Capitalization Strategy

Capitalization strategy Interreg NSR TOPSOIL

TOPSOIL: Resilient soil and water resources, understanding the water beneath your feet

Content

1 Introduction to TOPSOIL

1.1 Background and purpose of the project

The TOPSOIL project explores the possibilities of using the topsoil layers to solve current and future water challenges. It looks beneath the surface of the ground, predicts and finds **solutions for climate related threats**, like flooding during wet periods and drought during warmer seasons. The overall objective of the project is the joint development of methods to describe and manage the uppermost 30m of the subsurface, in order to **improve the climate resilience of the North Sea Region**. In addition, the project demonstrated a practical implementation of solutions in **16 pilot projects**.

Six major working areas have been identified where international cooperation is particularly beneficial.

1. **Flooding** in towns and agricultural areas due to the rising groundwater table caused by changed precipitation patterns.

2. **Saltwater intrusion** into freshwater reserves due to rising sea levels and changed irrigation, drainage and drinking water demands.

3. The need for a **groundwater buffer** to store water in periods of excess rainfall. The buffer of fresh water can be used for irrigation purposes during dry periods.

4. Better **knowledge and management of soil conditions**, which will provide better resilience to extreme rainfall events, improve water quality and crop yields.

5. The **capacity to break down nutrient**s and other environmentally hazardous pollutants in the uppermost layers is yet unexplored. By improving our understanding, better land management can be implemented.

6. Strong **seasonal imbalances in groundwater availability and quality** have increased during the last years. For the last year of TOPSOIL , results already achieved will be transferred and tested in new areas and they will further be disseminated to concerned stakeholders dealing with climate change adaption and integrated GW management.

These technical challenges have been addressed in an integrated approach, including stakeholders needs and perspective, and communication. Many good solutions have been achieved. To make the most of this project, during the last year of the project we will pay strongly attention to capitalize our achievements even more.

1.2 Capitalizing our results

The aim of the capitalization strategy is to reach better out with the TOPSOIL results, and to disseminate results to reach both regional stakeholders as well as European policy level. Expanding the stakeholder involvement strategy, the pilots will implement regional meetings with stakeholders who can contribute to further development of the TOPSOIL results after the project. Selected models / tools (e.g. the tTem) will be part of new business models.

Measures which were e.g. identified in models are only taken up if they are publicly acknowledged and controllable. As groundwater management is de facto impacted by very local decisions such as farming practices or local retention areas, modelling results and monitoring need to be linked and communicated to farmers and other land-users, as well as to local politicians and authorities.

We will further **capitalize our TOPSOIL results from the entire project**, so that local and regional stakeholders in groundwater management find better access to the support provided by the vast amount of knowledge. This also includes the development of new business models for selected tools or measures.

The capitalization strategy as presented in this document consists of two big parts: the first one is a *communication strategy*, since communication is the key to understanding and involving. The communication strategy is build up in two layers: a project layer and a pilot layer. The second part of the capitalization strategy is the *technical capitalization*. This part focusses on the technical aspects, the costs and potential risks.

This strategy may be adapted as a consequence to occurring events (such as drought periods) and changing media.

Situation analysis: SWOT

To help build on what TOPSOIL has been doing well, what has been lacking, to minimize risks and to take advantage of chances for success, a SWOT analysis has been carried out. The following bullets show the starting points of the project and this strategy. They are reflected in various publications / media and activities of the partners and also motivate the coming project implementation.

Strengths (internal)	**Weaknesses (internal)**
• Success of TOPSOIL (and strong partnership and existing network) • Willingness of partners to improve the situation • Availability of data and possible measurements	• Possible problems or delays with transnational testing (e.g. Covid-19) • Language barriers • Internal cross-departments communication
Opportunities (external)	**Threats (external)**
• More acknowledgement for climate change adaptation because of droughts (e.g. the drought of 2018) and floods • More interest of youth for climate related issues • In Germany: high pressure from EU on reducing nitrate input • More awareness of agricultural and horticultural production as being system relevant due to Covid 19	• Existing policies • Budget cuts in the public sector • Uncertain and contradicting information on the impact of climate change • Possible change of political focus from climate change to supporting the post-Covid 19 economy • Awareness of soil-water problems resulting from climate change is only local/regional (where regions have already been affected)

2 Communication Strategy

2.1 Target audience and main objectives of TOPSOIL communication

Before we take a deeper look at the target audience, we make a **distinction between communication at the project level and communication at the pilot level**. Target groups may differ depending on the 'communication and involvement level'. The activities proposed in the extension have all been initiated and/or supported by our stakeholders. This allows us to link scales and to integrate groundwater management better, e.g. from local decision, makers to catchment scale.

At a **project level** (inform), we want to

1. Emphasize the importance of groundwater and seasonal balancing.
2. Communicate and raise awareness about the 5 other shared challenges of our project and how the groundwater system works
3. Communicate the objectives, results, benefits and demonstration projects that are achieved and implemented in TOPSOIL to facilitate the uptake of measures and interaction with the general public.
4. Encourage European strategical managers and policy makers to adopt policies that take a sustainable use of our groundwater resources into account and contribute to an optimized seasonal balancing

Target audience:

- National and European strategical managers and policy makers
- General public
- Other European projects
- Water managers

At a **pilot level** (inform, engage & empower), we want to

1. Ensure that our activities and results become sustainable after the end of the project (empower water managers and farmers across NSR with the knowledge and expertise that has been built up by the transnational exchange between the project partners)

2. Communicate the objectives, results, benefits and demonstration projects that have been achieved and implemented in TOPSOIL to facilitate the uptake of measures and interaction with the general public and stakeholders in the different pilot project areas.
3. Encourage national strategical managers and policy makers to adopt policies that take into account a sustainable use of our groundwater resources and contribute to an optimized seasonal balancing.

Target audience

- General public (on a local scale)
- Other projects
- Regional water managers & local decision makers
- Farmers (SME's) and land-users

2.2 Activities to reach our target groups

2.2.1 Communication to reach 'general public'

Project level:

- About a dozen of short videos have been included in the TOPSOIL YouTube channel, reaching already more than 3.500 views. In addition, partners have produced as part of their own channels videos explaining their TOPSOIL activities.
- All partners in TOPSOIL present the project on their organisations website. Partners should make sure that the TOPSOIL animation video is embedded there.
- Partners have committed to share invitations and news updates on social media and explore the possibilities of different media channels (such as LinkedIn). Each partner will provide at least one news issue per 6 months to be published on the project's webpage.
- TOPSOIL provides contact details on the official website and in the newsletters and continuously updates of the TOPSOIL website with reports and results of the project.

Pilot level:

- UK1 & UK2: Development of an interactive game to communicate opportunities and implications (positive and negative) of actions by a broad range of sectors
- At least 5 press releases to be send out in the capitalisation phase (application form)
- [to be complemented by partners]

2.2.2 Communication to reach 'other European projects'

TOPSOIL partners are involved in or exchange with other project- both from the NSR programme and other funding structures. This contributes to improving transnational benefits of the project and strengthens sustainable groundwater management.

The following activities have been implemented or are planned until end of December 2021.

Project level:

- 2 newsletters to be send out before November 2021 in which we include an article about another NSR project (cross-over)
- Invitations and news updates to be shared on social media
- Explore the possibilities of other media channels (such as LinkedIn)
- Participation in NSR events (such as the video contest, conference,…)
- Invite other projects and stakeholders to our final partner meeting
- Continuous updating of the TOPSOIL website
- Close cooperation with the NSR cluster project C5a
- Publication of a report with recommendations on seasonal balancing

Pilot level:

- 4 videos of fieldwork to be made during the capitalisation phase
- UK1 & UK2: New data sets made publicly available in visual and understandable format (e.g. story maps and the use of drone footage overlaid with modelled outputs & e.g. measurements)
- UK1 & UK2: Development of an interactive game to communicate opportunities and implications (positive and negative) of actions by a broad range of sectors
- GE4: The triple measuring results shall be constantly published online. This shall enhance understanding and better acceptance of irrigation and groundwater buffering
- NL1: Using knowledge of the EU project TOPPS within the pilot which is dealing with integrated pest management (http://www.topps-life.org/)

2.2.3 Communication to reach 'water managers, (national and European) strategical managers, policy makers and local decision makers'

While the main focus of activities can be found in the regional pilots, at project level we aim to reach out in particular to either European or national networks.

Project level:

- Our newsletters have aimed to take up news of relevance in particular for water managers and policy makers. This focus will be strengthened.
- In March 2019 we set up a Policy Day "Groundwater & Soil management in a future climate: What if 2018 would become the new normal?" For our final partner event, we aim to reach out a 2nd time by presenting policy relevant insights of the full TOPSOIL project, reaching out to groundwater managers (application form).
- Publication of a report with recommendations on seasonal balancing (application form; target: 1.000 readers)
- We have a report with recommendations on five challenges which will be updated including the recommendations on seasonal balancing (target: 1.000 readers)

Pilot level:

The pilots have been active during the first phase of TOPSOIL. During the extension phase, the partners aim at the following:

- 5 policy recommendations (pilot level), which will be added to the TOPSOIL webpage
- Publication of 3 scientific papers
- 4 videos of fieldwork to be made during the capitalisation phase (application form)
- At least 5 press releases to be send out in the capitalisation phase (application form)
- Regional water managers will be informed through direct involvement in the pilots with targeted small (bilateral) meetings, delivering transnational benefits from the TOPSOIL results further to the regions.
- NL1 will set up a stakeholder dialogue on implementing changes in the legislative context on water quantity (NL1b/NL3) to jointly improve the regional legislative governance context on climate change adaptation in GW management which will be used as an example for the whole region.
- NL1 will transfer TOPSOIL results from UK for the further development of NL1a
- GE5: Organisation of dedicated workshops to expand the transnational learning and exchange will disseminate TOPSOIL results further, facilitating the uptake by other farmers and water managers

- GE4: Inform local and regional and Lower Saxony water managers on the results. In the Lower Saxony the Irrigators Umbrella Organisation will inform irrigation boards from other areas on TOPSOIL results.
- GE4: Using remote data transfer technology, the triple measuring results shall be constantly published online. This shall enhance understanding and better acceptance of irrigation and groundwater buffering
- GE3: Results on ground water levels as well as the controlled surface water level will be presented on a webpage, targeted to other water managers and other stakeholders, to facilitate discussions on better climate change adaptation.
- GE2: Use the detailed groundwater model (including MAR) as a decision support study for future MAR application
- DK1: Development of a catalogue of measures and the effect of them to be used for planning and decision support
- BE1-2: The experiences gathered during the implementation will be documented so that water managers and farmers can build their decisions how to transfer the measure to their area.

2.2.4 Communication to reach 'farmers, other SME's and land-users'

Project level activities are supportive here by targeting representatives of stakeholder groups and the general public. At pilot level, direct exchange and cooperation has been implemented from the beginning and further during development and testing of innovative measures.

Project level:

- TOPSOIL hosts open partner meetings which welcome stakeholders from agriculture and other SME's and land users'. This will be emphasized during the final partner meeting in 2021.
- Publication of a report with recommendations on seasonal balancing (application form)

Pilot level:

- Involvement of individual farmers, farmer organisation and/or SME's assessing how TOPSOIL solutions match their challenges and expectations.
- At least 5 press releases to be send out in the capitalisation phase (application form)
- UK1 & UK2 Demonstration events (1 to 1 and 1 to many) to showcase practical measures and increase uptake (particular agriculture focus)
- NL1-3: Use on-the-spot measurements to convince land users/owners of the need for measures. Different measures will be tested by farmers to avoid pesticides leaching into the surface water. Waterboard Hunze en Aa's is participating in the EU project TOPS which is dealing with integrated pest management
- GE5: Organisation of dedicated workshops to expand the transnational learning and exchange will disseminate TOPSOIL results further, facilitating the uptake by other farmers and water managers
- DK1: Simple measures to be used by private landowners in connection with gardens or houses will be described in pamphlets or on the website.
- BE1-2: The experiences gathered during the implementation will be documented so that water managers and farmers can build their decisions how to transfer the measure to their area.
- BE1-2: Using the test site for dissemination and training purposes

2.3 Organization and responsibilities

Communication is a joined effort of all partners, which needs, in particular at project level an efficient coordination. Vlaamse Milieumaatschappij (VMM) is work package leader and coordinates project level communication. While each partner is responsible for the content (including, publicity requirements, pictures and copyright), as the WP2 lead VVM decides on final publication on the project webpage and other project level publication jointly with CDR. Of course input from all partners is needed. Of course input from all partners is needed. VMM also coordinates the input for the periodical reporting in the OMS.

Partners lead the communication activities on a pilot level towards their stakeholders. A detailed overview of the partners' responsibilities and deliverables can be found in this document.

This division of tasks may be adapted as a consequence to occurring events (such as drought periods) and changing media.

Every partner has to meet the publication requirements.

Projects/partners must:

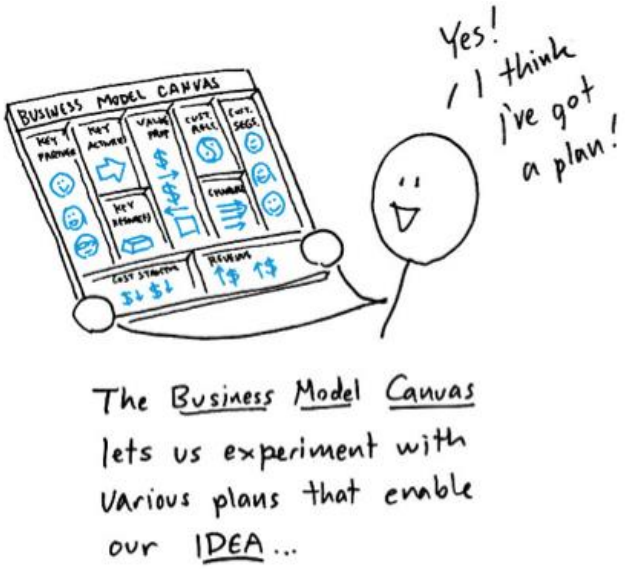
- Refer to the European Regional Development Fund and the North Sea Region Programme correctly and visibly in all project publications, both online and in print
- Set up a website and provide regular information about the project
- Make use of the **project logo** provided by the Joint Secretariat

3 Technical Capitalization

This part focusses on the technical aspects, the costs and potential risks of the capitalization phase.

The project partners need to reflect how the results of the pilots can be further developed, and if any potential business models can be applied to improve, multiply or upscale the results.

For selected measures or tools (e.g. tTEM) we will develop a (post TOPSOIL) follow-up plan, defining which steps will be taken and what resources will be necessary in order to continue project activities after the end of the project. To identify early on potential tools/measure which can be further developed, a workshop will be organized during the first partner meeting. The outcome of the workshop will be the next step towards the business model for selected measures or tools. We will use the "Strategyzer business model canvas" (see attachment). The partners will be guided through the process.



This business model will be translated to the following aspects:

- Identification of the **value proposition**
- The **resources necessary for the continuation of the TOPSOIL** action during the extended lifetime of the project as well as after the end of the project. This will allow an assessment of the direct leverage effect of the invested ERDF for every pilot
- The identification of opportunities to **improve** the outcomes of TOPSOIL actions (technical improvement)
- The identification of opportunities to **multiply or upscale** the outcomes of TOPSOIL actions (replicability)
- The identification of **gaps or (new) challenges** as a direct result of TOPSOIL actions and/or new societal demands (e.g. a more rapidly changing climate).

3.1 Overview of the 'technical capitalization activities'

As a large project, many activities are implemented at pilot level. The following table provides an overview on the planned activities between May 2020 and December 2021 (TOPSOIL extension phase) which aim to further develop methods and measures addressing seasonal balancing of groundwater. More information about these activities can be found in annex 1.

	Pilot	Output TOPSOIL I + **Additional output TOPSOIL II**	Methods TOPSOIL I + **Methods TOPSOIL II**
Belgian pilots			
BE1 BE2	Identify salinization & Increasing the availability of freshwater for agriculture	Salinization map & Possibility of freshwater storage **Downscaling from regional map to local situation** **Application and testing of an identified measure**	Aeroelectromagnetics + Monitoring/modelling **tTEM**
Danish Pilots			
DK1	Sunds	Groundwater model **Measures to manage seasonal changes in groundwater level**	Mapping, new methods further GW modelling and **tTEM**
DK2B	Contaminated land sites	Develop new management concepts for contaminated land sites **Further development to manage seasonal changes**	Methods describing chemical conditions for breakdown of pollutants **tMAG or other, tTEM**
DK4	Odense	Groundwater model as a management tool, new methods **Further development of techniques and models for administrators to handle seasonal groundwater changes**	Geological model, groundwater modelling, new methods **tTEM, swave reflection seismics**
German pilots			
GE2	Elbe-Weser-region	Maps, model, Management tool **Transfer to other area & prioritize measures**	Methods, Geological model, groundwater model **NMR, ERT**
GE3	Bremen-dam **Bremerhaven**	Management tool **Transfer to other area & prioritize measures**	Groundwatertable, geological model **Online monitoring**
GE4	AquaModul	Test of ADCP flow measuring technology; Triple Monitoring and interpretation **Transfer to other area; online monitoring**	Monitoring **Groundwater and flow measuring interpreted with groundwater model**
GE5	Südoldenburg	Maps, soil management system **Include new farms in the project, transfer to organic farms**	Soil mapping, sampling, monitoring **Implementing methods to protect groundwater on all plots of the farms** which are inside water protection areas
Dutch pilots			

NL1	Fresh water	Maps, model, new management approach **Implementation of CCA regulation on irrigation and drainage.**	Ground- and surface water model, improved model and testing of tTEM
NL2	Waterquality	Maps, model, new management approach **Transfer and testing of identified measures**	Methods, model study nutrients and pesticides. Monitoring impact.
NL3	GEOTOP	Geological model, data collection and analyse, new methods	Groundwater model, new management approach **tTem**
British pilots			
UK1	River Wear catchment	Maps, models & new integrated management approach **Showcase results** **Specific guidance on interventions for groundwater benefit**	Mapping and samples **tTEM, sensors, demonstration events**
UK2	East Anglia	Maps, models and new integrated management approach **Interactive game** **Uptake of measures**	Geophysics, samples, new management regimes

4. Annexes

Annex 1: Pilot activities during the extension phase of TOPSOIL

This section contains a short version of each pilot as planned for between May 2020 – December 2021.

BE 1&2: Realisation of a test site for groundwater buffering in saline area

Partners involved	• Flanders Environment Agency (VMM) • Aarhus University (AU)
Identified barrier addressed in extension	Based on results of the airborne survey (BE1) an opportunity map for different measures to increase the fresh water availability was made (BE2). However, **uncertainty about the financial and technical feasibility and the lack of field experience** constitute an obstacle, deterring farmers from investing.
Description of TOPSOIL II activity	**Demonstration project for creekridge infiltration.** In close cooperation with the local farmers, location 'Veurne' is selected for implementation of the first creek ridge infiltration system in Belgium to respond to the need for buffering winter precipitation excess and to provide an answer on water shortage during summer and help to better balances seasonal changes in groundwater availability due to climate change. The system will be built by VMM and maintained in collaboration with a local farmer. It consists of a controlled artificial recharge and drainage system. Nearby, fresh surface water will be collected during winter and pumped into the artificial recharge system. This causes higher groundwater levels and a growing fresh water lens. During summer, the infiltrated amount of water will be pumped up for drinking water or irrigation purposes. Research and monitoring will be implemented for an optimal design and management of the system. Additionally, location 'Koksijde' will be further investigated to identify the potential for implementing a similar system. Mapping of the fresh-salt water distribution on both sites will be done by using the tTEM method , developed by AU.
Outcomes	• **Implementation of practical measures**: The close cooperation with a local farmer will facilitate the uptake of the creek ridge infiltration system in other areas after the project. • **Decision support**: The experiences gathered during the implementation will be documented so that water managers and farmers can build their decisions how to transfer the measure to their area. • **Capitalization**: Our demonstration measure builds on TOPSOIL I results, and is closely monitored to identify needs for an optimal design. With the realisation of a test-site we can actually state that 'measures CAN be taken'. In addition, the test site will be used for dissemination and training purposes.

DK 1: Seasonal balancing of groundwater in the Sunds area

Partners involved	• Central Denmark Region • GEUS • Aarhus University (AU)
Identified barrier addressed in extension	In the Sunds area the groundwater table is situated close to the surface. This creates challenges, which will only grow in a future climate. In TOPSOIL I a detailed investigation of the area was made and a groundwater model was established. In this way we are able to further elaborate in large detail the effect of measures that can be taken to mitigate the effects of the climate change.
Description of TOPSOIL II activity	Climatologists expect hot and dry summers to occur more frequently in the future. It is expected that some of the excess winter precipitation can be saved to ease the consequences of summer droughts, and thereby achieve a better balance in the groundwater systems throughout the seasons. The first step is to establish a catalogue of measures (active and passive) by which winter surplus of groundwater can be used and/or transferred to summer time. Next, the groundwater model will be used to assess the effect of the different measures. If possible and necessary, minor technical studies will be performed in the pilot area or at related sites where the techniques can be better tested.
Outcomes	• **Implementation of measures**: The results will fall into 3 categories: - Instruments that can be brought into immediate use by regions, municipalities and companies. In the project, the effect of the measures on balancing between the winter surplus and the summer deficit of groundwater is elaborated - Simple measures to be used by private landowners in connection with gardens or houses. The tools will be described in pamphlets or on the website. - More complicated measures or issues that will require a larger project to be developed later. • **Decision Support**: Catalogue of measures and the effect of them to be used for planning and decision support • **Capitalization and Communication**: The results will be communicated via different channels depending on the receiver.

DK2B: Climate change impact on shallow and surficial drainage from contaminated land sites

Partners involved	• Central Denmark Region • Aarhus University
Identified barrier addressed in extension	In TOPSOIL I we developed the tTEM system, which has been implemented as an integral part of the toolbox used for contaminated land site investigation in Denmark. So far, the use and implementation of the tTEM system mainly focused on groundwater pollution in deep layers, and not on pollution in the very shallow groundwater and surface water. The risk for contaminants to leach to surface waters (e.g. rivers) through drainage pipes and shallow geological layers is high and, in many cases, risk assessments will be dependent on changes in precipitation patterns caused by climate change. The problem with shallow leaching of contaminants to surface water bodies is often controlled by seasonal changes in the groundwater level. To mitigate this problem, actions must be taken to balance the groundwater level through the increasing seasonal extremes. Such actions require detailed knowledge of the shallow hydrogeology system around the contaminated site and very shallow subsurface mapping is needed.
Description of TOPSOIL II activity	**Transfer the application of the tTEM system to shallow groundwater layers and strengthen the link to other geophysical methods such as tMag**. The geophysical data will be used in the investigations and in the risk assessments at selected contaminated sites. This will contribute to prioritize areas for remediation of pollution. Further, we will link the results with other experiences on tTEM within the TOPSOIL consortium so that the transnational exchange can contribute to further spreading the use of high resolution, high quality data in groundwater management.
Outcomes	• **Transfer and further development of management approaches**: development of a new and climate-proof way to manage contaminated land sites located close to surface water bodies through better understanding of contamination pathways and more robust risk assessments. This will be based on new data acquired with geophysical techniques tested on some of the regional contaminated sites. • **Decision support**: By improving the knowledge base on pollutions sources, land and groundwater managers can easier decide on the location of measures.

DK 4: Developing new techniques for mapping of aquifers as data base for modelling the possibility of groundwater storage in the urban areas

Partners involved	• Region of Southern Denmark • Aarhus University
Identified barrier addressed in extension	In TOPSOIL I the uppermost layers in the urban areas were investigated: geology and anthropology, for the robust risk assessment from the contaminated sites in the climate changing conditions. However, the first phase shows that the heterogeneity of the underground in the urban area makes the challenge more complex. We need to have more details about the underground to know groundwater flow. Knowing that is also crucial for the decision makers, who work with city plans and climate adaptation. Adapting to climate change in the cities starts with managing the unequal water distribution, which is caused by climate changes: increasing groundwater levels and flooding events (both from the surface water and extreme precipitation), lack of the groundwater during the summertime and, as a result, the groundwater quality problems.
Description of TOPSOIL II activity	**Development of a geophysical survey, which can be used in the urban areas and which would supplement the geological data to obtain a better view on the geological conditions**. It is common to apply geophysics when we don't have enough geological data but it is a challenge in the urban areas as the most of used methods are resistivity methods and they fail in the cities due to the noise from facilities, such as sewer, buried cables etc. Still, those facilities have a big impact on the groundwater transport paths and on the groundwater quality. For the extension we suggest an s-wave reflection seismic method, combined with tTEM, where possible and some direct push drillings with resistivity tool and groundwater sampling. By combining these methods we can develop a tool which can be used to define the underground in the city. We believe that the model developed within TOPSOIL I can be more detailed and therefore more suitable for work with climate adaptation.
Outcomes	• **Capitalization**: Uptake existing results into new techniques, which could be applied in the urban areas for underground investigations. • **Decision Support**: The model of the underground in the urban area will help to define the uppermost layers, including underground facilities. A groundwater flow will be possible to define. The model can be used by decisions makers, who work with physical planning of climate change adaptation.

Pilot GE2: Groundwater Buffering – A tool for seasonal aquifer management in moraine areas

Partners involved	• Landesamt für Bergbau, Energie und Geologie (LBEG) • Leibniz Institut für Angewandte Geophysik (LIAG)
Identified barrier addressed in extension	Groundwater storage could be the perfect tool to manage seasonal changes in rainfall and groundwater availability. In TOPSOIL I we could not assess the feasibility of this and other measures in the context of a saltwater prone groundwater body.
Description of TOPSOIL II activity	The measures of groundwater storage in the moraine aquifers, developed in our pilot during TOPSOIL I, should now be tested in a detailed small-scale model. We would like to create a detailed, small scaled groundwater model (based on our overview groundwater model from TOPSOIL I) and evaluate the impact of our aquifer management measures (groundwater storage in the geest areas) on the groundwater system. We will feed our groundwater model with aquifer parameters derived from geophysical measurements (LIAG) to get a better image of the aquifer. With these models, we could get a better acceptance from our stakeholders, because we can derive more detailed information on the hydrogeological consequences and the efficiency of the measures.
Outcomes	• **Implementation of Measures**: Detailed study of the impact of groundwater storage in the Cuxhaven geest area. By implementing a groundwater storage system in our groundwater model, the positive effect of pushing back the saltwater towards the sea could be shown as well. • **Decision Support**: - The small-scale groundwater model gives a new perspective on how groundwater management measures can be implemented in the future as an alternative towards drainage. It could be used as a decision support study that show the effectiveness of the method. - Additionally we will get detailed information about the kf-values in the study area through the NRM-data. The kf-values are an important input for the detailed flow model that will be created for the groundwater buffering study

Pilot GE 3: Interactive water management for balancing seasonal groundwater change

Partners involved	• Universität Bremen • Leibniz Institut für Angewandte Geophysik
Identified barrier addressed in extension	While the method developed in GE3 was considered very successful, the second water authority within the Country of Bremen requested to apply the developed method in their area so that the results would directly contribute to assessing the impact of measures. The method developed in TOPSOIL I will be tested in another area which has been proved to be sensitive within the H2020 FREEWAT project. Improving groundwater storage will contribute to stabilize groundwater levels and decrease responding saltwater intrusion.
Description of TOPSOIL II activity	Detailed and small scale groundwater modelling will be combined with online data input to verify the model and the effect of measures: The detailed modelling approach developed in TOPSOIL I will be further elaborated in a new pilot area. The new pilot is connected to the pilot area of the TOPSOIL partner LBEG, the same software will be used to allow interoperability. The new area links to many challenges: It includes a coastal aquifer, which is used for industrial and drinking water extraction and a superficial drainage system into a lake. It combines urban area with farmland and a protected wetland area. A model will link online and other monitoring data for small scale applications with spatial knowledge on hydraulic properties, including the interactions between the drainage systems and groundwater. This will allow to developing a resistivity based monitoring concept to observe seasonal changes and groundwater storage, providing relevant knowledge on measures for climate change adaptation.
Outcomes	• **Implementation of measures**: New measures will be evaluated on possible variations of the present drainage to provide seasonal groundwater storage in the southern part of Bremerhaven. By implementing an online groundwater monitoring system and comparing these data with the existing online data of the water level in the drainage system, the interactions between (controlled) surface water and groundwater can be shown. This is supposed to raise more awareness on the impact of groundwater management and the possibilities for seasonal water storage • **Decision Support**: The small-scale groundwater model gives a new perspective on how groundwater management measures can be implemented as an alternative towards drainage. It can inform decision makers on the effectiveness of the measures. • **Capitalization:** Results on ground water levels as well as the controlled surface water level will be presented on a webpage, targeted to other water managers and other stakeholders, to facilitate discussions on better climate change adaptation.

Pilot GE4: TOPSOIL AquaModul-Online

Partners involved	• Dachverband Feldberegnung Uelzen (DFU) • Landwirtschaftskammer Niedersachsen (LWK Uelzen)
Identified barrier addressed in extension	For controlled balancing of seasonal water demands and availability, groundwater buffering measures must be linked to monitoring. An adequate monitoring method for the typical glacially formed regions of the NSR was initiated in TOPSOIL I. Yet new emerging challenges are: • Unnoticed interruptions of datalogging due to natural events and vandalism in the small watercourses • The method's transferability to groundwaterbodies rsp. catchments with differing characteristics.
Description of TOPSOIL II activity	• Remote data transfer technology shall be installed using robust technology, which safely works in monitoring wells. • The developed "triple monitoring" shall be installed in another groundwaterbody-surface water- system with differing characteristics. According to EU directions additional or new irrigation abstractions are not allowed to impair groundwater-dependent ecosystems. But monitoring methods have not been viable to measure the "sum effects" of many local wells. This is hampering irrigation as a strategy for climate change adaption by agriculture. Groundwater buffering on the other side faces low acceptance today, because its effects today only can be estimated. The AquaModul- monitoring method helps to improve both. In the long, the "triple monitoring", which is also connected to precipitation recording, enables to differentiate effects of gw-abstraction or gw-buffering from climate change effects. This is of basic importance for longterm adaption decisions in protection of GW dependant natural systems as well as in agriculture/rural development. Therefore WFD and Nature 2000 goals as well as vigour of NSR's rural light soil (sandy) or dry areas will be strengthened.
Outcomes	• **Implementation of measures** for monitoring: A technology manageable in daily routine for parallel monitoring of upper and lower groundwater aquifers in combination with flow monitoring of sensitive small watercourses ("triple monitoring") principally enables to use groundwater resources more effectively. • **Decision Support** on controlling abstractions will be provided: Instead of completely allowing or refusing an irrigation well, then thresholds can be defined for starting, reducing or stopping GW abstractions in case of sensitive sites. The aim is to define variable thresholds for groundwater abstractions depending on the state of the groundwater buffer in order to manage wells in the surrounding of sensitive groundwater dependent ecosystems. The improved triple monitoring system shall provide the underlying technology. • **Capitalization**: Transferring and further developing the approach in TOPSOIL I, we will continue to inform local and regional and Lower Saxony water managers on our results. In the Lower Saxony Irrigators Umbrella Organisation will inform irrigation boards from other areas on TOPSOIL results. Using remote data transfer technology, the triple measuring results shall be constantly published online. This shall enhance understanding and better acceptance of irrigation and groundwater buffering

Pilot GE5: Different effects of conventional agriculture and organic farming on water quantity and water quality in drinking water protection areas

Partners involved	OOWV
Identified barrier addressed in extension	In TOPSOIL I, the pilot addressed precautionary drinking water protection at farm level with focus on nitrate. Four farmers practicing conventional farming are currently involved in the project. The extreme weather in summer 2018 showed a need to adapt the approach: Nitrate leaching was in particular high despite changed land management. The comparative analysis and the exchange of experience between the farmers indicated that organic and conventional farming may contribute differently to nitrate leachate. **Currently data on N-balancing are missing to directly compare conventional and organic farming and their impact on groundwater protection.** Besides measuring the nitrogen in soil, **investigations on farm data will be done to find better and cheaper parameters to evaluate groundwater compatible farming practices.**
Description of TOPSOIL II activity	Building on the close cooperation with farmers in TOPSOIL I, we would like to include 2 more farmers who are currently transferring their farm to organic farms and 2-3 already existing organic farms. It would allow a direct comparison between the different farming methods and crop rotations on farm level and to measure the effects on the seepage water and the groundwater under the same weather conditions. We will focus on farms in drinking water protection areas, where general soil data as well as rainwater monitoring is already in place. 2-3 farms will get digital soil maps to support the placement of measures. In spring and autumn nitrate concentrations in soil will be measured to quantify the effects of different farming methods and crops and their reaction to different weather conditions. As results related to these issues are of high interest to more TOPSOIL partners and other water managers, we will continue the transnational learning and exchange in dedicated workshops.
Outcomes	• **Implementation of measures:** Groundwater protection measures will be implemented and measured in close cooperation with farmers which will also facilitate the transfer to further areas after the project • **Decision Support**: The results on nitrate leaching will be compared with the planned fertilization, to check if the requirements of nitrate directive have been achieved, also considering land management approaches. While testing organic farming as a way towards solving the nitrate problem the results will lead to new knowledge supporting decisions on protection of groundwater management • **Capitalization**: The pressure from farm fertilizers on groundwater is most central in many areas of the Northern Sea Region, especially where sandy soils and intensive animal husbandry coincidences. Expanding the transnational learning and exchange in dedicated workshops will disseminate TOPSOIL results further, facilitating the uptake by other farmers and water managers

Pilots NL 1/2/3: Implementation of Climate proof Drentsche Aa

Partners involved	Province of Drenthe In close cooperation with Waterboard Hunze and Aa's (legal water managers). They will be partner within the project team although they won't be a TOPSOIL beneficiary. Waterboard Noorderzijlvest is available for knowledge exchange.
Identified barrier addressed in extension	Within TOPSOIL we modelled the impact to find solutions and common agreement between stakeholders. To adapt the impact of climate change farmers were asking for more groundwater for irrigation and intensify the drainage in the area. This could damage the goals of Nature2000. Most important barrier so far has been the **lack of common agreement between stakeholders of the impact of climate change and necessary adaptation measures**.
Description of TOPSOIL II activity	Combining the tasks and challenges of Natura 2000, the Water Framework Directive and Climate Change Adaptation at local level, during the implementation of measures is still new and not legally required. Transferring results on catchment based stakeholders dialogues in UK-1/2 to the Province Drenthe, we will set up dialogue between the competent stakeholders to develop a joint approach in the Province Drenthe on climate change impacts on different systems like groundwater and surface water. The options identified in TOPSOIL I will be further developed into legislative and technical measures and tested in the area. This will help the Province and the local decision makers to find a balance between winter and summer precipitation, but also dealing with the impact of incidental (extreme) showers and the resulting effects on the water table and on water quality. With TOPSOIL I insight into the regional soil structures has improved significantly and that has contributed to the interpretation of model data. But more detail is needed on a parcel level to ensure stakeholder support for the necessary measures. The tTEM tool could be used for this.
Outcomes	• **Implementation of measures** for adapting governance context: - Integrated legislation for irrigation and drainage to prevent drought problems in summer, including governance agreements between the provincial authority and the water board. - New regulations on buffers trips to prevent surface water from runoff with pesticides. • **Decision Support:** - Higher resolution data (results tTEM) on soil characteristics on parcel level which enables more spatially targeted measures as aid in creating support for the required measures by the individual farmers. - Unambiguous legal context for easier implementation of climate change adaptation measures. • **Capitalization**: - Establishment of stakeholder dialogue on implementing changes in the legislative context, transferring TOPSOIL results from UK and further developing results from NL1b/NL3 - Use on-the-spot measurements to convince landusers/owners of the need for measures. Waterboard Hunze en Aa's is participating in the EU project TOPPS which is dealing with integrated pest management

Pilots UK 1/2: Accelerating the resilience of groundwater systems

Partners involved	• The Rivers Trust • Wear Rivers Trust • Essex and Suffolk Rivers Trust • Norfolk Rivers Trust
Identified barrier addressed in extension	TOPSOIL I focused on developing local knowledge and solutions for increasing groundwater resilience by working with targeted stakeholders at specific locations. The challenge to be addressed TOPSOIL II is how to transform the uptake of practical measures to increase climate resilience through effective communication of data and evidence.
Description of TOPSOIL II activity	Knowledge on the impacts of human activities on the balance of water in soil and aquifers is largely restricted to experts and small numbers of stakeholders involved in specific projects. If action is to be taken at the scale required to address the regions groundwater resilience challenges, more effective and innovative communication is required. Underpinned by sound data & evidence we propose to deliver a number of actions to collect, collate and communicate information to different catchment stakeholders. These activities include: • Use technical data collected in TOPSOIL I to support specific demonstration events and case studies to showcase best practice and increase uptake e.g. farming methods • Develop decision support guidance for different sectors on actions to increase GW resilience • Develop interactive game to visualise the impacts to the groundwater balance of different interventions/activities by sector • Improve understanding of lateral flow in aquifer to aid better design of aquifer recharge schemes (potential uptake tTEM) .
Outcomes	• Implementation of measures: - Demonstration events (1 to 1 and 1 to many) to showcase practical measures and increase uptake (particular agriculture focus) - UK 2 pilot includes 2 catchments that are national pilots on abstraction reform (process, license regulation and practical measures to increase availability) TOPSOIL interaction with this process will be a key outcome, but exact activity TBC • Decision Support: - Increasing data availability and appropriate guidance will enable more effective planning and targeting of measures e.g. work in most vulnerable locations and avoid unintended consequences of other measures - Stakeholder collected data to support understanding and decision making (e.g. soil moisture) - Sector specific guidance on interventions for groundwater benefit • Capitalization: - New data sets made publicly available in visual and understandable format e.g. story maps and the use of drone footage overlaid with modelled outputs & e.g. measurements

	- Interactive game to communicate opportunities and implications (positive and negative) of actions by a broad range of sectors – including civil society.

Annex 2: Overview of TOPSOIL partners involved in the capitalization phase

Denmark	
	Central Denmark Region (Lead partner)
	Aarhus University (AU)
	GEUS
	Region of Southern Denmark
Belgium	
	Flanders Environment Agency (VMM)
Germany	
	Landesamt für Bergbau, Energie und Geologie (LBEG)
	Leibniz Institut für Angewandte Geophysik (LIAG)
	Universität Bremen
	Dachverband Feldberegnung Uelzen (DFU)
	Landwirtschaftskammer Niedersachsen (LWK Uelzen)
	OOWV
The Netherlands	
	Province of Drenthe
United Kingdom	
	The Rivers Trust
	Wear Rivers Trust
	Essex and Suffolk Rivers Trust
	Norfolk Rivers Trust

Annex 3: Deliverables from application form

#3: (C5.1) **Activities and Deliverables / , Policy Day** *(Addition)*

Field	Original	Changed
Project		TOPSOIL
Work Package		2 Communication activities
Parent activity		
Title		Policy Day
Activity description		Event presenting policy relevant insights and results of the full TOPSOIL project, reaching out to national, and European strategical groundwater managers.
Deliverable indicator		Exchange of Information Event (External)
Deliverable name and description		Policy Day providing space for discussion on climate change adapation and TOPSOIL results.
Target value		1

Field	Original	Changed
Project		TOPSOIL
Work Package		2 Communication activities
Parent activity		Policy Day
Number		
Title		Sub-indicator
Deliverable indicator		Number of participants
Deliverable name and description		selected strategical managers concerned about groundwater management and climate change adaption
Target value		40

Field	Original	Changed
Project		TOPSOIL
Work Package		2 Communication activities
Parent activity		
Title		Capitalization Strategy
Activity description		development of a capitalization strategy that combines dissemination, transfer of results and anticipating long-term needs (see also annex)
Deliverable indicator		Report / Strategy
Deliverable name and description		coordinate and sharpen further communication activities, including for selected tools/methods business plans
Target value		1

Field	Original	Changed
Project		TOPSOIL
Work Package		2 Communication activities
Parent activity		Capitalization Strategy
Number		
Title		Sub-indicator
Deliverable indicator		Number of Readers
Deliverable name and description		consortium and stakeholders
Target value		40

Field	Original	Changed
Project		TOPSOIL
Work Package		7 New management regime
Parent activity		
Title		Update: Recommendations on Seasonal Balancing
Activity description		Recommendations on Climate Change Adaptation in Groundwater Management
Deliverable indicator		Report / Strategy
Deliverable name and description		Concise recommendations for regional and local groundwater managers in each country on how climate change adaptation (e.g. balancing seasonal changes in water) can be better accommodated
Target value		5

Number		
Title		Sub-indicator
Deliverable indicator		Number of Readers
Deliverable name and description		National and European policy makers
Target value		40

#9: (C5.1) **Activities and Deliverables / 3, Newsletters** *(Modification)*

Field	Original	Changed
Target value	6	8
Date of modification	2015-06-17 14:08:02	2019-10-07 16:27:54

#10: (C5.1) **Activities and Deliverables / 4, Press releases** *(Modification)*

Field	Original	Changed
Target value	30	35
Date of modification	2015-06-29 11:55:12	2019-10-07 16:29:36

#11: (C5.1) **Activities and Deliverables / 5, Videos from fieldwork for social medias** *(Modification)*

Field	Original	Changed
Target value	16	20
Date of modification	2015-06-29 11:55:54	2019-10-07 16:30:53

#12: (C5.1) **Activities and Deliverables / 6, Videos from fieldwork for social medias (sub)** *(Modification)*

Field	Original	Changed
Target value	1600	2000
Date of modification	2015-06-29 11:57:11	2019-10-07 16:32:22