Template of Mid-Term Progress Report

Water Joint Programming Initiative 2018 Joint Call

Closing the water cycle gap - Sustainable management of water resources

This Template should be used by the Project Coordinator for the reporting of the project.

This template does not substitute national regulations

2018 Joint Call
Mid-Term Progress Report
Closing the water cycle gap - Sustainable management of water resources

Supporting tools for the integrated management of drinking water reservoirs contaminated by Cyanobacteria and cyanotoxins – BlooWater

This document must be filled in by the project coordinator with the help of its project partners and must be sent to the WaterWorks2017 Follow-up Secretariat by coordinator (for Consortium **BLOOWATER**).

The WaterWorks2017 Follow-Up Secretariat will ensure distribution to the concerned national funding agencies. The project coordinator is responsible for sending a copy of the report to its partners.

***Supporting tools for the integrated management of drinking water reservoirs contaminated by Cyanobacteria and cyanotoxins* - BLOOWATER**

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Project code: WaterWorks2017-CONSORTIUM BLOOWATER

Duration of project:
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Period covered by this report: 01/04/2019 – 31/10/2020

1. Publishable Summary

Cyanobacteria, known as blue-green algae, can rapidly multiply and form blooms, under favourable environmental conditions, and release toxic secondary metabolites into the water during their senescence and death. The presence of toxins from Harmful Algal Blooms (HABs) in drinking water reservoirs can pose serious risks to human health and activities. Effective risk assessment and management strategies need to be planned considering all possible routes of exposure for human populations.
The project aims to develop a low cost methodological approach based on the integration of monitoring techniques and treatment of drinking water affected by toxic blooms.
To this purpose four study areas, namely four lakes among Italy and Sweden, have been identified to carry out the data sampling and test cyanotoxins monitoring and forecasting models. A satellite/drone integrated methodology has been defined to integrate water and airborne data to implement and test an early warning system. The collection of historical series of data regarding weather, water, hydrogeological, nutrients etc. parameters have been started and will feed a common data archive to help test the forecast models and the development of the early warning system. Two kinds of modeling methods are being tested to simulate the occurrence of cyanobacteria blooms starting from the Swedish lakes and one additional Norwegian lake, they will be then tested onto the Italian ones, after the complete collection of the historical data series will be accomplished.

Laboratory tests have been set up to assess technologies to treat raw water with more efficient processes for cyanobacteria reduction, while a decision support system has been designed to provide information to stakeholders.

The technologies, tools and strategies developed during the project will contribute to the spread of safely managed drinking water services for all (SDG6), improved integrated water management (SDG6) and strengthen resilience to climate related-hazards like algal blooms (SDG13). The project will also impact on SDG1, SDG3, SDG9, SDG17 (social benefits).

The address of the project's public website is www.bloowater.eu.

2. Work Performed and the Results achieved during the reporting period

a. *Scientific and technological progress*

The project work plan is divided into five operational work packages whose ongoing activities and results obtained are described in the following paragraphs.

Although the work has progressed on all of the tasks, it has to be mentioned that there were a number of factors that delayed the initial schedule, such as first delays in the funding of some project partners that caused some initial delays in some delays in the organization of both field and laboratory activities and this was then intensified by additional delays related to the COVID 19 pandemic that made it impossible to go on with the sampling campaign and also difficult to meet and relate among partners.

In **WP1** the aim is to design and develop a monitoring system of bloom occurrences in terms of frequency, composition and intensity. The monitoring strategy is based on the integration of remote and proximal sensing technology and in situ data sampling.
During this reporting period, the choice and definition of the main parameters functional to modelling from the airborne system and in situ data sampling have been addressed as well as the choice of the sensor mounted on an unmanned aerial vehicle (UAV), the suitable satellite platform and the in situ sampling protocol. The study areas, where the monitoring system will be tested under real conditions, have been definitively chosen as scheduled in Sweden and Italy, whereas an additional site has been recently added for Norway. The study sites are described on **Milestone Summery 1.1** (in attached), except for the Norwegian site which will be inserted in the following period.

It should be noted that due to the authorization and logistical limits, the two lakes initially indicated in the project as Italian pilot areas (Lake Vico and Lake Garda) in November were modified respectively with Lake Albano and Lake Castreccioni-Cingoli, on the which both ENEA and UNIVPM have ongoing activities. The request submitted to the MUR was granted as there were no budget or activity changes.

Therefore, in the period March-October 2019 in Albano Lake we carried out in-situ analysis with standard and non-standard methods and comparison with satellite data on the same days, and we are waiting for the camera to be mounted on a drone (an ENEA prototype) for new acquisitions.

The sensor mounted on the UAV is a triple-band multispectral filter camera, the Survey3, Mapir Inc. , acquired and made available by the University of Rome III, to be used mounted on the Drone owned and piloted by ENEA. The drone/sensor system has been tested and is ready to be flown during the next water sampling campaign.
The acquisition of remote sensing data will be done from Sentinel-2 satellites. This platform will provide multispectral data for monitoring water surface condition variability, with a high revisit time (with 2 satellites under cloud-free conditions it results in 2-3 days at mid-latitudes).
The first water sampling winter season started in January 2020 and envisaged 6 acquisition dates every two weeks, but has been limited to 3 because of the strict lockdown caused by the outbreak of SARS-Cov2 pandemic.

The water samples collected during the three campaigns were analysed in the laboratory: analysis of nutrients (nitrogen compounds and phosphates), study of the phytoplankton population and measurement of the total chlorophyll concentration by Phyto-PAM-Phytoplankton & Photosynthesis Analyzer (Heinz Walz GmbH, Effeltrich, Germany); as well as filtration and extraction of photosynthetic pigments and spectrophotometer analysis.

The purpose of the **WP2** is to test two different, but at the same time complimentary, methods for simulating the occurrence of cyanobacteria blooms:
Process based (PB) modeling
Machine learning (ML) based methods.
During this reporting period, the goals of WP 2 were to 1) develop the data sets needed to test either of these approaches; 2) set up PB models on the lakes chosen as test sites by BLOOWATER.
The PB models use historical data to produce hindcast simulations that can be used to evaluate model efficacy for use in bloom forecasting in the second half of the project. There are no specific milestones or deliverables related to ML in the first half of the project, but clearly there was a need to begin evaluating these methods.
While we have not completely fulfilled the milestones and goals associated with the project mid-term, work has progressed on all of the tasks that were to be completed in the WP2.
Data collection has not yet been completed. The data sets for all the sites in Sweden and Norway are almost complete, while data collection continues for the two Italian lakes (Albano and Castreccioni). An initial version of this publicly available data archive is now available at http://www.hydroshare.org/resource/10e1281196d34550b42501f611e268f9 (**Deliverable 2.1 in attached**). Final publication will occur once a complete data record from all sites can be uploaded.
The modeling methods that will be developed by BLOOWATER have the goal of forecasting the probability of cyanobacteria blooms using PB and/or ML models that accept a combination of near real-time (NRT) lake monitoring data, and weather forecasts as input. In this reporting period, we have focused on the PB modeling approach, setting up PB models and developing methods to calibrate these models and access their accuracy. Such calibrated lake models capable of simulating lake conditions and cyanobacteria will become the basis for the forecasts produced in the second half of the project.
The hydrodynamic model GOTM (Burchard, 2002) is the foundation for all the PB modeling done in BLOOWATER and is coupled to the SELMA (Simple Ecological Model for Aquatic Systems) using the Framework for Aquatic Biogeochemical Models FABM (Bruggeman and Bolding, 2014) It is capable of simulating lake chemistry (nutrients and oxygen), as well as the abundance of three generic groups of phytoplankton: diatoms, flagellates, and cyanobacteria. It is our hope that changing concentrations of cyanobacteria simulated by SELMA can be used as a predictor of conditions favoring cyanobacteria blooms. The GOTM hydrothermal model simulations of water temperature are most accurate, as is always the case, since the hydrothermal algorithms are based

on well described physical processes. The hydrothermal model (water temperature and mixing depth) forms a strong foundation for the SELMA biogeochemical simulations, and these results are also very encouraging since biological state variables that are always more difficult to simulate, are predicted with a good degree of accuracy. For Lake Erken, both the magnitude and timing of simulated chlorophyll concentrations, a measure of the total phytoplankton, match well with the measured lake concentrations. In particular the model is able to simulate the correct timing of the spring and late-summer phytoplankton blooms that occur in Lake Erken every year. The factors controlling the phytoplankton (phosphate concentration) and affected by the phytoplankton (dissolved oxygen) are also simulated with good accuracy. The calibrated PB model for Lake Vansjø also predicted water quality variables (O2, Chl-a and cyanobacteria) within realistic concentration ranges, displaying well-defined seasonal patterns.To evaluate the ability of SELMA to forecast the onset of a cyanobacteria bloom we also compared the simulated chlorophyll of the generic cyanobacteria group in SELMA with proportion of chlorophyll associated with cyanobacteria based on the microscopic cell counts. Here model performance was less satisfactory, but still may be of value for predicting the timing if not the absolute magnitude of the blooms. Calibrations such as these are a necessary first step in developing a local model application that can be used as the basis for a forecasting system on any lake. The development of automated methods to produce these calibrations in a consistent, non-biased and repeatable manner, is an important first step in developing PB model forecasts for BLOOWATER. We continue to evaluate the calibration methods, particularly in regards to the simulations of the cyanobacteria that are key to the use of these models for forecasting purposes.

In the event of failure of accurately predicting cyanobacteria blooms with the PB models, the hydrothermal predictions, because of their extremely high accuracy, can add significant knowledge into Machine Learning algorithms. Given our initial success with the PB models and the potential for ML models to account for complex processes not explicitly described by the PB based models we will make developing hybrid PB-ML models a priority in the second part of the project. The postdoc hired to work in BLOOWATER by Uppsala University will have this work as a central task.

There were a number of factors that delayed this work package: first delays in the funding of some project partners caused some initial delays in starting up and this was then compounded by additional delays related to the COVID 19 pandemic that made it much more difficult to meet and interact between partners. To date it still has not been possible to have an in person meeting, and our experience shows that model development and applications aimed at specific project goals greatly benefit from in person modelling workshops, and also direct contact with stakeholders. Both a late start and long delayed physical meetings has led to some of the delays in data collection and model development discussed above.

A hiring of post doc by Uppsala University was delayed, in order to allow them to be in place when the project was more fully underway, and also due to the issues of trying to hire someone who would potentially need to move to Sweden during the pandemic. This position has now been advertised and we hope to fill it by the end of November.

In **WP3** we are to study, develop and validate sustainable and efficient technologies for the treatment of water affected by cyanobacteria toxicity. By the end of this reporting period we should have finalized **Deliverable 3.1 (in attached)** , a "practical report on data performances and economical assessment of conventional technologies for cyanobacteria reduction". This report has been prepared and includes a relatively thorough description of the most important groups of cyanotoxins and properties relevant to their removal by conventional water treatment processes, expected concentrations during blooms and target concentrations in drinking water. It then describes a two-step strategy for the removal of intracellular cyanotoxins (step 1) and extracellular cyanotoxins (step 2) using conventional treatment processes (chemical coagulation followed by sedimentation and/or depth filtration or dissolved air flotation, slow sand filtration, membrane filtration (MF, UF, NF), activated carbon (PAC, GAC, BAC) and oxidation by ozonation, chlorination and potassium permanganate). The special case of polymer-enhanced ultrafiltration (PEUF) using chitosan as coagulant is discussed as this will be further developed during the project (WP3.2 and WP3.3). Finally, an economic assessment of ultrafiltration and the PEUF process as compared to conventional chemical coagulation followed by sedimentation and depth filtration. The initial investments in the UF are more than twice those of the conventional system, but the energy consumption, sludge production, chemical consumption and operating costs are all lower. The PEUF system can probably best be described by the UF data, but the pre-coagulation step is assumed to significantly reduce fouling issues and thereby improve the operational stability of the UF process.

We have also started the laboratory tests to determine the design parameters for the pilot scale PEUF demonstration **(Deliverable 3.2, in attached)**. Initial tests have been done on sand filter backwash water (SFBW) rich in cyanobacteria (*Planktothrix rubescens*) with intracellular microcystin. A chitosan dosage of 4 mg/L was found to give very high initial clarification prior to the UF in preliminary batch tests, and the final removal of microcystin after UF was improved compared to the system without pre-enhanced coagulation. However, the most important improvement is expected to be the effect on reduced fouling of the membrane and possibly also reduced release of intracellular toxins, which will be tested in upcoming long-term bench scale tests.

WP4

WP4 purpose is the development of an integrated, well known and applied in many fields, DSS-GIS approach for the water cycle management. The first action of this work package was the definition of a comprehensive set of data that needs to be collected concerning the priority area identified for the participating countries. In parallel, an identification of the stakeholders (social, political, technological etc.) that operate in the water management at local, national, and international level will commence **(Deliverable 4.1, in attached)**.

It is important to underline that the developing DSS can be improved in order to manage the whole water cycle at different level from local to national.

Taking the above into consideration, an excel spread sheet is developing to help partners with the data collection. The data that needs to be collected till now is categorized as follows:

1. Statutory Legislation;
2. Bibliography/projects concerning, in particular, the cyanotoxin problem and the applicable technologies;
3. Phenology and bacteria species;
3. Stakeholders;
4. Water related ancillary data;
5. Ancillary data miscellanea;
6. Water quality and characteristics;
7. Drinkable water treatment plants;
8. Cartography of the pilot action site;
9. GIS

The **WP5** encompasses project management, coordination of the work, effective communications and dissemination of results.

The WP5 coordinator periodically emails project partners to share the project progress with individual work package managers and ensure the correct coordination management. Due to the COVID 19 pandemic video calls have been the only way to virtually meet each other .

The project web site and the social media accounts, on which a big effort has been played, grant an effective way to communicate and disseminate updates from the project.

To this aim, a Web designer, a Web developer and a System Engineer (from ENEA) have been working with the Bloowater team to define and analyse requisites and functions of the web site www.bloowater.eu according to the project objectives.

A free and open-source content management system (CMS) for publishing web content has been adopted that is Joomla in order to create, edit, archive, publish, collaborate on website content, data and information.

After designing and developing the site, a check on its accessibility and usability performance has been carried out, resulting in the accomplishment of national and international legal requirements.

Also a Search Engine Optimization (SEO) has been implemented for improving the quality and quantity of website traffic to the website from search engines.

The website structure is designed to integrate the three main components that are layout templates, URL pattern, and linkage structure in order to help web search and data mining.

The layout template mainly consists of HTML elements like table, menu, buttons, images, and input box, visually organized in page rendering with page with similar function having similar template.

The URL pattern maintains the same root for the linked pages, in other words sharing similar syntactic format where the roots is the name of our project.

The web site structure is also designed to be simple and understandable at a glance as the main

objective is to inform about the project and share information and data.
In particular, the web site comprises a homepage where a synthetic description of our project is displayed. In the menu bar there are links to the full description of the project and work packages, the study sites, the
A document management system has been established through the web site itself to allow partners to store, access and communicate uptodate documents and it is accessible to the WP leaders in order to ensure that all project participants are sharing information, official documents and data. In particular, data can be searched, uploaded or downloaded and that functions as a project archive. This document management system will be central to minimizing the administrative risks due to the complexity of the project.

b. Collaboration, coordination and mobility

The collaboration among the partners has been fundamental in this first year and a half of BLOOWATER's activities. During the first remote meeting in December, each partner's expertise and activity plans were equally shared in order to plan further joint activities on which to provide support to each WP leader.
The emergency situation due to the COVID-19 and the consequent block-down did not allow the mobility foreseen in this phase of the project not only for the coordination activity but also for the exchange activities between the different laboratories on the joint monitoring (WP1-WP2) and treatment (WP3) activities. During the remote kick-off meeting of the project, a meeting of the partners in Italy was scheduled in spring 2020, which Covid-19 case has been postponed. During this period the quarterly exchange of both group and individual emails with the project coordinator contributed to the sharing on the progress of the different activities and on the data demand for the Italian lakes, necessary to construct the functional data set for the development of forecast models based on those implemented for the Swedish lakes.

Each WP leader organized moments of confrontation with the other partners and provided progress reports on their activities to the coordinator. Each partner also contributed to the realization of the website by providing support material, images and information about their working group.

The interdisciplinary nature of the project has created synergies with several research groups interested in the topic of toxic blooms and assessment of risk to drinking water. In particular in the monitoring activity of the Bloowater working group ENEA has started the collaboration with personal not directly involved in the project but who have skills and developed prototypes in the Department of Robotics of Enea with which are running test campaigns for monitoring by drones. The current situation does not allow mobility but next year it may be appropriate to test with drones also on Swedish and Norwegian lakes. In this last year the collaboration with Università Roma 3 (Engineering Department) and Czech University of Life Sciences Prague /Department of

Applied Geo-informatics and Spatial Planning) has been strengthened to assess the potential of Sentinel-2 data to monitor algal blooms.

c. *Impact and knowledge output*

The difficulties and delays accumulated in carrying out both field and laboratory activities have strongly limited the possibility to measure the impacts of the project foreseen in this first part of BLOOWATER. The belief remains that it is possible to develop forecasting tools and treatment systems able to contribute to the improvement of the integrated management of water resources.
In this first phase the impacts' analysis of the project confirms the interest for the technological solutions proposed in the project, able to provide modular solutions to a more complex phenomenon. This is confirmed by the interest shown by both Regional Agencies for the protection of the environment (ARPA), both the Natural Park of Albano and Acquambiente managing the water service in the Marche region.
Current outputs are still in a preliminary phase that did not require partners to discuss intellectual property protection.

3. Table of Deliverables

Deliverable name	**Lead partner (country)**	**Date of delivery (dd/mm/yyyy)**	**Changes, difficulties encountered and new solutions adopted**
WP1			
MILESTONES 1.1- Identification of the study areas	ENEA (Italy)	30/06/2019	Change of sites and covid emergency have strongly contributed to the delay of mainly field activity and acquisition of previous and current data
MILESTONES 1.2 Database	ENEA (Italy)	30/09/2019	
MILESTONES 1.3- Choice and definition of the main functional parameters of the project, integration between acquisition systems	ENEA (Italy) + UU	31/12/2019	
WP2			
D 2.1 Publicly available data archive of all data used to force and calibrate lake water quality models	UPPSALA UNIVERSITY (SWEDEN)	30/09/2019	

WP3			
D 3.1 Waterworks as barriers to cyanobacteria and their toxins. An assessment of removal efficiencies and economic aspects associated with conventional treatment technologies.	NIVA (Norway)+ UNIVPM (Italy)	30/11/2019	
D 3.2 Bench Scale Testing of PEUF	UNIVPM (Italy)	30/10/2020	
WP4			
D 4.1 A guidelines on data collection and management;	ENEA (Italy)	30/06/2019	
D 4.2 A social mapping of the relevant stakeholders and the role;	ENEA (Italy)	30/11/2019	The delay accumulated in the first phase of WP1 has also strongly slowed down the activities related to this WP. The Covid emergency has increased the delay especially in the direct exchange with partners.
D.4.3 Database structure built up.	ENEA (Italy)	30/11/2019	

4. Budget review

Please include a budget breakdown here, i.e. how the funding has been used so far.

UU and NIVA partners have received the funding and part of it has been used so far as man-hours and external expeditures in the different WPs in which they are involved

ENEA and UNIVPM have not yet received the funding. The bureaucratic process for the assignment of funding takes several months from the moment the project is approved. The Covid emergency then further lengthened the time. Part of the activities were carried out with the part of own funding.

5. Consortium Meetings

Please list below the Consortium meetings which took place during the reporting period, by filling in the table below. Add/delete rows as necessary in the table below.

N°	Date	Location	Attending partners	Purpose/ main issues/main decisions?
1	17-12-2019	Remote meeting	All partners	comparison and exchange on joint activities; planning of deadlines; delays, variations and / or problems;

6. Stakeholder/Industry Engagement

Maximum 1 page

In the first year of the project it was possible to start a series of collaborations born from the common interest and objective of different stakeholders for management of water resource:

- **Regional Agency for Environmental Protection** - ARPA Lazio and ARPA Marche- showed interest in the project outputs and collaborated by providing historical data series on the new pilot areas of the project, Lake Albano in Lazio and Lake Castreccioni in Marche;

- **Regional Park** of "Castelli Romani", where the lake of Albano is located, is strongly interested in monitoring the quality of the lake water; is providing great logistical and administrative support for the necessary authorizations to navigate and fly within protected areas; and above all to extend the activity also in other lakes of the Park interested in the phenomenon of cyanotoxic blooms;

- **Acquambiente** a company totally owned by Local Authorities with a strong vocation in the management of water resources, both in terms of research, water supply, supply and distribution of drinking water and in the collection, treatment and purification of wastewater and wastewater until their return to the natural water bodies; the drinking water treatment plant located in the district of Castreccioni is managed by Acquambiente Marche S.r.l., which is therefore particularly interested in the treatment of waters subject to blooms

7. List of Publications produced by the Project - Open Access

- List all presentations, posters, and publications in scientific, peer-reviewed journals derived from this project, separating those in preparation, those in review and those accepted or in press.
- Provide websites and/or electronic copies of the key ones.
- Indicate all the co-authors for each publication.
- Order publications per date (chronologically) and for each year by alphabetical order.

Metadata on all project publications are required to be submitted as part of the final reporting. This will be done via the **Open Data & Open Access platform**, available at: http://opendata.waterjpi.eu/ (also accessible from the bar menu of the Water JPI website).

International	Peer-reviewed journals	1. 2. 3.
	Books or chapters in books	1. 2. 3.
	Communications (presentations, posters)	1. 2. 3.
National (separate lists for each nationality)	Peer-reviewed journals	1. 2. 3.
	Books or chapters in books	1. 2. 3.
	Communications (presentations, posters)	1. 2. 3.
Dissemination initiatives	Popular articles	1. Interview to Maria Sighicelli (ENEA) by Tg1-Italian National tv RAI1 (July 22nd 2020). https://www.enea.it/it/Stampa/eneainonda/22-07-2020-rai-1-tg1-20-00-durata-00-01.36 2. online local newspaper (Catel Gandolfo , Rome Italy) https://www.ilmamilio.it/c/comuni/28353-castel-gandolfo-il-progetto-di-enea-per-il-contrasto-ai-cianobatteri-nel-lago.html
	Popular conferences	1. 2. 3.
	Others	1. project description on ENEA website https://ambiente.sostenibilita.enea.it/en/projects/bloowater 2. news on ENEA website

		https://ambiente.sostenibilita.enea.it/news/rischio-alghe-tossiche-laghi-italiani 3. newsletter by EneaInforma July 9th 2020 https://www.enea.it/en/news-enea/eneainforma/archivenl/2020/eneainforma142020en_html/view_html; https://www.enea.it/en/news-enea/news/environment-lakes-enea-takes-action-against-cyanobacteria-and-microplastics/ 4. newsletter by ARPAT http://www.arpat.toscana.it/notizie/notizie-brevi/2020/progetti-enea-su-cianobatteri-e-microplastiche-nei-laghi?searchterm=bloowater 5. WJPI Newsletter http://www.waterjpi.eu/resources/newsletter/newsletter-septembre-2020/environment-lakes-enea-takes-action-against-cyanobacteria-and-microplastics?source=email 6. Tweet , Youtube and Facebook regular posts

8. Knowledge output transfer

For each of the Knowledge Output arising from the project so far, please complete the following table.

Short Title *Please provide a short and concise title to describe the Knowledge Output*	Join us
Knowledge Output Description *Please only include generated Knowledge Outputs, not those that are expected. Note: Knowledge Outputs can be non-deliverables, milestones or 'grey knowledge'. Also, multiple Knowledge Outputs could exist within one deliverable, and should be separated.* *Try to give a comprehensive description, making the Knowledge Output fully understandable to a non-expert.* *If relevant please provide detail of where the Knowledge Output differs from its equivalent, e.g. What are the key characteristics of the Knowledge Output? What research is it adding to and what is innovative about the Knowledge Output? (Max 500 characters).*	We are working on a citizen science initiative called "Join Us". This action has a twofold objective: on the one hand to involve the public, especially young people, and to raise public awareness about algal blooms; on the other hand to contribute to the knowledge of when, where and under what conditions algal blooms are most likely. Anyone who observes and recognizes an algal bloom in a lake can fill in a short report, available in the Join us section of Bloowater website and upload photos. In the next period, the initiative will be disseminated through social media: Facebook, twitter, ENEA web site.
Knowledge Type	Please choose one option – delete the rest: * services/tools

	* other
Link to Knowledge Output *If you can provide a link to the Knowledge Output then please do so, e.g. digital object identifier (DOI), web address, download, research paper.* *If the Knowledge Output is not publicly available currently but will be in the future, please provide details. Also, if it is available but only upon request, please state this.* *If the Knowledge Output is not planned to be publicly available, please state "Not available for public".*	https://www.bloowater.eu/join-us.html

Sectors & Subsectors
Choose as many options as required from the list. Pick those sectors that you think would benefit from the application of this Knowledge Output.
	• Basin Management
	• Drinking Water
	• Bathing Water
	• Others
	  ○ Governance
	  ○ Consumer Health & Welfare
	  ○ Stakeholder Involvement

End User *Choose as many options as required* *Per identified End User, please identify possible applications of the Knowledge Output.*	o Environmental Managers & Monitoring o Scientific Community o Civil Society
IPR *Please indicate whether IPR has been applied to this Knowledge Output (applied for a patent, copyright etc), or not.* *Please insert "n/a" if no IPR has been applied.*	n/a
Policy-Relevance If the Knowledge Output is relevant to the WFD or any other related Directives, please list and explain why	
Status *Please identify whether the Knowledge Output is finalised, is still being generated or whose status/future is unknown. Consider:* *• Is your knowledge conclusive enough that it provides sufficient evidence to make an impact on, or be applied by, an End User?* *• Is there a corroborating body of evidence, or are contradictory results, available?* *• Does your knowledge progress beyond the current*	" Join us" initiative is still being generated and more research is needed to validate the methods and the achievable results. Moreover, it is an opportunity to engage stakeholders: scientific and public community.

state-of-the-art / evidence base? • *Is more research or demonstration needed to validate the results?*	

9. Open Data

In relation to Open Data, the funded projects will be requested to submit metadata on all the resources directly generated by the project, as well as additional information on how these data will be exploited, if and how data will be made accessible for verification and re-use, and how it will be curated and preserved. Metadata on all project resources are required to be submitted as part of the final reporting. This will be done via the **Open Data & Open Access platform**, available at: http://opendata.waterjpi.eu/ (also accessible from the bar menu of the Water JPI website).

10. Problems Encountered during Project Implementation

The Covid 19 pandemic is creating many delays and problems for each of the partners and corresponding work package as described below.
In the WP1, the first water sampling winter season started in January 2020 and envisaged 6 acquisition dates, but has been limited to 4 because of the strict lockdown caused by the Covid 19 pandemic.
There were a number of factors that delayed the work plan: first delays in the funding of some project partners caused some initial delays in starting up and this was then compounded by additional delays related to the COVID 19 pandemic that made it much more difficult to communicate and collaborate between partners. To date it still has not been possible to have an in person meeting, and our experience shows that model development and applications aimed at specific project goals greatly benefit from in person modelling workshops, and also direct contact with stakeholders. Both a late start and long delayed physical meetings has led to some of the delays in data collection and model development discussed above. A hiring of post doc by Uppsala University was delayed, in order to allow them to be in place when the project was more fully underway, and also due to the issues of trying to hire someone who would potentially need to move to Sweden during the pandemic. This position has now been advertised and we hope to fill it by the end of November.
In the WP3, NIVA has had to postpone their own planned lab testing. It will be commenced now in October 2020.