

**RISK BASED INSPECTION OF FLOOD DEFENCE ASSETS**



ENVIRONMENT AGENCY

Ian Meadowcroft and Chris Fayers

Guidance Note 38

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## EXECUTIVE SUMMARY

MAFF High Level Targets (MAFF, 1999) include a target that the Environment Agency should have in place a programme for regular inspection of flood defence assets. The frequency of inspection 'should be risk-based, taking account of factors such as the status, nature and significance of the flood defence, main river or critical ordinary watercourse'.

This report presents a pilot system for determining inspection frequencies on the basis of risk. The main factors are defence condition, deterioration rate, criticality and land use band of the area protected.

The approach is based on the principle that inspection intervals should be sufficiently short to detect problems *before* the asset reaches a critical condition.

It is recommended that the method should now be piloted.

**Keywords:** Risk-based inspection, flood defence assets.

**Links to Duties and Powers:** MAFF High Level Targets.

**References:** See Section 5.

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## **1 INTRODUCTION**

This note gives draft guidance on assessing inspection intervals for flood defences based on risk. Further information including the rationale for the method is given in NCRAOA Report 27 (Meadowcroft and Fayers, 2000). An initial version of this guidance was circulated for comment and feedback. That feedback has been taken into account in this revision. This draft Guidance will now be pilot tested, lessons learnt will then be incorporated.

Sections 2 and 3 summarise the basis for the method and give guidance on how it is to be applied. Section 4 presents the steps necessary to assess inspection intervals. Note that this gives a guide to maximum intervals. Local circumstances and experience may indicate that more frequent inspections are warranted.

Land use bands characterise what is at risk, they reflect the value of land, property and infrastructure protected by the asset. There are six land use bands from A, high to E, low, and X. Land use band X signifies that there is no known risk of flooding, for example it is an upland watercourse.

Deterioration rate refers to the rate at which an asset's flood protection function declines. Deterioration rates should be allocated as, high, medium or low. A high deterioration rate signifies an asset that is 'soft' or susceptible to environmental degradation. Such structures are likely to have an indicative residual life of less than 5 years. An asset will also have a high deterioration rate if it is structurally stable but could be subject to sudden deterioration in condition such as vandalism or failure of an electrical or mechanical component. A low deterioration rate signifies an asset that is resistant to environment degradation, unlikely to be subject to sudden failure and with an indicative residual life of greater than 11 years.

Criticality refers to the importance of deterioration for the overall functioning of an asset as a flood defence. Some types of deterioration may have relatively little impact on flood defence function – such as damage to non-structural components. Other types of damage may be absolutely critical, such as damage to an embankment crest or gate control mechanisms. Note that criticality here does not relate to the land use - land use is dealt with as a separate parameter. The criticality status is once again allocated as, high, medium or low. A high criticality rating indicates that deterioration has a high potential impact on flood defence function.

The two parameters, deterioration rate and criticality are combined to give an indication of the 'stability'. This new parameter is determined by use of the matrix below. The three categories of high, medium and low are retained. In this case an asset with a high stability indicates that the assets defence function is at low risk of failure in the near future or that the importance of failure to the assets contribution to its flood defence function is non-critical. An asset with a low stability indicates that it may be in a poor state of repair, subject to likely sudden failure in some way, and / or the importance of deterioration to the assets proper function is critical. In this way the stability reflects:

- differing environmental robustness that different construction materials confer;
- the particular nature and operational performance of certain assets such as sluice gates;
- the possibility of catastrophic failure or vandalism;
- the importance of the asset to the functioning of the defence.

### 3 INSPECTION INTERVALS AND INSPECTION PROGRAMMES

The Guidance provides recommended maximum inspection intervals for all assets. Staff will develop inspection programmes for assets within their area that will depend on geography, logistics and resources. Assets may be inspected more frequently than the Guidance recommends. For example, if Asset A has an interval of 3 years and an adjacent Asset B has an interval of 18 months, it may be decided to inspect both at the same time (at 18 month intervals). If assets are currently inspected more frequently than 6-monthly then the reasons for this should be reviewed in the light of the interval indicated in this Guidance and specific local factors.

#### 3.1 Hidden faults.

A walkover inspection cannot detect all problems. Internal weaknesses such as voids below concrete or fissures may weaken an asset that appears to be in good condition. Therefore condition-based inspection should be supplemented by more detailed structural investigations as appropriate.

#### 3.2 Basis for inspection intervals

- i) The first inspection establishes the condition, deterioration rate and criticality of an asset.
- ii) The condition threshold is defined according to land use band / what is at risk (i.e. consequences in the event of a flood). Assets protecting high land-use bands will have a higher condition threshold than those protecting low land-use bands. In some cases assets may already be below the threshold in which case they would should be closely monitored (i.e. inspected at least 6-monthly). Note this is for the purpose of inspection, not for determining maintenance requirements.
- iii) The inspection interval depends on estimating the deterioration rate and criticality and then using those parameters to determine the stability as outlined in section 2.1. Estimates of the deterioration rate and criticality will be based on knowledge of the assets flood defence role, construction, components and function with reference to the descriptions given earlier.
- iv) It is anticipated that each inspection will provide a revised interval to the next inspection on the basis of the assessment (Figure 3.1).
- v) Once two or more inspections have been recorded, the 'historical' assessments will be used to extrapolate the deterioration. This will enable inspection intervals to lengthen if the status changes little between inspections

Condition Grade	Stability		
	L	M	H
	Inspection interval $t$ , (Years)		
1	1	1.5	2
2	0.5	1	1.5
3	0.5	0.5	1
4	CM <sup>1</sup>	CM	CM
5	CM	CM	CM

Note: <sup>1</sup>CM denotes close monitoring recommended.

Table 4.2 Basic inspection intervals given Condition Grade and Stability, Land use bands C and D.

Condition Grade	Stability		
	L	M	H
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1	1	1.5	3
2	1	1.5	2
3	0.5	1	1.5
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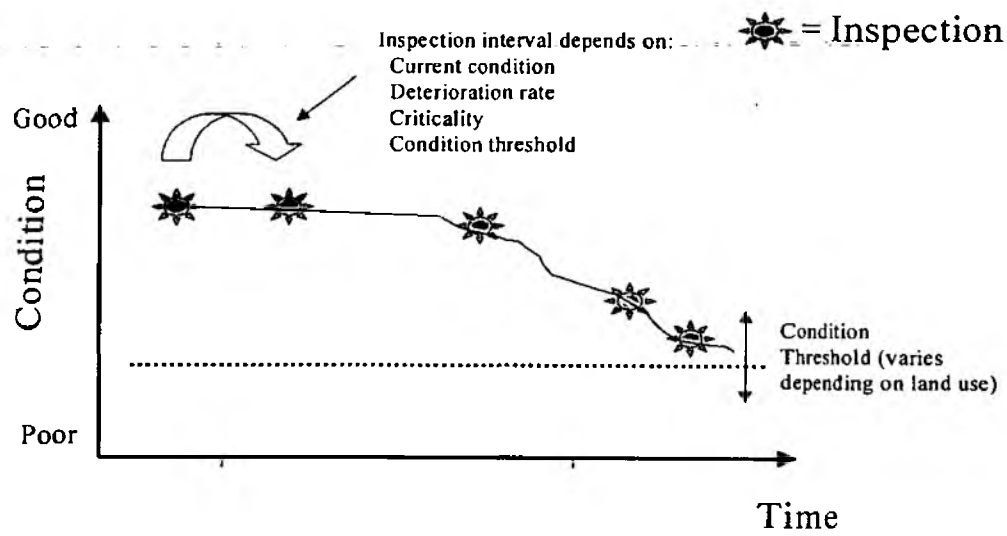


Figure 3.1 Diagram showing how inspection intervals may vary in future depending on circumstances



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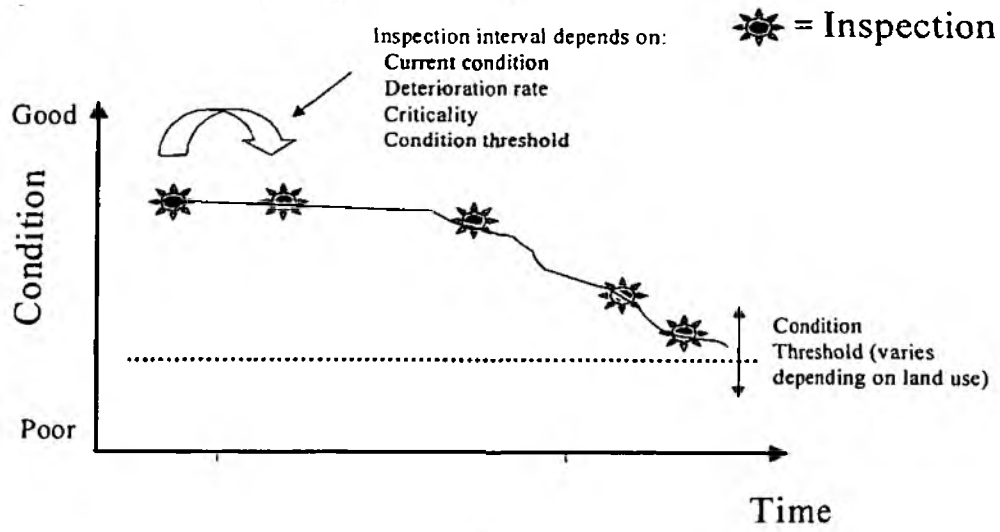


Figure 3.1 Diagram showing how inspection intervals may vary in future depending on circumstances