | ± | 0.026 | 29 | 0.104 | 0.40 | ± | 0.03 |
| 4 | 0.041 | 0.34 | ± | 0.03 | 30 | 0.082 | 0.382 | ± | 0.031 |
| 5 | 0.034 | 0.35 | ± | 0.03 | 31 | 0.099 | 0.918 | ± | 0.074 |
| 6 | 0.009 | 0.17 | ± | 0.02 | 32 | 0.040 | 0.37 | ± | 0.03 |
| 7 | 0.049 | 0.35 | ± | 0.03 | 33 | 0.036 | 0.25 | ± | 0.02 |
| 8 | 0.069 | 0.16 | ± | 0.01 | 34 | 0.079 | 0.50 | ± | 0.04 |
| 9 | 0.076 | 0.171 | ± | 0.015 | 35 | 0.060 | 0.37 | ± | 0.03 |
| 10 | 0.029 | 0.240 | ± | 0.021 | 36 | 0.168 | 0.89 | ± | 0.07 |
| 11 | 0.051 | 0.40 | ± | 0.03 | 37 | 0.099 | 0.975 | ± | 0.079 |
| 12 | 0.062 | 0.47 | ± | 0.04 | 38 | 0.082 | 0.57 | ± | 0.05 |
| 13 | 0.065 | 0.54 | ± | 0.04 | 39 | 0.040 | 0.32 | ± | 0.03 |
| 14 | 0.068 | 0.299 | ± | 0.025 | 40 | 0.046 | 0.34 | ± | 0.03 |
| 15 | 0.077 | 0.218 | ± | 0.019 | 41 | 0.060 | 0.367 | ± | 0.030 |
| 16 | 0.026 | 0.24 | ± | 0.02 | 42 | 0.057 | 0.62 | ± | 0.05 |
| 17 | 0.043 | 0.438 | ± | 0.036 | 43 | 0.062 | 0.400 | ± | 0.033 |
| 18 | 0.042 | 0.36 | ± | 0.03 | 44 | 0.061 | 0.453 | ± | 0.037 |
| 19 | 0.081 | 0.34 | ± | 0.03 | 45 | 0.100 | 0.302 | ± | 0.025 |
| 20 | 0.071 | 0.51 | ± | 0.04 | 46 | 0.032 | 0.30 | ± | 0.03 |
| 21 | 0.105 | 0.48 | ± | 0.04 | 47 | 0.071 | 0.47 | ± | 0.04 |
| 22 | 0.044 | 0.43 | ± | 0.04 | 48 | 0.082 | 0.62 | ± | 0.05 |
| 23 | 0.043 | 0.289 | ± | 0.024 | 49 | 0.036 | 0.194 | ± | 0.017 |
| 24 | 0.038 | 0.301 | ± | 0.025 | 50 | 0.038 | 0.20 | ± | 0.02 |
| 25 | 0.033 | 0.18 | ± | 0.02 | 51 | 0.037 | 0.288 | ± | 0.024 |
| 26 | 0.043 | 0.305 | ± | 0.026 | 52 | 0.027 | 0.16 | ± | 0.01 |
| | | | | | Avg | 0.059 | 0.389 | ± | 0.005 |
| | | | | | SD | 0.03 | 0.18 | | |

** The error in the yearly average is equal to the square root of the sum of the squared weekly errors divided by the number of weeks. SD is the standard deviation of the weekly results. Errors are given as 1$\sigma$.*

*Table A2: Detection limits in µBq·$m^{-3}$ of a well-type detector for a 7-day sampling period, with 10 days delay between sampling and start of measurement, 200,000 seconds counting time and a sample volume of about 50000 $m^3$.*

| Nuclide | Detection limit | Nuclide | Detection limit |
|---|---|---|---|
| $^{7}Be$ | 1.4 | $^{113}Sn$ | 0.1 |
| $^{22}Na$ | 0.2 | $^{115m}Cd$ | 8 |
| $^{24}Na$ | 600 * | $^{123m}Te$ | 0.1 |
| $^{40}K$ | 7 | $^{124}Sb$ | 0.4 |
| $^{51}Cr$ | 1.6 | $^{125}Sb$ | 0.4 |
| $^{54}Mn$ | 0.1 | $^{129m}Te$ | 5 |
| $^{57}Co$ | 0.1 | $^{131}I$ | 1.3 ** |
| $^{58}Co$ | 0.1 | $^{132}Te$ | 3 |
| $^{59}Fe$ | 0.3 | $^{134}Cs$ | 0.2 |
| $^{60}Co$ | 0.2 | $^{136}Cs$ | 0.2 |
| $^{65}Zn$ | 0.3 | $^{137}Cs$ | 0.1 |
| $^{75}Se$ | 0.2 | $^{140}Ba$ | 0.6 |
| $^{95}Nb$ | 0.2 | $^{140}La$ | 22 |
| $^{95}Zr$ | 0.4 | $^{141}Ce$ | 0.2 |
| $^{99}Mo$ | 20 | $^{144}Ce$ | 0.7 |
| $^{103}Ru$ | 0.1 | $^{202}Tl$ | 0.3 |
| $^{106}Ru$ | 0.9 | $^{210}Pb$ | 5 |
| $^{109}Cd$ | 3 | $^{237}U$ | 2 |
| $^{110m}Ag$ | 0.2 | | |

* *Due to the relatively short half-life of $^{24}Na$ and the long delay between sampling and measurement, this nuclide cannot be determined on the well-type detector. Therefore the detection limit for the coaxial detector is given (3 days waiting time, 100,000 seconds counting time).*

** *Due to the sample preparation procedure the volatile nuclide $^{131}I$ cannot be determined on the well-type detector, but a coaxial detector has to be used, the detection limit of which is given. (3 days waiting time, 100,000 seconds counting time).*

*Table A3: Weekly results of $^{7}Be$, $^{137}Cs$ and $^{210}Pb$ concentrations* in air dust sampled with a HVS in 1999 on the RIVM premises in Bilthoven (The Netherlands). Empty fields indicate that the value was below the detection limit given in Table A2.*

| Week number | Period | $^{7}$Be µBq·m$^{-3}$ | | | $^{137}$Cs µBq·m$^{-3}$ | | | $^{210}$Pb µBq·m$^{-3}$ | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 31/12-08/01 | 4400 | ± | 400 | 1.22 | ± | 0.18 | 490 | ± | 40 |
| 2 | 08/01-15/01 | 3000 | ± | 300 | 0.75 | ± | 0.12 | 250 | ± | 20 |
| 3 | 15/01-22/01 | 3900 | ± | 300 | 0.9 | ± | 0.2 | 360 | ± | 30 |
| 4 | 22/01-29/01 | 2700 | ± | 200 | 0.82 | ± | 0.16 | 340 | ± | 30 |
| 5 | 29/01-05/02 | 3800 | ± | 300 | 1.4 | ± | 0.2 | 320 | ± | 30 |
| 6 | 05/02-12/02 | 2800 | ± | 200 | 0.92 | ± | 0.16 | 132 | ± | 12 |
| 7 | 12/02-19/02 | 3600 | ± | 300 | 1.5 | ± | 0.3 | 340 | ± | 30 |
| 8 | 19/02-26/02 | 3200 | ± | 300 | 0.70 | ± | 0.18 | 116 | ± | 11 |
| 9 | 26/02-05/03 | 2400 | ± | 200 | 0.5 | ± | 0.2 | 157 | ± | 15 |
| 10 | 05/03-12/03 | 1460 | ± | 130 | 0.85 | ± | 0.19 | 270 | ± | 20 |
| 11 | 12/03-19/03 | 3200 | ± | 300 | 1.9 | ± | 0.4 | 420 | ± | 40 |
| 12 | 19/03-26/03 | 5300 | ± | 500 | 1.07 | ± | 0.17 | 450 | ± | 40 |
| 13 | 26/03-02/04 | 4000 | ± | 300 | 1.7 | ± | 0.2 | 510 | ± | 40 |
| 14 | 02/04-09/04 | 2900 | ± | 300 | 0.73 | ± | 0.09 | 300 | ± | 30 |
| 15 | 09/04-16/04 | 3300 | ± | 300 | 0.62 | ± | 0.12 | 179 | ± | 17 |
| 16 | 16/04-23/04 | 3300 | ± | 300 | 0.81 | ± | 0.13 | 207 | ± | 19 |
| 17 | 23/04-29/04 | 4200 | ± | 400 | 1.66 | ± | 0.19 | 400 | ± | 40 |
| 18 | 29/04-07/05 | 5400 | ± | 500 | 2.0 | ± | 0.2 | 330 | ± | 30 |
| 19 | 07/05-12/05 | 4800 | ± | 400 | 1.2 | ± | 0.3 | 310 | ± | 30 |
| 20 | 12/05-21/05 | 6400 | ± | 600 | 1.77 | ± | 0.17 | 430 | ± | 40 |
| 21 | 21/05-28/05 | 7800 | ± | 700 | 1.00 | ± | 0.16 | 360 | ± | 30 |
| 22 | 28/05-04/06 | 5600 | ± | 500 | 0.95 | ± | 0.16 | 340 | ± | 30 |
| 23 | 04/06-11/06 | 5000 | ± | 400 | 0.66 | ± | 0.18 | 190 | ± | 18 |
| 24 | 11/06-18/06 | 3600 | ± | 300 | 1.03 | ± | 0.14 | 260 | ± | 20 |
| 25 | 18/06-25/06 | 2800 | ± | 200 | 1.0 | ± | 0.2 | 147 | ± | 13 |
| 26 | 25/06-02/07 | 4300 | ± | 400 | 0.80 | ± | 0.14 | 270 | ± | 20 |

*To be continued*

*Table A3: Continued*

| Week number | Period | $^{7}$Be µBq·m$^{-3}$ | | | $^{137}$Cs µBq·m$^{-3}$ | | | $^{210}$Pb µBq·m$^{-3}$ | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | 02/07-09/07 | 4000 | ± | 400 | 0.77 | ± | 0.14 | 320 | ± | 30 |
| 28 | 09/07-16/07 | 6100 | ± | 500 | 1.8 | ± | 0.2 | 440 | ± | 40 |
| 29 | 16/07-23/07 | 3600 | ± | 300 | 1.1 | ± | 0.2 | 360 | ± | 30 |
| 30 | 23/07-30/07 | 4700 | ± | 400 | 0.94 | ± | 0.13 | 330 | ± | 30 |
| 31 | 30/07-06/08 | 9300 | ± | 800 | 1.7 | ± | 0.2 | 790 | ± | 70 |
| 32 | 06/08-13/08 | 5200 | ± | 400 | 0.64 | ± | 0.15 | 290 | ± | 30 |
| 33 | 13/08-20/08 | 3700 | ± | 300 | 0.74 | ± | 0.16 | 220 | ± | 20 |
| 34 | 20/08-27/08 | 5700 | ± | 500 | 0.85 | ± | 0.12 | 490 | ± | 40 |
| 35 | 27/08-03/09 | 4300 | ± | 400 | 0.87 | ± | 0.13 | 390 | ± | 30 |
| 36 | 03/09-10/09 | 4900 | ± | 400 | 1.6 | ± | 0.2 | 1050 | ± | 90 |
| 37 | 10/09-17/09 | 5800 | ± | 500 | 1.28 | ± | 0.17 | 1040 | ± | 90 |
| 38 | 17/09-24/09 | 3900 | ± | 300 | 0.78 | ± | 0.16 | 590 | ± | 50 |
| 39 | 24/09-01/10 | 2900 | ± | 200 | 0.50 | ± | 0.10 | 320 | ± | 30 |
| 40 | 01/10-08/10 | 4100 | ± | 400 | 0.42 | ± | 0.09 | 260 | ± | 20 |
| 41 | 08/10-15/10 | 4000 | ± | 400 | 0.81 | ± | 0.16 | 330 | ± | 30 |
| 42 | 15/10-22/10 | 3100 | ± | 300 | 1.46 | ± | 0.18 | 650 | ± | 60 |
| 43 | 22/10-29/10 | 2170 | ± | 190 | 0.56 | ± | 0.19 | 460 | ± | 40 |
| 44 | 29/10-05/11 | 3300 | ± | 300 | 0.97 | ± | 0.18 | 430 | ± | 40 |
| 45 | 05/11-12/11 | 2400 | ± | 200 | 0.84 | ± | 0.19 | 330 | ± | 30 |
| 46 | 12/11-19/11 | 2400 | ± | 200 | | | | 390 | ± | 40 |
| 47 | 19/11-26/11 | 2800 | ± | 300 | | | | 570 | ± | 50 |
| 48 | 26/11-03/12 | 4200 | ± | 400 | | | | 710 | ± | 70 |
| 49 | 03/12-10/12 | 3000 | ± | 300 | | | | 230 | ± | 30 |
| 50 | 10/12-17/12 | 2700 | ± | 200 | | | | 220 | ± | 30 |
| 51 | 17/12-24/12 | 3300 | ± | 300 | 1.5 | ± | 0.7 | 330 | ± | 30 |
| 52 | 24/12-31/12 | 2200 | ± | 200 | | | | 180 | ± | 20 |
| | Avg. | 3980 | ± | 50 | 1.06 | ± | 0.03 | 377 | ± | 5 |
| | SD | | 1500 | | | 0.4 | | | 200 | |

** The error in the yearly average is equal to the square root of the sum of the squared weekly errors divided by the number of weeks. SD is the standard deviation of the weekly results. Errors are given as 1$\sigma$..*

*Table A4: Precipitation per month* and $^{3}H$-, long-lived gross-α and gross-β activity in deposition sampled on the RIVM premises in Bilthoven (The Netherlands) in 1999*

| Month 1999 | Precipitation mm | $^{3}H$ Bq·m$^{-2}$ | | | Gross-α Bq·m$^{-2}$ | | | Gross-β Bq·m$^{-2}$ | | |
|---|---|---|---|---|---|---|---|---|---|---|
| January | 83.0 | 110 | ± | 40 | 2.3 | ± | 0.3 | 6.7 | ± | 0.6 |
| February | 77.0 | < 70 | | | 2.5 | ± | 0.4 | 6.4 | ± | 0.5 |
| March | 75.9 | < 100 | | | 1.6 | ± | 0.2 | 4.7 | ± | 0.4 |
| April | 72.8 | 190 | ± | 30 | 2.5 | ± | 0.3 | 6.2 | ± | 0.5 |
| May | 51.5 | 210 | ± | 30 | 3.8 | ± | 0.4 | 10.7 | ± | 0.9 |
| June | 87.7 | < 90 | | | 1.3 | ± | 0.2 | 5.3 | ± | 0.4 |
| July | 40.0 | 116 | ± | 10 | 1.9 | ± | 0.3 | 6.5 | ± | 0.6 |
| August | 97.6 | 170 | ± | 40 | 2.5 | ± | 0.3 | 10.0 | ± | 0.8 |
| September | 69.3 | 120 | ± | 30 | 1.7 | ± | 0.3 | 7.5 | ± | 0.6 |
| October | 54.5 | 102 | ± | 19 | 1.2 | ± | 0.2 | 5.3 | ± | 0.5 |
| November | 58.2 | 180 | ± | 30 | 1.5 | ± | 0.3 | 5.5 | ± | 0.5 |
| December | 152.3 | 330 | ± | 70 | 2.9 | ± | 0.4 | 8.6 | ± | 0.7 |
| Total | 920 | 1530 | ± | 110 | 25.5 | ± | 1.0 | 84 | ± | 2 |

* *The error in the sum is equal to the square root of the sum of the squared monthly errors. Errors are given as 1σ..*

*Table A5: Yearly totals** for gross-α and gross-β activity of long-lived nuclides, $^{3}H$, $^{210}Pb$ and $^{210}Po$ in deposition for 1983 – 1999 [5]*

| Year | Precipitation mm | Gross-α Bq·m$^{-2}$ | Gross-β Bq·m$^{-2}$ | $^{3}H$ Bq·m$^{-2}$ | $^{210}Pb$# Bq·m$^{-2}$ | $^{210}Po$# Bq·m$^{-2}$ |
|---|---|---|---|---|---|---|
| 1983 | 869 | 40 | 120 | 2100 | - | - |
| 1984 | 868 | 25 | 130 | 2610 | - | - |
| 1985 | 767 | 30 | 140 | 3800 | - | - |
| 1986 | 825 | 45 | 18000 | 2400 | 15 | 3 |
| 1987 | 975 | 24 ± 1(*) | 85 ± 3(*) | 2630 | 52 | 6 |
| 1988 | 887 | 36 ± 2 | 103 ± 3 | 1700 ± 40 | 110 ± 3 | 25 ± 1 |
| 1989 | 706 | 43 ± 1 | 89 ± 3 | 1560 ± 130 | 94 ± 7 | 24 ± 4 |
| 1990 | 756 | 68 ± 1 | 121 ± 4 | 1360 ± 120 | 85 ± 4 | 16 ± 2 |
| 1991 | 699 | 48 ± 1 | 85 ± 1 | 1060 ± 50 | 56 ± 1 | 10 ± 1 |
| 1992 | 946 | 44 ± 1 | 87 ± 1 | 1440 ± 50 | 83 ± 5 | 11 ± 1 |
| 1993 | 886 | 54.3 ± 0.7 | 87.9 ± 0.8 | 1310 ± 30 | 78 ± 3 | 6.0 ± 0.6 |
| 1994 | 1039 | 52.0 ± 0.7 | 91.2 ± 1.0 | 1210 ± 30 | 82 ± 3 | 12.7 ± 0.7 |
| 1995 | 724 | 39 ± 4 | 95 ± 8 | 970 ± 40 | (-)$^{1}$ | (-)$^{1}$ |
| 1996 | 626 | 16.4 ± 1.5 | 67 ± 5 | 970 ± 50 | 57 ± 3 | 9 ± 2 |
| 1997 | 760 | 23.1 ± 1.3 | 87 ± 3 | 1160 ± 60 | 80 ± 3 | < 10 |
| 1998 | 1238 | 31.1 ± 1.3 | 106 ± 3 | 1200 ± 110 | 91 ± 4 | < 16 |
| 1999 | 916 | 25.5 ± 1.0 | 84 ± 2 | 1530 ± 110 | (+) | < 5.1 |

(*) *Introduction of new method*
\- *No analysis*
(+) *α-spectroscopy analysis of $^{210}Pb$ stopped in 1999*
\# *Data from α spectroscopy*
(-)$^{1}$ *Result rejected [13]*
** *Errors are given as 1σ.*

*Table A6: Monthly values of $^{210}Po$ in deposition sampled on the RIVM premises in Bilthoven (The Netherlands) in 1999.*

| **Period 1999** | **$^{210}Po$ $Bq \cdot m^{-2}$** |
|---|---|
| January | < 0.29 |
| February | 0.78 ± 0.12 |
| March | < 0.29 |
| April | < 0.25 |
| May | < 0.74 |
| June | < 0.30 |
| July | < 0.31 |
| August | < 0.64 |
| September | < 0.30 |
| October | < 0.33 |
| November | < 0.36 |
| December | < 0.55 |
| Total | < 5.1 |

Measurements are carried out using α-spectroscopy. Errors are given as 1σ.

*Table A7: Weekly values of $^{7}$Be, $^{137}$Cs and $^{210}$Pb deposition sampled on the RIVM premises in Bilthoven (The Netherlands) in 1999.*

| **Week Number** | **Period** | **Precipitation mm** | **$^{7}$Be Bq·m$^{-2}$** | | | **$^{137}$Cs Bq·m$^{-2}$** | | | **$^{210}$Pb Bq·m$^{-2}$** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 31/12-08/01 | 28.7 | 49 | ± | 6 | | | | 2.1 | ± | 0.3 |
| 2 | 08/01-15/01 | 18.1 | 26 | ± | 3 | | | | 2.1 | ± | 0.3 |
| 3 | 15/01-22/01 | 16.2 | 34 | ± | 4 | | | | 2.9 | ± | 0.4 |
| 4 | 22/01-29/01 | 23.2 | 42 | ± | 5 | | | | 3.9 | ± | 0.5 |
| 5 | 29/01-05/02 | 1.5 | 10.1 | ± | 1.2 | 0.044 | ± | 0.013 | 1.1 | ± | 0.2 |
| 6 | 05/02-12/02 | 24.5 | 63 | ± | 7 | 0.030 | ± | 0.008 | 3.1 | ± | 0.4 |
| 7 | 12/02-19/02 | 10.1 | 32 | ± | 4 | 0.049 | ± | 0.012 | 2.8 | ± | 0.4 |
| 8 | 19/02-26/02 | 26.8 | 54 | ± | 6 | 0.035 | ± | 0.011 | 2.8 | ± | 0.4 |
| 9 | 26/02-05/03 | 51.0 | 40 | ± | 5 | 0.031 | ± | 0.008 | 3.5 | ± | 0.5 |
| 10 | 05/03-12/03 | 15.0 | 9.8 | ± | 1.2 | 0.021 | ± | 0.007 | 2.1 | ± | 0.3 |
| 11 | 12/03-19/03 | 7.5 | 10.8 | ± | 1.3 | | | | 1.5 | ± | 0.2 |
| 12 | 19/03-26/03 | 13.6 | 27 | ± | 3 | | | | 2.5 | ± | 0.3 |
| 13 | 26/03-02/04 | 4.7 | 6.3 | ± | 0.8 | 0.026 | ± | 0.007 | 1.1 | ± | 0.2 |
| 14 | 02/04-09/04 | 21.5 | 35 | ± | 4 | 0.019 | ± | 0.007 | 3.7 | ± | 0.5 |
| 15 | 09/04-16/04 | 26.5 | 51 | ± | 6 | 0.023 | ± | 0.010 | 4.6 | ± | 0.6 |
| 16 | 23/04-29/04 | 20.5 | 31 | ± | 4 | 0.041 | ± | 0.013 | 2.4 | ± | 0.3 |
| 17 | 23/04-29/04 | 0.0 | 1.7 | ± | 0.2 | | | | 0.34 | ± | 0.15 |
| 18 | 29/04-07/05 | 21.0 | 48 | ± | 6 | 0.053 | ± | 0.009 | 6.3 | ± | 0.8 |
| 19 | 07/05-12/05 | 11.1 | 32 | ± | 4 | 0.043 | ± | 0.008 | 2.1 | ± | 0.3 |
| 20 | 12/05-21/05 | 11.2 | 39 | ± | 5 | 0.056 | ± | 0.011 | 4.4 | ± | 0.6 |
| 21 | 21/05-28/05 | 1.5 | 8.5 | ± | 1.0 | 0.028 | ± | 0.011 | 1.5 | ± | 0.2 |
| 22 | 28/05-04/06 | 22.7 | 93 | ± | 11 | 0.053 | ± | 0.012 | 11.2 | ± | 1.3 |
| 23 | 04/06-11/06 | 44.0 | 67 | ± | 8 | | | | 4.9 | ± | 0.6 |
| 24 | 11/06-18/06 | 0.8 | 1.6 | ± | 0.2 | 0.031 | ± | 0.008 | 0.26 | ± | 0.08 |
| 25 | 18/06-25/06 | 6.5 | 12.9 | ± | 1.5 | 0.037 | ± | 0.010 | 1.3 | ± | 0.2 |
| 26 | 25/06-02/07 | 32.8 | 44 | ± | 5 | 0.032 | ± | 0.009 | 4.9 | ± | 0.6 |

*Table A7: Continued.*

| Week Number | Period | Precipitation mm | $^{7}$Be Bq·m$^{-2}$ | | | $^{137}$Cs Bq·m$^{-2}$ | | | $^{210}$Pb Bq·m$^{-2}$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | 02/07-09/07 | 20.0 | 36 | ± | 4 | | | | 4.5 | ± | 0.6 |
| 28 | 09/07-16/07 | 1.0 | 12.0 | ± | 1.4 | 0.045 | ± | 0.012 | 1.6 | ± | 0.2 |
| 29 | 16/07-23/07 | 8.6 | 11.3 | ± | 1.3 | 0.045 | ± | 0.011 | 1.3 | ± | 0.2 |
| 30 | 23/07-30/07 | 0.0 | 2.4 | ± | 0.3 | 0.037 | ± | 0.011 | 0.32 | ± | 0.15 |
| 31 | 30/07-06/08 | 7.5 | 14.0 | ± | 1.7 | 0.041 | ± | 0.010 | 1.9 | ± | 0.3 |
| 32 | 06/08-13/08 | 50.5 | 75 | ± | 9 | | | | 7.8 | ± | 0.9 |
| 33 | 13/08-20/08 | 35.5 | 48 | ± | 6 | 0.029 | ± | 0.010 | 4.1 | ± | 0.5 |
| 34 | 20/08-27/08 | 5.0 | 19 | ± | 2 | 0.038 | ± | 0.014 | 3.0 | ± | 0.4 |
| 35 | 27/08-03/09 | 0.3 | 7.1 | ± | 0.9 | 0.030 | ± | 0.011 | 1.7 | ± | 0.3 |
| 36 | 03/09-10/09 | 1.4 | 6.0 | ± | 0.7 | | | | 0.9 | ± | 0.16 |
| 37 | 10/09-17/09 | 17.5 | 23 | ± | 3 | 0.033 | ± | 0.009 | 5.0 | ± | 0.6 |
| 38 | 17/09-24/09 | 19.0 | 14.9 | ± | 1.8 | 0.017 | ± | 0.007 | 2.4 | ± | 0.3 |
| 39 | 24/09-01/10 | 36.5 | 59 | ± | 7 | 0.030 | ± | 0.009 | 5.9 | ± | 0.7 |
| 40 | 01/10-08/10 | 35.0 | 55 | ± | 7 | 0.040 | ± | 0.010 | 6.3 | ± | 0.8 |
| 41 | 08/10-15/10 | 7.5 | 15.4 | ± | 1.8 | 0.033 | ± | 0.012 | 3.7 | ± | 0.5 |
| 42 | 15/10-22/10 | 0.7 | 1.02 | ± | 0.15 | 0.032 | ± | 0.007 | 0.38 | ± | 0.11 |
| 43 | 22/10-29/10 | 5.1 | 11.4 | ± | 1.4 | 0.044 | ± | 0.013 | 1.1 | ± | 0.2 |
| 44 | 29/10-05/11 | 3.5 | 9.2 | ± | 1.1 | 0.046 | ± | 0.012 | 1.6 | ± | 0.2 |
| 45 | 05/11-12/11 | 21.5 | 38 | ± | 4 | 0.029 | ± | 0.008 | 3.8 | ± | 0.5 |
| 46 | 12/11-19/11 | 20.0 | 37 | ± | 5 | | | | 3.4 | ± | 0.8 |
| 47 | 19/11-26/11 | 10.5 | 20 | ± | 3 | | | | 3.3 | ± | 0.8 |
| 48 | 26/11-03/12 | 6.5 | 11 | ± | 3 | | | | 2.1 | ± | 0.8 |
| 49 | 03/12-10/12 | 35.0 | 68 | ± | 9 | | | | 4.6 | ± | 1.1 |
| 50 | 03/12-17/12 | 49.5 | 52 | ± | 7 | | | | 4.1 | ± | 0.9 |
| 51 | 17/12-24/12 | 15.5 | 17 | ± | 3 | | | | 2.0 | ± | 0.7 |
| 52 | 24/12-31/12 | 49.5 | 50 | ± | 6 | | | | 2.0 | ± | 0.8 |
| | Sum | | 1580 | ± | 30 | 1.22 | ± | 0.06 | 158 | ± | 4 |
| | SD | | | | 20 | | | 0.010 | | | 2 |

*Measurements are carried out using γ-spectroscopy. The error in the sum is equal to the square root of the sum of the squared weekly errors. SD is the standard deviation of the weekly results. Errors are given as 1σ. Empty fields indicate that the value was below the detection limit.*

*Table A8: Yearly averaged results and 5- and 95-percentile values in 1999 for α-activity concentration and ambient dose-equivalent rate, as measured by the macro stations.*

| Station (nr) | α-Activity concentration $Bq.m^{-3}$ | | | Ambient dose equivalent rate $nSv.h^{-1}$ | | |
|---|---|---|---|---|---|---|
| | 5-p | Year average | 95-p | 5-p | Year average | 95-p |
| Vredepeel(131) | 0.5 | 2.9 | 8.0 | 60 | 67 | 72 |
| Wijnandsrade (133) | 1.0 | 5.7 | 16.8 | 83 | 88 | 91 |
| Houtakker(230) | 0.7 | 3.0 | 8.3 | 72 | 75 | 78 |
| Huijbergen(235) | 0.6 | 2.9 | 7.3 | 65 | 68 | 71 |
| Braakman(318) | 0.6 | 2.5 | 6.9 | 74 | 76 | 79 |
| Vlaardingen(433) | 0.0 | 1.5 | 4.4 | 78 | 80 | 83 |
| De Zilk(444) | 0.3 | 1.8 | 4.8 | 73 | 78 | 83 |
| Wieringerwerf(538) | 0.3 | 2.1 | 5.8 | 79 | 82 | 86 |
| Bilthoven(627) | 0.4 | 2.4 | 6.4 | 71 | 74 | 77 |
| Biddinghuizen(631) | 0.5 | 2.9 | 7.8 | 86 | 88 | 91 |
| Eibergen(722) | 0.5 | 2.9 | 8.2 | 69 | 72 | 75 |
| Wageningen(724) | 0.7 | 3.8 | 11.3 | 92 | 96 | 100 |
| Witteveen(928) | 0.3 | 2.2 | 6.2 | 65 | 67 | 69 |
| Kollumerwaard(934) | 0.2 | 2.5 | 7.2 | 79 | 82 | 86 |

*Table A9: The yearly average results for ambient dose equivalent rate for the different NMR stations in 1999*

| Station | No. | Ambient dose equivalent rate $nSv.h^{-1}$ | Station | No. | Ambient dose equivalent rate $nSv.h^{-1}$ |
|---|---|---|---|---|---|
| Den Burg | 1001 | 74 | Nuenen | 1172 | 72 |
| Den Oever | 1003 | 78 | Bergeyk | 1174 | 99 |
| Julianadorp | 1004 | 65 | Waalre | 1175 | 70 |
| Petten | 1006 | 62 | Someren (dorp) | 1176 | 70 |
| Kolhorn | 1007 | 82 | Oisterwijk | 1178 | 75 |
| Egmond aan Zee | 1009 | 65 | Riel | 1179 | 68 |
| Heerhugowaard | 1011 | 73 | Oostelbeers | 1180 | 84 |
| Haarlem-Noord | 1014 | 74 | Hilvarenbeek | 1181 | 69 |
| Nederhorst den Berg | 1015 | 61 | Venray | 1183 | 62 |
| Enkhuizen | 1018 | 75 | Nieuw-Bergen | 1184 | 63 |
| Oosthuizen | 1019 | 67 | Sevenum | 1185 | 70 |
| Zaandam | 1021 | 67 | Reuver | 1188 | 65 |
| Gouda | 1024 | 70 | Nederweert | 1189 | 72 |
| Dordrecht | 1027 | 64 | Heyhthuizen | 1190 | 79 |
| Zuid-Beijerland | 1028 | 80 | Mariahoop | 1191 | 72 |
| Pijnacker | 1032 | 85 | Stramproy | 1192 | 66 |
| Rotterdam-Crooswijk | 1033 | 77 | Arnhem-Oosterbeek | 1193 | 78 |
| Maasvlakte | 1035 | 77 | Leiden | 1196 | 75 |

*Table A9: continued*

| Station | No. | Ambient dose equivalent rate $nSv.h^{-1}$ | Station | No. | Ambient dose equivalent rate $nSv.h^{-1}$ |
|---|---|---|---|---|---|
| Maassluis | 1037 | 87 | Hulst | 1197 | 72 |
| Hellevoetssluis | 1038 | 102 | Terneuzen | 1199 | 79 |
| Ouddorp | 1039 | 67 | Vlissingen | 1202 | 79 |
| Wekerom | 1041 | 84 | Halsteren | 1204 | 67 |
| Hooglanderveen | 1046 | 78 | Oud-Gastel | 1206 | 70 |
| Harderwijk | 1050 | 70 | Goes | 1207 | 76 |
| Wijk bij Duurstede | 1056 | 82 | Bruinisse | 1209 | 79 |
| Rhenen | 1061 | 77 | Burg-Haamstede | 1211 | 62 |
| Nieuwegein | 1062 | 84 | Vrouwenpolder | 1212 | 65 |
| Apeldoorn | 1066 | 73 | Wemeldinge | 1214 | 83 |
| Heerenveen | 1071 | 64 | Middelburg | 1215 | 76 |
| Oosterwolde | 1072 | 66 | Westkapelle | 1216 | 71 |
| Bergum | 1074 | 66 | Noordwijk-Binnen | 1217 | 80 |
| Witmarsum | 1076 | 94 | Stein | 1219 | 83 |
| Sneek | 1077 | 72 | Maastricht | 1220 | 90 |
| St Jacobiparochie | 1081 | 77 | Ravensbos | 1221 | 90 |
| Holwerd | 1082 | 81 | Vaals | 1222 | 86 |
| Leeuwarden | 1085 | 75 | Gulpen | 1223 | 77 |
| Zwolle-Zuid | 1087 | 78 | Kerkrade | 1224 | 89 |
| Ommen | 1093 | 70 | Hoensbroek | 1225 | 87 |
| Hardenberg | 1095 | 71 | Wijchen | 1226 | 81 |
| Assen | 1097 | 65 | Gennep | 1228 | 74 |
| Rutten | 1099 | 77 | Elst (gld) | 1229 | 91 |
| Lelystad | 1103 | 76 | Zevenaar | 1230 | 82 |
| Urk | 1105 | 76 | Nijmegen | 1231 | 68 |
| Eemshaven | 1106 | 77 | Amstelveen | 1233 | 76 |
| Uithuizen | 1107 | 82 | Amsterdam-Oost | 1234 | 72 |
| Wagenborgen | 1109 | 72 | Aalsmeer | 1236 | 76 |
| Winschoten | 1110 | 69 | Nispen | 1237 | 58 |
| Ter Apel | 1111 | 67 | Groesbeek | 1240 | 72 |
| Stadskanaal | 1112 | 66 | Tubbergen | 1243 | 70 |
| Nieuweschans | 1113 | 70 | Haaksbergen | 1244 | 66 |
| Bellingwolde | 1114 | 59 | Scheveningen | 1247 | 80 |
| Groningen | 1116 | 77 | Zaltbommel | 1251 | 75 |
| Leens | 1117 | 78 | IJzendijke | 1252 | 82 |
| Grijpskerk | 1118 | 75 | Ritthem | 1253 | 105 |
| Meppel | 1125 | 68 | Vlissingen-Haven | 1254 | 75 |
| Hoogeveen | 1126 | 65 | Nieuwdorp | 1255 | 84 |
| Steenwijksmoer | 1129 | 68 | ‘s Heerenhoek | 1256 | 77 |
| Nieuw-Amsterdam | 1130 | 70 | Driewegen | 1257 | 85 |

*Table A9: continued*

| Station | No. | Ambient dose equivalent rate nSv.h$^{-1}$ | Station | No. | Ambient dose equivalent rate nSv.h$^{-1}$ |
|---|---|---|---|---|---|
| Nw. Schoonebeek/Weiteveen | 1131 | 63 | Arnemuiden | 1258 | 76 |
| Emmen | 1132 | 70 | Heinkeszand | 1259 | 85 |
| Borne | 1135 | 71 | Baarland | 1260 | 88 |
| Hengelo (Gld) | 1136 | 73 | Biervliet | 1261 | 70 |
| Enschede | 1139 | 68 | Slijkplaat | 1262 | 78 |
| Losser | 1140 | 61 | Putte | 1264 | 59 |
| Oldenzaal | 1141 | 70 | Nieuw Namen | 1265 | 79 |
| Westerhaar | 1142 | 66 | Ochten | 1266 | 91 |
| Rijssen | 1143 | 68 | Opheusden | 1267 | 93 |
| ’s Heerenberg | 1144 | 84 | Slijk Ewijk | 1268 | 90 |
| Dinxperlo | 1145 | 81 | Doorwerth | 1269 | 67 |
| Varsseveld | 1146 | 71 | Randwijk | 1270 | 103 |
| Groenlo | 1147 | 84 | Beneden Leeuwen | 1272 | 75 |
| Deventer | 1148 | 77 | Appeltern | 1273 | 77 |
| Etten-Leur | 1154 | 71 | Puiflijk | 1274 | 85 |
| Den Bosch | 1157 | 65 | Bergharen | 1275 | 79 |
| Raamsdonkveer | 1159 | 83 | Beuningen | 1276 | 87 |
| Ulvenhout | 1160 | 67 | Denekamp | 1278 | 62 |
| Baarle-Nassau | 1161 | 94 | Winterswijk | 1279 | 70 |
| Uden | 1162 | 71 | Bilthoven | 1280 | 59 |
| Mill | 1163 | 66 | Maarheze/Gastel | 1281 | 70 |
| Oss | 1167 | 70 | | | |
| Roterdam-Waalhaven | 1034 | * | Wageningen | 1043 | * |
| Sluis | 1201 | * | Rilland | 1263 | * |

* *Station was not operational for a large part of 1999.*

*Table A10: Radioactivity in surface water (mBq·L$^{-1}$), as measured by RIZA*

| **Location: Eijsden (Meuse)** | | |
|---|---|---|
| **Date** | **Tritium** | **Residual-β** |
| 26-1-99 | 1800 | 41 |
| 23-2-99 | 1200 | 110 |
| 23-3-99 | 3000 | 30 |
| 20-4-99 | 24300 | 12 |
| 18-5-99 | 300 | 18 |
| 15-6-99 | 30200 | 10 |
| 13-7-99 | 24900 | 19 |
| 10-8-99 | 55700 | 10 |
| 7-9-99 | 30700 | 6 |
| 5-10-99 | 25200 | 35 |
| 2-11-99 | 3100 | 26 |
| 30-11-99 | 30800 | 25 |
| 28-12-99 | 1500 | 140 |
| **Average** | **18108** | **37** |
| **Location: Lobith (Rhine)** | | |
| **Date** | **Tritium** | **Residual-β** |
| 27-1-99 | 3200 | 31 |
| 24-2-99 | 4300 | 230 |
| 24-3-99 | 5600 | 24 |
| 21-4-99 | 5400 | 48 |
| 19-5-99 | 5300 | 120 |
| 16-6-99 | 4600 | 34 |
| 14-7-99 | 3000 | 48 |
| 11-8-99 | 6900 | 32 |
| 8-9-99 | 4800 | 42 |
| 6-10-99 | 2700 | 52 |
| 3-11-99 | 6900 | 21 |
| 1-12-99 | 3800 | 18 |
| 29-12-99 | 3600 | 150 |
| **Average** | **4623** | **65** |
| **Location: Schaar van Ouden Doel (Scheldt)** | | |
| **Date** | **Tritium** | **Residual-β** |
| 20-1-99 | 9300 | 80 |
| 18-2-99 | | 64 |
| 18-3-99 | 8200 | 49 |
| 15-4-99 | | 51 |
| 17-5-99 | 13100 | 70 |
| 15-6-99 | | 140 |
| 5-7-99 | 10400 | 130 |
| 2-8-99 | | 47 |
| 30-8-99 | 15900 | 63 |
| 27-9-99 | | 82 |
| 26-10-99 | 14900 | 120 |
| 25-11-99 | | 78 |
| 22-12-99 | 14000 | 86 |
| **Average** | **12257** | **82** |

*Table A11: Radioactivity in suspended solids ($Bq \cdot kg^{-1}$), as measured by RIZA*

| **Location: Eijsden (Meuse)** | |
|---|---|
| **Date** | **Cs-137** |
| 5-1-99 | 22 |
| 12-1-99 | 20 |
| 19-1-99 | 14 |
| 26-1-99 | 19 |
| 2-2-99 | 19 |
| 9-2-99 | 20 |
| 16-2-99 | 10 |
| 23-2-99 | 13 |
| 2-3-99 | 20 |
| 9-3-99 | 15 |
| 16-3-99 | 18 |
| 23-3-99 | 13 |
| 30-3-99 | 19 |
| 5-4-99 | 20 |
| 16-4-99 | 19 |
| 20-4-99 | 18 |
| 27-4-99 | 7 |
| 3-5-99 | 15 |
| 11-5-99 | 18 |
| 18-5-99 | 14 |
| 25-5-99 | 15 |
| 1-6-99 | |
| 8-6-99 | 20 |
| 15-6-99 | 14 |
| 22-6-99 | 11 |
| 29-6-99 | 16 |
| 6-7-99 | 20 |
| 13-7-99 | 11 |
| 20-7-99 | 12 |
| 27-7-99 | 14 |
| 3-8-99 | 14 |
| 10-8-99 | 15 |
| 17-8-99 | 15 |
| 26-8-99 | 12 |
| 31-8-99 | 12 |
| 7-9-99 | 12 |
| 14-9-99 | 11 |
| 21-9-99 | 12 |
| 28-9-99 | |
| 5-10-99 | 20 |
| 12-10-99 | 19 |
| 19-10-99 | 21 |
| 26-10-99 | 22 |
| 2-11-99 | 20 |
| 9-11-99 | 20 |
| 16-11-99 | 20 |
| 23-11-99 | 19 |
| 30-11-99 | 17 |
| 7-12-99 | 18 |
| 14-12-99 | 15 |
| 21-12-99 | 14 |
| 28-12-99 | 13 |
| **Average** | **16** |

| **Location: Ketelmeer-West** | |
|---|---|
| **Date** | **Cs-137** |
| 8-1-99 | 29 |
| 5-3-99 | 28 |
| 28-4-99 | 21 |
| 25-6-99 | 23 |
| 18-8-99 | 23 |
| 14-10-99 | 28 |
| **Average** | **25** |

| **Location: Lobith (Rhine)** | |
|---|---|
| **Date** | **Cs-137** |
| 27-1-99 | 22 |
| 24-2-99 | 22 |
| 24-3-99 | 19 |
| 21-4-99 | 26 |
| 19-5-99 | 24 |
| 16-6-99 | 23 |
| 14-7-99 | 24 |
| 11-8-99 | 22 |
| 8-9-99 | 24 |
| 6-10-99 | 27 |
| 3-11-99 | 21 |
| 1-12-99 | 21 |
| 29-12-99 | 21 |
| **Average** | **22.8** |

| **Location: Schaar van Ouden Doel (Scheldt)** | |
|---|---|
| **Date** | **Cs-137** |
| 5-1-99 | 14 |
| 3-2-99 | 12 |
| 4-3-99 | 18 |
| 1-4-99 | 19 |
| 4-5-99 | 16 |
| 31-5-99 | 19 |
| 29-6-99 | 14 |
| 22-7-99 | 14 |
| 19-8-99 | 15 |
| 17-9-99 | 18 |
| 11-10-99 | 14 |
| 11-11-99 | 12 |
| 9-12-99 | 14 |
| **Average** | **15.3** |

*Table A12: Radioactivity in seawater ($mBq \cdot L^{-1}$), as measured by RIZA*

| **Location: Noordwijk 10** | | |
|---|---|---|
| **Date** | **Tritium** | **Residual β** |
| 24-2-99 | 5000 | 50 |
| 26-5-99 | 5000 | 39 |
| 5-8-99 | 4300 | 25 |
| 22-12-99 | 4700 | 46 |
| **Average** | **4750** | **40** |

| **Location: Noordwijk 70** | | |
|---|---|---|
| **Date** | **Tritium** | **Residual β** |
| 18-2-99 | 2900 | 69 |
| 26-5-99 | 2300 | 54 |
| 5-8-99 | 5000 | 36 |
| 30-12-99 | 5700 | 62 |
| **Average** | **3975** | **55** |

| **Location: Terschelling 235** | | |
|---|---|---|
| **Date** | **Tritium** | **Residual β** |
| 15-2-99 | | |
| 18-5-99 | 500 | 38 |
| 12-8-99 | 1200 | 33 |
| 15-11-99 | | |
| **Average** | **850** | **35.5** |

# Appendix B Mailing list

| | | |
|---|---|---|
| 1 | - 10 | Directeur Stoffen, Afvalstoffen en Straling |
| 11 | - 19 | Regionaal Inspecteur Milieuhygiëne Zuid-West |
| 20 | | Hoofd afdeling Handhaving van de Hoofdinspectie Milieuhygiëne |
| 21 | | plv. Directeur-Generaal Milieubeheer |
| 22 | - 36 | Rijksinstituut voor Integraal Zoetwaterbeheer en Afvalwaterbehandeling |
| 37 | - 51 | Rijksinstituut voor Kust en Zee |
| 52 | | Veterinair Inspecteur Algemene Directie Keuringsdienst van Waren, Dr. Ir. G. Kleter |
| 53 | - 57 | Algemene Directie Keuringsdienst van Waren |
| 58 | | Directeur Keuringsdienst van Waren Zutphen |
| 59 | - | Hoofd Signalering Veterinaire Producten Keuringsdienst van Waren Zutphen |
| 60 | 62 | Keuringsdienst van Waren Zutphen |
| 63 | | European Commission, D.G. ENV.C.1 – Radiation Protection Unit |
| 64 | | Depot van Nederlandse publicaties en Nederlandse bibliografie |
| 65 | | Directie RIVM |
| 66 | | Directeur Sector Risico's, Milieu & Gezondheid |
| 67 | | Hoofd van het Laboratorium voor Stralingsonderzoek |
| 68 | | Hoofd van de afdeling Monitoring en Meetmethoden van het Laboratorium voor Stralingsonderzoek |
| 69 | | Auteur |
| 70 | | SBD/Voorlichting & Public Relations |
| 71 | | Bureau Rapportenregistratie |
| 72 | | Bibliotheek RIVM |
| 73 | | Bibliotheek LSO |
| 74 | - 88 | Bureau Rapportenbeheer |
| 89 | - 94 | Reserve exemplaren ten behoeve van het Laboratorium voor Stralingsonderzoek |