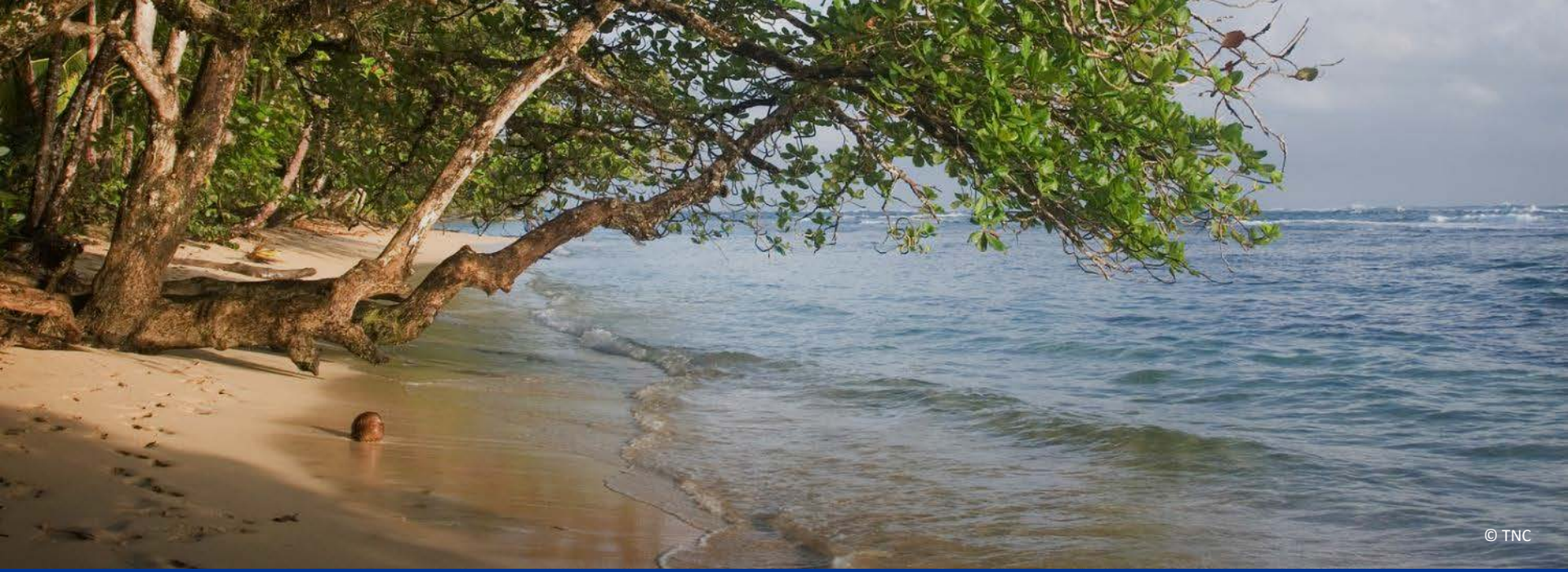

NNBF solutions using tidal wetlands

Candice Piercy

Nigel Pontee

US Army Corps of Engineers
Engineer Research and Development Center

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Outline of talk

1. Why should we be interested in NNBF?
2. What do we mean by NNBF?
3. What techniques exist for tidal wetlands NNBF?
4. What are the guiding principles?
5. Conclusions

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1. Why should we be interested in NNBF?

- Opportunities for habitat creation
- Potential for multiple benefits
- Potential financial savings - soft defences v hard defences
- Solutions that may be better adapted to change

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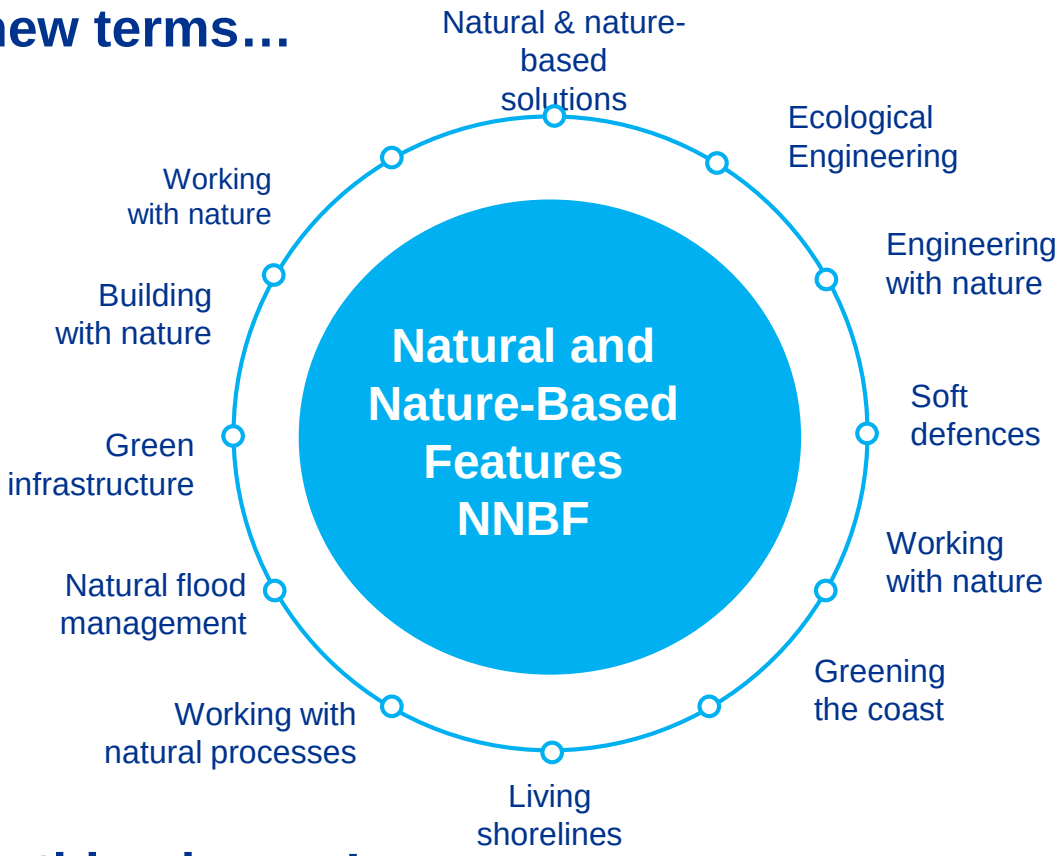
2. Lots of new terms…



But not everything is new!

2. What constitutes an NNBF solution?

NNBF uses natural features to…

- Reduce flood or erosion risks directly
  - Reducing waves and water levels
- Augment defence function
  - Reduces maintenance
  - Extends lifetime of defences
  - Reduces the requirement for hard materials
- Create additional environmental benefits
  - Ecosystem services – WQ, fisheries, carbon sequestration etc

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3. What is the spectrum of NNBF solutions?

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3. What is the spectrum of NNBF solutions?

- Type 1 - Creating large expanses of habitat

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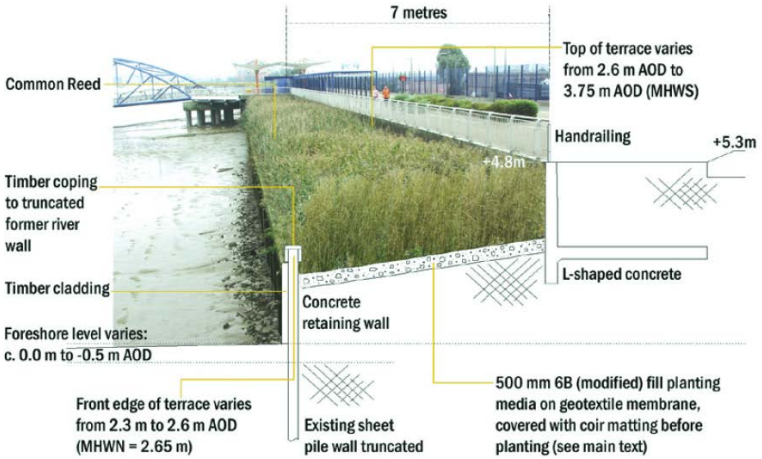
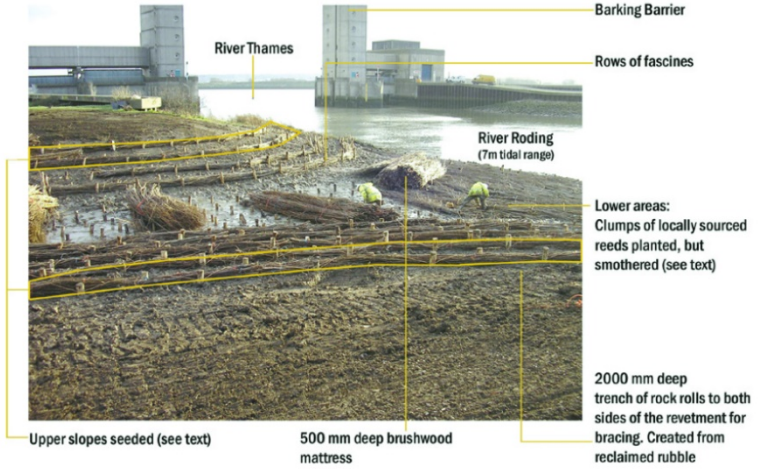
3. What is the spectrum of NNBF solutions?

- Type 2 - Enhancing existing structures



Eastern wall, Greenwich Peninsula, London: Site 2 north end, six years after implementation (autumn)



Barking Creek at Barking Barrier: Brushwood fascines installed on upper slopes and brushpacking being installed on lower slopes

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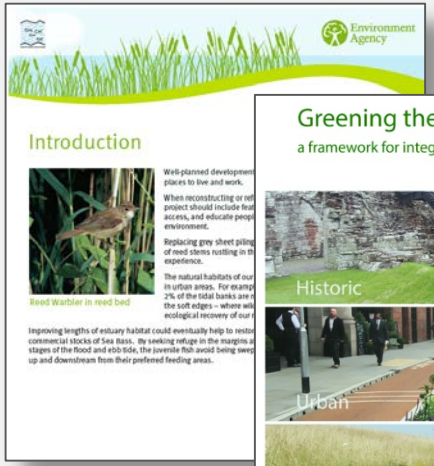
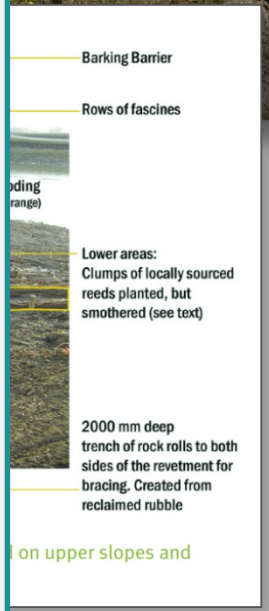
3. What is the spectrum of NNBF solutions?

Further information





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3. What is the spectrum of NNBF solutions?

- Type 3 – hybrid solutions

www.wetlandswatch.org

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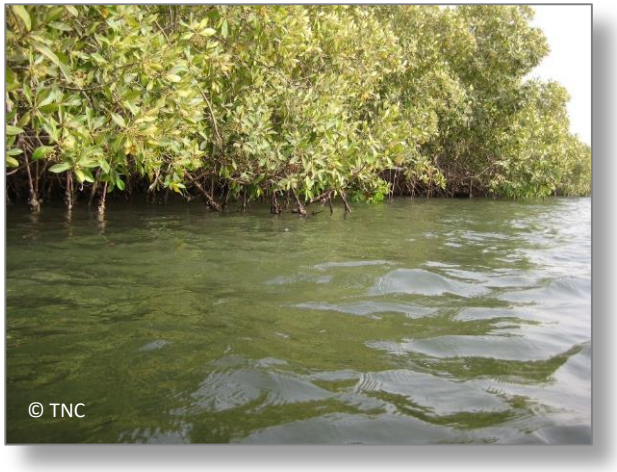
3. Type 1 – Creating large expanses of habitat

- Create new intertidal areas <u>further landwards</u>:
  - Managed realignment/Managed retreat
  - Regulated tidal exchange
  - Flood storage areas
- Reduce wave erosion, promote sedimentation, or artificially add sediment to <u>existing intertidal areas</u>
  - Sedimentation fields/ fences
  - Intertidal recharge
  - Vegetation planting
  - Wave energy reduction structures (e.g. Detached breakwaters, artificial reefs, edge protection)

3. Wave reduction

- Evidence of wave height reduction available from field measurements, laboratory studies and numerical modelling
- Main parameters known



Habitat	Wave reduction factors
Salt Marshes	• Incoming wave height & period • Depth of water above the marsh surface • Vegetation properties - number of stems, diameter, branching, height, stiffness, buoyancy
Mangroves	• Incoming wave height & period • Depth of water above the bed of forest • Underlying topography • Vegetation properties - density of vegetation, presence of aerial roots

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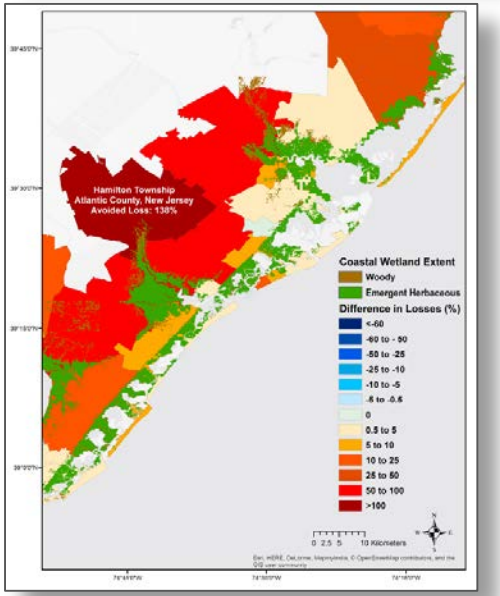
3. Saltmarshes

- Attenuates short waves
- Can model wetland evolution over decadal timescales
- Ecological benefits are high
- May attenuate short duration nuisance flooding
- Relationships between vegetation and flow are complex; effects are site and storm specific
- Further integrated research required to better quantify risk reduction



- Risks addressed
  - Shoreline erosion ✓
  - Nuisance flooding ✓
  - Short waves ✓
  - Medium waves ~
  - Storm surge ~

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3. Water level reduction - flood storage schemes

Context

- Estuary wide modelling showed areas of new intertidal in upper estuary could reduce water levels
- Alkborough site predicted to reduce water levels on extreme events by ~10cm (1 in 100 yr event)

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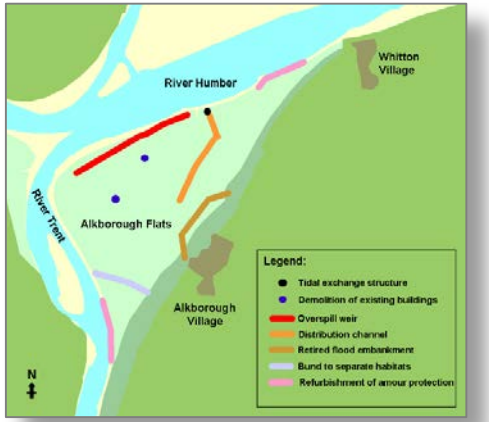
3. Alkborough Flats, Humber Estuary

Scheme elements



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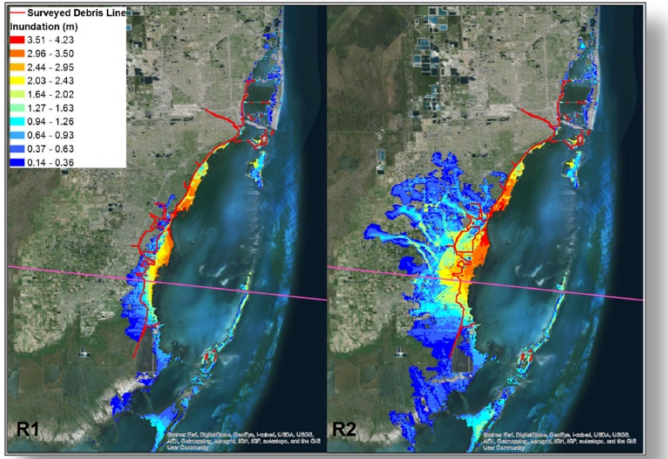
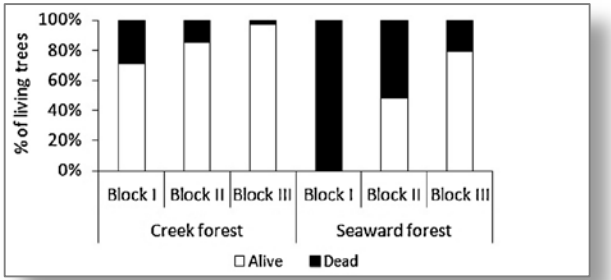
3. Mangroves

- Modeling and field evidence of storm surge and wave reduction
- Can reduce wind damages
- Limited latitudinal range
- Significant space and time requirements for establishment, restoration, or recovery
- Ecological benefits high
- Research needs on restoration/establishment and integration in urban landscapes





- Risks addressed
  - Shoreline erosion ✓
  - Nuisance flooding ~
  - Short waves ✓
  - Medium waves ✓
  - Storm surge ✓

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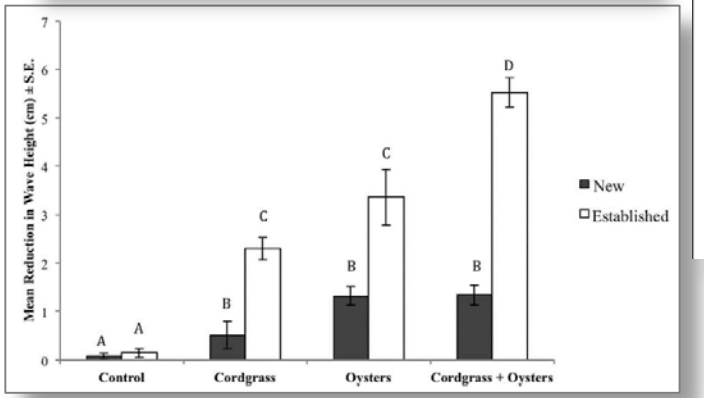
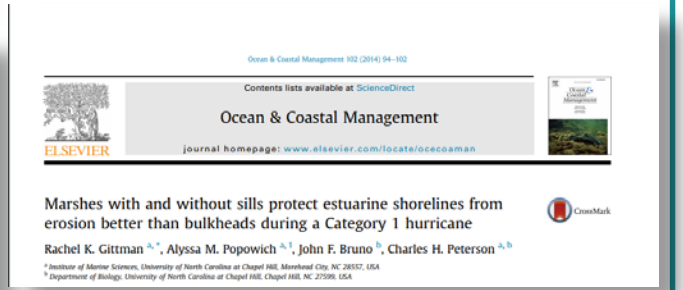
3. Type 3 - Hybrid approaches: living shorelines

- Effective for high frequency, less severe events
- Provide ecosystem benefits
- Use of sills limit adaptability to future conditions
- May be overwhelmed or damaged during major storms
- Small scales limit benefits
- What are effects at larger scales?





- Risks addressed
  - Shoreline erosion ✓
  - Nuisance flooding ~✓
  - Short waves
  - Medium waves
  - Storm surge

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4. What are the guiding principles?

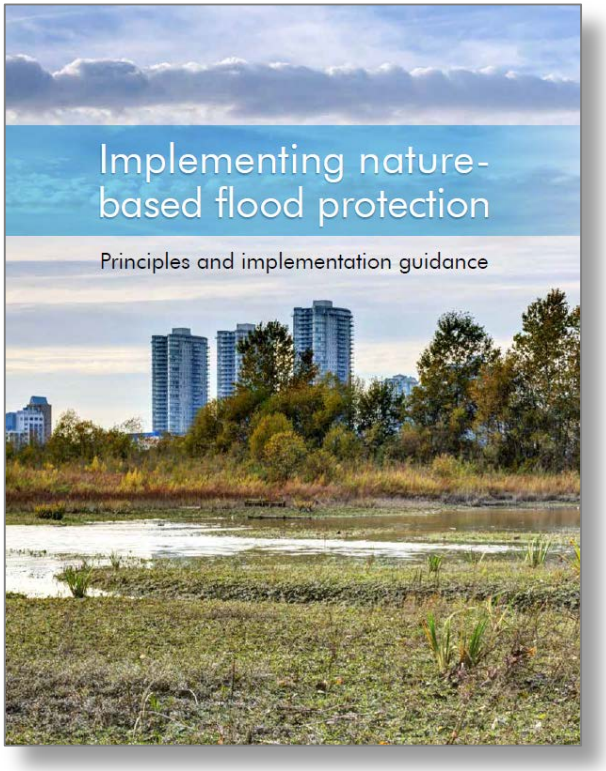
Learn from wetland creation & restoration experience:

- Design for minimum maintenance and reliance on self-design
- Use tides and waves to your advantage
- Allow creek networks to develop somewhat organically
- Consider interactions of hydrology, physicochemical processes, vegetation, and climate
- Design for multiple goals but identify priorities (erosion reduction vs. habitat)
- Give the system time – wetland function doesn't develop immediately
- Design for function, not form – processes > structure
- Resist the temptation to over-engineer the wetland
- Consider ecological communities, not 1-2 species

4. What are the guiding principles?

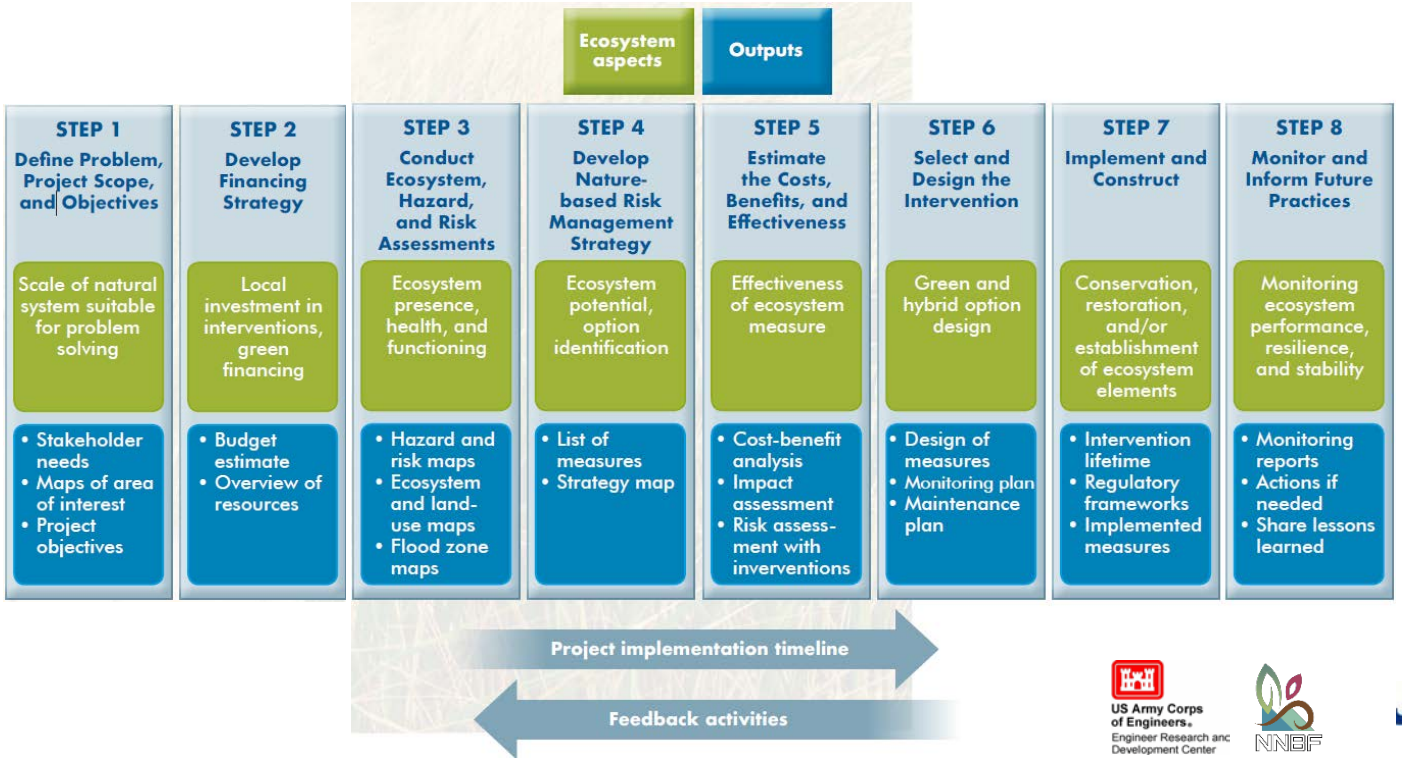
World Bank Principles and Implementation Guidance for Nature-Based Flood Protection

1. System-scale perspective
2. Risk and benefit assessment for a full range of solutions
3. Standardised performance evaluation
4. Integration with ecosystem conservation and restoration
5. Adaptive management



4. What are the guiding principles?

World Bank Principles and Implementation Guidance for Nature-Based Flood Protection



5. Conclusions

- Range of scales for NNBF options involving wetlands
- Wave and water level reductions
- Success depends on location, habitat characteristics, sources of risk and scale
- May need to be combined with structural elements obtain desired risk reduction
- Wetlands offer multiple additional wider benefits
- Engineering challenge – how can we harness these known properties in our designs?

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Final thought

EEA Technical Report No 12/2015

‘the lesson is clear:

think about green before investing in grey.’

Thank you

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