LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Environnement, du Climat
et du Développement durable

Administration de la gestion de l'eau

PROJECT SPECIFICATIONS:

Smart flow

Metering of gauge boards and determination of flow rates

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Context

1.1 Introduction

The Water Management Office maintains a network of monitoring stations on Luxembourg's streams and rivers. This network is constantly being expanded and modernised. Currently, data is collected at 42 stations.

Based on these data, a water balance model is run to calculate forecasts (water level, discharge).

As with all forecasts, the quality, station coverage and data resolution of the input data is crucial. By now, discharges are determined by manual discharge measurements for the whole spectrum of occurring water levels, so on an irregular and long term base. In order to improve and validate the related rating curves the idea came up to develop a solution of getting high resolution discharge data, similar to already existing market solutions but more on a camera based system to combine the advantages of recording pictures of the actual on site situation.

1.2 Project team

Name	Organisation	Department	Function
Nico Brettner	Water Management Authority	IT	IT Consultant
Daniel Goehlhausen	Water Management Authority	Hydrology	Project manager, technological expert
Etienne Lacour	Water Management Authority	Hydrology	Gauging station- Consultants technological expert
Daniel Majeres	Water Management Authority	Hydrology	Gauging station- Consultants technological expert
Christophe Gilbertz	Water Management Authority	Hydrology	Data analytics expert

1.3 Target audience

The data to be collected through this project are data relevant to the hydrologie/hydrometry department of the Water Management Authority (AGE).

These data will be used for the purpose of data validation and feeding the flood prediction model LARSIM which calculates the discharge and water level predictions.

Furthermore, the data is to be made available to any interested citizen via the OpenData.lu portal.

1.4 Project execution - Risks & preventive measures

The project should be coded by the company. However, a close collaboration with the project team is required to ensure meeting the objectives. As such, regular progress meetings and workshops will be organized on site.

1.5 Expected deliverables

It is expected to complete the tasks described below within a period of approximately six months:

- develop a model that can automatically detect/read the water level from a fix staff gauge
- develop a model that can automatically calculate the mean flow velocity of the wet cross section based on a camera measured surface flow velocity
- Discharge calculation ($Q=k*A*v_m$) [k = factor of rigurosity] [A= wet area m^2] [v_m=mean velocity of the cross section m/s] in the background. The k factor should be seen as an adjusting screw to align the calculated real time discharges to the measured and therefor referenced gauging. This factor varies from station to station and could even be dependent on the water level.
- Identify and compile a set of anomalies
- Compatible output of time series from the developed system in order to be able to import them into our database
- Documentation for internal use by the provider. (Results and technical documentation to be able to use the code or train it more)
- A final report and supporting documentation

1.5.1 1.5.2 Risks & preventive measures

Risk	Challenge	Probability	Impact	Mitigating action	Responsibility
No acceptance of new solution		Medium	High	Prepare and inform the department of the work through seminars and demonstrations	Principal and project manager
Inability to use the solution		Medium	High	Good knowledge transfer process and training	Project manager, experts, consultants
	Insufficient data	Low	Medium	Stay adaptable with the solution	Project manager and consultants
	Difficulty evaluating the performance of the algorithm	Low	Medium	Create a test set	Experts and consultants
	Inadequate hardware/software	Medium	Medium	Provide technical requirements	Consultants
Influence of the weather and water surface motion		Medium	Medium	Stay adaptable with the solution	Project manager and consultants

2 Project Goal

2.1 Description of work

The work consists of continuously analysing the still and moving images of various cameras in order to obtain a usable surface flow velocity and calculate an average velocity and the discharge of the cross section of the river. This data will be used to validate measured time series over the whole water level measurement spectrum.

All data must be provided with corresponding time stamps.

The data are divided into two groups:

2.1.1 Water levels

The water level values at the staff gauges visible in the pictures have to be determined and translated into consistent water level time series with a data resolution of 0,5cm (staff gauge subdivision is 2cm).

2.1.2 Flow velocity

Measure the surface flow velocity of the water in different sections using moving images and video files.

Calculate a mean velocity on the basis of the k-factor (roughness).

Calculate the discharge values.

2.2 Data and Technology Specifications

The data consists of two sets:

- Image or video data
- Correlated water level data from loggers determined by several transducer systems (radar, pressure sensor, bulb sensors)

The image and video data are recorded by different types of cameras which may still be determined during the project. Due to the location of the system, these cameras are positioned at different angles and distances to the gauge staffs and water surfaces. Therefore and depending on the installation site, the camera specifications may differ in their technical specifications.

If necessary, the system must be able to average the water levels within a given time resolution and read from the gauge staffs to take into account any fluctuations (ripples).

The averaged values of a gauge staff may deviate slightly from the sensor values under certain circumstances.

The quality of the images varies with the different environmental influences, such as weather, time of day, position of the sun, resolution, reflections.

Numerical data (water levels and even discharge values, calculated via rating-curves) will be provided as time series in .csv – or .zrx-format from a simple export out of our database and saved on a ftp-server.
Output series should also be in the same format to be able to import them directly into our Wiski-database.
The data resolution should be 15 min and/or 60 min.

Note: A precise arrangement of the data and image formats can be discussed and defined with the contractor during the project. The definition and implementation of the equipment will be done with the consultation of the final contractor.

Example file of the gauge staff from the Wark:

2.2.1 Staff Gauges

Staff gauges can be installed at different angles. The installation angle is taken into account in the scaling.

Furthermore, these can consist of several, non-contiguous segments at different distances from the camera.

2.2.2 Data transfer:

The image and video data are transferred to an FTP server of the administration at regular intervals.

Any additionally data required can also be stored here.

3 Execution

3.1 Timeframe

The timeframe is up to six months from kick-off to proof of concept. Therefore, the end of the project is latest at the end of 2023.

3.2 Work Environment

No office space will be provided. All data exchange is done via OTX the One Time eXchange platform of the CTIE.

There will be access provided to a specialized GPU server. This access can be on site or via the remote access solution of the CTIE. Each person working on the project needs to have a Luxtrust-Card and will get a VPN access to the GPU server.

Expert, Management and milestone meetings can be held online via Skype for Business.

3.3 Procedure

After the selection process, the next step will be to sign the necessary contracts. The work will start with a kick-off meeting. The kick-off session will mark the start of this project. Regular support and management meetings will help with the progression of the project. Weekly progress will be assessed and provided to management.

The project will finish when the deliverables have been achieved within their timeframe and when the solution is given during a final knowledge transfer session. A final presentation of results to higher management will mark the end of the project.

3.4 Security and confidentiality

A non-disclosure agreement and a non-compete clause need to be signed by any person working on this project as well as for the representative of the company.

Throughout the whole project and beyond, all employees involved in the project shall agree to maintain the confidentiality of all information and data in relation to the project and shall not use, disclose, furnish or make it accessible to anyone other than authorized employees.

The company conducting the project shall refrain for 12 months following the termination of work relations, from engaging in similar activities so as to not prejudice the interests of the Water Management Administration.

3.5 Intellectual property rights

The algorithm, solution, results as well as the data generated are protected by the relevant intellectual property and copyright laws and will remain the exclusive property of the Water Management Administration for the duration of the project and beyond.

Unless otherwise specified, the Water Management Administration grants no license or authorization with regard to the intellectual property rights, which it holds in respect of the project. Therefore, all sharing of the algorithm, solution, results and data in regard of the project is strictly prohibited unless specifically authorized by the Administration.

All disputes concerning this project shall be governed by Luxembourg law, and the courts of the Grand Duchy of Luxembourg shall have exclusive jurisdiction to hear and settle such disputes.

3.6 Knowledge transfer

A final knowledge transfer session, before the end of the project, should enable the consultants to provide the necessary knowledge to use and understand the solution. This session can be held with all involved parties.

3.7 Evaluation

The project will be evaluated based on the deliverables given in this document and their timeliness, but also on the candidate's ability to come with their own initiatives to achieve the deliverables.