

# Project Scoping Document: Guidelines on the Use of Natural and Nature-Based Features for Sustainable Coastal and Fluvial Systems

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# Project Scoping Document: Guidelines on the Use of Natural and Nature-Based Features for Sustainable Coastal and Fluvial Systems

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## Executive Summary

Natural and Nature-Based Features (NNBF) refers to those features that define natural coastal and fluvial landscapes and are either naturally occurring or engineered to mimic natural conditions. Some examples of coastal NNBF are beaches and dunes, salt marshes, oyster reefs and barrier islands. For fluvial systems examples - apart from floodplain restoration in rivers and streams – include a range of features to detain and retain flood waters or otherwise create space for water. International interest is growing in NNBF as a part of solutions that reduce flood risks to local communities while providing ecosystem services. However, there are presently no comprehensive NNBF guidelines available to support practitioners and/or stakeholders that are interested in this type of solution. In order to address this gap, an international team that includes scientists, engineers, and resource managers assembled in October 2016 at the US Army’s Engineer Research and Development Center (ERDC) to initiate work on a NNBF Guidelines Document that will provide NNBF practitioners with best available information concerning the conceptualization, planning, design, engineering, construction, and maintenance of NNBF to support resilience and flood risk reduction for coasts, bays, estuaries and river and fresh water lake systems.

As a first step in the NNBF Guidelines development process, an international team developed this Scoping Document. The Scoping Document is offered to the home institutions of project team members for the purpose of describing the global need for the project. In turn, the respective institutions may commit personnel and/or other resources to achieving the proposed project outcomes. This Scoping Document offers a rationale, timeline and business justification for this project that will culminate in the publication of an international document containing NNBF Guidelines. This Scoping Document also describes the structure of working groups, human capital and other resources needed to initiate and complete the project. When preparing this Scoping Document, considerable attention was also focused on providing the reader with a basic understanding of the proposed content of the NNBF Guidelines. Collectively, these previously identified elements of the Scoping Document justifies the commitment of time and resources by members of the international project team to develop and publish the NNBF Guidelines Document.

Work on the NNBF Guidelines Document is proceeding through contributions of individual Chapter Teams and an Editorial Board that will be chaired by USACE. Publication of the multi-authored, multi-organization NNBF Guidelines is scheduled for March 2020.

## 1 Background

Natural and Nature-based Features (NNBF, Box 1) have been used for decades to support a variety of objectives in coastal and fluvial systems. Beach, dune and river and lake restoration projects have been a longstanding part of flood risk reduction strategies in Europe, the United States and elsewhere. Restoration projects supporting floodplain, wetlands, seagrass, oysters and other habitats and communities have been undertaken around the world to restore ecosystem functions. In more recent years, there has been a growing interest in developing a technically sound engineering approach for integrating NNBF, in combination with conventional flood defense systems (e.g., levees, seawalls, etc.), for more comprehensive and sustainable flood defense. This interest was further stimulated by the outcomes of recent storm and flood events, including Hurricanes Katrina and Sandy in the United States as well as England's floods in Somerset and Cumbria, which have given rise to a range of studies and projects focused on the role of landscape features in flood risk management. The global dialogue that has been underway for several years, including within the Engineering with Nature (EWN) Program in the United States and the Building with Nature (BwN) approach in The Netherlands. Ultimately, these communications have revealed a demand for authoritative guidance on the use of Natural and Nature-Based Features in support of Integrated Water Resources Management.

### Defining Natural and Nature Based Features (NNBF)

Many different terminologies and definitions have been adopted in this area of practice, but for the purposes of these Guidelines, Natural and Nature-Based Features (NNBF) are defined as follows:

Collectively, NNBF can be differentiated into two related categories of features, natural features and nature-based features. *Natural features* (e.g. reefs, barrier islands, dunes, beaches, wetlands, flood plains and maritime forest) are comparatively “long-standing” in terms of age and are created through the action of natural physical, biological and chemical processes over time. Whereas, *nature-based features* are created by human design, engineering and construction to mimic natural features and are designed to provide similar, if not identical, services (Bridges et al., 2015). Figure 1 illustrates types of NNBF found in coastal environments with a brief description of relevant processes and performance factors for each

In order to address the need for guidelines, the US Army Corps of Engineers (USACE) initiated a collaborative project to develop and publish international guidelines on the development and implementation of Natural and Nature-Based Features (NNBF) to support engineering functions in the context of the overall sustainability and resilience of our coasts, bays and estuaries. Based on subsequent discussions with the Rijkswaterstaat and Deltares in the Netherlands and the Environment Agency and HR Wallingford in the UK, it was proposed to extend the scope to accommodate fluvial

systems. The guidelines are planned to address the full project life cycle, including conceptualization, design, engineering, construction, and maintenance. One of the key criteria for the success of the guidelines will be their ability to support technically sound use of NNBF based on best science and engineering practices. Developing these international guidelines will be a multi-author effort that draws from organizations across all of the relevant sectors, including government, academia, NGOs, engineering firms, construction companies, etc.

To facilitate clear communication within and across the participating organizations, this Scoping Document sets out both the business case for producing the NNBF Guidelines as well as the overall plan for producing them.

### Natural and Nature-Based Infrastructure at a Glance

GENERAL COASTAL RISK REDUCTION PERFORMANCE FACTORS:  
STORM INTENSITY, TRACK, AND FORWARD SPEED, AND SURROUNDING LOCAL BATHYMETRY AND TOPOGRAPHY



Figure 1. Coastal NNBF Examples from USACE 2013

## 2 Introduction to this Scoping Report

### 2.1 Objectives of the Scoping Phase

The objectives for the scoping report were to:

- establish an agreed business case for the production of the Guidelines;
- confirm the function, target audience, scope and specification for the document to be produced, including an outline of the contents and form of the final paper/electronic document;
- develop and agree to the conceptual framework for the assessment / design / management process for NNBF;
- develop and agree to the national and international project team structure and membership, including both practitioners and researchers. Ensure an appropriate mix of disciplines is drawn together;
- develop and agree on overall project management, editing and publishing and updating of the document; and
- provide information about the project so that participating organizations can secure any necessary dedicated funding and/or resources for the main phases of the project.

The final product from the scoping phase of our efforts is this Scoping Document, which is described in the following sections:

- background, introduction and objectives of the scoping study and the Guidelines
- the need for the Guidelines, including overview of benefits, value of collaboration, country statements;
- the objectives of the Guidelines;
- options assessment, including options considered and option preferred;
- summary of the preferred approach;
- proposed content and frameworks to be included in the Guidelines;
- information on form and layout, considering editorial aspects;
- the method of delivering the Guidelines, including management of the project and risks identified;
- project program;
- dissemination and communication; and
- key conclusions and recommendations.

### 2.2 Program of Activities During Scoping Phase

A series of meetings and telephone conferences of all partners and of working sub-groups have taken place during the scoping phase to inform the development and structure of the Guidelines that will be used to support engineered resilience and flood risk reduction for coasts, bays, estuaries and fluvial systems.

1. Initial USACE/ Rijkswaterstaat partnership meetings (New York, 2015; Washington, 2016; Delft, 2016) were used to shape the consortium and its potential scope both in the US as well as in Europe.

2. A kick-off workshop was hosted by USACE-Engineer Research and Development Center (ERDC) at the Environmental Laboratory at Vicksburg MS on 25-26 October 2016. An international team of more than 30 authors and contributors was assembled representing government agencies, private sector engineering and construction companies, universities, and NGOs from the US, UK, The Netherlands, the Republic of Korea, and New Zealand. The organizations represented included USACE, the Dutch Rijkswaterstaat, Deltares, the Environment Agency, the National Oceanic and Atmospheric Administration, the Korea Institute for Ocean Science and Technology, Stanford University, Caterpillar Corporation, Great Lakes Dredge and Dock, Anchor QEA, Biohabitats, Inc., Ecology & Environment, Inc., LimnoTech, Ramboll, Tonkin and Taylor, and HR Wallingford. Other organizations were able to participate in portions of the meeting by phone. The working / planning meeting developed thinking about the overall organization of the effort, the structure of the guidelines, and refined / expanded chapter outlines.
3. Bilateral meetings and telephone conferences were used to further shape this Scoping Document.
4. Working meetings in Brussels occurred 30 January 2017, with subsequent meetings in March and April 2017. During the April meeting, it was decided to expand the NNBF Guidelines to include fluvial systems.
5. In July 2017, the Environment Agency hosted a meeting in the UK to continue work on the NNBF Guidelines. During that meeting, emphasis was placed on developing/refining five chapters (e.g., General NNBF framework; Analysis of NNBF benefits; Wetlands and intertidal areas; Beaches and dunes; and Fluvial systems).

## 3 Need and Benefits Associated with NNBF Guidelines/Handbook

### 3.1 Introduction and overview of benefits

Existing guidance on the use of NNBF in coastal, estuarine and fluvial systems is limited, variable in detail and scattered through numerous and often obscure documents. However, a single, comprehensive and self-contained guidelines document can draw from a combination of recent and ongoing research internationally and partly from collation of previously published and unpublished best practice. Source material reviewed should also include that produced by aid agencies (UNDP, World Bank etc). The resulting 'Guidelines' will provide 'decision support' for competent engineers, scientists and other practitioners, rather than a manual or code of practice and reflect a variety of governance arrangements (legal and professional framework) which exist from country to country.

Key benefits of the Guidelines include:

- Collation and coordination of disparate sets of information in order to provide an authoritative guide that practitioners can use without having to search everywhere:
  - Provide a portal/links to this information so people can easily access it;
  - provide a degree of peer review/summary/analysis of the material referred to-- in this way bringing added benefit.
- Explanation of the need for whole-life design of NNBF measures including maintenance approaches;

- Dissemination and wider use of NNBF in a technically appropriate and consistent manner, including as a part of a multi-purpose project combining flood risk management, economic, social and environmental benefits;
- Inclusion of case studies that highlight existing NNBF projects and applications;
- Reinforcing the flexibility / adaptability of the NNBF approach, e.g., by introducing NNBF measures and solutions in adaptive policy pathways for the future;
- Facilitating the valuation of NNBF benefits; and
- Identifying science/engineering knowledge gaps in order to focus future national and international R&D.

## 3.2 Value of Collaboration

Partners from a number of countries and organizations (see 2.2. above) have expressed a desire in principle to participate and share effort in an international project to produce the NNBF Guidelines. This interest has arisen from a desire to learn from one another's experiences. Past experience suggests that considerable confidence in design and construction practices is gained within individual countries by being able to refer to authoritative guidance produced by an international team, which has discussed and resolved differences in practice and identified necessary improvements.

The endorsement and participation of national and public organizations as well as private sector firms and academia is key to the project. Participating partners will gain considerably from the experience and participation will facilitate subsequent uptake and implementation by their organizations and associated contractors, including facilitating subsequent training programs.

The benefits of international collaboration also include sharing costs associated with producing the Guidelines, enabling organizations to participate in the project at a fraction of the total project costs.

Finally, the effort to produce the Guidelines will result in an international Community of Practice (CoP), enabling those involved to discuss new and developing topics as they emerge during and after the production of the Guidelines. This CoP will be important if there is an ambition to maintain an electronic source of information beyond the initial production of the Guidelines.

## 3.3 Anticipated Contributions from International Community

### 3.3.1 United States

U.S. contributions to the NNBF Guidelines will be derived from a diverse group of scientists, engineers and resource managers that are affiliated with federal agencies, non-governmental organizations (NGOs), private sector engineering firms, and academic institutions who will be providing in-kind support to the effort. The USACE and the National Oceanic Atmospheric Administration (NOAA) are examples of two federal agencies contributing a large number of staff to this project. Contributions from these two entities are expected to include, but is not limited to: staff time for composing chapter text, figures, and tables; document review and editing; and distribution with subsequent integration into agency practices and community engagement. However, other federal agencies such as the US Fish and Wildlife Service (USFWS) are also expected to provide staff for inclusion of case studies and review of chapter text. NGOs like The Nature Conservancy (TNC) have also agreed to participate by adding NNBF subject matter experts to the team. TNC experts in this field will add value through the addition of innovative NNBF case studies and text that is critical to many NNBF Guidelines chapters. To date,

individuals from Texas A&M University (TAMU), University of Maryland, and US Naval Academy (USNA) are contributing to development of the Guidelines. Participants from other organizations are anticipated and will be added over time.

Individuals affiliated with these organizations will serve on various chapter teams with specific individuals serving as co-leads. It should also be noted that the USACE is willing to host future semi-annual meetings of the NNBF Guidelines working groups at the ERDC. In addition, the USACE will lead efforts to identify and maintain a web-based application that will serve as a repository for all data, text, figures, pictures, etc. associated with developing and maintaining the NNBF Guidelines Document.

### 3.3.2 Netherlands

Rijkswaterstaat will contribute to the NNBF Guidelines based on the Memorandum of Agreement between USACE and RWS, and its MoU with the Environment Agency. Contributions will be in-kind, including attendance at meetings by (senior-) staff members, and through adapting the scope of existing financial collaboration agreements with Deltares, a National Applied Scientific Institute (foundation of the Dutch Ministry of Economic Affairs). Focus will be on those natural systems and nature-based features that are present in the Netherlands, for which RWS and/or Deltares will provide co-leads, and some overarching thematic chapters. The Rijkswaterstaat will be able to host one international meeting per year, and will coordinate (active) collaboration (through a national backing group) with potentially other Dutch stakeholders (Ministry of Infrastructure and the Environment (I&M), Foundation for Applied Water Research (STOWA), Ecoshape, and Netherlands Water Partnership (NWP)). Deltares may additionally contribute to the NNBF Guideline based on on-going research with national and international partners for systems and nature-based features beyond those occurring in the Netherlands (e.g. tropical wetland systems, submerged vegetation).

### 3.3.3 United Kingdom

There is considerable interest from UK Agencies in contributing to the development of the NNBF Guidelines. Whilst they currently cannot contribute financially, they are keen to share expertise and in-kind resources including staff time, data and products from existing and ongoing natural flood management research, case studies and other initiatives. The Agencies wishing to engage so far are: Environment Agency & Natural England, Natural Resources Wales, Scottish Environment Protection Agency, and Department for Infrastructure, Northern Ireland. The Environment Agency & Natural England is also willing to host one international meeting in the UK during the time of project development.

### 3.3.4 Other Countries

Contributions from other countries will be added to the Scoping Document as needed and appropriate.

## 3.4 Alternatives Analysis for Pursuing NNBF Guidelines

Given the foregoing discussion it is clear that there is a good business case for proceeding with the Guidelines. The following conclusions have been reached regarding alternative options for developing the Guidelines:

**Doing nothing** is not preferred. As already stated, existing guidance on the assessment, design, construction, and maintenance of NNBF in the coastal, estuarine and fluvial environment is limited, variable in detail and scattered through numerous and often obscure documents. The lack of

authoritative guidance means it is often difficult to take an informed and balanced view about the use of NNBF. An approach for guiding objective (and if possible quantified) assessments is needed of the whole-life performance of each NNBF across a range of metrics.

**Doing the minimum** might represent simply drawing together a bibliography of existing guidance from the plethora available with some signposting as to where to look to tackle specific issues. This might be quick and easy to achieve but would fail to deliver the consistency of evaluation, or the degree of integration between disciplines and in whole life cycle and systems thinking.

**Doing something** more than the minimum might be best envisaged as adding to the minimum signposting guidance, some additional guidance which might plug the gaps in what is currently available. However, the different participating countries would identify different aspects on which they would like to focus and thus would tend to create guidance that was country specific. Thus the benefits identified in the country statements above of international collaboration (such as sharing where a country is strong and learning from others where it is weak) would be lost.

**The full Guidelines** resolves the problems associated with the above lesser options and, despite its cost and resource implications, is the only identified way of delivering the required integrated guidance. The integrated and international Guidelines team will set the necessary international baseline of good practice and will help the appropriate promotion, design, creation and management of NNBF. Detailed options for different aspects of the Guidelines are discussed in more detail in Chapter 5.

## 4 Objectives and Maintenance of the NNBF Guidelines

### 4.1 Objectives

Arising from the needs discussed in the previous section, the following objectives for the NNBF Guidelines have been confirmed during the scoping phase.

Principal objective:

- to provide a comprehensive and definitive guide that establishes best practices supporting the evaluation, design, implementation, maintenance and management of NNBF placed within coastal/estuarine/fluvial environments (including guidance on site investigation);

Specific objectives:

- to present a rational approach to the classification, evaluation and management, design, repair, upgrading and construction of NNBF for coastal erosion, fluvial erosion/deposition and flood risk mitigation;
- to distil principles, issues, methods and examples from existing guidance, recent research and practical experience on the use of NNBF for management of coastal and fluvial erosion, flood risk mitigation and for coastal storm damage reduction;
- to develop a generic and non-prescriptive conceptual framework, which should connect the overlaps and bridge the differences between countries, and adopt risk management approaches and principles for flood risk mitigation;

- to provide guidance on engagement to secure owner/community support. One of the biggest challenges to NNBF is public perception of what it is and what it can achieve;
- to identify any areas where new collaborative research might beneficially be promoted over the subsequent 5 years; and
- to provide a mechanism for the rapid integration and dissemination of new knowledge and practice into new applications as existing and future initiatives are completed.

Particular issues and principles to be addressed by or contained within the Guidelines were identified during the initial workshop and scoping stage:

- The need to adopt a systems-based approach, considering NNBFs in the context of coastal and fluvial processes at an appropriate scale.
- NNBF-based schemes, concepts and ideas:
  - Description and classification of the different NNBF and their design, creation and management;
  - Inclusion of a glossary, notations, and acronyms to facilitate a common understanding and referencing of NNBF and their performance metrics;
  - Description of approach to clarifying the need and objectives for using NNBF, specifically addressing Why, Where, What, & How each feature may be used; and
  - Include urban planning and landscape architect perspectives, including approach to engagement with communities and multi-stakeholder processes.
- Performance aspects of NNBF schemes:
  - Need to understand the way in which NNBF deal with, perform, recover and relate to storm events, shoreline development, flood plain restoration and other factors (e.g. human use);
  - Consideration and evaluation of how the various NNBF features interact with traditional coastal and fluvial management infrastructure;
  - Performance will be dependent on long-term maintenance and this requires dealing with a number of difficult questions about ownership, liabilities and enforcement in order to achieve standards of protection in the future; and
  - Climate change adaptation: NNBF can also be an effective part of the adaptation strategy, but NNBF also need to be adaptable.
- Decision-making:
  - Economics - Provide an idea of what return on investment the NNBF options will provide and guide consideration of how these “assets” perform;
  - Governance- Specific policies or regulations may be referenced to illustrate a particular point. However, since the Guidelines are written for an international audience the document will not focus on any national approach, except where national approaches provide generic guidance applicable to an international audience. Individual organizations may choose to develop separate policy guidance on the use of the Guidelines;
  - The Guidelines will need to describe tools and approaches for making comparisons of alternatives in order to inform decision making. The analysis and decision process for

conventional infrastructure (e.g., levees) is well established in policy and guidance. For NNBF, policy and guidance are in the early stages of development;

- The Guidelines should provide a basis for establishing confidence and confidence levels; and
- Analyzing Systems/Combining Features – Rarely will NNBF be implemented in isolation of other engineered responses and solutions. Guidelines should therefore inform good practice for comparing alternatives that include multiple components of NNBF and conventional infrastructure. Evaluations that attempt to finely disassemble integrated systems in attempts to define the “added value” of all component parts or measures can lead to unsupportable or erroneous conclusions. The whole value can be greater than the sum of the system’s parts. The Netherlands has information about integrated solutions and synergies.
- Monitoring. It is critical that NNBF be monitored and adaptively managed. The Guidelines should include information on how to monitor, opportunities for sharing the responsibility of monitoring and the monitoring data. This will be important to the adaptive learning process, especially in the comparison of range of events, from small to large storms. Performance of NNBF should include engineering outputs (attenuation of surge, waves, etc.) in addition to environmental and social outputs.
- Avoid being over-prescriptive, but reassure with case studies.

#### 4.2 Maintenance/Subsequent Revisions

It is planned that the first edition of the Guidelines may only need to be valid for about 5-10 years. It is envisioned that subsequent revisions will take into account:

- Additional types of NNBF;
- Further information on performance and metrics as available.

Guidelines will be available as a high-resolution pdf document that is provided as an electronic file on websites or through other electronic media. The pdf document will be constructed so that it is searchable and downloadable through approved websites. Maintenance of the pdf document will occur through updates to the parent document that exists in a format compatible with Microsoft Word software. Upon updating and approval, the parent document will be converted to a high-resolution pdf for upload to previously approved websites and/or other electronic media.

### 5 Production of the NNBF Guidelines

During organizing meetings and workshops undertaken in the scoping phase, representatives from the participating international organizations raised various queries on how the Guidelines would work, who would be the target audience and what the Guidelines should contain. A diverse, multi-disciplinary group of experienced practitioners and well-informed ‘industry’ professionals considered the options and addressed these queries.

#### 5.1 Type and Format of the Guidelines

The main queries that were raised and options that were considered during the scoping phase are grouped below:

### 5.1.1 Type of Guidelines

It was agreed that:

- As the Guidelines would be less mature than guidance available in other areas of engineering practice, a careful balance needed to be struck:
  - The Guidelines should be impartial rather than promotional;
  - The Guidelines require sufficient technical information and content to be usable by practitioners and not merely set out policy aspirations;
  - On the other hand, the Guidelines should encourage innovations and their subsequent implementation; and
  - The Guidelines should be regarded as a ‘decision support’ document as distinct from a prescriptive ‘decision-making’ code of practice.
- The Guidelines should facilitate the transfer of ideas/principles from one project context to another;
- When drafting text for the Guidelines, it is recommended to commence with some overall statement of problems, needs and opportunities to be addressed. After this the Principle-Issues-Methods-Examples (PIME) framework should be followed where practical (as adopted during the drafting of the International Levee Handbook):
  - Foundational Principles are first presented;
  - Issues and challenges are discussed next;
  - Methods for implementing the principles and addressing issues are then described; and
  - Case Examples are used to illustrate key points and applications, often in text boxes.

### 5.1.2 Content and Size

Options were considered by the participating organizations as to what the Guidelines should contain and how large it should be. The group was originally concerned at the start of the scoping study that it may become a detailed textbook on NNBF and thus too large to be of practical assistance. On the other hand, it was also agreed that merely producing a short document that provided ‘signposts’ to existing national documents would not achieve the desired degree of integrated international understanding.

As the study progressed, the international team agreed to the following:

- A complete description of each NNBF measure was required, with a focus on good practice and lessons learned for improving good practice;
- Detailed descriptions of common supporting tools (e.g. wave and sediment models) were not required, although information on the features, requirements and suitability of models in general should be included where appropriate;
- Existing guidance and links to web pages would be referenced where this was considered appropriate;
- To limit overall length, appendices should be avoided in preference to short text boxes within the body of the Guidelines where a little more detail could be given on a topic, e.g. on a method or a case study example;
- Practical limits would be agreed for chapter lengths and it was agreed to control the size of the Guidelines to a target length of 400-500 pages;
- A list of references should remain limited to about 1 page for each chapter, with preference to peer-reviewed literature and established national reference/guidance documents; and

- Consideration will be given to developing supporting electronic libraries of additional references that could be made available from the Guidelines website.

### 5.1.3 Target Audience

The group considered the various audiences that may be interested in the Guidelines and what level of technical ability these audiences may require. It was agreed that the Guidelines would be written for a primary audience of practitioners who would be implementing (designing, creating and maintaining) the NNBF measure. However, the Guidelines should recognize the multifaceted and governance-dependent nature of decision-making and therefore the Guidelines should also be useful to:

- Stakeholders wishing to understand strengths and weaknesses of NNBF measures;
- Communities wishing to use NNBF measures for flood risk reduction;
- Maximize ecosystem services benefits derived from placement of NNBF measures; and
- Provide evidence to inform policymakers, NGOs etc.

Queries were also raised by the group as to whether the Guidelines could be considered “international” and could also be used by developing countries. It was agreed that:

- An international review by well reputed organizations in other countries would be undertaken and there would be no pre-agreed limit to the number of reviewers; and
- Published documents from international agencies (UNDP, World Bank, Asian Development bank, European Investment Bank, etc.) should be consulted by the chapter leads and referenced during the course of writing the Guidelines.

### 5.1.4 Terminology to be Used

A key point of the discussions between the participating organizations throughout the scoping study, including at the international meetings, was the achievement of agreed definitions. It was noted that terminology and words could mean different things in different countries. For this reason, including a glossary of key terms was determined to be important.

In particular, the following was agreed:

- The word “Guidelines” should be adopted to convey better the concept of a non-prescriptive reference document, one that would be comprehensive in areas specific to NNBF but would not cover generic aspects of coastal and river engineering and management; and
- “Natural and Nature-Based Features (NNBF)” was a term not used in all participating countries. Many other phrases were common in the field, such as: Working with Nature, Engineering with Nature, Working with Natural Processes, Green Infrastructure, Green Engineering, Natural Infrastructure, etc. For this reason the Guidelines will include a clear definition of NNBF in the context of coastal and fluvial systems and flood risk management.

## 5.2 Risk Log

The project should maintain a clear log of risks (probability, impact) that will be assessed and managed on an on-going basis. The log should be updated on a regular basis by the Editorial Board (see section 8.1) to include new or emerging risks and to delete those risks that are no longer valid, and suggest control-measures for the relevant risks. The following risks were considered:

- Inappropriate use of resulting Guidelines. This might be associated with:
  - Limited science. Mitigation actions would include making clear in the introduction of the Guidelines that this is an emerging area of science;
  - Over-estimating flood risk management benefits. Mitigation action would include clearly setting out in the Guidelines the performance limitations of the NNBF being described and the uncertainties in that performance;
  - Inappropriate isolated use of NNBF measures. Mitigation action is to use the systems chapter to reinforce the importance of developing solutions in a systems context; and
  - Governance arrangements. Mitigation action is to stress awareness of differences in governance arrangements between nation states down to small communities which might affect implementation, funding, approval etc. of NNBF schemes.
- Guidelines not applicable outside a limited number of countries. Mitigation action is to focus on “principles” and “issues” which are commonly applicable.
- Failure to disseminate effectively, resulting in the document being ignored by practitioners. Mitigation involves (a) having a clear dissemination and communication strategy, possibly with training courses and/or webinars (b) utilizing the right mix of skills and disciplines in drafting the Guidelines.
- Guidelines rapidly becoming out of date. Mitigation actions would include: making clear that the guidelines are based on best available information at the point of drafting; having strategy and mechanism for updating the document.

### 5.3 Programming

The project duration is estimated to be approximately three years. This estimate takes into consideration all required milestones that occur between the kickoff meeting and the dissemination of the completed report (please see Section 8.2 for additional details concerning timing and management of the report).

### 5.4 Resources Required for Project Completion

Producing international Guidelines is a significant undertaking. This will involve considerable cross-organizational collaboration in terms of contributing to, and commenting on the Guidelines as a whole. Based on agreed tasks, each participating organization will be responsible for securing funds and/or allocating resources needed to support their participation during the anticipated duration of the project.

Several roles and/or responsibilities are envisioned for individuals that occupy different positions while participating in the “cradle to grave” development of the NNBF Guidelines Document. Table 1 provides a listing of the different positions that are anticipated, a brief position description, estimated number of individuals assigned that position, and estimated hours needed to fulfill that responsibility in a calendar year. Presenting the information in table format affords the reader of this report an opportunity to review the estimated resources that will be required to complete the NNBF Guidelines document. Please see Chapter 8 for more detailed information concerning team, group, and member structures; project milestones; and management of the project.

In addition, USACE will have the responsibility for maintaining the website that hosts draft chapters and associated exhibits (i.e., draft text, figures, tables, etc.). USACE will also provide the personnel needed to develop and maintain the website portal, which includes: authorizing access, data inventory, data

storage, site security, user Q/A, trouble shooting, periodic/routine updates, etc. (Please see Section 8.3 for additional details concerning web site support). Finally, USACE will be responsible for providing production editing and publishing the Guidelines in final form.

TABLE 1. Anticipated Number of Persons Required and Associated Hours to Produce Guidelines Document.

Position	Position Description	Estimated Person(s) Needed (per Position)	Estimated Hours (per Person per Year)
Editorial Board Chair	Ultimately responsible for leading the Editorial Board (i.e., decision making body) and ensuring associated issues concerning preparation, editing and publication of the NNBF Guidelines Document are remedied with minimal impacts to approved schedule.	1	240
Editorial Board Member	Participant associated with decision making body responsible for all issues concerning preparation, editing and publication of the NNBF Guidelines Document.	5	160
Co-Lead Chapter Team	Responsible for assimilating the contributions of the Chapter Team members, which includes formatting, editing, and review responsibilities.	17	160
Chapter Team Member	Responsible for authoring, editing, and reviewing of text, figures, tables, case studies, etc., that ultimately comprise a chapter in NNBF Guidelines Document.	>30	40-160
Contributing Author	Person not formally belonging to the Editorial Board or Chapter Team. Provides expert knowledge of specific NNBF subjects and prepares specific text, case studies, figures, tables, etc. for inclusion into a chapter (or chapters)	>20	8-80
Stakeholder Group Member	Persons not affiliated with Editorial Board or Chapter Team. This group reviews, advises and consults periodically with Chapter Teams; reviews draft text and provides recommendations for draft chapters.	20	8-40

Peer Review Group Member	Persons not affiliated with Editorial Board or Chapter Team. This group assists the Editorial Board by providing an external perspective and associated edits, revisions and/or recommendations in association with the draft NNBF Guidelines Document.	6	40
Web Support and Data Manager(s)	Persons responsible for maintaining web-based system and providing support (i.e., authorizing access, data inventory, data storage, site security, User Q/A, trouble shooting, periodic/routine updates, etc.	2	80

**5.5 NNBF Process Flow Chart**

The NNBF process flow chart developed as a part of the North Atlantic Coast Comprehensive Study following Hurricane Sandy will be used as a starting place for the development of Guidelines and will be updated as necessary (Figure 2).

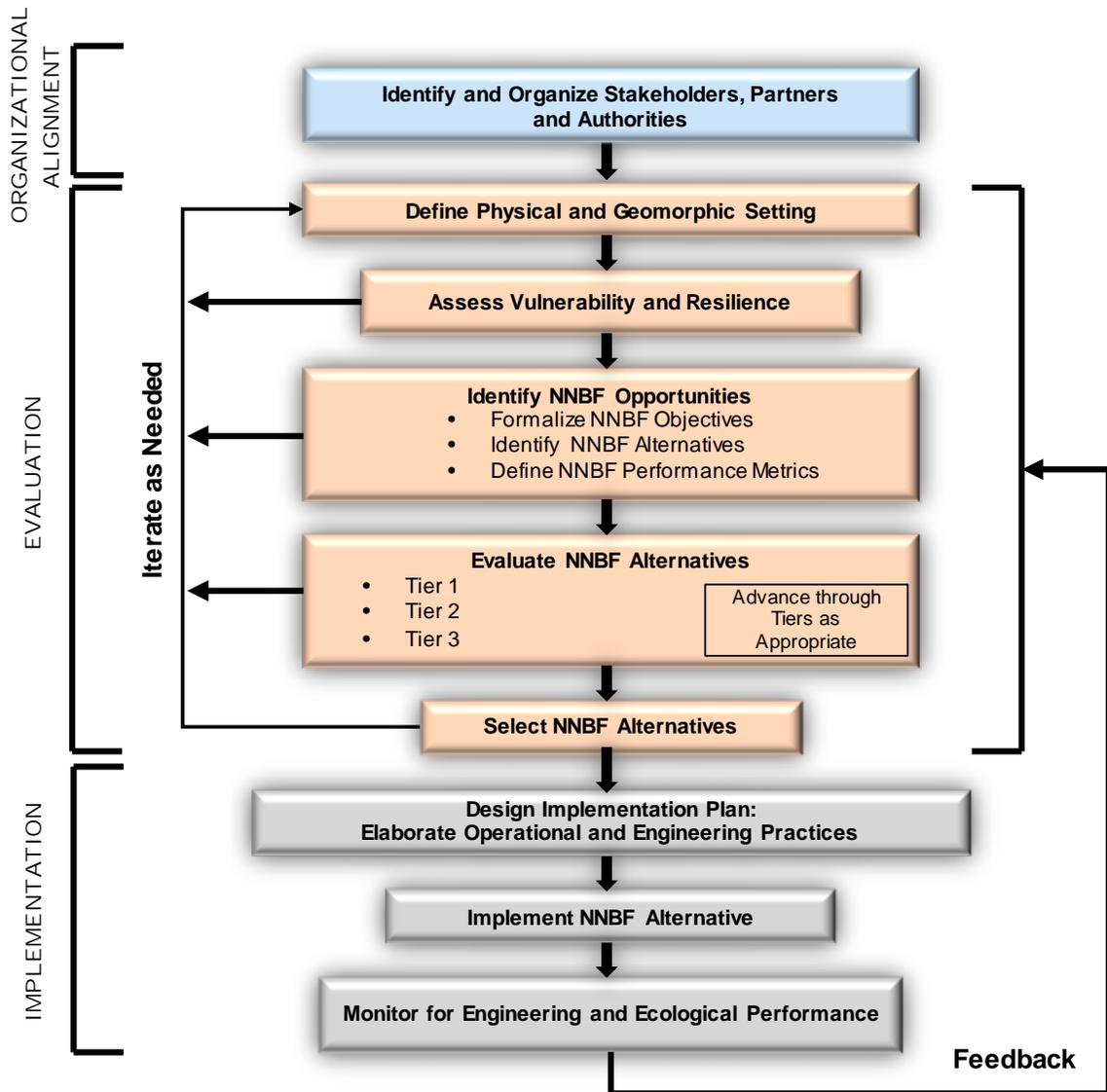


Figure 2. The NNBF process flow-chart

## 6 Description of Guidelines Content

### 6.1 The Proposed Contents List

An outline for the Guidelines was produced in advance of the first international workshop in Vicksburg MS (October 2016) and modified during that meeting. Further changes have been made following subsequent international and national meetings.

Some of the key elements that have informed development of the Guidelines content includes:

- The need for a glossary of terms and abbreviations;
- Case examples will be presented in text boxes within chapters. Case examples will cover things that have gone well and things that have resulted in problems/challenges, from large to small scale, and will demonstrate the tiered risk-based approach to flood risk management (including examples of construction, maintenance practice and usage);
- The project may well identify some gaps in knowledge, which need to be filled by further research. This will be the subject of a separate short report produced by a subset of authors and will not be included within the main document to avoid unnecessary detail (please see Section 6.3);
- Each chapter will start with a brief summary of key messages (e.g. text box);
- Recent and ongoing research will be referred to in the text within the relevant chapters;
- Signposting will be used to direct readers to existing guidance regarding relevant engineering tools, methods, etc.

## 6.2 A Summary of Chapters for NNBF Guidelines Document

### 1. Introduction

This chapter presents an overview, definition, and categorization of NNBF. The business case for why the Guidelines should be implemented is also discussed. Objectives are covered with regard to type and scope of guidance presented in this document, as well as its targeted audience.

### 2. Principles for use of NNBF in coastal and fluvial systems

The role of NNBF in coastal and fluvial systems is discussed in terms of a systems approach to resilience, the role of natural systems and processes supporting resilience, and how an integrated approach combines natural, nature-based, structural, and non-structural measures. An overview of the diversified benefits of NNBF are presented by the various counties and organizations that contributed to writing these Guidelines, which, in point, stresses the value of collaboration.

### 3. Community engagement

The issues, challenges, and benefits associated with community engagement are presented in this chapter. Guiding principles for community engagement (e.g., processes, tools, identification of interests/priorities, different forms of engagement, effective education of NNBF, etc.) are identified and discussed to facilitate the successful implementation of intended NNBF in alignment with the various stakeholders and their respective objectives. Case studies are presented to illustrate specific aspects of community engagement including lessons learned, collaborative problem solving, Landscape Visioning, developing opportunities, and merging community and commercial interests.

### 4. General NNBF framework

This chapter presents a framework that details the components and process flow for identifying, evaluating, and implementing NNBF solutions. Understanding the site physical and geomorphic setting in the context of available resources for constructing NNBF is necessary for assessing the

vulnerability and resilience of the system. This framework consists of the identification and evaluation of NNBF alternatives, definition of NNBF performance metrics, and lays out the implementation process and components of design, construction, maintenance, and monitoring to incorporate adaptive management.

#### 5. System considerations and combining features

NNBF represent part of a larger system of measures: NNBF alone, NNBF in combinations, and NNBF integrated with structural measures (e.g., levees, seawalls etc.). The use of a systems approach to flood risk management that makes use of NNBF is discussed in this chapter. Aspects such as the effects of NNBF on the design and maintenance of other features relative to processes operating at large temporal and spatial scales are explored and systems analyses approaches and tools to determine these effects are presented.

#### 6. Analysis of NNBF benefits

Different comprehensive approaches (e.g., ecosystem services) and analyses to calculate the benefits derived from NNBF projects are presented in this chapter. While these analyses will have to incorporate respective economic, environmental, and social parameters, tradeoffs should be considered and cost/benefit scenarios generated. Metrics and rules-of-thumb to quantify these benefits are provided.

#### 7. Monitoring, maintenance and adaptive management

This chapter provides guidance on determining NNBF functional performance by monitoring in order to adaptively manage and maintain the level of performance and benefits delivered. Monitoring must be tailored to specific NNBF project conditions and measure metrics against respective performance objectives. Monitoring approaches are discussed, and respective tools and techniques presented to meet these requirements.

#### 8. Section II: Introduction to specific types and roles of coastal NNBF

This chapter provides brief introduction to specific types and roles of coastal NNBF.

#### 9. Beaches, dunes and soft cliffs

Guidance on the use of dunes and beaches in the context of NNBF is presented in this chapter. Beach nourishment (sand or gravel), near-shore placement, dunes and soft cliffs are the four major features covered. Identification of where sustainable (but dynamic) beaches and dunes are appropriate is required with regard to site social, environmental, and economic constraints. Definition of performance objectives and metrics form the engineering design of these features and design considerations must take into account entire system key processes (e.g., water transport, aeolian processes, longshore transport, and biological). Construction methods for these features are presented and monitoring aspects discussed to facilitate project longevity/sustainability.

#### 10. Wetlands and intertidal areas

The guidance in this chapter includes tidal marsh, intertidal/transitional marsh (scrub shrub, etc.), mangroves, swamp forest. They are dynamic and changing habitats that provide an important transition between aquatic and terrestrial systems as well as providing flood water retention.

Wetland features and history of use are discussed relative to setting project performance objectives and metrics given site-specific conditions. Design considerations (e.g., native vegetation, materials, sediments, and other living components) are presented in relation to key hydrodynamic and ecosystem processes associated with functions of NNBF systems. Wetland construction/installation considerations and methods are described and consideration for monitoring project longevity /sustainability discussed.

#### 11. Islands

Guidance on the use of barrier, marine, and estuarine islands in the context of NNBF is presented in this chapter. Island features and functions, values, services, and costs are discussed relative to setting project performance objectives and metrics given site-specific conditions. Identification of where islands are appropriate is required with regard to site social, environmental, and economic constraints. Definition of performance objectives and metrics form the engineering design of these features and design considerations must take into account the entire system and key physical processes. Island design and construction/installation considerations and methods are described and consideration for monitoring project longevity /sustainability discussed.

#### 12. Reefs

Guidance on the use of colonized hard-bottom, coral, mollusks, etc. reefs in the context of NNBF is presented in this chapter. Identification of where reefs are appropriate is required with regard to site social, environmental, and economic constraints. Reef features, functions, values, and services are defined. Definition of performance objectives and metrics form the engineering design of these features and design considerations must take into account the entire system of key processes with a particular emphasis on the physical conditions (e.g., bathymetry, water temperature, sediment load) and impact on biological processes.

#### 13. Sub-aquatic vegetation

Guidance on the use of the NNBF of sub-aquatic vegetation (kelp and seagrass) is presented in this chapter. Sub-aquatic features and history of use are discussed relative to setting project performance objectives and metrics given site-specific conditions. Design considerations (e.g., native vegetation, materials, sediments, and other living components) are presented in relation to key hydrodynamic and ecosystem processes associated with functions of NNBF systems. Sub-aquatic construction/installation considerations and methods are described and consideration for monitoring project longevity /sustainability discussed.

#### 14. Upland plant communities

Guidance on the use of upland plant communities (forests, maritime shrub/scrub, maritime forest, riparian buffers, terrestrial forests/shrublands) in the context of NNBF is presented in this chapter. Upland plant community features and history of use are discussed relative to setting project performance objectives and metrics given site-specific conditions. Design considerations (e.g., native vegetation, materials, sediments, and other living components) are presented in relation to key physical and ecosystem processes associated with functions of NNBF systems. Construction/installation considerations and methods are described and consideration for monitoring project longevity /sustainability discussed.

15. Enhancing environmental value of conventional infrastructure in coastal settings

This chapter describes how NNBF can be applied to enhance the environmental value derived from conventional infrastructure in coastal settings. Examples of this enhancement include NNBF components added to structural features (e.g. building marsh behind breakwater to further soften foreshore environment. ,

16. Section III: Introduction to specific roles and type of NNBF in riverine systems

This chapter provides introduction to specific roles and type of NNBF in riverine/fluvial systems, application of NNBF principles to fluvial systems, key factors, and selection strategies.

17. Applying NNBF at watershed scale

This chapter will describe strategies for managing water at the scale of watersheds. In the context of flood risk management, this will include approaches for “making room for” water through the use of NNBF. Naturalizing landscapes through the use of land management, agricultural practice, restoration, and use of reservoirs will be discussed and illustrated through the use of case studies.

18. Applying NNBF at sub-watershed scale

This chapter describes how NNBF can be applied to bring about positive effects on channels and floodplains. Enhancing the environmental value derived from conventional infrastructure in riverine settings will also be described.

19. Naturalizing techniques

Use of specific techniques and materials that introduce more natural conditions to rivers and streams will be discussed and presented in the form of case studies (e.g., use of large wood, coir rolls etc.). Hybrid techniques that make use of both conventional engineering and more natural materials to accomplish bank and bed protection will be described and illustrated.

20. Summation and future directions

This concluding chapter will summarize key points in the Guidelines while pointing toward future directions in research and practice for NNBF.

### 6.3 Report on NNBF Knowledge Gaps and Recommendations for Future Research

Throughout the life of this project, the chapter teams and editorial board will strive to identify and include the best available information associated with NNBF. In doing so, it is likely that those affiliated with this project will identify new questions and knowledge gaps that should be considered when developing future research ideas, which seek to expand our understanding and application of NNBF. As such, the project team will document questions and knowledge gaps that are identified for the purpose of producing a second, concurrent report focused on uncertainties, gaps, and future research targets. A separate writing team will be formed to develop this companion report on research targets concerning NNBF science, engineering and/or resource management.

## 7 Form and Layout

The presentation of the Guidelines will include making good use of figures (including boxed examples, flow diagrams, lists of points to be considered, etc.) and case studies to illustrate the desired content.

### 7.1 Form and Layout – Editorial

English will be the primary language used; therefore, the Guidelines need to have a consistent quality of English. A consistent style that is easy to understand and that provides clear and concise information will be used in order to enhance communication for readers for whom English is not their primary language.

The project editorial board will work directly with chapter leads and teams to develop chapter templates and outlines to ensure consistency and coherence in document content. USACE editors and production staff will be actively engaged throughout in order to provide input on style and layout options that are consistent with the goals of the project.

The Guidelines will be published as a high resolution pdf document and will be made available in electronic form free of charge through a website that will be established and maintained by USACE. Participating organizations will be recognized both within the document and on the website through use of organization names and logos as appropriate. Links to this page will be made by participating organizations as a means of establishing and maintaining the NNBF technical community.

## 8 Method of Delivery

### 8.1 Project Team Structure

The following subsections provide information about the principal contributors to the NNBF Guidelines document. Figure 3 illustrates the dynamic interactions among these various entities.

#### 8.1.1 Editorial Board

The project team will be structured to include an Editorial Board and Chapter Teams (See Figure 3). Individuals may serve on the Editorial Board and Chapter Team(s). The Editorial Board is the decision making body for all issues concerning preparation, editing and publication of the NNBF Guidelines document. The board consists of a diverse team of 5-6 people (including chair) representing different types of organizations (e.g., governmental, academic, non-governmental, private sector, etc.) and different countries (Table 2). The Editorial Board members will meet no less than four times a year (e.g., virtually or in-person) and receive monthly updates from Chapter Team Co-Leads concerning progress. The Board will provide the Chapter Teams' Co-Leads with instruction, chapter reviews, edits, and recommendations for how to proceed. The Editorial Board will also work with chapter Co-Leads to manage the length and content of individual chapters and the overall document. Timelines for production of the Guidelines Document will also be reviewed periodically by the Editorial Board and adjusted, if needed.

### 8.1.2 Chapter Teams

The Chapter Teams are responsible for authoring and preparing text, figures, tables, case studies, etc. that ultimately result in a NNBF Guidelines chapter. Chapter Teams consist of several members (including co-leads) representing different types of organizations and different countries. This group meets frequently (approximately every month) to update their respective chapters. The team is led by two Co-Leads. The Co-Leads typically represent different organizations, which enhances diversity of the team composition (Table 3). Upon request by the Editorial Board, chapter Co-Leads will submit draft copies of their respective chapters for review and edit. The Co-Leads of the Chapter Teams are responsible for assimilating the contributions of the team members, which includes formatting, editing, and review responsibilities. The Co-Leads are also responsible for ensuring that team members stay engaged on the project, completing assigned tasks, and actively participate in the completion of the project.

### 8.1.3 Contributing Author

A Contributing Author does not formally belong to the Editorial Board or Chapter Teams. However, this individual is well known for his or her expertise in a science and/or engineering discipline that is directly applicable to a chapter (or chapters) in the NNBF Guidelines Document. A Contributing Author is typically sought when a Chapter Team identifies sections within a chapter that require additional details and/or contributions that cannot be derived from an existing team member and requires a source with considerable experience related to the subject matter. Typically, the Contributing Author is recommended by a member of the Chapter Team or Editorial Board as someone capable of providing additional insight and perspective to elements within a chapter. In those cases, the Chapter Team and Editorial Board should first agree that the additional expertise is needed to adequately address a section (or sections) within a chapter (or chapters). If approved, a Contributing Author will meet with the Chapter Team at a mutually agreeable time to review the existing draft chapter and offer his or her recommendations for additional text and/or perspective. The Chapter Team will consider the recommendations made by the Contributing Author. If the recommendations have merit, then the Chapter Team Co-Leads will seek the Editorial Board's approval for inclusion of the Contributing Author's text within a chapter. Final approval for a Contributing Author to participate and add the requested text is provided by the Co-Leads of a Chapter Team and the Editorial Board.

### 8.1.4 Stakeholder Groups

Chapter Teams will propose 2-4 individuals to serve as stakeholders to review, advise and consult periodically on progress with draft chapters. Chapter Team members and the Editorial Board members will recommend stakeholders to the Chapter Team's Co-Leads. In turn, the Chapter Co-Leads will inform the Editorial Board of proposed individuals that will serve as stakeholders. It is anticipated that the Stakeholders will receive no less than four updates per calendar year from the Chapter Teams. Updates will likely correspond with review of draft chapters before release to the Editorial Board. Information received from the Stakeholders will be forwarded by the Chapter Team Co-Leads to the Editorial Board for their awareness.

### 8.1.5 Peer-Review Group

A Peer-Review Group is proposed to assist the Editorial Board by providing an external perspective and comments and/or recommendations in association with the draft Guidelines Document. The Peer-Review Group will have an international composition of 5-6 individuals with diverse backgrounds,

expertise, and affiliations. It is anticipated that this Peer-Review Group would receive periodic progress reports of the NNBF Guidelines project. However, this group is anticipated to formally engage with the Editorial Board during Milestones 5 and 6, which requires a comprehensive review of the final draft of the NNBF Guidelines Document.

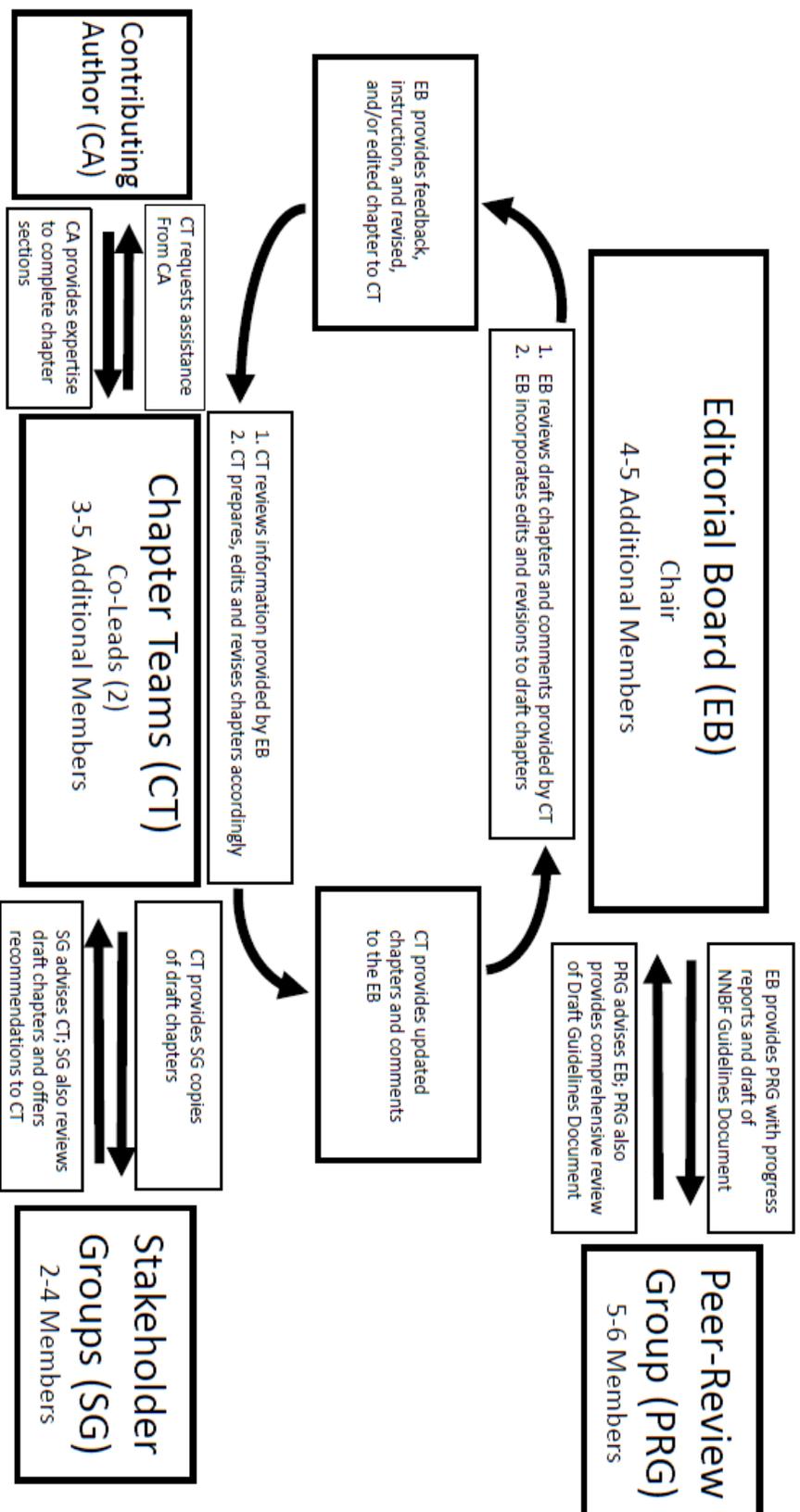


Figure 3. Flow of draft chapter editing/review and associated interactions among various groups.

## 8.2 Management of the Project

The production of the Guidelines will be undertaken in successive steps within the timescales agreed during the Scoping Study and outlined in this report. The program is milestone-driven, with milestones based on clear project deliverables and coordinated with international workshops and meetings, linked to national backing groups reviewing these deliverables. Figure 4 depicts a schedule for starting and completing the milestones associated with creation of the NNBF Guidelines Document. Anticipated deliverable milestones include:

- Milestone 1 (M1): Draft outline of the Guidelines. This should include the content, structure, format and substantive information of what will be included within each section and sub-sections of the Guidelines. The first draft outline of the Guidelines was developed and subsequently adopted in a meeting at the US Army's Engineering Research and Development Center in Fall 2016. Chapter Teams are working to expand existing chapters with an anticipated completion date of June 2017.
- Milestone 2 (M2a-M2b): This milestone consists of two parts: development of one-page overview (i.e., summary) of case studies (M2a) and a post-Scoping Report meeting of principals (M2b). During M2a, participants affiliated with chapter teams will develop one-page outlines for example case studies that will be highlighted in respective chapters. The information requested and associated text for each case study will be consistent across the chapters, and this will be accomplished through use of a standard template, which is distributed to all participants for their use. Following completion and acceptance of this Scoping Document, the principal representatives from various countries and the Editorial Board will meet to discuss current status of the Guidelines document and next steps (M2b). Actions discussed and/or approved during this meeting include, but are not limited to: review/confirmation of equitable distribution of Chapter Co-leads, review of progress to-date and prioritization of next steps, and continued development/refinement of actions supporting first in-person meeting, which includes approval of draft agenda.
- Milestone 3 (M3a-M3d): First draft of chapters. This milestone will consist of four parts: development of interim first draft chapters (M3a), first in-person meeting (M3b), completion/delivery of first draft chapters (M3c), and second in-person meeting (M3d). The chapters will be prepared by the Chapter Teams and coordinated by the Chapter Co-leads. During the development phase of the initial draft chapters (M3a), the first in-person meeting (M3b) will occur in the September/October 2017 timeframe. In-person meetings will include all Chapter Team members and the Editorial Board (Please see Section 8.3 for additional details concerning meetings). At the conclusion of M3a, the Chapter Co-leads will provide the Editorial Board with draft copies of the respective chapter(s) (Please see Section 8.1). The drafts should be based upon the agreed outline, with the interim draft having complete text, photos, case studies etc. to enable a full and thorough review by the Editorial Board. During M3a and M3b, the Chapter Teams will also make recommendations to the Editorial Board regarding the case studies that should be expanded and subsequently included in the respective chapters. In turn, the recommendation and case study overviews will be reviewed by the Editorial Board, and the board will approve the case studies that will be expanded for inclusion into the chapters. As part of M3c and M3d, the Chapter Teams will expand their approved case studies and integrate into the respective draft chapters. The second in-person meeting (M3d) will occur in the March/April 2018 timeframe to ensure timely completion of the first draft chapters, which is scheduled for June 2018 (conclusion of M3c).

- Milestone 4 (M4a-M4e): First full draft of Guidelines. This milestone will consist of five parts: delivery of the interim second draft chapters (M4a), third in-person meeting (M4b), completion/delivery of the second draft chapters (M4c), and fourth in-person meeting (M4d), and delivery of first full draft of the Guidelines document (M4e). This interim second draft of the chapters will be prepared by the Chapter Teams (M4a). The drafts should be based upon the agreed outline, with the interim second drafts having complete text, photos, case studies etc. During the development phase of the interim second draft chapters (M4a), the third in-person meeting (M4b) will occur in the September/October 2018 timeframe. Completion of the interim second draft chapters occurs December 2018, and the chapters are subsequently forwarded by Chapter Team Co-leads to the Editorial Board for review. The Editorial Board completes its review by February 2019 and returns the edited/revised second draft chapters to the Chapter Team Co-leads. During M4c and M4d, the Chapter Teams work to update the second draft chapters based on feedback from the Editorial Board. The fourth in-person meeting (M4d) will occur in the March/April 2019 timeframe. Chapter Teams will then provide Editorial Board with the complete second draft chapters (conclusion of M4c). Editorial Board will review these complete second draft chapters and input recommended edits and revisions. Following review, Editorial Board will assimilate all chapters (including most recent edits, comments, and revisions) and distribute to NNBF Chapter Teams (M4e). This will constitute the first full draft of the Guidelines Document.
- Milestone 5 (M5): Peer Review of first full draft of Guidelines Document. Editorial Board requests Peer Review Group to review the first full draft document. Peer Review Group is given two months to complete review with inclusion of comments and recommend edits and/or revisions to the document. Peer Review Group provides their feedback to Editorial Board. Editorial Board reviews feedback provided by Peer Review Group.
- Milestone 6 (M6a-M6c): Final draft completed. This milestone will consist of three parts: delivery of the final draft chapters (M6a), fifth in-person meeting (6b), and delivery of the final draft Guidelines document (M6c). Chapter Teams will update chapters based on the recommended edits, revisions and comments provided by the Editorial Board. Chapter Teams will continue to engage Editorial Board on a monthly bases to ensure progress continues on draft chapters. The fifth in-person meeting (M6b) will occur in the September/October 2019 timeframe. Chapter Team Co-Leads provide Editorial Board with revised final draft chapters (conclusion of M6a). In turn, Editorial Board compiles chapters into draft NNBF Guidelines Document. Editorial Board inputs remaining edits and revisions into this version of the document. Editorial Board completes all edits and revisions with Chapter Teams (M6c).
- Milestone 7 (M7): Editorial Board reviews and signs off on the final draft document at this time. No major changes would be expected to be made to this draft, other than editorial changes to improve style and English.
- Milestone 8 (M8): NNBF Guidelines Document published. Additional elements associated with this milestone includes the production of English paper and electronic versions of the Guidelines in the format agreed by the Editorial Board. Quality control of scientific and technical content will be addressed by the Editorial Board.

- Milestone 9 (M9): Initiate Dissemination and implementation. This will comprise: national and international launch events, involvement in one or more international conferences, training courses coordinated between the participating countries.

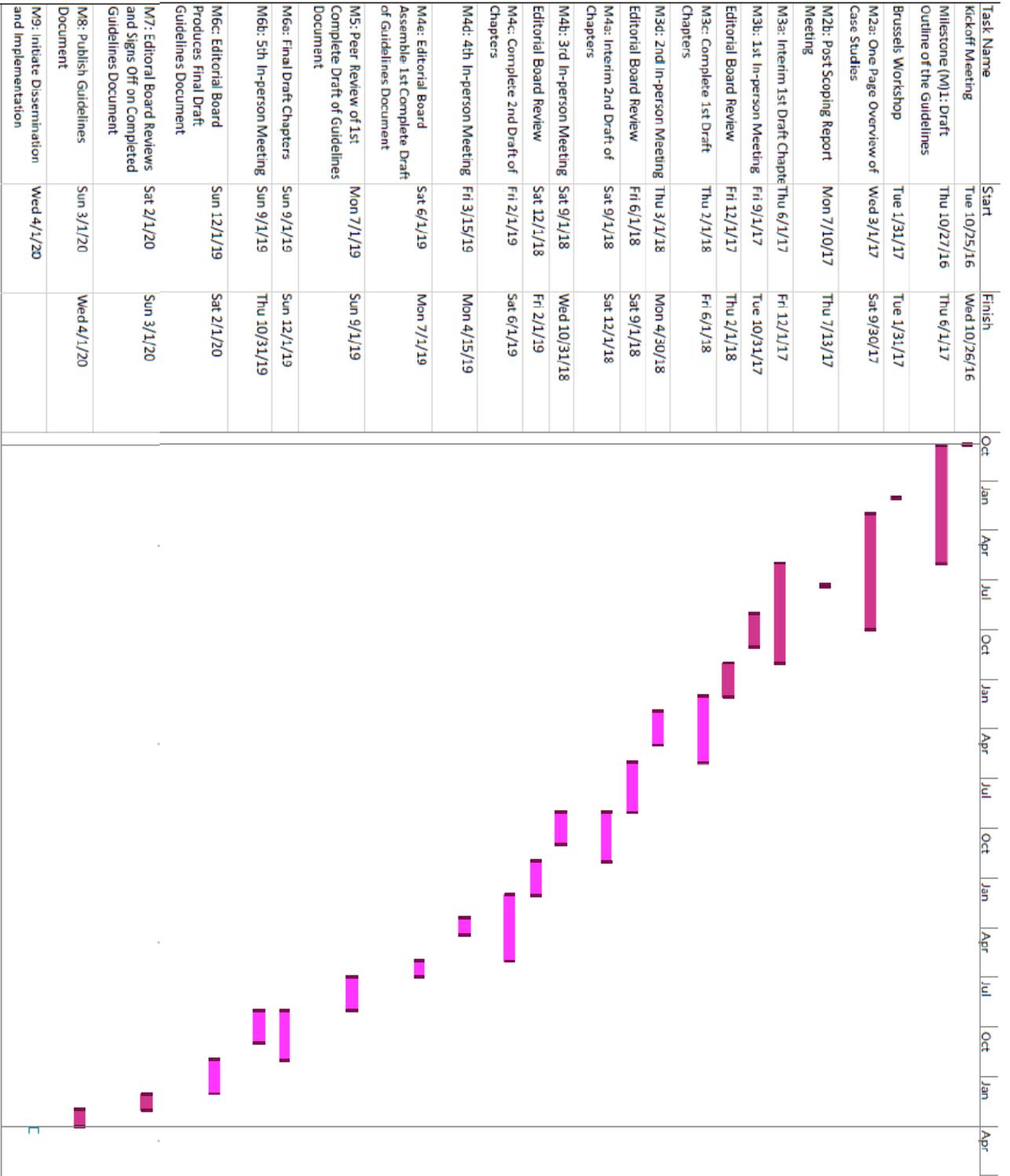


Figure 4. Schedule for Completing NNBF Guidelines Document

## 8.3 Meetings

As described in Sections 8.1 and 8.2, a series of in-person and web-based meetings are anticipated throughout development of the Guidelines Document. In-person meetings consisting of all Chapter Teams and the Editorial Board are anticipated to occur approximately every 6 months for the duration of this project. In-person meetings are designed to:

- ensure the previous milestones were completed as agreed and that Chapter Teams have received and acknowledged any feedback;
- set out work program for the milestones ahead;
- facilitate internal liaison with Chapter Teams; and
- facilitate liaison between Chapter Co-leads and Chapter Teams.

It is important to note that multiple face-to-face meetings may occur every 6-monthsto address the international nature of this project and anticipated travel constraints. For example, a core group of project representatives may host one of the biannual, in-person meetings in the United States and then host a similar, in-person meeting in Europe within a period of 1-2 months. This approach would enhance face-to-face communications by all participants and minimize travel burdens.

The Chair of the Editorial Board is expected to hold quarterly meetings with members of the Editorial Board to discuss progress, provide updates and review schedule of completion relative to actual results. Likewise the Co-Leads of the individual Chapter Teams are expected to hold virtual monthly meetings with their collaborators to review progress, develop/refine elements of the various chapters, review comments and edit/revise text accordingly. Meetings between the Editorial Board and the Co-Leads of the Chapter Teams are also expected to occur virtually on a monthly basis for the duration of the project.

## 8.4 Final Sign-Off Process

Technical content sign-off will occur during Milestones 4 and 6 by the Editorial Board (Please see Section 8.2 for milestone details). In brief, the Editorial Board will assemble the final draft of the Guidelines Document and sign-off prior to releasing it to the Peer-Review Group (Milestone 4). When the final draft is returned to the Editorial Board, the Peer Review Group's comments and recommended edits/revisions are considered and/or incorporated into the final version of the Guidelines Document. The Editorial Board then reviews the final document one last time before authorizing publication and distribution of the document.

## 8.5 Project website

To facilitate the effective management of the project and production of the Guidelines, a collaborative project website will be used. The website will be for internal use (web-based project management tool for the project) as well as for external communication, promotion and dissemination. The aim of developing a web-based project management tool for the Guidelines would be to aid the project management, to facilitate working across organizations, to ensure efficient and consistent communication, and provide an effective dissemination tool. The USACE anticipates hosting this website and also providing the staff necessary for technical service and management. USACE personnel

are anticipated to provide support through: authorizing access, data inventory, data storage, site security, user Q/A, trouble shooting, periodic updates, etc. Proposed functions and features associated with the website may include, but are not limited to:

For external use, a website may hold the following features

- public information about the project;
- a frequently asked questions section for public users;
- a news section for public users, including latest updates on the project;
- a call for information from the public by the project team.

For internal use, a website may hold the following features

- a password protected team website;
- a team registration/login plus control access by limited number of administrators;
- a document library showing history of document uploads. This will hold drafted material, templates, guidance for authors etc.;
- a page showing milestones/actions enabling the administrators to create/update/delete the project documents;
- a storage system with sitemap showing links to all folders and uploaded files;
- a meetings & events calendar;
- an online project document editing system.

## 9 Dissemination and Communications

### 9.1 Objectives

The Scoping Study identified the following objectives for dissemination and communication:

- to adopt a systematic approach to communicating the project to stakeholders;
- to encourage effective communication from the technical community to the project team, including consultation of draft documents and the collection of case studies. To facilitate this, a dedicated project website will be developed;
- to develop regular project updates and make available appropriate information to the project team, funders and the industry at large;
- to develop summaries and interim outputs offering end users the opportunity to identify further information for inclusion in the Guidelines;
- to disseminate information about the Guidelines through targeted publication in relevant scientific journals;
- to ensure an appropriate number of papers are included at international conferences as well as at specific national conferences for practitioners and /or researchers organized;
- to develop press releases near the publication date to improve dissemination;
- to arrange an international launch event and national and international training webinars.

## 9.2 Joint Communication Actions

All communications regarding the project will be coordinated, in advance, with the project Editorial Board, including all presentations at international conferences and other public outlets. This is to ensure consistency, accuracy, and coordination in the timing of public communication.

### *Encourage effective communication from the technical community to the project team*

Effective communication from the technical community will occur through engagement by Chapter Team Co-Leads, Team Members and the Editorial Board. The Editorial Board will manage this process and ensure the project team is fully updated.

### *Confirm regular project updates are developed*

Project updates will be produced on a regular basis and will be made available on the project website and linked websites with participating organizations. This will ensure funders, for example, are fully up to date on the project and also allow engagement with stakeholders. Furthermore, project updates will raise the profile of the project.

### *Articles in scientific journals*

Journal articles will raise the profile of the project and reach-out to wider stakeholders. Articles can also be used to attract specific information relevant to the effort. The Editorial Board will coordinate the development of project journal papers with Team Members.

### *Papers at conferences*

Papers at conferences will allow for the project to be showcased in front of peers. It will raise the profile of the project and also encourage dissemination of the Guidelines when published. Conferences will furthermore offer an ideal opportunity to canvass further international case studies and/or relevant examples.

### *Develop press releases near the publication date*

To ensure wider dissemination and also to communicate activities such as the launch of the Guidelines, up-coming training courses and so on. These activities will be coordinated by the Editorial Board.

### *Arrange launch event*

This event will mark the release/publication of the Guidelines. It could be an international conference / one day seminar with relevant speakers covering the chapters in the Guidelines. The Guidelines should be available at the launch.

### *Training events*

The Editorial Board will coordinate the development of potential national and international training events for practitioners in order to present the Guidelines and to encourage good practice in their application.