Reducing flood risk in north Reading and Lower Caversham

Costs and benefits review summary document

Date: July 2022

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Published by:

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

www.gov.uk/environment-agency

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1. Executive summary

This report provides an update on our work to investigate a potential scheme to reduce flooding in north Reading and Lower Caversham.

Using updated information, we have carried out a costs and benefits review of our proposed scheme of flood walls, earth embankments and a bypass channel to reduce the risks of flooding to homes and businesses.

The review has found that since our initial estimates there is an increase in the costs to deliver this scheme and a reduction in the economic benefits it could provide. We follow the Flood and Coastal Erosion Risk Management Appraisal Guidance which assures how public money is spent. Increases in scheme costs and a reduction in the economic benefits mean the proposed scheme is no longer cost beneficial and will not be eligible for Government funding.

We also found that the proposed scheme would lead to a slight increase in flood levels to a small number of properties. This would not be acceptable. We have not identified a way to prevent this.

We looked at various options to change the scheme design. We have not been able to find a cost beneficial option and recommend that the scheme is not progressed.

In June 2020, we published the Background and options summary. This provides an explanation on why we started investigating a scheme and how we carry out flood risk management projects. It summarises how we selected options to manage flood risk and why we did not progress alternative options.

This report follows the Background and options summary document and explains why our proposed scheme is now unable to attract government funding.

We have carried out robust assessments, including site investigations, updated flood modelling, and ground and property surveys to look at which communities would benefit from a scheme. This has given us an improved understanding of how flooding would occur in north Reading and Lower Caversham and what it means for the community. We have gathered a lot of useful information and data that can be used by the Environment Agency, our partner organisations and the public.

2. Scheme background

We started our initial assessment of a long list of options in 2015. We reviewed each option carefully, identifying which would or would not be appropriate for the Reading and Caversham area. Our published Background and options summary document explains why some options were not taken forward for further appraisal.

We identified 3 options that could be taken forward for further appraisal. These all consisted of combinations of flood walls, earth embankments and temporary barriers. The indicative alignment of these options covered the following areas:

- Flood walls and embankments from Nire Road to Christchurch playing fields
- Flood walls and embankments from Nire Road to Promenade Road
- Flood walls and embankments from Nire Road to Promenade Road including Waterman Place to Reading Bridge

We also considered the Existing Measures option, often described as the “Do Minimum” option. These existing measures include river channel maintenance, operating weirs in the area and ensuring existing structures such as culverts and riverbanks do not degrade over time.

It is important to keep the Existing Measures as a shortlisted option alongside other options, so that we can assess whether it is better to take action to reduce risk or carry on with the existing work.

Figure 1 – Caversham weir looking upstream from the right bank of the river Thames.

Based on our 2017 initial appraisal, we found that over 700 properties could be better protected if we implemented a scheme to reduce flood risk from a major flood (a flood with a 0.5% or a 1 in 200 chance of happening in any given year). Our findings indicated that the scheme options for flood walls and embankments could be economically viable and technically feasible, so we decided to progress with further appraisal to develop these options in more detail.

3. How the design evolved

We shared our short list of options with the local community in July 2018.

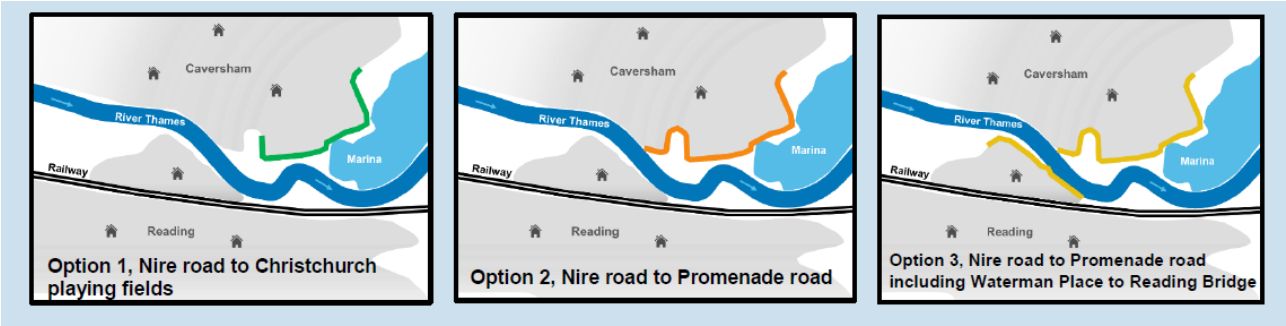

Figure 2 – Short listed option alignments shared at November 2018 drop-ins

At this early stage in the scheme, we were carrying out preliminary flood modelling to get a better understanding of how our proposals could change the flow of water through the area. We explained that if any of the proposals were found to increase flood risk elsewhere then we would need to amend the plans.

How to mitigate for changes in water levels

Our early modelling and design work focused on assessing a scheme that could reduce flood risk against a major flood (a flood with a 0.5% or a 1 in 200 chance of happening in any given year).

Flood modelling showed that while each of the 3 options, shown in figure 2 could significantly reduce flood risk in the area, they would all result in increased water levels elsewhere. This is because the proposed options would act to narrow the floodplain and cut off its existing flow route through the built-up areas in Lower Caversham. To mitigate for this, we reviewed the possibility of using flood storage areas, but our results showed this would not be effective.

We found that a bypass channel had the potential to offset the flood level increases seen as a result of the proposed defences. The channel would provide extra capacity for water to pass through Reading Bridge during a flood, instead of it backing up behind the bridge and its raised embankment. This would mimic the way flood water naturally flows downstream in the existing situation but avoiding the many homes and businesses in Lower Caversham.

The bypass channel became part of the scheme design, and we shared the draft drawing, shown in figure 3, during our November 2018 and summer 2019 public engagement.

We introduced small improvements to the existing weir to allow for increased capacity over the weir structure.

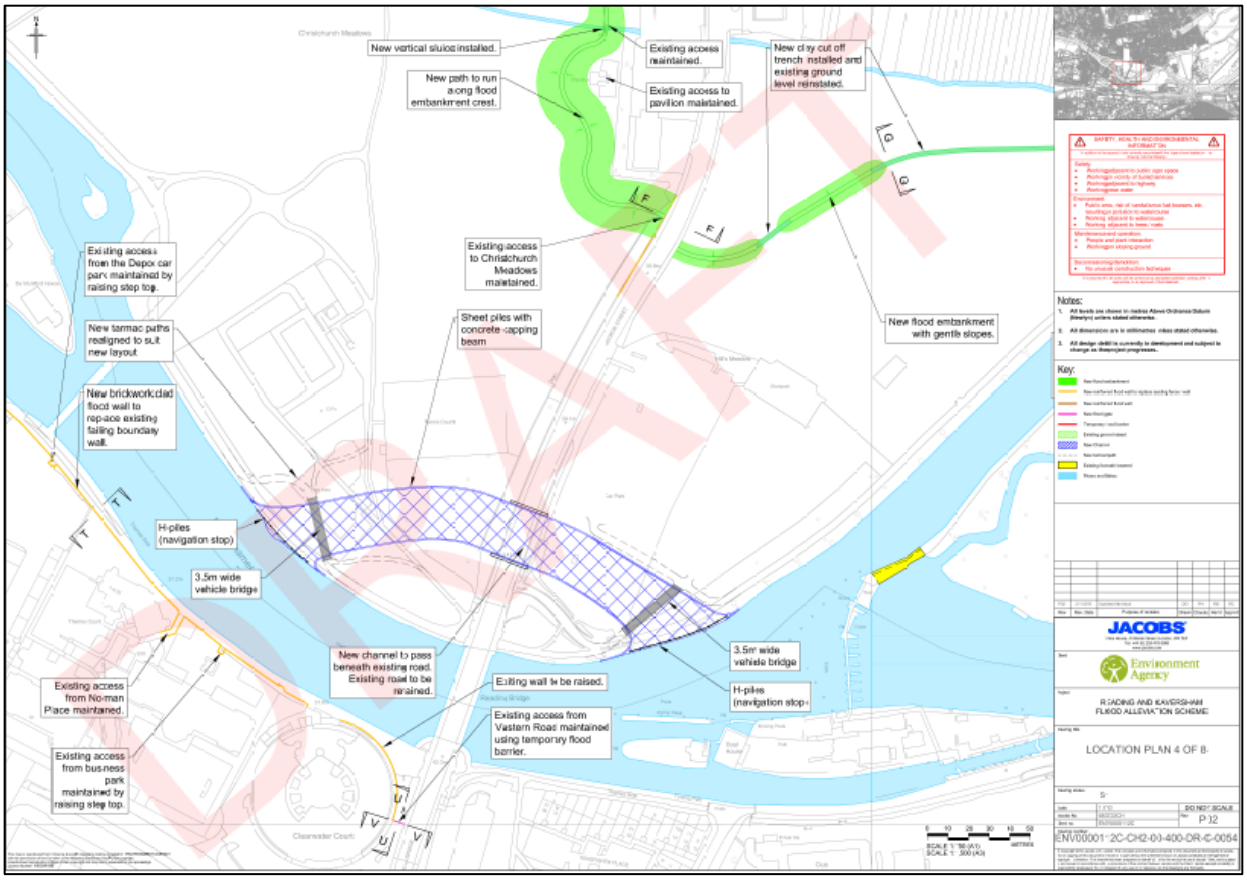

Figure 3. Draft drawing of the bypass channel

Design development

We developed the design further based on technical studies including flood modelling, and environmental studies such as ecology surveys and ground investigations. Our scheme design consisted of a combination of earth embankments, flood walls, the bypass channel and removable or temporary flood barriers to maintain access.

Based on public feedback, we made the following further changes to our initial proposals:

- **Trees** - We adjusted the alignment and type of flood walls and embankments. We found new construction techniques to minimise impacts on as many trees as possible.
- **Anti-social behaviour** - People raised concerns that earth embankments in Christchurch Meadows could create security and privacy issues where the embankment was close to properties. As a result, we changed most of the embankments in Christchurch Meadows to flood walls.
- **Public safety -** People raised concerns about creating a narrow footpath which could lead to increased anti-social behaviour. We replaced one section of permanent flood wall, located alongside the existing footpath to the west of Christchurch Meadows with temporary flood barriers.
- **Lower walls** - We lowered a section of flood wall in the Mill Green area by proposing a removable flood barrier which could be put on top of a lower flood wall when major flooding was expected.
- **Maintain existing views -** We changed the permanent flood wall to the north of Christchurch meadows to a temporary flood barrier.

- **Christchurch Ditch (also known as The Danall) maintenance** - We included ideas to clear the ditch, reprofile the channel to improve flow and add native planting and wildflower edges.
- **Loss of public open space** - We changed sections of proposed earth embankments in Christchurch Meadows to flood walls that take up less space.
- **Engagement about the scheme at different times** - We held and attended community events in 2019 and 2020 at different times, places and days including evenings and weekends. These helped to raise awareness of flood risk and how to be prepared for it as well as sharing information on our proposals and giving more people the opportunity to provide feedback.
- **Detailed plans and pictures** - People asked for more information to show how the scheme could look. We produced more detailed illustrations and before and after photo simulations.

We held public drop-ins in spring 2020 and shared the latest design illustrations and photo simulations.

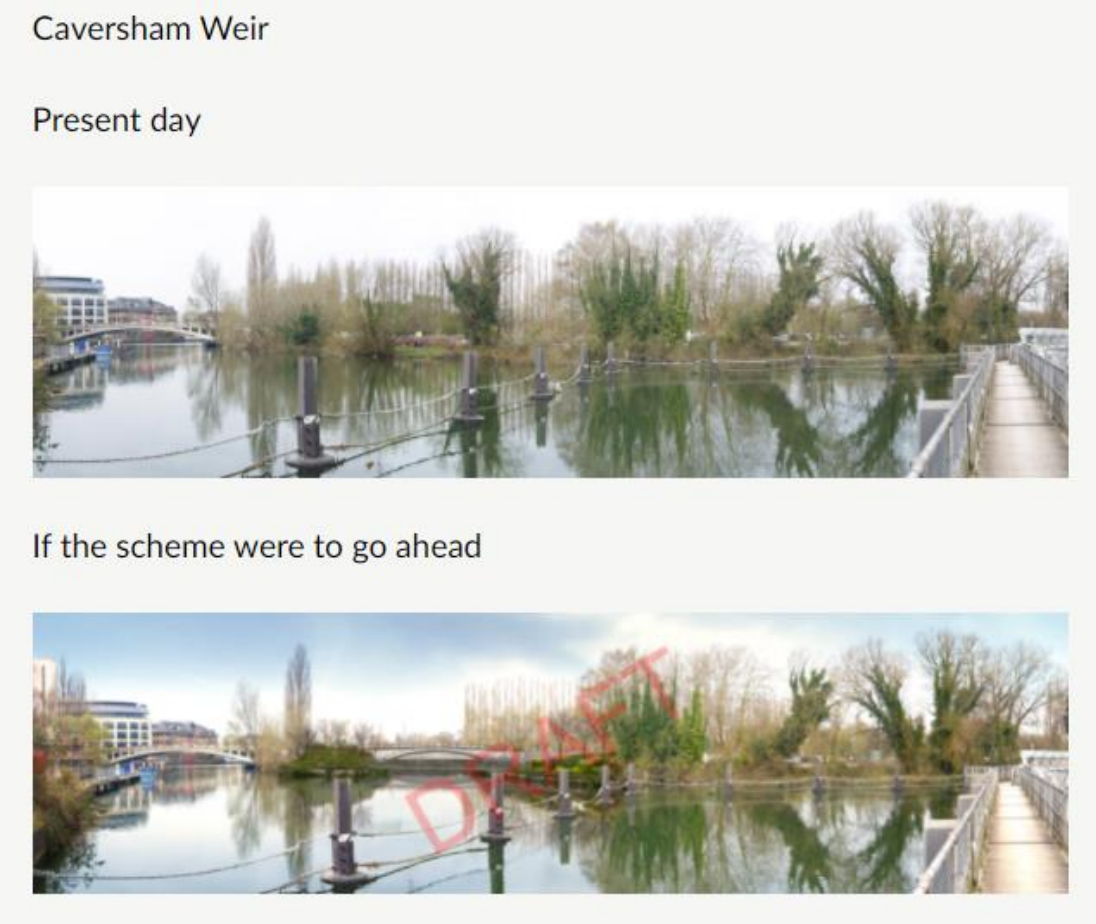

Figure 4: Before and after photo simulation from Caversham Weir

4. Cost benefit analysis

We follow the Flood and Coastal Erosion Risk Management Appraisal Guidance to assess if a scheme is economically viable. This is a requirement for all publicly funded flood risk management projects. The guidance sets out the cost benefit analysis method for us to follow. This is to make sure we spend money where it will provide the most benefit.

- Costs include the design, construction, compensation (for land taken up by the scheme), operation, maintenance, monitoring, and environmental enhancement associated with building a scheme. This is known as whole life costs.
- Economic benefits are calculated by working out how much damage would be caused to property and infrastructure in a flood. We compare this to how much money can be saved by building a flood scheme and reducing the flood damage. We consider the predicted future flood risk and other opportunities to provide environmental enhancement.

To demonstrate that a scheme is good value for money, the economic benefits must outweigh the costs. This is known as the benefit-cost ratio. The ratio must be greater than 1.

We calculate the amount of government Flood and Coastal Erosion Risk Management Grant-in-Aid funding that a project is eligible for based on funding rules agreed with Defra for partnership funding arrangements.

Any scheme where the benefits are greater than the costs can qualify for a contribution from Grant-in-Aid funding. The amount of funding given to a scheme is dependent on the scheme benefits and, in most cases, does not cover all costs. We need to find additional funding contributions from partners and other benefitting organisations.

The scheme costs and benefits quoted in this report are present value costs which have been assessed over 100 years. This is the estimated lifetime of the scheme in line with the appraisal guidance. We use standard discount rates (set by HM Treasury in The Green Book - Central government Guidance on Appraisal and Evaluation) to convert all current and future costs and benefits to present values. This is to reflect the total value of all future costs and benefits in today's prices, so they can be compared.

Discounting is based on the concept of time preference, which is that generally people prefer value now rather than later. For example, if Projects A and B have identical costs and benefits but Project B delivers a year earlier, time preference gives Project B, a higher present value because it is discounted by a year less than Project A.

In government appraisal, costs and benefits are discounted using the social time preference rate. This is to allow proposals of different lengths and with different profiles of net costs and benefits over time to be compared on a common basis.

5. Scheme benefits decrease

To understand what the flood risk benefit would be if we were to deliver a scheme, we use computer flood modelling. The scheme benefits are calculated for property and infrastructure not being damaged by flooding and for costs avoided, such as emergency services. The scheme benefits are compared against a baseline, which for this scheme is to continue with the measures that are already in place to manage flood risk, the Existing Measures option. This allows us to determine if increased costs can be justified for the further investment needed to deliver a flood scheme, compared with current flood risk management activities.

Flood modelling is also used to show how flooding in the area would change as a result of scheme proposals and whether any proposed changes would change flood risk for others.

We carried out more detailed and updated river modelling using Flood Modeller and TUFLOW software which included the predicted flood risk for a range of different sized floods. The updated flood modelling has shown that overall, existing flood water levels are slightly lower than the previous modelling showed. The mapped extent of flooding remains broadly the same.

The slightly lower flood levels reduce the calculated economic benefits the scheme could provide.

For the area the scheme could benefit, our review showed that in a major flood, 485 homes are at risk of flooding internally from the River Thames. Our initial appraisal had found that 739 homes would flood internally.

As the scheme progressed and we learnt more, we updated the costs and economic benefits. Our latest estimate of the benefit for a potential scheme reducing flood risk from a major flood is £126.8 million. At the time of publishing our Background and Options Summary in June 2020, this estimate was £143 million. The review has also found that the existing work we do now to reduce flood risk, the Existing Measures option, provides more benefit than our initial results showed. When developing a scheme, we always compare scheme costs and benefits against the Existing Measures option when calculating the benefit cost ratio.

The scheme benefits quoted in table 1 are more up to date than our initial estimates. This is because they are based on more detailed hydraulic flood modelling and information from our site survey work, which was not available when the benefits were previously assessed. The benefits are calculated over the proposed scheme lifetime of 100 years.

Option benefits	**Initial estimate** (million)	**Latest estimate** (million)	**Reason for change**
Existing Measures option (to continue as we are)	£54.5m	£99.7m	Differences are due to changes in flood risk indicated by our latest modelling and site survey work.
Scheme protection against a 0.5% (1 in 200) annual probability flood	£143m	£126.8m	

Table 1 Scheme benefits (over 100 years)

6. Scheme cost increases

We update the scheme costs regularly as we gain more information and develop a more detailed scheme design.

Scheme costs include pre-construction and construction works. Pre-construction works include design work, environmental assessments and planning applications. The construction stage includes materials and building costs, land purchase, contractor's site set up and running costs. We also consider what the maintenance and operational costs would be for the scheme over its lifetime of 100 years.

Our initial estimated scheme design and construction cost as quoted in the Background and Options Summary was £26 million. This had increased to approximately £30 million by our February 2020 public drop-ins. Our latest estimate of the scheme cost is £40.2 million.

The scheme costs are also compared against the baseline costs taken to be the Existing Measures option. The Existing Measures costs also cover the estimated maintenance and operational costs over a 100 year period to enable a like-for-like comparison.

Scheme Cost	**Initial estimate** (million)	**Latest estimate** (million)	**Reason for change**
Existing Measures option (to continue as we are)	£0.08	£0.08	Scheme increase resulting from more detailed assessment of scheme requirements
Scheme protection against a 0.5% (1 in 200) annual probability flood	£26	£40.2	

Table 1 Scheme costs (over 100 years)

7. Benefit cost ratio summary

The increase in scheme costs and the reduction of scheme benefits mean that the scheme is no longer cost beneficial. In our Background and Options Summary document we quoted a benefit cost ratio (BCR) for the scheme of 5.5 with an incremental benefit cost ratio (iBCR) of 3.4. Our latest appraisal results show a BCR of 3.2 and an iBCR of 0.7. The results are shown in table 3.

The Incremental Benefit Cost Ratio (iBCR) looks at the additional benefit provided by a proposed flood scheme, in comparison to the work we do now, the Existing Measures option. This ensures any additional action taken to reduce flood risk further over what we do now would provide value for money. The ratio must be greater than 1.

As explained in section 5 and shown in table 1, the updated flood modelling has shown that over a 100 year period, the Existing Measures that are in place to reduce flood risk provide better value for money than first thought, an increase of £45.2 million of estimated benefits. It also shows us that the proposed scheme benefits over the same time period are lower than initially thought a reduction of £16.2 million of estimated benefits.

Our initial results found the iBCR to be 3.4, following the cost benefit review the latest iBCR is now 0.7. With an IBCR of below 1 the scheme is no longer cost beneficial and will not be eligible for Government funding.

Option	Costs (million)	Benefits (million)	Benefit cost ratio	Incremental Benefit cost ratio
Initial appraisal results				
Existing Measures option (to continue as we are)	£0.08	£54.5	>650	n/a
Scheme (0.5% AEP)	£26.0	£143.0	5.5	3.4
Latest appraisal results				
Existing Measures option (to continue as we are)	£0.08	£99.7	>1,200	n/a
Scheme (0.5% AEP)	£40.2	£126.8	3.2	**0.7**

Table 3 Economic appraisal summary comparison - initial and latest appraisals

8. What else have we looked at?

Our latest appraisal results in table 3 show that developing a scheme which could reduce flood risk against a major flood (a flood with a 0.5% or a 1 in 200 chance of happening in any given year), is no longer economically viable. Our flood modelling also showed that, even with the bypass channel included in the design, the scheme would still lead to a slight increase in flood levels to some properties during larger floods. This would not be acceptable, and we have not identified a way to prevent this.

As part of the latest appraisal process, we looked at a variety of similar options to see if any of them could be economically viable and at the same time, not increase flood risk to other properties. The options we looked at all consisted of flood walls and earth embankments.

A smaller scheme

We looked into the viability of a scheme which could reduce flood risk for a range of smaller floods by lowering the height of the floodwalls and embankments. We also looked at shorter lengths of the floodwall and embankment alignments, including a range of different heights for each shortened alignment. Our flood modelling shows us that the majority of the properties that would benefit from a scheme would flood in the larger sized floods. Reducing the size and lengths of the flood walls and embankments would mean fewer properties would benefit from a reduction in flood risk. The scheme option with the highest iBCR is the one that would reduce flood risk to the most properties. This is the option that runs from Nire Road to Promenade Road including Waterman Place to Reading Bridge and reduces flood risk from a major flood (a flood with a 0.5% or a 1 in 200 chance of happening in any given year). Table 3 shows that this scheme is not economically viable as it has an iBCR of below 1. Lowering the heights and shortening the lengths of the scheme options gives even lower iBCR results, as the numbers of properties that would benefit is reduced. This further weakens the economic case.

A managed adaptive approach

We assessed whether a scheme could be possible by phasing the construction of different sections and heights of the scheme alignment over time. This is referred to as a managed adaptive approach and enables us to consider future uncertainties such as the impacts of climate change. This assessment showed that it would still not be cost beneficial to deliver a section of the scheme in the short term and adapt it in the future to increase flood resilience over time.

Result

Given that none of the alternative options we have explored will be cost beneficial, this does not change the outcome of the review and we recommend that the scheme is not progressed.

9. What does this mean for people and property at risk of flooding?

There is still a risk of flooding to homes, businesses and infrastructure in north Reading and Lower Caversham.

We have carried out robust assessments including site investigations, updated flood modelling, and ground and property surveys to look at which communities could benefit from a scheme. This work has given us an improved understanding of how flooding would occur in north Reading and Lower Caversham and what it means for the community.

Steps being taken to increase flood resilience in the area:

- We have shared our improved flood risk data with Reading Borough Council, as part of the Thames Valley Local Resilience Forum to support local flood response plans.
- We will continue to warn and inform the community when a flood is expected, through our Flood Warning Service to allow time to act.
- We will keep working with the community to make sure those who are at flood risk are aware of it and know how to prepare and respond to a flood.
- We will continue to work with Reading Borough Council as the Lead Local Flood Authority, by supporting their surface water schemes and explore whether there are any smaller scale opportunities they can do to manage flood risk in the area.
- Reading Borough Council have completed clearance work on Christchurch Ditch, also known as The Danall, which runs through the Christchurch and Hills Meadows. The ditch provides minor flood alleviation. The council have an annual ditch clearing programme across the borough.

10. Conclusion

The Flood and Coastal Risk Management (FCRM) appraisal follows a set process. We have explained how we have explored wide ranging approaches to reduce flood risk in our Background options summary report.

Our latest work which informs this report demonstrates that none of the options we have looked at are cost beneficial and would not attract central Government funding. We are recommending the scheme is not progressed.

We have gathered useful information and data that can be used by the Environment Agency, our partner organisations and the public.

Through our work

- More members of the community are aware of their flood risk in Reading and Caversham and what they can do to prepare for a flood.
- We have built new relationships with the community and businesses.
- We have an improved understanding of flood risk and improved flood mapping.
- We have a better understanding of the environment from our ground investigation works, tree and habitat survey, land surveys and reports that we can share with Reading Borough Council and others.
- We have a new database of historical information and visuals which we can share with partners and keep for the future.

Future changes in climate and the way schemes are developed and funded, could lead to the project being revisited in the future but there may still be significant economic and technical challenges to overcome.

We will continue to raise awareness of flood risk in the area and make sure that people know how to respond if flooding were to occur.

11. Glossary

Annual probability	The chance of something happening in any year. For example, a property flooding.
Annual Exceedance Probability (AEP)	The chance of something happening in any year is this or greater. For example, the chance of a flood happening. An area at risk from 1% AEP flood has a 1% or 1 in 100 chance, or greater, of flooding in any year.
Benefit Cost Ratio	The overall value for money of a scheme or proposal.
Existing Measures option	Includes defences, structures and plans that already exist to help protect an area from flooding. These may include physical structures like weirs, or walls, or embankments as well as measures such as flood warnings, the way in which structures are operated, or planned actions in response to flooding.
Do minimum	The Do Minimum option is also referred to as the Existing Measures option. It is used as a baseline economic reference case to determine if increased costs can be justified compared with current Flood Risk Management (FRM) activities carried out by the Environment Agency, and where applicable the local council and private owners.
Flood storage areas	Attenuate (to weaken or reduce in force) flood flows in the river by temporarily filling an area with flood water during periods of high river level, retaining a volume of flood water which is released back to the river after the peak river flows have passed.
Fluvial	Fluvial is a term used to refer to the processes associated with rivers and streams such as erosion, flow processes, and sediment and solute transport.
Main river	Usually larger rivers and streams. The Environment Agency carries out maintenance, improvement or construction work on main rivers to manage flood risk.
Major flood	Flood with a 0.5 % (1 in 200) chance of happening in any year.
Natural flood management	Interventions based on natural processes to intercept, slow or store flood water.
Present value (PV)	Current value of future values (costs, damages or benefits) discounted using a discount rate set by HM Treasury.

12. References

References included as hyperlinks in this document:

Document	Link
Reducing Flooding in Reading and Caversham information page	Reducing flooding in Reading and Caversham information page - Environment Agency - Citizen Space (environment-agency.gov.uk)
Reading and Caversham Flood Scheme Background and Options Report	Background and options summary document.pdf (environment-agency.gov.uk) How to reduce flooding in Reading and Caversham Background and options summary document, June 2020
Partnership funding	Partnership funding - GOV.UK (www.gov.uk) Partnership funding for FCERM projects Guidance Published 2 September 2021
Flood Modeller Pro	Flood Modeller | Industry leading flood modelling software
Standard appraisal guidance	Flood and Coastal Erosion Risk Management: appraisal guidance - GOV.UK (www.gov.uk) FCERM appraisal guidance Published 2 September 2021
Climate change guidance	Flood risk assessments: climate change allowances - GOV.UK (www.gov.uk) Guidance - Flood risk assessments: climate change allowances - When and how local planning authorities, developers and their agents should use climate change allowances in flood risk assessments. Environment Agency, 19 February 2016; last updated 22 July 2020
The Green Book - Central government Guidance on Appraisal and Evaluation, 2020	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938046/The_Green_Book_2020.pdf

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