Emission estimates for diffuse sources
Netherlands Emission Inventory

Ammunitions from hunting

Version dated June 2008

NETHERLANDS NATIONAL WATER BOARD - WATER UNIT
in cooperation with DELTARES and TNO

Ammunitions from hunting

1 Description of emission source

The emissions described here are emissions resulting from hunting and target shooting lanes. This fact sheet only relates to the application of lead shot. Ammunition used for hunting large game or used by the national defence organisation is not included.
In the national emission inventory, the emission source is assigned to the governmental target sector "Agriculture".

2 Explanation of calculation method

Emissions are calculated by multiplying an activity rate (AR), in this case the number of kilograms of spent shot, by an emission factor (EF), expressed in emission per AR unit. This method of calculation is explained in detail in the Handreiking Regionale aanpak diffuse bronnen [1].

Emission = AR x EF

Where:
AR = Number of kilograms of spent shot
EF = Emission factor (kg metal/kg spent shot)

The emission calculated in this way is referred to as the total emission. A specific proportion of this ends up in surface water: this is the net load of the surface water. The rest is assigned to the soil compartment.

3 Activity rates

The activity rate is the number of kilograms of spent shot. Van Bon and Boersema [2] estimated that the lead burden on the environment through the use of lead shot in hunting amounts to 230 tonnes/year. This figure is retained for the years 1985 and 1990. Based on the report published by De Straat [5], the total quantity of metal as of 1995 is estimated at 190 tonnes. Due to a lack of available information, this value is also retained for the subsequent years.

Table 1: Activity rate; quantity of spent shot

Year	1985	1990	1995	2000	2005	2006
kg of shot	230,000	230,000	190,000	190,000	190,000	190,000

4 Emission factors

Emission factors are based on the metal proportion of the total quantity of spent shot; this is shown in Table 2.
Due to a ban on shooting with lead shot, there has been less shooting with lead since 1993. Since 1993, some of the lead has been replaced with iron, bismuth and zinc. This document only examines the emissions of lead and zinc.

Table 2: Emission factors

Year	1985	1990	1995	2000	2005	2006
Content of lead (kg/kg shot)	1	1	0.25	0.19	0.19	0.19
Content of zinc (kg/kg shot)	0	0	0.04	0.1	0.1	0.1

5 Effects of policy measures

Due to the ban on using lead shot in hunting, which entered into force in 1993, there have been fewer lead shot cartridges fired. Other metals are used as a replacement, such as zinc, steel and bismuth.

6 Emissions calculated

The total emission is calculated by multiplying the activity rate defined in section 3 by the emission factor defined in section 4. The total emission values are shown in table 3.

Table 3: Total emissions

Year	1985	1990	1995	2000	2005	2006
Lead (kg)	230,000	230,000	48,000	36,000	36,000	36,000
Zinc (kg)	0	0	7,600	19,000	19,000	19,000

7 Release into environmental compartments

As stated in section 2, the emissions are distributed to the soil and water compartments. This is calculated according to the ratio as set out in the report published by Van Bon and Boersema [2]: 85% to soil and 15% to surface water.

Table 4: distribution of emissions among compartments

Total	Soil	Surface water
100%	85%	15%

If the emissions referred to in table 3 are distributed in accordance with the values specified in table 4, this gives the data set out in table 5.

Table 5: Emissions of lead and zinc distributed between compartments

Year	1985	1990	1995	2000	2005	2006
Soil						
Lead	195,500	195,500	40,800	30,600	30,600	30,600
Zinc	0	0	6,460	16,150	16,150	16,150
Water						
Lead	34,500	34,500	7,200	5,400	5,400	5,400
Zinc	0	0	1,140	2,850	2,850	2,850

8 Description of emission pathways to water

The specified emissions to water are direct emissions to surface water.
When calculating the surface water load due to this emission source, it is important to take into account the fact that the metals end up in the surface water in solid form and not as a solution. The national study 'WaterSysteemVerkenningen' (WSV [3]) uses a fraction of 1% of the yearly emission as net release of Pb-ions per year in solution.

9 Spatial allocation

The spatial allocation of emissions is worked out on the basis of a set of digital maps held by the Netherlands Environmental Assessment Agency (MNP). These maps present the spatial distribution of all kinds of parameters throughout the Netherlands, such as population density, traffic intensity, area of agricultural crops, etc. For the purposes of emission registration these maps are used as 'locators' to determine the spatial distribution of emissions. The range of possible locators is limited (see [6] for a list of

available locators), as not every conceivable parameter can be used as a locator. That is why the locator judged to be the best proxy of the activity rate of the emission in question is used.
It is assumed that the distribution of emissions throughout the country mirrors the national distribution of the locator.

The table below shows the locator used for the spatial allocation of the various emission sources.

Table 6: Locators for spatial allocation

	Locators
Hunting, soil emissions	Agricultural pasture land
Hunting, water emissions	Length of banks

The method used to determine the locators is described in [6]:

Length of banks
The bank length of surface waters is determined per grid cell measuring 500*500 metres. This is done by selecting the surface water from the topographical map and generating an overlay with the 500*500m grid square map, according to which the total length of the banks is added up per grid square. The data dates back to the end of the 1990s.

Agricultural pasture land
The Netherlands national land use register (LGN) and the yearly agricultural census (Statistics Netherlands) were examined per grid cell. This distribution shows twelve land use categories down to an area of 500 x 500 metres. The spread of the various classes throughout the Netherlands is taken directly from LGN5. However, farming acreage is based on yearly agricultural census (Statistics Netherlands). Therefore, the total area from the survey of Statics Netherlands is distributed among locations as shown in LGN. The data dates back to 2005.

10 Comments and changes in regard to previous version

No changes were made to the calculation methodology compared with previous emission inventories.

11 Accuracy and indicated subjects for improvements

The method used in Emission Inventory publications has been followed as far as possible in classifying the quality of information [7]. It is based on the CORINAIR (CORe emission INventories AIR) methodology, which applies the following quality classifications: CORINAIR uses the following quality classifications:

A: a value based on a large number of measurements from representative sources;
B: a value based on a number of measurements from some of the sources that are representative of the sector;
C: a value based on a limited number of measurements, together with estimates based on technical knowledge of the process;
D: a value based on a small number of measurements, together with estimates based on assumptions;
E: a value based on a technical calculation on the basis of a number of assumptions.

The activity rate, the number of kilograms of spent shot, is an estimate, so is classified under D. There is a large degree of inaccuracy in the emission factor, as it is based on estimates, so the EF is classified under D. The distribution among compartments is estimated and is therefore assigned to class E. All emissions to water will be direct emissions to surface water, so are classified under A. Spatial allocation based on bank length and soil distribution is reasonably inaccurate, so is classified under D.

Element of emission calculation	Reliability classification
Activity rates	D
Emission factor	D
Distribution among compartments	D
Emission pathways to water	A
Spatial allocation	D

Areas for improvement:

- As stated in section 8, it is important to take into account the fact that approximately only 1% of the lead emission will be dissolved. This will be included in the next update of the emission inventory (2009 t-2).
- The AR has been kept as a constant figure since 1995 – it will be necessary to check whether it is still correct.
- The distribution between the quantity of lead and zinc released will have to be reviewed.

12 Request for reactions

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13 References

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[3] Bentum, F. Van, G.G.C. Verstappen, F.H. Wagemaker. WaterSysteemVerkenningen 1996. Doelgroepstudie Bouwmaterialen. Memo no.: 96.023, RIZA, Lelystad.

[4] Most, P.F.J. van der, van Loon, M.M.J., Aulbers, J.A.W. en van Daelen, H.J.A.M., July 1998. Methoden voor de bepaling van emissies naar lucht en water. Publicatiereeks Emissieregistratie, no. 44.

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[6] Molder, R. te, 2007. Notitie ruimtelijke verdeling binnen de emissieregistratie. Een overzicht.

[7] Most, P.F.J. van der, van Loon, M.M.J., Aulbers, J.A.W. en van Daelen, H.J.A.M., July 1998. Methoden voor de bepaling van emissies naar lucht en water. Publicatiereeks Emissieregistratie, no. 44.