Scoping Study on Flood Risk and Resilience for the INTERREG France (Channel) England Programme

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Date: 24/05/2019

Version: 1.1

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Interreg France (Channel Manche) England

EUROPEAN UNION

European Regional Development Fund

1. Introduction

1.1 Context of the France Channel England Programme

The INTERREG France Channel England programme (FCE) is a funding Programme that supports innovative projects between French and English partners that are based in the eligible area for the programme. Figure 1 shows the relevant geography for this programme.

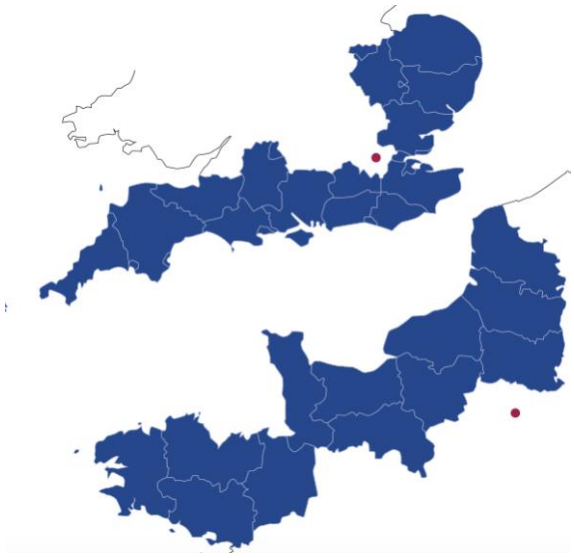


Figure 1 Eligible Area for Participants in the France Channel England Programme

The FCE Programme has commissioned this scoping review to support a cross-border event for experts and stakeholders to discuss the challenges linked to flooding during a "project lab", and to develop projects linked to **flood risk and resilience.** The review provides contextual information and through a structured interview, stakeholder insights that will help both the development of themes and projects, but also networking to build project development teams.

The projects developed through the project lab will fall within the range in value from €1m upwards (up to €48m for exceptional projects), and will be **practical**, with **tangible**, **measurable long-lasting results**, managing **flood risk and resilience** relating to Challenge 6 of the France (Channel) England Cooperation Programme.

Challenge n°6 states: *Improve risk prevention and the capacity to adapt to and mitigate climate change:*

- Ensure an integrated management of coastal area; including generating and sharing common information relating to climate change among maritime authorities;
- Promote shared approaches for the protection and management of natural areas;
- Promote integrated water management (water quality, conservation of natural resources and biodiversity);
- Develop preventative/mitigation measures for cross-border natural disasters, especially flooding and droughts;
- Implement measures in order to prevent and better manage pollution in order to protect biodiversity and ecosystems

The projects developed through the scoping exercise and lab must link to the FCE *Programme Priorities* and *Specific Objectives.* Those that have the most potential to align with the flood risk management topic are:

Specific Objective 1.1: Innovation – Increase the delivery and uptake of innovative products, processes, systems and services (in shared smart specialisation sectors).

Specific Objective 1.2: Social Innovation – Increase the quality and effectiveness of service delivery to the most socially and economically disadvantaged groups through social innovation.

Specific Objective 2.1: Low Carbon Technologies - Increase the development and uptake of existing or new low-carbon technologies in the sectors that have the highest potential for a reduction in greenhouse gas emissions.

Specific Objective 3.2: **Coastal and transitional water ecosystem** – Enhance and protect the coastal and transitional water ecosystems.

Noting that this Specific Objective focuses on Good Ecological Status, so therefore a project to address flood risk and resilience would also need to demonstrate improved water quality. Examples of natural flood management projects could be relevant.

1.2 Working with Stakeholders

The INTERREG FCE team are keen to develop impactful, innovative projects at scale, developing new products and services so as to improve economic, environmental and social outcomes in the FCE Region. The scoping exercise aims to identify relevant problems and challenges relating to flood risk and resilience and has involved discussions with relevant stakeholders to:

- understand and define the 'problems' and align them to the specific funding streams; and
- for stakeholders to identify their specific needs and interests in this area, so that we can ensure workshop participants can see potential partners and collaborators on common areas.

Through the "project lab", and afterwards, Stakeholders will have the opportunity to network and think about common solutions and begin the process of project scoping across the specific objectives.

2. Overview of the challenges of flood risk and resilience for the France (Channel) England region

2.1 Geographic extent of the region

The relevant area under scope in this review is the France Channel/Manche England which takes in the coastline in England from Norfolk to Cornwall and the Isles of Scilly, and in France from Pas de Calais to Finisterre and Morbihan in Brittany. The coastal regions face into the North Sea, English Channel/La Manche and to the Eastern Atlantic. The landforms and related issues for flood risk management in the County and Department jurisdictions abutting this coastline are highly varied. From low-lying land at or below sea level in the Cambridgeshire Fens and Cherbourg Peninsular[1], to

[1] Rott et al 2014 The marine flooding hazard along the western coast of Cherbourg Peninsula (Manche, France): A dynamic approach using both numerical modelling with LIDAR data. La Houille Blanche, n° 6, 2014, p. 39-45

high cliffs and uplands in the South of England and Finisterre, this diversity presents a diverse backdrop to those organisations concerned with flood risk and resilience, and therefore a significant challenge to understand how this pressure will impact on the landscape and coastline, and how adaptation should be addressed.

2.2 Evaluating and Planning for Future Flood Risk

In the context of adapting to a changing climate, a critical challenge is to understand how flood risk will change: *where and how it will be impacting in this diverse landscape and coastline on its communities, businesses and infrastructure.* This relies on the operation of the Statutory Authorities that are responsible for the management of flood risk. The key UK statutory authorities concerned with flood risk and resilience are identified in Table 1:

Table 1. English Statutory Authorities Responsible for the Management of Flood Risk and Resilience

Authority	Geographic coverage	
Environment Agency	England	• Strategic Overview of all forms of flooding • Flooding from (designated) Main Rivers and coastal areas • Flood risk assessments • Consultee to the planning system • Warning and informing • Management of flood assets
Upper Tier authorities (County/Unitary	County and Unitary boundaries	• Overview of all flooding within their boundaries as Lead Local Flood Authority • Surface water flooding • Ordinary watercourses • Development planning e.g. drainage, SuDs • Community resilience • Management of relevant flood assets
Coastal Authorities	District level / and in partnership groups	• Maintenance of coastal defences
Internal Drainage Boards	Drainage districts (level- based catchments)	• Manage water levels and drainage from land

Planning for flood risk and resilience is set within the context of the Environment Agency Flood and Coastal Erosion Risk Management (FCERM) Strategy. Following a 9-month preparatory period, the latest Strategy (in four sections) is currently out to consultation until 4 July 2019[2]. Underpinning the Strategy, the statutory Authorities execute a range of plans, to meet the requirements of the Floods and Water management Act (2010) and Flood Risk Regulations (2009).

These include:

- River Basin Flood Risk Management Plans (Environment Agency-led)
- Local Flood Risk Management Strategy (Upper Tier Authority led)
- Shoreline Management Plans (Environment Agency or Local (Coastal) Authority led)
- Surface Water Management Plans (Local Authority-led)

[2] https://consult.environment-agency.gov.uk/fcrm/fcerm-strategy-ambition-working-group

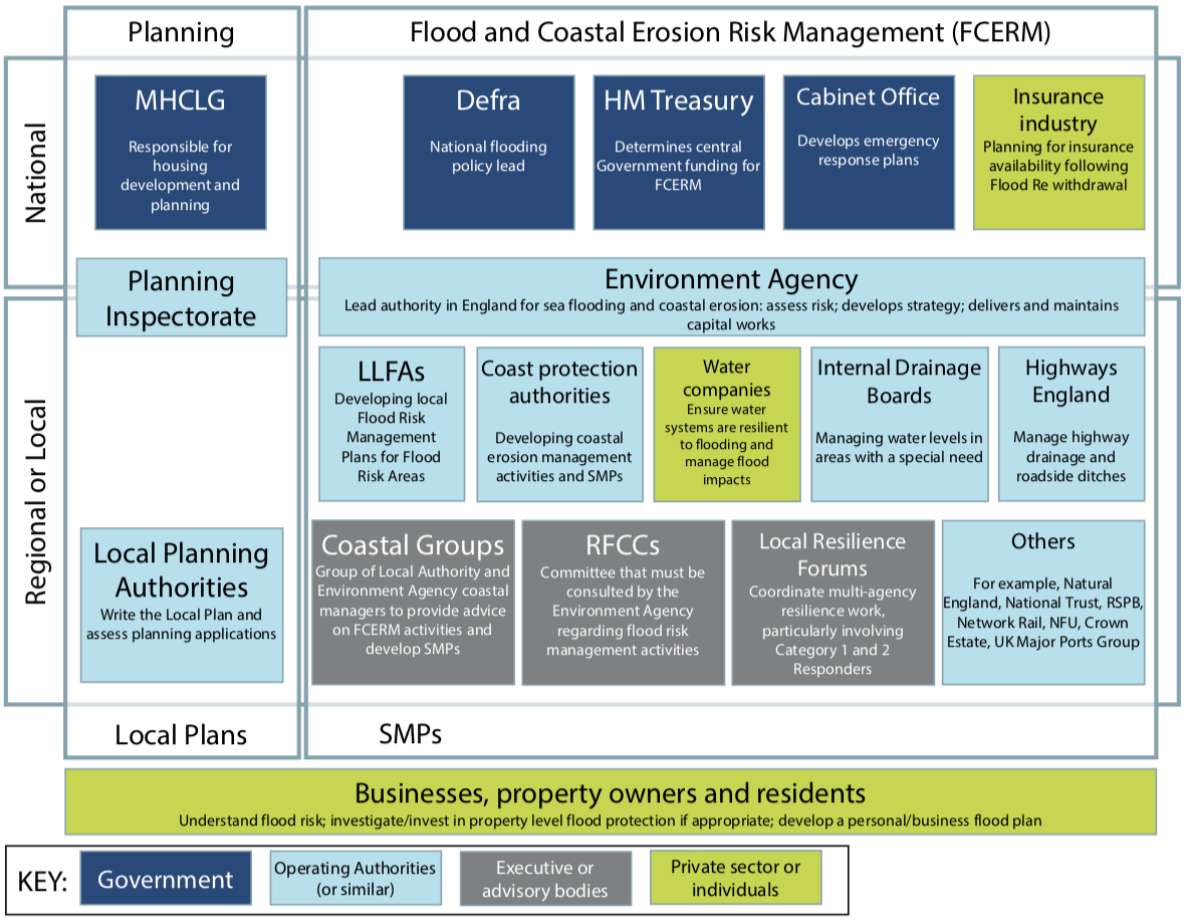


Figure 2. English Statutory Authorities and Wider Stakeholders Responsible for the Management of Flood Risk and Resilience [3]

Within France there is a strong similarity to the tiered approach on planning, following the requirements of the Floods Directive (2007)[4]. This led to the development and implementation of a new legal system for flood management based on three new strategic plans applicable to three separate territorial levels:

- a national strategy
- flood management plans (basin-level) and
- local strategies.

The French Statutory Authorities and their planning responsibilities is presented in Figure 4.

Prevention is the main French strategy in terms of social and political legitimacy with the State playing a central role in defining the non buildable areas. The principal resources come from the National Fund for Major Natural Hazards (NFMNH, also known as the "Barnier Fund"[5]), which is funded by taxes on home insurance contracts. The State maintains a central position through the legislation and the control of procedures, while responsibility for infrastructure is devolved to the municipal level. The main instruments for maintenance are River Plans, Water Management Plans,

[3] https://www.theccc.org.uk/wp-content/uploads/2018/10/Managing-the-coast-in-a-changing-climate-October-2018.pdf
[4] http://ec.europa.eu/environment/water/flood_risk/implem.htm
[5] https://www.ccr.fr/en/fonds-publics

the Action Programme for Flood Prevention (PAPI) and local plans. French Local Authorities are then the main actors for reducing the vulnerability of buildings and flood retention techniques[6].

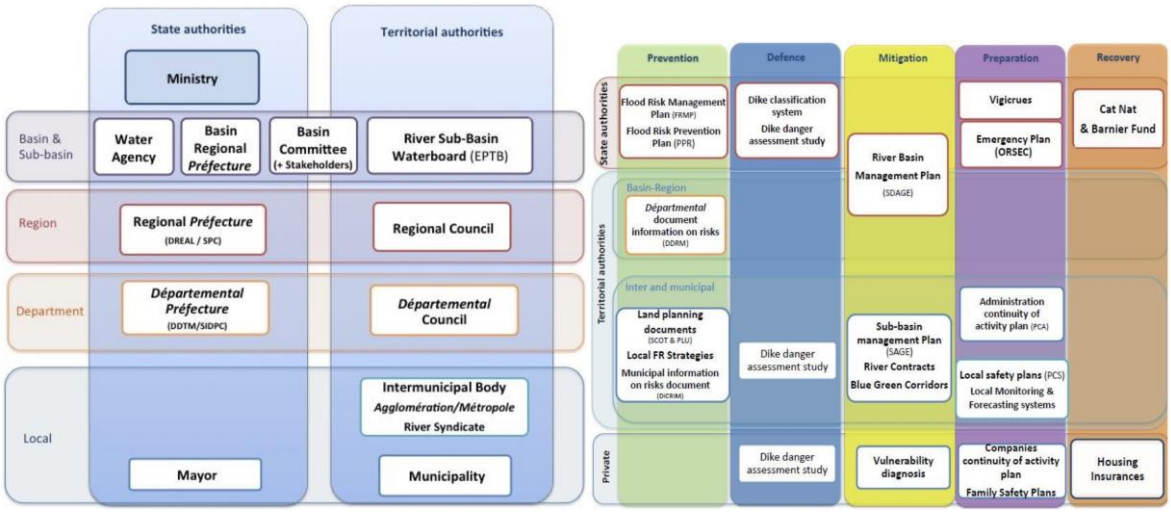


Figure 3: French Authorities with Statutory Responsibilities for Flood Risk Planning and Management[7]

In both the French and English cases, there is a blend of roles and responsibilities across the national/regional/local scale, with each system having its own specific challenges on delivering its plans, services, and in communication with the many stakeholders involved. The systems, processes and policies in the French and English systems will dictate how each jurisdiction is able to manage flood risk and be adaptive to a changing climate, but there is a critical question on what are the opportunities to learn from each and how can both be optimised to support social and economic 'resilience'.

2.3 Key Flood Risk and Resilience challenges in the France Channel England Region with a Changing Climate

Given the scale of the geography of the FCE region, it isn't possible to describe the critical issues for flood risk management in detail and the reader is directed to the sources of further information through the sources identified in this report.

As an overview, the FCE Region is faced with significant challenges at the present time, and likely to be exacerbated by a changing climate. Climate change[8] is already leading the melting of the polar ice caps, and with thermal expansion of the seas, this is predicted to cause a >0.5m of sea level rise in all climate change scenarios by 2100[9].

[6] http://www.starflood.eu/documents/2016/03/wp3-fr-final-webversion.pdf/

[7] C. Larrue, S. Bruzzone, L. Lévy, M. Gralepois, T. Schellenberger, J. B. Trémorin, M. Fournier, C. Manson, Thuilier, T (2016). Analysing and evaluating Flood Risk Governance in France: from State Policy to Local Strategies , STAR-FLOOD Consortium, Tours, France. ISBN: 978-94-91933-08-0

[8] https://www.theccc.org.uk/wp-content/uploads/2018/10/Managing-the-coast-in-a-changing-climate-October-2018.pdf

[9] https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Marine-report.pdf

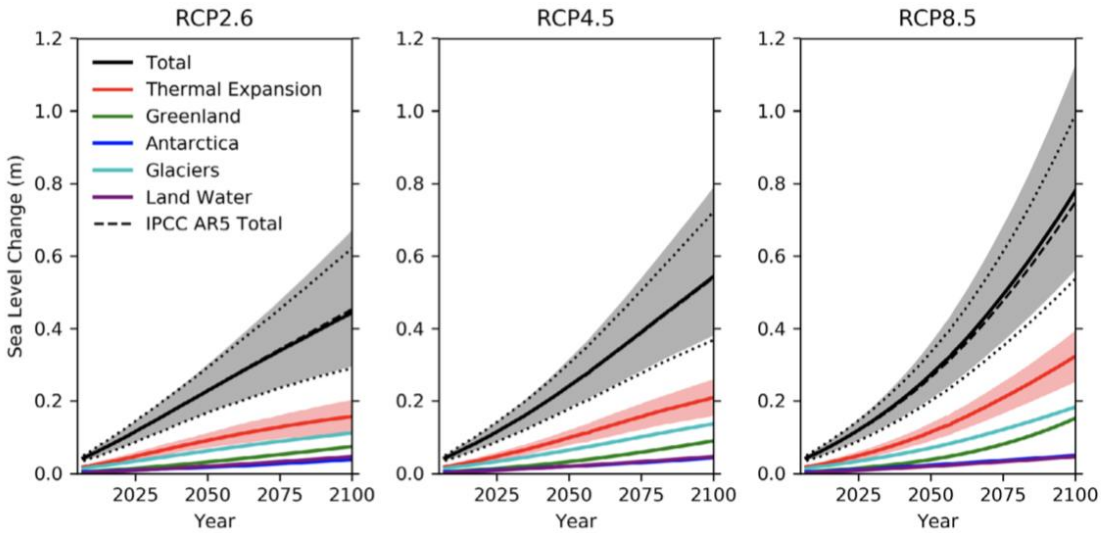


Figure 4: Predicted Mean Sea Level Rise to 2100 Based on Different Climate Scenarios and Contributions from Ice Melt and Thermal Expansion[5]

Atlantic storm (weather) systems are predicted to be tracking further to the South than in the previous 50 years, bringing higher wind speeds associated with the centres of anticyclone air circulation, as well as potentially be of greater intensity and frequency. Combined with a rising sea level, the higher wind speeds associated with the new track of the Atlantic storms are predicted to increase the risk of storm surges on Westerly-facing coasts and funnelling into the Channel/Manche coastal areas. When coinciding with high astronomical tides, storm surges have the potential to impact on low-lying coastal and estuarial systems, where high-energy sea water levels can overtop and damage both hard and soft defences and cause extensive flooding behind the line of defence, as well as causing erosion of soft coastlines. For the coastal communities, infrastructure and wildlife, this is a significant threat and effective adaptation will require this change to be accounted for in long-term land use and coastal defence plans.

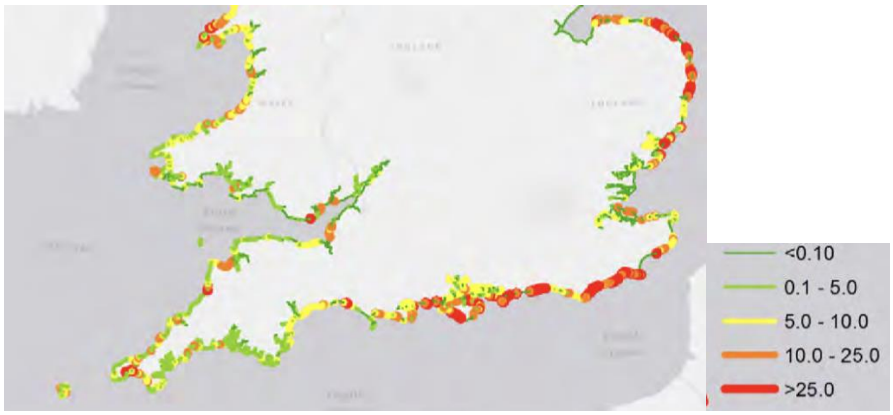


Figure 5: Coastal Erosion (m) in FCE England Region up to 2025 with 'no active intervention' (source : Environment Agency[10])

As well driving as rising sea levels, climate change is predicted to lead to warmer, wetter winters, with a significant (up to 70% by 2080) increased risk of rainfall intensity and duration with larger, and

[10] https://www.theccc.org.uk/wp-content/uploads/2018/10/Managing-the-coast-in-a-changing-climate-October-2018.pdf

warmer Atlantic weather systems that are slower moving passing through the region. The combination of these factors is expected to decrease the rainfall to the region by up to 23% in the summer but with a + 23% increase in the winter and with an 20—30%[11] increase in rainfall intensity that can overwhelm surface water drainage systems in build-up areas, and smaller water courses in a short period of time. Aggregated across sub catchments, the water levels in fluvial systems that receive this rapid run-off will themselves rise rapidly, with the potential for overtopping of river banks on a more frequent basis than now and leading to so-called flash flooding. Over-topping of flood defences is a critical risk that can damage the condition of the defence, leading potentially to failure.

2.4 Developing Future Plans and Strategies for Adaptation to a Changing Climate

In the context of Challenge 6 (Section 1.1), future plans must consider the impacts of an incremental changing climate on:

- surface water run off (urban and rural areas) to fluvial systems
- coastal and estuarial systems through a rising sea level, and increased storminess

Future plans will need to take account of these pressures. Shoreline Management Plans (SMPs) in England provide a baseline of non-statutory planning as revised between 2006 and 2011, and took account of the available climate change predictions, to recognise the potential threat and indicate policies that should be considered looking at the communities and infrastructure present, and of the costs of interventions on the coast. Furthermore, the National Planning Policy Framework stipulates that areas "likely to be affected by physical change to the coast" should be identified as Coastal Change Management Areas (CCMAs). Where a CCMA is in place, the local planning authority should ensure that "inappropriate development" is avoided. "Appropriate" should be defined in the CCMA in terms of the areas and circumstances where development is allowable and, if necessary, to make provisions for relocation away from the CCMA. It has been argued that SMPs were a lengthy and costly exercise that did not help communities consider the implications of abandoning their properties and livelihoods or help them envisage a resilient future. Since that time, the predictions have indicated that a rethink of coastal living in some locations[12].

[11] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69257/pb13274-uk-climate-projections-090617.pdf
[12] https://consult.environment-agency.gov.uk/fcrm/fcerm-strategy-ambition-working-group

Figure 6: Shoreline Management Plans SMPs for England

2.5 PESTLE analysis

The immediate challenges and pressures faced by the stakeholders in France and England were examined through interview using a PESTLE analysis approach. The aim is to delineate between them so as to be clear where to focus effort to address the barriers and blockers, and also assess where positive support can help drive issues forward, including through an INTERREG FCE programme.

Table 2. PESTLE Analysis of Issues Raised by Stakeholders

PESTLE Theme	Challenges / Need	Potential Opportunities
Political	• For a National Strategy with ambition with the impactful goals • The local vs national difference in politics on the approach - top down vs bottom up • Policy response favours hard engineering structures (and links to high Economic costs • Political leadership for new economic models around flood risk and resilience - e.g. paid ecosystem services	• Co-create solutions - esp around NFM can align viewpoints on solutions • Adaptive Pathways can lead to clear policy positions for specific areas - such as no-build areas.
Economic **Economic (continued)**	• Cost of adaptation, especially in the built environment • Challenge that cost/benefit will take up all available cash, leading to blight • England investment priorities based on Government housing targets, and not community health/need • the costs of adaptation a 'large number €m/£m' • Hard engineering 'defence' solutions embedded in thinking by many stakeholders but these are more costly and don't embrace 'resilience' thinking • More imaginative national funding	• Opportunity to align with strategic infrastructure programmes • Opportunity to link/align/associate future adaptation schemes with regeneration programmes • Urban - align adaptation into routine maintenance (e.g. roads and rainwater gardens) to keep costs down and make steady progress • Lower cost of natural capital compared to 'traditional civil engineering' • New opportunity for revenue based on natural environment • Community NGOs able to deliver natural

	model(s) that support community adaptation and helps them be in control of their future ● Land managers not compensated/paid for providing ecosystem services - a new model is needed	capital - recirculates national and local funding back into the community ● Lower cost solutions through NFM
Social	● Lack of understanding by national statutory bodies of how communities feel about the future, especially on the coast ● Government can't articulate what matters to individuals on the coast ● Deprivation and the exacerbation of the current situation. ● Feeling of hopelessness ● Communities to feel more in control and be empowered to reimagine their future ● Close interrelation between Political/Social and Economic suggests policy and must consider social and economic elements in decision making	● Development of resilience measures in pilot coastal communities can be amplified ● Lessons learnt from the approach to flood insurance in England (UK) and France ● Concept of Adaptation Pathways to make progressive change over time, supports communities facing into significant change ● The value and role of placemaking
Technological	● 'Technology' of natural flood management is not fully understood, leading to risk averse decision making vs hard engineering solutions ● Incentives for technology to be invested - need for better business case development ● Hard flood defences can remove habitat of intertidal zones	● Significant opportunity to develop and apply technology for catchment monitoring and management (sensors / telemetry networks) ● Significant investment by drainage boards in UK as a pathfinder for others on efficient and effective water management, improving water resource and flood risk management and reducing carbon spent in pumping etc.
Legal	● Ownership and management of future assets - both flood risk and critical infrastructure ● Future Governance frameworks between national and local communities ● Rights and needs of communities under threat of rising flood risk, to be respected and protected	● Community action to use local legislation and develop Co-Governance models ● Legal instruments drive action, what new or adapted instruments are needed?
Environmental	● Limited understanding by many stakeholders about what a naturally-functioning catchment should look like / do ● Uncertainty in climate predictions leads to paralysis in investment ● The scale of the environmental challenge makes small actions seem worthless	● Climate emergency declaration raises profile to policy makers and communities alike ● Greater awareness of carbon costs for engineers design and operations ● NFM solutions are becoming more attractive due to lower, cost, sustainability (multiple benefits - creating habitats; soil management)

The majority of stakeholders interviewed made the point that there are clearly specific political and economic drivers, however flood risk and resilience is a 'wicked' challenge, as the problems are difficult or seemingly impossible to solve. Each challenge is interconnected and there is incomplete or contradictory knowledge available on each. The challenges and needs highlighted must be considered within the systems within which they are found / exist, and there is a need for a broad set of stakeholders to be involved.

3. Themes for Flood Risk and Resilience across the France (Channel) England Cooperation Area

There are a number of common and inter-related themes within the strategic Flood Risk and Resilience challenges which are shared between the eligible areas of France and England. These themes include a blend of infrastructure, collaboration, systems thinking, capacity building and capability. These common and inter-connected themes are areas where cooperation would enable / deliver practical projects with tangible, measurable long-lasting results. The themes are illustrated in Figure 7 below and detailed further below.

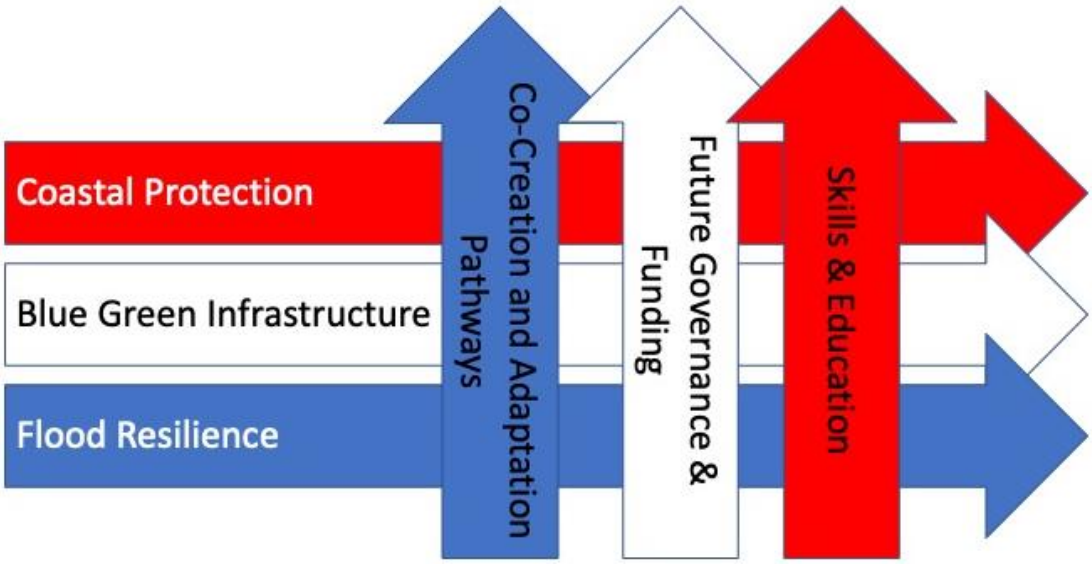


Figure 7: Schematic of the Flood Risk and Resilience Cross Cutting Themes

The themes are illustrated in this way to highlight the 'capital and operational' nature of Coastal Protection, Blue Green Infrastructure and Resilience, and the 'cross-cutting strategic and enabling' themes of Co-Creation and Adaptation Pathways, Future Governance & Funding, and Skills & Education. Innovation is needed across all of these themes to deliver the capacity to adapt to and mitigate climate change.

3.1 Coastal Protection

The UK's Committee on Climate Change reported in 2018 on 'Managing the [English] coast in a changing climate' highlighting the challenges facing coastal protection. It stated that:

We will almost certainly see 1m of sea level rise at some point in the future, possibly within the lifetimes of children alive today, and we must account for this change in long-term land use and coastal defence plans.

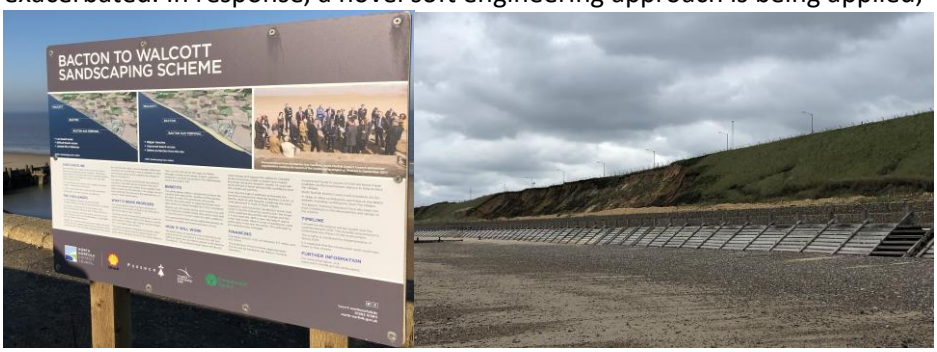
Meanwhile, the number and value of assets at risk on the coast has steadily been increasing. Many of these assets are protected by coastal defences that date back to the last century, so are deteriorating in the face of rising sea levels and eroding coastlines.

The French National Observatory on the effects of climate warming (ONERC) believes an 'optimistic' prediction for sea level rise is 0.40m, a 'pessimistic' prediction is 0.60m and an 'extreme' prediction

would be 1m of sea level rise by 2100, compared to the year 2000[13]. France's national strategy for the Sea and Coast[14] has a goal to achieve good resilience and adaptation to natural hazards and the consequences of climate change.

According to a number of stakeholders existing plans to protect coastal locations through hard defences are not likely to be cost-effective. As illustrated in Figure 7 above there are strong links between this theme and the three enabling themes.

A sample of the challenges facing the eligible area are illustrated in the following table:

Location	**Examples of the coastal protection challenges**
Pas de Calais	Large areas are vulnerable to flooding as illustrated by Figure 8 below. Without further coastal protection, sea level rise associated with a 2C global temperature increase will submerge the Channel Tunnel entrance[15]. Significant infrastructure requiring protection such as the Gravelines Nuclear Power Plant
Normandy	The risk of tidal flooding in Normandy is particularly high when onshore winds and storms occur at the same time as a spring tide. Low-lying, built-up, coastal areas are particularly at risk of storm flooding. The ONERC prediction for Sea Level Rise along the Normandy Coast is 1m by 2100, but some commentators are predicting this could be upto 2m. According to data from the Eurosion4 programme (2004)[16], 73.9% of the coastline of Seine-Maritime is subject to erosion.
Portsmouth	Some of the current defences along a 4.5km stretch of seafront at Southsea are more than 100 years old. They are likely to fail within the next 10 years. A scheme costed at £114.5m has been developed to protect more than 8700 homes[17]. The full funding for this scheme has not yet been identified.
Norfolk	The soft, sandy cliffs at Bacton, North Norfolk, England have been crumbling through slumping and coastal wave action. The challenge is that a UK Critical National Infrastructure site, the Bacton Gas Terminal, sits atop the cliffs. Coastal protection using traditional hard engineering (rock armour, wooden groynes, revetments) has not stopped the loss, and with a rising sea level will be exacerbated. In response, a novel soft engineering approach is being applied, 

[13] http://www.licco.eu/wp-content/uploads/2014/06/Two-Countries-One-Sea_EnglishVersion.pdf
[14] https://www.ecologique-solidaire.gouv.fr/sites/default/files/SNML%20version%20ENG_MTES.pdf
[15] https://www.thelocal.fr/20151201/how-france-would-look-if-sea-levels-rise
[16] Vivre avec l'.rosion c.ti.re en Europe, Eurosion database (2004).
[17] https://www.bbc.co.uk/news/uk-england-hampshire-47322050

	termed a Sand engine[18], placing up to 1.8mT of sand on the beach to create commencing May 2019. The approach will enhance the natural protection of the cliffs and beach from the erosive power of the sea. Over time it is predicted that the placed sediment will move through natural processes, feeding beaches along the coast and providing wider benefits to tourism and recreation.

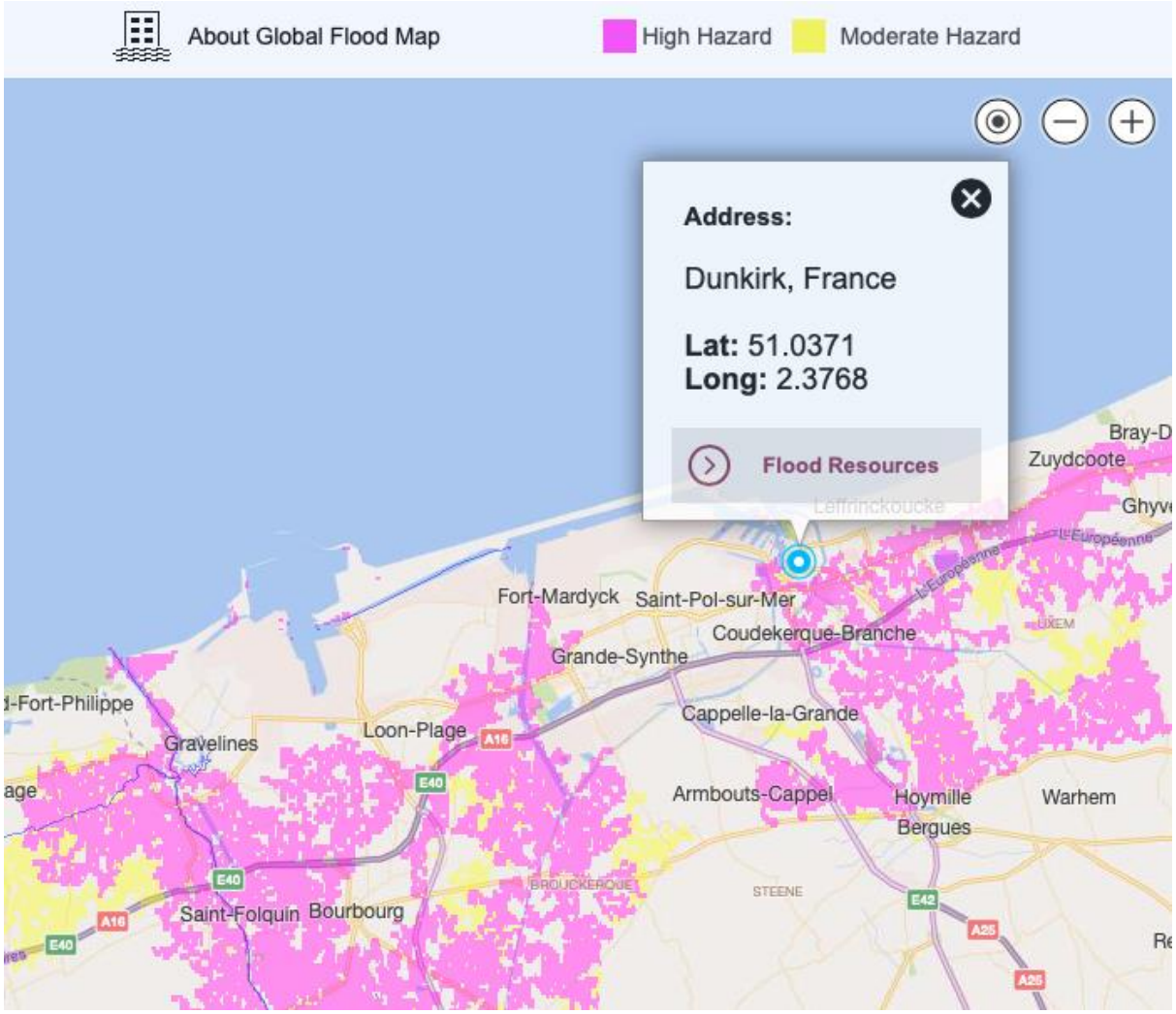


Figure 8: Flood Risk around Dunkirk and the Gravelines Nuclear Power Plant. Pink zones have a 1% chance of flooding annually[19]

Coastal protection is clearly a key theme for the France Channel England area, with a range of innovative approaches already being explored and tested in many locations. But the challenge is significant and the resources available are limited, creating the perfect conditions for innovation. Within this theme key opportunities stand out for potential collaborative projects:

- Coordinated systematic evaluation across recent and ongoing coastal protection projects to identify transferable lessons, tools and opportunities,

[18] https://coastalpe.maps.arcgis.com/apps/MapJournal/index.html?appid=0cbead21dce14c8982bbf832c7f34712#
[19] (https://www.fmglobal.com/research-and-resources/global-flood-map/flood-map)

- Exploring the opportunities for small coastal communities to think differently in their coastal protection solutions,
- Developing products / services to support 'Flood Resilience by Design' across professions
- Innovative approaches to managing closed landfill sites which are within flood zones or at risk of coastal erosion.
- Demonstration coastal protection schemes which can also deliver economic regeneration and ecosystem improvement
- Regenerating and protecting beaches which are linked to economic development

3.2 Blue Green Infrastructure (including Natural Flood Management)

The increasing awareness of the role of blue-green infrastructure delivering multiple benefits to water management has led to this being seriously considered to help deliver adaptation measures for flood risk and environmental quality. In effect this is taking action to manage flood and coastal erosion risk by **protecting, restoring and emulating** the natural regulating function of catchments, rivers, floodplains and coasts.

This approach can take many forms and is dependent on the nature of the catchment area, the challenge being faced at that point and elsewhere down the catchment or along the coastline.

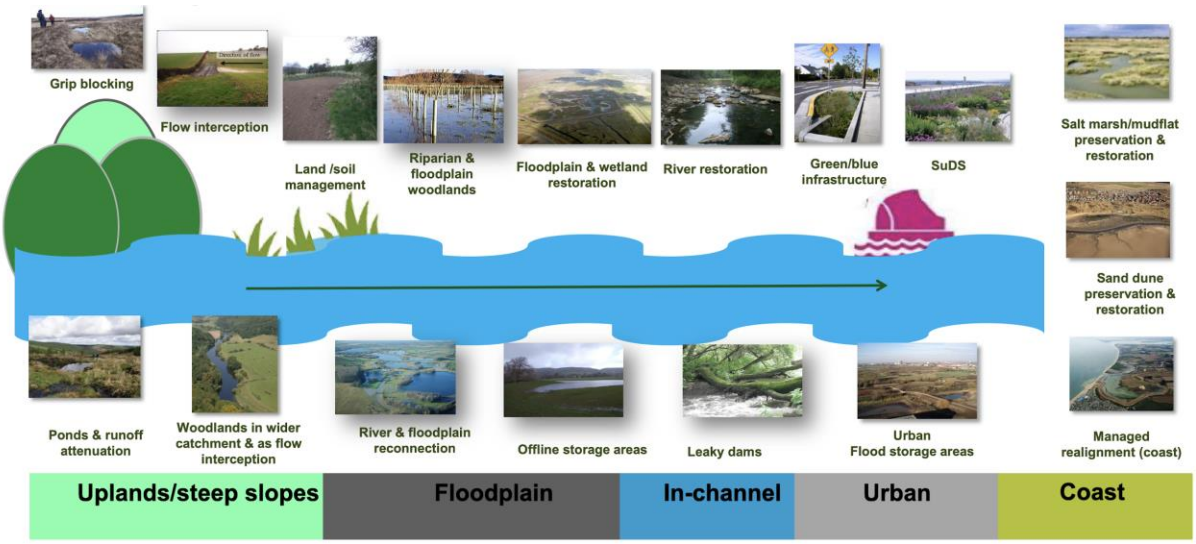


Figure 9: An Overview of Natural Flood Risk Management Approaches (From Environment Agency)

The integration of natural measures alongside 'hard' defences has been an established practice. However, as options for protection measures in communities now facing the impacts of climate change become more limited (for example, building ever higher flood walls), natural flood management and so-called 'upstream thinking' is expanding rapidly in its application. The key outcomes for natural approaches are reducing flood and coastal erosion risk, whilst protecting, improving and increasing habitats and biodiversity.

The wider environmental benefits should therefore also aim to improve environmental quality. For example, as land management is a key influence on flood risk, reducing the rate of water run off so reducing soil losses from land and wash out of fish and invertebrates from river reaches and being low or carbon neutral/positive. The 'slowing the flow' approach also allows reduces river erosion and enables sediment deposition in watercourses in silt traps.

Natural flood management approaches are also scalable. From the interventions identified in Figure 8, these can be delivered in combination, across catchment types and working across delivery bodies. In England, the Environment Agency is currently committing £14m to direct natural capital programmes at the catchment scale and nearly £2m are being delivered by communities. There is already an appetite for communities to develop and deliver natural flood management and work in partnership with a range of stakeholders, including the statutory authorities and landowners. An engaging example of community delivery and a win:win on ownership, cost management and effective management of flood risk can be seen in the film High Water - Common Ground[20]. There are also examples where Natural Flood Management delivers flow management to help manage stormwater into older surface water, and combined drainage systems in urban areas, through using urban greenspace[21] representing new solutions to help existing infrastructure to be resilient to climate change. These schemes often include ponds and lakes that enhance amenity, whilst storing excessive flood water.

Learning from the existing programmes shows that there are multiple benefits to be gained, as well as the flood-derived benefits from this 'ecosystem service'. These include reducing costs compared to traditional engineering solutions, health and wellbeing of communities creating schemes, as well as access to this green space one created. It also creates an opportunity to educate all stakeholders on natural processes behind the functioning of rivers and coasts, and how they interrelate with community life. The larger coastal schemes that have adopted realignment and habitat creation have also attracted 'environmental' tourist interest, which in turn supports the local economy. However, there are critical issues that present barriers to uptake of natural flood management relevant to Challenge 6 including:

- Enabling communities to develop and implement their own solutions, with the support of statutory authorities
- Political and scheme 'appraisal' processes that are based around hard engineering
- Confidence in the engineering assessment that it will deliver the benefits
- Ownership and maintenance of assets
- Novelty of the approach still requiring further monitoring and evaluation
- Funding for schemes, including national grant-based schemes
- Sustaining partnerships for the long term

A sample of the challenges facing the eligible area are illustrated in the following table:

[20] https://www.highwaterfilm.co.uk/common-ground
[21] https://www.wwtconsulting.co.uk/wp-content/uploads/2013/06/WWT-RSPB-guidance-SuDS-report-final-lowres.pdf

Location	Examples of the challenges for Blue Green Infrastructure
France	Agriculture is of critical importance across most of France. Natural flood management solutions may make sense but their is a need to work closely with farmers, through people they trust to review land-use in the valleys and catchment areas of the river basins (e.g., Lieue-en-Greve in Brittany).
Blyth Estuary, Suffolk, England	The issue of 'top down' policy making and 'bottom-up' resistance by communities with a different approach, relating to realignment of the coastline to support cost-effective flood 'defence' measures: The Blyth Estuary Group was formed in 2006 by Blyth stakeholders to protect the estuary and harbour and to oppose the abandonment of defences by the Environment Agency. The UK Government's coastal abandonment policy originated in Lord Deben's 2013 Climate Change Committee paper set the Agency and Local Authorities a target of realigning 10% of UK coast by 2030 and 15% by 2060 and a benefit cost ratio of at least 1:1.

Within this theme key opportunities stand out for potential collaborative projects:

- Strategic assessment of opportunities for natural flood management on the coast of Northern/Western France and Southern/Eastern England, reflecting social, environmental and economic criteria
- Development of design and creation services for natural capital that deliver both natural flood management and environmental quality improvement outcomes based on the critical evaluation of NFM schemes delivered in the FCE region.
- Enabling community-level innovation in leadership and ownership of natural flood management solutions, including relating to adaptive pathways for vulnerable communities
- Development of effective and efficient scheme appraisal (cost/benefit) models / scorecards that reflect the value natural flood management and the wider multiple benefits (economy, carbon, ecology etc).
- Development, and assessment, of natural flood management / natural capital delivered on a catchment, urban community and/or coastal cell scale.

3.3 Flood Resilience

The term 'flood resilience' is increasingly being used, with the acceptance that not all flooding can be prevented. Flood risks to communities and local economies are closely linked to the resilience of the local infrastructure, in particular the energy, transportation and communications systems which they use and depend on. We define flood resilience as follows:

'The capacity of individuals, communities, businesses, organisations and systems to survive, adapt, and grow in the face of flood risk, and even transform when conditions require it[22]'

Flood resilience approaches have been piloted and implemented in the English eligible area, e.g The Flood Resilience Community Pathfinder Project involving Devon County Council, Plymouth City Council, Torbay Council and the Environment Agency in 2015[23]. There are also a number of

[22] https://link.springer.com/article/10.1007/s10669-018-9709-2
[23] https://www.devon.gov.uk/floodriskmanagement/flood-resilience/

stakeholders such as the National Flood Forum who support communities to develop their flood resilience, and documents such as the 'Homeowners guide to flood resilience'[24].

Stakeholders in France have highlighted an exponential growth in interest in flood resilience (in part since the 2016 Seine floods in Paris), but with little evidence of change in planning and development projects. The role of the 'professional' in flood resilience is clearly key, but the plethora of tools and guidance for communities does not seem to be replicated for professional audiences who need to be considering resilient buildings, infrastructure and systems. Flood resilience requires the right approach to governance with just enough formal rules and legal certainty to drive action, but with enough freedom to support genuine community engagement and collaboration.

A sample of the challenges facing the eligible area are illustrated in the following table:

Location	**Examples of Flood Resilience challenges**
Dunkirk	The third largest port in France with significant energy infrastructure surrounded by a highly industrial economy. There are strong plans for coastal development but these need to have resilience designed in, and seek to deliver multiple benefits in an area with high unemployment and an ageing population[25].
Felixstowe	If a flooding event of the 0.1% per annum probability level occurred, the port of Felixstowe would be entirely inundated which would cause major disruptions to port operations and its recovery could take a significant period of time, e.g. 6-12 months[26]. The Port of Felixstowe handles over 40% of UK container traffic and thus a closure will quickly impact on the UK supply chain. During a normal working day approximately 5,000 large goods vehicles enter and leave the Port via the A14. A prolonged closure will have significant impact on national supply and logistics chains[27].
Devon (and across England)	Difficulty in engaging communities and volunteers to consider flood resilience issues and responses, particularly in areas where there hasn't been significant flooding in the past.
Brittany	In the winter of 2014, the Finistère area of Brittany in North Western France was hit with violent storms, bringing torrential rain, heavy wind and flooding. Winter floods in this part of France are common; in 2014, however, the heavy rainfall caused the river to rise to record levels – 2.5 times higher than average – threatening people and infrastructure. As the storm intensified, 55,000 households across the region lost power, and, as rivers breached their banks, the towns of Quimper, Morlaix and Quimperlé were submerged under as much as one metre of water. Homes and schools were evacuated and city centres were closed[28].

[24] http://www.knowyourfloodrisk.co.uk/sites/default/files/FloodGuide_ForHomeowners.pdf
[25] https://urbact.eu/sites/default/files/dunkirk_lap_designed.pdf
[26] resilience of the food supply to port flooding on east coast - Defra, UKrandd.defra.gov.uk/Document.aspx?Document...Eastcoasttidalfloodingscenarios.pdf
[27] https://www.suffolkresilience.com/uploads/2019-02-22_PUBLIC_VERSION_Op_Stack_MOU.pdf
[28] https://www.preventionweb.net/news/view/58732

Innovation and investment in flood resilience as a theme could significantly reduce the impacts of flooding and the large-scale economic consequences. Within this theme key opportunities stand out for potential collaborative projects:

- Supporting communities to develop flood resilience. Exploring the potential for an equivalent of the National Flood Forum in the French eligible area
- Development of social innovation products and services to support resilience
- Better tools for informing building and infrastructure designs and solutions for flood resilience
- Transfer / franchising of flood resilience businesses between countries for economic development

3.4 Co-Creation and Adaptation Pathways

'Co-Creation is the sharing of information, and leadership of the issue with stakeholders to develop new actions and ambitions.'

'Adaptation Pathways indicate a series of interrelated structured options which make sense under specific conditions and timeframes.'[29]

Climate change will increase flood or coastal erosion risk for many communities. Global maps which forecast how coastlines will change due to global warming[30] are illustrating significant changes such as the mouth of the River Somme, which will have crept inland to the town of Abbeville, which currently stands around 20 km away.

Flood risk touches every element of society. A whole system change is needed to deliver sustainable flood resilience. In this context, helping communities to make decisions on the best approach to reduce their risk isn't easy. There are places where traditional flood defences aren't feasible and we need to work together to find alternative, more sustainable options. Stakeholders highlighted that some communities who had been flooded in the past are feeling forgotten, and that investment will only return after their next major flood.

Approaches such as Co-Creation and Adaptation Pathways are being increasingly used to bring stakeholders together in their thinking and planning for uncertain futures. The Environment Agency (England) is also undertaking research and pilot activities to explore different approaches to collaborating with communities[31].

Within this theme key opportunities stand out for potential collaborative projects:

- Training and developing professionals to use co-creation and adaptation pathways approaches.
- Development of flood resilience products and services with support alternative responses to flooding
- Developing tools and services to systems thinking
- Monitoring and warning products and services for communities and businesses

[29] https://link.springer.com/article/10.1007/s11027-017-9773-9
[30] https://www.thelocal.fr/20151201/how-france-would-look-if-sea-levels-rise
[31] http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Documents/Issue_30_-_March_2019.sflb.ashx

3.5 Future Governance and Funding

Flood risk governance and funding arises in almost every conversation about flooding, wherever you are in the world. Who is responsible, who is involved, what are the rules, what actions are taken and how are they coordinated, and most obviously, who will pay. Calls to strengthen flood risk governance are echoed across Europe amidst a growing consensus that floods will increase in the future[32].

The statutory governance arrangements for France and England are illustrated in section 1 (Figures 2 and 3?), but these will need to evolve and include both formal and informal connections with the widest possible set of stakeholders including businesses, NGOs and citizens[33]. A reported strength of the English flood risk governance arrangement is that it has a range of approaches at its disposal, each of them tailored to specific circumstances in terms of the physical characteristics of an area and the potential for damage and economic loss[34].

In England, flood risk and resilience projects that are seeking Government (Grant in Aid) funding follow a partnership funding model[35]. The model focuses on 'outcomes' and sets out a range of criteria that assess the costs, benefits, the nature of deprivation in the location and scale of flood risk that the scheme is addressing, from which the scale of national funding is set. The remainder of the funding will need to be sought from other sources that will benefit from the scheme, including local land owners, local authorities, and commercial businesses.

The intention of the partnership approach was to enable national funding to be spread widely, catalysing more projects and also to draw financial support in partnership from local beneficiaries. The partnership approach also serves to amplify the local authority and community engagement, overcoming the concern that flood risk management was being done 'to' rather than 'with' the community. The approach though is influenced by the target setting by national Government to deliver higher protection to 300,000 homes within a financial settlement period. Therefore, the amount of funding allocated to a scheme, and the degree of priority will be influenced by scale of the outcome, and not by vulnerability alone. The approach also has been used in partnership with development schemes where inward investment can be used to enable development and deliver wider flood risk benefits. The challenge moving forward in addressing climate change is to be clear where development will be seen as sustainable, such that flood scheme design is delivering wider resilience to the community and infrastructure. Reflecting responses from stakeholders that are focused on community response, the ability for local communities to influence and develop solutions, to help them be more in control of their 'future destination', is becoming an ever stronger driver for 'social innovation'.

Within this theme key opportunities stand out for potential collaborative projects:

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[32] http://eprints.whiterose.ac.uk/108070/1/A%20framework%20for%20evaluating%20flood%20risk%20governance_author%20accepted%20manuscript.pdf

[33] Governance Strategies for Improving Flood Resilience in the ... - MDPIhttps://www.mdpi.com/2073-4441/10/11/1595/pdf

[34] Alexander, M.; Priest, S.; Micou, A.P.; Tapsell, S.; Green, C.; Parker, D.; Homewood, S. Analysing and Evaluating Flood Risk Governance in England—Enhancing Societal Resilience through Comprehensive and Aligned Flood Risk Governance; STAR-FLOOD Consortium: Utrecht, The Netherlands, 2016; ISBN 978-94-91933-07-3.

[35] https://webarchive.nationalarchives.gov.uk/20130404013812/http://archive.defra.gov.uk/environment/flooding/funding/documents/flood-coastal-resilience-intro-guide.pdf

- Translating research on Flood Risk Governance into pilot projects to develop new products and services, e.g. Alexander et al (2016) 'A framework for evaluating flood risk governance'
- Envisioning the inland and coastal futures through the eyes of communities to support adaptive pathways, using technology (for example Augmented Reality / Virtual Reality) to develop options for future incremental management of flood risk, and develop community resilience through a 'common ground' approach

3.6 Skills and Education

A survey carried out by the Chartered Institute of Water and Environmental Management (CIWEM) in 2016 highlighted the flood risk skills gap. The survey of over 830 UK professional engineers[36] and employers across the water industry identified flood risk engineering as having the biggest current shortfall in skills in the water industry and expected it to continue to experience the highest skills shortage over 5-10 years. The 2016 New Civil Engineer Industry Report, 'Skills: Meeting Demand' challenges universities and industry to enhance student's professional development using industry-led expertise as a key element of the programmes[37].

This remains a challenge in 2019, as stated in *Engineering skills for the future - The 2013 Perkins Review revisited*, 'we are not close enough to where we need to be as an engineering nation ready for a fourth industrial revolution' and we need to 'support lifelong learning and professional development to ensure workers continue to develop new skills in an increasingly technology-driven world.' This review highlights the wider engineering skills gap in England, but this is clearly relevant for flood risk and is likely to be replicated in the French eligible area.

New collaborations are seeking to respond to the flood skills gap in England with the Centre for Flood Risk and Resilience established at Brunel University London with the Environment Agency and industry partners[38].

The French Interior and Education Ministries initiated a collaborative project in 2016 to provide risk training for 400,000 11 to 14-year-olds in schools on the Mediterranean, plus almost a million of their adult family members[39]. This followed recognition that 17 million of France's 67 million people live in areas at risk from overflowing streams and rivers, and 1.5 million in zones threatened by sea-water flooding. A nationwide risk assessment in 2012 also showed that one job in three is potentially exposed to water-related hazards.

Within this theme key opportunities stand out for potential collaborative projects:

- Skills for flood resilient citizens
- Skills for flood resilient professionals
- Transferring the French Ministry project from the Mediterranean coast to be applied across the France Channel England region.
- Using interactive technologies to engage and educate stakeholders e.g. ESRI Story Map 'My School is Underwater'[40]

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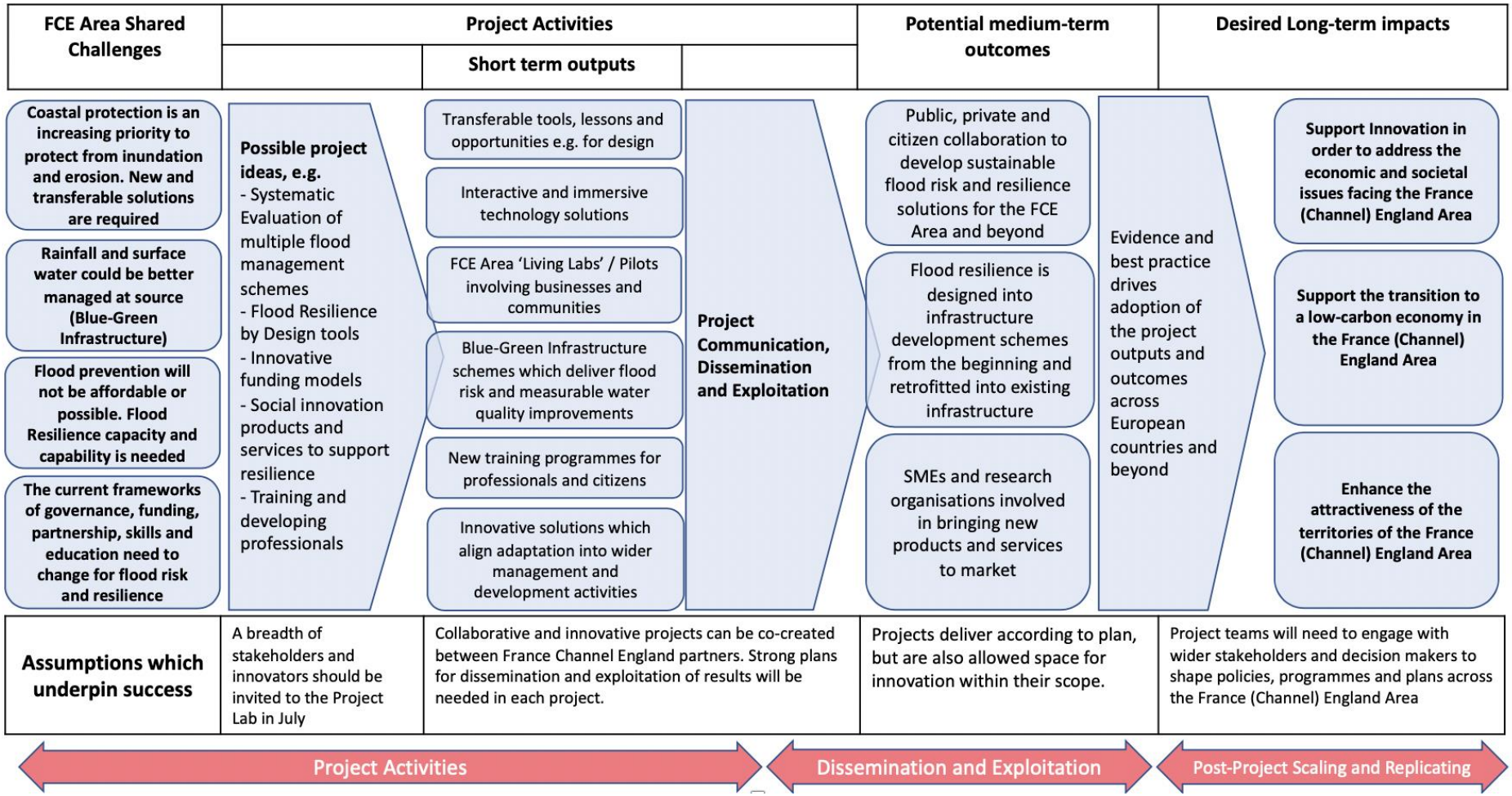
[36] https://www.matchtech.com/water-industry-experts-address-engineering-skills-gap
[37] http://www.costain.com/media/598137/costain_skills.pdf
[38] https://www.newcivilengineer.com/latest/london-centre-launched-to-tackle-flooding-skills-gap/10030438.article
[39] https://www.unisdr.org/archive/48335
[40] https://www.esri.com/about/newsroom/arcwatch/story-map-educates-schoolchildren-about-flood-risk/

4 Relevant measures of Success for Flood Risk and Resilience Projects

As stated in Section 1, Challenge 6 of the France (Channel) England Cooperation Programme highlights flood risk and resilience related actions which projects could seek to support. Projects must also align to one of the three selected Investment Priorities, and related Specific Objectives to be considered for funding. Finally, projects must have the potential to deliver a return on investment with appropriate output indicators. The Programme Manual covers the priorities and objectives in more detail and should be consulted in developing bids. This can be accessed here: https://www.channelmanche.com/assets/Programme-Manual/EN/Guidance-Note-1-Welcome-to-the-Interreg-VA-FCE-Programme1.pdf

This scoping exercise has explored the challenges from the stakeholders viewpoint, and what outcomes and impacts could be expected from successful projects in this area. This information has populated the PESTLE Table in Section 2.5. This assessment is not exhaustive but is intended to support the setting of funding call ambitions and expected targets. The information and ideas collated have been used to create a draft Theory of Change including problems, outcomes and impacts, with examples and illustrations for the projects and activities which could deliver the change. This Theory Of Change is provided below as Figure 10.

Figure 10: INTERREG FCE Programme: Flood Risk and Resilience Theory of Change



5 Flood risk and Resilience Related Projects Already Underway

There are a number of projects and programmes already underway which are in, or relevant for, the France Channel England region. These projects are being funded through other schemes such as the INTERREG 2 Seas programme which shares the same eligible area in England and partners with Nord, Pas de Calais, Somme, Aisne, and coastal provinces in Belgium and The Netherlands. Therefore all INTERREG 2 Seas projects will have relevant English partners and may also have French partners.

Table 3 below provides a description of these projects. INTERREG FCE will be well placed to adopt and develop further the activities or outputs from these projects in the wider English and French contexts.

Table 3. Existing Projects and their Relevance for the FCE Programme

Project (Funding body)	**Description**
ENDURE: ENsuring DUne REsilience against Climate Change (INTERREG 2 Seas)	**ENDURE** will work to improve & restore the ecosystem ability of dunes to act as adaptive, living sea defences for a coastline which is more naturally resilient to erosion, flooding & sea level rise.
Triple C: Climate resilient Community-based Catchment planning and management (INTERREG 2 Seas)	The **TRIPLE C** partnership will reduce flooding in the participating catchment areas by demonstrating and validating, though a series of pilot projects, how farmers can create cost-saving water retention and erosion control measures upstream.
FRAMES (INTERREG North Sea)	**FRAMES aims on increasing the resilience of areas and communities by working with the Multi-Layer Safety (MLS) Concept.** Traditional, static flood preventions,may not be sufficient anymore in the future. There will never be enough resources to protect every single citizen from flooding, but if we smartly combine resilience measures we can minimise impact. FRAMES shifts to Multi-Layer Safety, smartly combining resilience measures. ● Flood resilient areas: improving infrastructure and spatial planning measures ● Flood resilient communities: making people and social stakeholders better prepared ● Flood resilient authorities: reducing recovery times and increase response capacity

Sponge 2020: Co-creation and implementation of innovative, participative climate adaptation solutions in densely built areas (INTERREG 2 Seas)	**Sponge 2020** will improve the adaptation capacity of cities and densely built areas in the 2 Seas region by co-creating and implementing innovative climate change adaptation solutions with local stakeholders.
SARCC Sustainable and Resilient Coastal Cities (INTERREG 2 Seas)	**SARCC** will build the capacity of urban leaders, decision-makers and officers involved in coastal flood defences to deploy NBS and understand the additional benefits that they offer in comparison to traditional grey infrastructure.
Co-Adapt: Climate adaptation through co-creation	**Co-Adapt** will develop, test and roll-out approaches to co-creation of nature based and natural process solutions to improve adaptive capacity of the 2 Seas region to the water-related effects of climate change. It will directly decrease risk of flood & drought to 30,000ha through co-created NBS, leading to €5.4M of savings from reduced damages, and €5.8M of savings compared to using traditional hard engineering.
STAR2Cs Short Term Adaptation for Long Term Resilience to Climate Change	**STAR2Cs** will overcome the 'implementation gap' currently faced in delivering local action to build adaptation capacity by establishing an innovative transferable solution that: • identifies financial/social/technical/ecosystem-based mechanisms to deliver cost-effective adaptation • builds stakeholder knowledge/ability to participate in 'future-proofed' decision making • demonstrates success and cost-savings of integrated and incremental actions to implement adaptation for wider roll-out

6 Conclusions and Recommendations

The evidence and analysis presented in this report presents a shapshot of the issues relating to flood risk and resilience in the France Channel England Area, as articulated by stakeholders through interview, and from supporting data and reports. The issues have been assessed and compiled into 6 thematic areas, reflecting the priorities identified in the analysis.

The opportunity now is for the stakeholders interested in working with INTERREG FCE to assess this information and how it aligns with their own priority areas and ambitions and recognising the project ideas resulting from the lab will need to focus on implementation measures rather than research.

This report is intended to be shared with the stakeholders engaged, and with those who couldn't be reached within the timescales for this work. Recognising this report will be relevant to a range of stakeholders, the broadest possible set of stakeholders should be invited to the Project Lab to ensure that the ideas shared and developed can deliver against the aspirations of the programme. The project Lab attendees should be from a mix of public sector bodies, private sector and SMEs, Non-Government Organisations and Research Organisations.

Appendix - Stakeholders Engaged

A wide range of organisations were contacted during this Scoping Exercise. Those who we were able to interview within the timescales include:

Agur Dunkerque
Association of Drainage Authorities
Balfour Beattie
Combined Coastal Management Service for Eastern Solent Authorities
Cornwall County Council
DREAL - Direction Régionale de l'Environnement, de l'Aménagement et du Logement
Coastal Partnership East
European Rivers Network (France)
Environment Agency
Farsons Digital Water Cams
François Rabelais, University of Tours
Kent County Council
National Flood Forum
Norfolk Rivers Trust
Plymouth Marine Laboratory
Rivers Trust
Shoothill
Somerset County Council
Thames 21
West Country Rivers Trust