

Introducing the Plan

The TE2100 project was established by the Environment Agency in 2002 to come up with answers to the challenge of long term flood risk management planning for London and the Thames estuary.

It was agreed that a successful TE2100 Plan would be:

1. Technically feasible and adaptable to change
2. Environmentally sustainable
3. Economically justifiable
4. Socially and politically acceptable

TE2100 Strategic aim

To develop a flood management plan for London and the Thames Estuary that is risk based, takes into account existing and future assets, is sustainable, includes the needs of stakeholders and addresses the issues in the context of a changing climate and varying socio-economic conditions that may develop over the next 100 years.

Our recommendations

This Plan will direct the actions that are needed to manage and reduce tidal flood risk over the next 100 years. It is adaptable to a changing climate to ensure that the actions that are taken are the right ones, taken at the right time and will not waste money on over-engineered solutions.

Our key recommendations

1. The TE2100 policies will direct the implementation of actions and future flood management investment. As the climate changes, we will all need change how we manage and live with floods. In some areas there will be hard choices.
2. We are starting from a good position, we have a world class system of flood defences and flood preparedness plans. For the first 25 years of our plan we recommend continuing with how we manage tidal flood risk today through actively maintaining and improving the existing system at an estimated cost of £1.4 bn. We must continue to work closely with implementation partners to direct new vulnerable development away from high flood risk areas and ensure that those living there remain safe today, and in the future.

3. The middle 35 years of our Plan will see expenditure of the order of £3.1 bn with major renewal and replacement of the Thames tidal defences. This will bring opportunities to reshape and renew the riverside. We recommend that multi-agency riverside strategies are developed to inform spatial planning and asset management decisions and investments.

4. Our ten estuary-wide options have been designed to manage rising water levels through this century and achieve the TE2100 policies. We have considered the social, economic and environmental cost and benefits of these options based on conditions today, to come up with two front runners. But we recommend that flood risk is monitored and the Plan reviewed and updated at least every ten years.

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5. As the climate continues to change and water levels rise, we estimate that around 2050 a decision will be needed on how flood risk continues to be managed. By 2070 we recommend one of our two 'front runner' options is implemented. These are either continuing to upgrade and modify existing flood defences and floodplain management (option 1.4) or constructing a new barrier at Long Reach with associated works (option 3.2). Our estimated cost for the end of the century works is £4.2 bn – noting that the end of the century option may change as a result of a Plan review and changed conditions.

6. TE2100 supporting studies will be maintained and shared with implementation partners to form the basis of a monitoring programme for the TE2100 indicators for change. This will be used to demonstrate progress on TE2100 Plan implementation and to inform the plans of our partners such as strategic flood risk assessments and flood plans.

7. We recommend that 1200 hectares of intertidal habitat is created to replace areas lost due to sea level rise over the period of the TE2100 Plan. We have identified seven sites which have the potential for intertidal habitat creation.

8. We recommend that a Thames estuary land strategy is developed in partnership with decision makers, land owners and managers to safeguard land for future flood risk management and to bring together the various strategic plans and vision statements from across the estuary.

9. Our action plan contains 98 actions which are necessary for successful implementation of the TE2100 Plan. Our action plan is presented at an estuary-wide and local level and divided into three time horizons for decision-making and action.

10. Our action plan will be revised as a result of this consultation and will form the basis of the TE2100 final Plan and its implementation.

The TE2100 action plan will form the basis of continued partnership working with all those involved in flood risk management across the Thames estuary, especially where a multi-agency approach to managing flood risk consequence is needed.

This is how we got there



Our Vision – the TE2100 Objectives

- To manage the risk of flooding to people, and minimise the adverse impacts of flooding to property and the environment;
- To adapt to the challenges that we will face from climate change;
- To support and inform the land use planning process to ensure appropriate, sustainable and resilient development in the tidal Thames floodplain;
- To protect the social, cultural and commercial value of the tidal River Thames, its tidal tributaries and its floodplain;
- To enhance and restore estuarine ecosystems to contribute to biodiversity targets and maximise the environmental benefits of natural floods.

Understanding flood risk and the Estuary

In the early phases of the TE2100 project we collected essential data on habitats, the plants and animals of the Estuary and the sediments to understand how the estuary's natural processes work. With low level helicopter LIDAR⁵ we inspected the defences from the Thames Barrier to the sea. We studied today's flood risk and how it might change in the future and established our vision for future flood risk management. This is described by the TE2100 flood management policies.

TE2100 policies

Our aspirations for sustainable flood risk management for the next 100 years are based on an assessment of how much flood risk management activity we can justify in different parts of the TE2100 Plan area. There are five possible strategic levels of flood risk management available to us. These are defined as policies **P1** through to **P5**. For more information on the flood risk management policies look at our Technical Report chapter 5. The policies set the strategic direction of flood risk management in each part of the Estuary.

This is essential information for planners and those who live and work in these local areas. It is also the starting point for the development of flood management options for the Estuary.

Maintaining confidence

The Thames Barrier will continue to provide flood management to London through most of this century with some modification. Our investigations have confirmed that there is sufficient capacity in the system so major changes in the flood management system will not be needed until 2070 (based on current climate predictions).

However, significant improvements to the current tidal defence system will be needed before 2070 including raising the crest level of most of the flood defences and replacement of a large proportion of the assets as they reach the end of their lives. A comprehensive programme of continuing maintenance and improvements is therefore essential. Our first 25 years of the TE2100 programme includes this essential work.

Thereafter, our Plan will continue to provide confidence to the 1.25 million people who live and work in the London and Thames estuary tidal floodplain, and will provide a shared understanding of flood risk management for our strategic partners and other groups.

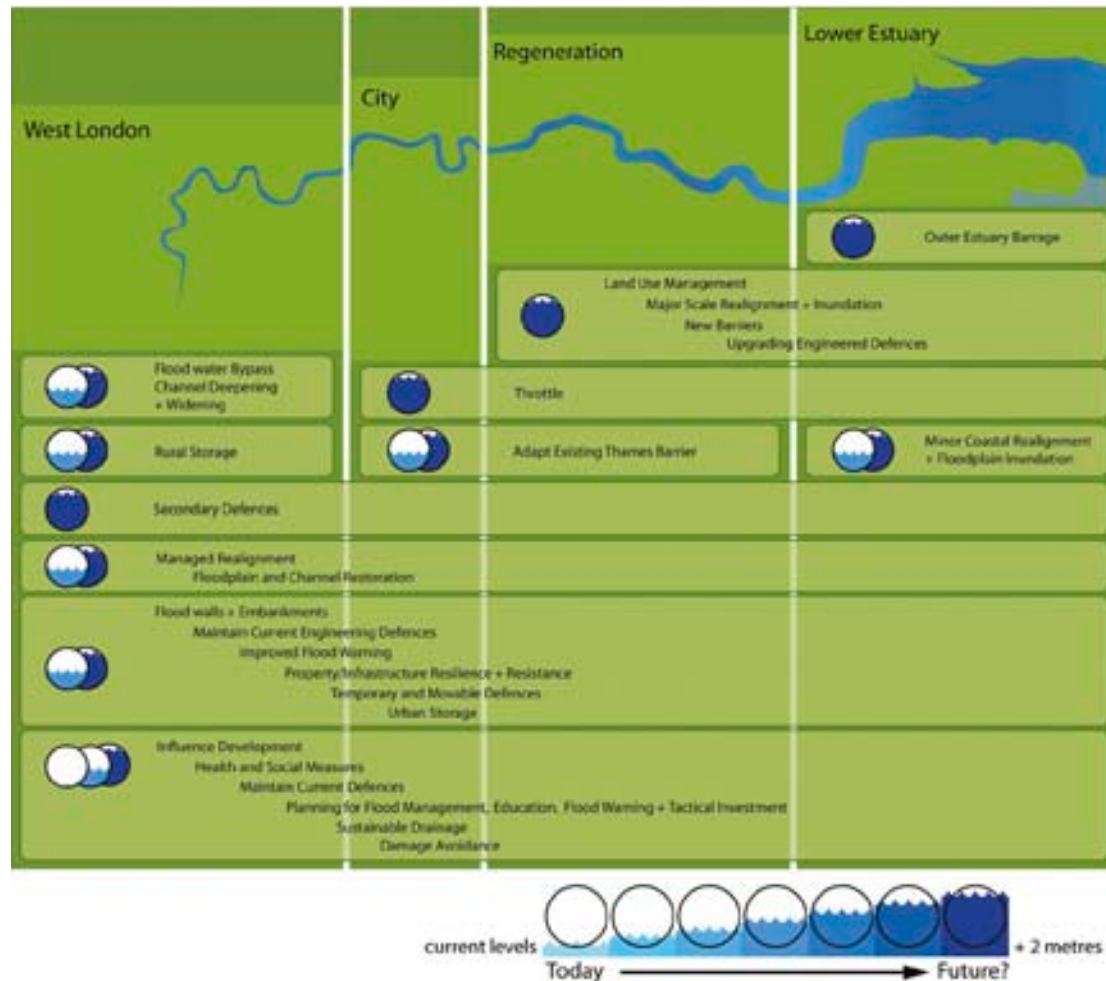
Developing the options and selecting the front runners

In phases 2 and 3 of the project we developed tools, models and techniques to help us develop a range of options to manage flood risk. We studied a wide range of possible options and through our investigations and assessments we identified the most promising options to be investigated further. The diagram overleaf is from our Early Conceptual

⁵ LIDAR (Light Detection and Ranging) a method of obtaining high quality measurements from a distance

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Early conceptual options: our starting point for options development



Options consultation in 2005 showing a summary of the possible options for managing flood risk in the estuary.

What options have been excluded? Following investigation, consultation and appraisal, some of these options have been excluded:

- **Throttle.** This was excluded because our further investigations showed that it was not effective in reducing flood risk.
- **A tide-excluding barrage** was excluded because of the adverse impacts that impounding the estuary would cause, including water quality, morphology and drainage.
- **A Barrier with locks** in the outer estuary (downriver of Canvey Island) was excluded because of cost, environmental impacts and constraints to navigation to the Thames Gateway Port and other port facilities on the estuary.
- **A Barrier in the outer estuary** (downriver of Canvey Island) was excluded because of cost and adverse impacts on the estuary environment and navigation.
- **Improved channel conveyance** from Teddington to Brentford. This was excluded on the grounds of adverse environmental impact and lack of sustainability.

How options reduce flood risk

An option is made up of a combination (or portfolio) of different actions which act together to achieve the recommended policy. This is shown in the Figure below. The green line represents the increasing flood risk, and the horizontal line represents the policy. The red line shows how each portfolio of actions reduces flood risk so that



Managing flood risk using 'portfolios' sequenced through the century

it stays below the policy level. It is therefore necessary to make decisions ahead of when they are needed. Some actions will require a lead in time of 20 years or more.

We have developed four generic options (the red “saw-tooth” line) which can successfully manage flood risk through the century.

These have been further developed to form ten estuary-wide options. We have investigated these options in more detail and tested them for effectiveness and efficiency in delivering our strategic vision. Our ten estuary-wide options are summarised in table 5.1.

Our recommended option: We recommend maintaining and improving the existing system (option 1.4) as the optimum approach for the first 60 years of our Plan, with new arrangements required by 2070 (under current government climate change guidance) for the option which takes us into the 22nd century. At this stage there are two front runners; continue to maintain and improve the existing system (option 1.4) or a new barrier at Long Reach (option 3.2).

Through our action plan (whole estuary – Zone 0), we are seeking your views on these recommendations.



Do you consider that we have identified the right strategic options for managing tidal flood risk in the Thames estuary, and do you agree with the final preferred options?



Find out more about our front runners in Designing an adaptable plan (overleaf) and Chapter 7.

Table 5.1. The TE2100 Estuary-wide options

Option 1. Improve the existing defences

- 1.1. Raise defences when needed
- 1.2. Allow for future adaptation of defences
- 1.3. Raise defences when they are replaced
- 1.4. Optimise defence repair & replacement

Option 2. Tidal flood storage

Four potential sites have been identified which are in the right location to store tidal waters and reduce the level of storm surges. The sites identified are at Erith Marshes, Aveley and Wennington Marshes, Dartford and Crayford Marshes, and Shorne and Higham Marshes.

Option 3. New Barrier

- 3.1. Tilbury Location
- 3.2. Long Reach Location

The new Barrier would be designed to resist the highest surge tides predicted under government climate change guidance.

Option 4. Barrier with locks

- 4.1. Tilbury Location
- 4.2. Long Reach Location
- 4.3. Convert Thames Barrier to a barrier with locks when the operational limit of closures per year is reached.

Sea level rise and pressure on habitats: Valuable habitat is being lost because our defences are preventing it from migrating landwards as sea level rises. Over the 100 year life of our Plan, 1,200 hectares of new habitat will be needed. We have identified seven sites which have the right characteristics for habitat creation, and we are likely to need to use four of these sites. The sites are shown on the estuary-wide option maps in our Action Plan Zone 0. The sites are:

- Grain Marshes
- All Hallows Marshes
- St. Mary's Marsh
- West Canvey Marshes
- Vange Marsh
- Bowers Marsh
- Fobbing Marshes.



Your responses to this part of our action plan will enable us to finalise our habitat creation programme.

Understanding the local issues

Having established estuary-wide options for flood risk management, these must be taken down to local level. There are a number of different choices for this local implementation which must be

designed to optimise flood risk management within each policy unit whilst remaining true to the requirements of the estuary-wide options. There is also a need to include managing flood risk from other local sources of flooding, for example tributaries or urban drainage. Just because these are local issues, it does not mean they are less important. It is the local choices which have the greatest and most immediate impact on the local environment and people.



Our action plan includes our recommendations on how these local issues should be further developed. We are seeking your views to assist us in finalising these recommendations.

Understanding consequences

The pressures of society, the environment and the economy are increasing the risk to those in the floodplains. We need to reduce the consequences of flooding and make the floodplains a safer place. We must take pragmatic measures which take account of the protection already offered by the defences. But the measures must ensure that in the event of failure or overtopping of the defence, existing and new developments are safe. Spatial

planning and emergency preparedness will have an increasing role in flood risk management in the Thames Estuary. We have studied the vulnerability of communities and infrastructure within the Estuary and have a wealth of data to share with emergency planners and other implementation partners.



Our action plan explains these local measures and seeks your views.

Designing an adaptable plan

Dealing with uncertainty: Chapter 4 describes the uncertainty of future change and the challenge this presents to implementation of our Plan. Our TE2100 plan must be adaptable to change and remain fit for purpose throughout its 100 year life. To achieve this, we have identified ten key indicators of the changes which will affect flood risk management. These indicators, or “triggers for change” must be monitored throughout the life of the TE2100 Plan (see table 5.2 opposite). The outputs from this monitoring programme will inform the regular reviews and re appraisal of the Plan. Importantly, they will also trigger decision-making if rapid change occurs in one or more of the indicators.

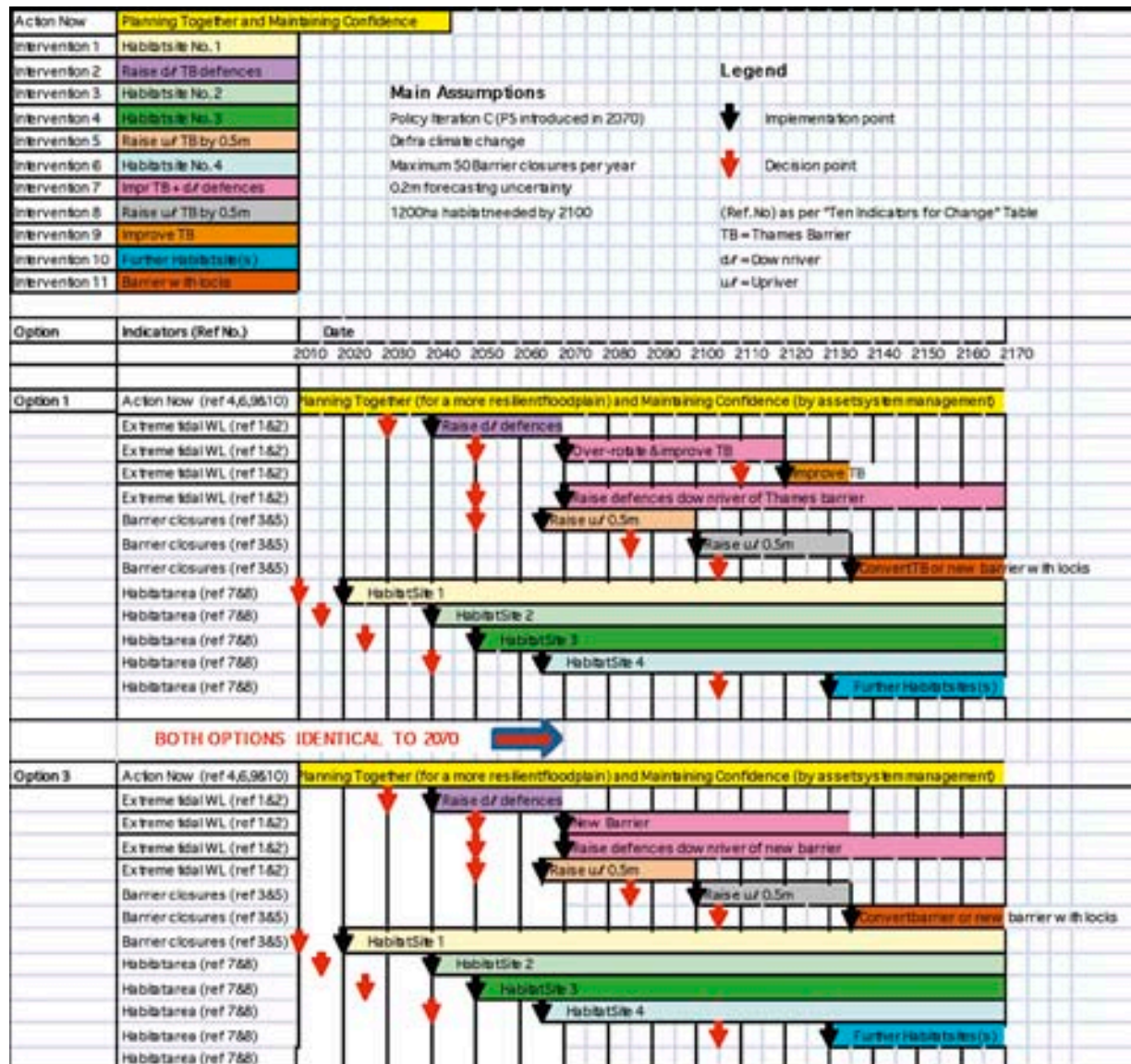
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Table 5.2. Ten indicators for change – and why they are important to TE2100

1	Mean Sea Level	The level to which protection may be required twice a day every day. Mean sea level is the level which determines the number of times per year that a barrier must be closed. This also has a major impact on the area of intertidal habitat in the Estuary.
2	Peak surge tide level	The extreme (but rare) tidal flood levels which will have to be managed. Peak surge tide level also determines the crest level of the defences including the Thames and other barriers.
3	Peak river (fluvial) flood flows	The combined tidal/fluvial flood risk at pressure points in West London and where tributaries meet the estuary.
4	Condition of flood defence structures	How to optimise the repair and renewal of defences for investment programmes getting best value for money whilst ensuring public safety. To ensure that the flood defence system will function as required. Identification of the improvements needed to ensure the integrity of the system.
5	Frequency of closure and reliability of the Thames/ other barriers	How much useful life remains for these important structures, and how efficient they are.
6	Developed area and value/ type of development	People and property at risk. Key social and economic information for flood risk management planning.
7	Extent of erosion/deposition	How stable the morphology of the estuary is and how this affects the ecology of the estuary and the defences.
8	Intertidal habitat area including mudflat and saltmarsh	The health and stability of the intertidal habitat zone, and whether we are complying with EU habitats regulations.
9	Land use planning and development activities	A measure of how well flood risk (i.e. safer floodplains) and opportunities for sustainability (e.g. the creation of green corridors) are being factored into development. Also predicts future needs for society and economics.
10	Public/institutional attitudes to flood risk	Public (hence political) appetite for risk and institutional preparedness to manage risk and to plan for/respond to emergencies.

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Table 5.3. TE2100 Plan options compared through the century



Planning for the long term: To plan effectively to the end of this century, we will be making decisions which affect future generations well into the 22nd century. Table 5.3 illustrates how our two front runners could provide a flood risk management system to the end of this century and beyond.

The indicators for change are shown. These must be monitored to ensure the Plan remains flexible and responds appropriately to change. Table 5.3 also shows how the two front runners recommended in our Plan would be implemented in stages. Some key points to note are:

- the arrows showing implementation date and decision dates;
- both options are identical from 2010 to the year 2070;
- the horizontal bars on the options charts show when each intervention starts and when it ceases to be of value;
- when an intervention ceases to be of value, a new intervention is implemented. But the decision to do this must be made 10, 20 or even more years earlier as shown;
- Table 5.3 shows the timing of interventions for the government current climate change guidance (Defra 06).

There is no way of knowing exactly what London and the Thames Estuary will look like so far in the future, The choice of “end of the century” option will be made around 2050 during a future review of the TE2100 Plan and will be based on the conditions prevailing at the time of the review.

TE2100 – Fit for Purpose over its 100 year life?

We recommend that the TE2100 Plan is reviewed against the 10 indicators for change every 10 years as a minimum – or more frequently if major change is occurs in one or more of the indicators being monitored.

If one or more of the indicators change significantly, this will trigger a movement of the bars on Table 5.3 showing the interventions. This could be likened to the channel volume sliders on a sound mixing desk, the final “mix” being the optimum decisions at each stage throughout the life of the TE2100 Plan.




There are many different ways in which we could respond to changes identified each time the TE2100 Plan is reviewed and updated. Table 5.4 shows the ways in which the TE2100 Plan is adaptable to change.

Table 5.4. How the TE2100 Plan is adaptable

<p>Changes to the timing of new intervention: If rates of change increase, interventions will be brought forward. If the rates of change are slower, then these interventions will be delayed.</p>
<p>Ability to change between options: If the rate of change of a critical factor is significantly different from the expected rate of change, it may be necessary to switch to an alternative option which can cope more efficiently with these new conditions.</p>
<p>Adaptation of engineering responses: Structures should be designed so that they can be adapted to changing circumstances. For example, providing foundations for new defences that can take higher future flood water loadings, or designing barriers and other control structures that can be modified in the future. The initial cost will be higher than responses that do not allow for subsequent adaptation, but this can result in significant savings over the whole life of the structure.</p>
<p>Safeguarding land for future options: Each flood risk management option will require land for new defences, enlarged defences, new barriers, new areas of habitat creation, and in some cases flood storage. Land allocations through the spatial planning system must be guided and informed by the requirements of the TE2100 options to ensure they remain possible.</p>
<p>Adaptation to new infrastructure: New infrastructure on the Thames estuary could have a major impact on flood risk management arrangements. For example, ports such as the proposed London Gateway Port at Shellhaven will require free access for navigation. Also, new transport links could provide the opportunity to combine a new crossing of the estuary with a new barrier. This could be brought forward in the TE2100 Plan if this is justified by the synergies and funding from different groups.</p>

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Three time horizons – three themes for flood risk management

	<p style="text-align: center;">The first 25 years from 2010 to 2034</p> <p style="text-align: center;">“Maintaining confidence and planning together”</p>	<ul style="list-style-type: none"> • Continuing maintenance, operation and essential improvements. • Safeguarding the spaces for future flood management. • TE2100 will have a real influence in the preparation of, and updating of regional and local strategic and spatial plans.
	<p style="text-align: center;">The middle 35 years from 2035 to 2069</p> <p style="text-align: center;">“Renewal and reshaping the riverside”</p>	<ul style="list-style-type: none"> • Many of the existing walls, embankments and smaller barriers will need raising and major refurbishment or replacement in this period. • These major projects provide an opportunity to reshape our riverside environment through working with spatial planners, designers, environmental groups and those who live and work in the Estuary area. • Towards the end of this period, a decision will be made on the century option to be adopted.
	<p style="text-align: center;">To the end of the century from 2070</p> <p style="text-align: center;">“Preparing for, and moving into the 22nd century”</p>	<ul style="list-style-type: none"> • From 2070 (based on government’s current climate change guidance) a major change will be needed and one of our “end of the century” options will be implemented. • This is a long time in the future but your views are important as they will set the basis from which future changes in attitudes are measured.

The supporting evidence

We have built up a comprehensive evidence base of data and results with over 300 studies and investigations. This evidence provides a firm foundation to our TE2100 Plan. It is also a valuable resource for us to share with implementation partners. 📄 To find out more see chapter 11.

Deciding on the Plan

In order to decide on our preferred Plan we have had to understand the impacts of all of our ten estuary-wide options. We have used two key methods – economic appraisal and strategic environmental assessment, to undertake this work which is described in chapter 7 “Deciding on the Plan”.

📄 For more information on appraisal and assessment see chapter 7.

Planning the implementation

Three phases have emerged for implementation of our TE2100 Plan, each having a different objective and theme representing the developing needs of flood risk management in the Thames estuary over the 100 years of the TE2100 Plan:

- Maintaining confidence and planning together” (2010 to 2034);
- Renewal and reshaping the riverside” (2035 to 2069);
- Preparing for, and moving into the 22nd Century” (from 2070).

Our consultation questions are in the short, medium or long term of the action plan. To aid your navigation through the action plan, we have colour coded the text according to the relevant time horizon and position in the Estuary.

A 100-year programme of works has been developed. The detail of the works proposed is contained in our action plan chapters 8 and 9. We have a high degree of confidence in the short- and medium-term programmes which take us up to the end of 2069. From 2070, given government’s current climate change guidance, a major change in the flood risk management system will be required. Our long-term programme, which takes us from 2070 into the 22nd century, has been

based on the options which come out best from our appraisal process measured against today's conditions. Significant changes in climate and other factors over the next 60 years may point to a different recommended option for the end of the century.



Your responses to the long term sections of our action plan will also guide future decision-making.

Building the partnerships


The overall responsibility for flood risk management lies with the Environment Agency but we cannot implement the TE2100 Plan alone. It requires a multi-agency approach to implementing the Plan. For instance, regional and local authorities will play a key part in delivering our recommendations for spatial and emergency planning procedures.



Your response to our action plan will help us build on existing partnerships and create new ones.

The action plan

Our action plan chapters 8 and 9 describes the actions required at local and estuary-wide level by the different people and organisations involved. This is central to our consultation and our questions are designed to seek your responses to our action plan to enable us to finalise our Plan. We are also seeking your views on our long-term plan. This will provide a basis for future decision-making.

But the work of the TE2100 Plan starts once this consultation is completed and we submit the final plan to Government in 2010. The first actions and investments are scheduled to start immediately the plan is agreed. Our programme indicates major expenditure of £1.4 bn in the first 25 years alone – though much of this represents a continuation of what we are doing now. The middle 35 years of our Plan has an estimated cost of £3.1 bn and the final years, to the end of the century, £4.2 bn (depending on the final option selected).  More information about the estimated costs of the options we are recommending and the proposed expenditure is contained within our TE2100 Technical Report. Details of how to get hold of this are in chapter 11.

This is a major investment. We are confident that our decisions are based on the best possible

science and we have worked with and listened to others throughout the development of this Plan. But this is the first time that all the elements of our Plan are presented together. It is now over to you to have your say.



The Thames Barrier – visitors on a technical tour