A review of skills and guidance in flood and coastal risk management benefit cost assessment

Appendix A - literature review

Date: April 2021

FRS18201 Appendix A

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Published by:

Environment Agency
Horizon House, Deanery Road,
Bristol BS1 5AH

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Executive Summary

This document presents the findings of a literature review of the existing guidance and training materials currently used to support the two Multi-Coloured Manual online benefits calculation tools, the Weighted Annual Average Damage tool and the Benefits:Costs Appraisal tool. This literature review is part of a research project being undertaken by the Environment Agency to find out how and by whom the existing tools are being used and what would be required from new training resources to improve the user experience and encourage greater uptake[1]. The findings will inform the development of survey and questionnaire content by highlighting potential themes and questions to explore with the identified user groups.

The specific questions considered by this literature review are:

- What guidance and training materials are currently available to support the Weighted Annual Average Damages and Benefits:Cost Appraisal tools?
- In their current state, do the tools support simple/quick assessment of potential damages avoided / benefits assessment?
- What potential barriers may be affecting uptake and successful use of the tools?

This review found that both online tools are relatively complicated to use, especially for those with limited or no experience of economic appraisal of flood schemes. The existing guidance available to accompany the online tools does not provide sufficiently comprehensive instructions to enable new users, or those with limited technical experience, to quickly understand the method, input data requirements or how to interpret outputs.

The findings indicate that additional, user-friendly guidance in some form is likely to help users better understand the tools and thus improve the quality of their outputs. Detailed information on what the new guidance should include will be collected through the stakeholder engagement process, however some initial suggestions have been identified by undertaking this literature review and these are summarised below:

1. It is recommended that the Environment Agency web page points users to the Multi-Coloured Manual web pages.

2. The Multi-Coloured Manual public guidance becomes rapidly too detailed. If it is intended that the Weighted Annual Average Damages tool be used by novice users, this should be introduced at Level 1 of the guidance.

[1] It is not within the scope of this research project to alter the underlying functionality of the tools themselves.

3. The Multi-Coloured Manual public guidance should provide a case study worked example for both the Weighted Annual Average Damages and Benefits:Cost Appraisal tools.

4. The levels of detail 1, 2 and 3 should be sequential so that a public user without access to the handbook would be able to progressively acquire the information needed to complete an assessment using the tools introduced at level 2 and 3 respectively.

5. Specific separate guidance for the Multi-Coloured Manual Online Tools would be helpful. This should be separate to the general guidance on appraisal of flood risk management schemes.

6. Key terms and concepts need to be explained in basic terms at their first use within the tool.

7. It should be made very clear that each row of the table in the Benefits:Cost Appraisal tool corresponds to a flood alleviation scheme providing a standard of protection equal to the exceedance probability of the row, and that the costs associated with that option should be entered.

8. The context of the decision-making criteria needs to be better explained. Users would benefit from being able to benchmark their assessment against successful business cases.

Purpose of document

This document is part of the Strengthening Local Investments Research and Development Project. The scope of the research is to provide an understanding of existing and potential users, existing and potential uses, and training requirements of two existing benefits assessment methods in the Multi-Coloured Manual (MCM): the Weighted Annual Average Damage method; and the Simplified benefit:cost appraisal tool for flood risk management (referred to from here-in as the 'Benefits:Cost Appraisal tool)'

This document presents research into the existing tools and guidance provided for the following existing MCM Online Tools both provided by the publishers of the Multi-Coloured Manual:

- "Weighted Annual Average Damages (WAAD) estimation tool"
- "Benefits:Cost Appraisal tool"

The tools and guidance have been reviewed by a practitioner with 6 years' experience in the area of Flood Risk Appraisal, including direct experience of developing economic assessment tools. The comments made, however, are with a relatively new practitioner in mind.

This report also makes some initial suggestions as to how the existing tools and guidance could be improved.

This report has been prepared exclusively for Jacobs' client, the Environment Agency, and no liability is accepted for any use or reliance on the report by third parties

Introduction

This document focusses on the MCM Online Tools and guidance available from the Multi-Coloured Manual (MCM). The MCM and Multi-Coloured Handbook (MCH) are published by through a partnership between Middlesex University, the Flood Hazard Research Council, the Environment Agency and the Department for Environment and Rural Affairs (Defra).

The following description of the MCH is taken from the MCM online.

> *The Handbook is intended to be a stand-alone "Step-by-Step" guide to assessing the benefits of flood and coastal erosion risk management. When put together with the knowledge of the costs of the plans and schemes required, the user can assess the relationship between the benefits and costs of investment decisions. This comparison should enable the users to identify those risk management plans and schemes which maximise the economic return to England and Wales, and therefore, represent "best value for money" by being economically efficient.*

The MCH and MCM are only accessible through subscription by individuals or businesses and is typically used by experienced users such as those at the Environment Agency or private flood risk management consultancies. This document investigates the freely available tools as part of the public sections of the MCM website; the Weighted Annual Average Damage (WAAD) tool and the Benefits:Cost Appraisal tool.

It is worth noting that the journey for Risk Management Authorities (RMAs) or other groups or individuals may start at the following page provided by the Environment Agency which also provides guidance and tools as to how to prepare an appraisal. These are however quite detailed (for example the 800-page long Flood and Coastal Erosion Risk Management Appraisal Guidance) and do not make reference to the tools and guidance available from the MCM.

Recommendation 1: It is recommended that the Environment Agency web page points users to the MCM web pages.

Guidance

Both the WAAD and Benefits:Cost Appraisal tools are accessed through the public section of the MCM website. It is noted that the two tools are not advertised on either of the home or public pages.

There are three levels of information available via the MCM website, increasing in levels of complexity based on a user's knowledge and experience. A screenshot of this is shown in Figure 1.

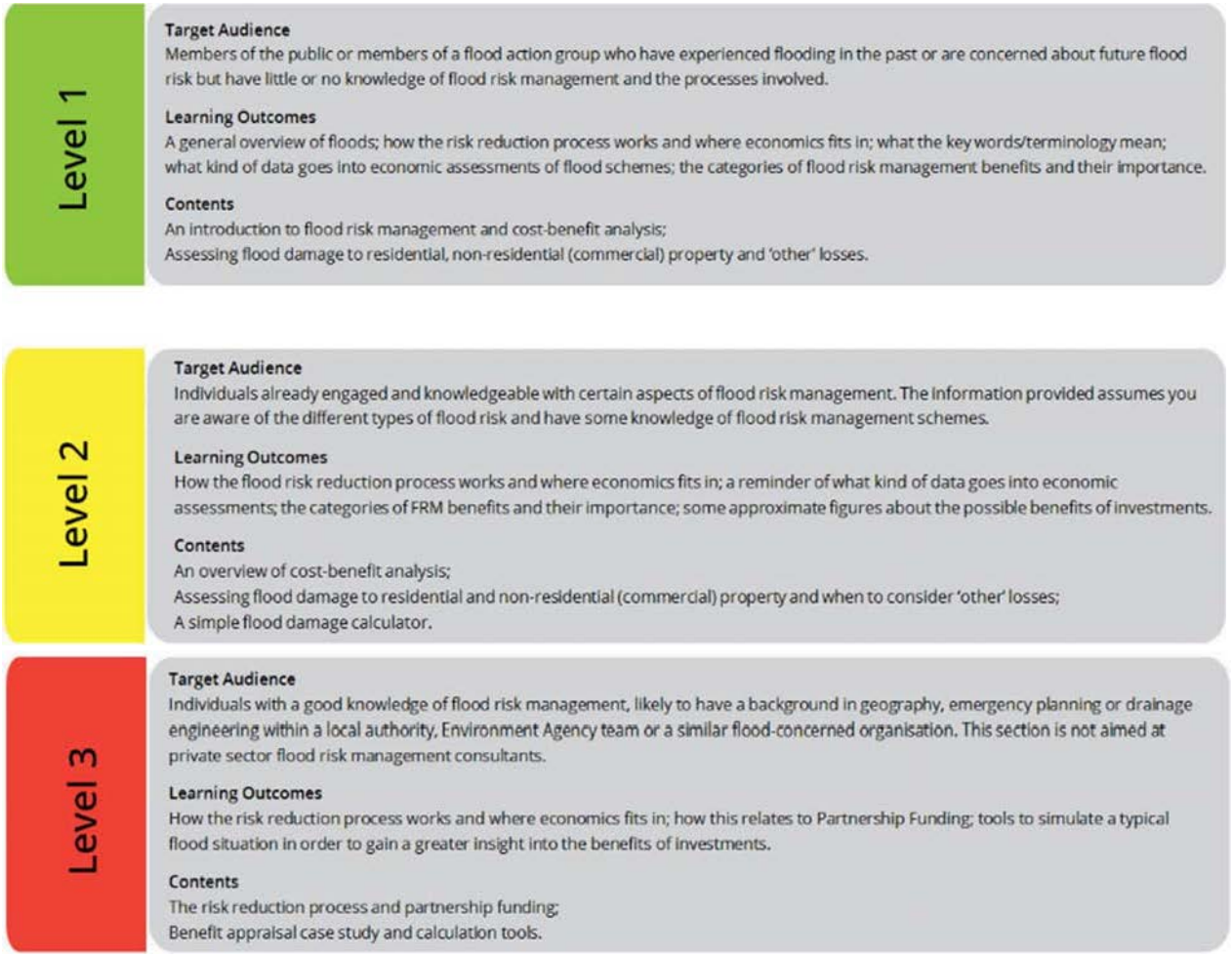


Figure 1 – Screenshot from MCM public guidance showing descriptions of the levels of guidance available.

Level 1

Starting at Level 1, the public guidance available online begins very simplistically by defining what a flood is and what types of damage are caused by floods. However, the guidance very quickly starts to get more involved and appears to go beyond the basic information required to use the WAAD tool and the Benefits:Cost Appraisal tool. For example, in step one of Level 1 of the guidance (https://www.mcm-online.co.uk/public/level1-step1/), intangible and indirect damages from flooding are

discussed and tables presented. There is no method within the two tools investigated that allows for this.

Recommendation 2: The MCM guidance becomes rapidly too detailed. If it is intended that the WAAD tool be used by novice users, then this should be introduced at Level 1 of the guidance.

A useful figure is presented in step 2 of Level 1 and is shown Figure 2. It is not clear, however, who this guidance is aimed at. Throughout the guidance, the advice is directed at “You”. However, regarding decision rules it is stated that “Appraisal will almost always be done for you by the authorities, but you will need at some time or another to understand what it means.”

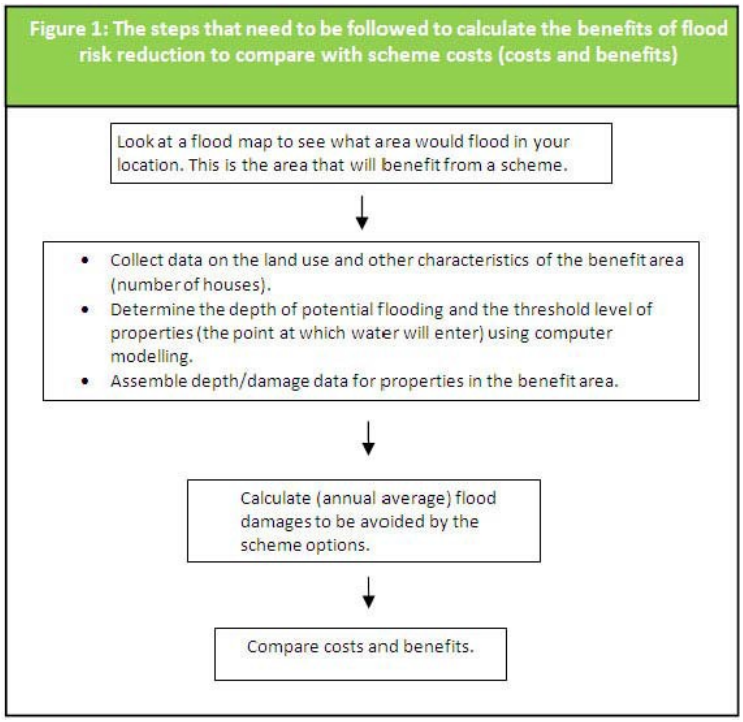


Figure 2 – Screenshot from MCM public guidance showing steps to calculate costs benefit ratios.

Step 3 of Level 1 goes on to detail more damages types that are again not able to be assessed using the two tools in question.

Level 2

Level 2 of the guidance contains the same information as Level 1 but in slightly greater detail. Again, the guidance includes detail that is not able to be assessed using the tools available.

The WAAD tool is introduced at step 3 of the Level 2 guidance. This tool is examined in detail in section 3 of this document.

Level 2

At Level 3, a discussion of the advantages of flood risk reduction is presented, the first mention of Partnership Funding and it links to economic assessment is made. A case study showing “a “walkthrough” of the cost- benefit appraisal process” is referenced. However, at the time of writing (October 2018) this was not available with a note stating, “This content is currently being updated and will be available again shortly.” Contact has been made with the publishers to request a copy of this case study, for the purposes of this research project. At step 3 of Level 3, both the WAAD tool and the Benefits:Cost Appraisal tool are presented. These are both discussed in section 3 of this report.

Recommendation 3: The MCM public guidance should provide a worked case study example for both the WAAD and Benefits:Cost Appraisal tools.

Recommendation 4: The levels of detail 1, 2 and 3 should be sequential so that a public user without access to the handbook would be able to learn the information needed to complete an assessment using the tools.

Analysis of the Benefits tools

This section discusses the tools available and their limitations, highlights potential barriers that may limit uptake, and proposes some initial ideas for improvement.

WAAD tool

The WAAD tool is intended to be a simple tool to enable users to assess the potential benefits of a flood alleviation scheme based on existing numbers of properties at risk.

The WAAD tool is accessed through the webpage. The spreadsheet is downloaded at the website too.

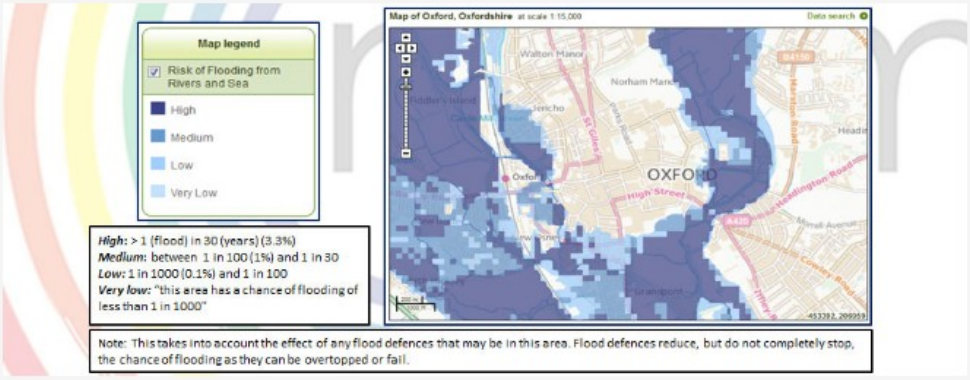
The welcome page to the WAAD tool with introductory guidance is shown below in Figure 3. The images in Figure 4 show the screen displayed when using the Excel workbook.

Level 2 Step One Step Two **Step Three**

The Weighted Annual Average Damage (WAAD) Estimation Tool

This "ballpark" estimation tool can be used if you have little or no understanding of the techniques of flood loss assessment and if you have no data for calculating the potential flood losses. The tool provides an indication of the potential annual benefits (or avoided annual flood losses) provided by a flood defence scheme for residential and non-residential (commercial) properties only.

Click on the Image below to download the tool as an Excel spreadsheet (1.6mb)



Warning: This is average data and may not be a true representation of a flood event at your locale. We do not recommend using it at a detailed scale (e.g.. street level).

Figure 3 – Screenshot of introductory information for the WAAD tool.

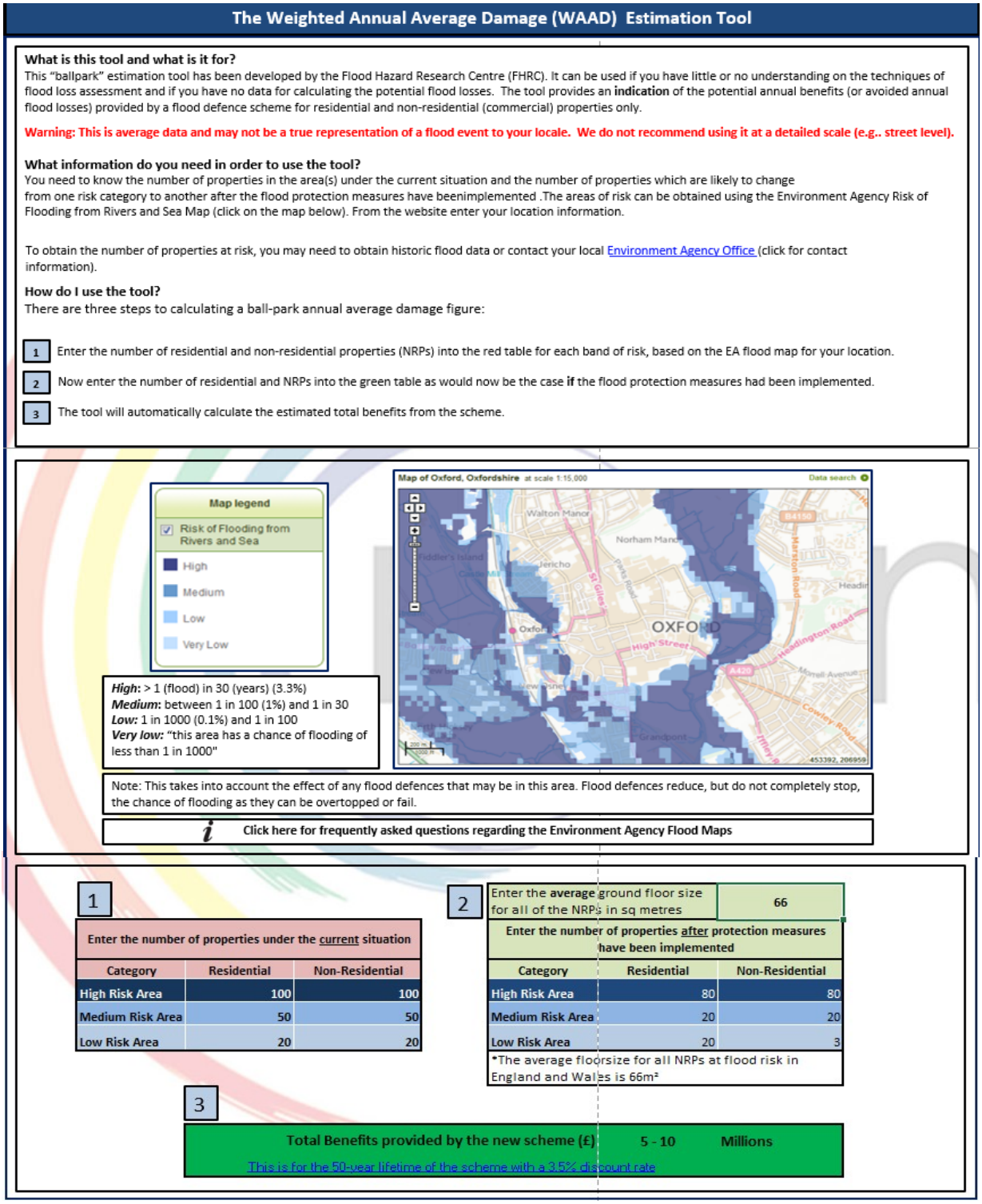


Figure 4 – Screenshot of WAAD tool Excel workbook.

Review of Guidance Text

There are three separate pieces of introduction and guidance text that a user reads before starting to use the tool. The first is at the public page of the MCM website where Level 2 of the MCM public guidance is described, the second is at Level 2 step 3 of the MCM guidance, and the third is within the tool itself.

The guidance text is frequently contradictory and confusing, particularly around who the intended target audience is for the tools.

- First instance in guidance: “Individuals already engaged and knowledgeable with certain aspects of flood risk management.”
- Second instance: “This “ballpark” estimation tool can be used if you have little or no understanding of the techniques of flood loss assessment.”
- Third instance: “Can be used if you have little or no understanding on the techniques of flood loss assessment”.

In general, the guidance presented through steps 1 and 2 of Level 2 is around the broader theory of flood alleviation schemes and is **not** a guidance on how to use the tool. The guidance discusses many types of damage that the WAAD tool cannot assess.

Recommendation 5: Specific guidance to the MCM Online Tools is required. This should be separate to the general guidance on appraisal of flood risk management schemes.

Review of user experience of the tool

Here are described imagined questions and potential confusions that are likely to be encountered by users when using the tool. They are listed in the order in which they would be experienced by someone using the tool using each page of the website in turn. A short comment is included against each of them.

Introduction

- What is weighted annual average damage?

The concept of the title of this tool is not discussed in the guidance or text within the tool. The title of this workbook appears misleading as it uses WAAD but actually outputs potential benefits.

- How big does the locale need to be to make the tool worthwhile?

There is a warning that the tool is not recommended for use at a detailed level e.g. street level. This would be made clearer by explaining why, e.g. “due to the range of benefits outputted, only schemes considering a minimum of 10 properties are applicable for the tool.”

- What does number of properties in the area under the current situation mean?

A vague description, which could be interpreted as meaning all properties in the area rather than those specifically at risk from flooding in the area.

- Which method should I use to get number of properties at risk?

There are three ways presented, the map, historic flood data or your local Environment Agency Office.

Step 1

- I’ve clicked on the map and entered my location information but how do I know the number of properties at risk?

From here the user must be aware of the presence of a flood map and must find a link to view long term flood risk information for the area. This link is not provided within the tool.

An example of the flood map (showing the River Brent in London) is shown below in Figure 5. It is a fair question to ask as to how users are expected to enter the numbers of properties at risk for each risk band and to know whether they are non-residential or residential. A caveat is given that it is a ball-park tool but that the inputs to it need to have reasonable confidence in order to produce a useful answer. There will remain the tendency for users to add as much detail as they can despite the extra effort not being proportionate to the low level of detail provided in the output.

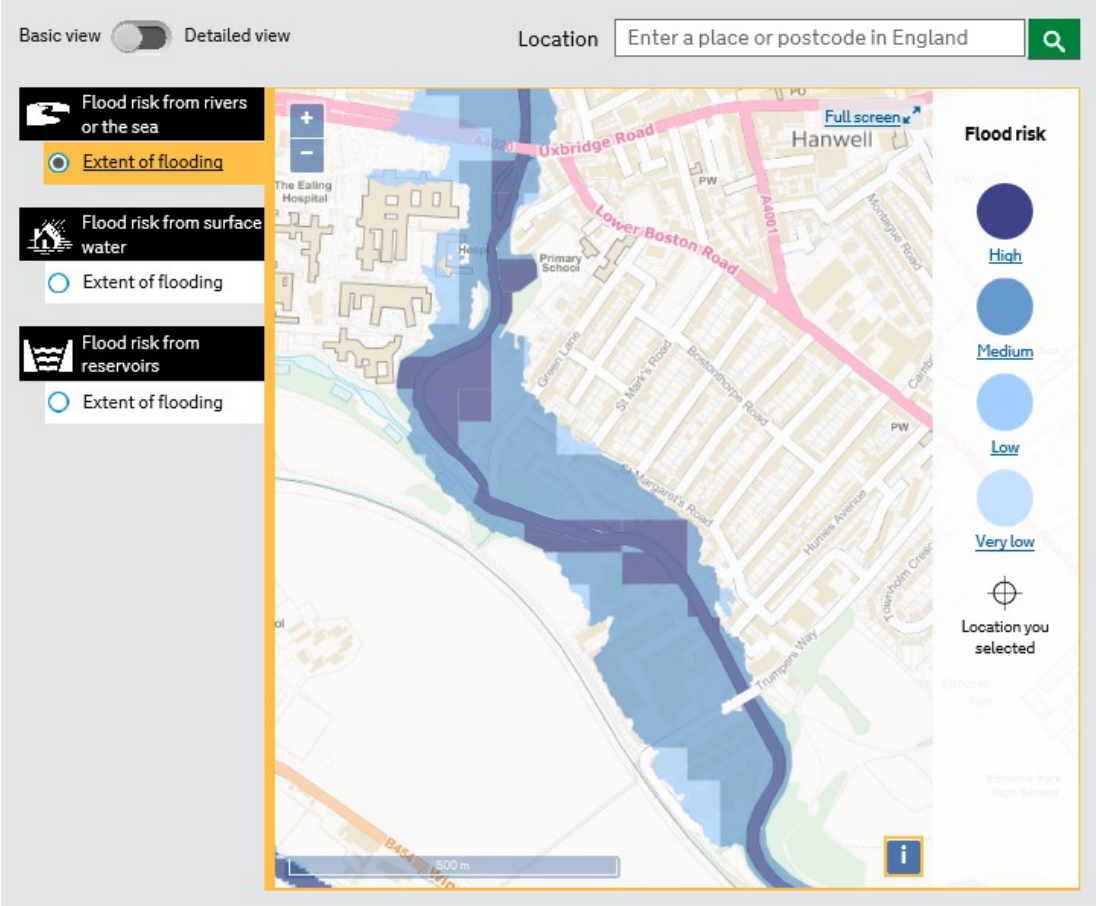


Figure 5 – Screenshot of long term flood risk map for England

As the tool is (apparently) not aimed at experienced consultants with access to Geographic Information Systems (GIS) it is inferred that users are required to count properties manually on their screen. Advances have now been made that enable cloud-based tools to output this information based on the drawing of a study area on a map[2].

- If a house flooded ten years ago, is it high risk?

[2] E.g. tool developed by CH2M (now Jacobs) as part of Flood Modeller

The descriptions of the flood risk bands are misleading, for example the definition of the High band is, “>1 (flood) in 30 (years) (3.3%)”. This definition is not consistent with the Environment Agency’s definition of the high flood risk band which is: “High risk means that each year this area has a chance of flooding of greater than 3.3%.” It is no longer considered good practice to refer to 1 in X year floods, as this terminology can be interpreted as meaning that these floods occur at regular intervals. It is now more accepted practice to refer to the probability of a flood event occurring.

- The link to the frequently asked questions regarding the Environment Agency Flood Maps does not work. This link is broken and needs to be repaired and maintained.

- What are the numbers already in the tables? – When users access the tool the tables already contain a set of numbers. These are not explained, could be misleading, and may cause errors in the outputs if the user fails to overwrite all the cells with their own data.

Step 2

- How do I calculate the average ground floor size for all the properties at risk?

The ability to alter the average floor area of non-residential properties is confusing as the tool is not supposed to be detailed. This could lead to users manually calculating the areas of many properties and thus taking a disproportionate approach to the tool which does not require this level of accuracy.

- How can I know the number of properties afterwards?

This is likely to be the biggest hurdle for users who are not practised and comfortable with making the sort of assumptions needed to support the number of properties at risk after the option has been implemented. There is significant potential for mistakes here as users may enter the number moving rather than the number remaining in each risk band, or not “carry over” properties moving from one band into a lower band. An example here would be very useful.

Step 3

- Total Benefits are very vague, what did I gain from entering the information?

The range of total benefits outputted are: £0M, £1M – £5M, £5M – £10M, £10M – £50M, £50M - £100M, £100M - £500M and £500M+. Some users may find that despite properties moving risk bands, the output of the calculator is £0M. Guidance is not given as to how to use the final output figure.

In addition to the concerns raised by the questions above, another key issue is that the tool is described as a way to calculate an indication of the potential annual benefits provided by a flood scheme. This is misleading because it actually provides is an estimate of the total

Present Value Damages based on applying the Weighed Annual Average Damages over a 50-year appraisal period.

Benefits:Costs appraisal tool

The Benefits:Cost Appraisal tool is intended to be a spreadsheet incorporating all stages of benefit:cost appraisal. It is intended for users with “a background in geography, emergency planning or drainage engineering…This section is not aimed at private sector flood risk management consultants.”

The Benefits:Cost Appraisal tool is accessed through the webpage. The spreadsheet is downloaded from the website too.

This tool is more advanced than the WAAD tool as it uses data for depths of flooding and return periods rather than weighted average damages based on flood risk bands. The tool is not particularly intuitive as was exemplified by a test session during which it took a group of experienced flood risk management consultants around half an hour to work out what information to enter and how the tool works.

The welcome page to the Benefits:Cost Appraisal tool with introductory guidance is shown below in Figure 6.

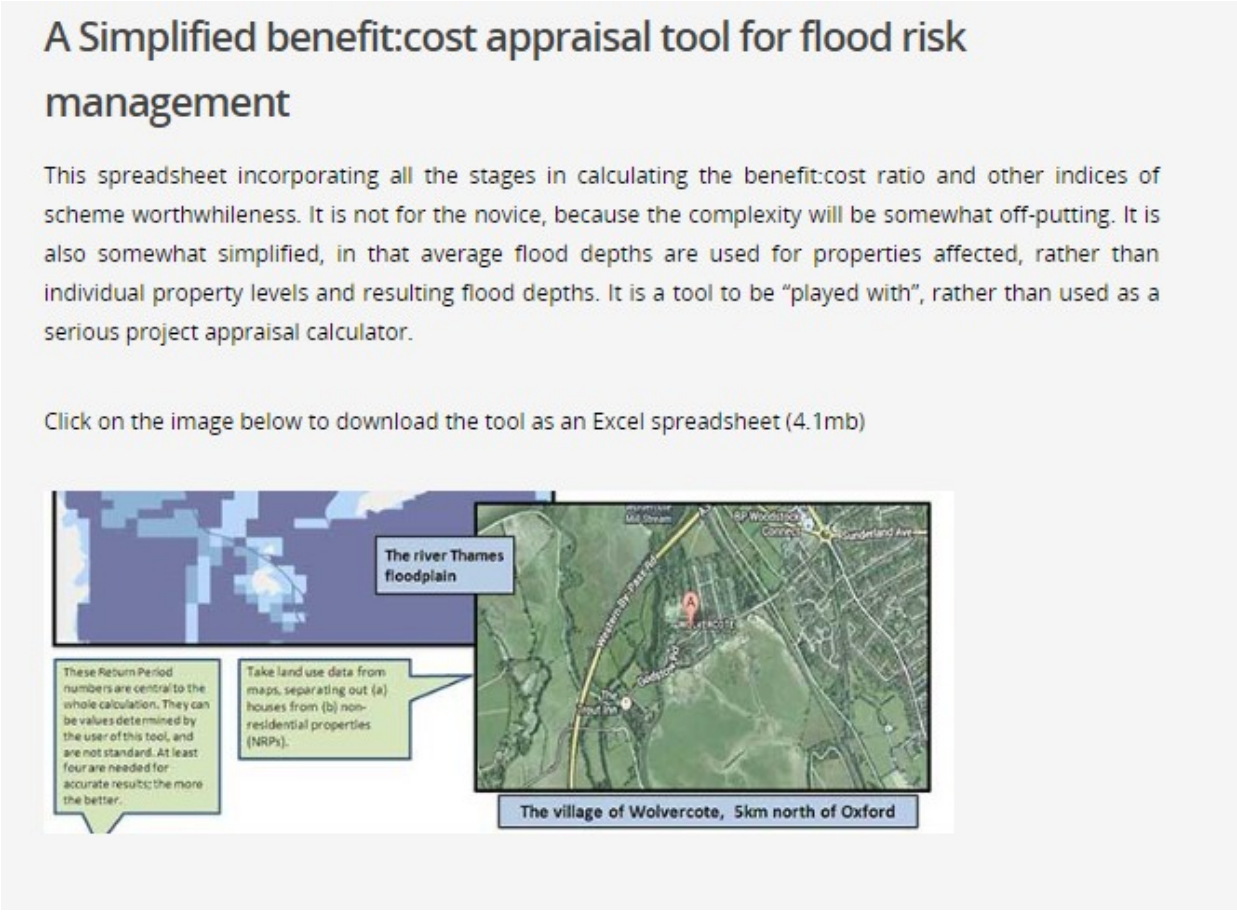


Figure 6 – Screenshot of introductory information for the Benefits:Cost Appraisal tool.

Review of Guidance Text

The introductory text for the tool is confusing. It is stated alternately that the tool is simplified, not for the novice, complex, then simplified again, and that the tool is to be “played with” rather than used for serious appraisal. It is possible that this confusing initial paragraph may be putting potential users off using the tool.

The guidance pertaining to the Benefits:Cost Appraisal tool in Level 3 of the MCM website is primarily around how and why economic appraisal is carried out for flood schemes. It is not specifically guidance on how to use the tool. The “walkthrough” document in Level 3 step 2 may provide this but is unavailable at the time of writing and therefore cannot be reviewed.

Review of user experience of the tool

Here are described imagined questions and potential confusions that are likely to be encountered by users when using the tool. Such uncertainty may limit use of the tool. Questions are listed in the order of the tabs of the workbook as they would be experienced by a user working through the tool. A short comment is included against each of them.

Introduction

- Do I not need to select step 1?

The prompt is “Select one of the steps below”. However, the process has to start at step 1.

Step 1

- What is a return period?

This is the first time this concept is introduced and even for those working in flood risk management is sometimes a hard concept to grasp. There is no statement as to the impact of different return periods (for example using a frequent return period (1in10 or less) is likely to give better accuracy to the results by providing a key data point at “the steep end of the damage curve”), only that 4 are needed as a minimum. (As a note, standard practice is now to use Annual Exceedance Probability (AEP%) to indicate the likelihood of a flood event occurring.)

- How do I know flood depths and numbers of properties at risk for each return period?

Without GIS software, this task will be very hard to complete. Users may be tempted to input depths based on experiences of flooding in the area. It is also not clear to users that the number of properties affected is cumulative, so errors may arise from users entering non-cumulative sub-totals.

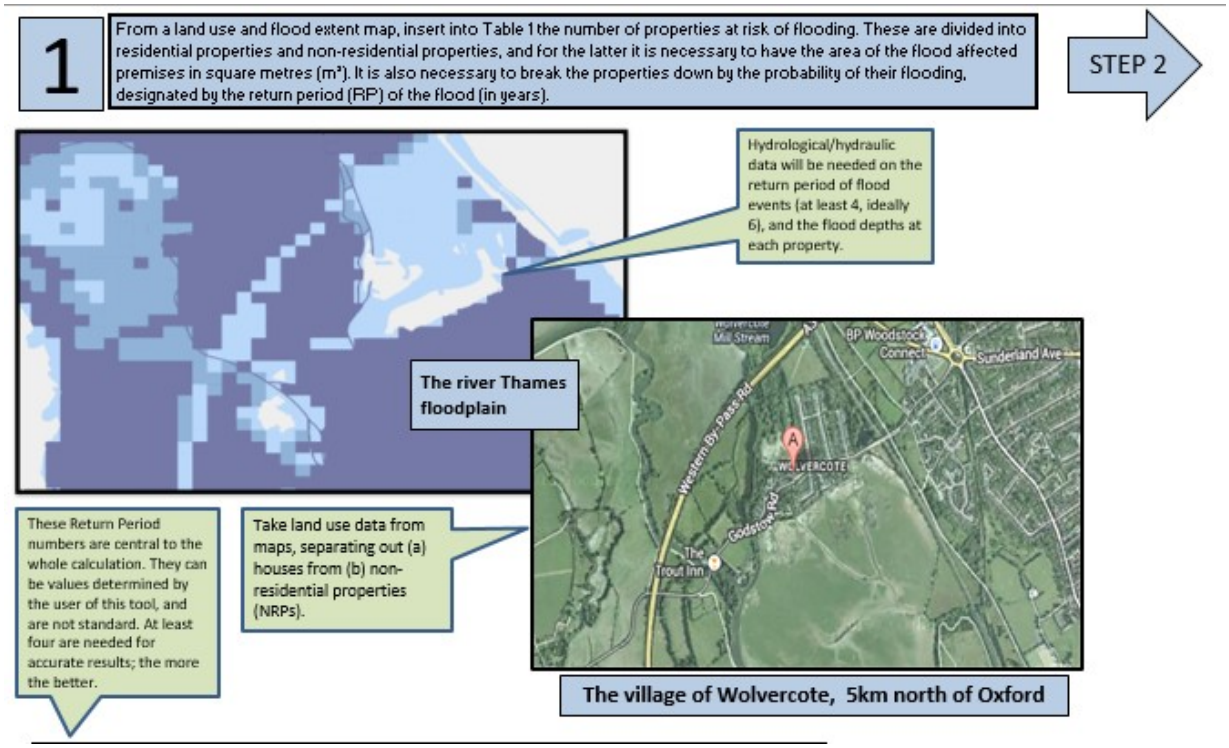


Figure 7 – Screenshot from step 1 of the tool

- Why is the average area of non-residential properties not the same in each return period?

It would be simpler to apply an average area as non-residential properties are not further sub-divided into types; adding varying areas based on those affected in each return period seems disproportionate.

Recommendation 6: Key terms and concepts need to be explained in basic terms at their first use within the tool.

Step 2

- Can I complete this without the Multi-Coloured Manual tables?

Despite the tool being targeted at inexperienced users, it is implied that the MCM is needed. However, sector average damages are embedded in the sheet and can be used directly. It is worth noting here that these values are outdated as they have been superseded by 2018 data. This will not significantly affect the output, however.

- Why do I have to enter the depth-damage data?

This process could have been automated fairly easily but instead is a manual step which adds another opportunity for user error. Users may not make the leap to interpolate values for flood depths not featured in the table.

- Why are there minus values?

These are applied when floodwater is around the property but not in it. This is not explained.

- Why are the green cells here not editable when they were before?

Inconsistency in formatting detracts from usability. This is a fairly simple element which could be adjusted.

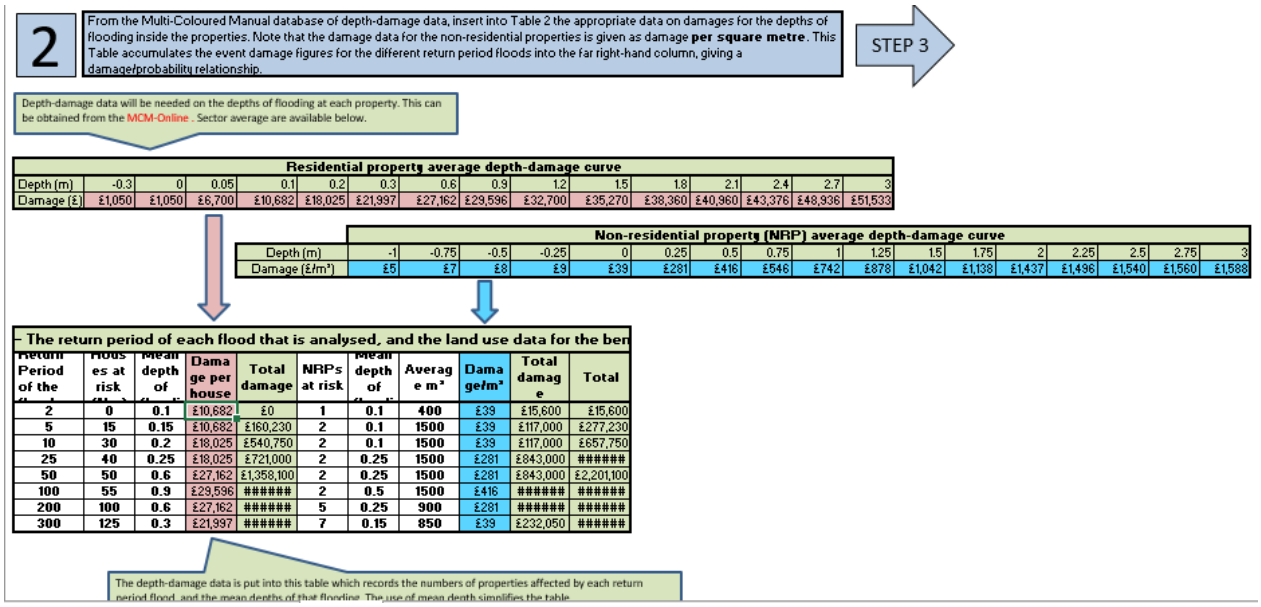


Figure 8 – Screenshot from step 2 of the tool

Step 3

- The description says that annual average damages must be calculated but the spreadsheet does that itself

This calculation is indeed automated. Text at the top of the tab states that “the discounted annual average damages must be calculated using the standard discount rate.” This is incorrect, the discount rate is not used to calculate annual average damages but applied to average damages to work out total benefits over the appraisal period.

- The only editable cell on this tab is the discount factor. However, I am not sure of any value other than 29.9 which I could use?

Discount factors are not explained nor are alternatives for appraisal periods shorter than 100 years given. The integration calculation is shown on this tab but is of little use to users of the tool.

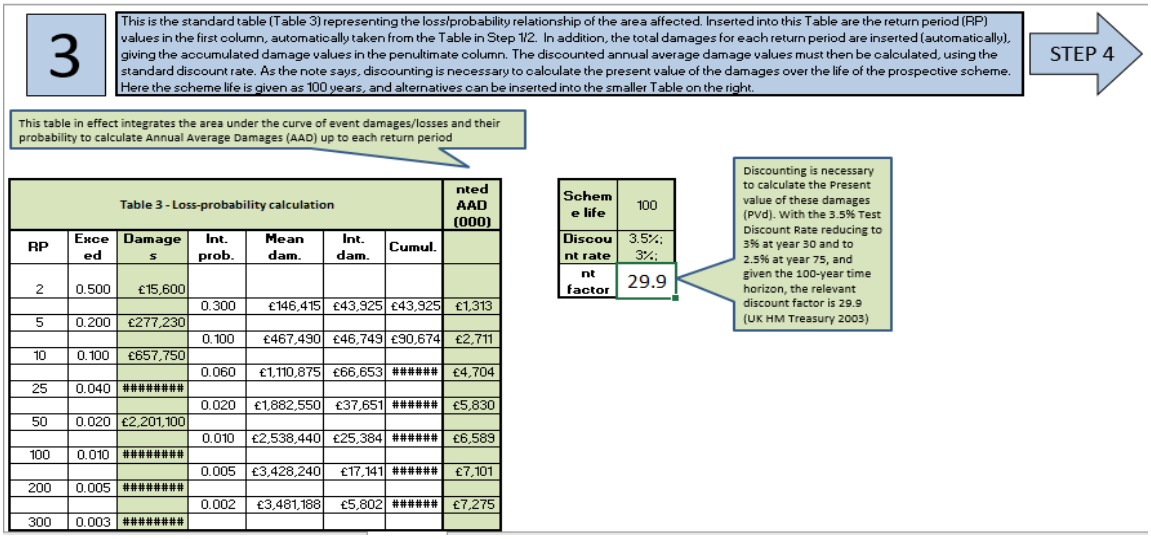


Figure 9 – Screenshot from step 3 of the tool

Step 4

- What am I entering costs for?

It is not explained that the costs to be entered in each row are the capital costs associated with a scheme which would provide the standard of protection indicated by the return period. An added cause of confusion is that the costs and benefits are now presented in £k rather than in £ as on previous tabs – this change is not highlighted and would be easy to overlook causing significant error in the outputs.

Recommendation 7: It should be made very clear that each row of this table corresponds to a flood alleviation scheme providing a standard of protection equal to the exceedance probability of the row, and that the costs associated with that option should be entered.

- Why is the concept of exceedance probability introduced without explanation?

This concept is a difficult one to grasp and should be explained. Better would be to use exceedance probability throughout rather than the need to switch from return periods.

- The callout box for the second graph Fig 2 is confusing, “The benefit:cost ratio is not the best measure of economic performance”

It should be explained that BCR is an important indicator.

- The callout box for the third graph is incomplete.

Sentence is not finished.

- Why are BCRs given to so many decimal places?

False precision is misleading. This is an issue observed throughout the tool.

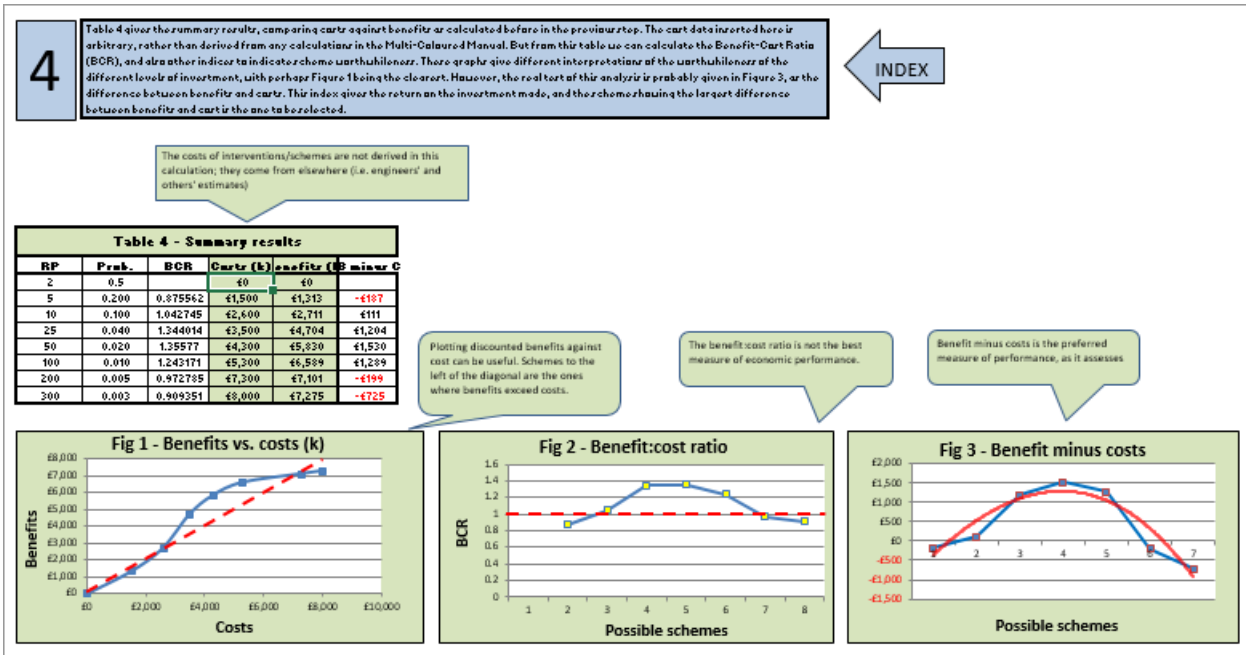


Figure 10 – Screenshot from step 4 of the tool

Recommendation 8: The context of the decision-making criteria needs to be better explained. Users would benefit from being able to benchmark their assessment against successful business cases.

Conclusions

It is very useful for those involved in Flood Risk Management to have access to freely available tools to assist with appraisal of Flood Risk Management schemes, and specifically economic assessment of schemes.

The tools considered by this research project can be useful to support decision making, but it is essential that those using them clearly understand what the tools can (and cannot) be used for, what data and knowledge is required to use the tools, and how to work through the tools effectively to obtain useful outputs. At present, the guidance supplied through MCM Online public is considered helpful, but this review has identified areas of weakness and omission. Specific guidance tailored to each of the tools is highly likely to improve the user experience, encourage wider uptake, and help ensure that they are usefully applied to support stronger local investment decisions.

Walkthrough documents will be essential to many users in successfully using the tools, either the existing from MCM (not seen) or additional instructions produced as part of this project. Care should be taken however to ensure that the walkthrough documents themselves are very clear and usable, fully aligned with the steps of the tools, and support the guidance and instruction that is already available through MCM online and within the tools themselves.

This review of the MCM online tools and associated guidance highlighted instances where improving the user interface within the existing tools could significantly enhance the user experience. Changes to the functionality of the existing tools were found but are not within the scope of this research project, but a question regarding potential cosmetic changes to the user-interface should be included in the survey to identify any common issues which could be addressed by simple improvements without affecting the functionality.

Recommendations from this report:

- It is recommended that the Environment Agency web page points users to the MCM web pages.

- The MCM public guidance becomes rapidly too detailed. If it is intended that the WAAD tool be used by novice users, this should be introduced at Level 1.

- The MCM public guidance should provide a case study worked example for both the WAAD and Benefits:Cost Appraisal tools.

- The levels of detail 1, 2 and 3 should be sequential so that a public user without access to the handbook would be able to progressively acquire the information needed to complete an assessment using the tools introduced at level 2 and 3 respectively.

- Specific separate guidance for the MCM Online Tools would be helpful. This should be separate to the general guidance on appraisal of flood risk management schemes.

- Key terms and concepts need to be explained in basic terms at their first use within the tool.

- It should be made very clear that each row of the table in the Benefits:Cost Appraisal tool corresponds to a flood alleviation scheme providing a standard of protection equal to the exceedance probability of the row, and that the costs associated with that option should be entered.

- The context of the decision-making criteria needs to be better explained. Users would benefit from being able to benchmark their assessment against successful business cases.

Appendix A. Additional Information

There is also available from the MCM online pages a frequently asked questions (FAQ) page which does give useful guidance on return periods.

However, the FAQ link is only available at the bottom of the last page of Level 3 Step 3. It is likely therefore that many users will miss this content.

An excerpt is shown below.

What is meant by a 'flood return period'?

This is more correctly termed the 'average flood return period' although the word 'average' is often missed out. The average flood return period has a very similar meaning to the average recurrence interval (see below). It refers to the long term average number of years between a flood of a given magnitude (e.g. a 50 year flood) will 'return' or recur.

What is meant by a 100 year flood?

The flood having a 1% or lesser annual probability (or average chance of occurring in a year). Another way of putting this is that a 100 year flood has 1 chance out of 100 of happening during any one year. Other floods have different chances of flooding during any one year as follows:

25 year flood – 4 chances in 100

50 year flood – 2 chances in 100

1,000 year flood – 0.1 chances in 100

Can two 100 year floods occur in a 2 consecutive Years?

Yes, although it is unlikely. 100 year floods are very unlikely to occur exactly every hundred years e.g. in 2014, 2114, etc. The chances of them occurring in any single year are exactly the same, and so experiencing a 100 year flood this year makes it no less likely that you will experience a 100 year flood next year, or the year after.

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