

# SCOREwater

Smart City Observatories implement REsilient Water Management

## DELIVERABLE D3.4

# INTEGRATION OF SMART WATER DATA MODELS (COMPLIANT WITH FIWARE-MODELS), SMART ALGORITHMS AND DATA-DRIVEN MODELS IN THE SCOREWATER PLATFORM

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## ABBREVIATIONS

Abbreviation	Definition
API	Application Programming Interface
CKAN	Comprehensive Kerbal Archive Network
FIWARE	Future Internet WARE
JSON	JavaScript Object Notation
ICT	Information and Communications Technology
IoT	Internet of Things
NGSI	Next Generation Service Interface
SDG	Sustainable Development Goals
SME	Small and Medium-sized Enterprise





## PROJECT ABSTRACT

SCOREwater focuses on enhancing the resilience of cities against climate change and urbanization by enabling a water smart society that fulfils SDGs 3, 6, 11, 12 and 13 and secures future ecosystem services. We introduce digital services to improve management of wastewater, stormwater and flooding events. These services are provided by an adaptive digital platform, developed and verified by relevant stakeholders (communities, municipalities, businesses, and civil society) in iterative collaboration with developers, thus tailoring to stakeholders' needs. Existing technical platforms and services (e.g. FIWARE, CKAN) are extended to the water domain by integrating relevant standards, ontologies and vocabularies, and provide an interoperable open-source platform for smart water management. Emerging digital technologies such as IoT, Artificial Intelligence, and Big Data is used to provide accurate real-time predictions and refined information.

We implement three large-scale, cross-cutting innovation demonstrators and enable transfer and upscale by providing harmonized data and services. We initiate a new domain “sewage sociology” mining biomarkers of community-wide lifestyle habits from sewage. We develop new water monitoring techniques and data-adaptive storm water treatment and apply to water resource protection and legal compliance for construction projects. We enhance resilience against flooding by sensing and hydrological modelling coupled to urban water engineering. We will identify best practices for developing and using the digital services, thus addressing water stakeholders beyond the project partners. The project will also develop technologies to increase public engagement in water management.

Moreover, SCOREwater will deliver an innovation ecosystem driven by the financial savings in both maintenance and operation of water systems that are offered using the SCOREwater digital services, providing new business opportunities for water and ICT SMEs.





## EXECUTIVE SUMMARY

This deliverable builds upon the information provided in D3.1 (in which the set-up of the SCOREwater platform is described) and in D3.2 and D3.3 (in which the initial implementation is described). This document describes the progress on the standard data models and protocols, proposed by Task 1.1 (specification of the SCOREwater platform), that will be implemented in and adapted for the SCOREwater platform in the three cities (Amersfoort, Barcelona and Gothenburg).

The application of these standard models is strongly related to the ingestion of data from all sensors and the publication of Open API's. Since the SCOREwater project started, the FIWARE foundation launched an initiative to develop standard data models and protocols. The SCOREwater project is involved in this process and has chosen to use these models. If the models are not suitable for our project, the SCOREwater project will provide input and feedback to further improve these standard models.

It can be concluded that from a content point of view the FIWARE data models are applicable to the datasets in the SCOREwater project. Missing are metadata on the dataset and individual data points. Metadata on the dataset can be incorporated into CKAN, which is also part of the SCOREwater platform, however there is no placeholder for metadata on individual data points (for instance a quality stamp). Furthermore, it is not possible to include raw information.

The current situation for this deliverable is that initial implementations of the standard data models have been realized. Validation and testing of the models has started. The focus until now has been on collecting, processing and harmonizing data from different sensors. In this phase it will be possible to check the completeness, provide feedback, extend the number of data models and participate in the initiative of the FIWARE foundation to create a library of standard data models. During the next phase the focus will shift towards the Data Market (usage, documentation, business models).

**NOTE: This document reports on the current status of the SCOREwater platform. The implementation of standard data models in the SCOREwater platform and the connection of new sensors and data sources to these models, is an ongoing process. Later, during the project, progress on the platform will be reported.**



## 1. INTRODUCTION

This deliverable reports the data models and protocols used in the SCOREwater Platform.

This is a “demonstrator” document. Additional information will be added as the project progresses. The current snapshot describes the progress made till October 2020.

The demonstrator is an important part of the development of the SCOREwater Platform, since it focuses on standard data models. These models are a prerequisite reuse of data sources and the development of algorithms, data driven models, applications and new solutions.

Paragraph 1.1 describes some generic characteristics of the SCOREwater Platform. More details can be found in Deliverable 3.1, 3.2 and 3.3. Paragraph 1.2 describes the progress on the implementation of the different data models.

### 1.1. SCOREWATER PLATFORM

The SCOREwater Platform is based on the FIWARE-architecture. It uses open source software components from the FIWARE catalogue, and follows the open data models and open API’s. These 3 aspects (software, data models and API’s) are strongly related.

To harmonize and standardize data sources, the SCOREwater Platform transforms the data that is ingested in the Platform and applies standard data models. This harmonized data is published through different standard API’s to fit the specific needs of data consumers. The Data Market gives access to these different API’s (with the appropriate access rights and license models). The scheme below shows a simplified version of this data ingestion, standardization and publishing process.

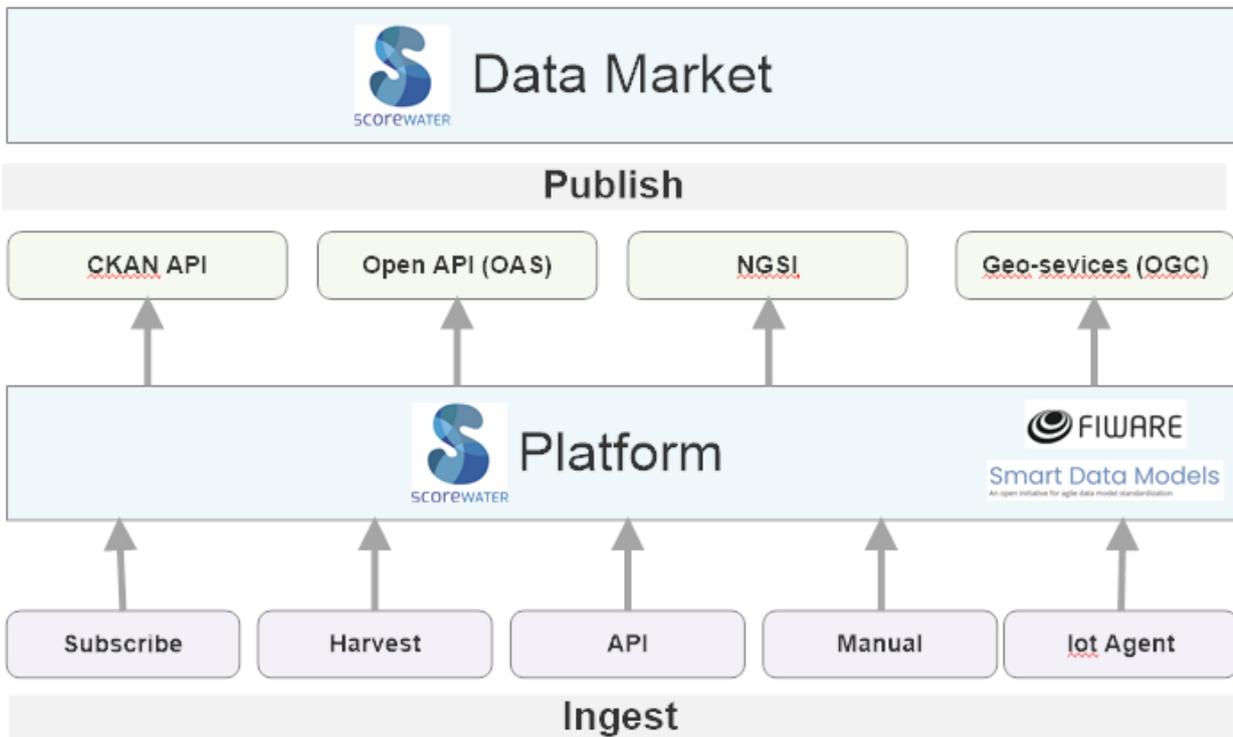


Figure 1 The SCOREwater Platform with different options to ingest, process and publish data.

## 2. SMART DATA MODELS

In parallel with the SCOREwater project the FIWARE Foundation launched an initiative to develop “smart data models” (FIWARE, 2020). It is an open initiative for agile data model standardization. This initiative creates a list of standardized terms and data models. All the data models are available in Github and free to use, with an open licence allowing its modification. The models provide examples in

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several formats, including JSON and CSV. This allows users to select the format which suits their needs. Additionally, there are JSON-schemas which help to check the validity of the json. All these data models work on the FIWARE platform.

An important part of this process is a governance model, allowing to submit new data models or give feedback on existing models. The SCOREwater project collaborates with this smart data models initiative from FIWARE and exchanges experiences from the project to help improve and extend the smart data models.

Within the SCOREwater project the first steps have been taken to implement these smart data models. Deliverable 3.1, 3.2 and 3.3 provide additional information. This deliverable provides an overview of the progress made on the different data models.

## 2.1. WEATHER OBSERVED

The Measure your City data (the citizen science project “Meet je Stad”) is ingested in the SCOREwater platform and harmonized according to the FIWARE data model “Weather observed” (FIWARE, 2020) Variables collected are temperature (degrees Celsius), relative humidity (percentage) and, depending on the type of sensor, illuminance (Lux).

Similarly, data from two weather stations in Göteborg is sent to the SCOREwater Platform and harmonized according to the same FIWARE data model. The data from these weather stations shows the rainfall per day (precipitation). The challenge is that it is a cumulative precipitation, while the FIWARE data model currently only includes one timestamp. There is no option to include a from/to timestamp, or a unit. This needs to be investigated further.

## 2.2. GREEN SPACE

The data from the soil moisture sensor network (D4.17) in the City of Amersfoort is mapped to the “Green space” FIWARE data model (FIWARE, 2020). This model contains a harmonized description of the conditions recorded on a particular area or point inside a greenspace (flower bed, garden, etc.), like soil temperature or soil moisture.

## 2.3. WATER QUALITY

Sensors from s::can in Barcelona upload data to the SCOREwater platform about water quality. This data is harmonized to the FIWARE data model “Water Quality Observed” (FIWARE, 2020). Mapping of the data is still ongoing and input is needed from the case.

Similar data from Talkpool sensors in Göteborg is ingested in the SCOREwater platform and transformed to the same FIWARE data model. Currently work is still ongoing regarding the mapping of the raw data to this data model. Input is needed from the case.

## 2.4. SEWER DATA MODELS

Currently there is no generic, international data model for sewer systems. The data model used within the City Of Amersfoort (Rioned, 2020) is focused on The Netherlands.

Within the FIWARE Smart Data Models initiative a data model “Water Network Management” (Github, 2020) is under development. This model and its entities are primarily derived from the EPANET platform. Whether it is useful for the SCOREwater demonstration projects needs to be investigated and tested. In a similar fashion SAREF4WATER (ETSI, 2020) will be investigated. Both evaluations have not started yet. Future versions of this deliverable will include an evaluation of these data models.

## 3. LESSONS LEARNED

Based on the first results, some feedback on the data models is provided in the table below (this is also described in D3.3). This feedback is collected from developers at Civity working on the SCOREwater platform and input from SCOREwater partners connecting their sensors and data to the platform.

In general, it can be concluded that from a point of view of the contents of datasets FIWARE data models can be applied to the SCOREwater datasets. However, they do not accommodate for metadata,



both on dataset level and on data level. Metadata on dataset level can be included in the CKAN metadata repository which is also part of the SCOREwater platform. Metadata on individual data points (for example a quality stamp) however cannot be included in a harmonized way. Furthermore, the data models do not accommodate for raw data. When investigating remarkable patterns in the harmonized data it might be useful to look up the underlying raw data. Raw data cannot be modelled using the FIWARE data models.

Table 1 Feedback on FIWARE data models

Data model	Observations
Water quality observed	Data collected can be incorporated into FIWARE model without a lot of effort
Air quality observed	Data collected can be incorporated into FIWARE model without a lot of effort
Weather observed	Some weather stations provide more information, not everything can be included in the standard FIWARE data model.
“sewer information”	Missing models and information systems. A first draft of a FIWARE Models has been published. Whether it fits within the SCOREwater project needs to be investigated.
Alerting	Still under investigation



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# ANNEX 1 – STOCKTAKING

A final Annex of stocktaking was included in all Deliverables of SCOREwater produced after the first half-year of the project. It provides an easy follow-up of how the work leading up to the Deliverable has addressed and contributed to four important project aspects:

1. Strategic Objectives
2. Project KPI
3. Ethical aspects
4. Risk management

## STRATEGIC OBJECTIVES

Table 2 lists those strategic objectives of SCOREwater that are relevant for this Deliverable and gives a brief explanation on the specific contribution of this Deliverable.

Table 2. Stocktaking on Deliverable’s contribution to reaching the SCOREwater strategic objectives.

Project goal	Contribution by this Deliverable
The SCOREwater platform will be based on existing open source software components, standards and data models.	This deliverable describes the data models used in the SCOREwater platform.
Identify existing systems and applications, and provide a functional and technical analysis of these systems and applications, including relevant standards, connections and data.	Deliverable 3.1, 3.2 and 3.3 describe software solutions for the SCOREwater platform. This deliverable describes the data models used in the SCOREwater Platform.
A prerequisite of the project is to base the SCOREwater platform on FIWARE	The implementation of data models is based upon the FIWARE Smart Data Models initiative.

## PROJECT KPI

Table 3 lists the project KPI that are relevant for this Deliverable and gives a brief explanation on the specific contribution of this Deliverable.

Table 3. Stocktaking on Deliverable’s contribution to SCOREwater project KPI’s.

Project KPI	Contribution by this deliverable
Open source software by default	This deliverable uses FIWARE open source components, models and standards for connecting and integrating sensor data in the SCOREwater platform (when available). The availability of these standardized data streams (open API’s) contributes to KPI’s 7 (Number of experiences related to ICT standardization and testbed standardized), 9 (Number of Open Data Catalogues in the Data Market), 21 (Cross-domain integration with other Open Data Catalogues), 10 (Standardization barriers identified and mitigation options demonstrated) and 12 (Technological barriers identified and mitigation options demonstrated). In upcoming updates of this document this information and results will be added.
FIWARE as prerequisite	This deliverable uses selected FIWARE data models for standardizing and harmonization of data in the SCOREwater platform.

## ETHICAL ASPECTS

Table 4 lists the project’s Ethical aspects and gives a brief explanation on the specific treatment in the work leading up to this Deliverable. Ethical aspects are not relevant for all Deliverables. Table 4 indicates “N/A” for aspects that are irrelevant for this Deliverable.

Table 4. Stocktaking on Deliverable’s treatment of Ethical aspects.

Ethical aspect	Treatment in the work on this Deliverable
Justification of ethics data used in project	N/A
Procedures and criteria for identifying research participants	N/A
Informed consent procedures	N/A
Informed consent procedure in case of legal guardians	N/A
Filing of ethics committee’s opinions/approval	N/A
Technical and organizational measures taken to safeguard data subjects’ rights and freedoms	In accordance with D9.2 where applicable
Implemented security measures to prevent unauthorized access to ethics data	In accordance with D9.2 where applicable
Describe anonymization techniques	In accordance with D9.2 where applicable
Interaction with the SCOREwater Ethics Advisor	N/A

## RISK MANAGEMENT

Table 5 lists the risks, from the project’s risk log, that have been identified as relevant for the work on this Deliverable and gives a brief explanation on the specific treatment in the work leading up to this Deliverable.

Table 5. Stocktaking on Deliverable’s treatment of Risks.

Associated risk	Treatment in the work on this Deliverable
Technical immaturity of FIWARE components	Standardization of data models is ongoing and in some cases in its early phases. Close collaboration with other EU-funded projects and the FIWARE-foundation limits this risk and helps to exchange knowledge and develop an open library of data models.
Missing of incomplete standards and data models	Collaboration with other EU-funded projects, FIWARE-foundation and other standardization bodies to develop open standards and data models. For the water sector new data models are being developed that will be used within the SCOREwater platform in the coming period.



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