SCOREwater

Smart City Observatories implement REsilient Water Management

DELIVERABLE D7.5
SERIOUS GAMING

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REVISION HISTORY

Version	Reason for changes	Name	Date
1	Original release to EU	Lluis Corominas	2021-12-22
2	Addressing the comments of the external reviewer following the review meeting 23 June 2022. The following has been updated with respect to the comments: • In section 4, the link to the video of the serious game has been updated • New section 6 related to ethics has been added. In addition to the above, section 5 Property rights has been further elaborated.	Ian Zammit, Lluis Corominas	2022-07-07

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ABBREVIATIONS

Abbreviation	Definition
CKAN	Comprehensive Kerbal Archive Network
ICT	Information and Communications Technology
IoT	Internet of Things
SDG	Sustainable Development Goals
SME	Small and Medium-sized Enterprise
UdG	University of Girona

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, from SCOREwater WP7 Dissemination and communication, is a serious game in the form of an app, which can be installed in tablets, computers and mobile phones. A serious game previously developed at ICRA has been adapted to include an introductory game (Intro at the Catalan Institute for Water Research) and two new mini-games which aim at enhancing public awareness of proper oil and grease separation, proper disposal of wet wipes and educated antibiotics consumption. Other enhancements have been conducted to deliver a product which is usable with success in sessions with 10- and 11 year old kids from primary schools. This brief report describes the serious game, and highlights the contribution of SCOREwater in upgrading the serious game.

Overall, this deliverable contributes to strategic objective 6 of SCOREwater (Increase citizen involvement and engagement in the transition to a water-smart, resilient society), which relates to public awareness. With the serious game we aim at improved practices with the usage of wet wipes, oils and greases and water at households which are respectful with the environment. This deliverable contributes to KPI 6: In Barcelona, reduce the release of wet wipes and discharge of oils and greases and antibiotics to the sewer systems.

1. INTRODUCTION

A serious game can help raise awareness on what effects on the urban water cycle cause our activities which are related to water use at households. This deliverable is the serious game fit for SCOREwater purposes. A serious game developed in the past by ICRA and University of Girona (UdG) (Suarez, 2019) has been adapted to include wet wipes and oils and greases (to fulfil the needs of SCOREwater). The scope of the deliverable involves the upgrade of the serious game. Then, sessions will be run at primary schools with the serious game (out of the scope of this deliverable; this is part of task 7.2). ICRA has been the task leader which has coordinated the development of the serious game including the identification of the serious game upgrade needs. The serious game update has been designed by ICRA and the coding has been subcontracted to an entity with long expertise in serious game development. The development of the serious game is part of task 7.2, public engagement via serious game; within that task 7.2 IERMB has collaborated with the fitting of the serious game with the school activities (especially what relates to creating surveys to the students which are well connected to the serious game) and BCASA has been seeking for feedback of the sustainable network of schools in Barcelona to identify mechanisms to introduce the game to schools for learning purposes. Overall, this deliverable contributes to strategic objective 6 of SCOREwater (Increase citizen involvement and engagement in the transition to a water-smart, resilient society), which relates to public awareness. With the serious game we aim at improved practices with the usage of wet wipes, oils and greases and water at households which are respectful with the environment. This deliverable contributes to KPI 6: In Barcelona, reduce the release of wet wipes and discharge of oils and greases and antibiotics to the sewer systems.

2. DESCRIPTION OF THE SERIOUS GAME AS IN THE DELIVERABLE

The aim of the serious game is to bring scientific and technological knowledge closer to the public in the field of the urban water cycle through a serious game. Serious games are defined as video games that not only entertain but also teach or transmit some knowledge. The starting point of the project is the game developed jointly by the Catalan Institute for Water Research (ICRA), a CERCA centre in the field of urban water cycle research, and the Graphics and Image Laboratory (GILAB), a TECNIO center with expertise in the design and development of serious games. The game is free and cross-platform, and can be used on computers, tablets and mobile phones. The languages of the game are currently Catalan (the language used in the schools of the demonstration activities of the case-study in Barcelona), Spanish and English, but can easily be translated into any other language. SCOREwater provides the game with the technological developments necessary to carry out activities that allow it to reach society through primary schools.

The game consists of a set of mini-games (Table 1) that allow the player to go through different stages of the urban water cycle in cities (households, sewers, a wastewater treatment plant, and a river). At each stage, different challenges are posed to the player that help him/her identify and acquire knowledge, and at the same time allow researchers to introduce concepts about recent scientific advancements. The connections between the mini-games allow to see the interconnections between different elements of the urban water cycle and to establish the link between activities in cities that generate changes in the quality of the water, their effects on the environment (river) and how research helps the sustainable development of cities. The in-game narrator is a researcher who guides students and transmits knowledge; the narrator is inspired by a famous researcher in the water field (Prof. Gustaf Olsson, emeritus professor from Lund University, Sweden). The serious game has been coded in UNITY.

Table 1. Summary of mini-games

Name of mini-game	Game explanation	Underlying educational goal	Figure
Intro at the Catalan Institute for Water Research	The player matches actions happening at households with water pollutants.	Allows players to understand the elements of the game (water and pollutants) and the actions at households that pollute water	3
Mini-game at the household	Players need to relate actions which pollute water to the different places in households where these actions take place.	Urban wastewater systems are built to collect sewage at our households for posterior treatment. Some actions we do at home can avoid water pollution. The system is not built for oils and greases nor for wet wipes (these need to be disposed in bins).	4
Mini-game at the sewer	Players have to make sure that sewers do not break nor clog (due to wet wipes or oils and greases).	Sewers function is to transport wastewater generated at households to wastewater treatment plants.	5
Mini-game at the wastewater treatment plant (screen)	The player needs to make sure that big residues get attached to screens and do not enter the wastewater treatment plant. This step removes wet wipes (besides other elements such as plastic bottles)	Technology based on screens exists to remove big residues at the entrance of wastewater treatment plants.	6
Mini-game at the wastewater treatment plant (oil and greases removal tank)	The player manipulates the air supply to the oil and greases removal tank to make sure that oils float and go to the upper layer of the tank; sand settles and goes down the tank. The player operates shovels to remove oils and greases and sand from the tank.	Technology exists to remove oils and greases and sand in wastewater treatment plants.	7
Mini-game at the wastewater treatment plant (biological reactor)	The player choses different bacteria and feed them with the pollutants and other molecules which allow their removal.	The player learns that biological reactions can remove dissolved pollutants generated at the households.	8
Mini-game at the river	The player activates three elements to remove pollutants that were not removed at the wastewater treatment plant. Hence the player protects fishes from dying of the pollutants.	Wastewater treatment plants do not remove 100% of the pollutants. Some still end-up in rivers. Yet, rivers have some capacity to remove pollutants thanks to physical, biochemical and biological activities happening in stones, roots of trees and fallen trees inside rivers.	9

Figure 1. General overview of the six mini-games and the introduction at ICRA

Figure 2. Presentation of the elements, Carbon, nitrogen, etc., and the actions at households which generate these pollutants

Figure 3. Mini-game at ICRA which relates the actions (microscope) with the pollutants (glass)

Figure 4. Mini-game at the household, which links actions that use water with the rooms they take place. These actions describe the pollutants generation.
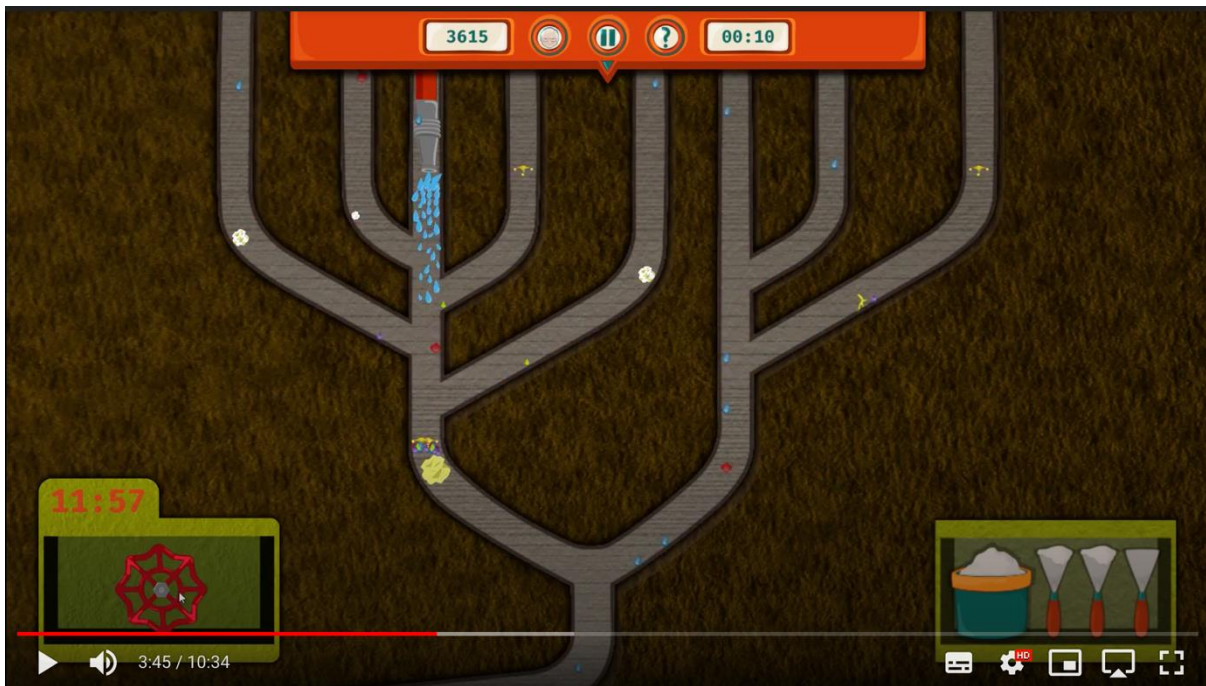
Figure 5. Mini-game at the sewer system; clogging with wet wipes and oils and hose to solve them.

Figure 6. Mini-game at the wastewater treatment plant (removal of big residues by means of screens)

Figure 7. Mini-game at the wastewater treatment plant in the oils and greases removal tank.

Figure 8. Mini-game at the biological reactor of the wastewater treatment plant.

Figure 9. Mini-game at the river.

3. HIGHLIGHTS OF THE NEW DEVELOPMENTS WITHIN SCOREWATER PROJECT

Table 2 highlights what has been developed new within the framework of SCOREwater.

Table 2. SCOREwater contribution to the mini-games development

Name of mini-game	SCOREwater contribution
Intro at the Catalan Institute for Water Research	New mini-game developed within SCOREwater
Mini-game at the household	Has been slightly upgraded. New actions shown in the new game (intro) have been also used in this mini-game; wet wipes disposal and oils and greases disposal has been added to the game.
Mini-game at the sewer	Has been upgraded with wet wipes and oils which cause clogging in sewers. An action has been added which is using a hose to sort the clogging out.
Mini-game at the wastewater treatment plant (screen)	This is a new mini-game developed within SCOREwater
Mini-game at the wastewater treatment plant (oil and greases removal tank)	This is a new mini-game developed within SCOREwater
Mini-game at the wastewater treatment plant (biological reactor)	No upgrades.
Mini-game at the river	Has been upgraded with new actions that involve using the power of stones, root trees and fallen trees.

4. DELIVERABLE FORMAT

The deliverable is in the format of an apk[1] file. This file can be installed in tablets, computers and mobile phones. The report on the deliverable is public. For revision purposes the reviewer can access the following link with a recording of a demo on the serious game. https://vimeo.com/727295579

5. PROPERTY RIGHTS

The serious game is protected and the property is shared between ICRA and UdG; such protection dates from before the SCOREwater project. The result from the SCOREwater project implies an upgrade of the product, but the same type and share of the property is applied to the new developed version. Besides ICRA there is no other SCOREwater partner that gets property on the upgraded version. A license agreement is in place now by which ICRA can use the serious game within SCOREwater activities; such an agreement ensures the proper execution of public awareness activities at schools within SCOREwater project planned for June 2022. This means, the serious game is not open to the general public yet. After the experience gained within the SCOREwater project in the sessions at the different schools a decision will be made on how to exploit the serious game. One of the potential options is to upload the game in google play or apple store to make it freely available to anyone. ICRA and UdG need to make decisions together on that particular issue. It is worth noting that SCOREwater only covered a small part of the development of the serious game; only covered an update of it to address SCOREwater relevant topics. So, the decision on what to do with the serious game is broader than the SCOREwater context.

6. ETHICS

The usage of the serious game at schools is not part of this deliverable. Anyhow, an ethics committee from the University of Girona approved the activity at schools for raising public awareness using this serious game. These activities and the ethics related will be described in deliverable 4.10.

7. REFERENCES

Suárez, A. (2019) Ciclo Urbano del Agua. Desarrollo y Testeo un videojuego serio en las Escuelas. Biotechnology BsC project at the University of Girona. Supervisors: Lluís Corominas and Manuel Poch.

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[1] A file with the APK file extension is an Android Package file that's used to distribute applications on Google's Android operating system.

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 3 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 3. Stocktaking on Deliverable's contribution to reaching the SCOREwater strategic objectives.

Project goal	Contribution by this Deliverable
6	Enhancing public awareness on the usage of wet wipes, pharmaceuticals consumptions, and oils and greases

PROJECT KPI

Table 4 lists the project KPI that are relevant for this Deliverable and gives a brief explanation on the specific contribution of this Deliverable.

Table 4. Stocktaking on Deliverable's contribution to SCOREwater project KPI's.

Project KPI	Contribution by this deliverable
6	In Barcelona, reduce the release of wet wipes and discharge of oils and greases and antibiotics to the sewer systems

ETHICAL ASPECTS

Table 5 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 5 indicates "N/A" for aspects that are irrelevant for this Deliverable.

Table 5. Stocktaking on Deliverable's treatment of Ethical aspects.

Ethical aspect	Treatment in the work on this Deliverable
Justification of ethics data used in project	Does not apply
Procedures and criteria for identifying research participants	Does not apply
Informed consent procedures	Does not apply
Informed consent procedure in case of legal guardians	Does not apply
Filing of ethics committee's opinions/approval	Does not apply
Technical and organizational measures taken to safeguard data subjects' rights and freedoms	Does not apply
Implemented security measures to prevent unauthorized access to ethics data	Does not apply
Describe anonymization techniques	Does not apply
Interaction with the SCOREwater Ethics Advisor	Does not apply

RISK MANAGEMENT

Table 6 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 6. Stocktaking on Deliverable's treatment of Risks.

Associated risk	Treatment in the work on this Deliverable
	No risk identified