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Determination of risks on inland waterways

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Abstract

In the order of the working group oil- and chemical-combating (WOCB) of Rijkswaterstaat EnSaCo executed in the period from 1992 to 1995, an investigation of the organization around calamities was executed. The study has been applied to the inland waterways of Netherlands which are administered by Rijkswaterstaat (Ministry of Transport, Public Works and Water Management). The investigation has been divided into four phases: (1) the classification of the inland waterways of the Netherlands into four risk-classes; (2) the determination per location whether the amount of preparation of combating acute spills measures the risks of these locations or not; (3) the comparison of the present situation with a situation in which the combating of oil and chemical spills is executed by non-governmental organizations; and (4) the development of standard contingency plans for combating spills for the different relevant locations in the Netherlands. Based on the three classes, the inland waters have been divided into: (1) 11 inland waters with a very large risk; (2) 23 inland waters with a large risk; (3) 13 inland waters with a moderate risk; and (4) 24 inland waters with a small risk. As a result of the study, Rijkswaterstaat has evaluated its present organization and preparedness and will also use the results to optimize the combating organization. © 1998 Elsevier Science B.V. All rights reserved.

Keywords: Oil-combating; Inland waterways; Risk determination; Spills; WOCB

1. Introduction

''The quantity and location of combating equipment is not based on an adequate risk analysis.'' This conclusion was the result of a study carried-out by the Dutch environmental consultancy, EnSaCo, commissioned by the workgroup oil- and chemical-combating (WOCB) in the period 1992–1995. The stimulus for this investigation was a seminar which was held to discuss whether or not the Dutch Government was optimally

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prepared to respond to a calamity on inland waterways. At the moment, the results of the study are being used by various regional directorates for developing plans and restructuring their organisation.

1.1. Workgroup oil- and chemical-combating

The Rijkswaterstaat, which is part of the Ministry of Transport, Public Works and Water Management, formed the workgroup oil- and chemical-combating (WOCB) in order to improve the combating of oil and chemicals on inland waterways. This workgroup has made recommendations in 1989 regarding the set-up and organisation necessary to control calamities at the regional directorates of Rijkswaterstaat. In 1992, the assignment was given for an extensive investigation, with the purpose of optimising the combating and disposal of calamity spills on the Dutch inland waterways. The investigation was confined to the Dutch waterways and to floating and dissolved spills.

1.2. Annual report, Spills Inland Waterways

Each year, the WOCB distributes the report, *Spills Inland Waterways*. These reports give an overview of the spills, in any given year, which are registered by all authorities dealing with water inland quality management. The data from these reports are used as a basis for the risk analysis.

2. Study

The study has been divided into four phases. A brief description, by means of the objectives, follows, as described in the following sections.

2.1. Phase 1: the classification of the inland waterways into four risk-classes [1]

Sub-objectives:

- Determine the effects of a possible spill on the 71 inland waterways.
- Determine the spill frequency in relation to size and location on the 71 inland waterways.

2.2. Phase 2: the determination, per location, whether the amount of preparation of combating acute spills is in relation to the risks of these locations or not [2]

Sub-objectives:

- Make an inventory of the combat equipment and manpower per 1-08-1994, available during the combat of acute calamities on the inland waterways.
- Estimate the effectiveness and practical experience with the combat equipment.
- Determine the costs of the combat equipment.

2.3. Phase 3: the comparison of the present situation with a situation in which the oil and chemical combats on inland waterways are partly or completely performed by private companies [3]

Sub-objectives:

- Make an inventory of the tasks for oil- or chemical-combating and removal on inland waterways which can possibly be farmed-out.
- Describe and investigate several alternatives in which private companies, as well as the government and combinations of both, are involved.
- Evaluate the possible alternatives with associated cost analyses.

2.4. Phase 4: the development of standard contingency plans for combating spills for the various relevant locations in the Netherlands [4]

Sub-objectives:

- Investigate the several inland waterways with regards to their similar characteristics.
- Develop guidelines in order to create a general applicable format for a contingency plan.
- Investigate the possibilities of automating the production and adjustment of the contingency plans for the several inland waterways.

3. Results

3.1. Phase 1

In order to classify the inland waterways, the following formula was used,

$$\text{Risk-class} = \text{effect-class} * \text{chance-class} * \text{size-class}.$$

Table 1
Water functions and associated weight factor which are important in determining the relevance of the effects of spills

Number	Water function	Weight
1	Drinking water	3.4
2	Natural value	3.0
3	Professional fishery	1.9
4	Cooling water	1.8
5	Transport of water, ice and sediment	1.8
6	Agriculture/cattle-breeding on banks/in river deltas	1.8
7	Swimming water	1.6
8	Main waterway	1.5
9	Branch waterway	1.3
10	Waterside recreation	1.2
11	Production of surface minerals	1.1
12	Recreation navigation	1.0

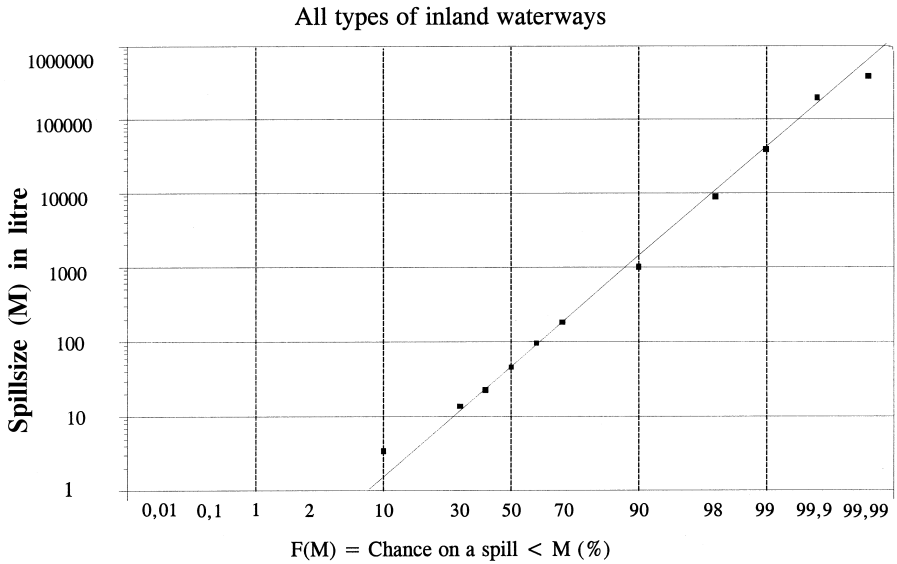

Fig. 1. Cumulative spillsize frequency.

The effect of a spill on inland waters is related to the functions of these waters. Therefore, EnSaCo used a multi-criteria (Saaty) method [5] to give weight to all functions an inland water can have. These functions, including the weight, are given in Table 1.

Data for the chance and size of the spills were taken from the Spills Inland Waterways over a 5-year period [6–10]. Normally, risk can be calculated as a function of effect and chance. In this case, size was also included (to determine the size of the spills that occur on any given inland water). Fig. 1 shows a cumulative spillsize frequency for all types of inland waters.

Combating equipment can be related to the size of these spills. Table 2 shows an overview of the chance of a spill for different types of inland waters.

Using the formula, the risk-class can be calculated. These risk-classes are shown in Fig. 2, where all inland waters of Rijkswaterstaat are divided into a risk-class expressed in one of the four colours.

Table 2
Chance of a spill for different types of water

Type of water	Chance of a spill	Expressed in quantity
Estuary	large	1 of 100 spills ≥ 500 000 l
Lakes	large	1 of 100 spills ≥ 70 000 l
Harbours	medium	1 of 100 spills ≥ 39 000 l
Rivers	medium	1 of 100 spills ≥ 31 000 l
Canals	small	1 of 100 spills ≥ 14 000 l

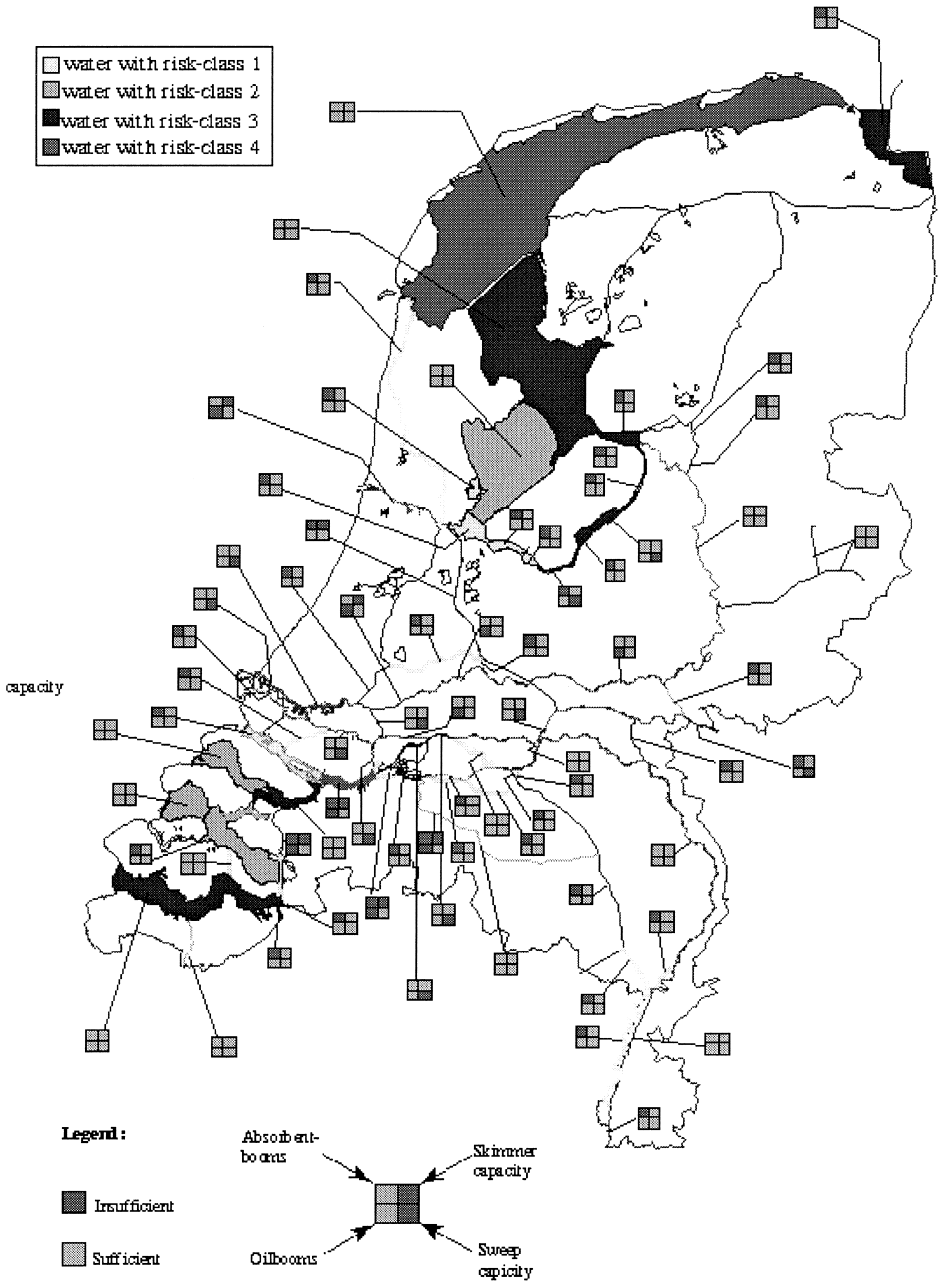

Fig. 2. All inland waters of Rijkswaterstaat divided into a risk-class are expressed in one of the four colours (situation in 1992).

The main conclusion is that there are certain risks present for the inland waters of the Netherlands. Risks are also present in harbours, but these are mostly small risks due to the absence of the mean water functions (small effect-class).

3.2. Phase 2

On the basis of the risk-analysis, the type and quantity of combating material were determined for all inland waters.

When these results are compared with the combating equipment present at that time, conclusions about sufficient/insufficient response can be made. These results are also shown in Fig. 2.

In this phase, the economic aspects of the combating equipment were also determined.

The main conclusion is that the water quality managers were insufficiently prepared for a calamity spill on the inland waters. The quantity and location of the combating equipment was not based on an adequate risk analysis.

3.3. Phase 3

This phase resulted in a comparison between combating by Rijkswaterstaat (government) and private companies. Availability and economic aspects were both part of the comparison.

The main conclusion is that the most satisfactory situation is both Rijkswaterstaat and private companies responding together in combating acute spills, where Rijkswaterstaat is responsible for the small spills (for example < 200 l) and the private companies for the remainder.

3.4. Phase 4

The result of Phase 4 was a format for contingency plans for inland waterways. Of course, the water quality manager must take into account the specific factors of the territory he is managing.

The main conclusion is that the standard contingency plan is a perfect document to initiate the discussions about uniformity between functions and responsibilities with regards to combat calamities of various organisations.

4. Discussion

The study was conducted for the purpose of optimising the combating and disposing of spills on the Dutch inland waterways. In fact, it has done more. During the study, a system was developed for the determination of risks on inland waters. This system can easily be updated by filling in new data from the *Spills Inland Waterways* reports. In addition, it can be transferred to a completely different area/country. In fact, on minor scale, this method can also be used for other water quality managers, such as polders and provinces. A list of actions taken as a result of the study is given in Table 3.

Table 3
Actions that have been taken, including agencies, as a result of the extensive study carried-out by EnSaCo and commissioned by the WOCB

Phase	Actions taken	Agency
1	Stimulate discussions about risks and their control. Several seminars have been held on this subject and more will follow.	Various governmental organisations and private companies
2	Combating equipment is related to the results of the study.	Various regional directorates of Rijkswaterstaat
	Exercises are conducted to test communication and equipment, functions and responsibilities and actions of cooperators and equipment.	Various regional directorates of Rijkswaterstaat and some polders
3	A number of agreements have been made between Rijkswaterstaat and private companies regarding the combating of spills and the use of each others' combating equipment.	Various regional directorates of Rijkswaterstaat and private companies
4	Development of contingency plans by use of the standard contingency plan	Various regional directorates of Rijkswaterstaat

Further, the determination of risks on inland waters has brought-up the discussion of calamities other than acute spills. Water quality managers sometimes become involved in nautical accidents where there are casualties. In this case, cooperation with other (life-saving) companies is a must. This item can be included in the contingency plans, as well as in the practical exercises. The past has proven that cooperation is very important and can even save lives when companies communicate and cooperate.

A risk analysis is absolutely necessary in the development of an adequate organisation to control calamities. The determined risks are used as a basis for assessing the quantity and location of the combating equipment.

5. Conclusions

The study described in this paper has certainly contributed to the improvement of combating acute spills. It is especially necessary to keep the subject of risks and their control alive. EnSaCo continues to stimulate water quality managers, the government, as well as private companies, to stay active in combating spills and trying to control the risks. The past has already proven that contingency plans and exercises contribute to an improved organisation for calamity control. An effective organisation certainly can save nature and lives.

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