Procurement and Installation of Monitoring Equipment

Demonstrators A and B

Deliverable D3.2

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Abstract (for dissemination, 100 words)	The report on Procurement and Installation of Monitoring Equipment provides an overview on the monitoring equipment purchased and installed in the Demonstrator A and B sites within the RECONECT project. The objective of this deliverable is to guide others and give valuable info to all stakeholders, planning to implement NBS in the future, on the selection of the right equipment, the procurement process and equipment installation.
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Executive Summary

The report on Procurement and Installation of Monitoring Equipment provides an overview on the monitoring equipment purchased and installed in the Demonstrator A and B sites within the RECONECT project.

The objective of this deliverable is to guide others in the process of developing their own data collection and monitoring plans.

The selection of equipment is based on the results of a comprehensive data gap analysis (D3.1) and Co-Monitoring and Co-Evaluation Plans (D2.6). This report is therefore closely linked to Deliverables 2.6 and 3.1 and should be read in conjunction with these.
The document serves as a reference for Co-Monitoring activities within WP3 (Task 3.3). In addition it is also a helpful document for RECONECT Collaborators in the process of developing their own data collection and monitoring plans.

Next to the helpful information for partners within RECONECT the report gives valuable info also to all stakeholders, planning to implement NBS in the future, on the selection of the right equipment, the procurement process and equipment installation.
While for Demo A sites the purchased equipment can be used already during the implementation phase of the NBS, in the Demo B sites some additional equipment has been selected to complement their ongoing monitoring activities.

Most of the selected equipment is linked to the selected WATER indicators. In five Demonstrator sites some new equipment has been purchased and installed.

With regards to NATURE indicators most monitoring activities are done by field surveying or GIS-based mapping using aerial or satellite imagery. In Aarhus this is supported by a relatively new equipment for eDNA analysis.

Monitoring PEOPLE indicators proved to be a challenging task. However, visitor counters or webcams, are being installed in Odense and Portofino, and they will be used to support the evaluation of the recreational opportunities.

It is very helpful to have support of local stakeholders and the community to organize fieldwork assistance, power supply and to arrange protection of measurement equipment.

Although the selected equipment varies from site to site depending on the specific needs, all equipment has been purchased according to EC guidelines and national procurement legislation. This doesn`t necessarily mean to award the cheapest bidder, but to select the equipment with the “best value for the money”.

Due to different type of barriers also described in this report, not all equipment has been purchased and installed by the time this report is written (February 2021). Some of the sites have already linked their equipment to the ICT platform and throughout the project more and more data from field sensors will be linked and displayed in a real-time mode. It is therefore foreseen to do an update of this report at a later stage.

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1 Introduction

The Report 3.2 on Procurement and Installation of Monitoring Equipment is closely linked to the replication and upscaling work and should provide all valuable information on the procurement and installation processes.
The term equipment used in this report refers to all technical tools (hardware and/or software) that can support the monitoring programme (e.g. rain gauges, video cameras, visitor counters, etc).

The report benefits all project partners who are concerned with monitoring activities and this also includes the Collaborator sites, which will be facing questions about monitoring equipment in the setup-phase of their NBS. Secondly, the report could also benefit the external audience, being all agencies and stakeholders interested in implementing and monitoring of NBS.

The purpose of the monitoring systems implemented in the demonstrator sites is to collect and derive scientifically-valid data for the monitoring and evaluation plans within RECONECT. While robust monitoring plans are described in detail for all sites in D2.6 (Report on Co-Monitoring & Co-Evaluation Plans), this report is clearly focussed on the SELECTION, PROCUREMENT and INSTALLATION of new monitoring equipment.

The high level of heterogeneity in regard to equipment across the demonstrator sites, which can indeed be noticed within this report, is on the one hand side linked to the heterogeneity of the demonstrator sites with different topographical, natural and cultural characteristics. All sites face different challenges and threads and have selected different indicators to be monitored. It`s therefore unavoidable that sites adopted different types of equipment for their monitoring plans. This report therefore cannot give advice which specific type of equipment is needed, but rather providing some general support on how to select, purchase and install equipment in a good way.

Next to that some demonstrators had already a number of sensors and equipment installed and valuable datasets available already before the start of the RECONECT project. For example in DA1 Hamburg the challenge was rather to identify and bring together all existing sensor data rather than selecting and purchasing new equipment.

The decision to buy certain equipment needs to be based on a comprehensive data gap analysis. Knowing the data already available is crucial to avoid purchasing equipment that not necessarily needed to gather new and relevant information for the monitoring activities. Sometimes it is even not sufficient to know whether the necessary data is available or not, but also to look in detail into characteristics of the data to determine whether the monitoring requirements can be fulfilled or not. Gathering all info on data availability can be a challenging and time consuming task, because the datasets are most of the times not all available within one department or institution.

Once a gap is identified, a strategy is sought to determine the technical requirements and specifications of the data to be acquired, hence bridging the gap. Sometimes there is the need to prioritize the data gaps, since budgets to purchase new equipment and new survey activities may be limited. It is therefore important to closely link the outcomes of the data gap analysis to the local context and to the most relevant indicators.

Plans for data collection within RECONECT have started in the early project phase with such an analysis. The results are described in D3.1 and are taken into consideration in the process to select and purchase new equipment.

As part of D2.6 “Co-monitoring and evaluation plans for Demonstrators A and B”, demonstrators have developed monitoring and evaluation plans to assess the performance of their NBS in achieving a selected number of sub-goals. In these plans, a focused set of indicators is presented together with the data/model that are required to assess those indicators. For each data/model required, characteristics such as the spatial coverage, temporal frequency, and the availability of the data/model to assess the indicator are described. This info of course must be taken into account in the decision to purchase and install specific equipment for in-situ measurements.

It is important to state that this report is not meant to provide a comprehensive guideline on how to execute monitoring and impact assessment activities. The data gathered with the equipment purchased and installed needs to be described and documented (metadata) well and of course validated, treated and in some cases processed further. These validation & processing steps as well as the “lessons learnt” in regard to the data treatment from the equipment mentioned in this report will be described in D3.4 (Report on co-monitoring activities).

Anyhow the descriptions on the equipment used for in-situ observations in the different sites are helpful to demonstrate the importance of various kind of measurements for baseline definition and recording time series during and after NBS implementation. They are frequently used to describe variations in precipitation, water levels or other water indicators, but also might stimulate ideas to use state-of-the-art equipment to monitor Nature or People indicators.

Following the objectives of this deliverable the information concerning each Demonstrator is split into the three sections: 1) selection criteria 2) description of the procurement process and 3) info on the installation works. Next to that, the additional info is added on how the new data has been or will be linked to the ICT-platform. Finally barriers and “lessons learnt” are described in the final chapter of this report.

2 Demonstrator A1 – Dove/Gose Elbe Estuary, Germany

2.1 Selection of the Monitoring Equipment

The main goal of the demonstration activities in the German Demonstrator (DA1) Vier- und Marschlande is the reactivation and the distribution of the storage capacity upon need of the rivers Bille, Dove and Gose Elbe, their tributaries and trenches (such as Brookwetterung or Curslack) and their flood plains in the area of 175 km^2, to create more retention volume for water during flooding. At the same time necessary stable water levels in the rivers can be provided during droughts.

The distribution of the storage volume during flood events will be managed by the RECONECT NBS operation and the real-time controlling system. It will make use of the previous studies and rainfall- runoff and hydrodynamic models as well as of the conceptual design of the operation system and further developed to be 'ready-to-use' by the operators and asset owners.

The implementation of a forecast system will reduce the water level in the lower stretch of the Dove-Elbe River in order to increase and use the existing retention volume in case of flooding. The monitoring is related to the existing gauging stations. From the main stations the water level can be seen online (Warndienst Binnenhochwasser Hamburg: www.wabih.de). There are several gauging stations (11) that deliver the water level (maximum peak water level, duration of inundation, etc.) in real-time once a day, and in case of a flood event every 30 minutes. Up to now there was need to purchase additional equipment.

Table 1. Status of equipment that is selected to monitor the Water, Nature and People Indicators in Demo A1- Dove/Gose Elbe Estuary, Germany

Equipment	Type	Quantity	Subgoal/ Indicators	Comment	Status
WATER					
No new equipment purchased and installed. Several gauging stations existing.					
NATURE					
No new equipment purchased and installed. Monitoring planned to be done by field surveys.					
PEOPLE					
No new equipment purchased and installed.					

2.2Description of the Procurement Process

No new equipment has been purchased.

2.3Installation of the Equipment

No new equipment has been installed.

3 Demonstrator A2 – Odense Coastal Area, Denmark

3.1 Selection of the Monitoring Equipment

For monitoring the selected water indicator “Changes in flood risk of areas behind NBS-dikes and changes in area effected by flooding” it is planned to establish an actual Digital Terrain Model (DTM) and Digital Surface Model (DSM) of the demonstration site. For this purpose LiDAR surveys are planned before and after NBS implementation to monitor changes in terrain and model the effect on flood risks of the removal of the existing summer dikes and more frequent flooding due to climate change.

A first survey flight has been executed by EUROSENSE in June 2022, but no new equipment was needed for this purpose. A combination with Interferometric Synthetic Aperture Radar (InSAR) using free satellite data from the COPERNICUS program monitoring is under discussion. For this purpose the installation of a radar reflector might be beneficial. This is supposed to be followed up in 2021.

In relation to this indicator it also planned to install sensors for a real-time measurement of the water level in the recreated stream beds.

For monitoring the selected indicator “Changes in the salinity of water in the surface, near ground water” no additional equipment is needed.

Monitoring of all Nature indicators will be done by field surveys and laboratory analyzes of vegetation samples and soil (described in detail in deliverable 2.6).

In relation to People indicators visitor loggers will be installed at the new trails and recreational facilities. Procurement and installation is planned to be done in 2021.

Two webcams have been installed to show the developments during the construction phase.

Table 2. Status of equipment that is selected to monitor the Water, Nature and People Indicators in Demo A2- Odense Coastal Area, Denmark

Equipment	Type	Quantity	Subgoal/ Indicators	Comment	Status
WATER					
radar reflector	tbd	1	flood risk reduction		under discussion
water level sensors	tbd	tbd	flood risk reduction	real time measurement of the water level in the recreated stream beds	under discussion
NATURE					
No new equipment purchased and installed.					

PEOPLE					
visitor loggers	tbd	tbd	increase recreational opportunities/ number of visitors	will be installed at the new trails and recreational facilities	planned for 2021
webcams		2	increase recreational opportunities/ attractiveness for living & visits	documentation of the construction phase & after NBS-implementation	purchased and installed

3.2Description of the Procurement Process

Purchasing of equipment is following the national legislation for procurement. Where possible at least 3 suppliers are asked to offer.

3.3Installation of the Equipment

The installed webcams have been installed in positions to document the process of construction works. They have also been connected to the RECONECT ICT-platform.

A potential new location for the webcams showing other areas of the project after construction will be evaluated in cooperation with project partners of the demonstration cluster and landowners in 2021.

Figure 1: Picture from photo point from the beginning of construction.

Figure 2: From the end of construction.

Figures 1 and 2 are taken by the webcams purchased and installed to document the changes during construction works. The impacts of the removal of the dikes will be monitored by WATER, NATURE and PEOPLE indicators, such as changes in flood risk, habitat boundaries and recreational opportunities.

When additional equipment is purchased and installed it will also be connected to the ICT-platform.

4 Demonstrator A3 – Tordera River Basin, Spain

4.1 Selection of Monitoring Equipment needed

In the forthcoming planning cycle of the EU Floods Directive, the main measure we would like to implement in the Tordera River Delta is to set back the levees along the final reach of the river. This measure will provide more room for the river, increasing its conveyance capacity and consequently reducing the extent of the flooded area and the economic losses associated to flooding. Water indicators will be monitored using hydraulic numerical models that have been developed within the context of the Levee Management Plan. There are four existing river gauging stations within the Tordera River Basin, which register flow discharge every five minutes.

Nature indicators will be monitored within the context of the Water Framework Directive Monitoring Programme.

It is not fully decided yet, how people indicators will be measured, but at the present moment no additional monitoring equipment is anticipated. Up to now there is no plan to purchase new equipment in the Tordera River Basin demonstrator.

Table 3. Status of equipment that is selected to monitor the Water, Nature and People Indicators in Demo A3- Tordera River Basin, Spain

Equipment	Type	Quantity	Subgoal/ Indicators	Comment	Status
WATER					
No new equipment purchased and installed. Several gauging stations existing.					
NATURE					
No new equipment purchased and installed.					
PEOPLE					
No new equipment purchased and installed.					

4.2Description of the Procurement Process

No new equipment has been purchased.

4.3 Installation of the Equipment

No new equipment has been installed.

5 Demonstrator A4 – Portofino Regional Natural Park, Italy

5.1 Selection of Monitoring Equipment needed

The Demonstrator in Portofino is a mountainous area close to the sea, characterized by high slopes gradient and small catchments. Heavy rain events occur with a strong spatial variability, so it is crucial to ascertain a more precise weather data within the pilot area. In order to close gaps in monitoring weather parameters in the pilot area (water indicators) the following sensors have been selected and installed:

- three weather stations to monitor rain intensity, cumulative rain and other weather parameters; two in the middle portion of two small catchments belonging to the pilot area and another one in a spatial position close to them but outside the pilot. Besides rain intensity, data could support assessing threshold values for shallow landslides triggering that often happens together with flash flood events.
- two hydrometers and webcams have been installed just before the culvert, in order to assess the effects of intense rain events and to evaluate the possible impact on the flow capacity at the mouth of the pilot areas culverted streams.

With regards to Nature and People indicators no equipment has been purchased and installed until now. Nature indicators will be monitored and assessed through GIS analysis and field surveys. Evaluation of the recreational opportunities is supported by 6 people counters at the crucial points of Portofino trails operational since 2009. Currently it is discussed whether a few more counters should be purchased and installed.

Table 4. Status of equipment that is selected to monitor the Water, Nature and People Indicators in Demo A4- Portofino Regional Natural Park, Italy

Equipment	Type	Quantity	Subgoal/ Indicators	Comment	Status
WATER					
weather stations		3	landslide risk reduction/ vulnerability	monitor rain intensity, cumulative rain and other weather parameters	Purchased and installed
hydrometers		2	landslide risk reduction/ vulnerability	to assess the effects of intense rain events and to evaluate the possible impact	Purchased and installed
NATURE					
No equipment purchased and installed.					
PEOPLE					
additional visitor counters		tbd	Increase of recreational opportunities/ number of visitors		planned for 2021

5.2Description of Procurement and Installation

To comply with Italian rules on Public Procurement (D. Lgs. 50/2016) and with the EC principles of “lowest price” or “best value for money”, the Portofino Park authority on 27th March 2019 asked for five economic offers to different companies, selected on the market, specialized in weather station provision and installation. By the due date on 12th April 2019 four offers were received and the best one was selected. (Request for Quotation is included in Annex 1 to this report.)

On 30th August 2019 (Decision No. 182) sensors provision and installation was assigned. The provision included also a PC to gather all the data from the sparse sensors.

5.3Installation of the Equipment

The sensors were installed at the following locations:

- Weather station 1: Mulino del Gassetta, Paraggi catchment.
- Weather station 2: Portofino town.
- Weather station 3: Agririfugio Molini, San Fruttuoso catchment.
- Hydrologic station and webcam 1: before the culvert at the mouth of Paraggi stream.
- Hydrologic station and webcam 2: before the culvert (ancient Abbey) at the mouth of San Fruttuoso stream (named Fosso dell’Alluvione).

All installations have been completed by 31th January 2020 and data transfer to the RECONECT ICT-platform was established with technical assistance by the project partner Interact. In September 2020 the data link with the platform was established including additional webcam images.

Weather and hydrologic data are constantly transferred via GSM link to a central server that has been installed in the Park authority head office, in Santa Margherita Ligure. Then, from the local server data are transferred to TeleControlnet ICT platform server cloud via API connection.

From the platform it is possible to access the full set of measured data: rain, temperature, pressure, humidity, wind intensity and direction at one hour time resolution. Data are displayed in quasi-real time and graphical format and can also be downloaded in CSV format.

6 Demonstrator B1 – Ijssel River Basin, the Netherlands

6.1 Selection of Monitoring Equipment needed

Weather and hydrological stations for rainfall and discharge/water depth data are continously available, while the flood plain (for channel cross section) is measured once in 2018 (in Herxen) and vegetation cover is collected twice (before and after the NBS implementation). Vegetation coverage can be measured through visuals inspections, drones and satellite data. Flood hazard assessment will be undertaken on a micro (local) scale (study area in Herxen) using a 1D/2D hydrodynamic model (SOBEK for example).

Currently, there is no plan to install a new equipment. However, for the people indicators it is currently under discussion to install a bicycle counter within the area.

Table 5. Status of equipment that is selected to monitor the Water, Nature and People Indicators in Demo B1- Ijssel River Basin, the Netherlands

Equipment	Type	Quantity	Subgoal/ Indicators	Comment	Status
WATER					
No new equipment purchased and installed.					
NATURE					
No new equipment purchased and installed.					
PEOPLE					
bicycle counter	tbd	tbd	Increase of recreational opportunities		under discussion

6.2Description of the Procurement Process

No new equipment has been purchased.

6.3Installation of the Equipment

No new equipment has been installed.

7 Demonstrator B2 – Inn River Basin, Austria

7.1 Selection of Monitoring Equipment needed

The aim is to demonstrate the benefits of Nature-Based Solutions (NBS) and runoff behaviour in Alpine catchments. For the Water Indicators: surface runoff reduction, slowing and storing runoff and flood hazard are monitored and evaluated. An overview of the equipment that is selected for the Water Indicators is presented in Table 1.

Soil moisture and related processes are often considered as one of the key components of the hydrological cycle and strongly influences surface runoff conditions. Soil moisture can be estimated by installing sensors in soils at various depths, aiming to track and visualize infiltration processes. To better understand the runoff behaviour in Alpine catchments it is required to use the right type of sensors to monitor soil moisture continuously and to find the optimal distribution to install them in the field.

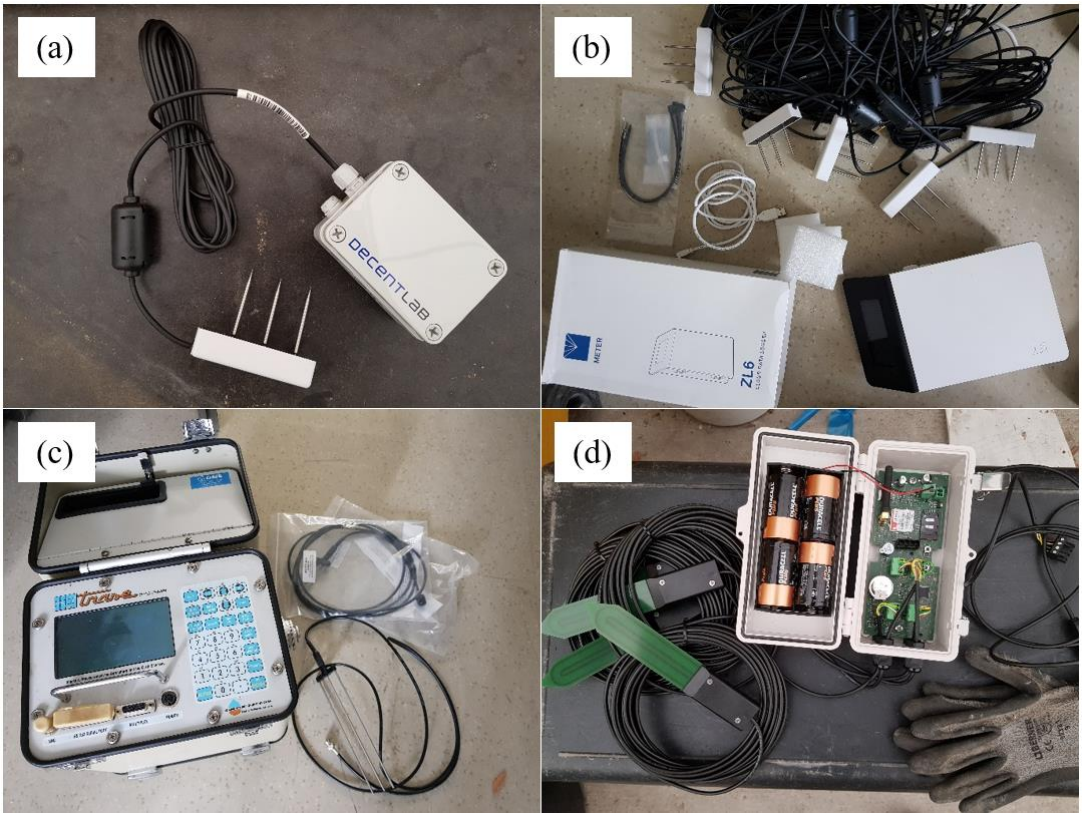


Figure 3: (a) TEROS-12 + Decentlab Datalogger + SENS (b) TEROS-11 + ZL6 Datalogger + ZENTRA Cloud (c) TDR (d) SMT100 + TrueLog100 Datalogger

As a first approach a lab test was carried out to test the different soil moisture sensors and dataloggers (Figure 1). Results of this test supported in decision making what type of soil moisture sensors were most suitable to purchase. It was found to use the SMT100 on locations where a large quantity of measurement points is required and the best option to install in the rainfall runoff plots. These sensors have a good accuracy for the most affordable price. Furthermore, there is a lot of freedom in programming and to use smaller measurement intervals.

In addition, materials are selected for the rainfall runoff plots. At these rainfall plots surface runoff is analyzed under different conditions to understand influence vegetation and soil conditions on slowing and storing of runoff. Subcontractor BFW (Austrian Research Centre for Forests) is involved in monitoring of these Water Indicators. Main equipment consists of a sprinkler system, pipes, weirs, pools that serve as water basin and a rain gage. Furthermore, tools are required for maintenance and storage. Materials are selected based on price comparison and quality, experience of technicians, workability for lab assistance and delivery times.

Finally, also materials are selected for a stream gage at the outlet of the catchment. This gage will monitor the water level continuously and these measurements are used to calibrate hydrological models. In addition, materials and sensors from earlier projects are re-used. However, additional tools and equipment had to be bought to mount the gage and to include for example a solar panel for power supply.

As NBS, afforestation in the catchment Geroldsbach-Götzens was installed in the torrent since the early 1950ies, resulting in changes in land cover, and habitat area and locations. As for the Nature Indicators, land-cover data is collected to map the forested area over time. This land-cover data can be obtained from open data sources, but in some cases, it was necessary to purchase old archive material. An overview of status of equipment that is selected and used for evaluation of the Nature Indicators is presented in Table 2.

Furthermore, fieldwork was carried out in order to identify and locate the relevant forest and soil types of the study area that can serve as input for hydrological modelling. In addition, the depth of the soil at different altitudes along transects was analyzed to get a better understanding of soil development, forest development and related hydrological properties. Fieldwork equipment and materials were also used from local subcontractors such as the Austrian Research Centre for Forests (BFW).

Changes in attractiveness of the NBS area and increase of property value and building prices after installing the NBS are evaluated as well. The reference situation (1950's) is difficult to compare, because of this rather old NBS not many data can be found for this situation. Aim is to use as baseline situation the earliest period when data is available. To evaluate indicators such as purpose of visits to the NBS site and damage costs and building prices, a qualitative assessment based on statistical data are carried out by DTU and UIBK. Important equipment that is needed to carry out these analyses is not selected yet and will be discussed with DTU in 2021. Data can be obtained from open data sources, but in some cases, it could be required to purchase statistical data as well. An overview of status of equipment that is selected and used for evaluation of the People Indicators is presented in Table 1.

Additional equipment purchases are foreseen in spring 2021 before the measurement period. This involves additional materials mainly for the rainfall runoff test site. Important are discussions with subcontractor and to involve local stakeholders before a decision is made on what will be bought. Besides that, costs of maintenance of equipment and when sensors need to be replaced can be expect during the RECONECT monitoring period.

Table 6. Status of equipment that is selected to monitor the Water, Nature and People Indicators in Demo B2

Equipment	Type	Quantity	Subgoal/ Indicators	Comment	Status
WATER					
Soil moisture sensors	SMT100	200	Flood & landslide risk reduction/ surface runoff reduction; slowing and storing runoff	Required for model parameterization and calibration	purchased and installed
Irrigation system*	Sprinklers	1	Flood & landslide risk reduction/ surface runoff reduction; slowing and storing runoff	Monitoring natural and artificial rainfall events. Required for model parameterization and calibration.	planned to buy and install 2021
	Pumps	2			Planned to buy and install 2021
	Water basins	4			purchased and installed
	Weirs	1			partly bought
Weather station	OTT Pluvio	1		Required for continuous monitoring of rainfall events	Planned to buy and install 2021
Data logger	DT-85M	1	surface runoff reduction; slowing and storing runoff	Required for continuous monitoring the rainfall-runoff plots	purchased and installed
Stream Gage	-	1	Flood hazard and delay time to peak	Water level measurement used to calibrate hydrological models	Planned to buy and install 2021
NATURE					
Maps and archive material	Remote sensing, satellite imagery, remote sensing	-	Land-cover data Habitat area and locations	Land-cover data is collected to map the forested area over time and evaluated changes in land-cover and habitats.	purchased and installed
Field equipment	General material for soil profiling	-	Land-cover data Habitat area and locations	Field survey to map the soil and to evaluate the NBS development	Finished
PEOPLE					
Statistical data	Statistics Austria	-	Purpose of visits to the NBS site Damage costs and building prices	To be discussed with DTU in 2021 if equipment is required	Planned 2021

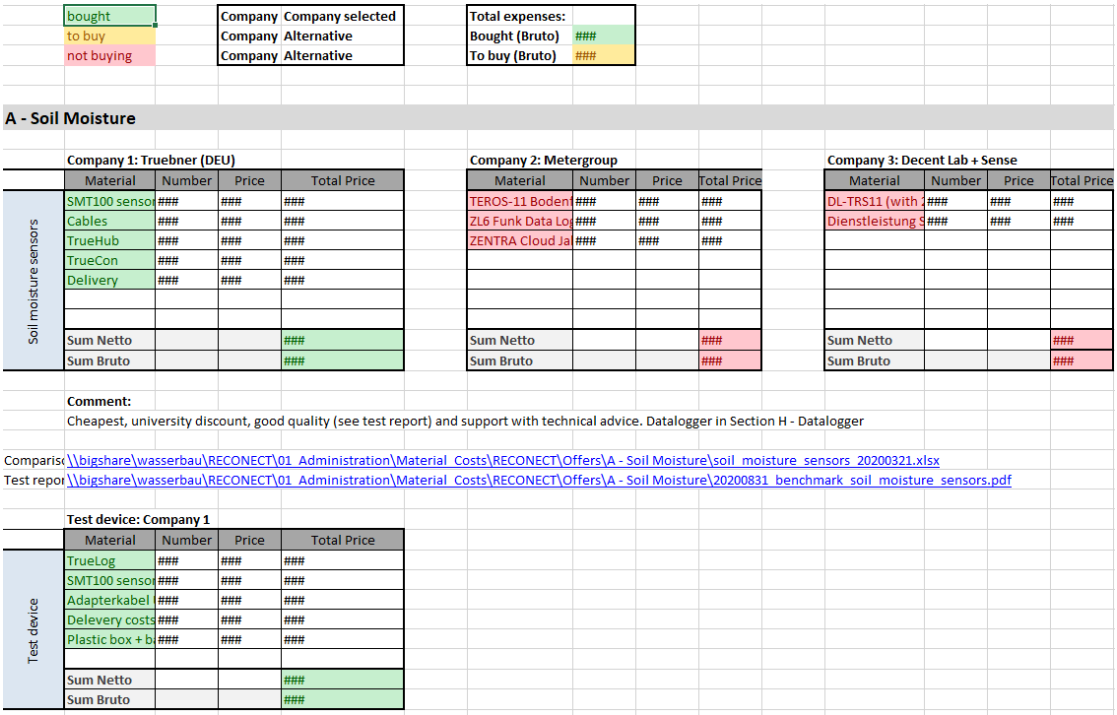
** irrigation system is handcrafted and consist of several small parts.*

7.2Description of the Procurement Process

To find the best value for money all equipment is selected based on price comparison, quality, experience of other experts, company service, workability and delivery times. In some cases, test devices are used to test out if the new equipment measures accurate and works well with existing logger systems and uses similar protocols. Money from other research projects is used as well, like for example the soil moisture sensors. For some equipment procurement rules by public authorities in Austria are also complied. These are regulated by the Bundesvergabegesetz, which allows direct contracts up to 100.000 euro.

However, internal university rules are stricter and require comparison offers depending on the price:
< 1000 Euro no offers
1000 – 2999,99 Euro 2 offers
3.000 – 9.999,99 Euro 3 offers
10.000 – 99.999,99 Euro 4 offers
A University controlling systems with regular internal and external audits makes is implemented (https://www.uibk.ac.at/innenrevision/).

At least three companies are always selected and compared to find the best offer. An example of the procurement soil moisture sensors is given in Figure 2. In green the materials that are bought, yellow if it is planned to buy, and red if not bought. Often a small comment is given the specific equipment is selected. Note that equipment can consist out of many smaller parts. Prices of the equipment that is planned for 2021 are an indication and more prices comparisons will be made.



bought	
to buy	
not buying	

Company	Company selected	
Company	Alternative	
Company	Alternative	

Total expenses:	
Bought (Bruto)	###
To buy (Bruto)	###

A - Soil Moisture

Soil moisture sensors

Company 1: Truebner (DEU)			
Material	Number	Price	Total Price
SMT100 senso	###	###	###
Cables	###	###	###
TrueHub	###	###	###
TrueCon	###	###	###
Delivery	###	###	###
Sum Netto			###
Sum Bruto			###

Company 2: Metergroup			
Material	Number	Price	Total Price
TEROS-11 Boden	###	###	###
ZL6 Funk Data Lo	###	###	###
ZENTRA Cloud Ja	###	###	###
Sum Netto			###
Sum Bruto			###

Company 3: Decent Lab + Sense			
Material	Number	Price	Total Price
DL-TRS11 (with 1	###	###	###
Dienstleistung S	###	###	###
Sum Netto			###
Sum Bruto			###

Comment:
Cheapest, university discount, good quality (see test report) and support with technical advice. Datalogger in Section H - Datalogger

Comparis \\bigshare\wasserbau\RECONECT\01_Administration\Material_Costs\RECONECT\Offers\A - Soil Moisture\soil_moisture_sensors_20200321.xlsx
Test repor \\bigshare\wasserbau\RECONECT\01_Administration\Material_Costs\RECONECT\Offers\A - Soil Moisture\20200831_benchmark_soil_moisture_sensors.pdf

Test device

Test device: Company 1			
Material	Number	Price	Total Price
TrueLog	###	###	###
SMT100 senso	###	###	###
Adapterkabel	###	###	###
Delevery costs	###	###	###
Plastic box + b	###	###	###
Sum Netto			###
Sum Bruto			###

Figure 4: Example of a price comparison of soil moisture sensors. In green the materials that are bought, yellow if it is planned to buy, and red if it would not be bought.

7.3Installation of the Equipment

A combination of monitoring and modelling is used to better understand runoff processes in Alpine catchments and to demonstrate the benefits of the NBS that have been implemented in the past years.

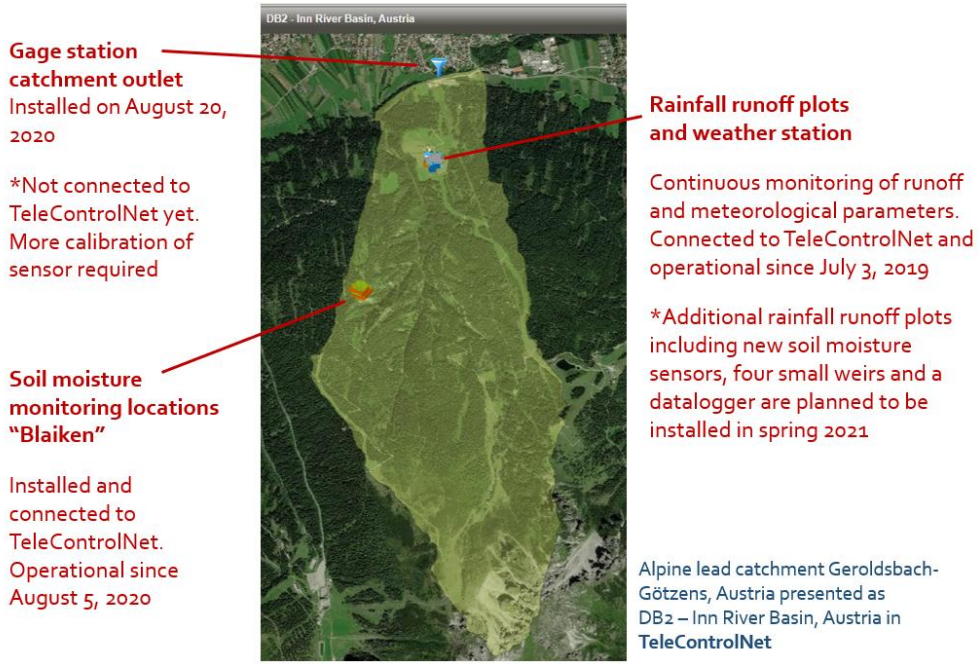


Figure 5: Important monitoring locations as 'DB2 – Inn River Basin, Austria' in TeleControlNet with dates of installations and times when going operational.

Figure 5 shows the lead catchment Geroldsbach-Götzens in TeleControlNet with the important monitoring locations: the 'Blaiken area' that contains different stage of afforestation, the artificial rainfall test site, and the gage station at the outlet of the catchment. Soil moisture sensors at Blaiken are installed on August 5, 2020 and operational on TeleControlNet. The rainfall runoff sensors and weather station are operational since July 3, 2019. An ultra-sonic sensor that measure the water level at the outlet of the catchment is installed on August 20, 2020. However, for the gage station improvements have to be made of construction and calibration before we can say that measurements are reliable enough to be uploaded on to the ICT-platform and shared openly. In spring 2021, additional soil moisture sensors, weirs and a new datalogger will be installed at the rainfall runoff test site. Furthermore, a possible replacement of the weather station that works with the new datalogger is foreseen.
Measurements have different temporal and spatial scales at different locations. Challenges are the accessibility, limited internet connection, different types of dataloggers, measurement intervals and power supply at these remote locations. Fieldwork is often carried out together with our experienced subcontractor BFW. An impression of the installation of equipment is presented in Figure 4. The left two pictures show the installation of soil moisture sensors on August 5, 2020. The right two pictures are taken during an artificial rainfall test of the National Workshop organized by UIBK, BFW and the local community on September 16, 2020.

Figure 6: Installation of equipment in the field together with subcontractor BFW (Austrian Research Centre for Forests). The left two pictures are made of the installation of soil moisture sensors on August 5, 2020. The right two pictures are taken at the artificial rainfall-runoff site during a National Workshop on September 16, 2020.

8 Demonstrator B3 – Aarhus, Egå Engsø and Lystrup, Denmark

8.1 Selection of Monitoring Equipment needed

Monitoring of discharge and water level time series, temperature and dissolved oxygen concentration in two rainwater ponds in the Lystrup area is based on online measurement of water level, oxygen concentration and temperature. Water level is used to calculate discharge based on discharge/water level relations, and retention in the rainwater pond is based on water level and a digital elevation model.

The data logger is model "CR300" from American Campbell Scientific (https://www.campbellsci.co.uk/cr300). The logger is a fully programmable minicomputer. Push of data to the cloud takes place via the built-in 4G mobile modem. The logger can be programmed to a very high frequency on the sensors (<1 minute). Data is stored partly locally on the data logger (backup), partly it ends up via the mobile network to Orbicon's hydrometry database HYMER. From HYMER data is transferred regularly to RECONNECT's website via www.telecontrolnet.nl.

The water level sensors are pressure probes from English Impress Sensors (https://www.impress-ensors.co.uk/images/products/Datasheets/Impress/D-S12S-SDI-12-Submersible-level-ransmitter-silicon-sensor.pdf).

The oxygen probes are optical oxygen probes from French Aqualabo (https://en.aqualabo.fr/userfiles/doc/Datasheet%20Oxygen%20Optical%20digital%20sensor%20OPTOD_2.pdf).

Monitoring of nature-indicators does not require selection of specific equipment. Instead various types of field monitoring has been carried out around Lake Egå.

The species abundance of the Great Crested Newt was compared by using two monitoring methods, eDNA monitoring and traditional monitoring.

<u>eDNA monitoring equipment:</u>

Each sampling equipment contains:

- 1x pair nitrile gloves
- 1x large Whirlpack collection bag
- 1x 60 mL Luer Lock plastic syringe
- 1x filter
- 1x small syringe with reusable cap and 1.5 mL DNA preservative solution
- 1x red Luer Lock cap
- 1x resealable zip lock bag
- 1x NatureMetrics addressed jiffy bag

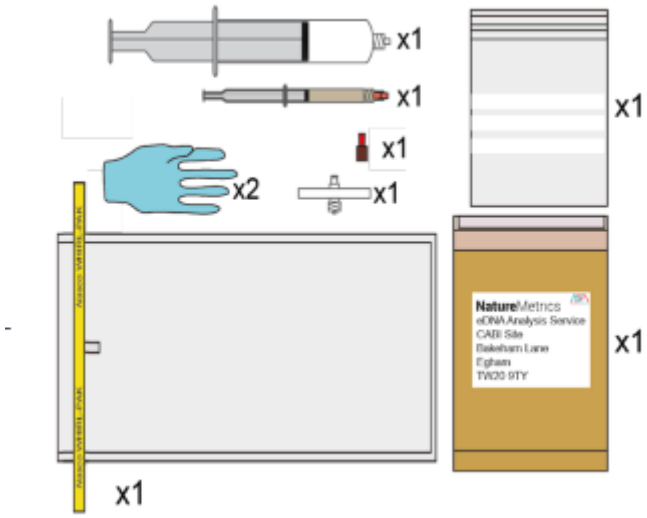


Figure 7: Nature Metrics equipment for eDNA monitoring

Such equipment enables to concentrate the DNA of the species into a filter. This filter is then sent to the lab for qPCR single-species analysis.

eDNA analysis allows detection of those species that sometimes cannot be detected with traditional monitoring approaches. With traditional monitoring, the species may be hidden, or even they may have left the water body. Furthermore, if the species are endangered, it might not be easy to find them with the traditional method. The DNA of a species can be detected in the water up to two weeks after the species has left the pond[1].

No equipment has been selected yet. We expect to select equipment, such as person counters to monitor 'soft' traffic around Lake Egå during 2021. By soft traffic we mean traffic by others than motorized vehicles.

Table 7. Status of equipment that is selected to monitor the Water, Nature and People Indicators in Demo B3- Greater Aarhus, Denmark

Equipment	Type	Quantity	Subgoal/ Indicators	Comment	Status
WATER					
water level sensors & oxygen probes	"CR300" American Campbell Scientific; optical oxygen probes- French Aqualabo		flood risk reduction/ flood peak	Monitoring of discharge and water level time series	rented from external consulting company
NATURE					
eDNA monitoring equipment	see Figure	2	Increase in	detection of	purchased

[1] Thomsen et al. 2011. Monitoring endangered freshwater biodiversity using environmental DNA. *Molecular Ecology*. Vol. 21 (11)

	1		biodiversity/ species richness	species when sometimes it cannot be detected via traditional monitoring	and installed
PEOPLE					
visitor counters	tbd	tbd	Increase in recreational opportunities/ number of visitors	count "soft' traffic" (visitors without motorized vehicles)	planned for 2021

8.2Description of the Procurement Process

The monitoring in the Lystrup area is carried out by the consulting company Orbicon (now WSP) which is responsible for delivery and installation of equipment and 2 years of operation and maintenance. In addition, the consultant handles data collection and data transfer to the ICT-platform.

Two consulting firms with experience in the task type were invited to tender. Selection of advisor was based on economically most advantageous offer, based on overall price and method description (method choice, equipment accuracy and feasibility). Two years rent of equipment is part of the contract.

The tender was made in accordance with the Danish tender legislation. Tender documents with related questions and answers to the tender are available in Danish.

Aarhus municipality received two offers for eDNA equipment: 1) from Nature Metrics based in UK, 2) from Eurofins based in Denmark.
Nature Metrics' offer was selected, for its price and for its number of replicates (12) per qPCR analysis, which could potentially increase the probability of detecting DNA of the target species.

No equipment for monitoring people indicators has been procured yet. There is a plan to start the process of procurement of person counter equipment when DTU and UFZ are closer to a final design of the questionnaires for monitoring specific people indicators. We expect to select, procure and install equipment during 2021.

8.3Installation of the Equipment

The existing outlet wells has a built-in overflow edge (weir) and a water brake in the outlet itself. The equipment is installed in these existing outlet wells from the two rainwater ponds. The data logger is located outside the well. Power supply with battery.

The pressure probes communicate with the logger via the digital SDI-12 protocol. This gives less noise (mm-variation on registration) and, on the one hand, better long-term stability than the cheaper analogue pressure probes. Water level measurement resolution 1 mm. Measurement accuracy <±0,1% on full scale (0-4 meter).

The oxygen probes Oxygen measurement resolution 0,01 mg/l. Measurement accuracy ±0,1 mg/l. Water temperature measurement resolution 0,01 degree Celsius. Measurement accuracy ±1%.

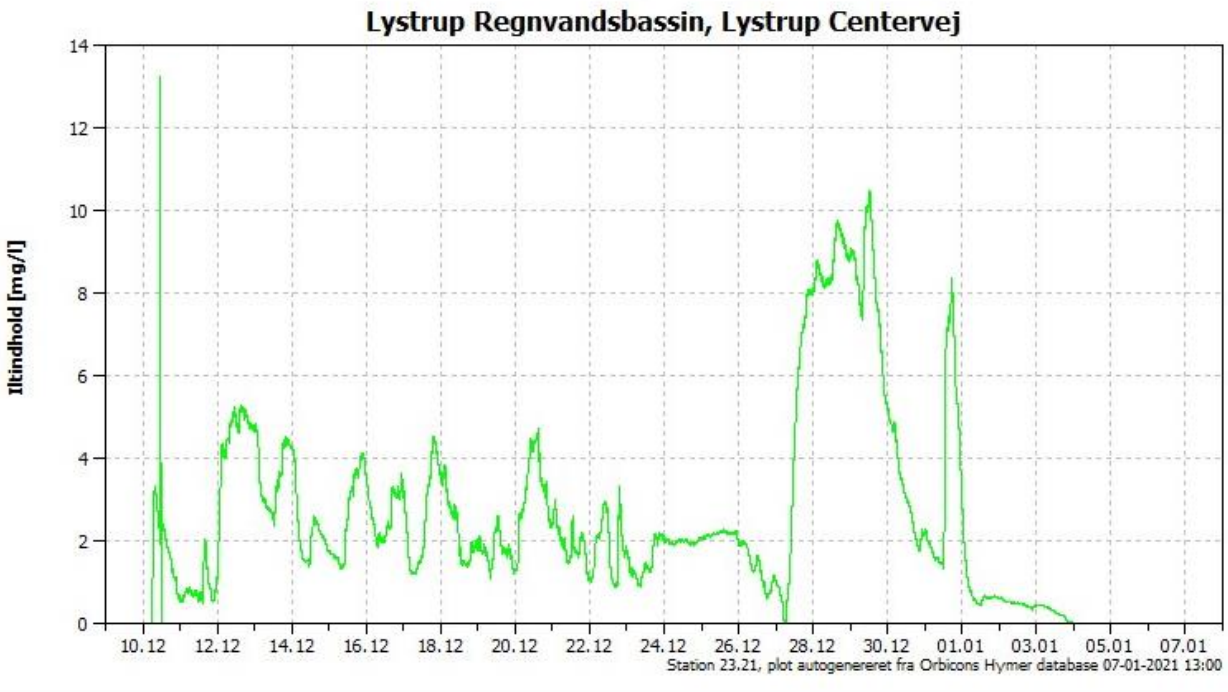


Figure 8: Example of oxygen concentration measurement at the outlet from the rainwater dam in Lystrup

Data from the Lystrup area is not yet connected to the ITC platform. Connection is performed when the water level / discharge and water level / pond volume relations are completed. Expected to happen in early 2021.

eDNA equipment is not installed in the site, but is a mobile device used within the monitoring program.

No equipment for monitoring people indicators has been installed yet.

9 Demonstrator B4 – Thur River Basin, Switzerland

9.1 Selection of Monitoring Equipment needed

Up to now it is not planned to purchase and install any new equipment. Priority is given to set up a database where the data from already existing equipment will be stored. This setup will all groups from within and outside the organization to access the data from the field.

Continuous river water level and discharge at downstream of NBS location are modelled based on measurements of discharge and water level at selected locations throughout the river course. There is an ultrasound sensor to measure the river water level located 500 m upstream of the NBS.
Data on rainfall for the entire catchment (>50 stations inside and outside the catchment) and water levels at selected gauging stations along the river are publically available.
Next to that an extensive long-term data series of the quality of groundwater (water contaminants samples and surrogate information such as electrical conductivity, water level and water temperature) is available.

Estimation of habitat areas is planned to be based on aerial imagery surveys. The surveys are done regularly, e.g. every two-years.

To evaluate the increase of recreational opportunities, the number of people that visit or spend time in the NBS area and the purpose of the number of visits to the NBS area can be assessed by the results of a questionnaire to the population in the surrounding communities. For the Thur case, no active evaluation on activities of people was conducted at the site before the NBS was implemented. However, the questionnaire contained comparisons of activities and number of people concerning the time before and after the restoration. Thus, the opinions expressed “before restoration” can be used as a reference/baseline.

Table 8. Status of equipment that is selected to monitor the Water, Nature and People Indicators in Demo B4- Thur River, Switzerland

Equipment	Type	Quantity	Subgoal/ Indicators	Comment	Status
WATER					
No new equipment purchased and installed.					
NATURE					
No new equipment purchased and installed.					
PEOPLE					
No new equipment purchased and installed.					

9.2Description of the Procurement Process

No new equipment has been purchased.

9.3Installation of the Equipment

No new equipment has been installed.

10 Demonstrator B5 – The Var Éco-Vallée, France

10.1 Selection of Monitoring Equipment needed

Low valley of the Var river is a good example of a long history of human interference in its morphological and sedimentation processes. Different measures in the valley and upstream of it have been implemented over the years. At the beginning the focus was on the structural measures followed by hydraulic structures along the Var river.

The monitoring activities described in report 2.6 have started, but up to now there is no need to buy additional equipment, since it is planned to use already available sources to monitor all water, nature and people indicators.

The water levels in the river and discharge are monitored. One monitoring is covering the whole NBS area and measuring monthly average water levels and discharge data since 2017. This data is foreseen to be used also as input for 1D-2D hydrodynamic modelling to predict water depths and flow velocities after NBS implementation.

Table 9. Status of equipment that is selected to monitor the Water, Nature and People Indicators in Demo B5- The Var Éco-Vallée. France

Equipment	Type	Quantity	Subgoal/ Indicators	Comment	Status
WATER					
No new equipment purchased and installed.					
NATURE					
No new equipment purchased and installed.					
PEOPLE					
No new equipment purchased and installed.					

10.2 Description of the Procurement Process

No new equipment has been purchased.

10.3 Installation of the Equipment

No new equipment has been purchased.

11 Demonstrator B6 – Les Boucholeurs, France

11.1 Selection of Monitoring Equipment needed

Following the storm Xynthia in 2010, the municipality of Châtelaillon-Plage has set up, with the municipality of Yves, Aix and Fouras, a system to fight against different types of flood called PAPI (Program of Actions Of Flood Prevention).
Lessons learned after Xynthia event and work done within PEARL project showed great potential of nature in this area to compensate flood and readiness of local community to know as much as possible about the existing solutions.

The monitoring activities described in report 2.6 have started, but up to now there is no need to buy additional equipment, since it is planned to use already available sources to monitor all water, nature and people indicators.

The evaluation of the defined sub-goal coastal risk reduction will be done with comparison of reference flood map and new flood maps. Achievement of this sub-goal is of high importance. Reduced coastal risk is providing security to population in NBS area and protects assets. The reference model result is available and will be used for comparison with of flood maps created with reconstructed protection wall exploring the effect of the same event. The reduction of coastal flood hazard is visible since within NBS embankments is renewed and the new flood gates are created in order to provide better protection.

Table 10. Status of equipment that is selected to monitor the Water, Nature and People Indicators in Demo B6- Les Baucholeurs. France

Equipment	Type	Quantity	Subgoal/ Indicators	Comment	Status
WATER					
No new equipment purchased and installed.					
NATURE					
No new equipment purchased and installed.					
PEOPLE					
No new equipment purchased and installed.					

11.2 Description of the Procurement Process

No new equipment has been purchased.

11.3 Installation of the Equipment

No new equipment has been purchased.

12 Linking Sensor Data with the ICT Platform

Most of the data gathered by the new equipment will be displayed at the RECONECT Service Platform, which is an ICT platform that combines a network distributed data, intelligent tools and standardized web-services, accessible through a centralized catalogue of network services. The platform is hosted by TeleControlNet (https://www.telecontronet.nl), which acts as a backbone for ICT services for data coming from NBS sites. Data from installed and connected sensors can be received in real-time, stored, managed, displayed and of course also analyzed.

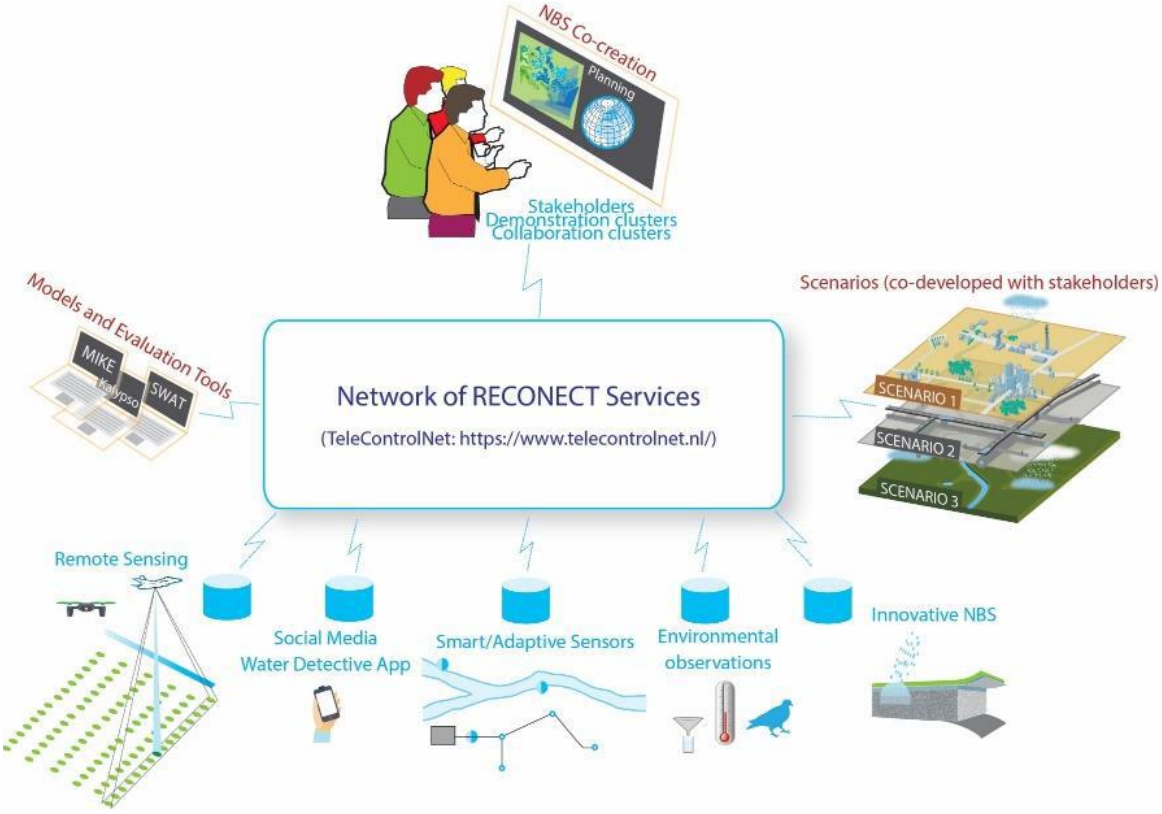


Figure 9: RECONECT Service Platform for supporting and displaying monitoring data for Demonstrators and Collaborators cases

Different kind of sensor data such as precipitation, relative humidity, temperature, wind direction, wind speed, water level and discharge can be displayed on the platform. The data can be shown in different formats such as graphs or bar charts.

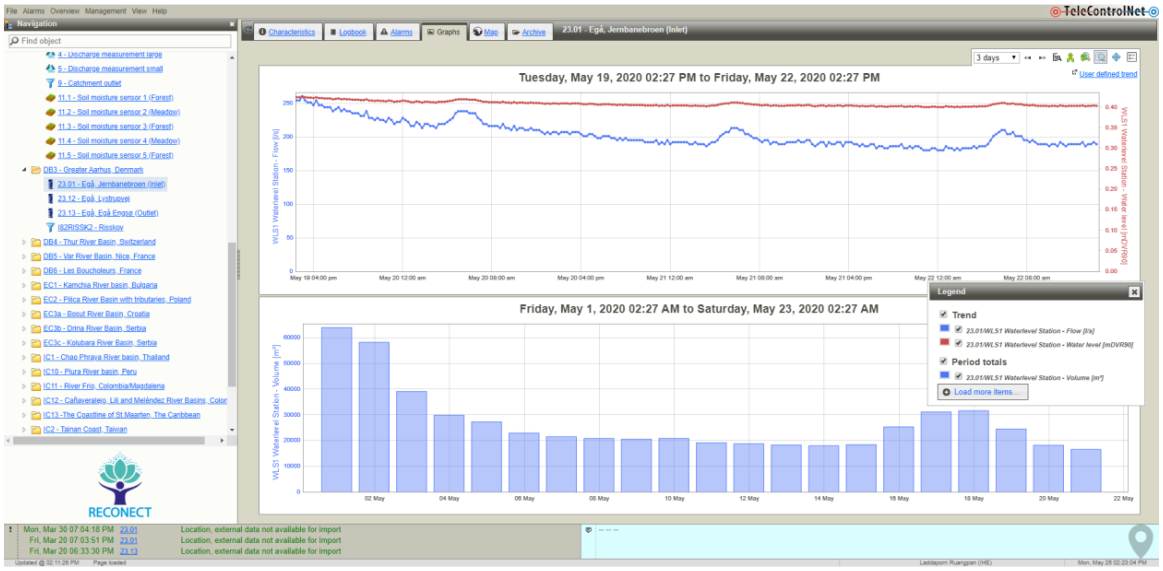


Figure 10: Example of monitoring data (water levels and retention volume) at Ega, Jernbanebroen (Inlet), Greater Aarhus, Denmark (DB3)

Integration of data from sensors already available before the RECONECT project and from new equipment purchased and installed is currently in progress in several Demonstrator sites. More than 30 sensor connections are already implemented and the number of data connections is contiously growing every month.

Table 11. ICT connections with monitoring equipment (status February 2021)

Demonstration Site	Sensor Data	Status ICT connection
DA-1 Dove/Gose Elbe Estuary, Germany	Gauging stations	Connection in progress
DA-2 Odense Coastal Area, Denmark	Webcams	2 sensor connections
DA-3 Tordera River Basin, Spain	Weather stations Waterlevel stations	4 sensor connections
DA-4 Portofino Regional Natural Park, Italy	Weather stations Waterlevel stations	5 sensor connections
DB-1 Ijssel River Basin, the Netherlands	Waterlevel stations	7 sensor connections
DB-2 Inn River Basin, Austria	Weather stations Soilmoisture Stations	12 sensor connections
DB-3 Greater Aarhus, Denmark	Waterlevel stations Weather stations	4 sensor connections
DB-4 Thur River Basin, Switzerland		No connections yet
DB-5 Var Éco-Vallée, France		No connections yet
DB-6, Les Boucholeurs, France		No connections yet

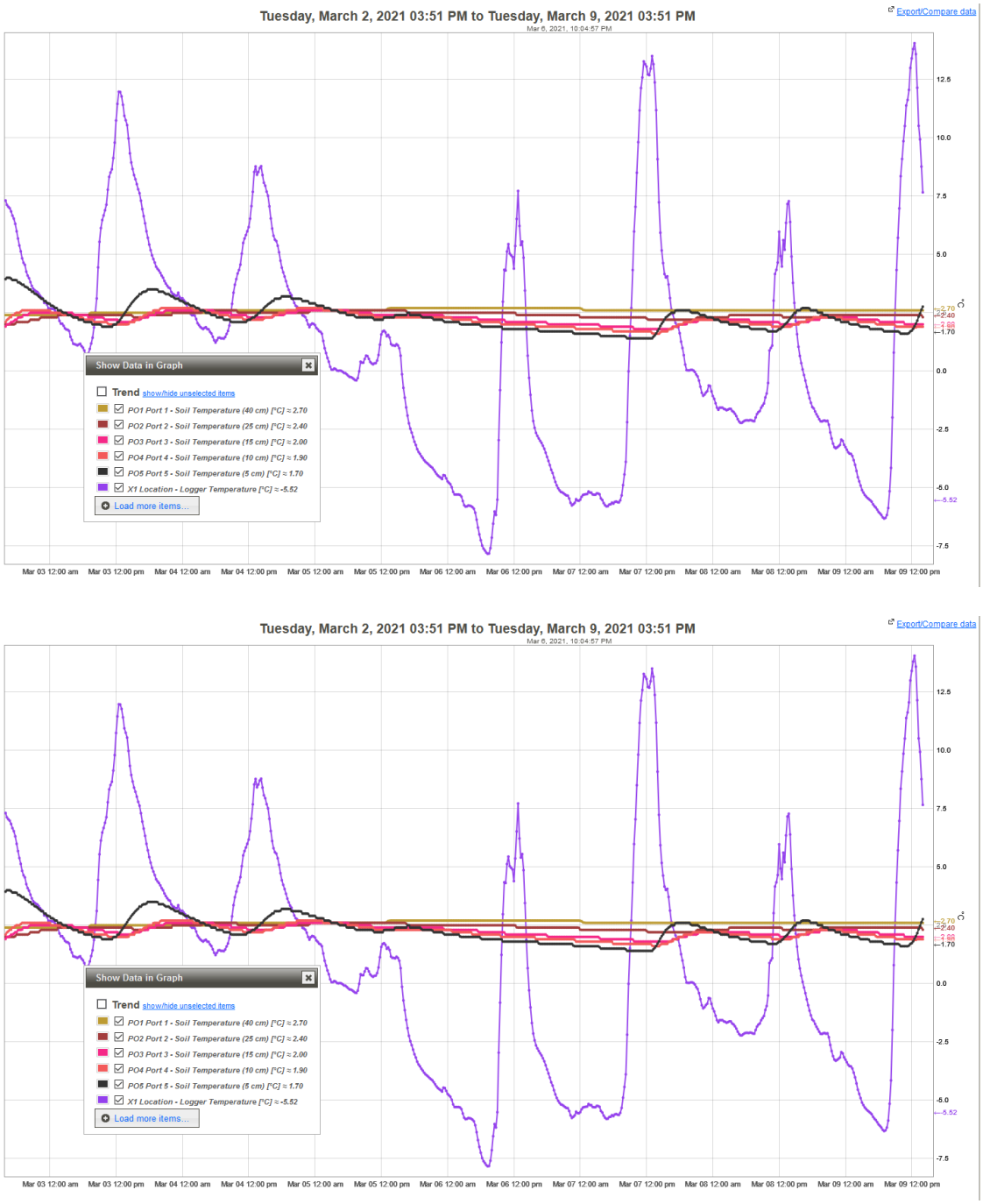


Figure 11: Graphs showing data transmitted to TeleControlNet in real time such as weather data from DA2 –Portofino Park and soil moisture from DB4- Thur River Basin

A detailed list of all parameters measured and linked to TeleControlNet up to now is added to this report in Annex B.

13 Other info, barriers & “lessons learnt”

From the information provided by the Demonstrators on the procurement and installation of equipment a number of conclusions and recommendations can be summarized as follows:

During the **selection phase** the main challenge was to identify the correct equipment needed although the monitoring plans were not worked out completely at that point of time. In the beginning of the project several Demonstrator sites came up with ideas and requests to purchase new equipment, but some of these requests had to be rejected, since they could not be linked directly to the selected target indicators.

RECONECT twinning activities and knowledge exchange between Demonstrator B and Demonstrator A sites as well as reflections in webinars and on general project meetings have been very helpful within the selection processes. Some Demo A sites have been inspired by equipment already in use in Demo B sides. All Demonstrators, being assisted by other RECONECT partners and advised by stakeholders, have finally selected that type of equipment best in line with their targets and the selected indicators to be monitored for NBS evaluation.

One important barrier that influenced and slowed down the procurement and installation processes was COVID-19. It was more difficult to get in contact with suppliers and delivery times went up. For example in Austria (Inn River Basin) some of the planned tools for water monitoring could not be purchased as planned in summer 2020.

Procurement processes to be applied may be different in regard to national or regional legislation and also different for public administrations and commercial companies. Nevertheless one of the important lessons learned is, that it pays off to have a good price comparison and to get at least a minimum of three offers coming in.

In some cases materials can be re-used and “cheaper sensors” can be compared with more advanced sensors or ask for a free trial sensor of a company to check if these have a similar accuracy. Sometimes universities get special discounts.

On the other hand it is important not to look only to price, but also to involve expertise of other researchers. It is certainly important to have a good technical evaluation on beforehand. For example, instead of several small dataloggers, it can save costs to have one advanced logger that works with all sensors and makes uploading data to the ICT-platform easier.

Furthermore, it is very helpful to have support of local stakeholders and the community to organize fieldwork assistance, power supply and to arrange protection of measurement equipment.

Finally calibration and validation of all sensors is important before data is uploaded to the ICT-platform and shared openly on TeleControlNet.

In regard to equipment **installation** the most important recommendation is to follow closely the instructions of the manufacturer. If the equipment is not installed correctly, it may result in wrong outputs and therefore lead to false conclusions.

Some equipment installations require certain meteo conditions or water levels and it is advisable in these cases not to delay installations if suitable conditions appear.

Of course COVID-19 also had an impact on the installation process in the field. During multiple lockdown periods in Tirol (Austria), Portofino (Italy) and other demonstration sites installation was not possible and even in periods outside the hard lockdown, it was difficult to have the support of the right people to install the sensors. Not only new installations, but also the maintenance of existing field equipment was difficult in these periods.

As described in the introduction this report on equipment is looking only to one pillar of the monitoring plans, being in-situ observations and measurements by using technical tools (hardware and/or software). Next to the in-situ data from the purchased equipment it is certainly needed to complement in-situ data by other methods for data collection such as surveys & census, citizen science or remote sensing techniques.

Geospatial datasets derived from remote sensing are another key element in the monitoring and evaluation programs of the demonstrator sites to assess some of the indicators. In some cases, mostly in small scale projects, data from drones or unmanned aerial vehicles (UAVs) might be used. Within RECONECT aerial survey flights in Portofino and Odense have been executed in 2020. For larger project sites and depending on the required spatial resolution to monitor certain indicators satellite data is another complementary datasource to be used.
For additional suggestions in regard to the use of EO and Remote Sensing techniques, data treatment and processing we refer to future deliverable D3.4 (Report on co-monitoring activities).

Lessons learnt in regard to monitoring equipment, covering the different dimensions (WATER, NATURE & PEOPLE) are summarized in the table below. The listed recommendations can guide stakeholders on aspects to think about, when looking to find and install the right equipment for a specific NBS context.

It must be addressed also that new type of equipment is coming to market continuously and some of the gained insights may change and evolve over time. Anyhow most of the lessons learnt described in the table are formulated in such a way that they remain valid at least in the medium term.

Lessons learnt on selection, purchasing and installation of equipment will be continuously revised by discussing *"good practises",* but also *"bad examples"* in upcoming webinars linked to Co-Monitoring & Co-Evaluation as well as Upscaling and Replication (WP4).

It is suggested that additional field visits are prepared and organised within RECONECT twinning activities or on occasion of the General Assembly meetings. A good example was given by EAWAG presenting their technical equipment to all partners on site at a field visit at Thur River Basin during GA meeting days in Zurich.

Some of the lessons learnt can also be linked to standardization processes addressed in WP5. While the heterogeneity of project sites requires to keep flexible in the specific type of equipment selected, methods for selecting, purchasing and installing equipment can (at least to some extent) be standardized. The lessons learnt described in this section of the report will therefore also feed into upcoming deliverables within WP4 and WP5.

WATER

Table 12. "Lessons learnt" for WATER, NATURE & PEOPLE indicators

Installation of suitable technical equipment is very important to monitor a number of variables for WATER indicators on a regular base.

Since there is a lot of equipment available it is important to identify the most relevant data gaps first and clearly outline the requirements for the equipment needed.

In a next step a good comparison of technical parameters and prices is crucial to identify the equipment with the "best value for the money".

Of course it is important also to make a careful selection of the right spots to install the equipment and make sure that the installation is done properly according to the equipment descriptions.

Measurements are most helpful in case they are linked in real time to an IT-platform, where they are accessible to all involved stakeholders and can be displayed in descriptive forms, such as graphs, tables or maps.

NATURE

Most of the NATURE indicators are monitored by field surveying or GIS-based mapping using aerial or satellite imagery. Technical equipment can be helpful to complement this info in a number of cases.

As described in the Aarhus demonstrator case modern equipment for eDNA analysis might be a helpful tool. Technical equipment can also be used to measure soil composition, air quality or other parameters, which might be relevant for NATURE indicators.

Using technical equipment from external service providers (subcontractors) can be a cost efficient alternative in case there is no need for a continous monitoring over longer periods of time.

GIS-tools are very helpful to analyze correlations (e.g. biotops, protected sites...) and display them in form of informative maps. Next to that measurements should be linked to an IT-platform, where they are accessible to all involved stakeholders.

PEOPLE

Using technical equipment for PEOPLE indicators is not immediately obvious. Anyhow some equipment like webcams or visitor counters might be helpful and have been purchased and installed in some of the project sites.

Webcams can be used to promote the recreational opportunities in the NBS sites. Visitor counters can provide objective information on the number of visitors, when being installed in key positions of the sites, such as entrance pathways, outlet gates or touristic places.

As for WATER and NATURE indicators it is recommended to link the measures in real time to an IT-platform, which can display them in descriptive forms, such as graphs, tables or maps.

Annex A- Exemplaric Offer Request Portofino

Ente Parco di Portofino prot. in partenza n. 0000631 del 27-03-2019

Parco di Portofino

Spett.le

OGGETTO: Richiesta di offerta per fornitura e posa in opera di centraline meteo ed idrometri in località varie dei Comuni di Camogli, Portofino e Santa Margherita Ligure, nell'ambito del progetto europeo "RECONECT" co-finanziato dal programma europeo per la ricerca e l'innovazione "Horizon 2020" (contratto N. 776866).
CUP D52H18000360006 – CIG Z9227B758C

Con la presente si richiede la Vostra migliore offerta per la fornitura ed installazione di:

- **n. 3 centraline meteo costituite ognuna da:**
  - pluviometro risoluzione 0,1 mm o 0,2 mm;
  - anemometro (velocità e direzione vento);
  - sonda termometrica (temperatura e umidità); Campo operativo di funzionamento sensore: Temperatura -20…+50 °C., umidità di 0…100 %UR
  - sistema di acquisizione e trasmissione in remoto via GSM/GPRS;
  - pannello solare di alimentazione;
  - regolatore di carica;
  - batteria di backup in grado di consentire il funzionamento del sistema per almeno 7 giorni in assenza di insolazione
  - quadro in policarbonato, pali di sostegno, cablaggi e tutto quanto occorra affinché l'impianto sia perfettamente funzionante.

- **n. 2 idrometri costituiti ognuno da:**
  - Trasduttore di livello non a contatto (ultrasuoni o radar) range 0-8 m, uscita 4-20 mA, comprensivo di cavi, datalogger di acquisizione con possibilità di invio messaggi di allarme/ protezione civile
  - telecamera a doppia ottica con visione Day/Night, - Protezione IP65
  - sistema di acquisizione e trasmissione in remoto via GSM/GPRS;
  - pannello solare di alimentazione;
  - regolatore di carica;
  - batteria di backup in grado di consentire il funzionamento del sistema per almeno 7 giorni in assenza di insolazione
  - quadro in policarbonato, pali di sostegno, cablaggi e tutto quanto occorra affinché l'impianto sia perfettamente funzionante.

Per tutte le apparecchiature dovrà essere garantito con cadenza oraria l'invio delle immagini e dei dati rilevati.

- **n. 1 pc ad uso server per la raccolta e salvataggio dei dati registrati dalle postazioni sopra descritte.**
  La trasmissione dati deve essere garantita via GPRS/GSM e si deve prevedere l'invio di tutti i dati e immagini mediante router da fornire, direttamente ad un server del

cliente via FTP, l'applicativo per la raccolta dati dovrà essere strutturato in modo da garantire la visualizzazione dei dati a più utenti via internet (applicativo web oriented).

Non essendo ancora certa la modalità di fornitura dell'energia elettrica alle varie postazioni, si chiede di quantificare la differenza di spesa tra l'alimentazione con pannello fotovoltaico e l'alimentazione con allaccio alla rete.

Si elencano di seguito i siti nei quali dovrà essere effettuata l'installazione, in tutti i casi su palo staffato a muro su fabbricato o su muro di sostegno, delle apparecchiature sopra descritte:

- 1 centralina meteo in Comune di Camogli, località Mulini di San Fruttuoso, accessibile solo a piedi a circa 30 min di cammino dal più vicino accesso veicolare;
- 1 centralina meteo in Comune di Portofino, località Mulino del Gassetta, accessibile veicolarmente con mezzi di piccole dimensioni (tipo Porter Piaggio);
- 1 centralina meteo sulla copertura della sede Comunale di Portofino, accessibile veicolarmente;
- 1 idrometro in Comune di Camogli, località San Fruttuoso, accessibile via mare con battelli di linea da Camogli;
- 1 idrometro in Comune di Santa Margherita Ligure, località Paraggi, accessibile veicolarmente;
- 1 pc ad uso server presso la sede dell'Ente Parco in Santa Margherita Ligure, accessibile veicolarmente;

Si chiede inoltre di formulare un'offerta triennale per la manutenzione ordinaria delle apparecchiature, che dovrà prevedere almeno due interventi all'anno su ognuna delle postazioni da installare.

L'importo netto massimo a base d'offerta per tutto quanto sopra descritto è fissato in 40.000,00 euro.

L'offerta non verrà valutata sul miglior prezzo ma col criterio dell'offerta economicamente più vantaggiosa, pertanto si chiede di fornire una dettagliata descrizione delle caratteristiche delle apparecchiature che si intendono fornire, ed eventualmente definire, in caso di discostamenti da quanto sopra descritto, adeguate motivazioni.

Per eventuali informazioni rivolgersi al geom. Roberto Cavagnaro responsabile dell'Ufficio Tecnico dell'Ente Parco ai n. 0185289479 – 3664384424 – mail: ufficiotecnico@parcoportofino.it

Le offerte dovranno essere presentate entro le ore 12:00 del 12 aprile p.v. a mezzo pec all'indirizzo: info@pec.parcoportofino.it o consegnate all'ufficio protocollo di questo Ente in Viale Rainusso, 1 – 16038 Santa Margherita Ligure.

Rimanendo a disposizione per qualsiasi chiarimento, porgo cordiali saluti.

Il Responsabile del procedimento

(Geom. Roberto Cavagnaro)

Annex B- List of measured parameters linked to TeleControlNet (status 10/03/21)

Demons.	loc_desc	display_code	unit_code	tagname_desc
DA3	Fogars de la Selva (Can SimÃ³)	flow	m3/s	Flow
DA3	Fogars de la Selva (Can SimÃ³)	precipitation	mm/h	Precipitation
DA3	Fogars de la Selva (Can SimÃ³)	waterlevel	cm	Water level
DA3	Montseny (la Llavina)	flow	m3/s	Flow
DA3	Montseny (la Llavina)	waterlevel	cm	Water level
DA3	Sant Celoni	flow	m3/s	Flow
DA3	Sant Celoni	precipitation	mm/h	Precipitation
DA3	Sant Celoni	waterlevel	cm	Water level
DA3	Fogars de la Selva (Pont Eiffel)	flow	m3/s	Flow
DA3	Fogars de la Selva (Pont Eiffel)	waterlevel	cm	Water level
DA4	Mulini San Fruttuoso	precipitation	mm	precipitation
DA4	Mulini San Fruttuoso	relative_humidity	%	relative humidity
DA4	Mulini San Fruttuoso	temperature	c	temperature
DA4	Mulini San Fruttuoso	winddirection	deg	wind direction
DA4	Mulini San Fruttuoso	windspeed	km/h	wind speed
DA4	Mulino del Gassetta	precipitation	mm	precipitation
DA4	Mulino del Gassetta	relative_humidity	%	relative humidity
DA4	Mulino del Gassetta	temperature	c	temperature
DA4	Mulino del Gassetta	winddirection	deg	wind direction
DA4	Mulino del Gassetta	windspeed	km/h	wind speed
DA4	Portofino	precipitation	mm	precipitation
DA4	Portofino	relative_humidity	%	relative humidity
DA4	Portofino	temperature	c	temperature
DA4	Portofino	winddirection	deg	wind direction
DA4	Portofino	windspeed	km/h	wind speed
DA4	San Fruttuoso	waterlevel	cmmsl	waterlevel
DA4	Paraggi	waterlevel	cmmsl	waterlevel
DB1	Deventer	waterlevel	cmnap	Water level
DB1	Doesburg brug	waterlevel	cmnap	Water level
DB1	IJssel Marle	depth	cm	Depth
DB1	IJssel Marle	ec	ms/cm	Electrical Conductivity
DB1	IJssel Marle	pressure	hpa	Pressure
DB1	IJssel Marle	rdo	mg/l	Rugged Dissolved Oxygen
DB1	IJssel Marle	rdosat	%	Rugged Dissolved Oxygen Saturation
DB1	IJssel Marle	temperature	c	Temperature
DB1	IJssel Marle	turbidity	ntu	Turbidity

DB1	IJssel Marle	waterlevel	cmnap	Surfacewater Level (Wijhe)
DB1	Kampen	waterlevel	cmnap	Water level
DB1	Keteldiep	waterlevel	cmnap	Water level
DB1	Olst	discharge	m3/s	Discharge
DB1	Olst	volume	m3	Volume
DB1	Olst	waterlevel	cmnap	Water level
DB1	Wijhe	waterlevel	cmnap	Water level
DB1	Zutphen	waterlevel	cmnap	Water level
DB2	Runoff plot 1	P09	%	ice cont. S1 TW
DB2	Runoff plot 1	P10	%	water co. S1 TW
DB2	Runoff plot 1	P11	kg/m3	density S1 TW
DB2	Runoff plot 1	P12	mmws	SWE S1 TW
DB2	Runoff plot 1	P25	pf	C_LF S1 TW
DB2	Runoff plot 1	P26	pf	C_HF S1 TW
DB2	Runoff plot 2	P13	%	ice cont. S2 TW
DB2	Runoff plot 2	P14	%	water co. S2 TW
DB2	Runoff plot 2	P15	kg/m3	density S2 TW
DB2	Runoff plot 2	P16	mmws	SWE S2 TW
DB2	Runoff plot 2	P27	pf	C_LF S2 TW
DB2	Runoff plot 2	P28	pf	C_HF S2 TW
DB2	Runoff plot 3	P17	%	ice cont. S3 TW
DB2	Runoff plot 3	P18	%	water co. S3 TW
DB2	Runoff plot 3	P19	kg/m3	density S3 TW
DB2	Runoff plot 3	P20	mmws	SWE S3 TW
DB2	Runoff plot 3	P29	pf	C_LF S3 TW
DB2	Runoff plot 3	P30	pf	C_HF S3 TW
DB2	Runoff plot 4	P21	%	ice cont. S4 TW
DB2	Runoff plot 4	P22	%	water co. S4 TW
DB2	Runoff plot 4	P23	kg/m3	density S4 TW
DB2	Runoff plot 4	P24	mmws	SWE S4 TW
DB2	Runoff plot 4	P31	pf	C_LF S4 TW
DB2	Runoff plot 4	P32	pf	C_HF S4 TW
DB2	Rain gauge	P01	c	Temp TW
DB2	Rain gauge	P02	%rf	Feuchte TW
DB2	Rain gauge	P03	c	Temp. 0cm TW
DB2	Rain gauge	P04	c	Temp. -10cm TW
DB2	Rain gauge	P33	cm	snow depth TW
DB2	Rain gauge	P37	v	Ubat TW
DB2	Rain gauge	P38	mm	Niederschlag TW
DB2	Rain gauge	P38B	mm/min	NiederschlagsintensitÃ¤t TW
DB2	Discharge measurement large	P05	ma	Waage
DB2	Discharge measurement large	P06	mm	Ultraschallpegel
DB2	Discharge measurement small	P07	xx	Reserve TW

DB2	Discharge measurement small	P08	xx	Reserve TW
DB2	Discharge measurement small	P34	xx	Reserve TW
DB2	Discharge measurement small	P35	xx	Reserve TW
DB2	Discharge measurement small	P36	xx	Reserve TW
DB2	Soil moisture sensor	BATTERY	%	Battery Percent
DB2	Soil moisture sensor	BATTERY_MV	mv	Battery Voltage
DB2	Soil moisture sensor	PO1_temperature	c	Soil Temperature (40 cm)
DB2	Soil moisture sensor	PO1_watervolume	m3/m3	Water Content (40 cm)
DB2	Soil moisture sensor	PO2_temperature	c	Soil Temperature (25 cm)
DB2	Soil moisture sensor	PO2_watervolume	m3/m3	Water Content (25 cm)
DB2	Soil moisture sensor	PO3_temperature	c	Soil Temperature (15 cm)
DB2	Soil moisture sensor	PO3_watervolume	m3/m3	Water Content (15 cm)
DB2	Soil moisture sensor	PO4_temperature	c	Soil Temperature (10 cm)
DB2	Soil moisture sensor	PO4_watervolume	m3/m3	Water Content (10 cm)
DB2	Soil moisture sensor	PO5_temperature	c	Soil Temperature (5 cm)
DB2	Soil moisture sensor	PO5_watervolume	m3/m3	Water Content (5 cm)
DB2	Soil moisture sensor	REFERENCE_KPA	kpa	Reference Pressure
DB2	Soil moisture sensor	TEMPC_LOGGER	c	Logger Temperature
DB2	Soil moisture sensor	BATTERY	%	Battery Percent
DB2	Soil moisture sensor	BATTERY_MV	mv	Battery Voltage
DB2	Soil moisture sensor	PO1_temperature	c	Soil Temperature (40 cm)
DB2	Soil moisture sensor	PO1_watervolume	m3/m3	Water Content (40 cm)
DB2	Soil moisture sensor	PO2_temperature	c	Soil Temperature (25 cm)
DB2	Soil moisture sensor	PO2_watervolume	m3/m3	Water Content (25 cm)
DB2	Soil moisture sensor	PO3_temperature	c	Soil Temperature (15 cm)
DB2	Soil moisture sensor	PO3_watervolume	m3/m3	Water Content (15 cm)
DB2	Soil moisture sensor	PO4_temperature	c	Soil Temperature (10 cm)
DB2	Soil moisture sensor	PO4_watervolume	m3/m3	Water Content (10 cm)
DB2	Soil moisture sensor	PO5_temperature	c	Soil Temperature (5 cm)
DB2	Soil moisture sensor	PO5_watervolume	m3/m3	Water Content (5 cm)
DB2	Soil moisture sensor	REFERENCE_KPA	kpa	Reference Pressure
DB2	Soil moisture sensor	TEMPC_LOGGER	c	Logger Temperature
DB2	Soil moisture sensor	BATTERY	%	Battery Percent
DB2	Soil moisture sensor	BATTERY_MV	mv	Battery Voltage
DB2	Soil moisture sensor	PO1_temperature	c	Soil Temperature (25 cm)
DB2	Soil moisture sensor	PO1_watervolume	m3/m3	Water Content (25 cm)
DB2	Soil moisture sensor	PO2_temperature	c	Soil Temperature (20 cm)
DB2	Soil moisture sensor	PO2_watervolume	m3/m3	Water Content (20 cm)
DB2	Soil moisture sensor	PO3_temperature	c	Soil Temperature (15 cm)
DB2	Soil moisture sensor	PO3_watervolume	m3/m3	Water Content (15 cm)
DB2	Soil moisture sensor	PO4_temperature	c	Soil Temperature (10 cm)
DB2	Soil moisture sensor	PO4_watervolume	m3/m3	Water Content (10 cm)
DB2	Soil moisture sensor	PO5_temperature	c	Soil Temperature (5 cm)

DB2	Soil moisture sensor	PO5_watervolume	m3/m3	Water Content (5 cm)
DB2	Soil moisture sensor	REFERENCE_KPA	kpa	Reference Pressure
DB2	Soil moisture sensor	TEMPC_LOGGER	c	Logger Temperature
DB2	Soil moisture sensor	BATTERY	%	Battery Percent
DB2	Soil moisture sensor	BATTERY_MV	mv	Battery Voltage
DB2	Soil moisture sensor	PO1_temperature	c	Soil Temperature (5 cm)
DB2	Soil moisture sensor	PO1_watervolume	m3/m3	Water Content (5 cm)
DB2	Soil moisture sensor	PO2_temperature	c	Soil Temperature (10 cm)
DB2	Soil moisture sensor	PO2_watervolume	m3/m3	Water Content (10 cm)
DB2	Soil moisture sensor	PO3_temperature	c	Soil Temperature (20 cm)
DB2	Soil moisture sensor	PO3_watervolume	m3/m3	Water Content (20 cm)
DB2	Soil moisture sensor	PO4_temperature	c	Soil Temperature (40 cm)
DB2	Soil moisture sensor	PO4_watervolume	m3/m3	Water Content (40 cm)
DB2	Soil moisture sensor	PO5_temperature	c	Soil Temperature (60 cm)
DB2	Soil moisture sensor	PO5_watervolume	m3/m3	Water Content (60 cm)
DB2	Soil moisture sensor	REFERENCE_KPA	kpa	Reference Pressure
DB2	Soil moisture sensor	TEMPC_LOGGER	c	Logger Temperature
DB2	Soil moisture sensor	BATTERY	%	Battery Percent
DB2	Soil moisture sensor	BATTERY_MV	mv	Battery Voltage
DB2	Soil moisture sensor	PO1_temperature	c	Soil Temperature (45 cm)
DB2	Soil moisture sensor	PO1_watervolume	m3/m3	Water Content (45 cm)
DB2	Soil moisture sensor	PO2_temperature	c	Soil Temperature (25 cm)
DB2	Soil moisture sensor	PO2_watervolume	m3/m3	Water Content (25 cm)
DB2	Soil moisture sensor	PO3_temperature	c	Soil Temperature (15 cm)
DB2	Soil moisture sensor	PO3_watervolume	m3/m3	Water Content (15 cm)
DB2	Soil moisture sensor	PO4_temperature	c	Soil Temperature (10 cm)
DB2	Soil moisture sensor	PO4_watervolume	m3/m3	Water Content (10 cm)
DB2	Soil moisture sensor	PO5_temperature	c	Soil Temperature (5 cm)
DB2	Soil moisture sensor	PO5_watervolume	m3/m3	Water Content (5 cm)
DB2	Soil moisture sensor	REFERENCE_KPA	kpa	Reference Pressure
DB2	Soil moisture sensor	TEMPC_LOGGER	c	Logger Temperature
DB3	EgÃ¥, Jernbanebroen (Inlet)	flow	l/s	Flow
DB3	EgÃ¥, Jernbanebroen (Inlet)	volume	m3	Volume
DB3	EgÃ¥, Jernbanebroen (Inlet)	waterlevel	mdvr90	Water level
DB3	EgÃ¥, Lystrupvej	waterlevel	mdvr90	Water level
DB3	EgÃ¥, EgÃ¥ EngsÃ¸ (Outlet)	flow	l/s	Flow
DB3	EgÃ¥, EgÃ¥ EngsÃ¸ (Outlet)	volume	m3	Volume
DB3	EgÃ¥, EgÃ¥ EngsÃ¸ (Outlet)	waterlevel	mdvr90	Water level
DB3	Risskov	precipitation_forecast	mm	Precipitation (Forecast)
DB3	Risskov	pressure	hpa	Air Pressure
DB3	Risskov	pressure_forecast	hpa	Air Pressure (Forecast)
DB3	Risskov	temperature	c	Air Temperature

DB3	Risskov	temperature_forecast	c	Air Temperature (Forecast)
EC1	Poda/Kamchia	waterlevel	mmsl	Waterlevel
EC1	Velichkovo/Kamchia	waterlevel	mmsl	Waterlevel
EC1	Dalgopol town	waterlevel	mmsl	Waterlevel
IC1	Upper Dhammaraja Gate	water_level	mmsl	Water level
IC1	Dhammaraja Gate	water_level	mmsl	Water level
IC1	ATG101	water_level	mmsl	Water level
IC1	Krung Thep 2	water_level	mmsl	Water level
IC1	Rabibadhana Nong Suea	water_level	mmsl	Water level
IC1	Lam Luk Ka Klong8	water_level	mmsl	Water level
IC1	Rabibadhana West Section	water_level	mmsl	Water level
IC1	Future Park Rangsit	water_level	mmsl	Water level
IC1	Liab Khlong 13	humid	%	Humidity
IC1	Liab Khlong 13	press	hpa	Barometric Pressure
IC1	Liab Khlong 13	rain10m	mm	Precipitation 10 minutes
IC1	Liab Khlong 13	rain1h	mm	Precipitation 1 hour
IC1	Liab Khlong 13	rain24past	mm	Precipitation last 24 hour
IC1	Liab Khlong 13	raintoday	mm	Precipitation day
IC1	Liab Khlong 13	solar	w/m2	Solar Radiation
IC1	Liab Khlong 13	temp	c	Air Temperature
IC1	Rangsit Khlong 7	humid	%	Humidity
IC1	Rangsit Khlong 7	press	hpa	Barometric Pressure
IC1	Rangsit Khlong 7	rain10m	mm	Precipitation 10 minutes
IC1	Rangsit Khlong 7	rain1h	mm	Precipitation 1 hour
IC1	Rangsit Khlong 7	rain24past	mm	Precipitation last 24 hour
IC1	Rangsit Khlong 7	raintoday	mm	Precipitation day
IC1	Rangsit Khlong 7	solar	w/m2	Solar Radiation
IC1	Rangsit Khlong 7	temp	c	Air Temperature