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## MANABAS COAST

### Baseline Assessment for all pilots

An initial activity of WP2 is a description and baseline assessment of each study pilot that will be used as the baseline to assess progress during the project and can aid in the future cooperation between the study pilots. The assessment also serves to establish the status of mainstreaming of NbS into the pilots. The assessment survey is divided up into three parts: 1) Description of the pilots, 2) Questions concerning how the enablers are currently addressed in the pilots, and 3) Brief questions about the MANABAS framework (inspired by ISBAM).

### Part 1: Pilot description

*Our aim is to mainstream nature-based solutions on the different coasts of northwest Europe. Therefore we need a description of the coastal system. This is divided into two sections: A) description of the coastal (natural) system of the pilot, and B) description of the governance system.*

**Name of pilot:** Western Scheldt estuary with 3 sites including Hedwige, Perkpolder, and Zwin sites

**Location of pilot:**

*Please include a satellite map/orthophoto or aerial photo of the area in order to see vegetation, houses, gully's, bars etc. Provide coordinates for the center of the map and the corresponding coordinate system*



Figure 1. Westernschelde estuary. 1) Zwin, 2) Perkpolder, 3) Hedwige

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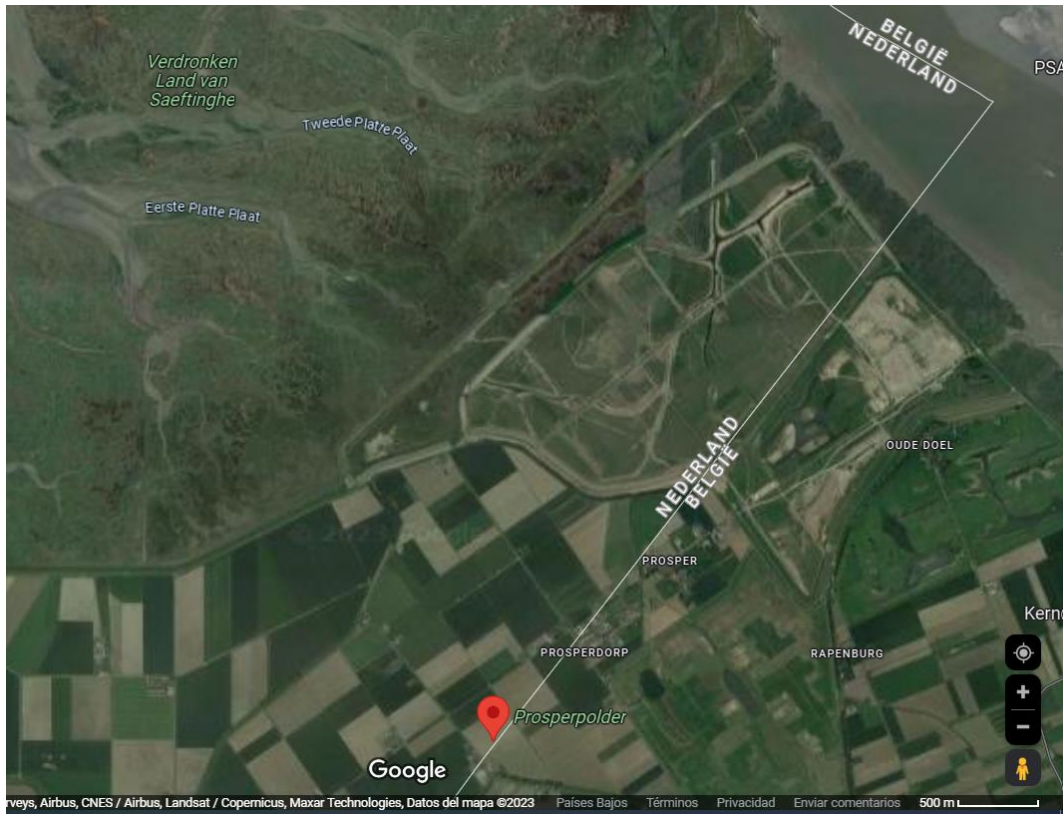


Figure 2. Location of the Hedwigepolder (source Googlemaps, 20-7-2023) coordinates:  $51^{\circ}20'15.5''N$   $4^{\circ}13'10.1''E$

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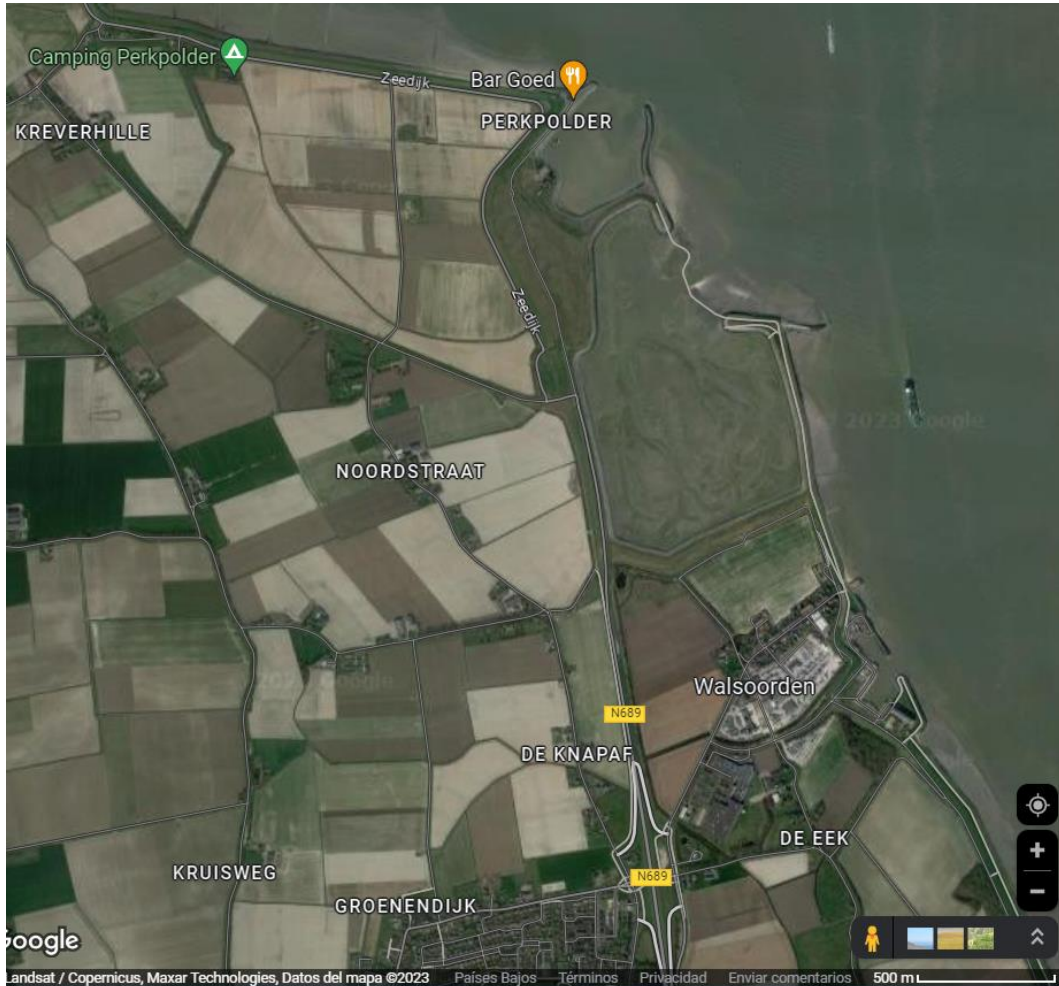


Figure 3. Location of the Perkpolder (source Googlemaps, 20-7-2023) coordinates:  
 $51^{\circ}23'28.1''N$   $4^{\circ}01'06.1''E$



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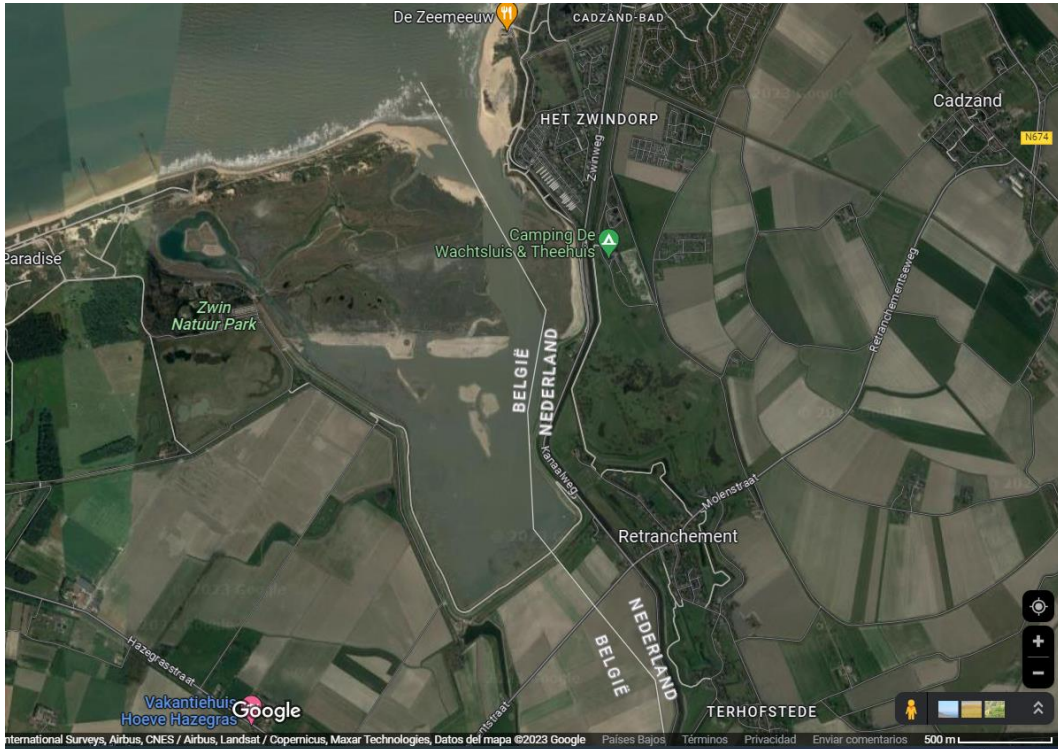


Figure 4. Location of Zwin (source Googlemaps, 20-7-2023) coordinates:  
51°21'31.2"N 3°21'10.5"E

### **Pilot aims/objective:**

#### *Aim of the HZ pilot study*

We (HZ) will evaluate and learn from three NBS sites (Figures 1, 2, 3 and 4) specific key enablers for mainstreaming NBS into coastal protection. Within Manabas we will determine the socio-technical and ecological feasibility of NBS projects as flood defense strategy. Moreover, the governance challenges of mainstreaming NBS for coastal protection will also be investigated. To achieve this objective we will first collect data for each site individually. Secondly, the data will be compared across sites to develop a mainstreaming approach for NBS in the Western Scheldt.

#### *Aim of the Nbs interventions at the pilot site*

At the request of the central government, the province of Zeeland is implementing nature restoration measures to expand the estuarine nature (salt marshes and mudflats) by 600 hectares. Some of these nature restoration measures are located at various locations in Zeeuws-Vlaanderen region (The Netherlands), including the Hedwige-Prosperpolder, Perkpolder and Zwin. Hedwige-Prosperpolder is a new tidal area of approximately

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300ha, Zwin is a nature park of 210 ha and Perkpolder is an estuarine nature of 75ha. Hedwige polder and Zwin are located across the Belgian border. The aim of all sites is to conserve the intertidal area of the Scheldt estuary and its nature. The specific aim of Zwin is to combat silting and expand the estuarine nature by increasing sediment storage capacity, relocating dikes, and restoring natural drainage.

### **Which nature-based solutions will you be working with in MANABAS?**

We will use three dike realignment projects in the Westerschelde estuary to research this topics (Figure 1):

- Hedwige-Prosper polder is a new tidal nature area of 300ha implemented in 2022 (Figure 2).
- Perk polder includes a 75 ha of created estuarine nature. It is located in the north of the municipality of Hulst (Figure 3)
- Zwin is a nature park of 210 ha.

### A. Description of the coastal system

*Please briefly describe those areas that are relevant for your pilot:*

1. The landscape including geology, morphology, and biology.
  - a. The pilot sites are located in the Western Scheldt estuary. The estuarine part is approx. 80 km long, and 4-8 km wide. The estuary is characterized by the presence of two channels. Sand bars are present between the channels. Along the flanks there are tidal flats and salt marshes. These intertidal areas are rich in biodiversity and are crucial bird habitats.
2. The hydrodynamic forcing from tide, water level, wind and waves. If possible, include some statistical values
  - a. Tidal range = 3.5-5.5 m, increasing into the basin. Water level is continuously monitored (10-minute interval) at 9 locations in the Western Scheldt.
    - i. Maximum tidal flow velocity maps are made biannually by Rijkswaterstaat at 20-m resolution. In the channels it's typically 1-2 m/s, on the tidal flats it's typically 0.3-1 m/s.
  - b. Waves (Hs) = depending on wind exposure between 0.05 m and ~0.2 m on average, and ~0.5 m 95<sup>th</sup> percentile. Hmax ~1.5 m. There is an operational SWAN model for the Western Scheldt. Waves are continuously monitored (10-minute interval) at 6 locations in the Western Scheldt.
  - c. Wind is dominated by SW winds; the coastline of Zeeuws-Vlaanderen is sheltered, the coastlines of Walcheren, Zuid-Beveland, and Reijmerswaal are more exposed.

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- i. NE storms result in the largest storm surges due to the location of the Western Scheldt within the North Sea.
    - ii. Hourly wind speed and direction data are available at 2 locations.
  3. Which current NBS solutions are already present (it can be a non-engineered original landscape)
    - a. Sand nourishments to maintain dunes are the only NBS in the Western Scheldt which are being used for coastal protection.
      - i. There are existing salt marshes fringing the estuary. When the width of salt marshes exceeds 50 m, they are included in coastal defence management. However, there are no NBS used for replacing previous hard infrastructure.
    - b. There are NBS for improving nature values:
      - i. Managed realignments
        1. Zwin (pilot site)
        2. Perkpolder (pilot site)
        3. Hedwige-Prosperpolder (pilot site)
      - ii. Increasing sedimentation on foreshores
        1. Knuitershoek
        2. Baalhoek
        3. Bath
        4. Zimmerman
      - iii. Eco-friendly dyke design
        1. Hansweert – testing blocks with mud and less concrete to improve seaweed cover
        2. (There are more pilots with eco-dykes in the Eastern Scheldt)
  4. Describe how study pilot is monitored.
    - a. Zwin. Retrospective analysis of the project implementation process to identify the main triggers, obstacles.
    - b. Perkpolder. HZ is monitoring the risk perception of citizens using surveys on this new developed landscape. In a past project, HZ University in collaboration NIOZ, Wageningen Marine Research, and Deltares monitored various geomorphological, hydrological, and ecological parameters (report: [https://deltaexpertise.nl/images/a/a4/Perkpolder\\_Eindrapportage.pdf](https://deltaexpertise.nl/images/a/a4/Perkpolder_Eindrapportage.pdf))
    - c. Hedwige-Prosperpolder. HZ University in collaboration with NIOZ, Wageningen Marine Research, Deltares, and Antwerp University are monitoring the hydrodynamics (flow patterns, waves, SSC), morphological changes (bed elevation) in the polder. Moreover, they will also monitor the ecological aspects (bird habitat, benthos, vegetation development,

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sediment properties). In addition, HZ is also monitoring the risk perception of citizens using surveys on this new developed landscape.

5. Describe the sediment dynamics: Macro or micro sediment budget, conceptually or detailed volumetric monitoring. Include any dredging.
  - a. Sediment budget is mainly determined by dredging. Net export of sediments ( $10^7 \text{ m}^3$  per year), of which dredging makes up ~90%.
  - b. Dredging in the main channel has resulted in increased tidal range, and increasing elevation and steeper edges of sand bars and tidal flats. The latter results in increased salt marsh development at the cost of tidal flats (= loss of bird habitat).
6. Long term trends. These could be chronic erosion, long-term subsidence or trends in mean sea level.
  - a. The secondary channel is silting up, without action the Western Scheldt may develop into a single-channel estuary.
  - b. There is a decrease in unvegetated intertidal habitat suitable for birds, though this is actively being stabilized through various measures as mentioned above.
  - c. Projected SLR is 0.85 m by 2100. Current expectations are that the morphology will be able to keep up with SLR by increased sedimentation.
  - d. SLR may lead to changes in tidal patterns, especially the east of the estuary may experience increased tides. This increases flood risk in addition to the effect of the rising average sea level.
7. Describe the current coastal protection being used in the study pilot.
  - a. The primary coastal defence consists of dykes, or, when present, sand dunes. Dunes are only found in the western part of the Western Scheldt where the coast is sandy. In the hinterland there are various old 'sleepers' dykes. These dykes are not part of the primary coastal defence, but serve to compartmentalize floods. For managing erosion, groynes are used.
8. Describe the current risk of flooding and erosion.
  - a. The differences in flood protection are based on that the risk of mortality should be 1:100000 per year or lower. This means that places where the mortality risk is high have higher flood protection standards than places where the mortality risk is lower. For example, a dyke protection a nuclear plant has a flood risk of 1:1000000 per year, while relatively higher elevated regions behind dunes have a flood risk of 1:1000 per year. Typically, the flood risk is 1:3000 per year in the Western Scheldt.
    - i. In the basis, reduction in flood risk is used to reach the minimum mortality risk. In specific situation where flood protection is too costly or too damaging to local spatial quality, other means such



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as evacuation planning can be used to reach the minimum mortality risk (multi-layered safety).

- ii. The 1:100000 per year mortality risk is a minimum. Location with high economic value or critical infrastructure may receive higher protection standards.

9. Which human activities impact your coastal system?
  - a. Dredging: dredging of the main channel has resulted in heightening and steepening of the mid-channel bars and fringing tidal flats, resulting in a loss of bird foraging habitat.
  - b. Pollution: the presence of 3 large harbors in the estuary has resulted in various chemical pollutants (like heavy metals, PFOA, PFAS, etc). Nutrient input is also high.
  - c. Disturbance: there are many human sources of noise and movement which disturb animals.
  - d. Ship waves: in areas where the main shipping lane is in close proximity to the coastline, ship waves are stronger than wind waves and can cause erosion.

10. Describe important culture and historical aspects in the study pilot

The Hedwige-Prosperpolder, Perkpolder and Zwin sites are part of the Western Scheldt estuary. This area has 800 years history of land reclamations, floods, and inundations. Over the centuries, polders have evolved, with farmers adapting them to protect against sea or river floods through the construction of levees, channels and pumping stations. Today, polder landscapes have become multifunctional becoming a vital part of the Dutch national identity. However, all sites changed their agricultural land into nature/ intertidal area.

They don't have historical elements, but they are part of Zeeuws Vlaanderen region which is considered by the Province of Zeeland of historical and cultural importance because it's a region with land reclamation for centuries. Therefore, over the years the salt marshes became agriculture land protected by embankments and dike resulting into a polder landscape with a cultural value. Cultural-historical elements are dykes, groynes, breakwaters, roads, drinking wells, sluices.

### B. Description of the governance context

*Please briefly describe those areas that are relevant for your pilot:*

11. Who are the landowners of the land?

The Hedwige and Zwin areas are located at the border with Belgium and the Netherlands. Thus, the land ownership is shared between the West Flanders province (Flemish Land Agency) and Province of Zeeland. The Province of Zeeland is owner of the Perkpolder area.

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12. What are the main land uses in the pilot area (ie agriculture, nature reserve, infrastructure)

Hedwige-Prosperpolder is surrounded by agriculture land on the East, the port of Antwerp and a nuclear energy plant on the West (Figure 2). Perkpolder has agriculture land and a national road (N869) on the West, a camping on the North and an urban area (Wal-soorden) on the South (Figure 3). Zwin area is surrounded by agriculture land on the West and South, an urban area (Zwindorp) and camping on the East (Figure 4).

13. What are the current laws and regulations that govern the use of nature-based solutions in the pilot (i.e Natura 2000, planning)?

Both Flanders and the Netherlands have various legal and policy requirements governing the project, which include compliance with habitat and bird directive areas, nature conservation decrees (Nature 2000, Birds habitat), water management regulations (Waterwet NL), landscape protection, and archaeological heritage preservation.

14. What is the current status of using nature-based solutions in your pilot area (ie to what extent are they mainstreamed into existing policy?)

The nature based projects are recently implemented and need to be monitored to study their effectiveness.

15. What are the current goal conflicts (ie protecting cultural vs natural areas, or protecting private land vs municipal-owned land, or agricultural uses vs nature preservation?) How are these dealt with?

Hedwige and Zwin: nature vs agriculture, land use, and property acquisition

Zwin: nature vs agriculture, land use, and property acquisition.

Perkpolder: nature vs transport

All sites provide opportunities for recreation.

The negative effects are compensated with nature values such as improved water quality, increased biodiversity, and socio-economic values such as increased flood safety, wellbeing and more local employment.

Citizens have negative perception about Hedwige while they have positive perception about the Perkpolder. They do not trust public authorities on the redevelopment of the sea landscape.

16. How are the stakeholders identified and involved

### **Zwin.**

Dutch actors: the municipality of Knokke-Heist and Sluis, Province of Zeeland, Nature organisations (Het Zeeuws Landschap, Natuurpunt), local business (Camping de Zwinhoeve), research institutes (NIOZ, HZ), citizens, and consultancy firms.

Belgian actors: the Province of West Flanders, the Maritime Service Coastal (MDK), the Agency for Nature and Forests (ANB), the Flemish Environmental Agency, Zwin Nature Park, Natuurpunt, Flemish agricultural organization;

### **Hedwige.**

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Dutch actors: municipalities of Hulst, Province of Zeeland, Rijkswaterstaat, Nature organisations (Het Zeeuwse Landschap, Natuurmonumenten) research institutes (e.g. U. Twente, TU Delft, U Groningen, R U Nijmegen), citizens;  
International administrators (Flemish-Dutch Scheldt Commission)

Belgian actors: municipality of Beveren, the Province of West Flanders, De Vlaamse Waterweg, Nature organisations (e.g. ANB, Natuurpunt) research institutes (U Ghent), citizens;

**Perkpolder**: governments, civil society organisations, market parties, citizens, etc.

17. Briefly describe the socio-economic development in the area.

Zwin: created nature area which increases local tourism and recreation with additional employment

Hedwige polder has led to loss of agriculture income.

Perkpolder: development project pending. The development project offers opportunities for recreation and tourism (includes nature area, holiday and residential houses, one camping, a golf course).

18. What do you experience as the main barriers to mainstreaming NbS in your pilot?

- Quantification of the NBS values/ benefits to overcome the funding gap.
- Negative perception of citizens and policy makers about the depoldering concept to redevelop the sea landscape.

Monitoring and analysis of the measures effect is taking place in The Zwin and Hedwige polder to gather more empirical evidence of the multi functionality of NBS measures.

Monitoring is taking place through EU or Dutch funded projects. In addition, the perceptions of citizens was studied in the Hedwige and Perk polders during the Polders2Cs Interreg project .

### C. Implementation scheme

*Please describe your timeline for implementing NbS during MANABAS and beyond (i.e. starting point, estimated finalization, monitoring period)*

The main activities that will be carried out during the pilot projects are: quantification of NBS benefits, risk perceptions of actors (public, civil and private) and upscale modeling tools used for monitoring. The timeline of these activities still needs to be defined.

## Part 2: Enabler Assessment

*Please consider the barriers identified in Part 1B (question #18). The enablers below are meant to be ways to overcome these barriers. However, these enablers are not set in*

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*stone and will be further developed, augmented and /or changed during the MANABAS Coast project. There may be other enablers that are more important in certain pilots or for mainstreaming NBS. We will explore these during our project. In this assessment we want to get an initial idea of how these proposed enablers by EcoShape play out in your pilot and for mainstreaming NBS on a large scale.*



### **Enabler 1: Technology and system knowledge**

- Which types of technology or systems knowledge are important in your pilot? (i.e. Sediment cell, salt marsh protection, salt marsh dynamics, sand nourishment, enhanced dune development)

Hydrodynamics measurements (tidal difference, wind dynamics and sediment deposition)

Ecological development: birds habitat and benthic ecosystem

- Are there any knowledge and technology gaps in your pilot that need to be addressed? Please briefly describe.

Natural development of the estuary and its effect on flood risk in the Western Schelt system

### **Enabler 2: Multistakeholder approach**

- Who are the main stakeholders in your pilot?

Dutch actors: local municipalities (Hulst, Sluis), Province of Zeeland, nature organization (Statbosbeheer, Het Zeeuws Landschap, Natuurpunt, Natuurmonumenten), Regional water authority (Waterboard Schelderstromen), Ministry of Infrastructure and water (Rijkswaterstaat), industry (harbor), local business (camping, hotels, horeca), (farmers, inhabitants), research institutions (HZ, NIOZ), citizens, and consultancy firms.



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Belgian actors: local municipalities (Knokke-Heist, Beveren), the Province of West Flanders, the Maritime Service Coastal (MDK), the Agency for Nature and Forests (ANB), the Flemish Environmental Agency, Flemish agricultural organization, De Vlaamse Waterweg, nature organisations (Zwin Nature Park, Natuurpunt), research institutes (UGhent, UAntwerp), citizens;

- How will you engage your stakeholders in the project?

Capacity building events (interviews, workshops, lectures, webinars, projects meetings, conferences, local events)

### **Enabler 3: Management, monitoring, and maintenance**

- What routines does your pilot have in place for management, monitoring and maintenance of the NbS?

Learn more about monitoring the hydrodynamics: what needs to be monitored, how and when. The ultimate goal is to design a testing scheme to provide guidelines on testing, long term monitoring and maintenance.

Monitoring of risk perceptions among stakeholders: citizens, public governmental institutions, private actors (local business, contractors).

- How do you measure the success of your pilot? Do you have any indicators for successful mainstreaming of NbS?

Proof of concept of the monitoring guidelines, risk perceptions, quantification of NBS benefits.

### **Enabler 4: Institutional embedding**

- How do current institutional arrangements already facilitate mainstreaming of NbS? Please describe and mention the key institutions
- All interventions/cases are based on policies for nature restoration. For other type of interventions (like flood protection measures) NbS are not mainstreamed yet. How committed is your organization to mainstreaming NbS within MANABAS Coast and after the project ends?

Our goal is to strengthen relationships with local and regional authorities and raise awareness about the added benefits of NBS for coastal protection.

### **Enabler 5: Business Case**

- Do you face problems with funding in your pilot? Please briefly describe, including the general sources of funding.

Generally, there are not direct funding available for NBS in the Netherlands, unless as nature restoration budget as part of other investments.

- How will your pilot and/or continued mainstreaming be funded after the MANABAS Coast project?

Not known yet.



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### **Enabler 6: Capacity building**

- What types of capacity building would your pilot need in order to facilitate mainstreaming of NbS?

Create a proof of concept about the effectiveness of NBS at local and regional scales. In addition, we aim to raise awareness about the added value of NBS at different governance levels: future professionals (HZ students), local and regional coastal authorities and civil sector.

### **Enabler ranking**

To what extent are the above enablers important for mainstreaming NbS in your region?  
Please rank (1 is least important, 10 is most important)

#### **Enabler 1: Technology and system knowledge**

1 2 3 4 5 6 7 8 9 **10**

#### **Enabler 2: Multistakeholder approach**

1 2 3 4 5 6 **7** 8 9 10

#### **Enabler 3: Management, monitoring and maintenance**

1 2 3 4 5 **6** 7 8 9 10

#### **Enabler 4: Institutional Capacity**

1 2 3 4 5 6 7 8 **9** 10

#### **Enabler 5: Business case**

1 2 3 4 5 6 7 8 **9** 10

#### **Enabler 6: Capacity Building**

1 2 3 4 5 6 7 **8** 9 10

### **Suggestion for additional enablers**



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Are there any aspects of mainstreaming enablers from your pilot that you can already suggest? If so please briefly state these:

### Part 3 MANABAS mainstreaming framework (inspired by earlier work e.g. ISBAM)

*Within MANABAS Coast we are working on a framework that helps in mainstreaming NBS. To develop this framework, we need information on the pilots as well as the ambitions and goals of the different organization involved. We build on work already done in the past such as the ISBAM approach, which was developed in the Interreg BwN project (see also the brochure in the appendix for a further explanation or online). Just as the enablers, the MANABAS mainstreaming framework is still a work in progress.*

*As a starting point for the MANABAS framework, 3 leading principles from ISBAM are evaluated. We would like to know if these principles can also be applied across the entire northwest Europe coasts and how they can be improved. .*

*Three leading principles have been identified that are deemed important to enable mainstreaming of NBS:*

MANABAS Coast principle 1: "Act at a landscape (system) scale, including both the natural and socio-economic system/context"

- Do you identify with this principle?

Yes

- Is this principle applied (to a certain degree) within your pilot? And within your organization? If yes, how?

Yes, the Westerschelde system is an estuary landscape and its management is divided among a variety of governmental organizations.

- In managing your assets, how are the system-wide effects and benefits taken into account?

The socioeconomic effect of the managed realignment interventions (assets) are taken into account in each site. E.g. Zwin nature park has increased tourism in the area and the

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income of local business. However, it is unknown what is the effect of such interventions on the natural landscape development.

- On a scale from 1 (room for improvement) to 10 (superb), do you think your organization adheres to this principle? Why?

1 2 3 4 5 **6** 7 8 9 10

We are a research institute, this principle is embedded in the research projects and education curriculum.

MANABAS Coast principle 2: "Integrate management of multiple assets and functions within the landscape system context"

- Do you identify with this principle?

yes

- Are relevant organisations/institutions efficiently cooperating to jointly address system-wide challenges? If yes, which challenges and how?

Organisations / institutions cooperate together within a project (e.g. Hedwige project, Manabas project) but they don't cooperate outside the projects

- If you see room for improvement in the integrated management of multiple landscape assets, what would be the necessary steps to take according to you? Briefly state

Currently, internal managements of assets is divided between different departments and they don't know about each other's work. Thus, the internal communication and sharing information need to happen first internal and next externally.

- On a scale from 1 (room for improvement) to 10 (superb) how much is this principle applicable to your organization?

1 2 3 4 **5** 6 7 8 9 10

We are a research institute, this principle is embedded in the research projects and education curriculum.

MANABAS Coast principle 3: "Embrace and leverage upon the natural dynamics of the system"

- Is this principle applicable to your situation/organization?

Yes, the Building with Nature group is busy with studying the natural dynamics of the system.

- What are the main natural processes that should be considered? Are these well-known with all the stakeholders?

See part 1A and 1B.

- How are using natural processes incorporated in the management practices within your organisation?

We are research institute, we contribute to knowledge development on natural and governance processes.





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- On a scale from 1 (room for improvement) to 10 (superb) how much is this principle applicable to your organization?

1 2 3 4 5 **6** 7 8 9 10

We are a research institute, this principle is embedded in the research projects and education curriculum.

Additional MANABAS Coast mainstreaming questions:

- In your view, what is essential in the mindset or way of working of people (policy makers, managers, professionals, general audience) to promote mainstreaming of NBS? Do stakeholders need more information on mainstreaming?

Yes, more inspiring examples are needed to be shared and create awareness among actions. In addition, involvement of policy makers should happen at the start of the pilot project.

- What other leading principle(s) would you suggest?

Capacity building is a key principle for institutional embedding and thus mainstreaming of NBS.

- How can we make these principles more applicable to the context of pilots?

By making them more operational using indicators that apply to the pilot context.

- **Finally: What does mainstreaming mean for your pilot? Please briefly describe.**

Move from implementing NBS reactively (i.e., in response to N2000 legislation), to implementing NBS proactively (i.e., as part of future flood defence to deal with SLR). This means that we must address current limitations in e.g. system knowledge, social acceptance, and implementation approach. In addition, we must share this knowledge among relevant actors to increased their awareness on NBS and get their acceptance as alternative solutions for coastal management.