2nd International Conference on River Flood Hydraulics

Edited by

Dr W. R. White

and

Jacqueline Watts
HR Wallingford Ltd
Wallingford, Oxon OX10 8BA, UK

Published on behalf of
HR WALLINGFORD LTD, WALLINGFORD
by
JOHN WILEY & SONS
Chichester · New York · Brisbane · Toronto · Singapore

2nd International Conference on
RIVER FLOOD HYDRAULICS
22–25 March 1994: York, England

Policy analysis of river-dike improvement in the Netherlands

by H.N.C. Breusers and M. Vis[2]

ABSTRACT

River-dike improvement along the rivers Rhine and Meuse has given rise to large-scale protests in the Netherlands due to its harmful impact on the river landscape and the natural and cultural values of the river dikes. A Government Commission was set up to assess the present basis for river-dike improvement such as the required safety level, the design methods and the procedures used to involve local and general interest groups in the design process.

To support the advice of the Commission, a study was commissioned by the Dutch government to DELFT HYDRAULICS and RAND's European-American Center for Policy Analysis (RAND/EAC) to analyse all design and institutional aspects related to river-dike improvement. The study has resulted in a set of recommendations and strategies to reduce the impact of dike improvement on other functions of the river dikes. Most recommendations were adopted by the Commission in their advice to the government and included in the Government Decision on the matter. The paper summarizes the way the problem was analysed and how strategies for dike improvement were derived.

1 INTRODUCTION

Flooding in the Dutch part of the rivers Rhine and Meuse regularly occurred in the past, the last major flooding was in 1926. The government decided in 1958, in the aftermath of the 1953 flood disaster in the delta area, to increase the safety against flooding from the river Rhine, by strengthening the existing river dikes to a safety standard of 1/3000 per year. Implementation of the strengthening however was very detrimental to the river landscape, to natural values and characteristic houses along the dikes, and generated intense protests from society. The Dutch river landscape is the result of a age-long natural and cultural development and is of great natural beauty.

In a review of the dike-improvement process, a River dikes Commission recommended in 1977 to mitigate the impact of dike strengthening by lowering the safety standard to 1/1250 per year and by improvements in the technical design. It was also recommended to improve the decision procedures to enable a better participation of the parties concerned and the general public in the decision process.

[2] DELFT HYDRAULICS, Delft, The Netherlands

2nd International Conference on River Flood Hydraulics. Edited by W. R. White and J. Watts

However, these recommendations had little effect on the actual process and did not improve social acceptance. Protests against river-dike improvement kept growing. In July 1992, the protests prompted the Minister of Public Works, Transport and Water Management to establish a new River dikes Commission (the Boertien Commission) and to assign a policy analysis study for the verification of the existing concepts to the combination DELFT HYDRAULICS/(RAND/EAC).

The policy analysis study on river-dike improvement had to focus on three main questions expressed by the Minister, viz:

- Do the considerations underlying the selection of the safety standard for river dikes contain any elements that have changed to such an extent that this might give rise to a different choice?
- Are there any new technological/scientific insights that may result in different calculation results?
- Have new elements emerged in recent commentaries (outside the scope of the previous questions) that might likewise result in a different choice or other calculation results?

The project area included the dikes along the non-tidal stretches of the river Rhine, its branches and the Meuse. The total length of river dikes in the project area amounts to 570 km of which 200 km had already been improved or was strong enough. The remaining 370 km required an estimated budget of 900 M*f*. (1 M*f* = 10^6 Dutch guilders) for improvement of the river dikes to a safety level of 1/1250 per year.

2 ORGANIZATION OF THE STUDY

For the execution of the project, DELFT HYDRAULICS/(RAND/EAC) associated with Delft Geotechnics, Bureau SME (institutional aspects) and Hamhuis+van Nieuwenhuijze+Sijmons (landscape architects).

The study had to be completed within a very short time period (5 months) in order not to lose momentum in the dike-improvement activities. In the first month, interviews were held with all agencies and groups involved, from which essential information on the pros and cons of the present decision-making and design process was obtained. The agencies involved are the waterboards, having the primary responsibility for flood protection, the provinces and Rijkswaterstaat, the national agency for water management and flood defence works.

Groups involved are action groups, environmental protection groups and nature conservation groups. Especially the water boards and the action groups held opposite views, the water boards putting emphasis on safety and the action groups on the preservation of the existing landscape, natural and cultural values of the dikes and the surrounding landscape.

It followed from the analysis that designs had improved in recent years, but were still insufficiently aimed at preserving the integral value of the river landscape. The system of subsidies provided by the central government did not stimulate creative design methods. The procedures for design and approval of dike improvement projects were inadequate for involvement and weighing of local interests and values, which limited the social acceptance of the projects.

The execution of the study was structured following a policy analysis approach as presented in figure 1. For various study aspects (safety standard, boundary conditions, design methods and the improvement of the tuning of function and values of the dikes) measures were generated to improve the process. Measures were, after screening, combined into (promising) strategies. Strategies were assessed using a number of decision criteria. Assessment of existing (and proposed) decision procedures led to the design of a new procedure.

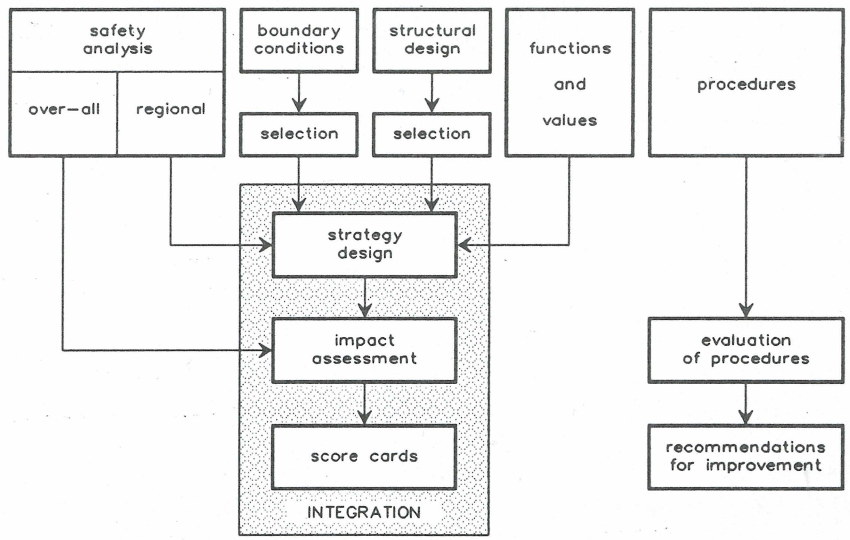

Figure 1 Policy analysis approach

3 RESULTS

3.1 Safety standard

The effects of a lower safety standard were assessed, using a number of criteria, such as the length of the dikes to be improved, the impact on landscape, nature and cultural values (the LNC-values), the present value (PV) of expected residual flood damage and construction costs. Personal risk could not be estimated with a reasonable accuracy as it depends on too many factors, such as failure probability of the dike system, rate and depth of flooding, possibilities for evacuation, etc.. Historical data on the number of victims could not be used, as conditions in the area (population density, infrastructure, communications) have greatly changed.

As can be seen from table 1, the effects of a lower safety standard on the preservation of LNC-values is limited, as most of the dikes, even those that are high enough, still need improvement. However, with a lower safety standard, personal risk and residual material flood damage increase. The optimum safety standard from a purely economic point of view is in the order of 10^{-4} per year. Taking all factors into account, the Boertien Commission recommended to maintain the present safety standard of 1/1250 per year. For areas with smaller flooding depths, the Commission suggested a lower safety standard.

As a lowering of the safety standard only has a minor effect on the preservation of existing values of the dikes and the river landscape, other measures will be necessary. Examples are a lowering of the design water levels for a given design discharge or improved design methods.

Criterion	Unit	Safety standard (per year)		
		1/1250	1/500	1/200
Length to be improved	km	370	320	270
Preservation of LNC values	%	75	79	84
Residual damage by flooding (PV)	M*f*	1,400	3,300	7,600
Dike improvement costs	M*f*	870	770	640

Table 1 Effects of the value of the safety standard against flooding

3.2 Boundary conditions

River Rhine discharge data were used to verify existing discharge extrapolation methods. Based on this verification, it was proposed to reduce the design discharge for the Rhine from 16,500 to 15,000 m^3/s. The proposed discharge includes a correction for effects of changes in the German part of the river basin.

The corresponding decrease in the design water level of 0.25 to 0.45 m resulted in a reduction by 5% of the length of the dikes to be improved. The reduction in construction costs was estimated at 10%. Verification of the analysis of river Meuse discharges confirmed the current design discharge of 3,650 m^3/s.

Numerous measures to lower the design water level for a given design discharge were evaluated with respect to their effectiveness and technical, financial and social feasibility. Some examples of measures:

- a partial diversion of the river discharge by means of overflow sections;
- flood storage in reservoirs or overflow basins;
- lowering of the minor riverbed and groynes; and
- lowering of the major riverbed by excavating the flood plain or by constructing secondary channels in the flood plains (in agreement with a plan for nature development in the flood plain proposed by the World Wildlife Fund).

None of the investigated measures or a combination of measures appeared to be feasible as an alternative for dike improvement. Excavation of the flood plain in combination with nature development can, however, contribute to the solution of local bottlenecks and the compensation for possible effects of climate changes.

3.3 Constructive design

The existing guidelines for river-dike design and present design practice were assessed, taking new technology and the state-of-the-art design practice into consideration. This led to recommendations for 'optimal' design methods by using more intensive soil-mechanical investigations and new computation methods. This will result in less massive dike cross-sections, thus allowing a better landscape design. At present, if there are valuable elements (natural or cultural values) on both sides of the dike, often only the element on one side of the dike is saved. To obtain a better solution in such a situation (a 'bottle-neck'), relatively expensive technical solutions are required to decrease the width of the new dikes. The application of these 'smart' structures like sheet piles, diaphragm walls and flap gates in solving these 'bottlenecks' was therefore also evaluated.

Based on this analysis, two design strategies for solving bottle-necks were developed and assessed. Solving half of the presently unsolved problems requires an increase of the construction costs with roughly one third. Solving almost all bottlenecks will double the costs.

3.4 Tuning of functions and values

Apart from the flood-protection function, other functions and values of a dike are of importance. Dikes often have a special vegetation, people live along them, many characteristics of the dikes have a cultural-historical value and dikes are an important element in the river landscape. Prior to dike improvement design, drawing up an extensive inventory of the present values is required. Also 'smart' designs should be more applied to create possibilities for the development of other values.

The quality of dike vegetation can be substantially improved by an environment-friendly management (no application of fertilizer, mowing once or twice a year). Recommendations were given for a change of the subsidy structure to stimulate creative designs and nature friendly management of the vegetation.

3.5 Procedures

The present practice in which technicians prepare their designs in a 'closed shop' situation while presenting them too late for review by the people concerned, was causing much discontent. Existing and proposed procedures for design and approval were therefore assessed and improvements recommended.

The recommendations included: (1) the development of provincial river-dike improvement plans that will give the boundary conditions for local designs and (2) the formation of steering groups at the local level that represent all interest groups involved. These groups can then express their ideas at an early stage of the design process, which will lead to a more open and creative design process. Verification of the quality of the design with respect to the preservation of existing values has to take place through a compulsory environmental impact assessment procedure.

4 POLICY OPTIONS

Measures to improve the present dike-strengthening practice were combined into strategies. The impact of these strategies, as well as the effect of a change in the safety standard, can be assessed using a number of criteria, like damage to the present functions and values, possible flood damage and the construction and maintenance costs. Policy options were formed by combining a choice for the safety standard and strategies for dike improvement, from which the decision makers can make their choice after weighing the effects of the policy options with respect to the decision criteria.

To illustrate the type of policy options presented to the decision makers, some options are presented in table 2. The effects of a change in the design discharge of the river Rhine and of various improvements of the present design methods is given. The strategy 'improved practice' refers to a 'sharper' design method, using the most up-to-date computation methods. The strategies 'selective saving' and 'saving all' refer to strategies in which part (50%) or almost all bottle-necks are solved by the application of alternative 'smart' constructions. The 'base case' refers to present design discharge and design practice.

Criterion	Unit	Base case	Strategy			
			present practice	improved practice	selective saving	safe all
Length to be improved	km	370	350	350	350	350
Preservation of LNC-values	%	75	79	79	89	98
Landscape quality	-	0	0	+	+	+
Quality of the vegetation	-	0	0	+	+	+
Dike improvement costs	M*f*	870	780	800	1055	1655

Table 2 Effects of changed river Rhine design discharge and alternative design methods

5 IMPLEMENTATION

The Boertien Commission adopted almost all recommendations for improvement that resulted from the analysis and advised the Minister to adopt the 'selective saving' strategy. The Government Decision on dike improvement closely followed the Commission's advice. It is expected that the new government policy will promote major improvements in the dike-strengthening process and will widen the public support for its results.