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Work Package 3

Work Plan – Resilient Coastal Laboratories

Status: Final version

Colophon: Interreg VB NSR Building with Nature

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1. Introduction

1.1 Interreg NSR project Building with Nature

Parts of this chapter are extracted from the Action Plan Building with Nature which is the base of the overall project (Interreg North Sea Region, 2016).

Introduction

Building with Nature, a phenomenon already known for several decades in which natural forces are used to build, construct or maintain a human intervention. In this interregional North Sea project experiences with Building with Nature (BwN) in different countries will be shared and further explored.

The BwN project builds upon successful existing networks for effective knowledge exchange: North Sea Coastal Management Group, Trilateral Cooperation on the Protection of the Wadden Sea, Ecoshape. They are involved in the project as beneficiaries and for the first time will join approaches and outcomes. Uptake is further assured through the participation of decision makers such as national governments in the project partnership.

This BwN project will demonstrate climate change solutions at seven target sites in coastal living laboratories and at six sites in catchment living laboratories. These sites comprise large-scale existing investment projects that will be leveraged and enriched with transnational best practice, performance monitoring and co-analysis, cost-benefit analysis and business case generation.

Objective and approach

The overall objective of the BwN project is to make coasts, estuaries and catchments of the North Sea Region (NSR) more adaptable and resilient to the effects of climate change. BwN creates joint transnational monitoring programmes, uses state-of-the-art analysis methods, and develops improved designs and business cases. BwN coastal and catchment laboratories generate the evidence-based that is currently lacking to incorporate building with nature solutions in national policy and investment programmes.

The contribution of BwN to increasing the resilience of water infrastructures to climate change is indirect and will be realised throughout the adoption of nature-based solutions by authorities in the NSR in parallel to, and after the BwN Interreg project. The main goal to achieve during the time frame of BwN is to create a well-documented evidence base that allows for policymakers and asset owners to incorporate Building with Nature / Nature Based Solutions and principles in decision-making processes.

Project Result indicators

Interreg NSR JS mentioned that the project indicators are ambitions to achieve within the project. However, it is understandable that the achievement of ambitions cannot be guaranteed. Though they can (and will) demonstrate that a concerted effort was made towards achievement. No financial consequences are

coupled to the defined ambitions/indicators. The project indicators (3) are as follows:

Indicator 1:

"New coastline plans using shared insights, designs and demonstrations of the effectiveness of the methods of Sand Nourishments, based on Building with Nature principles"

This indicator can be measured in the following way: in 2016 the number of kilometres coastline using shared insights, designs and demonstrations is zero. The ambition is to have 700 km of shared insights, designs and demonstration of Building with Nature principles (BE: ± 65 km, NL: ± 350 km, DE: ± 135 km, DK: ±150 km, a total of 700 km).

Indicator 2:

"New catchment areas managed using shared Building with Nature techniques as a result of the effectiveness of project demonstrations, based on Building with Nature principles."

Indicator two can be measured in the following way: in 2016 0 km of shared management insights of catchments is present. The ambition is to have 550 km shared management insights in 2020 (Eddleston water project, Room for the River, Kleine Nete catchment, Lauwersmeer and the catchment area of Raan).

Indicator 3:

"Climate change resilience increase at target sites."

10% aggregated reduced long-term projected erosion and flood probabilities at coastal sites and reduced flooding in catchments:

$$\frac{\text{Projected flood risk reduction projects in 2019} - \text{Projected flood risk reduction projects 2016}}{\text{Projected flood risk reduction projects in 2016}}$$

- Projected flood risk reduction projects 2019 for period 2020/2025 minus projected flood risk reduction projects 2016 for period 2020/2025 divided by projected flood risk reduction projects 2016 for period 2020/2025
- Definition of the criteria and projects to be included in the calculation will be defined during the project.

Project structure

The project structure consists of two different disciplines (catchments and coasts). These disciplines are coupled by means of the WP leaders, together with the business case development, upscaling practice and policy/capacity building work packages. The overall project coordination is facilitated by Rijkswaterstaat (NL). Rijkswaterstaat is the lead partner of this Interreg NSR project. The project

scheme is visualised in Figure 1. More information on the project structure and activities of other work packages can be found in the action plan (Interreg North Sea Region, 2016).



Figure 1 - BwN structure and WP leadership (Source: Interreg North Sea Region, 2016)

1.2 Work Package 3

Work package three is one of the six work packages of the full project and will put focus on resilient coastal laboratories. Learning by doing is a key element in this work package. By doing research to implemented BwN measures on a project’s lifecycle of different partners through monitoring it helps to identify knowledge gaps, provide lessons for other locations and enhances the understanding and applicability of BwN measures.

Resilient coastal laboratories within work package three of this Interreg Building with Nature project will focus on beach and shoreface nourishments, sediment management and erosion control. Partners involved are listed in Table 1.

Table 1 - List of partners involved in WP3

Organization	Acronym	Country	Contact person:
Ministry of Infrastructure and Environment - Rijkswaterstaat	RWS	The Netherlands	Quirijn Lodder; Quirijn.lodder@rws.nl
Schleswig-Holstein Agency for Coastal Defence, National Park and Marine Conservation	LKN.SH	Germany	Birgit Matelski; Birgit.Matelski@lkn.l andsh.de
Lansstyrelsen Skane - The County Administration Board of Skane	LS	Sweden	Pär Persson; Par.Persson@lansstyrelsen.se

Common Wadden Sea Secretariat	CWSS	Germany	Folkert de Jong; dejong@waddensea-secretariat.org
Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten-und Naturschutz	NLWKN	Germany	Frank Thorenz; Frank.Thorenz@nlwkn-nor.niedersachsen.de
Kystdirektoratet	DCA	Denmark	Anni Lassen; anl@kyst.dk
Afdeling Kust - Coastal Division	MDK	Belgium	Daphné Thoon; daphne.thoon@mow.vlaanderen.be

1.3 Report outline

This work plan is written for work package three of the Interreg NSR Building with Nature project (Milestone 5). Chapter one covers the contents and objectives of the overall project, project indicators, project structure and a short introduction of work package three. Chapter two will describe in depth the objective of work package three, research questions and research approach. Chapter three focusses on the boundary conditions like planning and budget. This documents ends with a list of references used (chapter four). Attached are the list of milestones in Appendix A and the description of external work to be done by each project partner in Appendix B.

2. Methodology

2.1 Objective

The objective of work package three, derived from the overall objective stated in section 1.2, is to make coasts of the North Sea Region (NSR) more adaptable and resilient to the effects of climate change by means of learning by doing. This learning by doing will be explored for the already sandy-managed coasts of each project partner shown in Figure 2. In Figure 3 the ambition of the project is visualized. In addition, the County Administration Board of Skane (LS) will contribute to this objective in various ways by learning from other partners on sandy coastal management and providing lessons learned on BwN solutions that are incorporating ecosystem based solutions (Eelgrass).

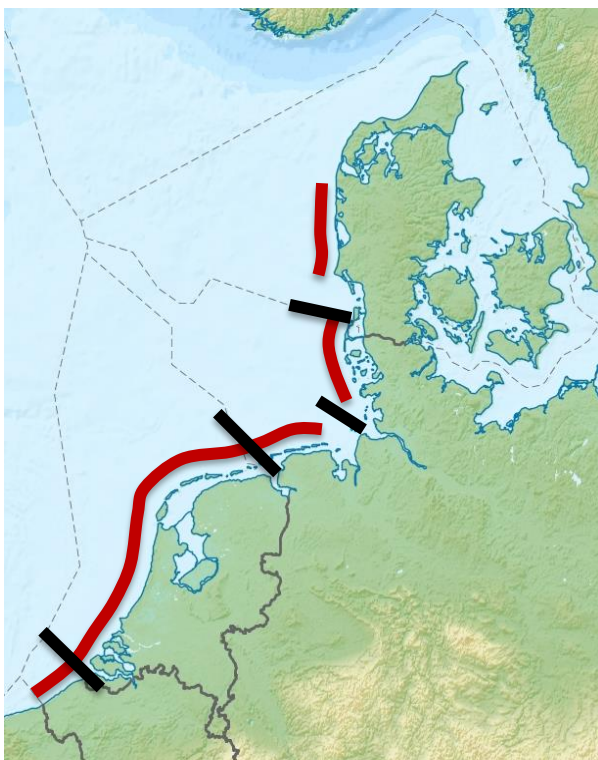


Figure 2 - Coastal stretches included in the BwN project by each partner.

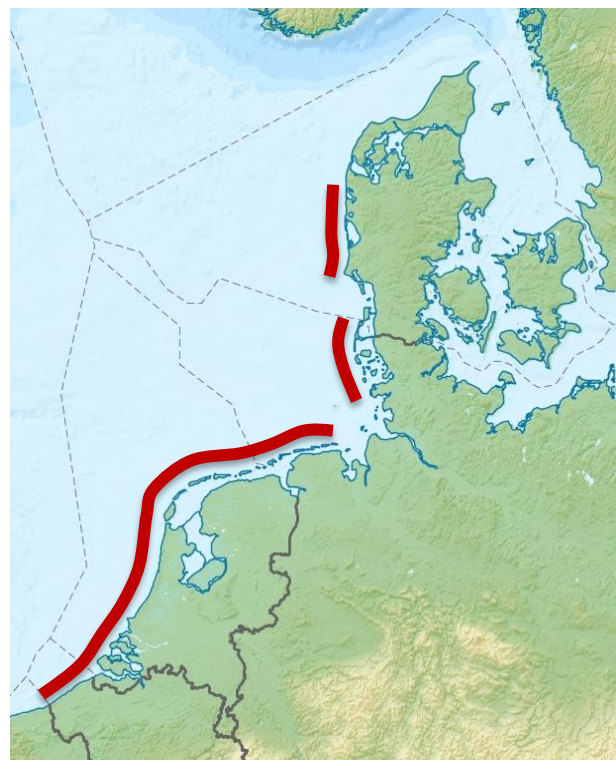


Figure 3 - Ambition to learn from each other and develop shared knowledge on sandy coastal management

In the end, the result of work package three is a common in depth evidence base that will help policymakers and asset owners to incorporate Building with Nature solutions in guidelines and decision making processes. Work package three will therefore contribute to work packages five and six.

2.2 Research questions

To come up with an evidence base of building with nature solutions with respect to climate resilience, several research questions are drawn. The main research question for this project is:

"In what way is resilience to climate change using Building with Nature principles best served in coastal management in the North Sea region?"

To answer the main question, several sub-questions are drafted:

- Given the current practices of all partners, which knowledge gaps can be identified to come up with a shared methodology of analysing all current practices (applied BwN solutions)?
- Can driving forces and/or coastal characteristics be identified which cause possible differences in coastal behaviour?
- What can be concluded from differences in coastal behaviour at each study site with respect to coastal management and climate resilience?
- What can be concluded from different approaches of building with nature solutions with respect to climate resilience?
- What can be concluded concerning the import and export of sediment towards the Waddensea back basin?
- Can a shared common best approach in coastal management be defined for all partners using Building with Nature principles?

2.3 Scope

The current project will focus on the North Sea region, in specific the Belgian, Dutch, German, Danish and Swedish sandy coasts. The sandy coastal region to be taken into account ranges between ± -10 m MSL towards the inner dune foot and/or inner toe of a dike and/or landward boundary of the coastal system in case only shorefaces are present as coastal defences (nearshore areas).

Climate resilience in this project is expressed as the ability to evolve with the expected sea level rise due to climate change. In addition, the building with nature principles will mainly focus on sandy solutions and the application of ecosystem based solutions (eelgrasses).

This research is limited to the budget available at each partner. The available budget per partner will result in effort and analyses differences within the project, see research approach, section 2.4. The available external work budgets are shown in Appendix B. The project started in officially in September 2016 and will last up to June 2020. A detailed planning is shown in chapter 3.

2.4 Research approach

2.3.1. Work plan work package three

The research of work package three starts with composing a work plan (Task 1, T1). The work plan (this document) is the first Milestone of WP3. The work plan consists of research questions, detailed planning, coastal laboratories definition, study sites, research approach, gap analysis, twinning programme and the needed assessments. This work plan is a living document and will be more detailed in the forthcoming years as the project will evolve.

2.3.2. Coastal laboratories definition

The Interreg VB NSR Building with Nature coastal laboratories are defined as coastal study sites in which Nature-Based human-made interventions took and take place to work with natural processes in order to grow with sea level rise, stabilize the natural system or to compensate negative effects as ongoing erosion.

2.3.3. Coastal laboratories

The coastal laboratories included in work package three can be seen in Figure 4. A short description of every laboratory is provided below.

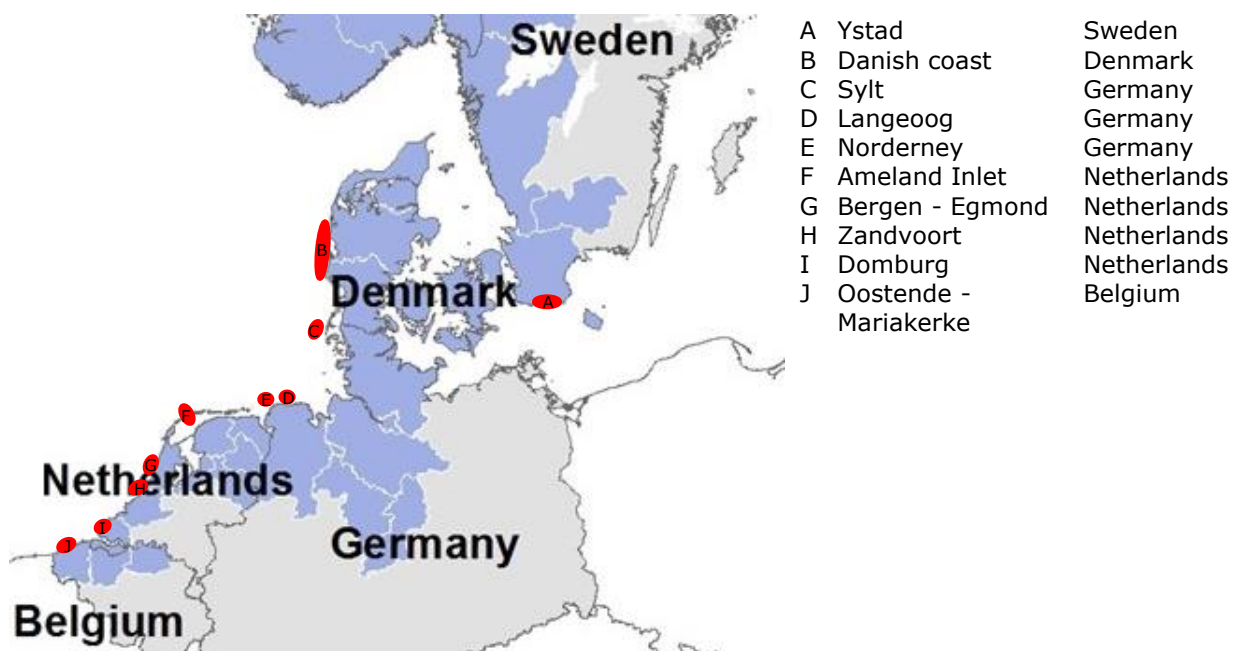


Figure 4 - Selected coastal laboratories

- In Ystad (A), Sweden, a pilot beach nourishment is currently being monitored and under research. Besides this sandy solution, along the Swedish coast several pilot projects will be executed which investigate the use of ecosystem (grasses) in order to prevent coastal erosion.
- Along the Danish coast (B), between Lodbjerg and Nymindesgrub, the Danish Coastal Authority is seeking to optimize the sandy coastal strategy concerning beach and shoreface nourishments.
- On the island of Sylt (C), Schleswig Holstein Germany, LKN.SH is maintaining the coast by regularly applying beach and shoreface nourishments. LKN.SH is looking for a long-term balance in the nourishments with respect to the expected sediment deficits in the Waddensea.
- On the islands of Langeoog (D) and Norderney (E), Lower Saxony Germany, NLWKN wants to develop a better understanding of the natural

processes in the shoreface and beach areas to optimize the coastal protection strategy using Building with Nature principles.

- In the Ameland tidal inlet (F), the Netherlands, Rijkswaterstaat wants to establish a research program concerning sediment management for tidal inlets of the Waddensea and compare this to other inlets of the Waddensea to come up with an overall sediment balance of the Waddensea.
- Bergen – Egmond (G), Zandvoort (H) and Domburg (I), the Netherlands, are included by Rijkswaterstaat as coastal laboratories to understand the behaviour of shoreface and beach nourishments with respect to the sandy coastal management strategy and coastal characteristics.
- In Oostende - Mariakerke (J), Belgium, the coastal division of the Flemish government is currently performing a research program including the monitoring of a beach and shoreface nourishment pilot to understand the behaviour and effectiveness of both nourishments for coastal protection.

2.3.4. Analyses

The first step in this research is the inventory and comparison of current practices of each partner. All partners will compose a factsheet of their current practice from flood prevention strategy to the execution and evaluation of nourishments. These factsheets provide an overview of current practices and arguments why this approach has been chosen. After composing the factsheets, an overall current practice comparison matrix will be made. This matrix will point out the essential similarities and differences in the current approach.

PRODUCT 2: COMPARISON CURRENT PRACTICES.

MARCH 2017

**ABSTRACT: RESEARCH PROPOSAL FOR COASTAL DYNAMICS CONGRES
2017 DENMARK**

OCTOBER 2016

At the same time of finalising the work plan and factsheets current practices, a data factsheet will be composed. This data factsheet contains metadata and examples of data available at the coastal laboratories that will be included in the project. The data factsheet is the first step in sharing the available data for co-analyses. The data factsheet will be an inventory of the data available at each partner, which, will be shared.

PRODUCT 3: FACTSHEET DATA.

MARCH 2017

After the analyses performed by each project partner individually (see next product), a co-analyses of all building with nature solutions will take place. The co-analyses will focus on performance monitoring of beach and shoreface nourishments in the selected coastal laboratories (SE, DK, D (2), NL, BE). The first step of the co-analyses is the definition of a common methodology to evaluate nourishments by means of shared Coastal State Indicators using the

same tools. Based on the current practices, a framework/methodology for co-analysing will be defined in 2017.

PRODUCT 4: SHARED METHODOLOGY CO-ANALYSES	DECEMBER 2017
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As mentioned, every project partner will perform different types of analyses on their included coastal laboratories. These analyses will result in a product of national analyses on the behaviour of nourishments in different coastal stretches (volume changes, design parameters, local hydrodynamics), the influence of ecosystem based solutions on coastal erosion, dune dynamics (T2-T5). Per partner is described which contribution to the product they will provide. At a later moment in time there will be determined which parts of the products will be converted into abstracts and submitted for conferences and/or publication.

Sweden (LS) (T7.1 – T7.3): Investigate how protection and restoration of marine environments and beaches can diminish and/or counteract coastal erosion along the Swedish coast. Pilots will be executed using eelgrass to avoid coastal erosion (measure the effect on the exposure of waves and currents on the coastline) and prohibition removal of sand bank in shallow water. Promising areas for coastal restoration using eelgrass will be identified. In addition, a GIS analysis will be performed to inventory suitable retreat locations for ecosystem based solutions.

Denmark (DCA) (T3.1 – 3.5): Optimizing sandy coastal management of a 110 km coastal stretch between Lodbjerg and Nymindegrab. This task concerns the analysis of the impact of two shoreface nourishments using common coastal state indicators (CSI's) in MorphAn and own software. Analysis of beach nourishments regarding design guidelines, analysis of dune erosion (using LIDAR, GIS and DHI-MIKE21 IG model) to different approach of dune strengthening. In addition, a classification of storm erosional impact on dune safety for use in storm surge preparedness will be developed. A total sediment budget for the Danish part of the Wadden Sea will be calculated in order to investigate if the sedimentation rate is able to keep up with the sea level rise.

Germany (LKN.SH) (T5.1 – 5.6): Evaluate Sylt shoreface nourishments (in total a 35 km coastal stretch) in order to create a long-term balance to the expected sediment deficits in the Waddensea due to sea level rise. This task concerns monitoring of the morphodynamic active areas, collecting and estimating data (hydrography, hydrology and biology), composing a morphodynamic model for the area, performing biological studies and providing/estimating optimal extraction sites for nourishment considering minimisation of ecological interferences.

Germany (NLWKN) (T4.1 – 4.4): Establish a coastal protection strategy for several East Frisian islands including Norderney and Langeoog. To achieve this goal, understanding of natural processes in the shoreface and beach area is needed. This task will be achieved by reporting on findings and activities; the

evaluation of the coastal morphodynamics, before and after shoreface/beach nourishments, monitoring and evaluation of new nourishments and optimising the design and techniques of nourishments. The total length of coast to be considered is 76 km.

The Netherlands (RWS) (T2.1 – 2.3): Performance analysis of shoreface nourishments, beach nourishments and coastal foundation at the Dutch North Sea Coast at selected locations (Dutch coast in total 350 km. Three sites will be investigated). This task will partly be executed by means of an MSc thesis and partly be subcontracted. The work consists of analysing the morphological behaviour of several shoreface nourishments (analyses of: volume changes, migration speed, design parameters, local hydrodynamics, wind, coastal layout, other nearby nourishments or coastal structures).

Belgium (MDK): Share research progress, provide reports, data, findings and conclusions of Oostende - Mariakerke nourishment pilot. At the end of the project, the Flemish developed knowledge will be incorporated within the projects results.

PRODUCT 5: NATIONAL ANALYSES

DECEMBER 2018

The next step is the execution of the co-analyses (twinning programme – application of common analysis tool to coastal laboratories). Part of this co-analyses contains coastal characteristics of the study sites. The results of the co-analyses are the basis for the evidence base and work packages five and six. These results will also be published by means of an (conference) publication.

PRODUCT 6: RESULT CO-ANALYSES BWN
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JULY 2019

A topic that has been identified by several project partners (RWS, NLWKN, LKN.SH and DCA) is the Waddensea back basin sediment balance. Several tasks of each project partner are contributing to this topic (T3.6; sediment budget for the Danish Waddensea, T5.7; evaluate modelling results with result to the impacts of nourishment on the Waddensea in consideration of sea level rise, T9; Waddensea back basin sediment balance). During the Husum meeting in June 2016, all partners agreed that Rijkswaterstaat will present a research proposal in September 2016 (Malmö meeting) on this topic. In the January 2017 meeting in Utrecht, the project partners decided to continue this topic individually per project partner and share knowledge that will be developed. No full integration of all developed knowledge will take place in this Interreg project.

A specific part of this subtask is the (additional application of) monitoring (bathymetry, waves, current and sediment transport) and modelling of the Ameland tidal system (RWS). Insight of the sediment dynamics on decadal timescales, both measured and modelled, is the main goal for this subtask. The result of this analysis can be compared to the Texel and Vlie inlets as well as dammed or partly open inlets (Haringvliet, Grevelingen, Eastern Scheldt).

Rijkswaterstaat will link this analysis to the currently ongoing research Coastal genesis 2 (in Dutch: “Kustgenese 2”). The analyses will lead to an updated sediment balance of the Dutch Waddensea with can optionally be coupled to sediment balances of the German and Danish Waddensea.

PRODUCT 7: MILESTONE 14: WADDENSEA BACK BASIN SEDIMENT BALANCE	DEC 2019
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PUBLICATION (ABSTRACT/PAPER)	TO BE DETERMINED
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The last step in this project is to draw an evidence base and guidance guidelines. Based on the individual analyses, data sharing, co-analyses, learning by doing and common lessons learned an evidence base will be consolidated. These conclusions will be converted into technical guidelines to help design, model and monitor BwN solutions. The evidence base is to be presented at the workshop/symposium on the Waddensea sediment system (CWSS) and will be used for a best practice analysis at the implementation of the Trilateral Waddensea Climate Change Adaptation Strategy (CCAS by CWSS).

PRODUCT 8: EVIDENCE BASE AND GUIDANCE	DECEMBER 2019
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2.3.5. Planning overview

In this section, a brief overview of the planning is shown. The overall detailed planning can be found in chapter 3.

Work Package 3 Brief Gantt chart			Year	2016	2017	2018	2019	2020
Product	Task	Description	Beneficiary					
P1	T1	Work plan WP 3	All		Mar			
P2		Comparison current practice and coastal characteristics	All		Mar			
P3		Factsheet data	All		Mar			
P4	T6	Shared methodology co-analyses	All		Dec			
P5		National Analyses						
	T2	Dutch North Sea coast nourishments	RWS			Dec		
	T3	Danish North Sea coast	DCA			Dec		
	T4	East Frisian Island	NLWKN			Dec ¹		Apr ²
	T5	Sylt shoreface nourishment	LKN.SH			Dec		
	T7	Swedish coastal retreat prevention (Grannian)	LS			Dec		
		Oostende - Mariakerke pilot project updates	MDK			Dec		
P6	T6	Co-analysis of national analyses	All				Jul	
P7		Wadden Sea back basin analyses						
	T3.6	Sediment budget Danish Wadden Sea	DCA				Jul	
	T5.7	Modelling impact nourishments on the Wadden Sea in consideration of SLR	LKN.SH				Sept	
	T9	Ameland tidal inlet monitoring and analysis	RWS				Dec	
P8	T10	Evidence base and guidance	All IHE CWSS				Dec	
		Finalization and preparation final event						Jun

Table 2 – Brief overview planning. Deadlines of activities in a particular month is shown.

¹⁾ Deadline first part focussing on former nourishments. ²⁾ Second part focussing on recent nourishments.

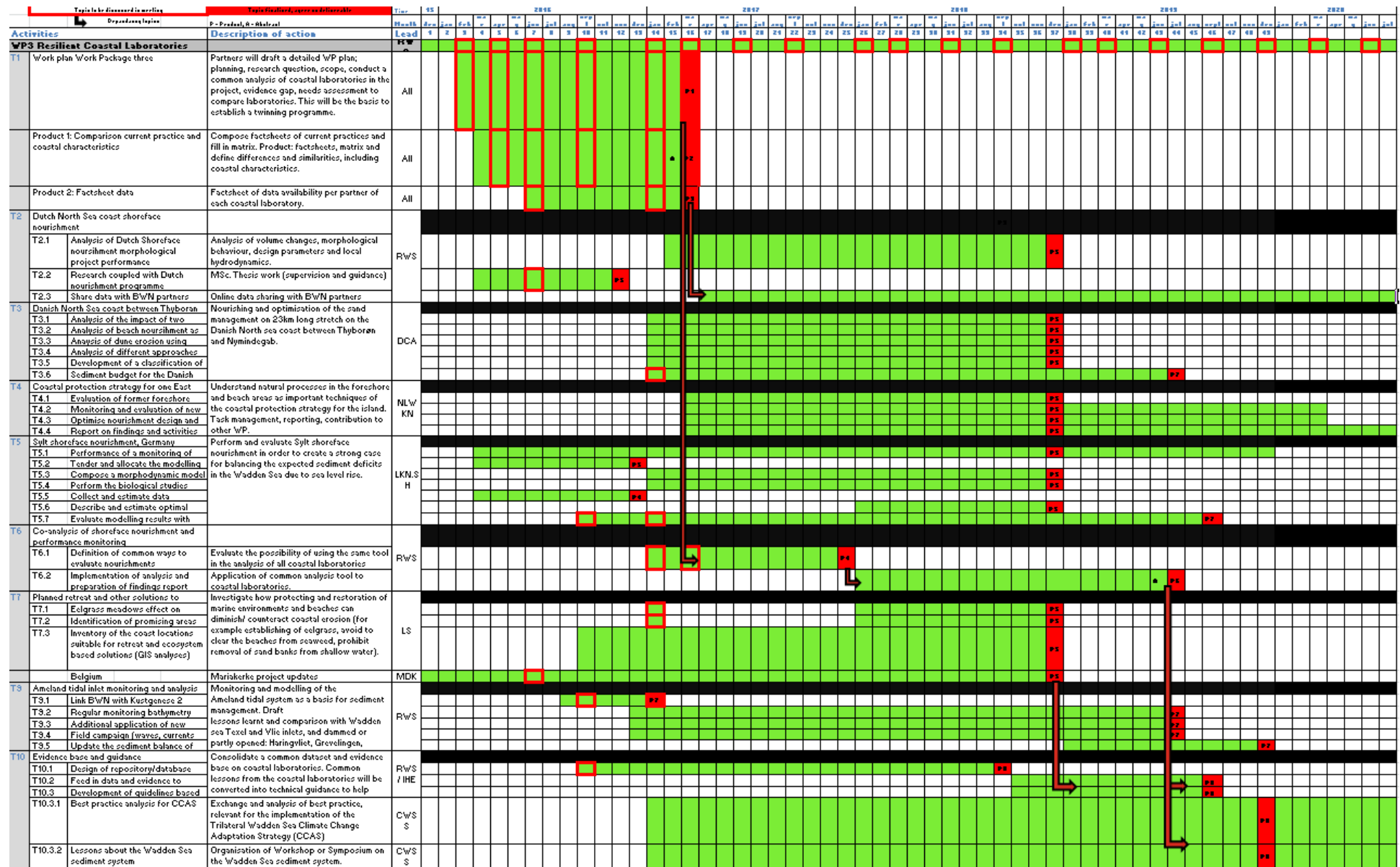
2.5 Connection with other work packages

An important element of the overall project is the connection with other work packages. Work package three will provide input for communication activities (WP2), Business case development (WP5) and upscaling (WP6). This work plan, as well as all produced products, will be shared with all work packages. As a first connection activity, the Danish Coastal Authority intends to organize a workshop regarding the Danish coast to develop a business case and upscaling to decision makers and policy makers.

3. Planning & budget

The WP3 project planning is shown on page 17, Table 3. The planning (and work plan) are living documents that will be updated periodically. For efficiency purposes the topics which are related to other work packages prefer to be discussed during the half yearly March and September meetings of the overall Interreg BwN project.

Table 3 - Planning WP3 (see separate excel file "Planning - Gantt chart WP3 V4 final.xlsx")



4. References

Interreg North Sea Region. (2016). *Building with Nature Action Plan; Final Version*. The Hague : Interreg NSR VB.

Appendices

A. List of milestones

Table 4 - List of Milestones. Important milestones for work package three are highlighted. For the time planning, see Gantt chart

Milestones:

MS1	Kick-off meeting
MS2	Launch event - partnership agreement signed
MS3	Communication plan
MS4	Defined objectives Policy Learning Group (PLG)
MS5	Final version of WP3 plan
MS6	Final version of WP4 plan
MS7	First draft of strategy to develop the capacity building programme
MS8	Full progress report 1.
MS9	PLG strategy and partners engagement
MS10	UIHE draft report BwN practices
MS11	Workshop 1: governance barriers and action plan
MS12	UIHE draft outline research programme and potential calls
MS13	Workshop 2: governance barriers and action plan
MS14	State of the art volume calculation techniques, updated sediment balance for the Wadden Sea.
MS15	Full progress report 2.
MS16	UIHE workshop on policy and research gaps
MS17	Full progress report 3.
MS18	Strategic document on policy learning and recommendations after the project
MS19	Recommendations and guidance on design and business case development
MS20	Coastal Laboratories: evidence base and guidance
MS21	Natural Catchment Laboratories: evidence base and guidance
MS22	Full progress report 4.
MS23	Final report

B. Description of external work to be done

Table 5 - List of external work to be performed for work package three by each partner

Description External work	Contracting beneficiary	Budget
Symposium in 2017 on intermediate results review and evaluation best practices as input for the trilateral governmental Wadden Sea Conference, early 2018	CWSS	€ 2,500
Symposium 2019 on final results evaluation best practices Wadden Sea	CWSS	€ 2,500
Study of how vegetation structures can diminish and counteract coastal erosion	LS	€ 68,000
project performance of nourishments and modelling of the Ameland Tidal inlet	RWS	€ 500,000
Purpose: (1) establish a morphodynamical model of the study site, (2) morphological monitoring and (3) biological monitoring	LKN.SH	€ 350,000
Small contracts with service providers to organize and conduct workshops, local seminars and field trips that will be part of WP 3.	NLWKN	€ 5,000
First level control (if not "in-house" by Lower Saxony administration)	NLWKN	€ 4,000
Monitoring of sand nourishment by means of beach and dune survey	NLWKN	€ 50,000
Monitoring of sand nourishment by means of surf zone survey (sounding)	NLWKN	€ 80,000
Monitoring of sand nourishment and adjacent bathymetry, including adjoined tidal ebb delta by means of nautical survey (sounding)	NLWKN	€ 120,000
Sedimentological analysis to determine the characteristic parameters of sediments and their spatial distribution, ex-ante and ex-post development	NLWKN	€ 15,000