

HADDMS Priority Registers Priority Culverts Verification User Guide

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1 Introduction

This document provides guidance on how to implement AMM130/10 when assessing and verifying flooding risks from highway culverts. It explains the procedure to follow to populate the Priority Culverts Register on HADDMS (Highways Agency Drainage Data Management System).

This document:

- Provides guidance on the data required and tasks necessary to undertake the verification process (or risk assessment for newly located culverts)
- Can be used to help identify where mitigation measures may be necessary to address the flooding risks.

As defined in AMM130/10, a Priority Culvert is a culvert that, if poorly managed or inadequate, poses a high risk of flooding. The risk may be to adjacent property or could affect road users. The culvert may also be a factor in producing a Flood Hotspot, as defined in AMM 122/10, which should be read in conjunction with this document.

For the purpose of this guidance, a culvert is a water conveyance structure with a span or diameter less than 5 metres. (Those greater than 5m are not considered likely to cause flooding and have therefore been excluded from this assessment process.) Highways Agency culverts with a span or diameter greater than 900mm are recorded in the Structures Management Information System (SMIS) and are inspected and assessed as structures.

2 Background

A recent report¹ compiled for the Highways Agency assessed the flood risks from certain culverts on the HA's network. The report includes a schedule of culverts where flooding has either been reported, or is considered likely to occur and pose a risk. The flooding risk from each culvert has been assessed and the results form the baseline assessment in the HADDMS Priority Culverts Register.

The baseline assessment only considered those culverts reported by Service Providers to have been associated with floods. It benefited therefore from an initial screening exercise to identify the higher risk culverts. The assessment was carried out by considering the flooding records, their impact on adjacent property or road users and their frequency (where known) to assess the risk posed by the culvert. A risk status was attributed, where possible, and this assessment and categorisation process is described in Appendix A.

So that the risks may be fully defined, a verification process is required to ratify the baseline assessment and hence confirm the flooding risks posed by an individual culvert.

A new "Priority Culverts Register" has been developed to manage and update the data generated by the assessment and verification process. This forms one of a number of

¹ Priority Culverts – Vulnerability of the network to flooding, HRG/URS December 2009

priority registers (that also include outfalls, soakaways and flooding hotspots) that will be managed through HADDMS.

Previously unknown/unidentified culverts are being added to HADDMS regularly as the system is populated by the HA's Managing Agent Contractors. Culverts added since April 2010 will not have been included in the initial baseline assessment. The HA will monitor the number of new culverts added to HADDMS and it is the HA's intention that the baseline assessment will be periodically re-run so that a baseline risk status can be assigned to the newly added culverts.

3 Procedure and Assessment Processes

3.1 Overview

The assessment includes the following processes, as shown in Figure 1

- Verify the culvert location;
- Identify the watercourse which flows through the culvert;
- Check if there are records of flooding at this location and if so, whether the flooding was caused by defects in the culvert;
- Where there are no records, estimate the flow through the culvert to be expected for a range of rainfall events and assess the hydraulic capacity of the culvert;
- Identify the number of occasions in a 10 year period that the culvert has caused a flood or estimate the number of times it could cause a flood;
- Identify or assess the actual or likely consequence of such floods, to adjacent property and to road users;
- Identify whether the existing drainage includes facilities that already address the risk of flooding;
- Record the results of the verification in HADDMS, which will calculate the overall risk status;
- Where necessary, establish a potential solution (and its estimated cost) to mitigate the risks;
- Record the solution put in place and its actual cost.

The assessment should be based on guidance given in Methods E and F in DMRB Volume 11 Section 3 Part 10 – HD45/09². Further guidance is given in CIRIA C689³ on the assessment of flows in culverts, factors that can cause flooding and recommended allowances for freeboard to reduce the probability of a blockage.

The priority register is used to record the current stage (and status) of the verification / assessment process, whether (mitigation) action is required, and if so whether that action has been completed. If, at any stage, the overall risk status is recorded as “X – Risk Addressed”, the process is complete.

Limitations

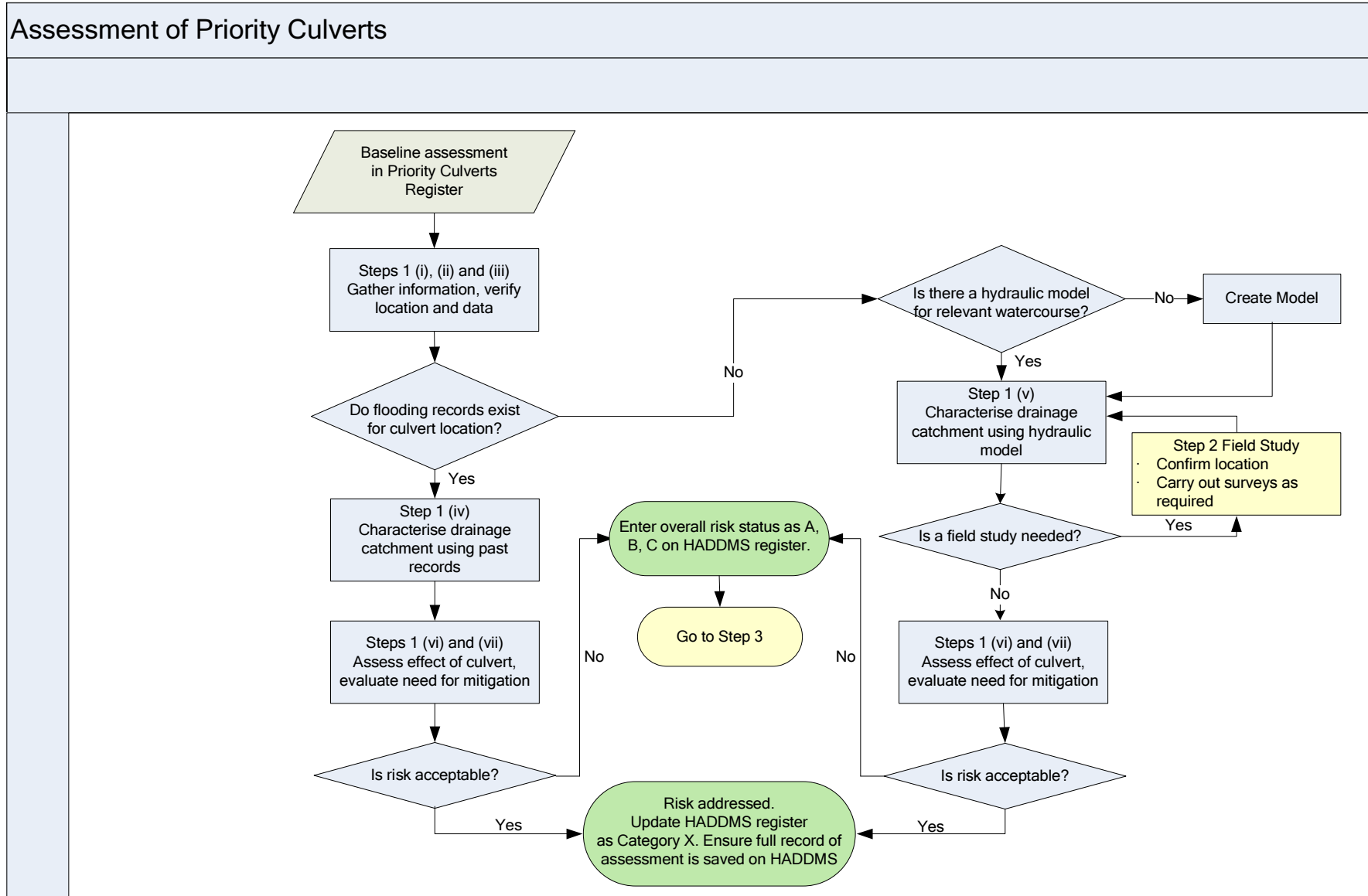
Although this user guide provides guidance for the different steps of the assessment and verification process, it cannot cover all permutations of flooding risk from culverts. Appropriate engineering and environmental solutions must be adopted based on site specific information. Further clarification can be provided by the HA if required.

Where there is good documented knowledge of the drainage system it may be possible to complete the assessment, verification and final risk categorisation from a desk study alone. However, in most cases, it is unlikely that a full assessment will be possible this way and a field study will be required.

² Subsequent references to this document simply refer to HD45. Other HA Standards and Advice notes are also referenced in this format, with full details provided at the end of the document.

³ C689 – Culvert Design and Operation Guide, CIRIA, 2010

Figure 1 - Verification process overview



3.2 Step 1 Desk Study – Verification of Risk Assessment

Step 1 (i) Gathering Information

For each culvert, all data pertinent to the risk assessment should be collected and collated. This includes

- details of the culvert itself (e.g. location, build type, invert levels),
- its environment (such as proximity to adjacent property, levels of carriageway and adjacent properties, risk of blockage),
- the details of the watercourse that flows through it,
- any records of historic flooding and the consequences.

Appendix B provides data requirements and potential data sources for the desk studies and field surveys.

Culverts with a span or diameter greater than 900mm are inspected and assessed as structures, so some of these details may be available on SMIS. Other details may be available from the relevant land drainage authority. Where the watercourse is a “main river” the authority is the Environment Agency. If not, it is either the local authority or drainage board. The Detailed River Network (DRN) layer in HADDMS can be used to determine the status and direction of flow of the water course. Where the culvert is not carrying a public watercourse, the responsibility for both culvert structure and watercourse lies with the Highways Agency.

Step 1 (ii) Verification of culvert location.

This is essential for all other activities. If this cannot be confirmed by desk study, it must be confirmed during field studies. No verified risk status can be recorded unless the location is first verified.

Step 1 (iii) Verification of relevant data.

There are a number of circumstances whereby the generic data used to generate the baseline assessment may be inaccurate (for example the culvert’s size, condition or invert levels, the effect on road users, the proximity of third party property) and all data contributing to this assessment must be verified by matching to site specific details. If this cannot be done by a desk study alone, a field study (see Step 2) will be required.

Step 1 (iv) Characterise drainage catchment using past records.

Where there are records of flooding at this location, these should be analysed to determine if the flood was caused, or partly caused, by defects in the culvert or the maintenance regime. These could include:

- blockages of the culvert,
- the culvert is damaged or silted up, limiting its capacity,
- the culvert is too small, or has too shallow a gradient to carry the flows in the watercourse without surcharge,
- the culvert has a hydraulically inefficient entry detail,
- The culvert screen has become blocked due to insufficient cleaning.

Determine the number of events in the past 10 years that were due, either in whole or in part, to culvert defects or insufficient maintenance. Assess, using the Flood Severity Index (see Appendix C), the effect, if any, of the worst flood event on road users. Identify if any adjacent property was affected by any of these events. If any of these events are recorded on the Flood Register in HADDMS, use the value of the Flood Severity Index already in the Flood Register.

Once the assessment is complete, the verification and action status on the HADDMS priority culverts register must be updated. See boxed paragraph in step 1 (vii) and Section 5.

Step 1 (v) Characterise drainage catchment using hydraulic model

Where no records of flooding exist, determine from the land drainage authority if there is a hydraulic model of the water course. If there is, obtain it and use it to determine predicted peak flows and levels for the following rainfall events:

- An event that can be expected to occur with an annual expected probability (AEP) of 50%
- An event with an AEP of 25%
- An event with an AEP of 10%

If no hydraulic model exists, use methods E and F in HD45 to create a model. This will require data from a topographical survey, and if no such data is available, a field study will be required.

Step 1 (vi) Assess effect of the culvert

- a) Where an existing model already takes account of the culvert, estimate the afflux (the increase in water level upstream caused by the culvert) associated with the three rainfall events described above and the corresponding increase in upstream levels of the water course.
- b) If it is necessary to create a new model, use CIRIA C689³ to determine the hydraulic capacity of the culvert, and compare this with the flows associated with the three rainfall events described above. If the hydraulic capacity exceeds all of these flows, allowing for the recommended freeboard, the culvert does not pose a flood risk. If the culvert's capacity is less than any of these flows estimate the afflux caused for each rainfall event and the effect on upstream water levels.
- c) If the *increase* in water levels caused by the culvert would result in flooding of the road or adjacent property, or cause other damage to the water course, the culvert will pose a flood risk. The possible effects of the increase in water levels, and the number of times within a ten year period, such effects can be expected, should be recorded in a spreadsheet, based on the pro-forma in Appendix A.
- d) Where it appears that the increase in upstream levels could cause the road to be flooded, the following information will be needed to assess the severity of the flood for road users. Full definitions are given in Appendix C.

- The classification of the road;
 - The AADT for the carriageway likely to be flooded;
 - The impact on traffic; and
 - The duration of the impact.
- e) Use the table in Appendix C to calculate the Flood Severity Index and record the appropriate factor in the spreadsheet
- f) Where it appears that the increase in upstream levels could cause adjacent property to be flooded, identify whether the land is used for residential, commercial or agricultural use, and enter the appropriate category. If more than one type could be affected, enter the more vulnerable category (eg residential). Should critical infrastructure be affected, this should be recorded as “residential”.
- g) Estimate the number of such events that could be expected in a ten year period and record the appropriate factor. If the assessment shows that property will flood more frequently than the road (or vice versa) record the factor corresponding to the greater number.

Step 1(vii) Evaluate need for mitigation.

On completion of the steps above, the flooding risk will have been established and hence the overall risk status.

On completion of the assessment, the above inputs must be manually entered against the appropriate culvert in the HADDMS Priority Culverts Register. Further details are given in section 5. The verification status must be changed to "Desk study complete - no field study required" or "Desk study complete - field study required" and the action status must be changed to "Not required" or "Required not done or not completed". The overall risk status will then be automatically calculated by HADDMS. A PDF version of the completed assessment, including the hydraulic model, must be uploaded as an attached document to the culvert asset inventory.

If the overall risk status is verified as D then the culvert is reported as “X – Risk Addressed”, the process is complete, and no mitigation is required. If the risk status is A, B or C, mitigation measures will be needed. Proceed to Step 3. Culverts with a verified overall risk status of A should be considered first.

3.3 Step 2 Field Based Study

This will be needed where a desk based study does not provide sufficient information to inform Steps 1(v) – (vii) or where the culvert location (Step 1(ii)) needs to be verified.

Step 2 (i) H&S and environmental risk assessment

Prior to undertaking any field works, Health and Safety and environmental risk assessments must be carried out. These should be based on all available information, although safe access, working near water and protected species must be key considerations

Once field data, as defined in Appendix A has been obtained, Steps 1(v) and (vi) are carried out, as described for the desk study and as shown on Figure 1, to determine the overall risk status. Once these steps are complete, the need for mitigation may be identified as in Step 1(vii) above.

On completion of the risk assessment using the field data the entries must be manually updated against the appropriate culvert in the HADDMS Priority Culverts Register. The verification status must be changed to "Field study complete" and the action status must be changed to "Not required" or "Required not done or not completed". The overall risk status will then be automatically calculated by HADDMS. A PDF version of the completed assessment, including the hydraulic model, must be uploaded as an attached document to the culvert asset inventory.

The need for mitigation measures should be determined as described in Step 1 (vii) above.

4 Identifying Solutions

4.1 Step 3 Mitigation - Outline Design

The steps through outline design, summarised on the flow chart in Figure 2, include:

- (i) Identify constraints based on individual sites, including: space, access, landscape etc.
- (ii) Identify and assess possible active management measures - i.e. can revised operational procedures provide the appropriate level of mitigation? (e.g. more frequent cleaning of the trash screen, enhanced inspection, vegetation clearance). If these measures can be implemented re-categorise the culvert on the register as risk status X – risk addressed.
- (iii) Where active management measures cannot reduce the risk to an acceptable level, identify and assess other possible solutions. Where the culvert carries a watercourse, consultation with the relevant land drainage authority will be required. For the optimum solution determine budget costs. Solutions should consider at minimum: catchment size; flood risk; space constraints; access and H&S; consents; landscape/ecological constraints; relative costs.

Those culverts requiring mitigation measures should be prioritised by carrying out a cost / benefit analysis. This could be an assessment against other culvert appraisals (e.g. remedying one high risk site needing a costly solution or five lower risk sites at the same cost) or could be a cost benefit analysis for different solutions at the same site. The Service Provider should also assess the opportunity for combining the construction of mitigation measures with other planned works. A check should be made to see if the proposed solution will help address problems identified in Local Resilience Forums or local catchment flood management plans.

- iv) Where it is established that physical mitigation measures are required, an outline design for reducing the flood risk should be developed. **Designers should ensure and seek to demonstrate that proposals are consistent with the principles of sustainability.** As a general rule designers should ensure the following points are material of consideration within the design process;
 - the solution is proportionate to the level of identified risk;
 - future maintenance regimes and whole life costs are considered as well as capital costs;
 - mitigation works can be incorporated with other planned works, where possible;
 - use of recycled materials and/or low carbon technology

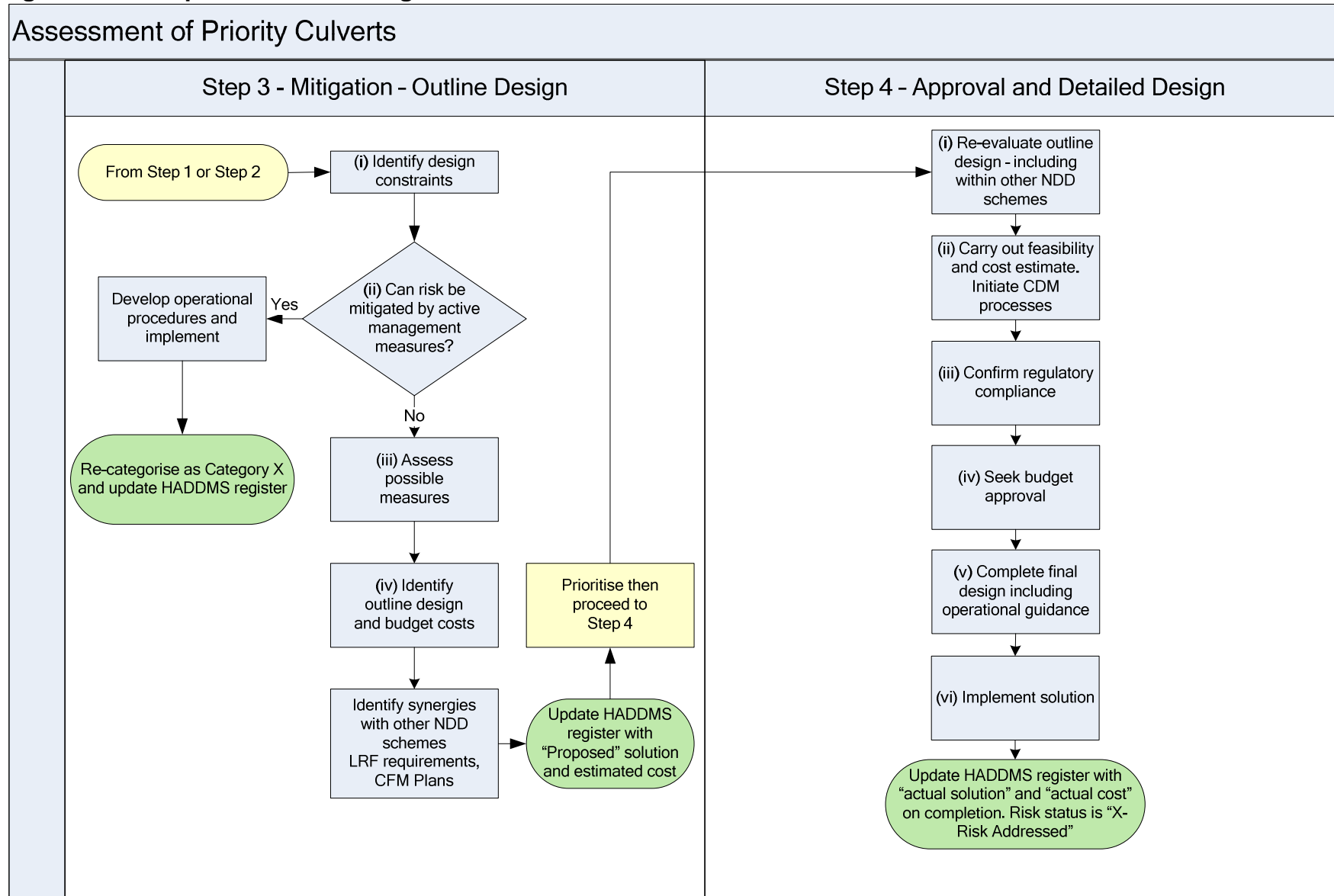
Measures (solutions) adopted may typically be as defined below:

Proposed Mitigation Measure / Solution	Definition	Example
New build	Addition of a new asset where nothing was available previously	Addition of a new culvert in a new location to provide additional flood relief.
Retrofit	Addition of a new asset or attribute to an existing asset	Addition of a new culvert adjacent to an existing one Addition of headwall or wingwalls to an existing culvert Improving the inlet or outlet hydraulic characteristics of the water course
Rebuild	Rebuilding an existing asset that had deteriorated such that it was no longer functional	Rebuilding a defective culvert.
Substitute	Substitution of an existing asset with an alternative form of asset	Replacing a brick culvert with a concrete culvert
Active Management	Non built, behavioural solutions	Regular inspection and maintenance for culverts prone to blockage, regular vegetation clearance adjacent to the culvert inlet and outlet. Improved liaison with the relevant authority

Guidance provided in HD 33, HA 103, HA 107 and CIRIA C689, should be taken into account during the design process.

The proposed solution and its estimated cost must be entered on to the HADDMS Priority Culverts Register

Figure 2 Steps in solution design



4.2 Step 4 Mitigation –Detailed Design

Once the outline design and budget costs are agreed, the following will be required to progress through to final design:

- (i) Re-evaluate outline design. This comprises a review of the chosen option to ensure it will reduce the flood risk.
- (ii) Undertake feasibility and cost estimate to determine construction costs, access, H&S, on going operational /maintenance requirements and costs, initiate CDM.
- (iii) Confirm approval in principle for consent from the land drainage authority, where the culvert carries a watercourse.
- (iv) Seek final budget approval for design and construction - This point comprises the commitment to design and build.
- (v) Complete final design including setting out operational guidance
- (vi) Once budget approval is granted and resources identified, the measures may be implemented.

Once measures are complete, the solution adopted and its actual cost must be recorded on the HADDMS Priority Culverts Register and the action status changed to “Required and complete”. All design details etc. must be entered on HADDMS. The overall risk status will become “X – Risk Addressed”

5 Populating the Register

5.1 Making Priority Culvert Register Entries

Service Providers should access the Priority Culvert Register through HADDMS. The register is a subsection of the asset inventory. The relevant culvert can be found from the HADDMS map. A “screenshot” of the register is given in Appendix D

5.2 Data fields

An example of data entries into the register is included in Appendix E. These are based on culverts identified in the baseline study – all post verification data entries are fictional, although they might represent typical outcomes. The type of data entry is highlighted in italics. A number of these fields are populated using pull down boxes (pick lists) – possible options in each case are shown in the “example” register entries in Appendix E. The data fields on the register are as follows:

Baseline information:

(These fields are initially populated from information in the baseline assessment)

- Baseline ID
 - Retained as reference to the baseline assessment (*Non editable number; historic data only, null for any culvert without a baseline assessment*).
- HADDMS ID
 - The HADDMS ID (*the HD43 asset reference number: automatically assigned by HADDMS*)
- Number of flood events per 10 years
 - This is the number of flood events recorded in the past 10 years. Where records cover a shorter period, a pro-rata number has been derived.
Defined from pick list:
 - *More than 5 events (>5)*
 - *Between 2 and 5 events (2-5)*
 - *Fewer than 2 events (0-1)*
 - *Not determined*
- Flood Severity
 - This is impact on road users of the most severe of the above flood events, as determined by using the Flood Severity Index, described in Appendix C. Defined from pick list:
 - *Index is 7 or more (7-10)*
 - *Index is between 3 and 6 (3-6)*
 - *Index is less than 3 (0-2)*
 - *No history of flooding*
 - *Not determined*

- Third party impact
 - This shows if adjacent property was affected in any of the above flood events. Defined from pick list:
 - *Residential [also includes items of critical infrastructure]*
 - *Commercial*
 - *Agricultural*
 - *None*
 - *Not determined*
- Overall Risk (status)
 - Where a baseline assessment has been carried out, this data field may be populated with the unverified risk status. (*data entered from baseline assessment; defined from pick list; verification status must be "baseline assessment carried out"*).

Verified Information:

Populated after undertaking verification or carrying out a new assessment. All register entries will have a HADDMS ID and item type. If a baseline assessment was previously carried out, the baseline ID is retained.

- Number of flood events per 10 years
 - Where flood records exist, this is the verified number of events that were caused by the defects in the culvert. [see Step 1 (iv)] Where no records exist, it is the number of events predicted by the hydraulic model [see Step 1 (v)]. (*Defined from pick list*)
- Flood Severity
 - Where flood records exist, this is the verified effect on road users of the most severe of the flood events, as determined by using the Flood Severity Index, described in Appendix C. Where no records exist, it is the severity predicted by the hydraulic model. (*Defined from pick list*):
- Third party impact
 - Where flood records exist, this shows if adjacent property was affected in any of the above flood events. Where no records exist, it is the effect on the most vulnerable category of property predicted by the hydraulic model. (*Defined from pick list*):
- Verification status
 - This field defines progress through the verification process. Defined from pick list:
 - *No assessment carried out*
 - *Baseline assessment carried out*
 - *Desk study complete - no field study required*
 - *Desk study complete - field study required*
 - *Field study complete*

- Action status
 - This field identifies whether action is required to provide a solution.
Defined from pick list:
 - *Required - complete*
 - *Required - not done or not completed*
 - *Not required*
 - *Not determined*
- Overall risk status
 - Once the above fields are completed HADDMS automatically calculates the Overall Risk Status. The Overall Risk Status can be:
 - *A (Very High)*
 - *B (High)*
 - *C (Moderate)*
 - *D (Low)*
 - *X (Risk Addressed)*
 - *Not determined*
- Proposed solution
 - Generic definition of proposed solution. Defined from pick list:
 - *New build*
 - *Retrofit*
 - *Rebuild*
 - *Substitute*
 - *Active Management*
- Proposed cost
 - Estimated cost (£) of proposed solution (*number field*)
- Actual solution
 - Identification of actual solution implemented. Defined from pick list:
 - *New build*
 - *Retrofit*
 - *Rebuild*
 - *Substitute*
 - *Active Management*
- Actual cost
 - Final cost (£) of implemented solution (*number field*)
- Last updated
 - The date on which the record was last updated (*not user editable and auto populated whenever record is saved*)
- Comments
 - (*Free text field, default blank*)

6 References

Design Manual for Roads and Bridges (DMRB):

Volume 4 Geotechnics and Drainage Section 2 Drainage:

Part 3 HD 33/06. Surface and Sub-surface Drainage systems for Highways

Part 4 HD 43/04 Drainage Data Management System for Highways. (Note that an Interim Advice Note is to be issued shortly revising the HD43/04 requirements)

Part 1 HA 103/06. Vegetated Drainage Systems for Highway Run-off

Part 7 HA 107/04. Design of Outfall and Culvert Details

Volume 11 Section 3 Part 10. HD 45/09. Road Drainage and the Water Environment

Highways Agency. Priority Culverts – Vulnerability of the network to flooding. Final Project Report. HRG / URS. December 2009.

CIRIA Culvert Design and Operation Guide – C689, 2010

Appendix A Procedure for Risk Assessment

This is the procedure that was used to produce the baseline assessment, and should also be used to verify the assessment.

The risk assessment considers the probability of a flood caused by a culvert, and the consequence of any such flood.

The probability of a flood is determined from the number of events recorded in the past ten years. Where occasionally this data is not available, an estimate should be made based on the probability shown on the Environment Agency's or other authority's models.

The consequence of a flood *caused by the culvert* is determined by considering its effect on both the carriageway of the highway, and on any third party property.

For carriageway flooding, the Flood Severity Index, given in Appendix C, should be used.

To assess the effect on adjacent property, flood levels are compared with levels of any property in the flood plain. Where it appeared that the property would be affected by such a flood, this should be recorded. If more than one type of property could be affected, the more vulnerable type of property is recorded.

The next page shows a completed example using the proforma that is available as a download from HADDMS and should be used to record the risk assessment, before the parameters are inputted into HADDMS. This will also form a record of the assessment, and must be uploaded as a PDF attachment to the culvert asset inventory.

Record of Verification of Risk Assessment of a Priority Culvert

Culvert location	Easting	513000	Northing	253650
Highways Agency Area		8		
Road number		A 421		
Date assessment recorded		28 August 2010		

Parameter to be determined	How parameter was determined	Number	Data to be entered into Priority Culvert Register in HADDMS	Comments
Number of flood events in the last 10 years	Using flood events recorded on HADDMS flood register	3	2-5	One incident has only outline details
Flood Severity Index for most severe event recorded, or 10% rainfall event if using a model	Using flood events recorded on HADDMS flood register	4.2	2-5.9	
Category of third party property affected	Using flood events recorded on HADDMS flood register	Industrial site	Commercial	Site partly affected
Overall risk status (see table below). This will be automatically calculated by HADDMS				

Severity	Number of events in past 10 years		
	>5	2-5	0-1
7-10	A (Very High)	A (Very High)	B (High)
2-5.9	A (Very High)	B (High)	C (Moderate)
0-1.9	B (High)	C (Moderate)	D (Low)
No history of flooding	D (Low)	D (Low)	D (Low)
Third Party Impact			
Residential	A (Very High)	A (Very High)	B (High)
Commercial	A (Very High)	B (High)	C (Moderate)
Agricultural	B (High)	C (Moderate)	D (Low)
None	D (Low)	D (Low)	D (Low)

Notes:

Higher of above two risks is given as Overall Risk Status

For assessments using verified data, Low Risk (D) is recorded in HADDMS as "X - Risk Addressed"

Methods of characterising the catchment

Using flood events recorded on HADDMS flood register

Use of hydraulic model to estimate floods

Appendix B Data Requirements

Process	Data Requirements	Possible Data Sources	Comment
Step 1 (ii) – (v). Verification of risk assessment			These procedures need staff with appropriate skills.
(ii) Verify culvert location.	Culvert Location/NGR.	As built drawings (see HADDMS). SMIS database Land drainage authority Other service provider records.	
(iii) Verification of relevant data (iv) Characterise drainage catchment using past records.	Effect on carriageway and road users Effect on third party property Category of third party property Number of events in past 10 years	HADDMS Flood Register Environment Agency (EA) Website; http://www.environment-agency.gov.uk/ Local Authority flooding records Press reports of flooding As built drawings; service providers records; SI reports; staff and site information. HA traffic data	Much EA sourced mapping data is already available on HADDMS and HAEnVIS
(v) Characterise drainage catchment using hydraulic model	Hydraulic model	Local Environment Agency office or Local Drainage Board	The Memorandum of Understanding (MoU) between the Highways Agency and the Environment Agency promotes the mutual exchange of data. The MoU should be cited when ordering data for HA use, as it may be possible to obtain it at reduced, or no cost.
	Topographic survey	LIDAR data on HADDMS	The extent of the survey should be proportionate to the scale of the possible flood, and the risk if it were to occur. In some cases, it may be possible to use data such as LIDAR where this is readily available, saving the cost of a field survey.

Process	Data Requirements	Possible Data Sources	Comment
(vii) Evaluate need for mitigation		<p>Service provider maintenance procedures</p> <p>As built drawings.</p> <p>Design drawings, schedules and specifications.</p> <p>HADDMS records.</p> <p>Field observations and records.</p>	Used for assessment by HD45/09

Appendix C Flood Severity Index

The Flood Severity Index is used to determine the severity of the impact caused by a flood on a carriageway. It uses five parameters and is defined as follows:

Flood Severity Index = Factor A*FactorB*FactorC*FactorD*FactorE*10

1. Road classification and size.

	Factor A
Motorway	1.0
All purpose trunk road dual 3 or more	0.9
All purpose trunk road dual 2	0.8
All purpose trunk road single	0.7
Not snapped to HAPMS	0.0

2. AADT for one carriageway

	Factor B
More than 25,000	1.0
15,000 – 25,000	0.8
Less than 15,000	0.6
Not known	0.8

3. Impact on Traffic

	Factor C
Total Closure	1.0
At least one lane closed	0.9
Hard shoulder only	0.6
Congestion only	0.7
No impact	0.0
Not known	0.7

4. Duration of Impact

	Factor D
More than 2 hours	1.0
Between 1 and 2 hours	0.9
Between 15 minutes and 1 hour	0.8
Less than 15 minutes	0.0
Not known	0.8

5. Critical time band affected

	Factor E
00:00 to 05:59	0.7
06:00 to 08:59	1.0
09:00 to 15:59	0.9
16:00 to 19:59	1.0
20:00 to 23:59	0.8
Not known	0.9 (use for predicted events)

Notes

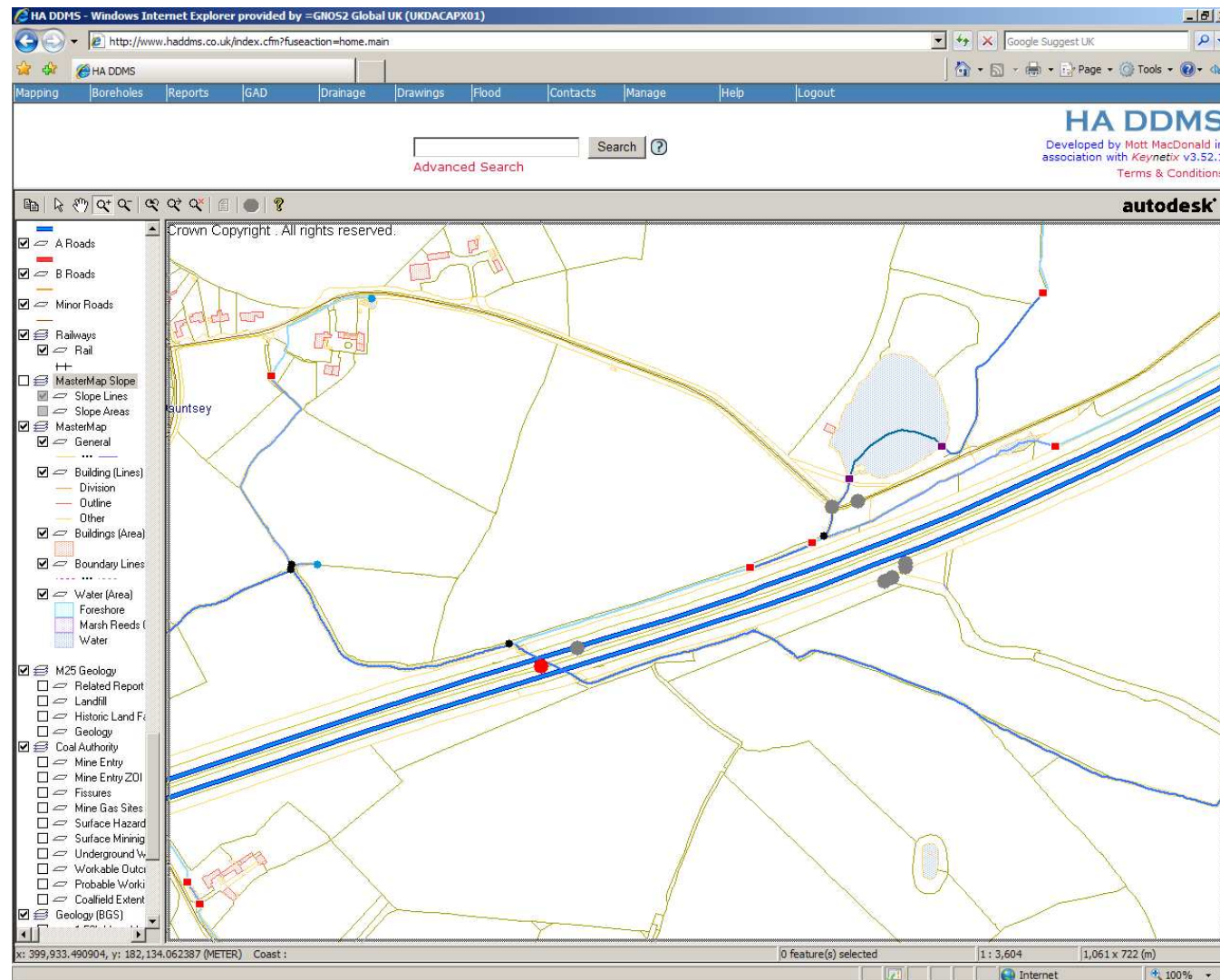
If a flood event is recorded on the Flood Register in HADDMS, use the value of the Index already recorded.

Where more than one type of road or impact is recorded, use the higher value score

If the impact spans more than one time band, use the higher score

The duration is the difference between the time a flood is first reported and when it is cleared.

Appendix D (1) Screenshot of HADDMS showing status of culverts



Appendix D (2)

Screenshot of HADDMS Culvert Register

Culvert Register	
Culvert Register ID	2977
HD43 asset ref	SU0081_3093a.1
Baseline assessment ID	02PC001
Baseline category	A (Very High)
Number of flood events	Not determined
Flood severity	Not determined
Max impact	Not determined
Verification status	Baseline assessment carried out
Action status	Not determined
Overall risk status	A (Very High)
Proposed solution	Not yet designed
Actual solution	Not yet built
Last updated	09/09/2010
Comments	