Coastal Adaptation and Transition Rapid Evidence Review

Consultant report for Coastwise in support of the development of the Coastal Adaptation Database and Archive



This document has been prepared for North Norfolk District Council by:

Resilient Coasts Ltd, Melville Building East, Royal William Yard, Plymouth, PL1 3RP.
https://resilientcoasts.com/

In association with:

- Coastwise
- North Norfolk District Council
- The Environment Agency

Project Steering Group:

- Rob Goodliffe
- Sophie Day
- Chris Smith
- Chloe Suttle
- Alastair Zangs

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Produced by	Resilient Coasts Ltd		
Project manager	Emma Rendle emma.rendle@resilientcoasts.com		
Project team	Kirsty Rhodes Emily Hunt	Date	21/03/2024
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Client manager	Rob Goodliffe Rob.Goodliffe@north-norfolk.gov.uk		

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Executive summary

In the UK, flooding and coastal erosion is a national challenge, with over 5.2 million homes and properties in England at risk[1,2]. Climate change is leading to sea level rise and increased storminess[3].With more frequent and severe flooding and coastal erosion events observed across the UK; an observation that is projected to continue[4]. The significant scale of coastal erosion risk is accelerating in East Riding of Yorkshire and North Norfolk[5]. These locations contain 84.1% of all residential properties at risk of coastal erosion in England in the next 20 years[5].

Local Authorities cannot eliminate the risk from coastal change, yet it can be managed to either mitigate the risk or adapt to the change. In many areas of the UK, it is no longer technically, socially, or economically feasible to continue to provide coastal protection measures for erosion[1]. Across the UK, an adaptation approach is needed to prepare communities for coastal change. To be 'climate ready', communities must be resilient to current and future climate hazards and potential economic shocks, with the ability to recover quicker from climate events[1]. National and Local Authorities are increasingly aware of the benefits of working with natural processes[6] and transitioning away from those defences which are unsustainable[1].

The UK government has a long-term ambition for managing flood and coastal erosion challenges and creating resilient places.

> *'Our vision: A nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100.'*[1]

To implement this, £200 million was invested nationally to launch the Flood and Coastal Innovation Programmes (FCIP) in 2020. Under this, £36 million has been allocated to support communities in areas at significant risk of coastal erosion to transition and adapt to a changing climate through the Coastal Transition Accelerator Programme (CTAP)[7]. In North Norfolk, CTAP is delivered by Coastwise under North Norfolk District Council (NNDC), with the aim to take a 'more proactive, collaborative and planned approach to coastal adaptation'[8].

In November 2023, Resilient Coasts Ltd were commissioned by NNDC, with support from the Environment Agency under Coastwise, to conduct a rapid evidence review of worldwide adaptation and transition initiatives for coastal erosion. The project objectives were to review adaptation and transition practical actions, projects, examples, policies, plans, and actions across sectors that could help advance good practice in delivering coastal adaptation in England.

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[1]Environment Agency (2020) *National Flood and Coastal Erosion Risk Management Strategy for England*. Available online (Accessed: 17/02/2024).
[2] Environment Agency (2019) *Flood awareness survey date* (unpublished).
[3] Environment Agency (2019) *Exploratory sea level projections for the UK to 2300*. Available online (Accessed: 17/02/2024).
[4] Global Commission on Adaptation (2019) *Adapt now: A global call for leadership on climate resilience*. Available online (Accessed: 17/02/2024).
[5] Environment Agency (2023) *Coastal Transition Accelerator Programme*. Available online (Accessed: 17/02/2024).
[6] Environment Agency (2017) *Working with natural processes to reduce flood risk.* Available online (Accessed: 17/02/2024).
[7]Defra. *Flood and Coastal Innovation briefing note*. Available online (Accessed: 17/02/2024).
[8] Environment Agency (2023) *Coastwise*. Available online (Accessed: 17/02/2024).

The rapid evidence review method undertaken explored examples of adaptation known to Resilient Coasts Ltd and the Coastwise Project Steering Group, and derived additional examples from a literature review and expert interviews. The Coastal Adaptation Database and Archive was developed, containing a baseline of adaptation examples exploring initiative successes, challenges and transferable lessons for NNDC. Alongside the database, an online archive of references was created and detailed case studies of adaptation examples were developed for this report. Interactive tools to enable visualisation of the information held in the Coastal Adaptation Database and Archive were developed via an interactive global Mapbox and a Tiki-Toki timeline.

Key project findings included:

- Local Authorities implementing adaptation initiatives require a skillset of strong communication, a strategic mindset, and system-based thinking.
- Adaptation strategy across the UK is too slow. Organisations planning adaptive measures must 'think on their feet' and consider a trial-and-error approach to implementation.
- Suitable metrics need to be defined early on in adaptation initiative planning to quantify long-term adaptation benefits.
- The mental and physical health benefits of adapting to coastal risk is under reported and should take a higher priority in cost benefit analysis of initiatives.
- Collaboration and effective intergenerational stakeholder engagement is key to successfully achieving a societally acceptable adaptative outcome.
- To mitigate barriers to implementing property rollback schemes in England, increased Local Authority expertise of existing regulations; early, independent site appraisal studies; and independent external engagement strategy support could support successful adaptation actions.
- There is value in exploring wider adaptation and transition examples, beyond coastal erosion, to identify transferable methods and techniques.

The project outputs are intended to provide learnings for delivering coastal adaptation in England. In this report, we present recommendations based on key project findings, that could be integrated into planning for and implementing adaptation actions for the eroding coastline of North Norfolk. All outputs were designed for future integration into an online Coastal Transition Hub and can be developed and added to with further examples of adaptation initiatives. It is expected that the project outputs will provide an effective tool for developing knowledge of adaptation and transition by Local Authorities and those working in climate change adaptation and disaster risk management, and can be integrated into engagement activities with coastal communities.

1 Introduction

The North Norfolk coast has some of the most rapidly eroding coastline in Europe, with rates of erosion expected to accelerate due to climate change[9][10]. Action is being taken to explore how best to adapt and transition communities at risk to become more resilient. Coastwise, part of the nationally funded Coastal Transition Accelerator Programme (CTAP), is being delivered by North Norfolk District Council (NNDC) over the period 2022-2027. Under CTAP, NNDC aims to develop a local Strategic Coastal Transition Plan, a Coastal Transition Manual and National Options for Transition.

In November 2023, Resilient Coasts Ltd were contracted by NNDC, with support from the Environment Agency, to conduct a rapid evidence review of adaptation and transition initiatives. Framed within CTAP and Coastwise, the project aimed to report on adaptation and transition initiatives across a range of sectors, reporting transferable insights that may inform adaptation to the challenges posed by coastal erosion along North Norfolk's coastline.

The project objectives were to:

- Utilise and build upon existing information to provide a rapid, yet robust, evidence review of past coastal adaptation/transition practical actions, projects, examples, policies, plans, and actions.
- Systematically collate evidence in a database and provide key searchable information of each identified record.
- Store documentation, where available, in an easily searchable and recallable format of each record in a system that is readily accessible and available to local government.
- Provide an archive system that meets appropriate and proportional national standards and could be integrated into a Coastal Transition Hub. If necessary, identify further methods where examples are already catalogued (e.g. scientific papers).
- Building upon existing work, provide a UK timeline in a suitable format which tracks the development and implementation of coastal change transition to date.

Key project outputs included:

- Final report and timeline of key milestones for adaptation (herein)
- Database, archive and timeline user guide (Appendix 3)
- Summary of search activities (Appendix 4)
- Interview transcriptions (provided separately) and summary notes (Appendix 5)
- including case studies (Appendix 6)
- Database of evidence (Access)
- Library archive of data sources (OneDrive)
- Interactive map of key examples (Mapbox)
- Separate timeline of all examples (Tiki-Toki)
- Map of interview contact network (provided separately)
- Development of structured interview and Google Forms survey questions (provided separately)
- Results of Google Forms survey (provided separately)

[9] Masselink, G. et al. (2020). Impacts of climate change on coastal geomorphology and coastal erosion relevant to the coastal and marine environment around the UK. *MCCIP Science Review* 2020, pp. 158–189. Available online (Accessed: 23/01/2024).
[10] Environment Agency (2023) *Coastwise*. Available online (Accessed: 23/01/2024).

- Workshop presentation slides (provided separately)

The definition of an initiative as either adaptation or transition relies on several key considerations. Adaptation strategies predominantly revolve around the adjustment to environmental changes[11], specifically those induced by climate impacts such as sea-level rise or increased erosion. Their primary goal is to minimise negative consequences and enhance resilience, focusing on sustained adjustments over time[12]. In contrast, transition schemes encompass a broader shift toward sustainable and resilient systems, involving fundamental changes in societal, economic, or environmental aspects to cope with long-term challenges[13]. The timeframe, scale of impact, risk management approaches, flexibility, innovation, and community involvement are critical aspects that further distinguish between adaptation and transition. While adaptation often involves flexible strategies and incremental innovations to manage specific risks, transition necessitates systemic and transformative changes[13] that address the root causes of vulnerabilities, potentially impacting entire sectors or communities. The classification may evolve over time as the scheme responds to dynamic environmental and societal factors, exhibiting elements of both adaptation and transition.

Coastal adaptation and transition initiatives in the UK are guided by national legislation[14,15], policy[16] and strategy[17], and regional Shoreline Management Plans[18]. There are various guidance reports[19,20,21] and reviews[22] that can be utilised by practitioners and planners to develop local adaptation strategy. Figure 1 provides an overview of milestone activities[23], drivers of change and key publications for coastal adaptation in the UK.

This report outlines the rapid evidence review method undertaken to explore adaptation initiatives, including a systematic literature review and an expert-opinion gathering exercise. The investigation reviewed examples of adaptation to an eroding coast in addition to transferable examples from sectors beyond coastal erosion, encompassing local, UK-wide, and international learnings. The methodology followed for database and archive development are described. Key findings of the evidence review and case studies of interest to the

[11] Smit, B. and Wandel, J. (2006) Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16(3), pp. 282-292. Available online (Accessed: 17/02/2024).
[12] Adger, W.N., S. et al. (2007) 'Assessment of adaptation practices, options, constraints and capacity', in M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds.) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK, pp. 717-743.
[13] Rotmans, J., Kemp, R. and Van Asselt, M. (2001) More evolution than revolution: transition management in public policy. *Foresight*, 3(1), pp 15-31. Available online (Accessed: 17/02/2024).
[14] HM Government. *Coast Protection Act 1949*. Available online (Accessed: 17/02/2024).
[15] HM Government. *Flood and Water Management Act 2010*. Available online (Accessed: 17/02/2024).
[16] HM Government (2020) *Flood and coastal erosion risk management*: *Policy Statement*. Available online (Accessed: 17/02/2024).
[17]Environment Agency (2020) *National Flood and Coastal Erosion Risk Management Strategy for England*. Available online (Accessed: 17/02/2024).
[18]Environment Agency (2024) *Guidance: Shoreline Management Plans*. Available online (Accessed: 17/02/2024).
[19] Rogers, J. (2010) *Beach management manual*. CIRIA. Available online (Accessed: 17/02/2024).
[20] Environment Agency (2010) *The coastal handbook*. Available online (Accessed: 17/02/2024).
[21] The Climate Change Committee (2018) *Managing the coast in a changing climate*. Available online (Accessed: 17/02/2024).
[22] Defra (2012) *Coastal Change Pathfinder Review: Final Report*. Available online (Accessed: 17/02/2024).
[23] Environment Agency (2022) *Flood and Coastal Innovation Programmes*. Available online (Accessed: 17/02/2024).

CTAP/Coastwise initiatives are presented. Building on transferable lessons for an eroding coast, the report concludes with a set of recommendations for future work and next steps.



Figure 1. Timeline of key policy, guidance and activities that inform coastal adaptation initiatives in the UK.

2 Rapid review method

Resilient Coasts Ltd undertook a three-stage approach to the rapid evidence review, agreed with the Project Steering Group (PSG), to identify examples of adaptation and transition initiatives:

1. Review of known initiatives of interest identified by Resilient Coasts Ltd and the Project Steering Group.
2. Expert structured interviews and online survey.
3. Literature search by systematic key word search.

Examples of adaptation and transition initiatives were collated in the Coastal Adaptation Database alongside an archive library of open-source reference documents. A select number of case studies were also written up for this report.

2.1 Known initiatives of interest

The project steering group provided a diverse collection of literature, initiatives, and sources of potential interest, which were organised into a tabulated format (Appendix 1. Table 7). The methodology for reviewing literature provided by the project steering group involved a systematic process to identify and assess relevant initiatives and sources. A preliminary screening of each source title and abstract was conducted to determine its suitability for entry into the database, and an overview of the source tabulated for future reference.

Review documents, due to their brevity and limited project-specific information, were set aside at this stage to accommodate project time constraints. These materials may be revisited for potential database inclusion during later stages of the project, especially for extracting insights and details that might contribute to future additions. Sources were excluded from immediate inclusion if there was insufficient information to populate the database, if they represented entire databases themselves, or were deemed irrelevant to the project's scope. Out of the 48 sources examined, 17 were considered suitable for immediate input into the database based on their alignment with project objectives and the volume of available useful information.

In addition to initiatives of interest identified by the PSG, Resilient Coasts Ltd has contributed knowledge of known adaptation initiatives for addition to the Coastal Adaptation Database.

2.2 Interviews and survey

As part of the evidence review, Resilient Coasts Ltd consulted with the PSG to create a contact network map, encompassing experts involved in designing and implementing adaptation and transition initiatives across a range of sectors. Invitations were issued by email to participate in an interview or, alternatively, to submit expert opinion by an online survey issued in Google Forms. Interviews were conducted with 10 experts working in the field of adaptation (Table 1) and an additional 5 survey responses were collected. The interviewees comprised of practitioners and researchers from Local Authorities, government organisations, academia and the private sector working in the UK and internationally.

The interview and survey questions were designed to capture insights into the skills required to work in adaptation initiatives; collect further examples of adaptation initiatives to supplement the database; and to gain expert opinion on success factors, challenges and lessons learnt from adaptation schemes. The interviews followed a flexible approach whereby we could explore adaptation themes and ideas of interest raised by the interviewee. All interviewees

were asked to give consent to the interview being recorded and made aware that their name may be used as a reference.

Table 1. List of expert interviews conducted, in date order.

Interviewee	Role	Organisation	Initiative of interest	Interview date
Kellie Fisher	East Anglia Coastal Area Manager	Environment Agency	Broadland Futures Initiative	13th December 2023
Richard Jackson	Coastal Change Manager	East Riding of Yorkshire Council	East Riding Coastal Change Pathfinder Project	14th December 2023
Katie Parsons	Research Fellow in Education, Geography and Environment	Loughborough University	British Academy initiatives in Vietnam	14th December 2023
Jessica Johnson	Associate Professor in Solid Earth Geophysics	University of East Anglia	Risk reduction through community-based monitoring: the *vigías* of Tungurahua, Ecuador	15th December 2023
Tom de la Rosa	Flood and coastal innovation programme (FCIP) manager	Environment Agency	Highways England Natural Flood Management Pilot Programme	19th December 2023
Alan Frampton	Strategy, Policy and Environment Manager for Flood and Coastal Erosion Risk Management	Bournemouth, Christchurch and Poole Council	Shoreline Management Plans	20th December 2023
Tim Bartlett	Specialist Adviser for Flood and Coastal Risk Management	Lewes and Eastbourne Council	Ringmer wetlands	20th December 2023
Lydia Burgess-Gamble	Promoting Adaptation to Changing Coasts (PACCo), Lead Project Manager	Environment Agency	PACCo initiative – Lower Otter Restoration Project	21st December 2023
Quirijn Lodder	Principal Advisor Coastal Flood Risk Management	Rijkswaterstaat	Prins Hendrik Zanddijk	21st December 2023
Jed Ramsay	Project Leader	Project Groundwater	Project Groundwater	21st December 2023

2.3 Literature search

The literature search followed the methodology for Quick Scoping Reviews (QSR) described by Collins et al. (2015)[24]. This review method provides an understanding of the volume and characteristics of available data, minimises bias and ensures transparency and accessibility for further scrutiny and additions. The QSR method follows an eleven-step process as shown in Table 2.

Table 2. The Quick Scoping Review method.

Determining the review question/s	The review question was determined during project procurement and kick-off meeting. Primary Question: "Identify examples of past practical actions, projects, examples, policies, plans, and activities that have, for any particular place (nationally or internationally), delivered or attempted to deliver a coastal transition/adaptive outcome on an eroding coast." Secondary Question: "Identify examples of transferable adaptation/transition initiatives across other sectors"
Establishing Steering Group and confirm method	The Project Steering Group consists of NNDC client project leads and the Environment Agency, a project partner and end user of outputs. The evidence review and archive method was confirmed during project meetings.
Establishing a review team	The Resilient Coasts Ltd review team consists of: Emma Rendle – Project director Kirsty Rhodes – Project manager Emily Hunt – Technical lead
Hold an inception meeting	A project kick-off meeting and subsequent regular interim meetings were held.
Develop a protocol	See the QSR protocol in Table 3.
Search for the evidence	Evidence search conducted over project duration November 2023 – February 2024, following protocol strategy. Search results were recorded.
Screen the search results	The criteria outlined in the protocol were consistently applied to search returns and the results of each screening phase recorded. Each result was screened to determine relevance.
Extract evidence	Evidence relevant to the review question was extracted to create a list of evidence for addition to the Coastal Adaptation Database.
Synthesise the results	The findings section of this report describes the volume and characteristics of the evidence base. This report makes recommendations for further research.
Communicate findings	QSR findings were recorded in the Coastal Adaptation Database and the final report admitted to the PSG for review. A discussion of project findings is planned for 29th February and 1st March during a Monitoring Evidence and Learning workshop.
Sign off project	Project sign off planned for w/b 26th February.

The QSR protocol was designed to outline the details of review scope and methodology, for both the primary and secondary review question, including search terms and evidence locations to be used (Table 3 and Table 4).

[24] Collins, A. et al. (2015) *The Production of Quick Scoping Reviews and Rapid Evidence Assessments. A How to Guide.* Joint Water Evidence Group. Available online (Accessed: 23/01/23).

Search activity returns were compiled in a summary table to ensure transparency (Appendix 2. Table 8). The search terms used, search location and total number of returns was recorded for each search. Following the search scope protocol, returns to be screened were accessed and titles and hyperlinks added to the search summary spreadsheet. Duplicate results were removed from the screening process. Each result was initially screened reading only the title of the evidence and marked as relevant, not relevant or uncertain. Evidence marked as relevant or uncertain at this first stage was obtained in full and a second phase screening was completed by reading the abstract or introductory paragraph to determine which examples were relevant to the review questions. The full text of relevant evidence was screened for addition to the Coastal Adaptation Database.

Table 3. Quick Scoping Review protocol for primary question.

Primary Question: "Identify examples of past practical actions, projects, examples, policies, plans, and activities that have, for any particular place (nationally or internationally), delivered or attempted to deliver a coastal transition/adaptive outcome on an eroding coast."	
PICO elements	
Population The subject or unit of study.	Coastal areas globally
Intervention The proposed management regime, policy or related intervention/ exposure applied or investigated.	Any intervention type including practical actions, projects, policies, plans, and activities.
Comparator The control with no intervention or an alternative to the intervention.	Not applicable.
Outcome The effects of the intervention.	Impact on coastal erosion rates, socio-economic impacts, return on investment, unexpected outcomes.
Scope of the review:	
Date restrictions	Only evidence published after 2000.
Language restrictions	Only evidence published in English.
Number of returns	The first 20 returns of each search.
Search terms: Groups of keywords used for systematically searching for evidence. Where search locations allowed, an asterisk was applied to search for alternative forms of words. For example, the search term ero* will capture erode, eroding, erosion.	
Primary search term: Coastal erosion (Coast* ero*)	Secondary search terms: AND adaptation (adapt*) AND transition
Search locations:	Google Scholar[25]
	CoastAdapt Case Studies[26]
	ClimateScan[27]
	University of Oxford's Nature based Solutions Initiative[28]
	UK Adaptation Inventory Database[29]

[25] Google Scholar. Available online (Accessed: 17/02/2024).
[26] CoastAdapt. Available online (Accessed: 17/02/2024).
[27] Climatescan. Available online (Accessed: 17/02/2024).
[28] University of Oxford (2024) *Case study platform*. Available online (Accessed: 17/02/2024).
[29] Tyndall Centre for Climate Change Research (2021) *UK Adaptation Inventory*. Available online (Accessed: 17/02/2024).

Table 4. Quick Scoping Review protocol for secondary question.

Secondary Question: "Identify examples of transferable adaptation/transition initiatives across other sectors."	
PICO elements	
Population The subject or unit of study.	Global, any sector.
Intervention The proposed management regime, policy or related intervention/ exposure applied or investigated.	Any intervention type including practical actions, projects, policies, plans, and activities.
Comparator The control with no intervention or an alternative to the intervention.	Not applicable.
Outcome The effects of the intervention.	Severity of hazard impact, socio-economic impacts, return on investment, unexpected outcomes.
Scope of the review:	
Date restrictions	Only evidence published after 2000.
Language restrictions	Only evidence published in English.
Number of returns	The first 10 returns of each search.
Search terms: Groups of keywords used for systematically searching for evidence	
Primary search term: Climate change	Secondary search term: AND adaptation (adapt*)
Search locations:	Google Scholar[30]
	CoastAdapt Case Studies[31]
	ClimateScan[32]
	University of Oxford's Nature based Solutions Initiative[33]
	UK Adaptation Inventory Database[34]

2.4 Database and archive development

2.4.1 Database review

A review of existing open-access databases was conducted (Table 5), with the goal of extracting valuable insights to inform the design of the Coastal Adaptation Database. Key learnings from this review included the importance of comprehensive coverage, a user-friendly interface, and regular updates to keep the database current. The incorporation of advanced search functionality, interactive mapping features, and collaboration tools for stakeholders emerged as crucial aspects for consideration. The potential to tailor local data, inspired by region-specific datasets, and implement a community-based approach similar to CoastalResilienceNetwork, were identified as valuable strategies. Educational resources, tutorials, and extensive documentation were highlighted to support users with varying levels of expertise.

In the development of the Coastal Adaptation Database, the learnings from the review of existing open-access databases have been integrated. The database input form provides a simple and user-friendly interface, leveraging lessons from databases with user-friendly interfaces like CoastAdapt and Cornwall Coastal Data Hub. The incorporation of advanced

[30] Google Scholar. Available online (Accessed: 17/02/2024).
[31] CoastAdapt. Available online (Accessed: 17/02/2024).
[32] Climatescan. Available online (Accessed: 17/02/2024).
[33] University of Oxford (2024) *Case study platform*. Available online (Accessed: 17/02/2024).
[34] Tyndall Centre for Climate Change Research (2021) *UK Adaptation Inventory*. Available online (Accessed: 17/02/2024).

search filters mirrors the functionality found in CoastAdapt, allowing users to query the database efficiently based on initiative type, key words, region, or date, and so on. The database user guide provides clear instructions, suitable for a range of levels of expertise, inspired by takeaways from the review.

Table 5. Review of existing open-access databases.

Database	*Pros*	*Cons*	*Additional info*	*Transferable ideas*
CoastAdapt	Comprehensive: Covers a wide range of coastal adaptation strategies. Covers case studies, datasets and introductions to topics – good for a wide range expertise levels. User-Friendly Interface: Navigating the database is intuitive. Regular Updates: Database is consistently updated with new research and adaptation projects. User training materials available for effective use. Search functionality allows users to query by adaptation strategy, region, or date. Advanced filters available.	Limited Geographic Coverage: Focuses primarily on a specific region (Australia), limiting its global applicability. Privacy protocols restrict certain data access.	Advanced filters for refining search results. Export options for downloaded datasets.	Wide range of topics that are accessible for all skill-levels. User-training materials – in depth and easy to follow. Searchable. Key differences – spatial coverage.
Cornwall Coastal Data Hub	Region-specific data for Cornwall. Tailored for local adaptation strategies. Interactive mapping features for visual data exploration. Collaboration tools for local stakeholders. Regular updates on Cornwall's coastal conditions.	Limited coverage beyond Cornwall.		Similar categorization for datasets. Searchable. Map viewer – good way to visualize the datasets, but a bit clunky. Some good ideas.
Channel Coastal Observatory	Provides real-time or periodic updates. Search and filter options for specific monitoring parameters, dates and region. GIS integration for spatial analysis of monitoring data. Collaborative features for data sharing among monitoring entities.	Limited to monitoring data.	Not available for contribution from stakeholders etc. Direct collaborators only.	Differences – CoastWise will be less GIS focused. The interactive map viewer gives ideas for the Mapbox section. This database is largely focused on monitoring data.

Database	*Pros*	*Cons*	*Additional info*	*Transferable ideas*
CoastalResilienceNetwork	Community focused approach: Emphasises community-based adaptation strategies. Educational Resources: Provides resources and case studies to educate communities on resilience. Community engagement events for data enrichment.	Limited Technical Data: Focuses more on community stories and less on technical data relevant to researchers and policymakers. Needs Regular Updates: Some data may be outdated, requiring regular maintenance. Limited advanced search features.	Qualitative data retrieval via community-based stories and case studies. Educational resources accessible through a separate section. Planned updates to enhance search functionalities. Links to and describes various apps for data viewing/ downloading.	Mapping portal – very similar to how CoastWise will be visualised in Mapbox. Interactive tutorials. Literature resources library – classification/categorisation of papers is useful
Catchment Based Approach Data Hub	Collaborative platform for stakeholders. Search tools for catchment-specific data retrieval. Searchable map and lists alongside each other. Extensive user guide and videos (Youtube).	Requires active stakeholder engagement for data. Not regularly updated (last update 2021).	Emphasis on community involvement in data collection.	Searchable map and lists alongside each other. Makes it user-friendly. Mostly data focused rather than literature. Youtube videos

2.4.2 Database design

The initial phase involved designing the Coastal Adaptation Database structure. The decision was made to utilise a front-end and back-end split to enhance data security. The front-end allows users to add entries via a form, and interact with a copy of the database tables, providing a responsive and user-friendly interface, while the back-end securely stores the central data.

The main table was structured to accommodate initiative-related information. Fields were defined to capture project details (Appendix 3. Table 9). Each row in the main table represents a unique project entry, indexed uniquely which references to files stored within the archive.

Drop-down menus in column headers allow users to filter data based on specific criteria like Initiative Status, Sector, or Location, hence drop-down options were integrated where possible. To support this, 'look-up' tables were generated, standardising entries, and ensuring consistency.

The user interface was developed to improve user-friendliness and consistency. The 'Evidence Review Form' was designed to guide users through data entry to reduce the likelihood of errors. All data entries will be conducted through the form, which subsequently adds the entry to the central database and is stored in the central back-end database.

The development process prioritised adherence to national archive standards throughout (Section 2.4.4). This included incorporating comprehensive metadata, standardised documentation practices, and data preservation mechanisms, aligning the database with archival best practices.

The database user guide can be found in Appendix 3.

2.4.3 Archive development

The archive was developed and stored within OneDrive, utilising a well-organised folder structure that aligns with the sector classification system (Table 10). The sector list was designed to encompass a broad range of sectors that may offer transferable knowledge to the coastal sector, drawing from other classification systems[35,36].

OneDrive was chosen as the storage solution for the project's archive due to its cloud-based collaborative features, robust security measures, and its user-friendly interface. Additionally, the scalability of OneDrive accommodates the project's evolving storage needs.

Each sector was technically classified by the Resilient Coasts Ltd team and further reviewed by the PSG. These sectors correspond to a folder within the OneDrive archive (Figure 2).

[35] ClimateADAPT. *Adaptation in EU policy sectors*. Available online (Accessed: 17/02/2024).
[36] Office for National Statistics. *UK Standard Industrial Classification Hierarchy*. Available online (Accessed: 17/02/2024).

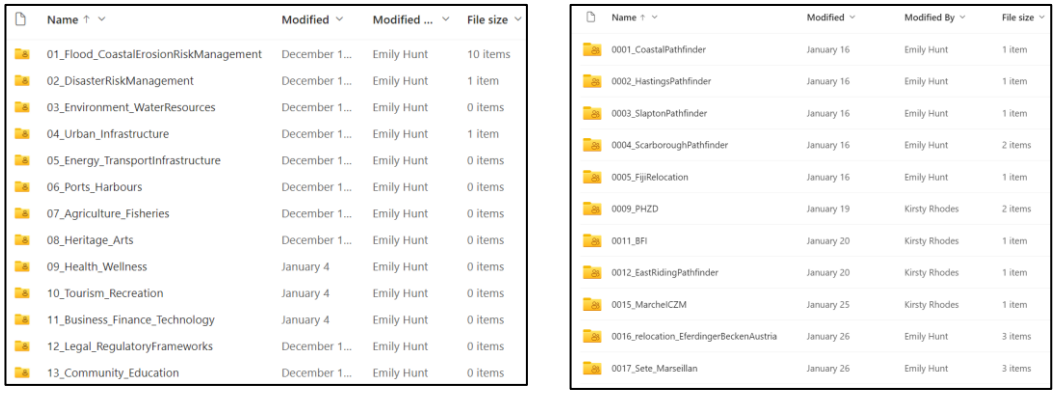


Figure 2. The archive folder is structured by sector (left), whereby each sector contains folders relevant to individual projects (right).

To ensure a standardised and systematic approach, each initiative has its unique folder within the sector-based structure, corresponding to the unique identifier assigned within the database. The initiative folder names, as well as the names of files and documents contained within, adhere to a standardised naming protocol outlined in the user guide. This enhances consistency and ease of reference for users navigating the archive.

2.4.4 National archive standards

The national archive standards[37] refer to a set of guidelines, best practices and principles that serve as benchmarks for ensuring the effective management, preservation, and accessibility of historical records and valuable information. In the context of this database, we adhere to these standards to ensure we meet archival best practices.

The Coastal Adaptation Database follows a well-defined structure, with standardised tables, forms, and fields to facilitate efficient data organisation. This approach aligns with standards that prioritise the clarity and coherence of archival information. Each entry in the database is accompanied by comprehensive metadata, encompassing project details, citations, and linked evidence. This mirrors standards that highlight the significance of detailed documentation, providing essential context for understanding and contextualising archived materials. The database utilises backup and data preservation mechanisms to safeguard against loss or corruption, including the use of cloud-based storage and version control.

Designed with accessibility in mind, the database facilitates easy search and retrieval of information. Adhering to standards promoting accessibility, users can dynamically filter data based on project status, sector, location, and other relevant criteria, improving the process of accessing archived content.

In promoting collaboration, the database serves as a central repository for project-related information. This aligns with standards that advocate for shared access to archival materials. User-friendly forms, structured data entry protocols, and consistency checks further contribute to the database's fidelity to standards, improving accuracy and reliability in archival records.

Through integration of these practices, the Coastal Adaptation Database ensures that the information it houses is well-maintained and accessible, reflecting alignment with the best practices established by national archival standards.

[37] The National Archives. Available online (Accessed: 17/02/2024).

3 Synthesis of review findings

3.1 Literature review

The literature evidence review breakdown is presented in (Table 6). The QSR literature search returned a total of 50,074 records. The project scope parameters were applied, leaving 98 records remaining for screening. The screening process described in Section 2.3, was applied to the 98 records and those that were not relevant to the project needs were removed. 37 records were found to be of relevance to the project scope. A total of 21 records of interest identified by Resilient Coasts Ltd and the PSG were added to the evidence review.

A total of 58 records were found to be relevant to the project scope for review and addition to the Coastal Adaptation Database.

Table 6. Literature evidence review results.

	Records removed in screening process	Total records remaining
Literature search return results		50074
Scope restrictions applied	49976 records removed	98
Exclusion of duplicates	5 records removed	93
Relevance screening phase 1 (title only)	19 records removed	74
Screening phase 2 (abstract)	61 records removed	37
Addition of initiatives of interest (RCL and PSG)		21
Total records to be reviewed in full for addition to database.		58

Due to project time limitations, 12 records from the literature review were reviewed in full and added to the Coastal Adaptation Database. The remaining 46 relevant records were tabulated, and it is recommended that these are added to the database at a later date (Appendix 4. Table 11).

3.2 Interviews and surveys

Resilient Coasts Ltd conducted ten interviews and received five survey responses from expert practitioners and researchers working across a range of sectors, risk types and adaptation initiatives. This part of the evidence review highlighted adaptation initiatives across multiple sectors. A further 8 initiatives from interview and survey responses were researched and reviewed for addition to the Coastal Adaptation Database, taking the total to 20 records. Interview summary notes have been summarised as one-page overviews (Appendix 5). The key findings from interviewees and survey respondents are summarised below, grouped by theme.

3.2.1 Skills

The skills required to work in adaptation planning and implementation across all sectors were strong communication and a strategic mindset, with a high capacity for system-based thinking.

The importance of engagement expertise and the ability to communicate to a range of audiences, including residents, landowners, business owners, partnering organisations, politicians and senior decision makers was highlighted repeatedly by experts. Empathy was identified as important, especially when engaging with at risk, vulnerable communities on emotive topics linked to climate change vulnerability. Effective engagement officers should be

able to discern what people want, understand their constraints, and have the ability to empower stakeholders and communities. Conceptualisation is an important facet to effective communication. Experts identified this as the ability to communicate complex scientific concepts to operational agencies, enabling effective and informed decision making. Utilising people skills internally within the strategic or implementing organisation was also identified as important. To encourage innovation in adaptation, experts expressed that leaders must inspire teams to push boundaries, do things differently and take risks.

Experts described that the ability to look strategically at a problem is key for successful adaptation initiatives. Experts elaborated that the strategy process for thinking through complicated problems involves monitoring all data and taking a step back to look at an issue at a local authority and national level. This allows practitioners to ensure that the initiative continues to work towards key objectives and informs business cases for adaptation measures.

In addition to key skills in communication and strategic thinking, experts identified skills in monitoring, trouble shooting and system thinking as a highly important.

Technical skills were discussed with some experts as an important factor but were not perceived as being as significant to working effectively in the field of adaptation as skills in communication and strategy. There were no references made by any experts for the requirement for a particular academic or technical qualification to work in adaptation.

Multiple experts stated that the skillset of organisations planning and implementing adaptation needs to expand.

3.2.2 Key adaptation learning

Interview discussions and survey questions regarding adaptation initiatives identified key transferrable lessons for adaptation and recurring discussion themes.

The impact of flood and erosion on people's mental and physical health, and the associated cost to society, is under reported. The health benefits of adapting to coastal risk should take a higher priority in cost benefit analysis of initiatives. These are often considered as co-benefits and are not monitored or reported on in adaptation scheme appraisals but rather discussed anecdotally within adaptation networks.

Building on the common discussion point that personnel with good communication skills are of vital importance to adaptation initiatives, experts highlighted the importance of involving stakeholders in the entire journey to an adaptative outcome. Community engagement was referenced as vital. Regarding engagement strategy, experts recommended that consideration should be given to individual engagement, particularly in the case of risk to residential properties. The feeling among some experts was that group discussions arguably have their place to ensure transparency and save time and resources but can escalate and be dominated by negative participants with the loudest voices. There were differing views on appropriate engagement tools to achieve effective community engagement. Experts from Local Authorities expressed their experience in visual data representation, such as flood maps, causing panic and doing little to facilitate meaningful engagement. However, experts from the education sector described how Local Authorities tend to underestimate what stakeholders understand. The challenge of communicating technical data is best tackled by assessing the engagement approach, rather than limiting information sharing.

A notable finding from experts across the fields of climate education and disaster risk management was that adaptation initiatives have been successful in community participatory

approaches. Adaptation initiatives for climate change adaptation in Asia (Table 20) and volcano disaster risk response in Ecuador (database 0014) took the engagement approach a step further to train and involve communities in risk monitoring and adaptation research. This allows knowledge sharing to flow both ways as scientists convey concepts to local communities whilst benefiting from local knowledge.

Another notable finding from the UK was the potential for landowners and private estates to contribute to the adaptive capabilities of an area. Experts in the field of infrastructure and flood risk management reported success in implementing practical adaptation measures by engaging with these groups (database 0006).

In terms of a national approach to adaptation, multiple experts noted that we are adapting too slowly to climate change. The consensus amongst these experts was that the organisations planning adaptive measures must think more 'on their feet' and consider a trial-and-error approach to implementation.

Experts expressed a level of frustration with the legislative framework and current scale of adaptation with one expert noting that coastal adaptation needs to have a coastal zone management approach. The same expert described that to adapt communities and places, we need to take a bigger, multi-sector approach and not just think about coastal risk but climate change risk in totality.

3.2.3 Opinions of database concept

Experts were asked their opinion of the activities of this project, specifically their views on the objective to create a database of adaptation and transition examples, to be hosted by Coastwise on a Coastal Transition Hub, which is outside the scope of work. The questions were designed to collect feedback on desired functions of the database and to gain an understanding of who would utilise this resource, and for what purpose.

Experts reported that they were unaware of any one centralised database of adaptation initiatives but advised that there are similar databases either under development or currently hosted online. The challenge is maintaining these after the project lifetime.

Most experts responded that they would refer to a database of adaptation examples, if one existed. Although to be most useful, the database should have a search function in order to interrogate the information. To ensure relevant returns the database should have certain tags, such as the range of stakeholders involved. The respondents suggested that the purpose of accessing the database would be to assist them with; writing compelling business cases and justification to access funding for adaptation action, gaining an insight into how to form good stakeholder networks, and to review failure mechanisms of past initiatives.

3.3 Case studies

During the rapid evidence review twenty examples of adaptation initiatives were added to the Coastal Adaptation Database comprised of twelve examples from the literature review and eight examples from interviews. From the database, nine examples of particular interest were identified and reviewed in greater detail. These are provided in Appendix 6, as case studies.

Six case studies pertain to adaptive measures for an eroding and flooding coast. A further three case studies of cross-sectoral wider transferable examples are given. These case studies showcase particularly pivotal or innovative examples of adaptation, both in the UK and internationally. Here we describe initiative successes, challenges and lessons learnt that are potentially transferable to adapting to erosion on the North Norfolk coast.

Three case studies were compiled describing adaptive initiatives in the UK. These case studies provide examples of adaptation to coastal erosion risk and river catchment flooding by Local Authorities and a national Government Agency, Highways England:

- Scarborough Coastal Change Pathfinder Project (Table 12)
- East Riding Coastal Change Pathfinder Project (Table 14)
- Highways England Natural Flood Management Fund (Table 18)

The Scarborough and East Riding Pathfinder Projects (Table 12 and Table 14 were two of the five larger Pathfinder initiatives and attempted adaptation via rollback, and buy and leaseback schemes. Both Councils experienced difficulties in implementing property rollback. The lesson learnt to mitigate these challenges, were to 1) increase the expertise of the existing regulations within the Local Authority, 2) obtain early and independent site appraisal studies, and 3) gain independent external mediation and support, particularly to overcome engagement challenges.

The Highways England case study (Table 18) provides an innovative example of working in collaboration with non-governmental organisations to benefit from their existing relationships with landowners. The framework for a reverse auction method for delivery of adaptation measures by landowners could be applied to the coast, for example, by funding landowners to implement cliff stabilisation and groundwater control measures to mitigate contributing factors to coastal cliff erosion.

Six case studies were compiled describing adaptive initiatives outside the UK. These international case studies review adaptation strategies in the flood and coastal erosion risk, and community and education sectors.

- Prins Hendrik Sand Dyke, Netherlands (Table 13)
- The Marche Integrated Coastal Zone Management Plan, Italy (Table 15)
- Engineering with Nature Initiative, USA (Table 16)
- Prioritising Coastal Adaptation and Development Options for Local Government, Australia (Table 17)
- Relocation as adaptation to flooding in the Eferdinger Becken, Austria (Table 19)
- Youth-led Adaption to Climate Change Challenges, Vietnam (Table 20)

Adaptation strategies implemented include projects initiated through a regional ICZM Plan, soft-measures alongside traditional hard engineering, community relocation, participatory community-led intervention, and the development of a Local Authority decision-making framework.

A key finding of the international case studies was the importance of initiative monitoring. Planning for real-time monitoring systems during project implementation was critical in controlling negative environmental impacts during construction of the Prins Hendrik Sand Dyke (Table 13). Multiple initiatives highlighted the importance of an ongoing long-term adaptation monitoring strategy to ensure actions achieve long-term desired outcomes. The ‘Prioritising Coastal Adaptation and Development Options for Local Government’ project, Australia (Table 17), designed a coastal adaptation monitoring and evaluation framework. The resulting framework tool provides a series of templates for best practice principles which could be used to monitor adaptive outcomes on the UK coast. Building strong partnership relationships was key to initiative successes. This learning extends to partner organisations, stakeholders and communities.

Collaboration across sectors was key to reducing project costs and minimising the environmental impact of beach nourishment activities on the Marche ICZM Plan, Italy (Table 15). This initiative also reported that a robust stakeholder engagement strategy was key for empowering stakeholder participation and gaining community cooperation. The Engineering with Nature Initiative's, USA (Table 16) focus on collaboration and engagement also resulted in project plans that were broadly accepted by communities. In Vietnam (Table 20), intergenerational engagement was carried out, to include both youth and elderly in adaptation knowledge-sharing. These demographics are often left out of the conversation. Across initiatives it can be concluded that communities are willing to share knowledge and often are willing to adapt to climate issues affecting their properties but want to feel seen and heard.

Suitable metrics need to be defined early in the adaptation initiative planning phase to quantify long-term adaptation benefits. A common theme among successful adaptation initiatives is the use of a cost benefit analysis approach to strengthen project planning (Marche ICZM Plan, Italy, Table 15 and Engineering with Nature, USA, Table 16). Broadening initiative objectives to include economic, social, and environmental benefits is a common strategy across case studies. The ecosystem services approach of the Prins Hendrik Sand Dyke project, Netherlands (Table 13), supported the cost benefit analysis and project legacy.

Multiple case studies report challenges of national and regional budget uncertainties. These include issues related to construction, repair and ongoing maintenance costs, and challenges of cost sharing between partners. In the Youth-led Adaption to Climate Change Challenges Project, Vietnam (Table 20), cost is a barrier to upscaling projects and influencing policy change. The ICZM Plan implemented in Italy (Table 15) questioned the criteria to evaluate who should support the costs of coastal protection schemes. If there are co-benefits for other sectors, such as the tourism industry, consideration should be given to who should be called upon to mobilise resources needed for the implementation of adaptation measures.

The Marche ICZM Plan, Italy (Table 15) and the Prioritising Coastal Adaptation and Development Options for Local Government, Australia (Table 17) are examples of Local Authorities implementing regional plans and frameworks to compensate for a lack of a national strategic approach. Lessons from these case studies may be particularly useful to North Norfolk District Council in implementing local adaptation measures.

3.4 Limitations

Several limitations of the project were noted. The short project timescale limited the number of entries that were added to the Coastal Adaptation Database. Some experts that wanted to participate in the interview process could not commit to an interview slot due to the short project timeframe which also fell over the Christmas and New Years holidays.

Throughout the rapid evidence review, it was challenging to source documented examples of adaptation initiatives that did not work. Often, incomplete cancelled projects are not reported on and learnings regarding maladaptation pitfalls are not shared, despite being highly valuable information to planners.

During the course of the evidence review, it became clear that the search term 'transition' did not return the expected results in identifying initiatives aiming to deliver a transition outcome to erosion. Return results were largely sources focussed on the monitoring and impact of erosion and climate change hazards, rather than describing adaptive or transition pathways. In some cases, practitioners and researchers reported case studies that do describe a

transition outcome via adaptive measures, however, the term ‘transition’ itself is not used. The term ‘transition’ may be too novel within the field of adaptation and creating adaptation pathways to return significant relevant results in a QSR. To further capture transition examples, it is recommended to next conduct a more comprehensive literature review method and to extend the scope search returns reviewed.

4 Visualisation Tools

Interactive tools were developed for visualisation of the adaptation examples held within the Coastal Adaptation Database. These tools are an interactive timeline and global map.

4.1 Tiki-Toki Timeline

A comprehensive timeline of adaptation examples was developed using Tiki-Toki[38] (Figure 3), a platform designed for dynamic and interactive timelines. The process began by exporting all initiative examples from the database, encompassing project specifics, dates, and associated images/videos and websites. With a Tiki-Toki account established, a new timeline was initiated, and the exported data was imported, populating the timeline with all initiatives within the database. Customisation options were then explored to configure the timeline's appearance, layout, and additional features, such as images, descriptions, and multimedia elements. Tiki-Toki's functions, include zooming, filtering, and categorisation, were utilised to enhance the timeline. Each initiative is categorised by sector, and ‘tagged’ with the initiative type (e.g. ‘Project’, ‘Plan’, ‘Fund’ etc), as described within the database. Visual enhancements, including images, icons, and color-coded categories, were incorporated to ensure a visually appealing and informative representation.

Tiki-Toki remains a free resource, with the assumption that fewer than 200 entries will be used. Should there be a requirement to either embed the timeline into a website, or add more than 200 entries, a subscription fee of $25 per month would apply.

[38] Tiki-Toki Timeline Maker (2024) Available online (Accessed: 17/02/2024).



Figure 3. Screen-grab of the interactive timeline, developed within Tiki-Toki[38]. Initiatives can be expanded to view further information, alongside relevant images/videos and a link to a relevant website.

4.2 Mapbox

Mapbox[39] was utilised to create an interactive and visually engaging platform to demonstrate key case studies spatially. The map was designed to display geographical coordinates associated with each case study, allowing users to visually explore project locations (Figure 4).

The embedded HTML, CSS and JavaScript code utilises Mapbox features, providing users with a dynamic map interface. Within a HTML file, HTML is used for structuring the content, CSS for the styling and layout of the map, and JavaScript for initialising Mapbox and enabling interactivity. The initial step involved acquiring a Mapbox access token and setting up a basemap within Mapbox. A GeoJSON format was used to structure the spatial data, encapsulating features such as title, location, and description for each case study. These features were then dynamically loaded onto the map using Mapbox's feature layer function.

A sidebar was added to enable navigation through all projects. Users can interact with the map by clicking on project listings in the sidebar, enabling the map to centre on the selected case study. Simultaneously, the associated popup provides a brief overview of the selected initiative and a link to the project website or source information.

[39] Mapbox. Available online (Accessed: 17/02/2024).



Figure 4. An interactive map developed for Coastwise, whereby users can easily navigate case studies. The screenshot demonstrates the initiatives used as case studies.

5 Summary and recommendations

Key learnings from the rapid evidence review that could be integrated into planning for, and implementing, adaptation actions for an eroding coast are below.

1. In building a team to plan and implement adaptation, prioritise an individual's on-the-job experience, communication skills and a demonstrable background in strategic thinking.
2. Consider utilising tools that incorporate competing values, opinions, and perceptions of stakeholders into decision-making, to reach societally acceptable achievable outcomes.
3. Local adaptation strategy should reflect what is achievable and will be 'successful', but also what is societally acceptable.
4. Adopt a trial-and-error approach to adaptation by acting more 'live' in implementing initiatives. Organisations can test practical actions, monitor and adjust the scheme overtime.
5. Adaptation approaches should not just plan for coastal erosion risk but consider wider climate change risk and future projections for change to ensure sustainability.
6. To facilitate successful rollback schemes, Local Authorities should consider: developing internal expertise and understanding of existing regulations; commissioning early, independent site appraisal studies; and seeking independent external engagement support and mediation services.
7. A cost-benefit analysis of adaptation measures should consider not only the properties, infrastructure, and assets at risk but also the impact on community and individual physical and mental health.
8. Robust metrics should be in place for cost-benefit analysis. In the case of implementing soft adaptation measures, such as habitat restoration, consideration should be given to quantify co-benefits through an Ecosystem Services approach.
9. A robust engagement strategy is critical to gaining public support to strengthen initiative success. Stakeholders should be brought on to the transition pathway journey at an early stage and engagement officers should develop a range of appropriate

engagement strategies and materials to communicate technical information in an accessible format.

10. Utilise local knowledge and empower, and fund where possible, landowners to implement sustainable land management practices and nature-based solutions to control groundwater and erosion rates.
11. In building stakeholder relationships and developing local knowledge-sharing, consider partnership with NGOs to harness their existing relationships with landowners.
12. Ensure intergenerational engagement is actioned. Youth engagement should be prioritised to reach young people who have the motivation for climate action.
13. Ensure a robust monitoring and evaluation framework is in place with a change in mindset to undertake continuous monitoring. Consider partnership with universities to adopt a monitoring model undertaken in academia.
14. To ensure long-term CTAP legacy consider which organisations will lead and support efforts to carry initiatives forward beyond the end date of 2027.

This project provides a baseline of adaptation examples held with in the Coastal Adaptation Database and Archive. It is recommended that further examples are added to create a comprehensive synthesis of adaptation and transition examples. It would be beneficial to understand the legacy of an initiative, which is ongoing particularly where initiatives or schemes are relatively recent (past decade). A periodic review of the case studies should be conducted to capture any more recent publications which review the initiative and detail the lessons and findings.

Further value lies in ensuring that the Coastal Adaptation Database and Archive, and associated tools (Mapbox and Tiki-Toki timeline), are shared with the Coastwise network, to enable knowledge and information dissemination. The outputs from this project would benefit wider risk management authorities and at-risk communities if hosted on an accessible, open-source online hub i.e. a specific website or pages on the UK government portal (.gov.uk). The Coastal Adaptation Database and Archive as a resource is invaluable to share with coastal communities and the affected public and stakeholders.

The database held initiatives may help justify the case for action through adaptation and support difficult conversations through positive examples and messaging. The database provides examples of successful soft or green adaptation interventions and measures that have the potential to shift public mindset away from implementing purely hard or grey traditional engineering defence. Supporting stakeholder to understand their options in developing integrated hybrid initiatives and concepts across the wider spectrum of solutions, measures and interventions is imperative in adaptation planning.

Recommendations for next steps in the database and archive development:

1. Further populate the Coastal Adaptation Database and Archive with adaptation examples from the rapid evidence review that could not be completed in the project timeframe.
2. Extend the QSR literature search to search additional databases and/or use additional search terms. This is especially important to capture learnings from other sectors and cases of maladaptation.
3. The term ‘transition’ may be too novel within the field of climate change adaptation to return significant relevant results in a QSR. To better capture transition examples from other sectors, it is recommended to conduct a comprehensive literature review and to extend the sources. These initiatives may not have been collated or published.

4. Compile additional detailed case study write ups focussing on transferable lessons for the North Norfolk coast.
5. Conduct additional expert interviews to gain valuable insights into adaptation initiatives. Incorporate resulting initiatives into the Coastal Adaptation Database and Archive.
6. Widen the reach for survey through social media campaign, analysis and incorporation of results into the Coastal Adaptation Database and Archive.
7. Development of the Coastwise Coastal Transition Knowledge Hub or specific website to host the Coastal Adaptation Database and Archive to support knowledge sharing and dissemination.
8. Mapbox tool development; including integration of story maps to detail adaptation case studies using Storytelling function.
9. Update the Coastal Adaptation Database and Archive with all developments v2.0.
10. Update this report with key findings and recommendations from the above actions 1-9 to create an updated report (i.e. v2.0).
11. Update the supporting user guide and videos to align with any of the above updated.

Appendices

6 Appendix 1. Project Steering Group reference screening

Table 7. Tabulated results of relevant literature; screening process applied to PSG shared reference materials.

Title	Date	First Author/Org	Sector	Document type	Relevance	Info
The coastal handbook	2010	EA	Erosion	Report	Not relevant	Guidance/how-to about coastal management, with a few case studies within. Case studies are incredibly brief, couldn't fill in database from it
Coastal Change Pathfinder Review	2012	DEFRA	Erosion	Report	Relevant	Good resource. Defra's Coastal Change Pathfinder Programme, which aimed to road test new and innovative approaches to planning for and managing coastal change. Fifteen local authorities involved. Plenty of info on lessons learned etc. 1 entry for pathfinder, 3 extra for case studies
Coastal Change Adaptation Planning Guidance	2013	East Riding of Yorkshire Council	Erosion	Report	Not relevant	Guidance/how-to about coastal management, with a few very brief case studies within. Case study in appendix can be used - East Riding Coastal Pathfinder Project. Same project as above
TURNING BACK TO THE SEA A BLUE NEW DEAL TO REVITALISE COASTAL COMMUNITIES	2015	NEW ECONOMICS FOUNDATION	Coastal communities	Magazine	Not relevant	Guide on how to work with coastal communities, over a wide range of sectors. Multiple case studies throughout, but very brief (one para). Good resource to identify additional case studies.
Coastal loss innovative funding and financing (CLIFF)	2022	DEFRA,, NRW, EA	Coastal loss funding	Report	Not relevant	holistic review of past research and case studies, and garner expertise across the insurance, banking, government and non-governmental organisations (NGO's) sectors to inform the development of potential solutions.
Progress in adapting to climate change	2023	Climate change committee	All sectors re. Climate change	Report	Not relevant	Progress review of national adaptation programme to climate change across all sectors - progress to date. May be difficult to add to database - maybe one entry per sector?
Coastal Adaptation Supplementary Planning Document	2023	Broads Authority	Erosion	Report	Uncertain	The purpose of the SPD is to provide guidance on the implementation of local plan policies along the coast from Holkham in Norfolk to Landguard Point, Felixstowe in Suffolk. Overall guidance, rather than executed examples, potentially not what we're after. But 9-10 brief case studies with just enough information to easily populate the database (appendix 4)
How can our communities, towns and cities be healthy, connected and safe places to be whatever the weather?		ClimateXChange	Flood risk, community resilience, buildings and infrastructure	Webpages	Uncertain	Multiple links to docs/webpages on adaptation plans for different sectors. Probably at least 3 entries if combining plans based on sector.
Coastwise	2023	EA	Erosion	Webpages + YouTube videos	Relevant	Coastwise. Plan/aims rather than success/failures, but useful to include
Coastal Transition Accelerator Programme (CTAP)	2023	EA	Erosion	Webpages	Relevant	Plan/aims rather than success/failures, but useful to include initial details and update as project progresses
Coastal Transition Accelerator Programme (CTAP)		DEFRA + EA	Erosion	pdf summary	Not relevant	All info here found in CTAP.url
National Flood and Coastal Erosion Risk Management Strategy for England	2020	EA	Erosion, Flood	Report	Not relevant	The Strategy provides a framework for guiding the operational activities and decision making of practitioners supporting the direction set by government policy which includes its flood and coastal erosion risk management policy statement. Identifies a wide range of challenges identified
National Flood and Coastal Erosion Risk Management Strategy for England	2020	EA	Erosion, Flood	Multiple reports	Not relevant	Additional files (supplementary material etc.) to the pdf above
National Flood and Coastal Erosion Risk Management Strategy for England	2020	EA	Erosion, Flood	Report	Not relevant	The Strategy provides a framework for guiding the operational activities and decision making of practitioners supporting the direction set by government policy which includes its flood and coastal erosion risk management policy statement. Identifies a wide range of challenges identified
Enabling pathways for sustainable livelihoods in planned relocation	2023	Bower et al	Flood risk (relocation)	Article	Not relevant	Gives strategies of relocation - what worked and what didn't across 14 cases of flood-related planned relocation. Depends on if we'd want these together or not - not enough info within article to add 14 separate entries
Find out more about the north Norfolk coast		NNDC	Erosion, Flood	Webpage	Relevant	To be paired with other NNDC sources. Links to other pages with info on strategies and challenges
View Shoreline Management Plans		NNDC	Erosion, Flood	Webpage	Relevant	Links to SMP5 and SMP6 (East Anglia Coastal Group)- each should be a separate entry. Each link leads to many docs on each SMP. Choose 1 subsection from 1 SMP
Coastal Adaptation	2019	NNDC	Erosion, Flood	YouTube video	Relevant	To be paired with other NNDC sources. Written webpages more beneficial for inputting into database
Coastwise: North Norfolk 's Coastal Transition Accelerator Programme		NNDC	Erosion, Flood	PPT	Relevant	To be paired with other NNDC sources. Presentation re. coastwise, and case study sites. Written webpages more beneficial for inputting into database
Living with change: Our shifting shores		National Trust	Erosion	Webpage	Not relevant	Very brief. Links to some good case studies (listed below)
Adapting to Coastal Change at Studland Bay	2023	National Trust	Erosion	Webpage	Uncertain	Policy implementation. Description, followed by a 2023 update from PM.
Responding to climate change at Mount Stewart		National Trust	Erosion	Webpage	Not relevant	Multiple strategies in the area listed, no comment on success so would need to find additional articles
Shifting shores at Birling Gap and the Seven Sisters		National Trust	Erosion	Webpage	Not relevant	Multiple strategies in the area listed, no comment on success so would need to find additional articles
Cwm Ivy on the North Gower coast		National Trust	Erosion	Webpage	Not relevant	Interesting project but no details on this page, so would need to find additional articles
BLUE NEW DEAL FOR COASTAL COMMUNITIES	2017	NEW ECONOMICS FOUNDATION	Fishing	Video	Uncertain	"This film tells the story of Graham Doswell, a third-generation small-scale fisherman from Eastbourne who with NEF, has led an effort to secure a better future for the inshore fishing community, local residents and visitors. Graham's story shows what can be achieved when local people and businesses have the power to decide what success should look like where they live."
UK Adaptation Inventory (version 1)	2021	Jenkins	Climate Adaptation - all sectors	Database	Not relevant	UK climate adaptation database. The UK Adaptation Inventory (version 1) was compiled as part of the OpenCLIM project. Users can select various options to explore the different adaptation options. Links to case studies. Good source
UK Adaptation Inventory Database	2022	Jenkins	Climate Adaptation - all sectors	Database	Not relevant	As above. Example of database development
Opportunities for Local Involvement in Transformational Adaptation on the English Coast	2021	Van der Plank	Flood risk	Webpage and article	Not relevant	From 124 papers and policies, the strengths, weaknesses, opportunities and threats (SWOT) of coastal flood risk management in England were identified. Links to paper: DOI: 10.1016/j.ijdrr.2020.101961. EH has access, but it's not open source. Can coastwise provide access?
How to move a country: Fiji's radical plan to escape rising sea levels	2022	Lyons (The Guardian)	SLR - relocation	News article	Relevant	Includes success, challenges + failures. Good case study. Look for expert for publications
How to move communities away from flooding risks with minimal harm	2023	Standford	Relocation	Website + video	Not relevant	High level overview/reference to Bower paper, listed above.
This town is relocating to higher ground due to sea-level rise. Here's what that entails	2023	CNBC	SLR - relocation	News article	Uncertain	Some details on project, would need to be find additional info/sources. "the Quinault Nation has a plan to relocate the entire town of Taholah, where Frenchman lives, to an area a mile uphill on tribal land. A smaller town north of Taholah, called Queets, is planning to relocate as well."
Document library		NNDC	Development Plan Documents	Database	Not relevant	Good example of archive/inventory
Adaptation to Coastal Change Quick Scoping Review	2018	DEFRA	Erosion	Report	Not relevant	Good example of scoping review.
Impacts of climate change on disadvantaged UK coastal communities	2011	Zsamboky, et al	Erosion	Report	Uncertain	Literature review. 4 good case studies, with detail + lessons learned etc. Located in the full report, downloaded at bottom of page
Assessing Coastal Erosion and Climate Change Adaptation Measures: A Novel Participatory Approach	2023	Coelho et al	Stakeholder engagement, erosion	Article	Uncertain	Presents method + case study for stakeholder engagement. But little feedback on success/challenges and implementation. Good resource for planning workshops etc.
Global climate adaptation assessed by structured expert judgement for coastal areas	2023	Magnan et al	Climate Adaptation - all sectors	Article	Not relevant	"A structured expert judgement using local case studies shows that, for coastal areas, today's global adaptation is halfway to achieving the full adaptation potential." Summary and metrics on an aggregation of case studies
Towards a typology for coastal towns and small cities for climate change adaptation planning	2021	Lehmann	Coastal climate change adaptation	Article	Not relevant	"A typology can inform stakeholders about the physical hazards a coastal town or small city may be exposed ." " A typology is presented here that includes 34 parameters that cover physical, economic, environmental and social characteristics. This typology has been used within this Special Issue to obtain information about all 22 case studies of the Special Issue."
A typology of household-level adaptation to coastal flooding and its spatio-temporal patterns	2014	Koerth et al	coastal flooding	Article	Not relevant	Review of behaviours. " We applied a cluster analysis in order to categorise the adaptive behaviour of coastal households. Coastal households were found to cluster in four groups that we term: the comprehensives, the theoreticians, the minimalists and the structurals. "
ClimateScan		ClimateScan	Climate adaptation, urban resilience	Database	Not relevant	"Climate scan is an interactive web-based map application for international knowledge exchange on 'blue-green' projects around the globe. It focuses mainly on the topics surrounding the areas of urban resilience, climate proofing and climate adaptation."
Climate Change Adaptation Manual (NE751)	2020	Natural England	Climate adaptation	Report	Not relevant	"This Adaptation Manual is a resource to support practical and pragmatic decision-making, by bringing together recent science, experience and case studies, and is intended to be an accessible entry point to a range of available resources and tools. "
Introducing a web-based portal to explore the concept of coastal resilience	2022	Townend et al	Coastal resilience	Article	Not relevant	"A method to quantify coastal resilience in both space and time has been developed. The resulting Coastal Resilience Model has now been implemented as the web-based CRM Portal. The purpose of the portal is to allow users to explore (i) the implications of future change on local and national resilience and (ii) their own view of the relative importance of the Performance Measures that make up the Coastal Resilience Index. The CRM Portal can be accessed at: https://coastalresilience.uk/crm/."
Adapting to Coastal Change and Hazard Risk in Aotearoa NZ	2022	New Zealand Coastal Society	Coastal adaptation	Report	Relevant	Contains a series of 18 articles, including successful projects and challenges. Very good resource to include in database. Each article included will likely be a separate entry. Pages 17, 26, 33 (3 initiatives detailed), 48, 87
Lincolnshire Coastal Vision	2015	Atkins	Sustainable coastal development	Report appendix	Relevant	Probably out of date but it did lead to a lot of activity later within Lincs CC
Sustainable Development at the Coast: the Lincolnshire Coastal Study	2015	van Dijk et al	Sustainable coastal development	Article	Relevant	"This paper describes the approaches used in the Lincolnshire Coastal Study to develop an agreed set of Principles for sustainable spatial development". Good case study, use with row above, and additional sources?
SALTFLEET TO GIBRALTAR POINT STRATEGY	2019	EA	Sustainable coastal development	Presentation/ PPT	Relevant	Non-technical summary. Use in conjunction with above?
Adaptive management responses on a sediment dynamic coast in Auckland	2015	Morgan et al	Erosion	Article	Relevant	"this example of an adaptive management response seeks to minimise future risk to infrastructure, whilst addressing some of the outstanding concerns within the local community."

7 Appendix 2. Quick Scoping Review reference screening

Table 8. Tabulated results of relevant literature; screening process applied to results of QSR literature review.

									Phase 1 - screening of title		Phase 2 - screening of abstract/intro	
									Screen the title only and mark as relevant, uncertain or not relevant.		Screen the abstract of records marked as relevant or uncertain in phase 1 - proceed if	
Primary search term	Secondary search term	Search location	Number of returns	Return number	Search return titles	Link	Open source?	Date accessed	Relevance	Notes	Relevance	Notes
coast* ero*	adapt*	Google Scholar	16900	1	Preliminary assessment of coastal erosion and local community adaptation in Sayung coastal area, central java – Indonesia	https://sciendo.com/article/10.2478/v10117-012-0028-2	Yes	18/01/2024	Relevant		Relevant	
				2	Quantifying coastal flood vulnerability for climate adaptation policy using principal component analysis	https://www.sciencedirect.com/science/article/pii/S1470160X21006713	Yes	18/01/2024	Uncertain	Adaptation itself or study to inform action?	Not relevant	Monitoring of erosion rather than adaptive measures
				3	Vulnerability in Samoa	https://library.sprep.org/sites/default/files/223_1.pdf	Yes	18/01/2024	Uncertain		Not relevant	Vulnerability assessment rather than adaptive measure
				4	The grey – green spectrum: A review of coastal protection interventions	https://www.sciencedirect.com/science/article/pii/S0301479722003978	Yes	18/01/2024	Uncertain		Not relevant	High-level review. Does not deliver adaptation
				5	Relative Sea Level Rise, Coastline Variability and Coastal Erosion in the Niger Delta, Nigeria: Implications for Climate Change Adaptation and Coastal Zone Management	https://[illegible]6760/JESCC_Vol_11_Iss_9_Special_02_1-libre.pdf?1608670355=&response-content-disposition=inline%3B+filename%3DJESCC_Vol_11_Iss_9_Special.pdf&Expires=1705957640&Signature=EbemqYb5aamZjgNjrRwYPJQ7vUOttgKM3UoIxFp3hk2YbMF1Q0VM-MHkyNUqxSZHTzFF9Ig~qSiHO7AeSh2oZrWT3EQt80e8wPQSXGkdmihz~ihos5jIA6npE5BvBftHyjcsd-	Yes	18/01/2024	Uncertain		Not relevant	Vulnerability assessment rather than adaptive measure
				6	Coastal Impacts, Adaptation, and Vulnerabilities	https://link.springer.com/book/10.5822/978-1-61091-460-4	Yes	18/01/2024	Uncertain	Is this too general to be an example of initiative?	Not relevant	High-level review. Does not deliver adaptation
				7	Climate change adaptation frameworks: an evaluation of plans for coastal Suffolk, UK	https://nhess.copernicus.org/articles/15/2511/2015/nhess-15-2511-2015.pdf	Yes	18/01/2024	Uncertain		Not relevant	Framework rather than adaptation measure
				8	The Happisburgh footprints in time: Environmental change and human adaptation on the East Anglian coast	https://rai.onlinelibrary.wiley.com/doi/abs/10.1111/1467-8322.12096	No	18/01/2024	Uncertain	Anthropoligical historical study? 05_Reference\Non_open_source\Literature screening\The Happisburgh footprints in time Environmental change and human adaptation.pdf	Not relevant	Anthropoligical ancient history study
				9	Tourists' Perception of Coastal Changes – A Contribution to the Assessment of Regional Adaptation Strategies?	https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118548165.ch18	No	18/01/2024	Uncertain	\05_Reference\Non_open_source\Literature screening\TouristsPerceptionOfCoastalChanges_contributionToTheAssessmentOfRegionalAdaptationStrategies.pdf	Not relevant	Tourists perception of climate change and implications for adaptation. Does not deliver adaptation
				10	Mangrove management for climate change adaptation and sustainable development in coastal zones	https://www.tandfonline.com/doi/abs/10.1080/10549811.2017.1339615	Yes	18/01/2024	Relevant		Relevant	
				11	An AHP-derived method for mapping the physical vulnerability of coastal areas at regional scales	https://nhess.copernicus.org/articles/13/1209/2013/	Yes	18/01/2024	Uncertain	Adaptation itself or study to inform action?	Not relevant	Vulnerability assessment rather than adaptive measure. Leads to two possible sources? "Unavoidable solutions for coastal adaptation in Reunion Island (Indian Ocean)" need access
				12	Storm Surges and Coastal Erosion in Bangladesh—State of the System, Climate Change Impacts and "Low Regret" Adaptation Measures	NA	No	18/01/2024	Not relevant	Return result is citation only. Full source unavailable online	Not relevant	
				13	Technological Options for Adaptation to Climate Change in Coastal Zones	https://www.jstor.org/stable/4300206	Yes	18/01/2024	Uncertain		Not relevant	High-level review of technology in adaptation. Does not deliver adaptation
				14	Impact of sea level rise to coastal ecology: a case study on the northern part of Java Island, Indonesia	https://sciendo.com/article/10.2478/quageo-2014-0008	Yes	18/01/2024	Uncertain	Impact only or any adaptation measures?	Relevant	Supplement return 1?
				15	Adaptation technologies and legal instruments to address climate change impacts to coastal and marine resources in Tanzania	https://www.ajol.info/index.php/ajest/article/view/135611	Yes	18/01/2024	Relevant		Relevant	
				16	Adapting to Pacific Island mangrove responses to sea level rise and climate change	https://www.int-res.com/abstracts/cr/v32/n3/p161-176/	Yes	18/01/2024	Relevant		Relevant	
				17	Climate Change Adaptation and Coastal Property Rights: A Massachusetts Case Study	https://heinonline.org/HOL/LandingPage?handle=hein.journals/bcenv40&div=15&id=&page=	Yes	18/01/2024	Relevant		Relevant	
				18	Adapting to Sea Level Rise: A Guide for California's Coastal Communities	Griggs/publication/241451545_Sea_Level_Rise_Vulnerability_of_California's_Coastal_Communities_and_Adaptation_Strategies_for_Reducing_Future_Impacts_Gary_Griggs_Director_Institute_of_Marine_Sciences_University_of_California_Santa_/links/56fbf55408ae1b40b8064054/Sea-Level-Rise-Vulnerability-of-Californias-Coastal-Communities-and-Adaptation-Strategies-for-Reducing-Future-Impacts-Gary-Griggs-Director-Institute-of-Marine-Sciences-	Yes	18/01/2024	Uncertain		Not relevant	A guidebook for managers and planners. No information on successes or failures of this initiative.
				19	COASTAL EROSION AND BEACH NOURISHMENT IN SCANIA AS ISSUES IN SWEDISH COASTAL POLICY	https://lucris.lub.lu.se/ws/files/21599805/Coastal_policy_Sweden.pdf	Yes	18/01/2024	Relevant		Relevant	Case study of coastal erosion policy in Ystad
				20	Adaptation of a freshwater evaluation framework to a coastal system: The case of Kamari, Santorini	https://www.sciencedirect.com/science/article/abs/pii/S0301479721004680	No	18/01/2024	Relevant	\05_Reference\Non_open_source\Literature screening\adaptationFreshwaterEvaluationFramework_CoastalSystem_KamariSantorini.pdf"	Relevant	
coast* ero*	transition	Google Scholar	15300	1	Coastal environmental monitoring using remotely sensed data and GIS techniques in the Modern Yellow River delta, China	https://link.springer.com/article/10.1007/s10661-010-1716-9	No	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative. 2023_147_NOR_RAP\05_Reference\Non_open_source\Literature screening\coastalEnvironmentalMonitoring_RemotelySensedData_GIS_ModernYellowRiverDeltaChina.pdf"	Not relevant	
				2	Coastal erosion vs riverine sediment discharge in the Arctic Shelf seas	https://link.springer.com/article/10.1007/s005310000113	Yes	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				3	Management-transitioning from single-sector management to ecosystem-based management: what can marine protected areas offer	https://books.google.co.uk/books?hl=en&lr=&id=3bTnt5OEmswC&oi=fnd&pg=PA11&dq=coast*+ero*+transition&ots=IselvI3n9c&sig=9OtYdbNtmVDKCDg2VgaTYTPAwWo&redir_esc=y#v=onepage&q&f=false	No	18/01/2024	Uncertain	05_Reference\Non_open_source\Literature screening\Marine_Protected_Areas_A_Multidisciplinary_Approach_Part_I_Threats_to_marine_ecosystems_and_resources.pdf"	Not relevant	Overview of EbM
				4	Marine Transgression in Modern Times	https://www.annualreviews.org/doi/abs/10.1146/annurev-marine-022123-103802	No	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				5	The Impact of Physical Processes along the Louisiana Coast	https://www.jstor.org/stable/25737050	No	18/01/2024	Not relevant	Impact review rather than adaptation/transition initiative	Not relevant	
				6	Ecosystem classification for EU habitat distribution assessment in sandy coastal environments: An application in central Italy	https://link.springer.com/article/10.1007/s10661-007-9851-7	Yes	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				7	Vulnerability in Samoa	https://library.sprep.org/sites/default/files/223_1.pdf	Yes	18/01/2024	Not relevant	DUPLICATE	Not relevant	
				8	Short- and long-term thermo-erosion of ice-rich permafrost coasts in the Laptev Sea region	https://bg.copernicus.org/articles/10/4297/2013/bg-10-4297-2013.pdf	Yes	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				9	Coastal dynamics and submarine permafrost in shallow water of the central Laptev Sea, East Siberia	https://tc.copernicus.org/articles/10/1449/2	Yes	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				10	Bed Profile Changes due to Tsunami Effects on Near Shore Coasts: Tuzla Case Study	https://www.jstor.org/stable/25743002	Yes	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				11	Layout of the artificial coast in Lianyungang and its implementation	https://link.springer.com/article/10.1007/BF02884829	No	18/01/2024	Uncertain	05_Reference\Non_open_source\Literature screening\LayoutArtificialCoast_Lianyungang_implementation.pdf"	Not relevant	Modelling of erosion and accretion. Describes engineering works in the 1980's.
				12	Coastal ecosystems in transition	https://agupubs.onlinelibrary.wiley.com/doi/book/10.1002/9781119543626	No	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				13	Sedimentology, stratigraphic architecture and preliminary hydrostratigraphy of the Metaponto coastal-plain subsurface (Southern Italy)	https://www.isprambiente.gov.it/files/pubblicazioni/periodicitecnici/memorie/memoriesc/90-cilumbriello.pdf	Yes	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				14	From Forced to Voluntary Labour in Rural Africa: The Transition to Paid Voluntary Labour on the Roads of the Northern Territories of the Gold Coast	https://www.cambridge.org/core/journals/international-review-of-social-history/article/from-forced-to-voluntary-labour-in-rural-africa-the-transition-to-paid-voluntary-labour-on-the-roads-of-the-northern-territories-of-the-gold-coast/63C4402B5BC984E6A6113F6E6266369D	Yes	18/01/2024	Not relevant	Non-relevant topic	Not relevant	
				15	Evolution of the Rhone Delta coast since the end of the 19th century	https://hal.science/hal-00070934/	Yes	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				16	The biology of coastal sand dunes	https://books.google.co.uk/books?hl=en&lr=&id=Z9XPa7-Je8YC&oi=fnd&pg=PR11&dq=coast*+ero*+transition&ots=9OzfTHir3A&sig=BdTJ5Y8hdP	No	18/01/2024	Not relevant	Not related to adaptation/transition initiatives	Not relevant	
				17	Self-Stabilized Fractality of Seacoasts through Damped Erosion	https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.93.098501	Yes	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				18	Nutrient dynamics and phytoplankton development along an estuary–coastal zone continuum: A model study	https://www.sciencedirect.com/science/article/abs/pii/S0924796310001600	Yes	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				19	Seasonal and interannual variability of sedimentation and organic matter distribution in the Buor-Khaya Gulf: the primary recipient of input from Lena River and coastal erosion in the southeast Laptev Sea	https://bg.copernicus.org/articles/8/2581/2011/	Yes	18/01/2024	Not relevant	Monitoring related rather than adaptation/transition initiative	Not relevant	
				20	Impacts of a lengthening open water season on Alaskan coastal communities: deriving locally relevant indices from large-scale datasets and community observations	https://tc.copernicus.org/articles/12/1779/2018/	Yes	18/01/2024	Not relevant	Monitoring and impact related rather than adaptation/transition initiative	Not relevant	
coastal erosion	adaptation	CoastAdapt Case Studies	3	1	The Sydney Coastal Councils Group experience: Prioritising coastal adaptation options at the local level	https://coastadapt.com.au/sites/default/files/case_studies/CS06_The_SCCG_experience.pdf	Yes	18/01/2024	Relevant		Relevant	
				2	Adapting to sea-level rise in the Torres Strait	https://coastadapt.com.au/sites/default/files/case_studies/CS011_Adaptation_in_the_Torres_Strait.pdf	Yes	18/01/2024	Relevant		Relevant	
				3	Tweed River Entrance Sand Bypass Project	https://coastadapt.com.au/sites/default/files/case_studies/CS03_Tweed_River_Sand_Bypass.pdf	Yes	18/01/2024	Relevant		Relevant	

coastal erosion	transition	CoastAdapt Case Studies	0	No returns									
coastal erosion	adaptation	ClimateScan	0	No returns									
coastal erosion	transition	ClimateScan	0	No returns									
Filter applied: coastal erosion	adaptation	Oxford's Nature based Solutions Initiative	18	1	Coastal mangrove restoration is practiced as a community-based climate change adaptation initiative in Bangladesh.	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/coastal-mangrove-afforestation-using-a-community-ecosystem-based-adaptation-approach/	Yes	18/01/2024	Relevant		Relevant	
				2	Coral gardening for climate change adaptation	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/coral-gardening-for-climate-change-adaptation/	Yes	18/01/2024	Uncertain		Not relevant	Insufficient information available
				3	Oyster breakwater reefs support climate adaptation	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/oyster-breakwater-reefs-support-climate-adaptation/	Yes	18/01/2024	Relevant		Relevant	
				4	Ecosystem-based adaptation to cope with sea-level rise and extreme climatic events	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/ecosystem-based-adaptation-to-cope-with-sea-level-rise-and-extreme-climatic-events-on-the-uruguayan-coast/	Yes	18/01/2024	Relevant		Relevant	
				5	Local committee promotes food security and adaptation through agrobiodiversity, coastal afforestation, and a pearl farm	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/local-committee-promotes-food-security-and-adaptation-through-agrobiodiversity-coastal-afforestation-and-a-pearl-farm/	Yes	18/01/2024	Uncertain		Not relevant	Source information not available in English
				6	Ecosystem-based approaches to mangrove and wetland restoration in the Paz River basin	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/ecosystem-based-approaches-to-mangrove-and-wetland-restoration-in-the-paz-river-basin/	Yes	18/01/2024	Relevant		Relevant	
				7	Mangrove protection in the Indus Delta	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/mangrove-protection-in-the-indus-delta-in-pakistan/	Yes	18/01/2024	Relevant		Relevant	
				8	Locally-managed Marine Protected Areas and artificial coral reefs in Bali	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/locally-managed-marine-protected-areas-and-artificial-coral-reefs-in-bali/	Yes	18/01/2024	Uncertain		Not relevant	
				9	Bioremediation to reduce nitrate contamination	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/bioremediation-to-reduce-nitrate-contamination/	Yes	18/01/2024	Uncertain		Not relevant	
				10	Community-led mangrove restoration and sustainable fishing	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/connecting-the-dots-biodiversity-adaptation-food-security-and-livelihoods-mangrove-restoration-by-the-pred-nai-community-in-thailand/	Yes	18/01/2024	Uncertain		Not relevant	Insufficient information available
				11	Applying ecosystem-based disaster risk reduction through a ridge-to-reef approach	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/applying-ecosystem-based-disaster-risk-reduction-through-a-ridge-to-reef-approach/	Yes	18/01/2024	Relevant		Relevant	Source information: https://reliefweb.int/report/haiti/coastal-partners-applying-ecosystem-based-disaster-risk-reduction-eco-drr-through-ridge
				12	Community-led mangrove forest restoration and seaweed farming	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/community-led-mangrove-forest-restoration-and-seaweed-farming/	Yes	18/01/2024	Relevant		Relevant	
				13	Pointe au Chien Indigenous Community Oyster Restoration Project	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/pointe-au-chien-indigenous-community-oyster-restoration-project/	Yes	18/01/2024	Relevant		Relevant	
				14	Sand dune restoration for coastal resiliency	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/sand-dune-restoration-for-coastal-resiliency/	Yes	18/01/2024	Uncertain		Not relevant	Ongoing project with insufficient information available
				15	Reef enhancement and vegetation restoration to enhance coastal resilience in Grenville Bay	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/reef-enhancement-and-vegetation-restoration-to-enhance-coastal-resilience/	Yes	18/01/2024	Relevant		Relevant	
				16	The Medmerry project for intertidal habitat restoration with managed coastal realignment	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/managed-coastal-realignment-for-intertidal-habitat-restoration/	Yes	18/01/2024	Relevant		Relevant	
				17	Wallasea Island Wild Coast restoration project	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/wallasea-island-wild-coast-restoration-project/	Yes	18/01/2024	Relevant		Relevant	
				18	Coastal mangrove forest restoration for carbon sequestration	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/coastal-mangrove-forest-restoration-for-above-and-below-water-carbon-seuqestration/	Yes	18/01/2024	Relevant		Relevant	
Filter: coastal erosion	transition	Oxford's Nature based Solutions Initiative	1	1	Bioremediation to reduce nitrate contamination	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/bioremediation-to-reduce-nitrate-contamination/	Yes	18/01/2024	Not relevant	DUPLICATE	Not relevant	
Filter: coastal erosion	adaptation	UK Adaptation Inventory Database	1	1	Innovative approach in the stabilisation of coastal slopes	https://www.icevirtuallibrary.com/doi/10.168	Yes	18/01/2024	Relevant	Database source: https://www.nismod.ac.uk/opencli m/adaptation_inventory	Relevant	
Filter: coastal erosion	transition	UK Adaptation Inventory Database	0	No returns								
climate change	adapt*	Google Scholar	17800	1	Are we adapting to climate change?	https://www.sciencedirect.com/science/article/abs/pii/S0959378010000968	Yes	18/01/2024	Uncertain		Not relevant	High-level review. Does not deliver adaptation
				2	Strategies to adapt to an uncertain climate change	https://www.sciencedirect.com/science/article/abs/pii/S0959378008001192	Yes	18/01/2024	Uncertain		Not relevant	High-level review of uncertainty. Does not deliver adaptation
				3	Adaptation planning for climate change: concepts, assessment approaches, and key lessons	https://link.springer.com/article/10.1007/s11625-007-0032-y	Yes	18/01/2024	Uncertain		Not relevant	High-level concepts of adaptation rather than delivering adaptaion measures
				4	Europe adapts to climate change: Comparing National Adaptation Strategies	https://www.sciencedirect.com/science/article/abs/pii/S0959378010000269	Yes	18/01/2024	Uncertain		Not relevant	Review of strategy rather than adaptation strategy itself
				5	Are there social limits to adaptation to climate change?	https://link.springer.com/article/10.1007/s10584-008-9520-z	Yes	18/01/2024	Uncertain		Not relevant	High-level review. Does not deliver adaptation
				6	Adapting agriculture to climate change	https://www.pnas.org/doi/abs/10.1073/pnas.0701890104	Yes	18/01/2024	Uncertain		Not relevant	Aims to inform those delivering adaptation
				7	A framework to diagnose barriers to climate change adaptation	https://www.pnas.org/doi/abs/10.1073/pnas.1007887107	Yes	18/01/2024	Uncertain		Not relevant	Does not deliver adaptation
				8	Adaptation to climate change in the developing world	https://journals.sagepub.com/doi/abs/10.1191/1464993403ps060oa	Yes	18/01/2024	Uncertain		Not relevant	High-level review. Does not deliver adaptation
				9	An Anatomy of Adaptation to Climate Change and Variability	https://link.springer.com/chapter/10.1007/978-94-017-3010-5_12	No	18/01/2024	Uncertain		Not relevant	Does not deliver adaptation
				10	Robust adaptation to climate change	https://core.ac.uk/reader/288355770	Yes	18/01/2024	Uncertain		Not relevant	Does not deliver adaptation
climate change	adaptation	CoastAdapt Case Studies	27	1	Kingston Beach: Climate change adaptation showcase	https://coastadapt.com.au/case-studies/kingston-beach-climate-change-adaptation-showcase	Yes	18/01/2024	Uncertain		Not relevant	Assessment of risk and recommendations for adaptation
				2	Old ways for new challenges: Indigenous Adaptation to Climate Change	https://coastadapt.com.au/sites/default/files/case_studies/CS08_Indigenous_adaptation.pdf	Yes	18/01/2024	Relevant		Relevant	
				3	AdaptWater: A climate change adaptation tool for the urban water industry	https://coastadapt.com.au/sites/default/files/case_studies/SS15_AdaptWater.pdf	Yes	18/01/2024	Uncertain		Relevant	Tool - full text review needed
				4	Summerland Credit Union: Climate change risk adaptation assessment and planning	https://coastadapt.com.au/sites/default/files/case_studies/SS34_Summerland_Credit_Union.pdf	Yes	18/01/2024	Relevant		Relevant	
				5	Prioritising climate change adaptation options for iconic marine species	https://coastadapt.com.au/sites/default/files/case_studies/SS44_Marine_Megafauna.pdf	Yes	18/01/2024	Uncertain		Not relevant	
				6	Climate change knowledge and adaptation in Aboriginal local government councils	https://coastadapt.com.au/case-studies/climate-change-knowledge-and-adaptation-aboriginal-local-government-councils	Yes	18/01/2024	Relevant		Relevant	Supplement 'Old ways for new challenges: Indigenous Adaptation to Climate Change'
				7	Implementing climate change adaptation options for Little Penguins	https://coastadapt.com.au/sites/default/files/case_studies/SS65_little%20penguins.pdf	Yes	18/01/2024	Uncertain		Not relevant	Proposed adaptation only
				8	Defence climate change risk assessment	https://coastadapt.com.au/sites/default/files/case_studies/CS09_Defence_risk_assessment.pdf	Yes	18/01/2024	Relevant		Relevant	Plan examples. See Horn Island and Yorke Island examples
				9	The Great Barrier Reef's climate change journey	https://coastadapt.com.au/sites/default/files/case_studies/SS9_The_GBR_and_climate_change.pdf	Yes	18/01/2024	Uncertain		Relevant	Relevance as a partnership approach?
				10	Climate Change in Australia website: a comprehensive resource to support adaptation	https://coastadapt.com.au/sites/default/files/case_studies/SS30_The_Climate_change_in_Australia_website.pdf	Yes	18/01/2024	Not relevant	Case study of database for climate data	Not relevant	
climate change	adaptation	ClimateScan	1	1	ECCA 2019 CCB Lisbon 28 31 May 4th European Climate Change Adaptation conference	https://www.climatescan.nl/projects/3209/detail	Yes	18/01/2024	Uncertain		Not relevant	Insufficient information available. Source unavailable
climate change	adaptation	Oxford's Nature based Solutions Initiative	19	1	Coral gardening for climate change adaptation	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/coral-gardening-for-climate-change-adaptation/	Yes	18/01/2024	Not relevant	DUPLICATE	Not relevant	
				2	Oyster breakwater reefs support climate adaptation	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/oyster-breakwater-reefs-support-climate-adaptation/	Yes	18/01/2024	Not relevant	DUPLICATE	Not relevant	
				3	Coastal mangrove restoration using a community ecosystem-based adaptation approach	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/coastal-mangrove-afforestation-using-a-community-ecosystem-based-adaptation-approach/	Yes	18/01/2024	Not relevant	DUPLICATE	Not relevant	
				4	Indigenous association works to secure land rights and sustainably manage natural resources	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/indigenous-association-in-guyana-secures-land-rights-and-sustainably-manages-natural-resources/	Yes	18/01/2024	Uncertain		Not relevant	Adaptation effectiveness not reported
				5	Seed banking and a hybrid of traditional and novel sustainable agriculture techniques	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/seed-banking-and-a-hybrid-of-traditional-and-novel-sustainable-agriculture-techniques/	Yes	18/01/2024	Uncertain		Not relevant	No transferable lessons
				6	Nature-based solutions across landscapes for climate change mitigation	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/model-habitat-research-plots-of-carbon-sequestration/	Yes	18/01/2024	Uncertain		Not relevant	Reporting not available at this stage
				7	Combined climate smart agriculture and ecosystem-based approaches to adaptation	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/combined-climate-smart-agriculture-and-ecosystem-based-approaches-to-adaptation-in-burkina-faso/	Yes	18/01/2024	Relevant		Relevant	Transferable lessons in community engagement
				8	Peru's Potato Park preserves and restores diversity of potatoes and other Andean crops	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/perus-potato-park-preserves-and-restores-diversity-of-potatoes-and-other-andean-crops/	Yes	18/01/2024	Uncertain		Not relevant	
				9	Governance for ecosystem-based adaptation project in the Sixaola River basin	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/governance-for-ecosystem-based-adaptation-project-in-the-sixaola-river-basin-on-the-border-of-costa-rica-and-panama/	Yes	18/01/2024	Relevant		Relevant	
				10	Community forests and REDD+	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/community-forests-and-redd/	Yes	18/01/2024	Relevant		Relevant	Transferable lessons in community engagement
climate change	adaptation	UK Adaptation Inventory Database	4	1	SP Energy Networks Climate Change Adaptation Report	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/479266/clim-adrep-sp-energy-networks-2015.pdf	Yes	18/01/2024	Relevant	Database source: https://www.nismod.ac.uk/opencli m/adaptation_inventory	Relevant	
				2	Port of London Authority: Adapting to Climate Change	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/503257/climate-adrep-port-london.pdf	Yes	18/01/2024	Relevant		Relevant	
				3	Climate Change Adaptation: Putting Principles into Practice	https://link.springer.com/article/10.1007/s00267-013-0217-3	Yes	18/01/2024	Relevant	\05_Reference\Non_open_source\Literature screening\ClimateChangeAdaptation_PuttingPrinciplesIntoPractice.pdf"	Relevant	
				4	Developing adaptive capacity within groundwater abstraction management systems	https://www.sciencedirect.com/science/article/abs/pii/S0301479711000090	Yes	18/01/2024	Relevant	05_Reference\Non_open_source\Literature screening\developingAdaptiveCapacity_groundwaterAbstractionManagementSystems.pdf"	Relevant	

8 Appendix 3. User guide: Coastal Adaptation Database, Archive and tools

The Coastal Adaptation Database is designed to simplify the management and organisation of information related to namely flood and coastal erosion related adaptation 'initiatives' although extends to examples from other sectors tackling their response to climate change which have strong parallels and lessons to be captured. These initiatives form case studies as entry lines within the database. The literature, with corresponding citations and evidence, are stored on a cloud-based central archive. The database is built in a Microsoft Access platform, providing users with a user-friendly interface for efficient data entry and retrieval. It serves as a centralised repository for information related to various initiatives, facilitating collaboration, analysis, and decision-making.

8.1 Key features

8.1.1 Structured data entry

Users can input initiatives details row by row in the main table or utilise a more user-friendly form for consistent data entry (recommended). The template includes essential headers such as initiatives name, source, link to evidence, date accessed, lessons learned etc.

8.1.2 Search and filtering

The database enables easy search and filtering through drop-down menus, ensuring efficient retrieval of information. Users can filter and interrogate the information based on; initiative status, sector, location, key words, and other relevant criteria.

8.1.3 User-friendly form

The 'Evidence Review Form' provides a user-friendly interface for entering data, enhancing consistency and accuracy across different users. Data entered through the form populates the main table or database.

8.1.4 Data accessibility

The 'All Data' table on the left-hand side panel displays all information, allowing users to review and analyse the entire dataset. Subsets of data can be created easily, filtered by parameters such as sector, location, and initiative status.

8.2 Getting started

8.2.1 Opening Microsoft Access

Before you begin using the database, first create a personal copy of the front-end. Copy the most recent version of the database's front-end and paste it in a local folder, giving it a unique filename (for example, by adding your initials). The front-end allows users to add entries via a form, and interact with a copy of the database tables, providing a responsive and user-friendly interface, while the back-end securely stores the central data. Therefore, it is *strongly recommended* to not open or interfere with the back-end of the database. Data can be input, edited and extracted from the front-end.

To begin using the Coastal Adaptation Database, open Microsoft Access on your computer. You can typically find it in your list of installed applications or by searching for it in the Start menu. After opening Microsoft Access, locate your personal front-end of the Coastal Adaptation Database within your saved files. You can do this by navigating through the file explorer or by using the recent files list.

To set up your personal front-end database, follow step 1-6 below (Figure 5) in order to link it to the centralised back-end. You will only need to follow this initial process once unless the front- or back-end is moved/updated.

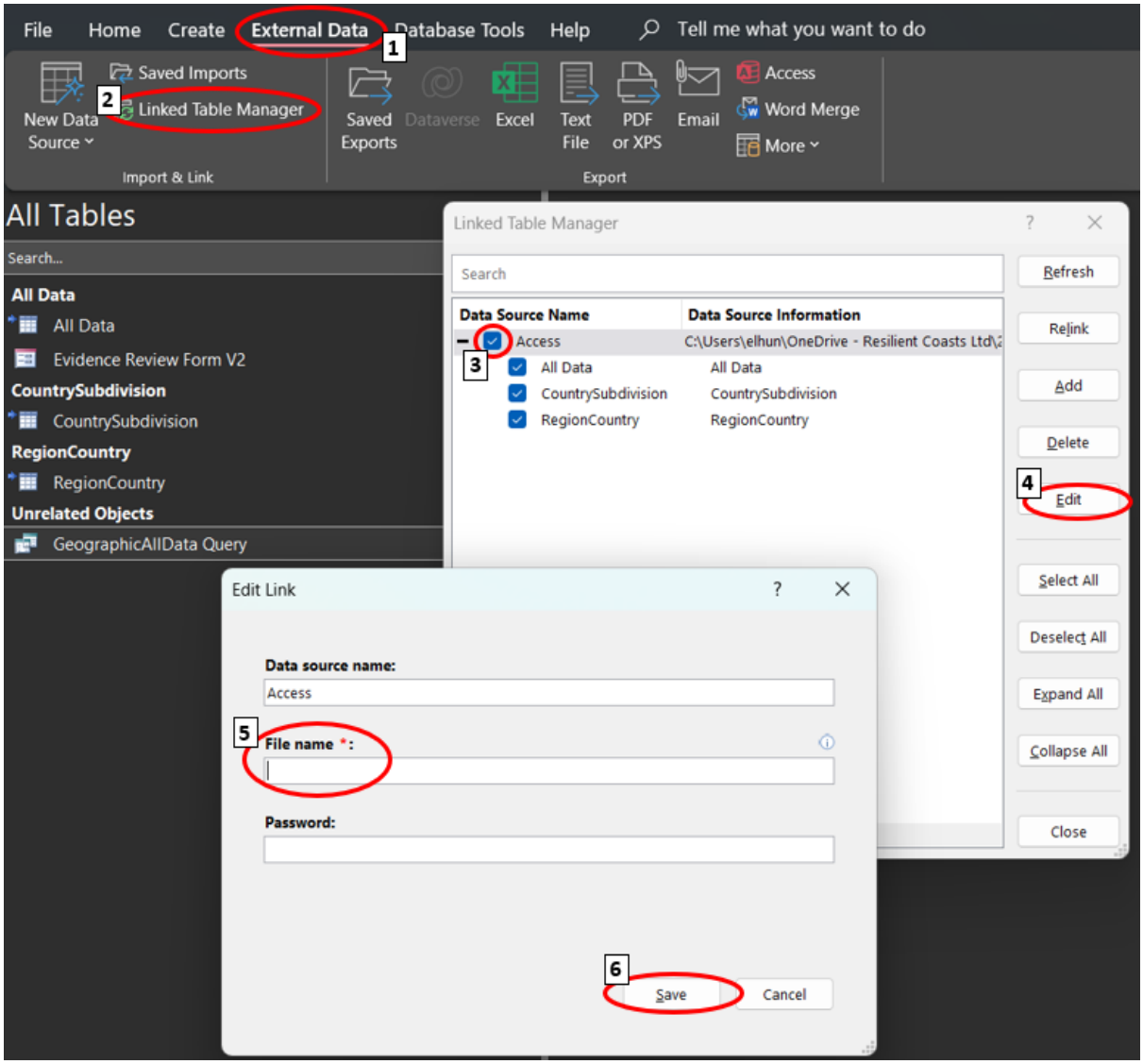


Figure 5. Demonstration of how to link the front-end of the database to the centralised back-end database.

1. Select ‘External Data’ from the ribbon.
2. Select ‘Linked Table Manager’. A pop-out window will appear.
3. From the pop-out window, click the ‘Data Source Name’ tick box to select the database.
4. Click ‘edit’. A pop-up box will appear.
5. Set the ‘File Name’ to the full file pathway of the centralised back-end database. To find the full file pathway, locate the file on your system, right-click on it, select ‘Properties’, and you'll find the pathway under the ‘Location’ or ‘General’ tab. Ensure that any spaces or quotation marks are removed from both sides of the path name. ‘Save’, ‘Refresh’ and ‘Close’.

8.2.2 Tables and forms

Tables and forms are the primary tools for interacting with data. The main table (Figure 6) is where raw data is stored, and it resembles an electronic spreadsheet with rows and columns. Forms, such as the 'Evidence Review Form’ (Figure 7), provide a user-friendly interface for

data entry. Forms guide you through inputting data and ensure consistency. You will notice that the main table can be seen, and interacted with, below the form (Figure 7). Clicking on a different row within the table, will select that row and enable you to view or edit it within the form.

To open the main table, double-click on the table name ‘All Data’ in the left-hand panel. Forms are opened in a similar manner by double-clicking on the form name.

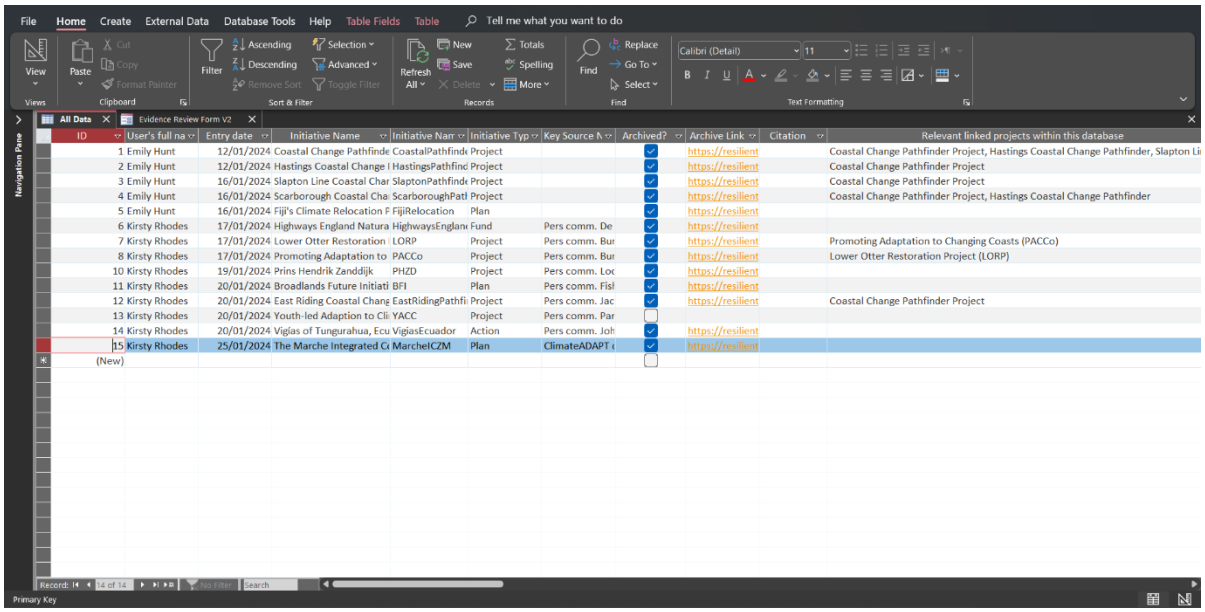


Figure 6. A screenshot of the main table, situated on the front-end of the database.

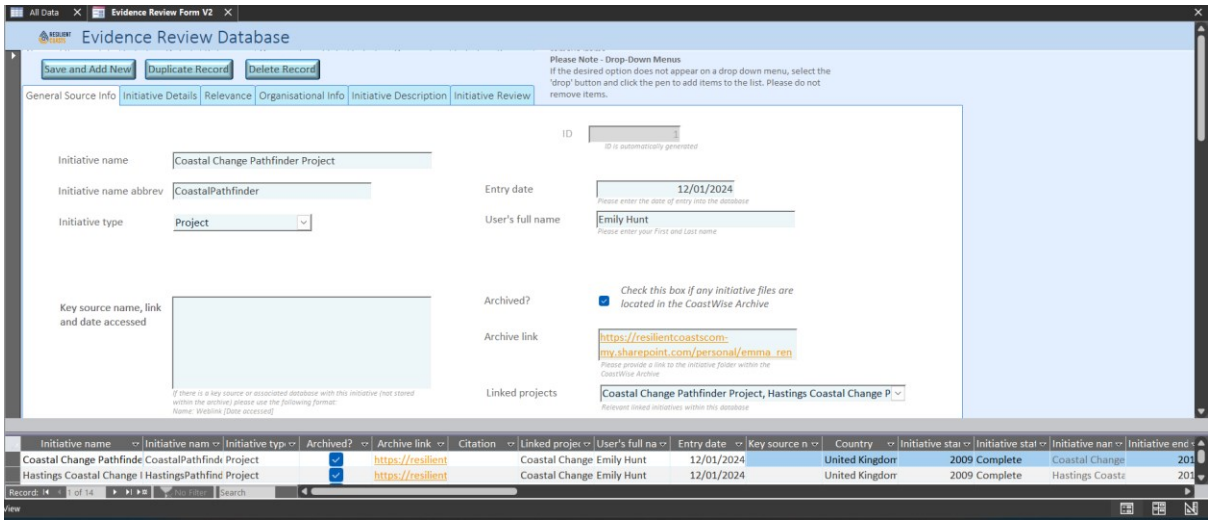


Figure 7. A screenshot of the database form, used for populating the main table.

8.3 Entering data

Once you've opened the 'Evidence Review Form,' you will see a series of fields related to initiative details. To create a new entry, click on each field and enter the relevant information.

The form is designed to guide you through the necessary details. As you fill in the form, the data will automatically populate the main table. This ensures consistency and accuracy across different users. Descriptions of each field can be found in Table 9.

8.3.1 Record management buttons

- 'Save and Add New': Saves the current record and opens a new blank form for additional entries.
- 'Duplicate Record': This button allows you to create a copy of the current record, useful for cases where initiatives share similar details.
- 'Delete Record': Clicking this button will remove the current record from the form. Exercise caution as this action is irreversible.

8.3.2 Using drop-down menus

For certain fields such as initiative status or sector, drop-down menus ensure standardised entries. Click on the cell with the drop-down menu, and a list of options will appear. Depending on the field, the drop-down may allow you to select either a single option, or multiple options, as specified in the database field description table (Table 9).

Table 9. Database fields and description to aid user entry.

Data Field	Description	Format
ID	Primary key. Unique ID for each entry, automatically generated	Autonumber
User's full name	First and last name of user	Short text
Entry date	Date of entry	Date (dd/mm/yyyy)
Initiative Name	Full name of the adaptation or transition initiative. Ensure this encapsulates the unique initiative.	Short text
Initiative Name Abbrev	An abbreviated version of the full initiative name, particularly used for file/folder names. Ensure no spaces or special characters. See section 8.3.4 for guidance.	Short text
Initiative Type	Project/policy/plan/action/fund.	Drop down
Key Source Name, Link and Date	If there is a key source or associated database that is not able to be stored within the archive, please reference it/them here.	Short text (Name: Weblink [date accessed])
Archived?	Check the box if any initiative files are stored within the Adaptation Archive	Yes/No
Archive Link	If the box above is checked, provide a link to the initiative folder within the Adaptation archive. Ensure this is not a local pathway.	Hyperlink
Citation	If the key document is not accessible (e.g. a subscription-access journal), provide a Harvard-style citation	Short text
Relevant linked initiatives within this database	If there are any initiatives within the database that are linked to this initiative (e.g. subproject of a larger initiative, predecessor etc.), select the appropriate initiative(s)	Drop down (multiple selections)
Spatial Scale	Select the most appropriate option to describe the spatial extent of the initiative. Single site (e.g. singular feature), local (e.g. small region/town), regional, national, multi-national, global	Drop down
Region	Spatial region. This limits the countries that appear from the drop-down list. If multiple regions are involved, use this drop down to select the appropriate countries, and then leave blank.	Drop down

Country	Options will update based on the geographic region selected. Select involved country(s)	Drop down
State/County	If the initiative was a single site/local/regional, select the appropriate state/county. This list can be added to manually (see section 8.3.2)	Drop down - editable list to add appropriate options
Initiative Status	Complete/ongoing/planned/unknown	Drop down
Initiative Start Date	Type the year the initiative started (if known/applicable)	Number (yyyy)
Initiative End Date	Type the year the initiative ended (if known/applicable)	Number (yyyy)
Timeframe	If known, select the timeframe the initiative occurred (will occur) over	Drop down
Date Unknown?	If the start/end date or timeframe is unknown, check this box	Yes/No
Key Words	Select all relevant keywords from the drop down box. This will be used to filter the database.	Drop down (multiple selections)
Relevance	If not directly related to the coastal sector, please detail how the content/ideas from the initiative can be transferred to the coastal sector.	Long text
Sector	Which sector(s) is the initiative linked to? See Table 10 for Sector list and examples.	Drop down (multiple selections)
Key Implementing Organisation	Detail the key implementing organisation.	Short text
Implementation Partners	List any implementation partners involved.	Short text
Funding Bodies	List any funding bodies to the initiative.	Short text
Key Stakeholders	List any stakeholders that were directly influenced by, or engaged with, the initiative	Short text
Stakeholder Engagement Strategy	Select all stakeholder engagement strategies used. If none took place, select 'No Engagement'	Drop down (multiple selections)
Currency	Select the currency required. If the relevant currency isn't specified, please convert to USD.	Drop down
Upfront Costs	State the initial costs associated with the initiative.	Short text
Ongoing/Maintenance Cost	Detail any further costs associated with the initiative e.g. if the initiative is ongoing or requires regular maintenance.	Currency
Problem Description	Describe the initial problem that led to the initiative. Outline any problems/causes, introduce the topic.	Long text
Problem Definition	Select any relevant definitions of the problem.	Drop down (multiple selections)
Initiative Overview and Objectives	Outline the initiative and detail the aims/objectives.	Long text
Initiative Enablers	What enabled the initiative to take place? Select all appropriate options.	Drop down (multiple selections)
Key Deliverables	List all key deliverables.	Long text
Initiative outcomes	List the outcomes (positive/negative) resulting from the initiative. Both short and long-term impacts/outcomes.	Long text

Success factors	What outcomes from this initiative demonstrated success? What factors enabled initiative success?	Long text
Failure mechanisms	Challenges, barriers and risk factors.	Long text
Lessons Learned	What are the key lessons learned and takeaways from this initiative? What knowledge can be passed on to subsequent initiatives?	Long text
Additional Information	Space for any further details.	Long text

In most cases, the drop-down options cannot be altered. However, in some cases (e.g. 'State/County'), you can add new items if the desired option is not specified (Figure 8). While it is encouraged to add additional items to these drop-down menus, items must not be deleted. Please check to ensure that no duplicate items are added.

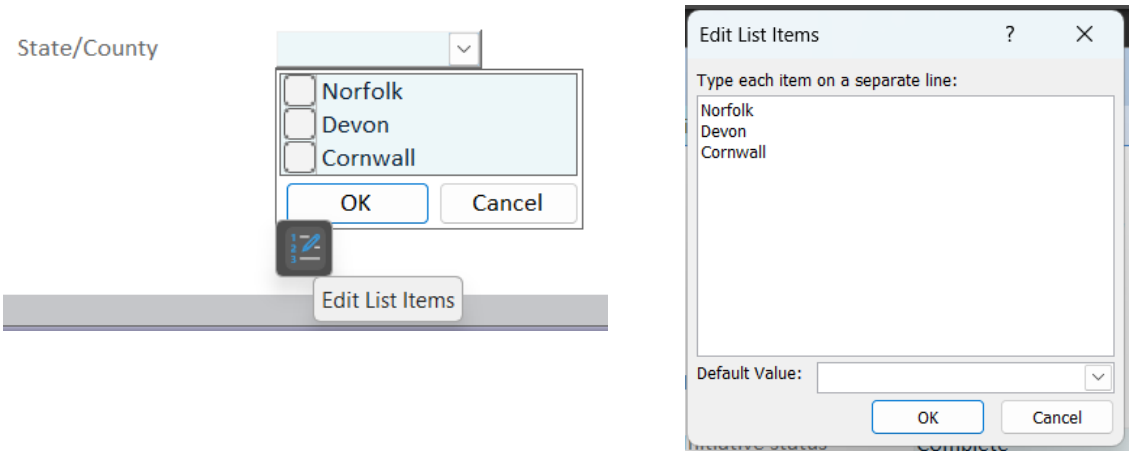


Figure 8. Adding a new item to a drop-down menu.

1) Drop down the menu using the arrow.
2) Click the icon with the pencil (left Figure 8).
3) Add any required list items on a separate line (right Figure 8).
4) Click 'OK'.
5) Select the required item.

8.3.3 Manual entry via table

While not recommended, you can enter data directly into the table by clicking on a cell and typing. Use the Tab or enter key to move horizontally. Begin typing in a blank row to begin a new data entry or amend existing entries by selecting the relevant cell. It is advised to use the user-friendly form for consistency.

8.3.4 Standardising initiative and document names

To maintain consistency and ease of reference, it is crucial to adhere to standardised naming conventions for both initiative folders and individual files.

When abbreviating initiative and document names:

- Aim for brevity and clarity.
- Utilise 'CamelCase' for multi-word names, with the first word in lowercase and subsequent words capitalized. Additionally, represent 'and' or '&' or 'in' with an underscore.
- Avoid spaces or special characters.

- For example, "Adapting to Coastal Change and Hazard Risk in Aotearoa NZ" should be abbreviated as "coastalChange_HazardRisk_Nz".
- A known initiative acronym/abbreviation may also be used.

To name initiatives, folders and filenames within the archive (see section 8.4 for information on adding folders/files to the archive), please follow the following guidance:

- The initiative folder name follows the format {ID}{initiativeNameAbbreviated}, where the ID number is a four-digit unique ID number automatically generated upon adding the initiative entry to the database.
- For individual files, use the format {ID}{documentdate(YYYY)}{lead author surname}{abbreviated doc name}.
- The ID number in both folder and filenames should always consist of four digits (e.g., 0001, 0016, 0101, 1016).
- The lead author field may include the organisation's name where appropriate (e.g., DEFRA).

8.4 Adding to the archive

The Coastal Adaptation Archive functions as the centralised cloud-based repository for storing all open-access materials referenced within the Coastal Adaptation Database. The archive can be accessed on OneDrive via: AdaptationTransition Archive (accessible until 31/12/24, after which it is expected the archive will be hosted centrally by DEFRA/ EA).

To contribute to the archive, determine the most appropriate sector (likely determined while inputting the initiative into the database) for the initiative from the classification table (Table 10). Create an initiative folder within the identified sector, adhering to the naming conventions outlined in Section 8.3.4. Subsequently, add all relevant open-access documents directly into this initiative folder. Ensure each document is appropriately named using the specified format (see Section 8.3.4). If a document pertains to multiple initiatives, include it in every relevant initiative folder. Finally, input the archive link, ensuring it is not a local path, into the database.

Table 10. The sector list used to classify initiatives within the Adaptation Archive and Coastal Adaptation Database, and some examples of themes that each sector may include.

Sector	Examples	
Flood and coastal erosion risk management	Coastal Catchment Estuary	River/ stream Urban, cities and towns Rural and villages
Disaster risk management	Earthquake Volcano Tsunami	Hurricane/ cyclones Drought Landslide
Environment and water resources	Potable water Catchment management Water quality Air quality	Soil quality Ecosystem preservation Habitat restoration Climate-resilient biodiversity
Urban and infrastructure	Coastal infrastructure resilience Homes City planning	Community centres Community resilience
Energy and transport infrastructure	Renewable energy Fossil fuels Nuclear Power station	Rail networks Roads and bridges Dams
Ports and harbours	Airports	Harbours

	Ports	Infrastructure resilience
Agriculture and fisheries	Land management Fisheries management Aquaculture and mariculture Adaptation in farming	Food security measures Supply chain resilience Sustainable practices
Heritage and the arts	Historic buildings and monuments Museums and galleries Archaeology	Marine archaeology and wrecks Designated sites Religious and spiritual sites
Health and wellness	Hospitals and medical centres GP surgeries Dentistry	Supportive therapies Wellbeing and non-traditional
Tourism & recreation	Tourist attractions Recreation assets	Resorts and accommodation Wellbeing
Business, finance and technology	Retail and high streets Offices Factories and warehouses Web-based commerce Risk, insurance and reinsurance	Funding mechanisms Funding partnerships Active technology New and emerging technology
Legal and regulatory framework	International law International agreements	National policy National permitting and licencing
Community and education	Schools and nurseries Community engagement strategies Stakeholder engagement strategies	Educational programs Training and capacity building

8.5 Data retrieval

8.5.1 Search and filter

Searching and filtering are powerful tools to quickly find specific information within the database.

8.5.2 Using drop-down menus

- In the main table (‘All Data’), look for the drop-down menus in each column header. These menus allow you to filter data based on specific criteria, for example Initiative status, sector, or location. Click ‘Select All’ to select/deselect all options. Tick any criteria you require to filter using the key words (Figure 9).

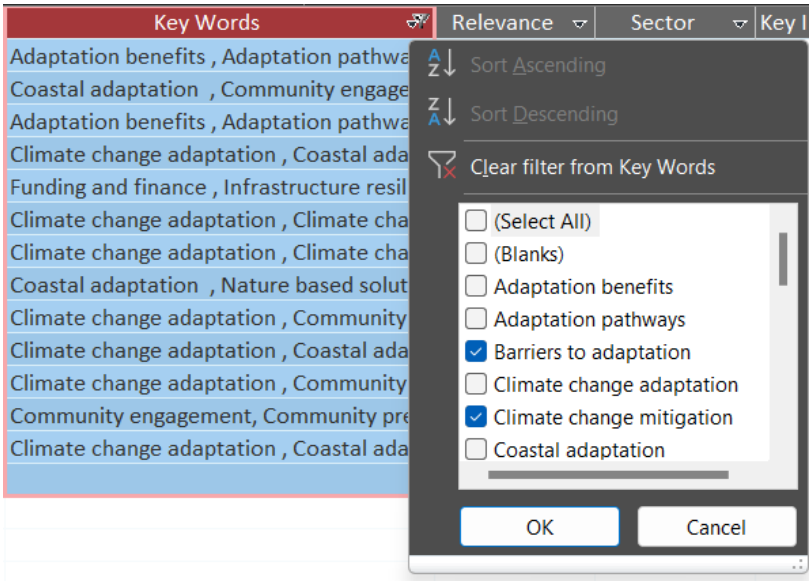


Figure 9. Example of how to filter for relevant initiatives within the database. Click the drop-down in the header of the column you would like to filter by, and 'tick' and relevant criteria.

Customise your view by selecting specific columns, using the tick boxes, and sorting options, using Sort A to Z/ Sort Z to A.

8.5.3 Text search

Utilise the built-in 'find' option to search for specific terms or keywords. Click on the magnifying glass icon on the Home tab or use the Ctrl + F shortcut.

8.5.4 Creating a query to view a subset of data

A Select Query in Microsoft Access allows you to retrieve specific data from one or more tables based on defined criteria. This is particularly useful when you want to view a subset of data without altering the original tables. This is a more advanced method of filtering data and customising/tailoring the data. For a simplistic way to filter data, see Section 8.5.1.

A Select Query does not create a new table; it retrieves and displays data dynamically based on the specified conditions. The query can be run as a 'Make Table' query to output as a table (see here for further information).

8.5.5 Creating a query

1. On the "Create" tab, in the "Queries" group, click "Query Design."
2. On the 'Add Tables' window, double-click the tables you want to retrieve data from. A pop-out box will appear.
3. Close the 'Add Tables' window when finished.
4. In the pop-out box, double-click the fields you want in your query.
5. Optionally, add expressions to the "Field" row.
6. Optionally, add criteria to the "Criteria" row to narrow results. See here for further information.
7. In the 'Query Design' tab, click the "Run" button to execute the query and see results in a datasheet.
8. Review the data and make adjustments as needed.
9. Modify fields, expressions, or criteria based on the initial results.
10. Rerun the query until it returns the specific data you want to view.

For further information on creating Select Queries, follow the steps on the following page, section: 'Create the select query'.

8.6 Mapbox overview

The interactive map, developed within Mapbox[40], serves as a user-friendly tool for exploring initiatives held with in the Coastal Adaptation Database.

8.6.1 Using the interactive map

To view the map, open the HTML file in a web browser. Each initiative location is marked on the map and users can click on the markers to access brief descriptions of the initiatives along with direct links to the respective source website or material online. The side panel lists all initiatives by ID number, as per the database, and a short title. Clicking on an initiative in the side panel centres the map on the selected case study with a popup providing additional details.

8.6.2 Editing the interactive map

Adding new initiatives to the map is a straightforward process that doesn't require coding expertise. Follow the below steps to add more initiatives to the map:

1. Open the HTML file containing the map code. It is recommended to open with Notepad++[41] (see https://notepad-plus-plus.org/online-help/ for installation information), however notepad or any alternative plain text reader will work. Either open the file within the application, or right click on the HTML file within Windows Explorer, click 'Open with', and select the preferred application.
2. Locate the GeoJSON variable within the `<script>` tag. It contains an array of features representing each initiative in GeoJSON format. This will be approximately 200 lines down.
3. Each initiative is represented with a block of code as below:

```
{'type': 'Feature',
'properties': {
'title':'0010: Prins Hendrik Sand Dyke, NLD',
'location':'0010: Texel, Netherlands',
'description':
'<strong>Prins Hendrik Sand Dyke</strong><p> Dutch soft coastal protection
design, reclaiming land and creating habitat along a failing dyke. The scheme
is recognised for ecological innovation and co-benefits, despite higher costs
and uncertainties about habitat longevity. <a
href="https://www.jandenul.com/projects/prins-hendrik-sand-dyke-netherlands"
target="_blank" title="Opens in a new window">Read more</a></p>',
'icon': 'markerSVGCoastwise'
},
'geometry': {
'type': 'Point',
'coordinates': [ 4.819821, 53.027013]
}
}
```

Each block initiative is separated by a comma and a line. To add a new initiative to Mapbox, copy the above block of code and paste after the final existing block. As per Figure 10, grey text should not be altered. The coloured text should be altered as detailed below:

   a. Title (Figure 10; green text): Title text, that appears in the map's side bar. Initiative ID number (assigned within database), a shortened version of the initiative name and the 3-letter country code[42], in the format '[XXXX]: [Initiative

[40] Mapbox maps. An online tool for developing interactive maps. Available online (Accessed 17/02/2024)
[41] notepad++. Available online (Accessed: 17/02/2024).
[42] IBAN (2024) *Country codes alpha-2 & alpha-3*. Available online (Accessed: 17/02/2024).

name], [Country Code]'. Ensure that the single quotation marks remain either side of the full title.

b. Location (Figure 10; dark blue text): Location, appears in the blue banner of the pop-up box. Initiative ID number (assigned within database) and the project location. Add town, state and/or country (long name) as appropriate. Write in the format '[XXXX]: [Location]'. Ensure that the single quotation marks remain either side of the location text.
c. Description (Figure 10; purple, orange and light blue text): The description is split into 3 sections:
    i. Initiative title (purple text): Input the full initiative title, between the `>` `[Insert text]` < symbols. Quotation marks are not required. This text forms the bold text within the pop-up box.
    ii. Initiative description (orange text): Input a brief (1-2 sentences) overview of the initiative between the `<p>` `[Insert text]` `<a` symbols. Try to capture the main aim and key successes/challenges. This text will appear in the pop-up box.
    iii. Initiative link (light blue text): Input a link to a key website/document of interest. Or link to archive. Ensure the full link is within the double quotation marks.
d. Co-ordinates (Figure 10; red text): Input the longitude and latitude of the initiative location. This can be copied from Google Maps by dropping a marker on the required location, and copying the co-ordinates from the pop-up box. Note that Google Maps will provide the "latitude, longitude" (in that order), so ensure that they are inputted as [longitude, latitude] (reversed order), with a comma delimiter and surrounded by square brackets.

4. Ensure that the entire block of code is surrounded by curly brackets { } (as shown in Figure 10). Ensure there is a comma between every code block. Do not add a comma after the last code block.
5. Save the HTML file containing the updated map code. Open the HTML file in a web browser to view the interactive map, including the new marker addition.

```
{'type': 'Feature',
'properties': {
'title':'0010: Prins Hendrik Sand Dyke, NLD',
'location':'0010: Texel, Netherlands',
'description': '<strong>Prins Hendrik Sand Dyke</strong><p>
Dutch soft coastal protection design, reclaiming land and
creating habitat along a failing dyke. The scheme is recognised
for ecological innovation and co-benefits, despite higher costs
and uncertainties about habitat longevity. <a
href="https://www.jandenul.com/projects/prins-hendrik-sand-dyke-
netherlands" target="_blank" title="Opens in a new window">Read
more</a></p>',
'icon': 'markerSVGCoastwise'
},
'geometry': { 'type': 'Point',
'coordinates': [ 4.819821, 53.027013] } }
```

Figure 10. Block of code representing each initiative. When adding an additional initiative, grey text must remain the same. Coloured text should be altered to suit.

To change the appearance or functionality of the map, some coding expertise is recommended. Mapbox guides[43] can assist with the process of editing the code to change the visualisation.

8.7 Tiki-Toki timeline overview

8.7.1 Using the interactive timeline

The interactive timeline provides a chronological representation of adaptation initiatives across different sectors. To access the interactive timeline, click on the link below[44], or copy and paste it into your web browser.

https://www.tiki-toki.com/timeline/entry/2004278/Coastal-Adaptation-Timeline/

The timeline can be navigated in numerous ways (Figure 11). Click on each initiative to expand the description, show an image/video, and link to further information. Simply click on the image to expand, or the video to play.

[43] Mapbox. *Mapbox documentation*. Available online (Accessed: 17/02/2024).
[44] Resilient Coasts Ltd (2024) *Tiki-Toki Coastal Adaptation Timeline*. Available online (Accessed: 17/02/2024).



Figure 11. Extracted screenshot of the Tiki-Toki timeline.

The timeline can be navigated by scrolling the mouse wheel, dragging the main stage (1), dragging the slider (2), clicking the slider to jump to a date (2) or using the arrow keys. Within the timeline users can: adjust visual settings (3), switch between 2D/3D modes (4), access admin settings, whereby initiatives can be added/edited (with an admin account) (5), and access the introduction to the timeline (6).

Using the button in the lower left (Figure 11), it is possible to switch between 2D and 3D modes. The settings button in the lower right (Figure 11) enables you to enter search terms to filter down to initiatives of interest, to filter by the category (sector), switch the view type (changes overall appearance of the timeline), and alter the spacing and zoom of the overall timeline. Additionally, each initiative is 'tagged' with the scheme type (e.g. Plan, Policy, Project, Action etc.). Clicking on these tags will filter the initiatives by the selected tag. Further information can be found on the Tiki-Toki website[45].

8.7.2 Editing the interactive timeline

Using the unpaid version of Tiki-Toki means that only one user can assume admin/editing responsibilities (Figure 12). To edit existing initiatives and add new ones to the timeline, it is recommended to watch the official Tiki-Toki introduction video[46] from 1:00 minute to 2:20 minute. Select the story you want to edit, or 'Create New Story' (Figure 12). Under the 'Basic info' tab you can add the title, start/end date and description text. Navigate through the tabs to add media and tags. Ensure to click the calendar next to the start date and set the date format to 'YYYY' for each entry. Sectors are defined as categories within the timeline, as determined within the database. Tags refer to the project type (e.g. 'Project', 'Action', 'Fund' etc.).

[45] Tiki-Toki (2020) *Create an interactive timeline with Tiki-Toki Timeline Maker*. Available online (Accessed: 17/02/2024).
[46] Tiki-Toki (2014) Tiki-Toki videos: Getting started with Tiki-Toki. Available online (Accessed: 17/02/2024).

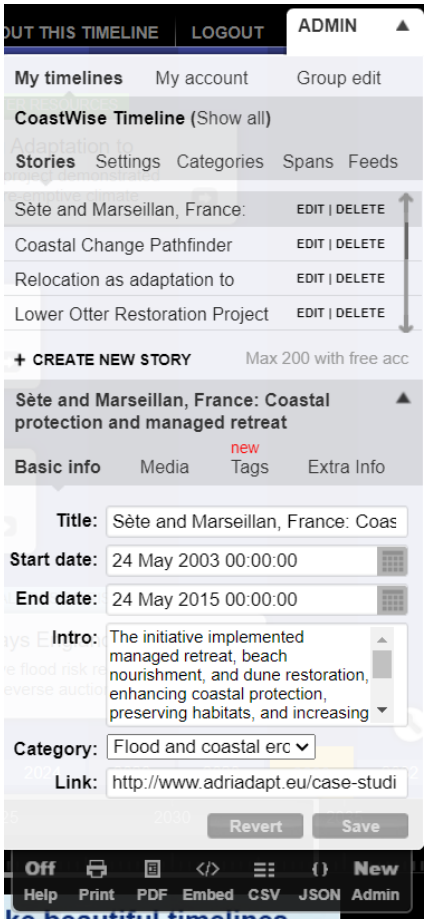


Figure 12. Screenshot of the settings page and how to insert initiatives into the Tiki-Toki interactive map.

8.8 Useful links

- Microsoft Access general guides: https://support.microsoft.com/en-au/office/get-started-with-access-000df874-6a6a-49e4-8c95-51cd4d368039
- MS Access Query Guide: https://support.microsoft.com/en-us/office/create-a-make-table-query-96424f9e-82fd-411e-aca4-e21ad0a94f1b
- MS Access Query Criteria Guide: https://support.microsoft.com/en-us/office/examples-of-query-criteria-3197228c-8684-4552-ac03-aba746fb29d8
- Archive Principles and Practise: https://cdn.nationalarchives.gov.uk/documents/archives/archive-principles-and-practice-an-introduction-to-archives-for-non-archivists.pdf
- Mapbox Documentation: https://docs.mapbox.com/
- Tiki-Toki Tutorials: https://www.tiki-toki.com/blog/entry/tiki-toki-tutorials/

9 Appendix 4. Quick Scoping Review results

Table 11. Literature review returns reviewed as relevant to be added to the Coastal Adaptation Database at a later date.

Title	Link	Source
Preliminary assessment of coastal erosion and local community adaptation in Sayung coastal area, central java – Indonesia	https://sciendo.com/article/10.2478/v10117-012-0028-2	QSR
Mangrove management for climate change adaptation and sustainable development in coastal zones	https://www.tandfonline.com/doi/abs/10.1080/10549811.2017.1339615	QSR
Impact of sea level rise to coastal ecology: a case study on the northern part of Java Island, Indonesia	https://sciendo.com/article/10.2478/quageo-2014-0008	QSR
Adaptation technologies and legal instruments to address climate change impacts to coastal and marine resources in Tanzania	https://www.ajol.info/index.php/ajest/article/view/135611	QSR
Adapting to Pacific Island mangrove responses to sea level rise and climate change	https://www.int-res.com/abstracts/cr/v32/n3/p161-176/	QSR
Climate Change Adaptation and Coastal Property Rights: A Massachusetts Case Study	https://heinonline.org/HOL/LandingPage?handle=hein.journals/bcenv40&div=15&id=&page=	QSR
Coastal erosion and beach nourishment in Scania as issues in Swedish coastal policy	https://lucris.lub.lu.se/ws/files/21599805/Coastal_policy_Sweden.pdf	QSR
Adaptation of a freshwater evaluation framework to a coastal system: The case of Kamari, Santorini	https://www.sciencedirect.com/science/article/abs/pii/S0301479721004680	QSR
Adapting to sea-level rise in the Torres Strait	https://coastadapt.com.au/sites/default/files/case_studies/CS011_Adaptation_in_the_Torres_Strait.pdf	QSR
Tweed River Entrance Sand Bypass Project	https://coastadapt.com.au/sites/default/files/case_studies/CS03_Tweed_River_Sand_Bypass.pdf	QSR
Coastal mangrove restoration is practiced as a community-based climate change adaptation initiative in Bangladesh.	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/coastal-mangrove-afforestation-using-a-community-ecosystem-based-adaptation-approach/	QSR
Oyster breakwater reefs support climate adaptation	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/oyster-breakwater-reefs-support-climate-adaptation/	QSR
Ecosystem-based adaptation to cope with sea-level rise and extreme climatic events	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/ecosystem-based-adaptation-to-cope-with-sea-level-rise-and-extreme-climatic-events-on-the-uruguayan-coast/	QSR
Ecosystem-based approaches to mangrove and wetland restoration in the Paz River basin	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/ecosystem-based-approaches-to-mangrove-and-wetland-restoration-in-the-paz-river-basin/	QSR
Mangrove protection in the Indus Delta	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/mangrove-protection-in-the-indus-delta-in-pakistan/	QSR
Applying ecosystem-based disaster risk reduction through a ridge-to-reef approach	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/applying-ecosystem-based-disaster-risk-reduction-through-a-ridge-to-reef-approach/	QSR
Community-led mangrove forest restoration and seaweed farming	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/community-led-mangrove-forest-restoration-and-seaweed-farming/	QSR
Pointe au Chien Indigenous Community Oyster Restoration Project	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/pointe-au-chien-indigenous-community-oyster-restoration-project/	QSR
Reef enhancement and vegetation restoration to enhance coastal resilience in Grenville Bay	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/reef-enhancement-and-vegetation-restoration-to-enhance-coastal-resilience/	QSR
The Medmerry project for intertidal habitat restoration with managed coastal realignment	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/managed-coastal-realignment-for-intertidal-habitat-restoration/	QSR
Wallasea Island Wild Coast restoration project	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/wallasea-island-wild-coast-restoration-project/	QSR
Coastal mangrove forest restoration for carbon sequestration	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/coastal-mangrove-forest-restoration-for-above-and-below-water-carbon-seuqestration/	QSR
Innovative approach in the stabilisation of coastal slopes	https://www.icevirtuallibrary.com/doi/10.1680/jensu.16.00047	QSR
Old ways for new challenges: Indigenous Adaptation to Climate Change	https://coastadapt.com.au/sites/default/files/case_studies/CS08_Indigenous_adaptation.pdf	QSR

AdaptWater: A climate change adaptation tool for the urban water industry	https://coastadapt.com.au/sites/default/files/case_studies/SS15_AdaptWater.pdf	QSR
Summerland Credit Union: Climate change risk adaptation assessment and planning	https://coastadapt.com.au/sites/default/files/case_studies/SS34_Summerland_Credit_Union.pdf	QSR
Climate change knowledge and adaptation in Aboriginal local government councils	https://coastadapt.com.au/case-studies/climate-change-knowledge-and-adaptation-aboriginal-local-government-councils	QSR
Defence climate change risk assessment	https://coastadapt.com.au/sites/default/files/case_studies/CS09_Defence_risk_assessment.pdf	QSR
The Great Barrier Reef's climate change journey	https://coastadapt.com.au/sites/default/files/case_studies/SS9_The_GBR_and_climate_change.pdf	QSR
Combined climate smart agriculture and ecosystem-based approaches to adaptation	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/combined-climate-smart-agriculture-and-ecosystem-based-approaches-to-adaptation-in-burkina-faso/	QSR
Governance for ecosystem-based adaptation project in the Sixaola River basin	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/governance-for-ecosystem-based-adaptation-project-in-the-sixaola-river-basin-on-the-border-of-costa-rica-and-panama/	QSR
Community forests and REDD+	https://casestudies.naturebasedsolutionsinitiative.org/casestudy/community-forests-and-redd/	QSR
Climate Change Adaptation: Putting Principles into Practice	https://link.springer.com/article/10.1007/s00267-013-0217-3	QSR
Developing adaptive capacity within groundwater abstraction management systems	https://www.sciencedirect.com/science/article/abs/pii/S0301479711000090	QSR
NNDC CTAP	https://engageenvironmentagency.uk.engagementhq.com/north-norfolk_ctap	PSG
SMP5	https://www.eastangliacoastalgroup.org/smp-5	PSG
SMP6	https://www.eastangliacoastalgroup.org/smp-6	PSG
Adapting to coastal change and hazard risk in Aotearoa New Zealand: Our evolving coastal planning framework	https://www.coastalsociety.org.nz/assets/Publications/Special-Issues/SP5-reading-WITH-REVISIONS.pdf	PSG
Adapting to coastal change and hazard risk in Aotearoa New Zealand: Managed retreat at Matata	https://www.coastalsociety.org.nz/assets/Publications/Special-Issues/SP5-reading-WITH-REVISIONS.pdf	PSG
Adapting to coastal change and hazard risk in Aotearoa New Zealand: TCDC SMP Project	https://www.coastalsociety.org.nz/assets/Publications/Special-Issues/SP5-reading-WITH-REVISIONS.pdf	PSG
Adapting to coastal change and hazard risk in Aotearoa New Zealand: HDC Wharekawa Coast 2120	https://www.coastalsociety.org.nz/assets/Publications/Special-Issues/SP5-reading-WITH-REVISIONS.pdf	PSG
Adapting to coastal change and hazard risk in Aotearoa New Zealand: HB Clifton to Tangoio Coastal Strategy	https://www.coastalsociety.org.nz/assets/Publications/Special-Issues/SP5-reading-WITH-REVISIONS.pdf	PSG
Adapting to coastal change and hazard risk in Aotearoa New Zealand: Elevating engagement with communities	https://www.coastalsociety.org.nz/assets/Publications/Special-Issues/SP5-reading-WITH-REVISIONS.pdf	PSG
Adapting to coastal change and hazard risk in Aotearoa New Zealand: Shoreline adaptation plans for Tamaki Makaurau	https://www.coastalsociety.org.nz/assets/Publications/Special-Issues/SP5-reading-WITH-REVISIONS.pdf	PSG
Sustainable Development at the Coast: the Lincolnshire Coastal Study	https://www.icevirtuallibrary.com/doi/abs/10.1680/ICZM2012.57494.0014	PSG
Adaptive management responses on a sediment dynamic coast in Auckland	https://search.informit.org/doi/abs/10.3316/informit.733062485190174	PSG

10 Appendix 5. Interview summary notes

10.1 Interview summary 1. Kellie Fisher

Interviewee:	Kellie Fisher
Organisation:	Environment Agency
Role:	East Anglia Coastal Area Manager
Date:	13/12/2023
Interviewer:	Kirsty Rhodes & Emma Rendle

Key skills and experience for adaptation career:

Kellie has a technical background is as a geotechnical engineer with a specialism in coast and is chartered with CIWEM.

Troubleshooting is an important skill in adaptation. Thinking through coastal issues and understanding how to tweak the case to speak to different people is important.

Communication skills, having empathy for people, and the ability to look strategically at a problem is key for adaptation.

Initiatives of interest:

- Small-scale initiatives such as supporting a landowner to look at different options for their business or a home that is in need of renovation in an erosion zone.
- Broadland Futures Initiative (see database ID 0011).
- Happisburgh and Hemsby adaptation.

Key takeaways:

Adaptation is not actively nationally supported in the same way that traditional defence is. However, it is possible for the EA to accept a business case from a risk management authority that is sufficiently proportionate, realistic, and well-thought out to give grant in aid for adaptation.

An adaptation challenge faced is the case of rural isolated properties and towns that don't qualify for funding from a technical, environmental, or economic perspective.

Adaptation is more difficult when it comes to flood compared to erosion. Erosion is finite and we must adapt, or homes are lost. Whereas flood has a higher recovery element to it. Adaptation to flood is a much more politically charged issue. For instance, who decides when a property can no longer be sustained? The conversation with flood adaptation is lagging compared to erosion.

A key lesson learnt from Kellie's background of projects is to take a baseline, options, benefits approach with stakeholders. They should understand the baseline (i.e. why defences don't always work), then can have a conversation about adaptation options on the table can be initiated, prompting consideration of the benefits.

Coastal Adaptation Database:

Kellie's key source of information is speaking to the right people. A database of adaptation case studies could aid in writing a compelling business case to access funding and make adaptation happen on the ground.

10.2 Interview summary 2. Richard Jackson

Interviewee:	Richard Jackson
Organisation:	East Riding of Yorkshire Council
Role:	Coastal Change Manager
Date:	14/12/2023
Interviewer:	Kirsty Rhodes

Key skills and experience for adaptation career:

Richard started working in the Sustainable Development team at East Riding of Yorkshire Council in 2010. His career progression within the council, working across multiple roles and sectors including coastal management, has led to his current position as Coastal Change Manager, leading on aspects of coastal policy and adaptation.

Communication skills are vital across a spectrum of people. Practitioners must be able to communicate with residents, farmers, caravan site owners and so on to understand what they want, their constraints, and to empower them. Adaptation practitioners must bridge the gap to communicating these findings to decision makers. A strategic head is important including the ability to monitor data, speak to the public, and to take a step back and look at an issue at a national and local authority level to make your case.

Initiatives of interest:

- East Riding Pathfinder (see database ID 0012).
- Small local initiatives enabled by Pathfinder.

Key takeaways:

A challenge for coastal adaptation challenge is that the Shoreline Management Plans (SMPs) are the baseline to everything coastal teams do, but they do not do the job of directing adaptation. SMPs set the policy in terms of where we can defend but doesn't tell us what to do in the places that we can't defend. There have been discussions in SMP refresh thinking regarding how to make adaptation higher profile.

The levels of expertise and funding needed to strategize residential roll-back must be greater.

In Local Authority engagement efforts, it is surprising to still now be having conversations with the public about why adaptation is needed. The Pathfinder projects involved very intense engagement over a short period that raised awareness, but this has dropped off. There are a lot of people moving in and out at the coast and this discussion is constantly restarting with new residents and, with CTAP, further inland than ever before. This effort requires careful management of sensitive discussions.

Coastal Adaptation Database:

Key sources of information used currently are from the Coastal Group and LGA Coastal SIG. These groups share information on what other areas are doing nationally. International insights come from conferences and websites, such as Coastal News Today[47], rather than direct engagement. A forum type approach to the Knowledge Hub, to see what people are working on, would be more useful than case study write ups. However, case studies will be valuable for new starters.

[47] Coastal News Today. Available online (Accessed: 14/12/2023).

10.3 Interview summary 3. Katie Parsons

Interviewee:	Katie Parsons
Organisation:	Loughborough University
Role:	Research Fellow in Education, Geography and Environment
Date:	14/12/2023
Interviewer:	Kirsty Rhodes & Emma Rendle

Key skills and experience for adaptation career:

Katie has a trans-disciplinary background in social care and human geography. Katie's research focus uses creative participatory approaches when working with children, youth and communities on the topic of disaster mitigation and climate change adaptation.

Using play and creative approaches is helpful in tackling sometimes disruptive and emotional subjects linked to climate change vulnerability.

Listening skills are required in adaptation initiative and ensuring participants have a voice. The foundations of Katie's projects are gaining trust and developing relationships first, then gathering knowledge about what children and indigenous communities already know on the project focus.

Initiatives of interest:

- EA initiatives including Skipsey adaptation with East Riding of Yorkshire Council.
- Reimagining Rivers with the Girl Guides.
- British Academy initiatives in Vietnam (see database ID 0013):
  - Youth-led adaptation for climate change challenges in Vietnam: social action, inter-generational and inter-cultural learning.
  - Advancing policy and practice on climate action through intergenerational dialogue in Vietnam and beyond across South-East Asia.

Key takeaways:

Effective engagement between communities and Local Authorities helps to break down barriers. There is an issue with how agencies can work with communities is that authorities give limited information and options. It is more beneficial for all parties involved to give communities the information and let them play with it. In most cases, they will come to the conclusion in line with the authorities thinking. Authorities should be putting the power in stakeholders' hands and trust that they will come to the same, sensible conclusion. If they come to a different conclusion after going through the same knowledge practices as practitioners, authorities should stop and think - could they be right?

Practitioners are often wary to work with communities and educate them, not wanting to give them information assuming they won't understand and it's 'too much' for them. Katie thinks information is never too much, but it must be said in the right way and broken down in an accessible way.

Some key learnings from adaptation initiatives in Asia are that we need to bridge the gap between indigenous communities and government officials. The knowledge that indigenous communities have of climate change impacts and their experience of small-scale community-led adaptive interventions should be known on a government policy level. Initiatives in Vietnam that Katie has contributed to have had success bridging this gap through creative engagement approaches.

10.4 Interview summary 4. Jessica Johnson

Interviewee:	Jessica Johnson
Organisation:	University of East Anglia
Role:	Associate Professor in Solid Earth Geophysics
Date:	15/12/2023
Interviewer:	Kirsty Rhodes

Key skills and experience for adaptation career:

Jessica has a geophysics background and is currently commencing coastal research in Norfolk, utilising an innovative sensing suite to monitor rockfall, slow erosion and slow movement (slumping). The project has a community engagement element.

An important skill in engagement activities is the ability to communicate technical terms and uncertainty.

Initiatives of interest:

- Distributed Strain, Temperature and Acoustic seNsing Suite (DiSTANS).
- Risk at Margins.
- STREVA strengthening resilience in volcanic areas.
- Risk reduction through community-based monitoring: the *vigías* of Tungurahua, Ecuador. (see database ID 0014).
- Hawaiian Volcano Observatory community-engagement activities.
- New Zealand ShakeOut.

Key takeaways:

Bringing the community along is key to disaster preparedness.

Utilise the community in adaptation to disasters through preparedness. Many projects have found success by enlisting and training the people who live there as scientists themselves. Locals become involved in installing sensing instruments and interpreting data, using their experiences and local knowledge. This community member provides an often-missing link between local people and a monitoring agency.

Expectations is a big challenge in adaptation initiatives; both of the residents, who think practitioners and researchers can fix everything, and of the scientists. As scientist, we think that everyone will be happy for monitoring and adaptive actions, potentially in their back garden, but that is not always the case.

Coastal Adaptation Database:

Jessica would use a database of adaptation case studies. There would be a requirement to search by the range of stakeholders and gain insights into forming good networks with different stakeholders to ensure a legacy. Searching by adaptive strategies implemented, as well as outcomes, would be useful.

10.5 Interview summary 5. Tom de la Rosa

Interviewee:	Tom de la Rosa
Organisation:	Environment Agency
Role:	Flood and Coastal Innovation Programme (FCIP) Manager
Date:	19/12/2023
Interviewer:	Kirsty Rhodes and Emma Rendle

Key skills and experience for adaptation career:

Tom has a geology background with a specialism in water and flood risk management. He has held role in the public and private sector in operations, and project design and delivery.

For delivering adaptation, wider important skills are engagement and monitoring. Secondarily would be around financing skills but engagement and monitoring at forefront.

Initiatives of interest:

- Our Future Coast.
- Making Space for Sand.
- Bude Climate Partnership.
- Highways England Natural Flood Management Pilot Programme (see database ID 0006).

Key takeaways:

Empowerment is at the heart of resilience. We need to effectively communicate and engage to identify and deliver solutions to problems that our communities have.

Core facets of both adaptation and resilience currently centre around monitoring, for instance, monitoring thresholds for adaptation pathways, such as sea level rise. We need to change our mindset to continuous monitoring.

Typically flood and coastal issues have been managed and mitigated through engineering design. This works when there is a clear feasible engineering solution to an issue that can be delivered. However, due to design or data constraints, an engineered solution is not always possible. The skill base therefore needs to expand. This isn't groundbreaking and has been happening across country for a while but is more prominent now as we shift from risk mitigation and management to resilience and adaptation as the concepts by which we can strengthen vulnerability and respond to climate change.

The pace at which we learn from other examples and apply these learnings to current activities is too slow for the pace of climate change. We are adapting too slowly to climate change. This perhaps stems from a tolerance for uncertainty or acceptance of climate change impacts. That pace dramatically needs to change and we need to get more comfortable with working 'live'.

Coastal Adaptation Database:

Tom's main source of information a network of contacts. In a database, it would be preferable to put a face to cross-sectoral projects by providing a contact that could be reached through the database.

A pitfall to avoid is publishing a long list of PDFs with no helpful description. A search function that gives relevant returns is needed.

10.6 Interview summary 6. Alan Frampton

Interviewee:	Alan Frampton
Organisation:	Bournemouth, Christchurch and Poole Council
Role:	Strategy, Policy and Environment Manager
Date:	20/12/2023
Interviewer:	Emma Rendle

Key skills and experience for adaptation career:

Alan is experienced in all aspects of FCERM projects including engineering design, policy, strategy, economic appraisal. He has worked at a strategy/policy level being involved in writing SMP policy for the South West, and A New Coastal Change Adaptation Planning Guide for England (2015). BCP council is a centre of excellence providing FCERM services across the South West.

Skills in system thinking are most relevant to adaptation planning.

Initiatives of interest:

- Case studies included in Managing the Coast in a Changing Climate report (2018 for Committee on Climate Change).
- Brownsea Island adaptation by the National Trust.

Key takeaways

A barrier to adaptation is the skill shortage and requirement for strategic thinking. Resource and funding are issues. In many Local Authorities, experts cannot only be focussed on the coast and must split their time.

Coastal adaptation needs to be a coastal zone management approach.

A question here is 'what Local Authorities can do?' Who are outside of localised CTAP but need adaptation/transition plans. Adaptation plans need to be funded and led by a planning guidance document.

If we are going to adapt communities and places, we need to take a bigger, multi-sector approach and not just think about coastal risk but climate change risk in totality.

We have to take a Master Plan approach to transition and take the community along. They need to be involved in decision making.

10.7 Interview summary 7. Tim Bartlett

Interviewee:	Tim Bartlett
Organisation:	Lewes and Eastbourne Councils
Role:	Specialist Adviser for Flood and Coastal Risk Management
Date:	21/12/2023
Interviewer:	Emma Rendle

Key skills and experience for adaptation career:

Tim's has a career background in pollution as an Environmental Health Officer and various roles specialising in long-term flood and coastal risk for large scale communities.

Technical qualifications aside, practitioners engaging with communities on flood risk and adaptation measures require the skills needed to have difficult conversations one to one. We must have the ability to assess the situation not from your perspective as a professional but from the point of view of the (reasonable) person living there. Empathy is important.

Initiatives of interest:

- Ringmer wetlands.
- Cockshut stream wetland project.
- Radio 4 case study of climate change and insurance companies. Brisbane Australia and how adaptation had failed. Mississippi, New Orleans.

Key takeaways

In Eastbourne we have sea defences that we manage but long term will need to look at adaptation. This has been brought home by recent storms.

Engagement is needed to gain an understanding of the fundamental impact of a hazard on an individual. Understand 'what is the level of impact to which they are suffering?' and 'what does that mean?' if you multiply that up to a community level. Thinking about public perception is key for adaptation planning.

It is important to take people along with you – they are part of the problem and part of the solution. People understand the issue of flooding and know that there needs to be change. There are a lot of negative voices out there but they are the minority.

A trial-and-error basis can work by implementing a solution and tweaking it. Successful flood management projects can be done outside the realms of a normal pathway of an engineering pre-FEED process.

There is opportunity to be found in private estates who have ideas for adaptation on their land. We can empower them. They can take examples that have worked and implement adaptation. This way, we can take small individual steps to reduce impact.

10.8 Interview summary 8. Lydia Burgess-Gamble

Interviewee:	Lydia Burgess-Gamble
Organisation:	Environment Agency
Role:	PACCo Lead Project Manager
Date:	21/12/2023
Interviewer:	Emma Rendle

Key skills and experience for adaptation career:

Lydia has a fluvial background including an MSc in Environmental Science and PhD in River Restoration. Lydia's career in the Environment Agency began in flood and coastal erosion risk management and now works in the Environment and Business team working on policy and practical restoration initiatives.

Skills instrumental to Lydia's career path are technical, science and policy skills. Thinking through complicated problems and bringing people together is important.

Initiatives of interest:

- PACCo initiative – Lower Otter Estuary project (see database ID 0008 and 0007).

Key takeaways:

Thinking used to centre around defence rather than adaptation and resilience. Since around 2010 I have worked in adaptation, but we didn't call it that.

It is important in cross-country projects to find a way of working in partnership that keeps everyone working collaboratively, and tackles issues head on. Projects should have a facilitated event at initiation to think about how best to work as a partnership and have way of keeping a check on how it's working. Collecting partner feedback in non-confrontational way will help this.

Coastal Adaptation Database:

Be aware of similar project such as the Restoring Meadows, March and Reefs (ReMeMaRe) initiative which is commissioning a database of coastal and estuarine restoration projects. Another coastal information hub is funded through championing coastal coordination.

10.9 Interview summary 9. Quirijn Lodder

Interviewee:	Quirijn Lodder
Organisation:	Rijkswaterstaat
Role:	Principal Advisor Coastal Flood Risk Management
Date:	21/12/2023
Interviewer:	Emma Rendle

Key skills and experience for adaptation career:

Quirijn has worked at Rijkswaterstaat, part of the Dutch Ministry of Infrastructure and Water Management, since 2002 in different flood risk management roles and is a guest lecturer at Delft University of Technology.

Conceptualisation is important – bringing scientific concepts to a level that is actually helpful to operational agencies making decisions.

Initiatives of interest:

- Prins Hendrik Zanddijk (see database ID 0010).
- The Delta Programme.

Key takeaways:

The Netherlands has a risk-based approach to coastal flood risk management. When looking at adaptation, it is helpful to distinguish between operational adaptation projects and adaptation strategies. In the Netherlands, flood risk management is a lot of money, but not expensive. We spend around €1.5billion per year on it, which is only around 0.02% of our GDP.

One of the key lessons from the Delta Programme is that it enables political decision making on a 6-year cycle which is critical to adaptation.

Stakeholders can engage in how to do a project. But the need for the project is generally not so open. Especially if a project is needed to comply with the law, because the law is already passed. Think of the bathtub approach – someone living near a defence might be annoyed by works but we also need to consider the million people further back at risk. In the end they live in a place providing societal vital function. It is not up to an individual when their impact has a decision on others because this is already designed by parliament.

The Dutch strategy is to maintain the flood defence system, upgrade it and perhaps allow some smaller retreat to allow for natural dynamics. Managed Realignment, like in some places in UK, is not needed but it is a discussion point for the long-term.

For the Netherlands, the policy is strategic goal, tactical approach and operational objectives. Strategy should always reflect what society would like to do and what is achievable.

A current observation in the Netherlands is that the additional costs of adapting to sea level rise are sometimes less than initially perceived because the benchmark should include the defence renovations that are required anyway.

Coastal Adaptation Database:

Multiple platforms are collating case studies. The challenge is maintaining these after the project lifetime.

10.10 Interview summary 10. Jed Ramsay

Interviewee:	Jed Ramsay
Organisation:	Project Groundwater
Role:	Project Leader
Date:	21/12/2023
Interviewer:	Emma Rendle

Key skills and experience for adaptation career:

Jed has a background in engineering, project management, maintenance, navigation, licencing, land management and asset management.

People skills is important in adaptation initiatives. Leaders must inspire teams to push boundaries, do things differently and take risks.

Strategic thinking and the ability to see the bigger picture is key. You must be able to take a step back to make sure we are going in the right direction.

In any project you want to bring about, including adaptation-focused initiatives, the practical, technical side is the easy bit. Getting people to want to do it and be a part of it, recognise the need or pay for it is the real challenge.

Initiatives of interest:

- Project Groundwater – specifically the engagement strategy

Key takeaways:

What I'd like to see done for adaptation to groundwater needs long-term change. Including legislation and funding system review, and the development of a national ground water flood map.

We must plan beyond adaptation project periods. At Project Groundwater, we are setting up a new organisation to operate at a national level, outliving the project period, to take the initiatives forward.

Adaptation to groundwater has particular challenges due to a lack of data. It is unknown how any people are impacted by groundwater flooding and how climate change will impact groundwater in the future.

In adaptation we must look outside only physical modelling to human behaviour.

For a successful engagement strategy at a national policy level, the approach has to be more personal. Building relationships with people is important. This is a challenge because you can only get very limited time with people of influence, such as politicians.

Adaptation projects should have a focus on the mental health impacts of hazards. Studies on the mental health cost to society of impacts of flooding have been estimated at 5 times greater than the cost of damage to property. But the primary focus of flood risk cost:benefit analysis is property damage costs.

Coastal Adaptation Database:

A database of adaptation case studies would be useful to Project Groundwater. We are not trying to reinvent the wheel – we want to learn from cases that have and have not worked. Sometimes it is more valuable to learn the pitfalls of unsuccessful initiatives.

11 Appendix 6. Case studies

11.1 Scarborough Coastal Change Pathfinder, UK

Table 12. Case study: Scarborough Coastal Change Pathfinder, UK.

Scheme title	Scarborough Coastal Change Pathfinder Project	**Scheme type**	Project
Sector	Flood and coastal erosion risk management	**Location**	Scarborough, North Yorkshire, UK
Implementing organisation	Scarborough Borough Council	**Scheme partners**	
Scheme dates and status	2009-2011, complete	**Funding source and budget**	DEFRA, £1,022,500
Scheme photograph/location map/figure			

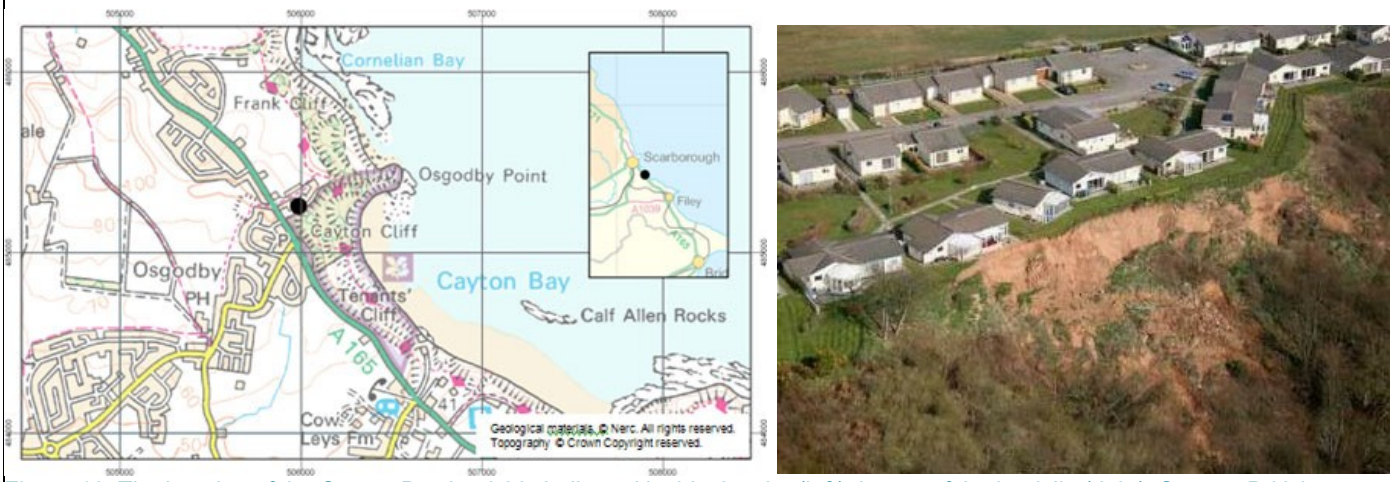


Figure 13. The location of the Cayton Bay landside indicated by black point (left). Image of the landslip (right). Source: British Geological Survey, National Landslide Database, 2024 (left), Scarborough Borough Council, 2012 (right)

Problem definition

Knipe Point comprises 56 properties situated atop Cayton Cliffs, just south of Scarborough. These cliffs have experienced substantial landslips due to the combined impacts of coastal erosion and the inherent instability of the coastal slopes. The remobilisation of a landslide in 2008 led to the loss of private land and mandated the demolition of three properties. Additional properties were deemed vulnerable over the next five years, including sections of the old A165 and properties situated beyond. The affected land is privately owned by the National Trust and Knipe Point Freeholders Ltd.

Scheme summary and outcomes

The proposed initiative for Knipe Point was a multifaceted approach addressing the challenges posed by coastal erosion and landslips. The key components included:

1. Conducting regular consultations and meetings with the affected community to ensure their active involvement in decision-making processes.
2. Developing a comprehensive adaptation action plan specifically tailored for Knipe Point to mitigate the impact of coastal erosion and land instability.
3. Implementing adaptive solutions by acquiring nearby land that was not susceptible to coastal erosion or instability. Property owners facing displacement due to coastal erosion should have the opportunity to rebuild on the acquired land, subject to project-defined conditions.

While facing challenges and slower progress than anticipated, the initiative has contributed to increased awareness of coastal change, propelled by significant media exposure. The development of Scarborough's first emergency evacuation plan stands as a noteworthy achievement. Lessons learned from the initiative provide valuable insights for future programs, particularly in understanding the complexities of gaining community buy-in and the time required for consensus-building. Despite strained relationships between residents and the Council, the project has set the

stage for potential future benefits, including the rollback of properties at risk and positive environmental outcomes associated with relocating people from the area.

Scheme successes

Two notable success factors emerged from the initiative.

1. The initiative successfully increased public knowledge and understanding of coastal change, fostering engagement and inquiries about property risk levels.
2. The production of an emergency evacuation plan, the first of its kind in Scarborough, demonstrates the initiative's positive impact on community safety and preparedness. These achievements underscore the importance of public education and infrastructure development in coastal change adaptation initiatives.

Scheme limiting factors/challenges

Several challenges have impeded the project's success:

- Strained relationships between residents and the Council stemmed from perceived slow progress and unmet expectations.
- The lack of community cohesion, exacerbated by the majority of households being second homes, posed a significant challenge.
- Delays in property rollback, difficulties with insurance payments, and struggles in finding a suitable relocation site contributed to the initiative's slower-than-expected pace.
- Insufficient external support and the absence of independent mediation have strained community relations.
- The established criteria did not involve any means testing and did not consider the diverse financial circumstances of beneficiaries, including those who were second homeowners.

Lessons learned

- The project has highlighted the difficulties in gaining community buy-in for a rollback scheme and the time-consuming nature of consensus-building.
- The project demonstrated the need for early, independent site appraisal studies.
- The complexities of differing agendas between primary and second homeowners emphasised the importance of aligning project goals with community needs for effective and timely support.
- Independent mediation and external support were identified as potential enhancers for project success.

References

British Geological Survey (2024) *Knipe Point, Cayton Bay, North Yorkshire*. Available online (Accessed: 09/02/2024).
Defra (2012) *Coastal Change Pathfinder Review: Final Report*. Available online (Accessed: 19/01/2024).
Rowe, S. (2012) *Scarborough Borough Council Pathfinder*. Available online (Accessed: 09/02/2024).

11.2 Prins Hendrik Sand Dyke, The Netherlands

Table 13. Case study: Prins Hendrik Sand Dyke, The Netherlands.

Scheme title	Prins Hendrik Zanddijk (PHZD) (Prins Hendrik Sand Dyke)	**Scheme type**	Project
Sector	Flood and coastal erosion risk management	**Location**	Texel, Netherlands
Implementing organisation	An alliance of the Ministry of Infrastructure and Water Management and the waterboard Hoogheemraadschap Hollands Noorderkwartier	**Scheme partners**	Witteveen+Bos Raadgevende Ingenieurs (Lead consultant), Jan De Nul (civil engineers) and various partner consultants
Scheme dates and status	2017-2019, complete	**Funding source and budget**	Dutch Government, €23.9m construction
Scheme photograph/location map/figure			



Figure 14. The Prins Hendrik Zanddijk site showing existing dyke and land reclamation activities. Source: Fordeyn, J. et al., 2019a.

Problem definition

Texel, one of the Dutch Wadden islands, is a low-lying area vulnerable to flooding and coastal erosion. In 2006, a coastal assessment reported that more than 70% of the 24-kilometre long Wadden Sea dyke protecting the island of Texel failed to meet legal safety requirements. Assets at risk included water pumping stations, agricultural land, residential properties and two nature reserves.

Scheme summary and outcomes

The Prins Hendrik Zanddijk (PHZD) was a land reclamation project proposed in lieu of repairing the existing failing dyke. Along the Prins Hendrik Polder, in front a 3.2 km section, the PHZD implemented soft coastal protection design. Dune and salt marsh habitat were created and a beach sandbody was reclaimed seaward of the dyke.

The main purpose of the design was to create an alternative coastal protection scheme for flood and erosion risk. Central to the design were the interactions between ecology and sediment dynamics and stability. The design also considered nature development and recreational appeal through habitat creation, ecological pilots and public infrastructure development.

The PHZD project is part of the Dutch government's Flood Protection Program 2. The PHZD is one of 87 projects to upgrade dykes for the period 2015-2020. Project outcomes impact the planning and implementation of adaptive measures for the current 2022-2026 phase.

Scheme successes

- The project adapted 200 hectares of the Wadden Sea, a UNESCO World Heritage Site, for which the project was awarded the Netwerk Groene Bureaus-Nature prize 2019, for most educational project. The award recognises innovation, biodiversity benefits and cooperation.
- An ecosystem services assessment, conducted by the University of Antwerp, found that the PHZD project resulted in ecosystem services benefits 3 to 7 times greater than the alternative hard-engineered solution. Benefits are quantified at an additional €0.55million to €1.47million annually, in comparison to dyke restoration alone.
- The project leads reported good cooperation between partners and contribute this factor to the ecological success of the project.

Scheme limiting factors/challenges

- The project was significantly more expensive than traditional defence and requires higher management costs long-term (€0.12million/yr maintenance and management). However, this is justified by the ecosystem services generated.
- An unknown factor is what is the lifetime of the beach and dune habitat created will be. Cost:benefit analysis for Dutch flood-risk management projects are based on infrastructure which is built, maintained and eventually replaced, so there is a clear lifetime assigned to the asset. This cost:benefit model cannot be applied effectively to habitat creation.
- Construction of the PHZD required the extraction of sand from the North Sea, 10-15 km from Texel. The extraction process causes physical disruption and increases turbidity to seabed habitats. However, the impact assessment concluded that sand extraction and transport activities had no significant long-term effects, and that benthic species recover in one to four years.
- Project planners took learnings from previous similar initiatives regarding the risk of temporary saltwater intrusion during the construction phase. To prevent damage to agricultural land, mitigation measures were put in place through an extensive real-time monitoring system and extraction of saline seepage water through drainage systems.

Lessons learned

- The PHZD represents a shift in mindset, allowing for setting project objectives wide enough, to encompass co-benefits, and embracing the fact that it's going to be a dynamic and adaptive management process long-term.
- Involving ecologists at an early stage of the design process ensured environmental success of the project.
- An ecosystem services approach supported cost:benefit analysis and quantified the long-term economic benefits. This is an important factor to consider in project legacy, especially given the high construction and management/maintenance costs associated with a soft coastal protection design in comparison with traditional hard solutions.

References

Fordeyn, J. et al. (2019a) A holistic approach to coastal protection for the Prins Hendrik Polder. *Conference: Wodcon XXII Enhance the Harmony between Dredging and Ecology*. Available online (Accessed: 19/01/2024).
Fordeyn, et al. (2019b) An ecosystem services assessment of the Prins Hendrik zanddijk. *Terra et Aqua,* 157, pp. 31-46. Available online (Accessed: 19/01/2024).
Jan De Nul (2019). *Prince Hendrik Sand Dike wins NGB-Nature Prize 2019*. Available online (Accessed: 19/01/2024).
Pers Comm. Lodder (2023).

11.3 East Riding Coastal Change Pathfinder, UK

Table 14. Case study: East Riding Coastal Change Pathfinder, UK.

Scheme title	East Riding Coastal Change Pathfinder Project	**Scheme type**	Project
Sector	Flood and coastal erosion risk management	**Location**	East Riding of Yorkshire
Implementing organisation	East Riding of Yorkshire Council	**Scheme partners**	
Scheme dates and status	2009-2012, complete	**Funding source and budget**	DEFRA, £1,205,609

Scheme photograph/location map/figure



Figure 15. Storm conditions at Spurn (left) and coastal erosion at Seaside Lane, Easington (right). Source: Boyes, S. et al., 2016.

Problem definition

Cliff erosion is well documented between Bridlington and Spurn Point, driven by coastal processes and exacerbated by the effects of storms. Recorded cliff erosion rates are fairly constant at between 1.5 and 2.5 m per year, with isolated individual losses in excess of 20 m recorded in some years.

The Flamborough Head to Gibraltar Point SMP identifies a number of residential properties, businesses (largely caravan parks) and local transport infrastructure that will be at risk from coastal erosion on the East Riding coast over the three epochs.

Scheme summary and outcomes

The East Riding of Yorkshire Council Pathfinder Project aimed to explore planning for, and managing, adaptation to coastal change for coastal communities. The approach included community engagement, adaptation planning, and delivering adaptive solutions. The East Riding Pathfinder Project delivered on its objectives; however, some elements have not been as effective as anticipated (such as buy and lease back). The main outcomes were:

- Community engagement: partnership working and group structures; establishment of a coastal officers group; development of Coastal Partnership; and future development of the ICZM Adaptation Communications Toolkit.
- Adaptation planning: rollback review and links to Local Development Framework; and vulnerable groups priority outcome – a process for identifying and prioritising those most at risk.
- Delivering adaptive solutions: enhanced assistance package including both relocation and adaptation support packages; investigation of rollback and buy and lease back; delivery of small grants fund.

Scheme successes

The scheme has had multiple successes:

- Removal of properties at risk. Adaptation by relocation, demolition and site restoration, access improvements, and rollback.

- The development and adoption of a consistent definition of 'imminent risk'. Benefits are that it provides certainty to residents for when they need to relocate, and it is fair as the same policy is applied along the coast. This removes individual risk for officers and the council as subjectiveness is removed.
- Increased knowledge and understanding of coastal change internally among Council departments. Immediately after the project, it was concluded that coastal residents also had a better understanding of coastal risk. However, movement on the coast has meant education must often be started again.
- The project has gleaned lessons in adaptation, such as legislative learnings and findings on rollback and buy and lease back, that can inform future programme delivery including current schemes such as CTAP.
- The Council has an increased adaptive capacity through partnership structures.
- Pathfinder funding has allowed for a proactive approach to trialling new approaches.
- Individual interventions to come from the Pathfinder Project have been a success - such as adaptation steps including moving roads to maintain access to vulnerable coastal community.
- The relationship built with residents was positive and unexpected. These have since been maintained.
- There were unexpected benefits to people's mental and physical health (anecdotal expert observations rather than monitored and reported findings).

Scheme limiting factors/challenges

- Some elements have not been as effective as first thought such as buy and lease back. This component has proved more difficult to test within the wider legislative and policy framework than had been anticipated. Buy to lease back components do not work in deprived areas where there are low value properties.
- Rollback has been a success with caravan sites, but not with residential properties.
- Pathfinder was a limited time, one-off project but has raised the expectations of residents with regards to expected coastal change assistance.
- There is a lack of guidance on legislation which exists to support coastal adaptation activity.
- An unexpected barrier to relocation initiatives is the personal circumstances of residents and how wedded people are to their location. Finding an alternative location that people are happy with proved challenging.

Lessons learned

- The risk-based approach allowed the integration of existing coastal management mechanisms. The process has ensured consistency and transparency, which has led to greater acceptance of decisions amongst the community. This is particularly important given the fact that this programme prioritises the most vulnerable residents rather than a particular community. This approach could easily be repeated on other stretches of coastline as long as a coastal monitoring programme is in place.
- The project highlighted benefits of partnership working to tackle coastal change.
- There is need for a better understanding of how existing regulations and powers can be used to support coastal adaptation.
- Levels of expertise and funding needed for successful residential roll-back must be greater.
- An evolving engagement approach is needed when informing people about erosion risk. The council found individual conversations are more productive than group meetings where often the conversation is dominated by a few members of the community.

References

Boyes, S. et al. (2016) *The East Riding Coastline: Past, Present and Future*. Available online (Accessed: 08/02/2024).
Defra (2012) *Coastal Change Pathfinder Review: Final Report*. Available online (Accessed: 19/01/2024).
Pers comm. Jackson (2023).

11.4 The Marche Integrated Coastal Zone Management Plan, Italy

Table 15. Case study: The Marche Integrated Coastal Zone Management Plan, Italy.

Scheme title	The Marche Integrated Coastal Zone Management (ICZM) Plan, 2019	**Scheme type**	Plan
Sector	Flood and coastal erosion risk management	**Location**	Marche region, Italy
Implementing organisation	Marche Region Regional Council, Infrastructure, Territory and Civil Protection Department	**Scheme partners**	Local authorities
Scheme dates and status	2019, ICZM Plan complete, implementation ongoing	**Funding source and budget**	Marche Region Regional Council, budget unknown

Scheme photograph/location map/figure



Figure 16. San Michele beach in the municipality of Sirolo in 2008 prior to works (left) and in 2020 following beach nourishment (right). Source: Marche Regional Administration.

Problem definition

The coastline of the Marche region of Italy has a landscape of beaches and cliff faces heavily impacted by erosion. Climate change and sea level rise are expected to lead to an increased risk of storm surge-induced flooding and erosion events, in addition to landslides along coastal cliffs.

Much of the 176 km long coastline is heavily urbanised and river modification activities inland have reduced transport of sediment to the shoreline. Certain coastal defences built in previous years are now thought to exacerbate local issues. Examples of prior maladaptation includes defensive blocks deployed at the base of the sea cliff of Mount Conero which since appear to accentuate wave energy. Shoreline retreat in the municipalities of Sirolo and Numana puts properties and coastal roads at risk impacting residents, businesses and tourism industry related activities.

Scheme summary and outcomes

The Marche Integrated Coastal Zone Management (ICZM) Plan was approved in 2005 and further updated in 2019. The ICZM Plan sets out a long-term strategy for coastal management aiming to address coastal erosion along the Marche region. The plan directly addresses climate change impacts, following guidance from the National Table on Coastal Erosion. Stakeholder consensus-building is integrated in the plan to encourage public acceptance of proposed measures. The plan focusses on soft techniques to adapt to coastal retreat, addressing the imbalance between sediment erosion and accretion, and reducing the environmental impacts of coastal defences.

Data collection and surveying efforts, including flood risk scenario modelling, identified high risk areas along the Marche region coastline where adaptive measures should be prioritised. Examples of adaptation measures implemented through the ICZM Plan at Sirolo and Numana include beach nourishment and cliff stabilisation of Mount Conero. Maintenance of hard defence structures was also conducted. In Sirolo, around 156,000 m^3 of sand and gravel were used for beach nourishment along a 1,200 m shoreline in the San Michele Bay. In Numana, a breakwater located to the north of the village was removed and around 172,000 m^3 of sand and gravel were used along 1,500 m of beach front. Two groynes in the area were constructed and an existing groyne restored.

The 2019 ICZM Plan update sets out the requirement for new protective interventions and the ongoing maintenance of existing hard and soft measures. In Sirolo and Numana, the updated ICZM strategy plans for periodic beach

nourishment activities. Soft measures aim to preserve the natural environment, restore coastal dune habitat, and maintain beach accessibility for locals and tourists.

Scheme successes

The initial 2005-2016 ICZM Plan implemented 277 protection measures along the Marche coastline. Satellite monitoring showed an overall trend of shoreline advancement of 2,445 m for the period 1999-2012 following implementation of the planned interventions. The success of measures following the 2019 ICZM Plan update are not yet reported. Implementation, and subsequent monitoring activities, are currently ongoing. In addition to achievements in managing shoreline retreat, the Council report numerous scheme successes:

- The robust stakeholder engagement strategy for the development of the 2019 ICZM Plan update resulted in strong stakeholder participation and community cooperation. 52 parties participated in consultation and planning of measures. 65% of the proposed modifications were accepted.
- Reported co-benefits for tourism.
- The sand and gravel used for beach nourishment fulfilled strict legislative requirements for material origin and composition. Materials used conformed with the naturally found local material and minimised environmental impact.

Scheme limiting factors/challenges

Key limiting factors to the ongoing success of the ICZM Plan implementation include:

- National and regional budget uncertainties that threaten planned maintenance requirements and the implementation of new measures.
- Beach nourishment activities will need to be repeated periodically due to ongoing erosion. The availability of materials that conforms to strict legislative requirements could prove a barrier to maintenance.

Lessons learned

This case study highlights the importance of a collaborative approach by working with trade associations, regional councillors, municipal administrators, the private sector, environmental organisations, technicians, citizens and interested parties. Incorporating a range of engagement techniques including public stakeholder meetings, interviews and public information encouraged community buy-in and aided in the high level of acceptance of proposed measures.

There are learnings from this case study regarding the practical implementation of beach nourishment. Planners realised the requirement for collaboration between municipalities to connect the demand and supply of beach nourishment materials. By identifying dredging activities, the scheme optimised the availability of materials and reduced the need for disposal of dredged materials in landfills or at sea.

The Council have implemented a regional plan, compensating for the lack of a national strategic approach to ICZM. As of 2017, only three of the fifteen coastal regions of Italy have a regional ICZM Plan in place. Pioneers, such as the Marche and Emilia Romagna region are considered advanced in the field of sustainable coastal development through their ICZM approach which incorporates climate change aspects for adaptation to coastal erosion. Researchers from the Italian National Research Council and University of Calabria, Italy, believe that to manage erosion risk effectively, a national ICZM approach, such as that modelled in the Marche region, is needed to bridge the gap between science and policy.

Analysis of tourism revenue co-benefits was carried out under the EU-funded SHAPE (Shaping an Holistic Approach to Protect the Adriatic Environment between coast and sea) project. The study concluded that local tourism businesses that benefit from coastal defence and adaptation, could be called upon to contribute directly to the mobilisation of the resources needed for the implementation of such measures. Learnings from this study have opened discussions questioning the criteria to evaluate who should support the costs of coastal protection schemes. The use of cost-benefit analysis also strengthened project planning.

References

Cantasano, N. et al. (2017) Integrated coastal zone management in Italy: a gap between science and policy. *Journal of Coastal Conservation* 21, pp. 317–325. Available online (Accessed: 25/01/2024).
ClimateADAPT (2020) *Addressing coastal erosion in Marche region, Italy case study*. Available online (Accessed: 25/01/2024).

11.5 Engineering with Nature, USA

Table 16. Case study: The Engineering with Nature, USA.

Scheme title	Engineering with Nature	**Scheme type**	Project
Sector	Flood and coastal erosion risk management	**Location**	USA
Implementing organisation	The U.S. Army Corps of Engineers	**Scheme partners**	Various including the Water Institute, the University of Georgia, Rijkswaterstaat and the Environment Agency
Scheme dates and status	2010-ongoing.	**Funding source and budget**	The U.S. Army Corps of Engineers, budget unknown
Scheme photograph/location map/figure			



Figure 17. An Engineering with Nature Initiative: The Murrells Inlet Navigation Dredging Project. Dredged material was used to raise beach elevation at Garden City Beach to control erosion. Beach before (left) and after (right) placement of dredged materials. Source: USACE, 2018a. Photo by USACE Charleston District.

Problem definition

The long-term resilience of infrastructure and communities is under increasing pressure from population growth, climate change, sea level rise and natural disasters. Traditional engineered solutions for flood risk management typically work against natural processes, cause environmental degradation and reduce aesthetic value. The U.S. Army Corps of Engineers' (USACE) infrastructure and operations were viewed as often in conflict with environmental and social interests. The Engineering with Nature (EWN) initiative, launched in 2010 by the USACE, aims to tackle issues of flood risk, ecosystem loss and challenges to navigation through the intentional alignment of natural and engineering processes.

Scheme summary and outcomes

Projects implemented through the EWN initiative intend to deliver economic, environmental, and social benefits efficiently and sustainably through collaboration.

There are four key elements of the EWN initiative:

- Using science and engineering to produce operational efficiencies supporting sustainable delivery of project benefits.
- Using natural processes to maximum benefit, thereby reducing demands on limited resources, minimizing the environmental footprint of projects, and enhancing the quality of project benefits.
- Broadening the benefits provided by projects to include substantiated economic, social, and environmental benefits.
- Using science-based collaboration to organize and focus interests, stakeholders, and partners to reduce social friction, resistance, and project delays while producing more broadly acceptable projects.

The USACE's EWN initiative aims to advance the development and practical implementation of methods that demonstrate the benefits of an ecosystem approach to infrastructure development and operations. The four principles above are integrated into the design, construction and operation of projects at multiple scales. Initiative outputs include field-scale projects, demonstrations, research and development (R&D), guidance development, education, communication, and partnering. The EWN projects have been rolled out across the US and internationally.

The EWN Atlas Series is a key initiative publication which showcases real-world examples of working with nature to deliver adaptive outcomes. The atlases present case studies relating to flood and erosion risk management, ecosystem restoration and

other purposes both from the US and internationally. Another notable initiative product is the 5-year strategic plan to build upon existing knowledge and expand implementation, demonstration and communication of EWN practices.

Scheme successes

Since 2010, the USACE has advanced its ability to deliver water resources and infrastructure projects generating a diverse array of economic, environmental, and social benefits. The focus on collaboration and engagement has resulted in project plans that are broadly accepted by communities. Implementation of projects that are sustainable and work with natural processes has reduced demands on limited natural resources and minimized environmental impacts.

Under the key initiative element of collaboration, the USACE report that the application of leading social science practices has been a success, resulting in effective stakeholder engagement.

The EWN initiative was awarded the USACE Chief of Engineers Environmental Award for Natural Resource Conservation (2013) and the USACE Sustainability Award for Green Innovation (2014).

Scheme limiting factors/challenges

Initiative challenges are not widely reported. However, a workshop conducted by the USACE in 2011 identified key challenges for the implementation of sustainable practices in the science, engineering and operational practice of navigation infrastructure.

1. Funding issues related to construction, repair and maintenance costs, cost sharing between partners, operations and maintenance pressures, and risk and uncertainty.
2. Institutional constraints associated with interagency coordination challenges, lack of trust between the USACE and stakeholders, and the “status quo” mindset. Potential mechanisms identified for overcoming institutional challenges included embedding a culture of creativity and innovation in the USACE, establishment of EWN performance goals at a district level and the collation of EWN case studies to strengthen institutional knowledge.
3. Communication challenges – both within the USACE and between the institution and the public. EWN concepts should be integrated into coastal engineering guidance and communication further supported by sponsoring USACE training programs, courses, and workshops. Effective public relations knowledge transfer was also identified as a requirement.
4. Suitable metrics were required for routine incorporation to research and project implementation to quantify EWN benefits and project successes. In partnership with The Water Institute, the USACE has published a series of reports identifying practical options for improving the evaluation of the economic, environmental, and social benefits of natural infrastructure and nature-based solutions.

Lessons learned

Key elements enabling initiative success are identified as:

- Collaboration and active stake-holder engagement.
- Forming a multidisciplinary, focused team.
- Clearly defining the problem, opportunities, and objectives on a system-level scale.
- Ensuring project management plans define the roles, responsibilities, and contributions of each individual and/or partnering organization.

The EWN Atlas collections identified key enablers for project success:

- **Innovation**: developing new science, engineering practices, and methods of working.
- **Creative problem-solving**: planning, project formulation, and design.
- **Documentation**: recording the diverse benefits and performance of nature-based solutions.
- **Open communication**: sharing widely and strategically to facilitate progress.
- **Education and Training**: preparing people to support future needs and practice.
- **Collaboration**: partnering across organizational boundaries and sectors in order to innovate.

The EWN initiative has highlighted the power of broad collaboration across international government, private sector, academic, and non-government organisations to deliver multifunctional, widely accepted projects with co-benefits.

A science-based approach incorporating the results from physical models examining the interaction of flood surge and waves on engineering designs into the formulation of full-scale coastal protection planning and design is key. This approach has accelerated the USACE's ability to adapt to coastal change, support infrastructure investments and demonstrate the value of EWN.

To mainstream EWN concepts and practices, the USACE has hosted events where scientists, engineers, landscape architects, policy analysts, and planners can share knowledge and results of recent innovative research. Structured engagements are vital in bringing together practitioners and decision makers, evolving knowledge sharing and leading to more informed decision making about the value of integrating EWN into project designs, master plans, and national investments.

Disciplined collaboration and committed investment in education and training helps to build a foundation for the continued advancement of sustainable practices. The USACE has collaborated with academic institutes to reach university students from a broad range of disciplines who will become future practitioners.

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11.6 Prioritising Coastal Adaptation and Development Options for Local Government, Australia

Table 17. Case study: Prioritising Coastal Adaptation and Development Options for Local Government, Australia

Scheme title	Prioritising Coastal Adaptation and Development Options for Local Government	**Scheme type**	Project
Sector	Flood and coastal erosion risk management	**Location**	Sydney NSW, Bega NSW and Sunshine Coast QLD, Australia
Implementing organisation	The Sydney Coastal Councils Group (SCCG)	**Scheme partners**	Multiple local councils, Oak Ridge National Laboratory (USA) and the University of the Sunshine Coast.
Scheme dates and status	2013–2014, completed.	**Funding source and budget**	The Australian Government
Scheme photograph/location map/figure			

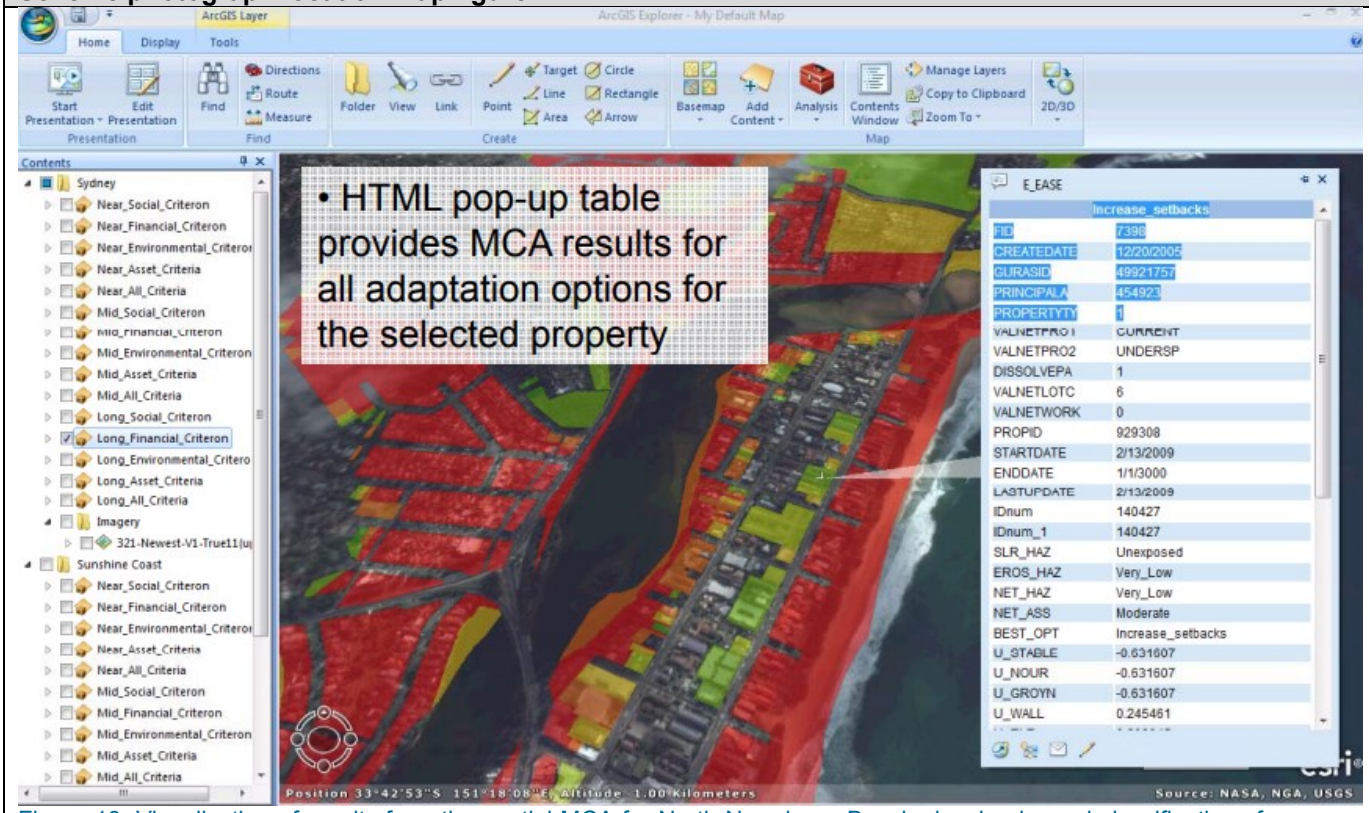


Figure 18. Visualisation of results from the spatial MCA for North Narrabean Beach showing hazard classifications for exposed properties (green: low; red: high). The pop-up table to right of map provides a list of metrics for the specific property indicated by the arrow, including hazard classifications and identification of the single best adaptation option for the location. Source: Preston, B.L. et al., 2014.

Problem definition

Communities, assets and infrastructure along the Australian coastline face beach erosion, shoreline recession and inundation. While the need for climate change adaptation is widely recognised among authorities, stakeholders and residents, the implementation of practical adaptation actions remains limited and appropriate monitoring and evaluation even more so. This is partially due to a lack of guidance available to local government on the appraisal of specific adaptation options, limiting decision-making capabilities and contributing to the possibility of maladaptation. Furthermore, councils face the challenge of reconciling competing values, such as economic development versus preserving natural resources, to reach societally acceptable adaptive outcomes.

Scheme summary and outcomes

The Prioritising Coastal Adaptation Development Options for Local Government Project aimed to address the need for guidance at a local government level, via a participatory, multi-criteria analysis (MCA) of coastal adaptation options. The MCA framework considers:

- Data on exposure and risk,
- Feasible adaptation options,

- The economic, social and environmental values that influence local government decision-making, and
- The resulting MCA allows for appraisal of adaptation strategies in response to coastal inundation and erosion.

The development of the MCA Coastal Adaptation Framework incorporated multiple approaches:
A literature review which identified 15 feasible coastal adaptation options catagorised as Protection, Accommodation, Retreat or Cross-Cutting Options.
Surveys and workshops with local government staff to collect views on adaptation options and to build an understanding of the fundamental values that influence decision making.
Development of a Bayesian Belief Network incorporating geospatial information and local government values.
Spatial representation of MCA results within a GIS was produced at an individual property scale.

The project highlighted the requirement for a coastal adaptation monitoring and evaluation framework. The resulting framework tool provides a series of templates for best practice principles for adaptation planning, adaptive capacity and monitoring outcomes.

Scheme successes

The visualization of MCA results within a GIS enabled rapid comparison among different locations with respect to hazards, assets at risk, and the utilisation of different adaptation options.

The MCA approach offers multiple advantages for supporting adaptation planning:

- scalability for use in different contexts
- inclusion of monetary and non-monetary values for assessing costs and benefits of an adaptation action
- identification of potential trade-offs.

The project effectively incorporates local preferences for adaptation options and different values in decision-making at a local government level with data on hazards, assets and the performance of a variety of adaptation options. The resulting appraisal findings allow councils to identify optimal local adaptation pathways.

Scheme limiting factors/challenges

- Local authorities and stakeholders should understand the limitations of the MCA framework as a screening tool providing proof of concept, rather than a replacement for detailed site-specific studies.
- The MCA framework is highly sensitive to subjective opinions of stakeholders and opens projects up to the potential for ongoing debate regarding appropriate criteria and weights for analysis.

Lessons learned

The project highlighted that establishing pathways to an adaptative outcome is a dynamic process. Adaptation options should be reviewed against climate change trigger points that alert managers to the need to transition from one set of adaptation measures to another.

Across regions, the opinion of different coastal adaptation options was uniform across Local Government staff:

- Hard engineered options that require a long-term investment commitment from councils and create a 'moral hazard' are of the lowest preference.
- Capacity building activities are viewed as low-cost and generate the required community support.
- An overall preference was to move toward anticipatory adaptive planning and development.

Although formal planning tools, such as the MCA, can identify priority adaptation options, ultimately effort must also be invested in the monitoring and evaluation to ensure actions achieve long-term desired outcomes.

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11.7 Highways England Natural Flood Management Fund, UK

Table 18. Case study: Highways England Natural Flood Management Fund, UK.

Scheme title	Highways England Natural Flood Management Fund	**Scheme type**	Fund
Sector	Urban and Infrastructure	**Location**	Cheshire, Derbyshire, Lancashire, Yorkshire, UK
Implementing organisation	Highways England (now National Highways)	**Scheme partners**	Mersey Rivers Trust, Don Catchment River Trust, Atkins Ltd., NatureBid
Scheme dates and status	2020-2023, complete	**Funding source and budget**	Highways England, budget unknown
Scheme photograph/location map/figure			

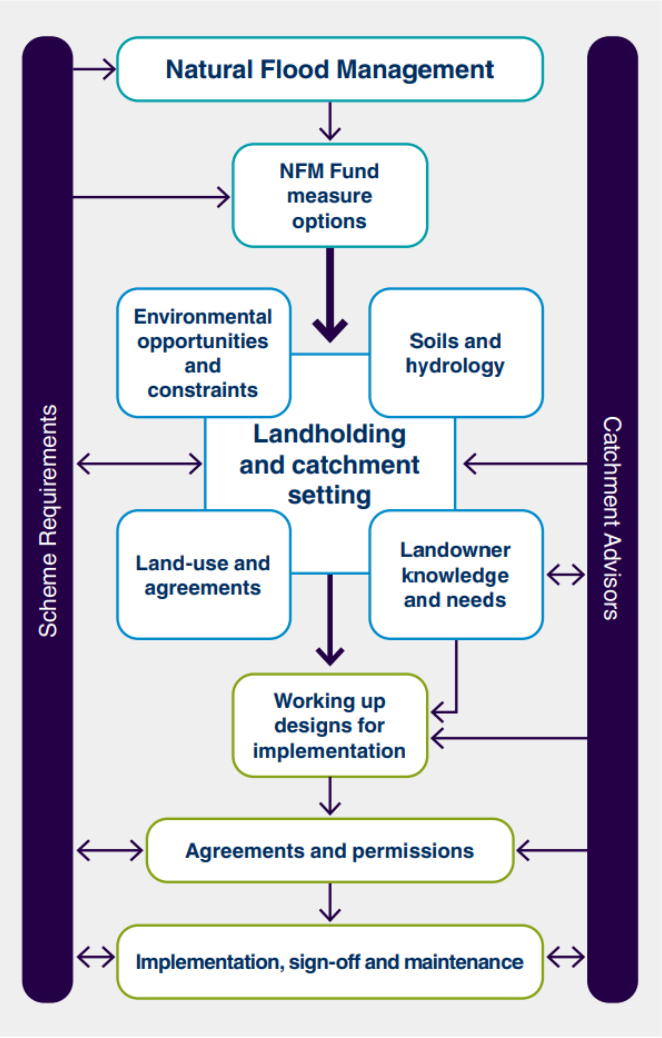


Figure 19. The process of Natural Flood Management (NFM) Fund measure selection and interactions with key processes leading to NFM measure design, implementation and maintenance. Source: Highways England, 2021.

Problem definition

Highways England (now National Highways) is responsible for the management, development and maintenance of the strategic road network in the UK. Operational areas are outsourced to the private sector for operation and management services. Contractors provide multiple site services including flood management which is effective, but costly. Highways England has identified sections of major road networks known to be particularly vulnerable to flooding and vehicle collisions.

Scheme summary and outcomes

Highways England sought collaboration with non-governmental organisations (NGOs) to define a new delivery model for flood risk reduction for the road network. In partnership with The Rivers Trust, an incentivised funding model for

delivery of Natural Flood Management (NFM) was developed. The partnership co-designed a reverse auction method which identified desired risk-reduction outcomes, held on an online portal. Landowners could bid against each other proposing their methods for flood management measures that work with natural processes. To educate and empower landowners, several guidance documents were published regarding the design and implementation of NFM measures.
The fund was piloted in parts of the Little Don, River Etherow and River Irwell catchments in Northwest England where multiple NFM actions were implemented.

Scheme successes

- The partnership empowered local trusts to be able to award funding to deliver NFM in their catchment.
- The framework allowed Highways England to gain the benefits of individual small-scale interventions without the requirement for multiple individual contracts with landowners, as The Rivers Trust held these contracts.
- The project facilitated rapid action in flood-vulnerable areas through quick delivery of flood mitigation – action on the ground began only six months after grant award.
- The NatureBid platform was an effective engagement tool empowering landowners to use their knowledge of the landscape to work with nature for flood mitigation.
- The scheme gave the freedom for people to think outside the box and give unexpected solutions for land use management practices.
- A major contributing factor to enable project success was the project coordinators' successful case to Highways England leadership to award money upfront by grant award mechanism to the partner NGOs, which is unique. The justification for this was that small local trusts do not have the capital reserves to work and deliver at the scale required to impact the highways.

Scheme limiting factors/challenges

- The competitive element of the bidding structure, designed to drive down costs, did not work on this small scale as there were too few landowners for a given area.

Lessons learned

- The project was facilitated by partnership and fostered an improved relationship between Highways England and landowners.
- The business case design allowed for the implementing organisation, Highways England to reap the benefits of engagement with multiple landowners, without the requirement for multiple contracts, as each landowner was instead contracted through the Rivers Trust.
- Incentivised funding models need to be on the right scale.
- Landowners care about flood risk in their local area and this model gave them freedom and empowerment to think of solutions, utilising local knowledge.
- This case study provides an example of an incentivised funding model for delivery of adaptation measures by landowners that could be transferred to a coastal setting. The learnings hold a transferable lesson to the coast to utilise local knowledge through empowerment and a competitive framework.

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11.8 Relocation as adaptation to flooding in the Eferdinger Becken, Austria

Table 19. Case study: Relocation as adaptation to flooding in Eferdinger Becken, Austria.

Scheme title	Relocation as adaptation to flooding in the Eferdinger Becken, Austria	**Scheme type**	Project
Sector	Flood and coastal erosion risk management	**Location**	Eferdinger Becken, Austria
Implementing organisation	Local government	**Scheme partners**	Federal Ministry for Transport, Innovation, Technology and Ministry of Finance, Regional government secretaries, Department for Surface Water Management, Local authorities
Scheme dates and status	2013-2016, complete	**Funding source and budget**	National funding, €325 million
Scheme photograph/location map/figure			



Figure 20. Examples of structure deconstruction to rebuilding from the Eferdinger basin, 2015-2018. Source: Schindelegger, 2021 © Seebauer, Babcicky.

Problem definition

The Eferdinger Becken area in Upper Austria faces a significant and recurring flood hazard, due to its location along the Danube River. The absence of flood protection measures, coupled with the vulnerability of the region to floods with a 100-year return time, has resulted in approximately 154 houses being regularly inundated. Climate change is increasing the frequency of extreme hydrological events by 4 to 10 %, increasing the risk. Within Austria, there is no legal right to claim financial aid for flood protection. Major flood events in 2002 and 2013 triggered the need for government to take action.

Scheme summary and outcomes

The primary aim was to engage all potential residents in a relocation initiative, emphasising the communication of potential hazards and risks, identification of challenges, and the establishment of shared objectives and measures. Additionally, the project aimed to organise financial support for relocation efforts, secured through collaboration with regional and national authorities.

A collaborative effort involving affected households, civil protection authorities, and various stakeholders resulted in the identification of a resettlement area encompassing 154 properties. The local government successfully negotiated

substantial support from the Ministry of Finance and national funds, totalling 325 million EUR, to offer compensation for homeowners choosing relocation. The compensation rate was fixed at 80% of the house value. The application process, initially set for the end of 2015 and later extended to mid-2016, saw active homeowner engagement, with 149 households requesting relocation compensation by January 2016. Of these, 146 received offers, and 80 opted for relocation, supported by regional authorities in obtaining substitute plots at affordable prices. The funding allocation included 20% for essential activities such as demolitions, debris deposition, and re-cultivation.

Scheme successes

- The significant number of residents deciding on resettlement following the extreme floods of 2002 and 2013 demonstrates increased awareness and acceptance of the need for proactive measures.
- The negotiation and rapid securing of a 250 million EUR budget with the federal government, unique in the country's history, allowed for efficient implementation of the project.
- Offering 80% of the house value as compensation to relocation volunteers provided a good incentive, facilitating a considerable number of households opting for relocation.
- The reduction of households' exposure to flooding by over 50% (as of 2016), indicates project success.
- Each individual property owner was able to decide independently if they would accept the offer, which differs from other relocation projects within Austria that have required a common and joint decision from the community.

Scheme limiting factors/challenges

- Initially, voluntary relocations faced limited interest due to residents' attachment to their properties and the financial cost associated with relocating.
- The non-movers, often older and less mobile individuals, are less resilient to future flood events, leading to increased vulnerability within the remaining communities.

Lessons learned

- The challenges faced by non-movers emphasise the need for tailored support mechanisms, particularly for older and less mobile individuals.
- The individualised decision-making approach for property owners proved to be a significant departure from traditional community-based reallocation actions, offering flexibility and enhancing community engagement.
- The rapid negotiation and securing of funding in record time set a precedent for efficient government collaboration, demonstrating the feasibility of rapid responses to urgent situations.
- Planned relocation requires a long-term approach, introducing the scheme gradually to familiarise the community with its specifics, benefits, and drawbacks.
- The decision on who should be given the opportunity to move should consider various household reactions, including psychosocial, intangible, and non-monetary impacts, extending beyond a structural protection perspective.
- In voluntary relocation programs, some residents opt to leave, while others remain. Those who stay deserve particular attention and support, as they contend with risks and potentially encounter reduced governmental willingness to provide flood protection or emergency assistance. Program managers should distribute attention to both those who leave and remain.

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11.9 Youth-led Adaption to Climate Change Challenges, Vietnam

Table 20. Case study: Youth-led Adaption to Climate Change Challenges, Vietnam.

Scheme title	Youth-led Adaption to Climate Change Challenges in Vietnam	**Scheme type**	Project
Sector	Community and Education	**Location**	Vietnam
Implementing organisation	Younity4Action	**Scheme partners**	VNU Central Institute for Natural Resources and Environmental Studies, University of Hull, Loughborough University
Scheme dates and status	2020-2022, completed	**Funding source and budget**	British Academy, £252,200
Scheme photograph/location map/figure			

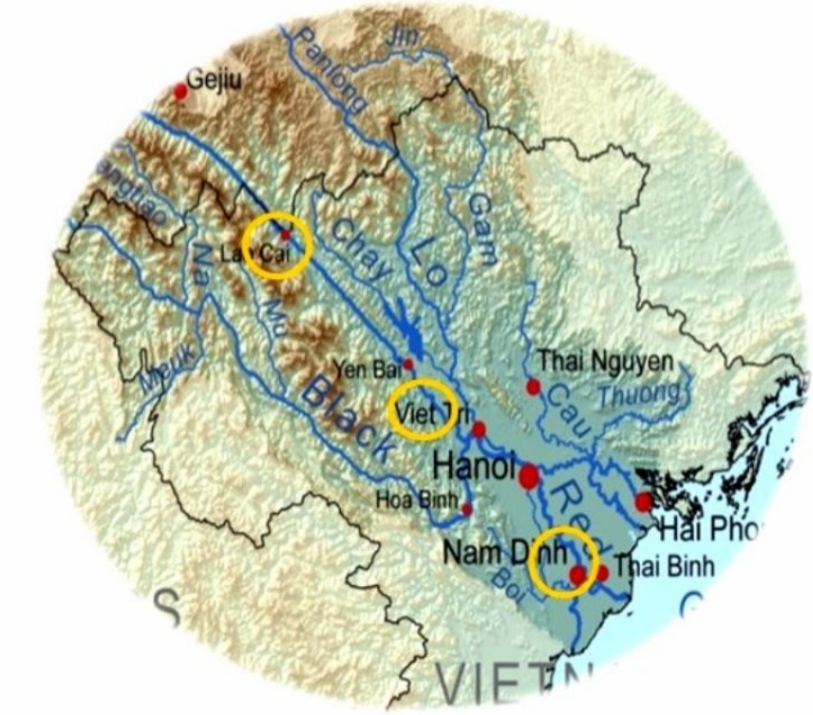


Figure 21. Three project sites in the Red River Catchment. Source: Younity4Action.

Problem definition

In the Red River Catchment (RRC) in Northern Vietnam, sea level rise and a range of hydrological extremes are placing communities and agricultural land at risk of more severe and frequent flooding events, landslides and soil erosion. High cost hard-engineered solutions are unlikely to be a viable solution in Vietnam, a low-middle income country. Communities must adapt to climate change through education, awareness-raising and capacity development amongst citizens to build community-led climate action and resilience.

Scheme summary and outcomes

The Youth-led Adaption to Climate Change Challenges in Vietnam (YACC) project focused on developing youth-focused and youth-led perspectives and climate action on the sustainable development challenges facing the RRC. The project sought to explore how local, traditional and indigenous knowledges can develop understandings and strengthen local and societal resilience through four key principles:

1. The centrality of youth for sustainable climate action
2. The utilisation of participatory action research
3. The importance of intergenerational and intercultural learning through community-based dialogue
4. The role of creativity and innovation in building climate action and community resilience

The project aimed to understand the existing knowledge base of locals, how communities were already adapting and what their vision for the future was.

The project worked with youth across 3 locations in the RRC. The project supported research capacity development (through workshops and training) which enabled youth to research 'at risk' local communities and investigate and

capture both the challenges faced, as well as identifying adaptive responses to and resilience against these challenges. Youth participants discovered self-led community interventions undertaken in rural areas. These included adaptation to temperature extremes in agriculture, the necessity to raise structures in response to flooding and implementing nature-based solutions to tackle river bed erosion. The youth participants co-analysed their findings with the research team and developed creative outputs as a tool for climate change education, and to further support community resilience capacity.

Creative outputs are held in a digital storymap including animations, a comic strip and illustrated storybook. The project outputs informed a traditional water puppetry performance for the showcase and policy exchange event at the Vietnam Museum of Ethnology in Hanoi, to an audience of policymakers and practitioners. A project video was also produced to describe and share action taken.

Scheme successes

- Intergenerational and diverse social and cultural ways of adapting to and living with climate change were investigated and shared to support wider community resilience building.
- Following training, the youth involved reported feeling empowered to interact with climate and environmental action in their communities.
- Following creative performances, policymakers from Vietnam's Ministry of Agriculture and Rural Development have adopted using traditional water puppetry performance within their disaster preparedness programmes.
- An ongoing legacy of this closed project is its advancement through a follow on project: Advancing Policy and Practice on Climate Action through intergenerational dialogue in Vietnam and beyond across Southeast Asia.
- The YACC project methodology has been showcased in Thailand, Malaysia, Cambodia and Vietnam to non-governmental organisations and charities, so they can adopt same methodology. This is currently being put together in a policy brief for the UK and other countries.

Scheme limiting factors/challenges

- Often communities lack a basic understanding of how climate impacts hydrology and the changes that are projected. Older generations can put this down to anger of gods rather than climate change. This challenge was targeted through educational events.
- Multiple small projects, such as YACC, gives promising results but practitioners need to think on a larger scale to instigate significant change in adaptation planning and education. Cost is a barrier to upscaling projects such as YACC and influencing policy change.

Lessons learned

- There is strong evidence that the youth-led approach worked effectively to support community-based intergenerational dialogue and to support and inspire independent community-based climate action.
- The role of creativity and storytelling was critical to project successes.
- Arts and creativity are important mechanisms for community engagement - a lesson that climate change policymakers and practitioners in Vietnam reported to take note of.
- Communities reported increasing instability and uncertainty in the weather patterns making adaptation difficult leading to serious impacts on livelihoods. However, the youth found significant evidence of community resilience to these challenges.
- The youth researchers learnt about adaptive strategies that communities were already undertaking and communicated these to practitioners. This project showcased that small-scale community-led mitigation and adaptation measures are being implemented in rural communities. These actions are often unknown by policy- and decision-makers.
- The communities welcomed the opportunity to talk about the issues faced and to share how they were adapting to these challenges. Communities are willing to share knowledge but want to feel seen and heard.
- The YACC transdisciplinary, participatory approach brought together the social and environmental sciences, along with the arts and humanities, and offered young people a vehicle to 'act' on climate change.

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