Catchment to Coast

Outline Business Case

Southend-on-Sea Borough Council and Thurrock Council

Version 1.0, 14th January 2022

Two Tree Island – An historic coastal land fill site spanning Southend-on-Sea and Castle Point Boroughs

Issue and revision record

Revision	Date of Issue	Originator	Checker	Approver	Description
1.0	14.01.2022				Initial version for SBC cabinet

Comment sheet

Changes from EoI Submission to OBC

Summary of Submission

Project name:	**Catchment to Coast**
Project reference:	**SOU019**
Total Project Value:	**£6.323m**
OBC Submission Value for Approval:	**£6.323m**
Public Contributions (£):	**£0 (will involve benefits in kind)**
Private Contributions (£):	**£0 (will involve benefits in kind)**
Primary Source of Risk: **Pluvial Flooding** Secondary Sources of Risk: **Fluvial Flooding Coastal Erosion**	
Milestone Full Business Case Approval	**31/03/2023**
Milestone – Readiness for service	**31/03/2025**
Project completion	**31/03/2027**
Short description of the project	The Catchment to Coast project intends to address current risks of flooding and coastal erosion at historic landfill sites. The study area focuses on the boroughs of Southend-on-Sea and Thurrock, who are leading on the project, including areas within the district of Rochford and borough of Castle Point. The project spans three catchments and will employ innovative flood and coastal resilience measures through a combination of nature-based solutions and erosion protection and sustainable drainage systems in a focussed, catchment-wide, approach.
Short description of the benefits	Benefits generated by the Catchment to Coast project will take the form of quantitative reductions to flood risk and coastal erosion and increased understanding and learning of the use of innovative measures based on the data gathered. This qualitative learning will be shared with DEFRA, the EA and the wider IRF programme as the project progresses to

	compound the learning across projects, with the outcomes used following the project completion to inform future knowledge and decisions regarding capital schemes.	
Lead Authority	**Southend-on-Sea Borough Council (SBC)** Thurrock Council (TC)	
Delivery Partners	Castle Point Borough Council (CPBC) Rochford District Council (RDC) Environment Agency (EA) Anglian Water (AW) Kings College London (KCL) The University of Essex (UoE) AmbioTEK CIC (ACIC) Essex Wildlife Trust (EWT) Mott MacDonald (MM) Thames 21 (T21)	
Project Risk (£)[1]	**£621k**	**10%**
Optimism Bias value (£)	**£1.255m**	**20%**

[1] These risks relate to the scope of work being funded by the flood and coastal resilience programme if this is different to the whole project.

Expenditure Profile:

Costs per phase	Phase 1 2021-23	Phase 2 2023-25	Phase 3 2025-27	Total
Flood and Coastal Resilience Innovation Programme Funding	£1.631m	£4.171m	£521k	£6.323m
Contributions	£0	£0	£0	£0
Total Project Expenditure	£1.631m	£4.171m	£521k	£6.323m

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Contents page

Appendices

1 Catchment to Coast project partner Memorandum of Understanding
2 High-level project programme

1 Executive Summary

The Catchment to Coast project intends to address the current risks of flooding and coastal erosion in the boroughs of Southend-on-Sea and Thurrock as well as parts of the district of Rochford and borough of Castle Point. The project spans three catchments and will deliver innovative flood and coastal resilience through a combination of nature-based solutions, sustainable drainage systems and erosion protection through a focussed, integrated catchment-wide approach.

The project will be undertaken as a collaborative partnership with key stakeholders and technical consultants. Southend-on-Sea Borough Council will be acting as the Project Lead for the Catchment to Coast Project. In addition, Thurrock Council will be a key project partner. The project forms part of the 6-year Flood and Coastal Resilience Innovation Programme led by the Environment Agency (EA) and the Department for Environment, Food & Rural Affairs (Defra).

The locations and measures being explored further within the Catchment to Coast, as shown in Figure 1.1, are as follows:

- Surface water flood risk reduction in Shoebury, Prittle Brook and Stanford-le-Hope catchments, and in the Wharf Road, Balstonia Park and Tank Hill Road areas using nature-based solutions such as leaky dams and regenerative agriculture in the upper catchment areas, with the retrofitting of Sustainable Drainage Systems (SuDS), including the implementation of water storage and community re-use measures, in the middle and lower catchment.
- Surface water flood warning beacons in high surface water flood risk areas of the Shoebury, Prittle Brook and Bulphan catchments.
- Coastal erosion risk reduction measures at Two Tree Island, Coalhouse Fort, Fobbing Marshes, Tilbury, Tilbury Marshes and Castle, The Warren, Hadleigh Seawall, Leigh Station, Canvey Heights Country Park and Benfleet Creek, including implementation of bio-tiles and off-shore bio-barriers to reduce the impact of waves. The use of coir rolls and dredged material to further stabilise and encourage the generation of new saltmarsh.

Figure 1.1: *Catchment to Coast project study areas*

The wider innovative resilience programme requires a focus on innovation and learning to help increase understanding of measures and better inform flood resilience and coastal erosion capital programmes into the future. The following innovative aspects will be explored as part of the Catchment to Coast project:

- Using innovative measures and processes, or both to deliver flood resilience and coastal erosion protection
- Exploring measures that provide flood benefits and drought protection, such as water storage and re-use, for example in allotment areas
- Taking a whole-catchment approach to the reduction of flood risk and wider management of water as a resource
- Working across boundaries in partnership with other risk management authorities to better take account of flood risk and management within hydrological catchments
- Regenerative agriculture and soil health improvements, including mapping, to help manage flood risk and improve agricultural efficiency
- Hydro-citizenship, involving increasing awareness of flood risk and drought and getting buy-in from communities to better allow the delivered measures to be managed and maintained after the project completion.
- Achieving wider benefits, such as pollution risk reduction, carbon efficiencies, improved carbon sequestration, biodiversity net gain and socio-economic benefits from measures.

Based on the innovation focus and goal of reducing flood risk and coastal erosion whilst gaining wider benefits, the objectives of the Catchment to Coast project are:

1.) **Improved Flood Resilience:** Increase the resilience of communities, agricultural land and infrastructure to flood and coastal erosion risks within the project area
2.) **Creating Awareness and Education:** Provide opportunities for education and increased awareness and responsibilities within the communities

3.) **Pollution Reduction:** Achieve improvements to water quality and reduce/diffuse pollution through intervention
4.) **Wider Benefits:** Provide and demonstrate the value of wider benefits from innovative flood risk and coastal erosion risk reduction measures
5.) **Data Capture, Monitoring, Reporting and Learning:** Provide increased knowledge and data regarding innovative solutions
6.) **Influence Future Policy Making**: Influence local policy to drive improved decision making around flood risk and coastal erosion reduction

The project will be divided into three main phases:

Phase 1 (April 2021 to March 2023): project set-up, partnership creation, baseline data gathering, modelling, optioneering and detailed design
Phase 2 (April 2023 to March 2025): construction, installation and measure delivery
Phase 3 (April 2025 to March 2027): post installation monitoring, measure performance assessment, project learning

The project is 100% grant funded, with £6.323m assigned to the project over its 6-year lifetime.

2 Strategic Case

2.1 Project Background

Southend-on-Sea Borough Council and Thurrock Council have responsibility for local flood risk as Lead Local Flood Authorities under the Flood and Water Management Act (2010). SBC also has a responsibility for the flood and coastal erosion risk along its frontage as the Risk Management Authority (RMA) following the Coastal Protection Act (1949).

Historically, the boroughs of Southend-on-Sea and Thurrock have experienced multiple flood events, causing widespread disruption to roads and residential properties. The flooding during these events has primarily resulted from intense rainfall coinciding with high tidal and fluvial levels, causing flooding from surface water, sewer, and fluvial sources. There are also concerns of flooding during a tide locking scenario.

Along the Catchment to Coast frontage there are localised areas of erosion. It is uncertain at this present time in the project whether any accretion will be maintained or will slow down and then start to erode with sea level rise.

The defence line around Southend-on-Sea has a maximum unmaintained life (residual life under no active intervention) of 21 to 30 years, with the maximum life of 31 to 40 years.

Historic landfill sites in Thurrock, Castle Point and Southend-on-Sea are fronted by saltmarsh and are at risk of coastal erosion – the 2010 Shoreline Management Plan for Essex and South Suffolk identifies a general trend of erosion throughout the middle and lower estuaries, combined with sediment accretion in the upper estuaries and their creeks systems. Additionally, there is an overall net loss of saltmarsh in Benfleet and Southend-on-

Sea, which is estimated conservatively at approximately 1.5ha per year. The seawall along the frontage at Hadleigh and Leigh Station is filled with unknown material which has the potential to be contaminated.

2.2 Case for Change

Within Southend-on-Sea, groyne repairs are scheduled to commence in April 2022 to restore missing boards and piers across the coastal frontage to increase accretion on beaches through reduced sediment transportation. Other works are currently proposed including localised capital maintenance works with reviews into potential defence replacements in several urbanised areas.

The visual inspection of coastal defences, flood gates and flap valves are undertaken cyclically and used to reactively inform maintenance works. Emergency inspections and repairs are undertaken on an ad-hoc basis as required based on reports of issues received.

Proactive measures to reduce the risk of coastal flooding are undertaken in line with the Southend Shoreline Strategy. It should be noted that coastal asset improvements focus on defences in areas where there is a risk to residential properties, businesses and infrastructure to ensure risks of flooding and erosion are minimised, with historic landfill sites a lower priority.

Surface water flood risk in the SBC area is primarily addressed reactively based on incidents, with highway drainage cleansing, riparian ownership enforcement and advice provision the primary activities. Proactive measures are undertaken in line with the Local Flood Risk Management strategy and contents of the Southend Surface Water Management Plan, with the viability of a flood defence scheme currently being explored within the Eastwood Brook catchment.

2.3 Catchment to Coast Project and Project Scope

An expression of interest for the Catchment to Coast project was submitted to DEFRA in January 2021 jointly by Southend-on-Sea Borough Council and Thurrock Council. This was approved in May 2021 awarding the Catchment to Coast project a total of £6.323m grant funding between April 2021 and March 2027 to deliver innovative measures to reduce flood risk and coastal erosion in the project study areas.

The submitted expression of interest outlines the proposed actions and study areas that forms the scope of the Catchment to Coast project. It should be noted that as an innovative resilience project there is an emphasis on the innovation and learning aspects, rather than achieving the maximum benefits, which allows for a unique opportunity to explore new types of resilience and processes and in areas that may not have attracted funding through normal routes.

The reduction of flood risk will be explored through the delivery of measures within the following hydraulic catchments. The study areas constitute the entire hydrological

catchment areas to allow a fully holistic approach to assessment of risk, implementation of measures, monitoring and learning of the benefits that can be achieved through such an approach. These catchments are:

- Shoebury
- Prittle Brook
- Stanford-le-Hope catchments

The measures being explored within the project involve the use of nature-based solutions, such as leaky dams and regenerative agriculture in the upper catchment areas, with the retrofitting of Sustainable Drainage Systems (SuDS), including the implementation of water storage and community re-use measures, in the middle and lower catchment.

Surface water flood warning beacons are being explored within high surface water flood risk areas of the Shoebury, Prittle Brook and Bulphan catchments.

To reduce the risk of coastal erosion, measures are being investigated at the following historic landfill sites across the project study area:

- Two Tree Island
- Coalhouse Fort
- Fobbing Marshes
- Tilbury
- Tilbury Marshes and Castle
- The Warren
- Hadleigh Seawall
- Leigh Station
- Canvey Heights Country Park
- Benfleet Creek

The potential measures being considered include the implementation of bio-tiles and off-shore bio-barriers to reduce the impact of waves. The use of coir rolls and dredged material to further stabilise and encourage the generation of new saltmarsh.

The wider innovative resilience programme requires a focus on innovation and the following will be explored as part of the Catchment to Coast project:

- Using innovative measures and processes, or both to deliver flood resilience and coastal erosion protection
- Exploring measures that provide flood benefits and drought protection, such as water storage and re-use, for example in allotment areas
- Taking a whole-catchment approach to the reduction of flood risk and wider management of water as a resource
- Working across boundaries in partnership with other risk management authorities to better take account of flood risk and management within hydrological catchments
- Regenerative agriculture and soil health improvements, including mapping, to help manage flood risk and improve agricultural efficiency

- Hydro-citizenship, involving increasing awareness of flood risk and drought and achieving buy-in from communities to better allow the delivered measures to be managed and maintained after the project completion.
- Achieving wider benefits, such as pollution risk reduction, carbon efficiencies, improved carbon sequestration, biodiversity net gain and socio-economic benefits from measures.

2.4 Strategic Policy Links

This OBC and the goals of the Catchment to Coast project align with the following strategies, plans and policies within Southend-on-Sea Borough Council and Thurrock Council:

Southend-on-Sea Borough Council Core Strategy Policies:

- CP4 - The environment and urban renaissance: Sustainable development must be used with a focus on the inclusion of green spaces and protection and enhancement of natural resources
- KP2 - Development principles: The inclusion of appropriate flood resilience measures in all development to mitigate risks on site and the wider area where possible
- KP3 - Implementation and resources: Required use of flood protection or mitigation measures such as SuDS within all developments
- G7 - Coastal protection: Important areas, including two-tree island, will have development restrictions to protect the existing wildlife and retain the views and visual amenity
- C15 - Retention of open spaces: Open spaces will be retained and safeguarded for public use and recreation
- H12 - Environmental improvement of residential areas: Public open space will be retained to reduce environmental impacts and, where possible, improved to increase local biodiversity and ecology

Southend 2050: The Borough's shared ambition for the future based on feedback from residents and businesses. Key outcomes include: acting sustainably based on the ongoing climate emergency, valuing public spaces and that all development is high quality and sustainable.

Southend-on-Sea Borough Council Local Flood Risk Management Strategy (2015): The LFRMS forms a requirement of the Flood and Water Management Act 2010 and provides a high-level summary of surface water flood risk along with objectives for the management and reduction of this. Key objectives include improving understanding, undertaking measures that include wider benefits and continuing to actively manage flood risk and coastal erosion.

Southend-on-Sea Borough Council Surface Water Management Plan (2015) (SWMP): This study builds upon the LFRMS to explore surface water flood risk in more detail through hydrological modelling. Critical Drainage Areas (CDAs), which constitutes areas of higher risk, are created with high level options included to guide further work into the potential

implementation of mitigation measures. The Southend-on-Sea Borough Council SWMP created 6 CDA's, two of which are Shoebury and Prittle Brook, which form part of the IRF project.

Southend-on-Sea Borough Council Coastal Flood Risk Management Implementation Plan (2019): The strategy outlines how to best manage the coastline to protect people, properties, designated habitat and agricultural land from flooding. It details the processes as to how asset inspections, maintenance and future schemes will be undertaken.

Thurrock Council Core Strategy:

- Policy SSO12- Protect and enhance the natural, historic and built environment including biodiversity, landscape character, Conservation Areas, Listed Buildings, Scheduled Monuments and other heritage assets and open space through positive improvement.
- Policy SSO14- Promote sustainable development in Thurrock through the prudent use of water and other natural resources, sustainable design, methods and materials, and integration of land-use with the maximum re-use of land.

Thurrock Council LFRMS (2015): The current strategy draws upon 12 national regional and sub-regional plans including the Thurrock Multiagency flood plan to improve manage and protect areas from flood risk through active measures and through community flood resilience which is one of the key objectives of this project.

Thurrock Council SWMP (2014): These plans build upon the findings of the previous LFMRS and identify potential high-level options that can be undertaken within a catchment to reduce flood risk. The SWMP has identified 14 Critical Drainage Areas (CDAs). Bulphan, Stanford Le Hope and East Tilbury areas are within these CDAs and form part of the study area of the Catchment to Coast IRF project and options will be explored to reduce flood risk to residents, businesses and infrastructure in these locations.

Thurrock Council Shoreline Management Plan (SMP): The first SMP for Essex was published in 1997. The Plan provides a foundation for sustainable coastal defence policies within a particular sediment cell and establishes objectives for future management of the shoreline. Thurrock lies within the first Coastal Unit, of the Shoreline Management Plan, which covers the 'Mardyke to North Shoebury' and the preferred coastal defence policy for this coastal unit is to hold the existing line of flood defence. A plan to outline the measures required to manage the coastline through either the maintenance, construction or removal of defences. The development of landfill site into biodiverse rich nature areas will contribute to key objective of reducing leachate and improving shoreline erosion, maintaining bed level, reduction of smothering of shellfish habitat, defence to climate change and protection of SSSI.

Water Framework Directive: Thurrock is covered by the Thames River Basin Management Plan (RBMP) and Southend falls within the South Essex RBMP. RBMP's identifies the current quality of water bodies in the borough and sets objectives for making further improvements to the ecological and chemical quality. One of the key objectives under the WFD is the requirement to prevent deterioration in the current status of water bodies, whilst heavily

modified water bodies (HMWB) must achieve 'good ecological potential' (GEP) within a set deadline. The project will help reduce/diffuse agricultural pollution through upland conservation and land management practices thereby improving water quality within Mardyke, Shoebury and Prittle Brook catchments.

2.5 Project Objectives

The aims of the wider Environment Agency flood and coastal resilience innovation programme, of which the Catchment to Coast project falls within, are to:

- Encourage local authorities, businesses and communities to test and demonstrate innovative practical resilience actions in their areas
- Improve the resilience of 25 local areas, reducing the costs of future damage and disruption from flooding and coastal erosion
- Improve evidence on the costs and benefits of the innovative resilience actions and demonstrate how different actions work together across geographical areas
- Use the evidence and learning developed to inform future approaches to, and investments in, flood and coastal erosion risk management

Specific objectives have been set for the project to align with the above and achieve the goals of reducing flood risk and coastal erosion whilst generating learning and achieving additional benefits to the project locations and surrounding areas. These are:

1.) **Improved Flood Resilience:** Increase the resilience of communities, agricultural land and infrastructure to flood and coastal erosion risks within the project area
2.) **Creating Awareness and Education:** Provide opportunities for education and increased awareness and responsibilities within the communities
3.) **Pollution Reduction:** Achieve improvements to water quality and reduce/diffuse pollution through intervention
4.) **Wider Benefits:** Provide and demonstrate the value of wider benefits from innovative flood risk and coastal erosion risk reduction measures
5.) **Data Capture, Monitoring, Reporting and Learning:** Provide increased knowledge and data regarding innovative solutions
6.) **Influence Future Policy Making**: Influence local policy, including planning, to drive improved decision making around flood risk and coastal erosion reduction

2.6 Key Innovation and Learning

As an innovation driven project there is a significant emphasis on the use of new products and processes, monitoring performance and reviewing the success of measures post-delivery. The project will be able to provide new evidence and learning throughout the different stages of the project life, examples of these are shown in Figure 2.1.

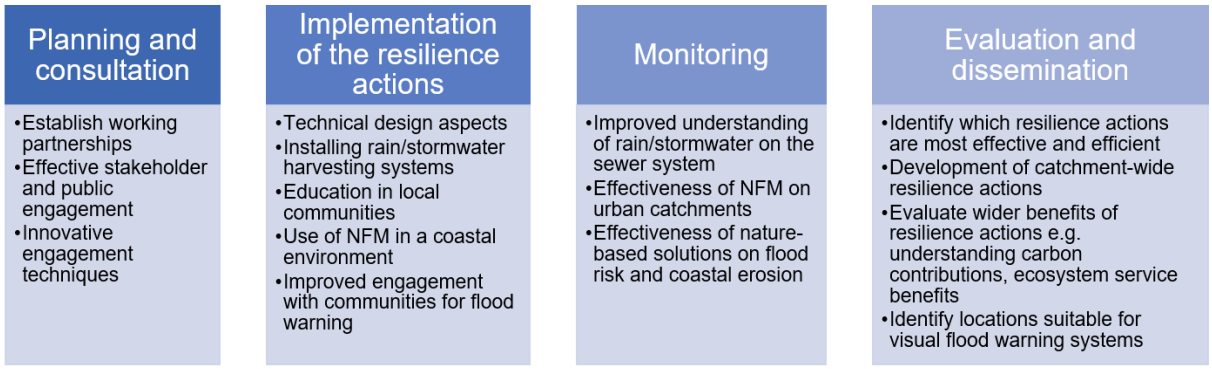

Figure 2.1: *Lessons to be learned from the Catchment to Coast project*

Outputs from the project will be shared directly with DEFRA, the EA and other projects in the IRF programme throughout the project lifetime. Data and learning will also be shared with other projects that involve the use of working with natural process (WWNP) measures to reduce flood and coastal erosion risk, such as research studies that are being conducted in the UK and other locations across the world.

The Catchment to Coast project partnership includes AmbioTEK CEC, King's College London and the University of Essex and these partners are specifically involved to aid with the monitoring and learning aspects of the project respectively.

Data collection and monitoring will form a key part of the project to allow the successful determination of how effective the delivered measures have been. AmbioTEK CEC have a background on providing low-cost, easy to deploy monitoring equipment and have worked with KCL historically on similar projects. The ability to easy deploy monitoring equipment will allow large amounts of high-resolution, high-quality data to be captured to quantify the performance and benefits created by the delivered measures.

As part of the project a PhD student will be employed from both KCL and the University of Essex, with one working over years 2-5 of the project and the second over years 3-6, creating an overlap during the middle two-year delivery phase and first year of the monitoring and learning phase. The role of the students will to be critically assess the measures employed and to determine the quantitative and qualitative benefits. The phasing allows for the reviewing and assessment aspects to be undertaken across the lifetime of the project.

As an innovation driven project, the Catchment to Coast project will seek to identify overlaps with other local or national projects to maximise the benefits of both and achieve efficiencies, where possible. Doing so may generate financial savings allowing more measures to be constructed within the project area, or for measures to be delivered in other project areas with the learning shared, ensuring the goals of the project and learning aspects can be maximised.

3 Economic Case

3.1 Options Longlist and Shortlist

An initial long list of potential options was explored as part of the expression of interest submission, as shown in Table 3.1 below. These measures will be reduced to a shortlist and subsequently preferred options once further site investigations, modelling and optioneering has been undertaken. This will be completed following the submission of this OBC and detailed in the Full Business Case.

Installing integrated water management solutions	Upper catchment (above Stanford-le-Hope and Shoebury, Prittle Brook)	• NFM to reduce and control runoff e.g. creating offline flood storage areas • Contour bunding • Intercept flow paths and divert the runoff to ponds before channelling it to ditches • Create interconnected wetland systems
	Mid catchment (Stanford-le-Hope, Shoebury, Balstonia Park, Tank Hill Road)	• Rainwater harvesting in individual homes near pinch points in the sewer system • Rainwater harvesting for re-use systems within allotments or public toilets • Use stormwater harvesting in Shoebury green areas to reduce runoff; the recycled water can be used for greywater purposes e.g. in the allotments • Retrofit of green roofs including use of mycelium based materials
Installing nature-based solutions and land management practices	Upper catchment (above Stanford-le-Hope, Wharf Road, Shoebury, and Prittle Brook)	• Changes to agricultural practices to reduce polluted runoff • Planting trees and vegetation on flood flow routes and slopes • NFM, such as leaky dams • Reintroduce meanders to rivers and remove silt in cut-off meanders to attenuate flow by slowing and storing floodwater • Create offline storage areas to provide temporary flood storage which can reduce peak flow • Create weir structures using NFM techniques
	Lower catchment / coast (Thurrock Thameside Nature Park, Fobbing Marsh, Canvey Island, Two Tree Island, the seawall at Hadleigh, Leigh Station, Canvey Heights Country Park and Benfleet Creek)	• Bio-tiles or Bio-blocks for patch and repair works to maintain or improve the existing standard protection and increase biodiversity • Natural or hybrid enhancements to encourage natural biological succession, reduce the water velocities at foreshore level and reduce the wave action/energy • Beneficial dredging to enhance the establishment of saltmarshes in the estuary • Coir structures to aid saltmarsh regeneration
Installing local monitoring and early warning systems	Mid catchment (Stanford-le-Hope, Shoebury)	• Local telemetry system to observe flow data in the catchment and the sewer network • Visual warning system for surface water flooding using light beacons at high-risk locations

Table 3.1: *Lessons to be learned from the Catchment to Coast project*

All options have been assessed with regards to technical, environmental and social impacts. It should be noted that no finalised options have been selected or presented as part of this OBC as further exploration into viability and impacts is required during the option assessment and detailed design phases to determine the specific final measures and locations. This is due to the IRF project being an innovation and learning driven project which allows more flexibility for adaptation throughout the project than normal flood alleviation and coastal erosion mitigation schemes.

3.2 Costs and Benefits

An economic assessment has been undertaken to determine the quantitative benefits of the options and the incremental benefit-cost ratios, Net Present Value (NPV) and the qualitative benefits associated with the Project Objectives.

The project whole-life costs are £6.323m, which includes:

- SBC and TC staff costs
- Project management support
- External consultant costs (modelling, optioneering, detailed design, EIAs)
- Surveys (topographic, ground investigations, UXO, ecology, contamination, aerial and drones)
- Pre and post measure delivery monitoring
- Stakeholder engagement
- Evaluation and learning aspects (PhD students)
- Future maintenance
- Risk contingency (10%)
- Optimism bias (20%)
- Inflation (3.5%)

Cost estimates will be re-evaluated at the optioneering and detailed design stages of the project to allow the risk and optimism bias of the proposals to be reduced where appropriate.

The benefits that will be generated by the Catchment to Coast project will take the form of a reduction to flood risk and coastal erosion and increased understanding and learning of the use of innovative measures based on the data gathered. This learning will be shared with DEFRA, the EA and the wider IRF programme as the project progresses to compound the learning across projects, with the outcomes used following the project completion to inform future knowledge and decisions regarding capital schemes. As such the innovation and learning forms a key part of the project, and that which will be achieved through the Catchment to Coast project can be categorised into three areas:

- Lesson learning from the implementation of measures;

- The value at risk benefits once measures are implemented, which constitute the economic, environment and social damages which can be avoided by the scheme implementation; and
- The value potential benefits, which are the additional economic, environmental and social value that is created by the implementation of measures.

The lesson learning from the scheme will be an ongoing process throughout the entire 6-year span of the project. The project partnership includes a wide variety of partners who bring a wide range of experience from other projects, research, and fields of expertise. Lessons learnt from other and similar projects will be incorporated into the outline and detailed design phases of the project. All data and learning generated through the Catchment to Coast project, and others within the wider IRF programme, will be used to increase knowledge surrounding the delivery of innovative resilience measures and better inform capital flood schemes nationwide.

The University partners and others involved in the monitoring will feed back into the project once the scheme has been constructed to determine how the scheme is performing. All lessons will be fed back to support understanding by the Catchment to Coast project team and wider IRF programme surrounding what does and doesn't work in relation to the innovation measures and processes being employed.

The value at risk benefits and value potential benefits have been identified for each of the scheme locations and will be presented in more detail within the final FBC document. Within the Crouch and Roach operational catchment and the Mardyke operational catchment the key value at risk benefits and value potential benefits are shown in Table 3.2:

FCERM_AGAST Category	Sub-category	Business as Usual baseline – potential damages	Following scheme implementation – damages avoided	Following scheme implementation - added value
Economic	Residential properties	Properties are currently at risk of flooding	Reduction in the flood depths and duration and the damage caused by flood events	Potential improvement to residential properties resale value
	Non-residential properties	Properties are currently at risk of flooding	Reduction in the flood depths and duration and the damage and losses of a business caused by flood events	Potential improvement to rentability of the property
	Emergency costs	Emergency services costs incurred during flooding	Reduction in emergency services resources and costs associated with reduction in flood depth and duration	
	Infrastructure	Damage to some utilities from flooding	Reduced flood risk and disruption to some of the utilities in the area	Improved reliability of some utilities in a flood event

	Transport	Major roads and railways are at risk of flooding and erosion	Reduction in damages to the roads and railway from flooding	Improved reliability of the transport networks
	Agriculture	Farmland in the catchments is at risk of flooding	Reduction in damages to the farmland	
Environmental	Biodiversity	Ecological assets and wildlife at risk of flooding	Reduction in the biodiversity loss	Creation and restoration of habitats
	Change in WFD status	Decrease in WFD status	Reduced changes in the WFD status	No change or improvement to WFD status
	Historic environment	Potential flooding of historic assets	Reduction in flood risk to assets	
	Landscape			Improvement of visual impact of areas
Social (individual and family)	Way of life	Closure of local amenities in flood events	Reduced impacts on local amenities	Increased sense of place
	Skills and competency			Improved understanding of flooding and adaptation / resilience
	Recreation	Temporary reduction in access to recreation areas	Reduced risk of flooding to areas	Improvement in access to recreation areas
	Health and wellbeing	Negative mental health impacts during flood events	Reduces negative mental health impacts during flood events	Potential improvement to mental health
Social (Community)	Community	Disruption to communities during flood events and recovery time	Reduction in disturbance	Improvement to public realm
	Culture			
	Political systems			
Knowledge and Skills				

Table 3.2: *Crouch, Roach and Mardyke operation catchment key value at risk benefits and value potential benefits*

For the historical landfills the value at risk benefits and value potential benefits that could be generated are shown in Table 3.3:

FCERM_AG AST Category	Sub-category	Business as Usual baseline – potential damages	Following scheme implementation – damages avoided	Following scheme implementation - added value
Economic	Residential properties			Increased attractiveness of the area
	Non-residential properties	Commercial properties at risk (TBC)	Reduction of erosion risk to properties	Increased attractiveness of the area
	Emergency costs			
	Infrastructure			
	Transport	Loss of road networks	Reduce risk of road loss	Improved reliability of network
Environmental	Biodiversity	Loss of habitats from contamination and erosion	Reduction of habitats lost	Biodiversity net gain from improvements
	Change in WFD status	Deterioration of the current waterbodies	No change to the current waterbodies	Improvement of the current waterbodies
	Historic environment			
	Landscape			Improved natural landscape through nature-based solutions
Social (individual and family)	Way of life			
	Skills and competency			
	Culture			
	Recreation	Disruption to recreation and tourism activities	Reduction in the disruption to recreation and tourism activities	Potential improvement in the recreation and tourism activities
	Health and wellbeing			
Social (Community)	Community			
	Culture			
	Political systems			
Knowledge and Skills				

Table 3.3: *Historic landfill sites key value at risk benefits and value potential benefits*

3.3 Critical Success Factors

The following constitute the critical success factors. The Catchment to Coast project will:

- Improve resilience to flood risk, drought and coastal erosion through the delivery of physical measures
- Improve resilience to flood risk and drought through increased community awareness, hydro-citizenship, education and training opportunities
- Improve procurement of specialist contractors vs traditional frameworks, achieved through learning outcomes and innovation
- Achieve wider benefits, such as improved carbon sequestration, biodiversity net gain, pollution reduction, regenerative agriculture and socio-economic gains
- Achieve buy-in from local communities surrounding the retrofitting of rainwater harvesting systems
- Improve planning policy surrounding green roof implementation and the use rainwater harvesting on new developments and retrofitting
- Create a tool to map flood risk management measures within the catchment and quantify the reduction in flow achieved

4 Commercial Case

The procurement and delivery of all measures will be undertaken in line with existing Southend-on-Sea Borough Council and Thurrock Council procurement policies. A formal procurement strategy will be created during year two of the project, following the submission of this OBC.

5 Financial Case

The cost of the options being considered have been generated based on previous project experience and industry cost databases such as the EA cost estimation for SuDS guidance, SPONs, susdrains tools and other guidance (Table 5.1). It should be noted that only high-level average costs are provided as specific details surrounding the location, type, number and sizing of measures within refined to preferred option/s through the optioneering and detailed design phases.

Category	Measure	High-level estimate	Unit
Regenerative Agriculture	Land use change	£ variable*	per ha
	Contour ploughing	£ 0	per ha
	Tree planting (2m spacing, 2500 per ha)	£ 7,500	per ha
NFM	Leaky dam	£ 1,500	per dam
	Grassed attenuation area	£ 60	per m^3
	New channel	£ 70	per m
	Two stage channel (modification to existing)	£ 60	per m
	Washland / Scrape	£ 10	per m^2
	Inland wetland	£ 40,000	per ha
SuDS retrofit	Water butt installation	£ 200	per system
	De-paving	£ 70	per m^2
	Green roof retrofit	£ 110	per m^2
	Water re-use system retrofit (residential)	£ 3,500	per property
	Water re-use system retrofit (commercial)	£ 20,000	per unit
	Rain garden	£ 500	per garden
Warning Systems	Flood warning beacons	£ 3,500	per unit
Coastal Erosion Reduction	Bio-tiles	£150	per m^2
	Bio-blocks	£ 200	per unit
	Coastal wetland creation	£ 17,000	per ha

Table 5.1: *High level average cost estimates for the potential mitigation measures being considered*

* due to the wide range of variables, such as existing land use, proposed land use, soil type and soil condition, and lack of available information, no costs have been detailed at this stage.

The summary of the predicted project spend breakdown is presented in Table 5.2 below. This is presented based on the three phases of the project: Phase 1 – project set-up, optioneering and detailed design; Phase 2 – construction and delivery, and; Phase 3 – monitoring, review and learning.

Costs per phase	Phase 1 2021-23	Phase 2 2023-25	Phase 3 2025-27	Total
Flood and Coastal Resilience Innovation Programme Funding	£1.631m	£4.171m	£521k	£6.323m
Contributions	£0	£0	£0	£0
Total Project Expenditure	£1.631m	£4.171m	£521k	£6.323m

Table 5.2: *Project funding source breakdown based on the three primary project phases*

Where measures are implemented within land owned by partners, contributions towards future maintenance, including the mobile phone costs for the flood warning system, will be provided as part of the project. As part of the community engagement aspects of the project it is intended that assets will be adopted and maintained by non-local authority groups into the future.

Where partnership funding contributions towards maintenance cannot be covered by the project alternative sources of funding will be identified. Future maintenance and asset replacement costs will be considered during the optioneering and detailed design phases to ensure that no onerous financial burdens are placed onto asset owners and ensure the sustainability of measures. Potential funding sources include:

- Leader Funding is available to local businesses, communities, farmers, foresters and land managers. Projects can apply for the funding through Local Action Groups for projects which create growth, jobs and are beneficial to the local economy. £138m had been made available to England between 2015 and 2020.
- The EIP-Agri Fund (European Innovation Partnership for Agricultural Productivity and Sustainability) provides support to projects which show innovation and link research with farming or forestry practices. The purpose is to provide grant funding to operational groups to assist with projects that aim to improve productivity and sustainability.

- The water capital grants scheme under Countryside Stewardship will be managed and delivered through Catchment Sensitive Farming in 2018. Work funded by the Catchment Sensitive Farming grant scheme over recent years has already brought efficiencies for thousands of farmers and has enhanced local environments throughout England by improving water quality.

It should be noted that majority of measures delivered as part of the Catchment to Coast project will constitute works that would have been considered or required as part of existing strategies and risk reduction activities. As such delivery as part of the IRF programme allows for the implementation using grant funding and the installation of measures sooner than would have been programmed under normal circumstances, thus reducing the reactive maintenance works and costs of Southend-on-Sea Borough Council and Thurrock Council.

6 Management Case

6.1 Governance and Partnership Arrangements

Southend-on-Sea Borough Council are the lead partner of the Catchment to Coast project in collaboration with Thurrock Council. The active members of the Catchment to Coast partnership are:

- **Southend-on Sea Borough Council (project lead partner)**
- **Thurrock Council (joint lead partner)**
- Castle Point Borough Council
- Anglian Water - Catchment Management Team
- Essex Wildlife Trust
- Environment Agency
- Thames 21
- AmbioTEK CIC
- King's College London
- University of Essex

The project management and reporting structure are presented in Figure 6.1.

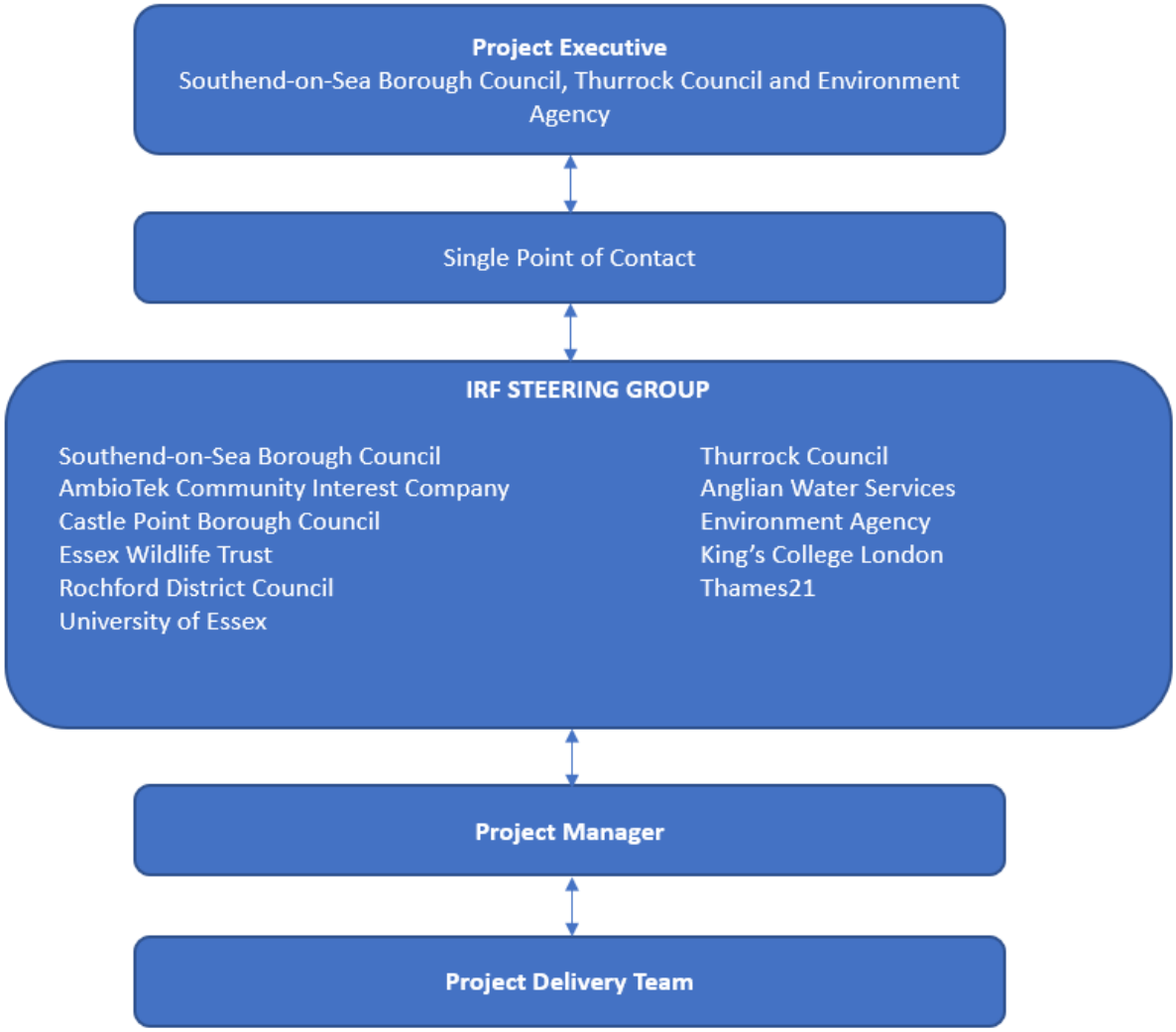

Figure 6.1: *Catchment to Coast project management and reporting structure*

6.2 Roles and responsibilities

The IRF Executive Project Board will determine the overall strategic direction as well as oversee any legal or financial decisions that Southend-on-Sea Borough Council is required to make as the Lead Authority Responsible Partner. The Board will also be responsible for determining any disputes within the project.

The Board constitutes an Executive Officer from the Agency, two Executive Officers and the relevant Elected Members from the IRF Lead Project Partners. The Board will meet annually (at a minimum) and not more than quarterly unless a Dispute Resolution Meeting is called.

The IRF Steering Group will formed including an appropriate representative from each partner organisation. The Steering Group will agree and lead the programme's priorities and make key decisions on project deliverables. Occasional input may be required from additional stakeholders or SME's and ad-hoc attendance will be determined by the progress and stage of the project.

The IRF Project Manager will report the progress of the Project Delivery Team and highlight any risk or critical path items to the Steering Group for consideration and direction. The IRF Senior Responsible Officer (SRO) from the Lead Authority Responsible Organisation within the Steering Group will report to the IRF Executive Project Board and chair the quarterly meetings. External communications and engagement will be directed and agreed by the Steering Group. The Steering Group will meet quarterly as a minimum; special meetings may be called as deemed appropriate.

The IRF Project Delivery Team/s will be accountable for managing the day-to-day delivery of the project, including detailed design and construction. The Team will be chaired by the IRF Project Manager and will meet not more than monthly unless a certain workstream necessitates additional meetings. The Team will be comprised of relevant representatives and SME's from the Partnership who are critical to the successful delivery of project workstream over the six years, and membership may vary as the programme progresses.

Project progress will be reported at the IRF Steering Group by the IRF Project Manager. In addition, key decisions to be made will be discussed and determined at the Steering Group and cascaded to the IRF Delivery Team/s by the IRF Project Manager as required.

An IRF Project Manager is in place to support the work of the IRF Lead Project Partners. The IRF Project Manager will be responsible for overseeing all delivery elements of the programme including financing and reporting to Defra and the Environment Agency.

The project has developed a Memorandum of Understanding (Appendix 1) which formalises the project group structures detailed above and confirms commitment to the project by all partners.

Southend-on-Sea Borough Council have the overall responsibility of the project and the work that is undertaken within it, including financial management and project quality.

Should project partners not deliver agreed activities or workstreams performance will be escalated via the dispute process with a decision made by the steering group and then projective executives as to the appropriate action to take regarding ensuring the activities in question are completed. Such action may include but is not limited to, removing the partner from the Catchment to Coast project, ceasing payment and/or seeking financial or other forms of compensation from the relevant partner.

6.3 Programme

The project delivery will be divided into three main phases:

- Phase 1 (April 2021 to March 2023): project set-up, partnership creation, baseline data gathering, modelling, optioneering and detailed design
- Phase 2 (April 2023 to March 2025): construction, installation and measure delivery
- Phase 3 (April 2025 to March 2027): post installation monitoring, measure performance assessment, project learning

The high-level project programme can be found in Appendix 2.

6.4 Communications and Stakeholder Engagement

Stakeholder engagement will form a key part of the Catchment to Coast project due to the scope, size and scale of the project, and the large number of other organisations, stakeholders, businesses and communities that fall within the study areas. It is essential that appropriate engagement is undertaken with all relevant stakeholders to ensure the successfully delivery of appropriate measures, ensure adoption and acceptance from local communities and organisations, and in measuring the success and impacts of the project.

A communication and engagement sub group has been established between project partners with initial stakeholder mapping undertaken. A Communications Plan has been created and agreed between partners and engagement plans are currently being created. Project task-groups have been set up covering the following areas to engage with appropriate partners, stakeholders and SME's which meet regularly to focus on more specific aspects of the project:

- Communication and Engagement
- Historic Landfills and Lower Catchment
- Monitoring and PhD students
- Regenerative Farming and Upper Catchment (to be finalised)
- Flood Warning Beacons (to be finalised)
- Middle catchment Measures (to be finalised)
- Ecology and Biodiversity (to be finalised)

Specific engagement will be undertaken following the acceptance of the OBC and progression of the project to the optioneering stages to ensure all stakeholders are able to input into the project and influence the option types, sizes and locations. As an important aspect to the success of the project discussions are currently ongoing surrounding the employment of a dedicated resource for the project to aid engagement with the communities and businesses.

Due to COVID-19 restrictions, the available methods for in-person public engagement are likely to be limited and it is anticipated that virtual meetings and consultations will be prioritised. Project partners Thames 21 and the Essex Wildlife Trust (EWT) will support all communications and engagement activities throughout the lifetime of the project.

A dedicated project website will be set up which will form the central point of public information to communicate project updates and receive feedback. Project updates in local media channels, such as the Echo, a daily newspaper covering South Essex, or posts by the Councils on online local community groups (e.g. Nextdoor) will raise the profile of the scheme and outline the benefits to local communities.

One of the proposed resilience actions is the implementation of an additional surface water flood warning system using light beacons in the relevant project areas. A letter drop, digital drop or in-person house visits (if COVID-19 restrictions allow) will be considered to communicate information about the flood warning system to the local communities. A full demonstration will be provided to all residents to exhibit the beacons functionality. It is particularly important that residents are aware of the flood warning system and how it will

be used, otherwise, it will be ineffective in reducing the impacts of flooding in the towns. After the resilience actions have been implemented, lessons learnt will be shared with the public.

The project will also allow for the utilisation of the existing EWT River and Coastal Warden roles to undertake some of the monitoring tasks. Thames 21 will provide training to additional volunteers on the practical delivery of small-scale NFM, including teaching them the skills to build leaky dams and plant trees, and on monitoring NFM interventions. All engagement activities will look to develop a sense of hydro-citizenship amongst communities and stakeholders.

The proposed resilience actions include NFM in the upper catchments in Thurrock, Southend-on-Sea and Rochford. Engaging with the local landowners and farmers can provide useful inputs into the planning and design of the resilience actions in these areas and also establish shared objectives. Their knowledge will enable better consideration of potential measures through the optioneering and design stages. Early engagement with the landowners and farmers will also help the project partnership to foresee any issues that may lead to an objection. The project partnership will consider creating a memorandum of understanding with landowners and farmers who will be affected by the resilience actions implemented under the Catchment to Coast project.

Engagement with planners, policy makers and developers will be undertaken throughout the project to share learning surrounding the viability of delivering SuDS, including water re-use and recycling measures. Whilst SuDS are required to be included within new developments to manage flood risk, doing so will allow the use of detailed local data, to better allow the consideration of such measures in planning policies and decision making. It is a goal of the Catchment to Coast Project that such measures become common place across Southend-on-Sea and Thurrock.

The project partnership seeks to ensure all public and stakeholder engagement to be effective and meaningful. Clear feedback loops between consultation and the impact on the design will be established. An evidence trail of stakeholder and public views will help to keep track of their influence on the project. Talking to stakeholders and the public early in the planning and design process means any issues can be identified promptly and allows sufficient time to work through them. The local community are more likely to accept development if they understand why the resilience actions are needed and if they have been allowed to influence the project. Establishment of a transparent process (except areas requiring commercial sensitivity) will also increase the likelihood of the project being accepted by stakeholders and the public.

6.5 Risks

A risk register for the project has been developed to identify and manage the risks. The register will be updated by all partners throughout the project lifetime with the content and mitigation measures discussed during weekly project delivery team calls as well as during all progress meetings and workshops.

Current key, high-level risks are outlined in Table 6.1.

	Key Risks	H/M/L	Owner	Counter Measures and approach
1	COVID-19	H	All	Follow latest government guidelines and minimise face-to-face interactions, where possible
2	Disengagement from stakeholders	M	SBC / TC	Undertake engagement early and regularly
3	Lack of acceptance from stakeholders to the project, options and/or locations being considered	M	SBC / TC	Undertake engagement early and regularly
4	Computational modelling instabilities cause delays or prevent options from being properly assessed	L	SBC / TC	Allow extra time for checking and calibration, use pre-existing models where possible
5	Necessary approvals from statutory bodies are delayed or withheld	M	SBC / TC	Engage early with relevant bodies and submit applications as early as possible
6	Costs increase due to supply chain or availability issues, including Brexit	M	SBC / TC	Place orders as early as possible and undertake early engagement with construction contractors
7	Unforeseen issues arise on site during construction and delivery	M	SBC / TC	Undertake all appropriate site investigations and trial holes as required
8	Baseline monitoring is not sufficient or in the correct place to enable appropriate learning	M	SBC / TC	Undertake detailed planning to ensure sufficient coverage of monitoring stations

Table 6.1: *Key project risks*

7 Recommendations and Next Steps

It is recommended that all of the next steps for the Catchment to Coast project are undertaken. These include:

- Reduce the long-list of options to a shortlist
- Undertake public and stakeholder engagement and commence training and education aspects
- Undertake modelling, environmental assessments (and all other necessary assessments) to allow the short-list to be reduced to preferred options for each project location
- Undertake further surveys and data gathering to support decisions surrounding optioneering and detailed design
- Undertake detailed design and seek appropriate consents and permissions
- Undertake procurement and prepare contractors to allow construction to be commenced from April 2023
- Complete the Full Business Case
- Undertake initial baseline modelling

- Set up the remaining task groups
- Set up a project website
- Agree and implement the PhD student roles and get students in place
- Continue recording and mitigating risks and recording lessons learnt

8 Appendices

Appendix 1 – MoU between project partners
Appendix 2 – High level project programme