nextGen
Circular Water Solutions

Data Management Plan

Updated Version

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[1] PU = Public
PP = Restricted to other programme participants (including the Commission Services)
RE = Restricted to a group specified by the consortium (including the Commission Services)
CO = Confidential, only for members of the consortium (including the Commission Services)

Document history

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Summary

This document is the updated version of the NextGen Data Management Plan (DMP) and intents to provide an analysis of the main elements of the data management policy that is used by the NextGen project with regards to all the datasets that are generated by the project. It is based on the initial version of the DMP (D7.2) and is updated to the current situation and the progress that has been made in this aspect.

The first section is an introduction to the document regarding the purposes as well as the structure of the document and the synergies with other tasks and deliverables. The second section states the purpose of data generation and collection, explains the relation to the project objectives, specifies the types and formats of data and existing reused data, identifies the origin and size of data as well as the data utility. The process of making the data 'FAIR' is described in section 3, that is making it findable, openly accessible, interoperable and re-usable through clarifying licenses. Furthermore, the allocation of resources for the data collection and management is explicitly described in section 4. The crucial aspect of data security, developing and establishing a backup and recovery plan for all NextGen data is presented in section 5. With regards to the ethical aspects, a number of ethical issues have been identified for the execution of NextGen, specifically humans, non-EU countries, data protection and compliance with the GDPR and others (section 6). The conclusions of the document are presented in section 7.

The DMP is obviously not a fixed document, but it evolves during the lifespan of the project and functions as a dynamic document of agreements. This report presents the updated version of the NextGen DMP, in which all the progress and updates of the data management policy that has been conducted is described and is expected to be used in the project implementation.

Disclaimer

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Abbreviations

CE	Circular Economy
BY-NC	Creative Commons, Attribution + Non-Commercial
CC-BY	Creative Commons, Attribution
CC-SA	Creative Commons, Attribution + Share Alike
CoP	Community of Practice
DMP	Data Management Plan
GDPR	General Data Protection Regulation
KPI	Key Performance Indicators
TEB	Technology Evidence Base
WP	Work Package

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1. Introduction

1.1 Purpose of this document

Europe's communities are in many ways uniquely placed to transition from a linear to a Circular Economy (CE) model. This approach becomes more relevant and urgent in the water sector where largely linear production - consumption - disposal chains exacerbate resource depletion issues, contributing to increasingly volatile raw material and energy costs as competition for diminishing resources. Engineered water systems are strongly interdependent with the natural water environment meaning that traditional linear approaches to water services provision risk polluting source waters, resulting in high subsequent treatment costs. A radical redesign of water services to deliver a new generation of validated, progressive solutions to underpin the CE model is urgently required.

NextGen aims to evaluate and champion innovative and transformational CE solutions and systems that challenge embedded thinking and practices around resource use in the water sector. In order to accomplish that, it is necessary to develop practical approaches, tools and partnerships as well as policy and legal framework conditions, which accelerate the acceptance of such technologies and broaden the market reach and uptake. Towards this direction, the project attempts to develop and demonstrate technological, business and governance solutions for water in the circular economy and bring new market dynamics throughout the water cycle at 10 high-profile, large-scale demonstration cases across Europe.

The purpose of the updated **Data Management Plan (DMP)** is to provide an analysis of the main elements of the data management policy that is used by the NextGen project with regards to all the datasets that are generated by the project.

The DMP is not a fixed document but evolves during the lifespan of the project and functions as a dynamic document of agreements. This report is based on the initial version of the DMP (D7.2) and is updated to the current situation and the progress that has been made in this aspect. The final purpose it to have a well-designed DMP for the successful outcome of the overall NextGen project.

1.2 Structure of this document

This deliverable is structured as follows:

- Section 2 provides a data summary of the project. The DMP states the purpose of data generation and collection, explains the relation to the project objectives, specifies the types and formats of data and existing reused data, identifies the origin and size of data as well as the data utility

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- Section 3 presents the process of making the data 'FAIR', that is making it findable, openly accessible, interoperable and re-usable
- Section 4 refers to the allocation of resources for the data collection and management
- Section 5 refers to the crucial aspect of data security, developing and establishing a backup and recovery plan for all project data
- Section 6 presents the ethical issues for the execution of NextGen, specifically humans, non-EU countries, data protection and compliance with the GDPR and others
- Section 7 concludes the document
- Appendix A shows a depiction the Dataset for DMP
- Appendix B presents an illustration of the Zenodo Research Data Repository
- Appendix C contains a template of the informed consent form for acquisition and usage of data
- Appendix D: presents the NextGen Taxonomy of technologies

1.3 Relationship with other deliverables

This document is related to and complements the following deliverables:

- WP1:

D1.1 Assessment of baseline conditions for all demo cases

D1.2 Operational demo cases

D1.3 New approaches and best practices for closing the water cycle

D1.4 New approaches and best practices for closing the energy cycle in the water sector

D1.5 New approaches and best practices for closing materials cycle in the water sector

D1.6-D1.7 Technology Evidence Base

- WP2:

D2.1 Environmental Life Cycle Assessment and risk analysis of NextGen demo case solutions

D2.2 Economic assessment and cost efficiency analysis of NextGen demo cases solutions

D2.3 Re-design and stress test of NextGen selected case study systems

D2.4 – 2.5 NextGen Water in the CE re-design toolbox

- WP8:

D8.1 H - Requirement No. 3

D8.2 POPD - Requirement No. 4

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2. Data summary

2.1 Purpose of the data collection/generation

Data acquisition in NextGen is performed in the context of WP1 "*Demonstrate Technologies & Systems for Water in the Circular Economy*" and WP2 "*Assess Technologies and Design Systems for Water in the CE*", and are exploited within WP5 "*Explore new business models and support market creation*". More specifically, WP1 organises the demonstration of next generation circular water systems and services in the 10 demo cases and is responsible for collecting and collating the NextGen Technology Evidence Base, whereas WP2 develops and demonstrates the tools needed to assess the whole water value chain for each demo case for different future conditions using data from large-scale demonstrations and stakeholders.

The purpose of the Data Management Plan (DMP) is to provide an analysis of the main elements of the data management policy that are used by the NextGen project with regards to all the datasets that are generated by the project. The DMP should address the points presented below on a dataset by dataset basis and should reflect the current status of reflection within the consortium about the data that are generated, collected, stored and processed.

In principle, publicly funded research data are a public good, produced for the public interest that should be made openly available with as few restrictions as possible in a timely and responsible manner that does not harm intellectual property. On this basis, the DMP intends to help researchers consider at an early stage, when research is being designed and planned, how data will be managed during the research process and shared afterwards with the wider research community.

NextGen project, as all the H2020 projects, is taking part of the **Open Research Data Pilot (ORDP)** carried out by the European Commission. This implies that the NextGen consortium has to make it possible to:

- develop (and update) a Data Management Plan (DMP) → initial DMP done M6 (intermediate DMP is written in M24 and final DMP in M48)
- ensure that our data are FAIR for third parties → each partner creating a dataset is asked to fill in a descriptive table "Dataset for DMP" (Appendix A)
- deposit the data produced in a research data repository → a community for NextGen will be created on the public repository Zenodo (see Appendix B)
- provide related info about the raw data used to validate our research (metadata)

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The benefits of a well-designed DMP not only concern the way data are treated but also the successful outcome of the project itself. A well-designed DMP guides the researchers first to think what to do with the data and then how to collect, store and process them, etc. Furthermore, a planning in data treatment is important for addressing timely security, privacy and ethical aspects. This way the research data are kept in track in cases of possible staff or other changes. The DMP can also increase preparedness for possible data requests. In short, planned activities, such as implementation of well-designed DMP, stand a better chance of meeting their goals than unplanned ones.

The process of planning is also a matter of communication, increasingly important in a multi-partner research. The characteristics of collaboration should be accordingly harmonised among project partners from different organisations or different countries. The DMP also provides an ideal opportunity to engender best practice with regards to e.g. file formats, metadata standards, storage and risk management practices, leading to greater longevity and sustainability of data and higher quality standards.

Ultimately, the DMP should engage researchers in conversations with those providing the services. In this context, the DMP becomes a “living” document in accordance with relevant standards and community best practice. Data should be shared, edited, and monitored among those contributing to the project. Releasing research data should follow legal, ethical and commercial terms and conditions. To serve the multiple purposes just described, the DMP should be designed for easy digital exchange across a variety of applications. The best way to approach this in today's complex world of information technology is through a metadata standard describing a data model of elements constituting the DMP.

2.2 Relation to the objectives of the project

NextGen is aiming to demonstrate technological, business and governance solutions for water in the circular economy and bring new market dynamics throughout the water cycle at 10 large-scale demonstration cases across Europe. In order to accomplish that, it is necessary to develop practical approaches, tools and partnerships as well as policy and legal framework conditions, which accelerate the acceptance of these technologies and broaden the market reach and uptake. These approaches consist of implementing CE technologies and solutions, developing of decision support tools and business cases, assessment of market readiness and of policy and legal framework conditions, and capacity building activities.

The well-monitored demo sites (WP1) form an excellent basis for building long-term CE track records and for addressing questions related to scaling-up CE. Thus, existing data of operational sites are collected and included in the Technology Evidence Base (TEB) that has been developed in the scope of the project.

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The project, thus, builds on **ten Large Scale Demonstration Cases** where next generation circular water systems and services are either already deployed at full scale (six cases) or are to be deployed in the near future (four cases), demonstrating the replication potential of the approaches in practice. These real-world demonstrations allow us to create and disseminate a comprehensive **Technology Evidence Base (TEB)** (task 1.1) of the proposed solutions' effectiveness, performance, enabling conditions and opportunities for business development (**WP1**) fed by multi-parametric technology's assessment, process redesign, and long-term, uncertainty-aware, stress testing results both at the individual and whole system levels (**WP2**). Crucially, ***NextGen*** empowers citizens and stakeholders to learn about and be involved in the design of circular solutions from the start supporting their engagement through novel means, to both allow them to understand what 'closing the cycle' could mean in a 'risk-free' learning environment (through Serious Game) and to visualise hidden aspects of the cycle (e.g. energy flows) as part of an enhanced demonstration experience (through Augmented Reality applications) (**WP3**). The project addresses the socio-political, regulatory and governance (pre)conditions for circular water systems and services and proposes an actionable EU Roadmap for Water in the CE (**WP4**). All this work gears towards the development and demonstration of new CE business models and market opportunities, also supporting the emerging CE business ecosystem through a water in the CE Marketplace, firmly embedded into, and extending the outreach of Water Europe's real face-to-face water marketplace (**WP5**). Last but not least, NextGen connects, creates synergies with, and supports learning (**WP6**) and also networking with three Associated Partners as a specific case from overseas markets (India, South Korea and China) in partnership with Water Europe and experts in science communication.

In particular, the TEB is a web-based knowledge repository that intents to provide information on what is available, what has already been applied and tested under different contexts, what were the main lessons learned and what are the key legislative and regulatory issues that need to be considered. In particular, different CE experiences and practices, technical and regulatory contexts, as well as policy analysis and policy recommendations are recorded. The material that complements and supports CE implementations includes diagrams and schemes, reports, peer reviewed journals, best practice guidelines, datasets, audio-visual material. Furthermore, important information on economic viability of the CE implementations will included in the repository.

A dedicated freeware ***NextGen Toolkit*** (hereafter termed the ***NextGen Interactive Interface***), has also been developed (task 2.4) that collects, improves and demonstrates all instruments and methods compiled within the scope of the NextGen project. Towards this direction, the NextGen Toolbox supports decision-making through the presentation of appropriate tools for individual solution assessment and system-wide evaluation and stress testing. It also comprises information on e.g. outputs of the models, databases, KPIs relationships based on user experience, etc. The toolbox is developed in close cooperation with user groups from the NextGen Communities of Practices (CoPs). The purpose of the toolbox is to interact with the

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user to get user profile and also to get case specific information from the user. It chooses which info, tools and recommendations or questions are adapted to the user profile. It links and contextualizes information from tools and information from users and present user centred info, tools, recommendations and questions. It will have a web based interactive interface and will guide the user based on input data in the following categories: (a) Components of the physical system; (b) Flows of water, energy and materials; (c) Actors involved, including water utilities, industries, technology providers, end-users, and (d) Roles of the actors and their interactions.

A **NextGen Augmented Reality Application** (task 3.2) is currently under development to visualise the hidden or intangible elements of the technologies, as well as to understand options, scenarios, opportunities and challenges. The NextGen AR application will be demonstrated for selected NextGen demo cases, using the respective data of monitoring the performance of the technical solutions. The application will also provide the user the capabilities of loading maps, specifying points of interest on the maps and finally building campaigns around the points of interest.

A **Serious Game** (SG) is under development to allow citizens to visualise and get familiar with a more circular approach to water management, also supporting advice provision, role-playing and negotiations between stakeholders of the water value chain. The SG is also implemented on specific demonstration sites but will be generic enough to be played beyond these cases and beyond NextGen, using the respective data of the modelling activities testing the performance of the implemented technologies.

Regarding the **NextGen Marketplace** (task 5.2), several services are developed such as linking to the NextGen Technology Evidence Base (WP1) and allowing users to explore the showcases, finding collaborators and clients by building on a 'match-making' functionality, providing personalised information to interested parties, funding innovation and supporting spinoffs. Further functionalities include F2F meetings, social connect facilities, messaging and notifications, material for making informed decisions about investments and securing future water supply, technical guidance for CE technologies, regulation/legislation, business case and business development advice, experiences and funding and related support. NextGen Marketplace intends to share experiences and outcomes with stakeholder groups through its online platform that will be linked to existing networks, including Water Europe Marketplace and Project Ô.

2.3 Types and formats of data generated/collected

According to an internal survey carried out between project partners, all partners produce some kind of publications and presentations. Other types of data produced by many partners are datasets, posters, produced software, multimedia products (images, video, audio etc.), lessons, brochures, technical guides, flyers etc.

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In particular, within WP1, data regarding the performance of the technical solutions proposed in the project are collected as in-situ data by the site leaders. Additionally, a short description of the demo sites and some KPIs in terms of water, energy and materials are compiled by the CTGs for setting the baseline and quantifying the impact of the proposed system. For this purpose, a general description of each site is collected through a factsheet template, where a description of the current and NextGen systems, in terms of technologies used and volumes treated, as well as block diagrams, flow schemes, pictures and videos of the technologies has been included. Data for KPIs are requested from the site leaders in an excel form, which is constantly updated during the project execution. Additionally, lessons learned from the case study, outcome of the assessments and legal and regulatory information concerning the whole value chain of the technology.

For the use of this data, Consent Forms have been compiled (Appendix C) and distributed to the demo site leaders to provide their agreement that the baseline data of the factsheets can be openly published. For this purpose, the open-access repository Zenodo will be used. More information on the Zenodo platform is described in Appendix B.

WP2 assesses economic and environmental performance of individual CE water technologies and associated risks, optimises the systems and makes assessment and modelling results and tools available in a sustainable manner.

To perform this, the following data is collected:

1. technology specific data (e.g. system configurations, mass balances, energy and chemical demand, performance information, costs, etc.) for baseline (i.e. status quo) and NextGen demo cases technologies data.
2. infrastructure data (storage capacity, pipes sizes, etc.) for modelling the components of the physical and engineered system
3. historical data (water and material flows, energy, etc.). Historical data will be retrieved and converted into an interoperable and standard data format (such as OGC standards including WaterML 2.0 and InfraGML) and stored for further use in the water tools UWOT and Hydroptim.
4. definition of management boundary conditions: criteria and objectives, current and future scenarios. Management boundary conditions are defined with water authorities/utilities and stakeholders within the CoP activities at the CS sites
5. data regarding the stakeholder needs and interests for the NextGen toolbox are collected as part of the CoP meeting. The main interest on the tool, the use cases for using it as well as the expected view of the results are reported in an anonymized way. Once the tool is developed, it allows the creation of user profiles giving the possibility to use the tool in a personalized way. Finally, the users are able to provide their feedback on the returned results of the tool, aiming to collect this data and further improve the returned results.

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The following data are generated:

- Assessment of environmental impacts in various categories (e.g. global warming potential, primary energy demand, human toxicity, …) of the applied technologies using defined LCA indicators.
- Assessment of cost in standard categories (raw material cost, personnel, capex, etc.)
- Risk assessments generate site specific uncertainty estimations to assess the probability of achieving the predefined objectives, e.g. reduction of microbial counts, compliance with of environmental legislation using recycling products. The data generated will be in the form of probability distributions as a function of system parameters (e.g. treatment time, yield)
- Model configurations combining inputs (standard or shocks including CC), systems (e.g. upstream changes, failure of components) with corresponding performance (e.g. circularity indicators of the water utilities, ecoefficiency, reliability, contamination risk, materials produced, profits, ecosystem services etc.).

Within WP3, data regarding stakeholders' views of the demonstrated circular water solutions are collected as minutes of CoP meetings. The perspectives of the stakeholders are reported in these minutes, e.g. as anecdotal stories in PDF or Office Open XML format. In these minutes, all personally identifiable data are anonymised. For the purposes of cross-fertilisation between the demo cases, the CoP reports are stored and made available to the project partners in the NextGen SharePoint.

WP4 is expected to collect and process information regarding the socio-political and governance context for water in the circular economy. Relevant information, in the form of legal documents, reports, policy papers etc., are collected and, where appropriate, are included in the NextGen Interactive Interface as part of the project's knowledge environment.

One main component of WP5 is the Marketplace, aiming at providing information on showcases collected in WP1, storing information of new initiatives and spin-offs in the field of innovation funding and, most important, collecting information referring to end users, technology providers and products. All information is stored in online databases. Selected information may be exported in other forms such as PDF (factsheets) or CSV (tables).

Finally, WP6 collects information, as above, for the project's associate partners (India, South Korea and China) and their relevant cases, technologies and contexts.

2.4 Reused existing data

Within WP2, and more specifically as part of the NextGen TEB, data about the technologies of NextGen are used and returned to the users. Furthermore, the users potentially have access to the data of the Technology Evidence Base that is currently created as part of WP1.

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The Marketplace (WP5) is built on the technology developed in the NextGen project. Special attention is given in the collaboration between NextGen and Project Ô, to ensure synergies between the proposed Marketplace development of the two projects are exploited with a view to produce, if possible, an integrated Marketplace.

Existing data is being re-used in all ten demo sites originating from previous related studies or survey of existing studies.

2.5 Origin of the data

One part of the data are measurements collected by the monitoring stations at the demo sites (Appendix E). Some of them originate from meteorological stations operated by national or local agencies and stakeholders. Another part of data is produced by project partners. The size of all data produced by this project cannot be estimated precisely. It is estimated that data originating from the demo sites and are collected by the monitoring network of the project makes a significant part of the overall data. Currently, data on the baseline conditions of the demo sites have been collected from monitoring stations and from sampling and analysis. Apparently, it is expected that the size of the data will continue rising over the next years.

For WP1, data are obtained from in-situ monitoring of the performance of the technical solutions tested within NextGen. Respectively, data collected within WP2 are also obtained from in-situ monitoring of the technical solutions tested within NextGen, from the modelling activities and from interviews with the contact persons of the sites and from the CoP of the sites as the users of the NextGen Interactive Interface.

Data collected within WP3 are obtained from stakeholders participating in CoP meetings, and the general public voluntarily participating in outreach events, serious games and augmented reality activities at the demo cases. We ensure fully informed understanding of the implications of participation through information sheets and consent forms that has been distributed in these events.

In WP5 data is collected from project partners in the first phase of the project. Additional information may be collected or accessed online by connecting the Marketplace with other established European platforms. In the final phase the Marketplace will be opened to registered users who may add further content.

2.6 Expected size of the data

For the NextGen Interactive Interface (WP2) data of about 10-15 participants have been collected and processed. Furthermore, few hundreds of users are expected to be using the Toolkit and provide data.

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In WP3, the size of data collected is difficult to estimate but it is considered substantial, as it relates to the input from approximately 4 to 6 stakeholder organisations from the ten CoPs, and thousands of citizens participating in the living labs events and three serious games and augmented reality activities.

In WP5 it is expected that the Marketplace database will store active users, technology providers and technologies in the order of hundreds.

2.7 Data utility

Data collected within WP1 is useful for the work of other WPs of the project, such as WP2 and WP5. WP1 comparisons of the different solutions tested is used for engineering, water utilities and other specialized audience for selecting the best circular technologies to be applied in future projects.

The data collected and generated in WP2 is used to assess economic and environmental performance of individual CE water technologies and associated risks, optimise the systems and make assessment and modelling results and tools available in a sustainable manner.

Data collected within WP3 is useful for the partners in the demo cases. The outcomes of the stakeholder collaboration in the CoPs and the public engagement in the Living Labs will benefit the devise, implementation and acceptability of the CE water technologies. Data collected within WP3 are expected to be useful for WP4 of the project as well. Generic lessons from WP3 are included in the EU roadmap for water in the CE.

In terms of data availability, the intention of NextGen was from the start to produce as much as possible freely available research data, findings, results, reports and deliverables, and share them with minimal restrictions, e.g. the attribution to the authors or creators. With regards to produced software, programming code, interface components, etc., the IP and copyright have been recorded and most of the software is now available as open source with an open source license.

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3. Making Data FAIR

In general terms, the research data should be 'FAIR' that is findable, accessible, interoperable and re-usable. These principles precede implementation choices and do not necessarily suggest any specific technology, standard or implementation-solution.

3.1 Making data findable

3.1.1 Discoverability of data

All NextGen subsystems, including the Technology Evidence Base, the Marketplace and the Interactive Interface developed within the framework of the project, will be integrated into a common online system. They all give (open or limited) access to certain data categories. Thus, one way to increase the discoverability of the data is to develop HTML pages rich in <meta> tags which provide metadata about the HTML document and are parsable by other machines. Additionally, all subsystems, and mostly the integrated system of the three elements, will be linked to the project website. Efforts will be taken to establish also cross-links to other relevant websites and platforms e.g. Water Europe.

Measurements and analysis data collected at various project sites are associated to the related case study areas stored in the TEB (Appendix E) and thus will be discoverable also through this system.

NextGen encourages project partners to store datasets produced in open research repositories (i.e. Zenodo) and obtain Digital Object Identifiers (DOIs).

3.1.2 Identifiability of data and standard identification mechanism

Objects stored in the NextGen TEB will be associated with a unique and persistent ID, at the appropriate resolution (i.e. scale or aggregation level). The detail page of these objects can be accessed through a specific URL.

Large parts of the NextGen TEB are written in Python and use the Django framework. The Python code follows in general PEP 8 styling recommendations which regulate also the naming conventions for the source code. In the database, Django specific tables have the prefix *django_*. Additionally, intermediate tables realizing many-to-many relations are named after the names of the connected tables.

Other platforms which are used to store certain data categories originating from the NextGen project (e.g. Zenodo, Bitbucket) provide similar search capabilities. In the context of the project, snapshops of the whole database will be exported and stored in the research data repository Zenodo obtaining a DOI. This will include the baseline data that have been collected for all the 10 demo cases as well as the data after implementing the CE technologies and solutions based on the monitoring activities of each case study. Other categories of data

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produced by this project such as publications and presentations will also be uploaded to Zenodo research repository providing DOIs.

3.1.3 Naming conventions used

The proposed naming convention for datasets in the NextGen project consists of three parts:

- A prefix indicating the data category (e.g. metadata, backup data, template)
- A short name for the dataset
- An integer indicating the version of the dataset

The above information will also be used as a unique code for the dataset. Additional metadata such as the data provider and the creation date will be associated with the code and uploaded to the repository.

3.1.4 The approach towards search keyword

The NextGen Marketplace will provide a variety of ways for data retrieval, such as full text search with approximate string matching and innovative advanced search capabilities based on the attributes and relations of various data categories, including keywords and tags. Other platforms which this project will use for certain data categories (e.g. Zenodo, Bitbucket) provide similar search capabilities.

3.1.5 The approach for clear versioning

Various information systems are developed during the lifetime of the NextGen project. Many of them require the collaborative development of software applications, websites and other computer programs either from scratch or at least significant parts of them. The management and version control of the source code may become a significant problem, especially in large software development projects involving several developers.

The NextGen IT team systematically uses **Git** as the source code management system for software development. Git allows the collaborate development of the software providing effective distributed version control. It is easy to use and yet powerful and efficient to handle even large projects.

A copy of each Git repository will be uploaded ("pushed") to a publicly available Git server such as **GitHub** or **Bitbucket**. They are both well-established online servers which support distributed source code development, management, and revision control. They enable world-wide collaboration between developers and also provide some additional facilities to work on documentation and to track issues. GitHub provides paid and free service plans. Free service plans can have any number of public, open-access repositories with unlimited collaborators. Private, non-public repositories require a paid service plan while Bitbucket allows private repositories to be shared with up to five collaborators.

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In general, all datasets produced by NextGen will receive a unique code, part of which will specify the version of the dataset.

3.1.6 Use of standards for metadata creation

Presently there are numerous standardisation activities including risk assessment and protection of a high level of services, although sometimes optional, is considered integrated in the entire operational process.

Standards which have been considered include the following:

- ISO 9001:2015 provides an integrated approach to quality management - putting quality at the heart of business, touching on business resilience.
- ISO/IEC 27001 is an internationally recognised best practice framework for an information security management system.
- ISO/TR 37150:2014 Smart community infrastructures - Review of existing activities relevant to metrics addresses community infrastructures such as energy, water, transportation, waste and information and communications technology (ICT), focuses on the technical aspects of existing activities which have been published, implemented or discussed. Economic, political or societal aspects are not analysed.
- ISO 19115, Geographic Information – Metadata
- ISO 19110 Geographic information – Methodology for feature cataloguing
- ISO 19139, Geographic Information – Metadata -Implementation Specification
- OGC Catalog Service

Efforts have been made that all textual information collected in the NextGen project and especially all new information produced and stored in the NextGen databases will be UTF-8 encoded.

3.2 Making data openly accessible

3.2.1 Data openly available

An internal survey has been carried out during the first phase of the project, addressing, among others, data availability issues. As a result of the survey, it turned out that most of the data produced by this project will be openly available.

Thus, it is expected that most of the data produced or collected in the framework of the NextGen project will be openly accessible. However, for some reasons, related to licensing issues, 3rd party data policy, and the use of personal or sensitive data, accessing may be restricted. The Marketplace is such an example, where efforts are taken to provide more targeted and personalised information to the users, including product information related to the user's preferences, social connecting and targeted notifications, utilizing advanced

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methodologies such as machine learning. As part of this process, information of the individual user's preferences will be collected and stored, to which only the Marketplace application will have access.

In any case, project members embraced the principle expressed by the Commission to make the data "*as open as possible and as closed as necessary*".

3.2.2 How the data are made available

Several websites will provide access to the project data. They can be accessed through the project website (access to project data) or the NextGen online Marketplace. Specifically, the project's online environment (the MarketPlace linked to the Interactive Interface which also will integrate the TEB), will form part of Water Europe's infrastructure and as such will be developed and maintained beyond the project timeline, providing access to collected as well as to new material.

Additionally, during the project, a copy of all relevant data as well as other data categories (publications, presentations, etc.) will be made available to open data repositories such as Zenodo. Finally, at the end of the project a snapshot of the available data will be uploaded to the Zenodo platform.

3.2.3 Methods and software tools needed to access the data

The data will be made available online through the WWW service. Thus, in order to discover, visualize or download the data only a common browser will be required from the user. Some online applications may require the user to register first before accessing the data. The format of downloadable files will be (solely or additionally) in an open standard such as CSV and PDF. Tools to access these files will be freely available in the internet. User guides will be elaborated and provided for online environments, as well as for any non-intuitive tools produced within the framework of the project.

3.2.4 Deposition of data, associated metadata, documentation and code

Several websites will provide access to data such as the following:

- the project website (access to project data)
- the NextGen Marketplace (Products & Services, Stakeholders etc.), which will also provide access to the NextGen TEB
- the data collection and monitoring system of the demo cases
- the Zenodo open data research repository, including a copy/snapshot of all relevant data as well as other data categories (publications, presentations, etc.)

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3.2.5 Access provided in case of restrictions

To gain access to the online Marketplace, a user will have to register to the Marketplace first and provide data regarding the user's background and fields of interest. The procedure is then simple and straightforward, involving the verification of the user data via email. During this procedure, the user may have to provide profile information such as personal information, his affiliation and interests.

3.3 Making data interoperable

3.3.1 Assess the interoperability of your data

Datasets produced by the NextGen project will be interoperable allowing data exchange and reuse. All systems will be user friendly, well documented and unless otherwise specified openly accessible. The NextGen project will follow established European metadata vocabularies, standards and methodologies.

3.3.2 Use of standard vocabulary for data sets, to allow inter-disciplinary interoperability

A vocabulary used by this project will be adopted and adjusted, based on the Taxonomy of technologies that has been compiled for the Circular Water Solutions (Appendix D). This taxonomy will also be made available to everyone through the research data repository Zenodo.

3.4 Increase data re-use

3.4.1 Licenced data to permit the widest reuse possible

Project partners intend to provide most of the data openly accessible, either immediately or after an embargo period. In these cases, the preferred license types are CC-BY (Creative Commons, Attribution) and CC-SA (Creative Commons, Attribution + Share Alike) and BY-NC (Creative Commons, Attribution + Non-Commercial).

3.4.2 Cases when the data will be made available for re-use

Some data are already available online through the project websites. Other datasets will be uploaded to Zenodo and will be made immediately available through this service. Finally, for some data an embargo period will be necessary for them to be published first. It is estimated that for these data the embargo period will not last longer than until the end of the project. It is not expected that NextGen will seek patents.

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3.4.3 Data useable by third parties

Almost all relevant data produced and used in this project are available by third parties or will be made available after the end of the project. A small part of them will still remain closed either because of licensing issues or because they refer to personal information (e.g. user profiles) or sensitive data (Communities of Practice feedback of stakeholders).

3.4.4 Data quality assurance processes

Data validation process will be finalized by the end of the project.

To ensure a high quality, data collected from various sources in NextGen undergo validation routines as follows: All parameters measured by the monitoring stations must be checked against extreme values, in order to identify possible defect of instruments or another malfunction of the system. The responsible user will be notified in case of an issue.

Upon data entry into the Evidence Base or the Marketplace several validation routines must apply informing the user in case the record is incomplete or erroneous. Such validation checks include missing mandatory values and data type check.

Finally, several constraints embedded in the database should ensure the integrity of the data.

3.4.5 Length of time for re-usable data

All open data will remain re-usable for at least five years after the end of the project and maintained by the project partners. As suggested earlier, the project's online environment will form part of Water Europe's infrastructure and as such will be developed and maintained well beyond the project.

Datasets uploaded to the Zenodo repository may remain accessible for a much longer period.

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4. Allocation of resources

4.1 Costs for making your data FAIR

Most of the project partners apply software tools, technologies and protocols which comply to the FAIR principles and/or facilitate FAIR use of data. The use of WWW for various applications of the project documents this approach.

Additional efforts are required at least for the following tasks:

- Implementing various searching techniques (est. costs: 3 MM)
- Data conversion (est. costs: 2 MM)
- Establishing interoperability with other projects and platforms, Water Europe Marketplace and Project Ô in particular (est. costs: 6 MM)
- Developing Single Sign On (SSO) functionality (est. costs: 3 MM)
- Managing data in open research data repositories (est. costs: 1 MM)
- Developing and implementing a data management plan (est. costs: 1 MM)
- Implementing special interfaces (API) for accessing data through the Internet (est. costs: 2 MM)

The costs will be covered by the project partners responsible for the respective tasks.

4.2 Responsibilities for data management

The following project partners were responsible for the data management:

KWR is the responsible partner for the overall coordination of the data management.

KWB is responsible for developing and coordinating the collection of relevant data as well as populating the Technology Evidence Base.

ICCS is responsible for developing the NextGen Interactive Interface.

NTUA is responsible for developing the NextGen online Marketplace. Additionally, NTUA will create a *Community* within the Zenodo research data repository to allow project members to upload their data.

Additional data managers at the 10 project partner demo cases (WP1) or Communities of Practice (WP3) take care of the other data produced locally.

4.3 Costs and potential value of long-term preservation

A snapshot of all relevant project data will be stored in the research data repository Zenodo upon termination of the project. This dataset will receive a DOI and will be preserved for the

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foreseeable future. However, the dataset will continue to grow even after the end of the project as real-time measurements will keep coming from the various project sites. Project partners responsible for the stations and other local stakeholders involved in their management and the exploitation of the data have an interest to keep these stations in operation as long as possible.

As the NextGen online Marketplace linked to the Interactive Interface and also integrating the TEB, will form part of Water Europe's infrastructure and as such the collected and new data are expected to be preserved at a long-term basis far beyond the project duration.

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5. Data security

5.1 Data recovery, secure storage and transfer of sensitive data

Developing and establishing a backup and recovery plan for all NextGen data is a crucial part of data security. While a general-purpose repository like Zenodo will store and publish the significant releases of the data produced in NextGen, a backup plan takes care of the daily backups of all data. A variety of backup software exists for all operating systems, enabling manual and automated backup of the data. State of the art backup systems offer efficient storage of data (full and incremental backup, differential, backwards deltas) which keep track with older versions and even allow the reconstruction of the data at any single point in time.

From the perspective of the data security, we distinguish between the following data categories:

- Data having no overall importance for the project. These data are often temporary and/or serve as an intermediate step for the production of other data. They are usually stored in various files. For this category of data, it is in the responsibility of the local system administrators to establish reliable backup plans, if necessary.
- Data stored in the project's website, in the NextGen Evidence Base the Interactive Interface or the Marketplace will be encrypted and backed up centrally in a remote backup server. The backup server will be located physically at a different site than the other servers and will be connected with them through the Internet. Thus, it will not be affected by any malfunction or damage which may occur at the site of each server. A filesystem snapshot utility based on rsync (e.g. rsnapshot) will be used to make periodic snapshots of local servers and transfer the data securely via ssh protocol to the remote backup server.
- Data collected by the monitoring systems at the various case study sites. These data can grow into large volumes depending on the size of the monitoring network, the number of the observed parameters and the recording time step. In case of high frequent observations, more frequent backups or establishing a replication system will be required. Depending on each case, monitoring data may be and stored in local and/or remote backup servers.
- The NextGen Git repository stored in a remote server will serve as a means to backup software code produced during the project. An established service provider will be selected (e.g. GitHub or Bitbucket) guarantying long term preservation of the data. As the code is expected to be open source, its management will be taken care by the community.

At the end of the project, a copy/snapshot of all significant data will be stored in the project's repository at Zenodo. The infrastructure of Zenodo has been developed and is supported by CERN which guarantees long term data safety and availability.

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6. Ethical aspects

6.1 Introduction – scope of ethical issues

The purpose of this section is to describe how personal data, originating from workshops, interview and other events in NextGen, should be collected, managed and used. It aims to identify general guidelines on selection of participants, ensuring gender balanced representation, as well as measures to protect particular individuals and stakeholders are involved in the project, anonymise their contribution and minimise risks resulting from misuse of their information.

Handling of other types of data such us informed consent procedures that are implemented regarding the participation of humans in project events, this are more explicitly described in the H-Requirement No3. (D8.1). Additionally, matters related to the collection and processing of data required for research and development within the NextGen project, the applicable regulations relevant to data usage, the general guiding principles for the technologies to be developed, specifying data usage for the CE solutions have been presented in detail in the Protection of Personal Data (POPD) - Requirement No. 4 (D8.2).

In principle, NextGen does not deal with data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, trade-union membership, healthy and sex life. Nor NextGen involves activities or results raising security issues, or "EU-classified information" as background or results. Only data with a strict connection to the aim of the research are collected and processed.

Despite the rather "non-sensitive" nature of collected data, NextGen takes into account and addresses all major principles for data protection related to:

- quality of data and data processing;
- legitimacy and categories of data processing;
- right of access to the personal data;
- subject's right of information and objection;
- confidentiality and security of processing

Persons involved in related activities are properly informed of the project aims, expected results and limits of the research. NextGen ensures that the participation in its research activities does not entail any risk and burden for the individuals concerned. For this purpose, relevant information about the project and the intended use of the data is provided to persons involved before getting informed consent. Collected data are anonymised at the acquisition time and proper access and authorization properties are attached to them by the NextGen researchers.

The Ethics Advisor of the project is responsible for overviewing the proper management of data at the project level. In cases where the investigation activity does not directly involve the

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coordinator, the investigator shall refer to the Data Protection Officer in his/her own institution, who transfers all information on acquired personal data to the coordinator after the completion of the investigation activity. If there is no Data Protection Officer at the organization, the project partners have to confirm that they respect the guidelines set by their National Data Protection Authorities.

6.2 Ethics review, ethics section of DoA & ethics deliverables

A number of ethics issues have been identified for the execution of NextGen, specifically humans, non-EU countries, data protection and compliance with the GDPR and others. A response to each of these issues is given below.

6.2.1 Humans

Ethics issues in NextGen are a subject of this deliverable, other deliverables (D8.1 & D8.2) as well as the relevant framework and continues to be developed and improved throughout the project.

As humans are involved in NextGen, ethical issues related to their involvement, notably regarding recruitment and informed consent procedures need to be sufficiently described.

In D8.1, it is explicitly described how personal data as part of workshops, focus groups, interviews, CoPs, living labs and other dissemination activities in NextGen should be collected, used and managed. These reports also propose measures to protect particular individuals and stakeholders, anonymise their contribution and minimise the risk of their stigmatisation from improper use of their data. As a rule, it is recommended that to the extent possible, only anonymized information is stored as part of the collected data.

In D8.2, the foreseen ethics considerations are explicitly described, related to the collection and processing of the data required for research and development of the NextGen project. Issues such as data collection, informed consent, confidentiality, the code of conduct and the balance between data protection and freedom of rights have been identified. Information is also provided on procedures to be implemented for data collection, storage, protection, retention and destruction in compliance to EU Legislation.

In NextGen, demo cases are being implemented in close cooperation with local stakeholders, end-users, knowledge providers, technology providers, and water management agencies, thereby building local CoP groups. In NextGen, cooperation through associate partnerships has been established.

Data are collected from participants in workshops and other opinion elicitation activities. Personal data may also be obtained from already existing data files owned by the different companies, industries and public administrations involved to the project, provided that said entities already poses the necessary consents to reuse personal data for research purposes. Each of the data sources used already comply with the data protection legislation applicable to each of the countries of origin, and in particular all data files should already be registered

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at the relevant data protection agency. All original data files have to be particularly compliant with the right to access, modify, cancel and object to further treatment of personal data.

6.2.2 Non-EU countries

The objective of NextGen is to establish a market breakthrough of circular water technologies as robust, effective, sustainable, and cost-efficient answers to the water, energy and material challenges in urban areas worldwide. It practically explores replication potential though adoption of systems and services by demo cases within the project and opens new global markets in regions such as India, China and South Korea.

These regions were selected based on the severe water resources problems encountered and the long-term working relationships that already exist between local stakeholders and NextGen partners, particularly recognizing specific framework conditions, such as socio-economic, cultural and environmental characteristics. Addressing the social and governance challenges to uptake of circular solutions for water systems and services (WP4) and promoting dissemination and capacity building activities (WP6), encourages the sharing of knowledge with stakeholders. Addressing CE issues in water scarce urban areas, enhances the availability of sufficient and high-quality water for ecology, agriculture, drinking water and other water-related industries, thus increasing the sustainable development of urban environments.

The consortium confirms that the ethical standards and guidelines of Horizon2020 are rigorously applied, regardless of the country in which the research is carried out.

6.2.3 Data protection and compliance with the GDPR

In this section, it is presented how step-by-step the NextGen intends to meet the new data security, transparency, and privacy rights standards. Also, the consent guidelines are described.

The NextGen consortium intents to inform the EASME regarding each activity, what data is collected, stored and processed as a result of these interactions. In those cases where personal data is involved, detailed information is planned to be provided:

1. on what personal data is collected, stored and processed
2. on the recruitment process, inclusion/exclusion criteria for participation
3. on privacy/confidentiality and the procedures that are implemented for data collection, storage, access, sharing policies, protection, retention and destruction during and after the project
4. on how informed consent is pursued
5. if application/s need to be filed with a local/institutional ethics review bodies (if personal data is being collected) and if yes, which bodies / where / when.

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Data are collected in accordance with the General Data Protection Regulation (GDPR), a Regulation describing precisely the rights of data subjects and the obligations of data controllers and processors. The GDPR affects mainly the Marketplace as this is expected to be the main component where information related to personal data is collected. Persons registering for getting access to the Marketplace are providing their consent through the online form using clear and plain language. Users are able to withdraw their consent at any time, get informed of the data the system has collected and stores about them and apply to export them or permanently erase them from the system. Sensitive data collected by the Marketplace are planned to be encrypted before storing them in the database.

More specifically, the following sub-sections describe how NextGen will address various data protection issues in accordance with the GDPR.

Legal framework and transparency

- A detailed list of the processing activities will be prepared determining what information is processed and who has access to it. This list will be ready to be showed to regulators upon request.
- A legal justification on the data processing activities will be prepared since in principle, processing of data is illegal under the GDPR unless it can be justified according to one of six conditions listed in Article 6. Provisions related special categories of personal data in Articles 7-11 will be taken into consideration as well.
- The privacy policy will provide clear information on data processing and legal justification so that data subjects are aware that their data is being collected and why. This will be provided to the users (e.g. of the marketplace) at the time their data will be collected and will be presented in a concise, transparent, intelligible and easily accessible form, using clear and plain language.

Data security

- The principles of "data protection by design and by default," including implementing "appropriate technical and organizational measures" to protect data are followed from the very beginning. Technical measures include encryption, and organizational measures include techniques that limit the amount of personal data collected or deleting data, which are no longer needed.
- Encryption anonymization and pseudeonymization will be used whenever feasible as it is one of the basic GDPR requirements.
- For internal development and operational processes, a security policy protocol will be prepared ensuring that all team members are knowledgeable about data security. It will include guidance about email security, passwords, two-factor authentication, device encryption, and VPNs wherever necessary.
- In case of data breach where personal data is exposed, a prompt and proper notification to the supervisory authorities within the relevant jurisdiction will be

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submitted within 72 hours. The data breach will be also communicated quickly to the data subjects if this is able to put them at risk.

Accountability and governance

- A member of the NextGen platform will be designated for ensuring GDPR compliance. This person is empowered to evaluate data protection policies, monitor GDPR compliance, assess data protection risks, advise on data protection impact assessments, cooperate with regulators and evaluate the implementation of those policies.
- In case of data processing by any kind of third parties (analytics software, email services, cloud servers, etc.), a data processing agreement between the NextGen project and this party will be signed. This agreement will spell out the rights and obligations of each party for GDPR compliance.

Privacy rights

- NextGen users have the right to see what personal data are collected and how it is being used. They will also be in position to know how long their information is planned to be stored and the specific reason for keeping it for that length of time. This information will be communicated to the users free of charge within the first steps of their subscription to the service. The identity of the person requesting any specific data will be first verified.
- All data will be kept up to date by putting a data quality process in place. Users will be easily in position to view (Article 15) and update their personal information for accuracy and completeness (e.g. in the NextGen Marketplace).
- All users will have the right to ask for deletion of all their personal data. This request will be honoured within about a month.
- Users will be in position to request restriction or stop processing of their data if certain grounds apply, mainly if there's some dispute about the lawfulness of the processing or the accuracy of the data. This request must be in position to be honoured within about a month. However, while processing is restricted, the project will be still allowed to keep storing their data and a proper notification to the data subject must be sent before the beginning of processing again.
- Users will be able to receive a copy of their personal data in a format that can be easily transferred to another format (commonly readable format, e.g. spreadsheets).
- No data will be processed for the purposes of direct marketing (outside the scope of the project).

Consent guidelines

For the purposes of the project and according to the GDPR guidelines specific consent guidelines are practiced:

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- Consent must be freely given. No data subject will be cornered into agreeing upon the usage of their data. Consent to data processing will not be a condition of using the data. The one exception is when some piece of data is needed for the data subject to provide them a data related service.
- Consent must be specific. The request for consent will be presented in a manner which is clearly distinguishable from the other matters. It will be clear what data processing activities are carried out, granting the subject an opportunity to consent to each activity.
- Consent must be informed. The users will be aware of the data processor's identity, the processing activities that will be conducted, the purpose of the data processing, and that they can withdraw their consent at any time. The latter will be described in plain language ("in an intelligible and easily accessible form, using clear and plain language"). That means no technical jargon or legalese. Anyone accessing the Marketplace will be able to understand what they are asked to agree to.
- Consent must be unambiguous. There will be no question about whether the data subject has consented. Consent will be clear in any circumstances.
- Consent can be revoked. Marketplace users will have the right to withdraw consent at any time. This process will be foreseen to be made easy for them to do so.

6.2.4 Other procedures for data management

Up to now there is no other procedure for data management in the framework of the NextGen project, apart from the ones that have been already described in the present document.

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7. Conclusions

Most of the data produced or collected in the framework of the NextGen project are generally expected to be openly accessible. Exceptions may apply for reasons related with licensing issues, third party data policy, and the use of personal or sensitive data, thus accessing this information may be restricted.

In particular, all NextGen subsystems, including the Technology Evidence Base, the Interactive Interface and the Marketplace, will be integrated into a common online system, which will be giving open or limited access to certain data categories.

Additionally, datasets produced by the NextGen project will be interoperable allowing data exchange and reuse. All systems will be user friendly, well documented and unless otherwise specified openly accessible. The NextGen project will follow established European metadata vocabularies, standards and methodologies.

NextGen encourages project partners to store datasets produced in open research repositories (i.e. Zenodo) and obtain Digital Object Identifiers (DOIs), including the baseline data that have been collected for all the 10 demo cases as well as the data after implementing the CE technologies and solutions based on the monitoring activities of each case study. Other categories of data produced by this project such as publications and presentations will also be uploaded to Zenodo research repository providing DOIs. The infrastructure of Zenodo has been developed and is supported by CERN which guarantees long term data safety and availability. All open data will remain re-usable for at least five years after the end of the project and maintained by the project partners.

A backup and recovery plan will be developed and established for all NextGen data as it comprises a crucial part of data security. A number of ethics issues have been identified for the execution of NextGen, specifically humans, non-EU countries, data protection and compliance with the GDPR and others. Also, for the purposes of the project and according to the GDPR guidelines specific consent guidelines are practiced and consent forms have been compiled and used.

In conclusion, the benefits of a well-designed DMP not only concern the way data are treated but also the successful outcome of the project itself. A properly planned DMP guides the researchers first to think what to do with the data and then how to collect, store and process them. The process of planning is practically a process of communication, increasingly important in a multi-partner research. The characteristics of collaboration should be accordingly harmonised among project partners from different organisations or different countries.

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Appendix A: Dataset for DMP

1. Data set name and reference	**NextGen_Data_WPx_Tx.x_Name_Vx**				
2. Data set description	**What are the data in the data set about?**				
	Purpose of the data within Fiware4Water project:				
	Potential reuse (to whom it could be useful, future application, etc.)**:**				
	Data type *(select from the list)*:	Select	If "other", specify:		
	How were the data generated? (Experiments, measuring instruments, observation, compilation, simulation, etc.)				
	Partner(s) who generated the data:		Owner partner(s) of the data:		
	File(s) format (.csv .xls .txt .etc) **:**		Estimated volume (in MBs):		
	Is a software required to display and process the data set?	Select	If "yes", is the software available to public?	Select	If "yes", provide the name/link to obtain this software:

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3. Data sharing	**Openness level of the data set** (make a tick mark "x" aside the appropriate of the 3 options (CO, RE, OA) and answer the related questions):	**Confidential Access (CO):** Access limited to the partners and/or EC		If **CO**, specify why (intellectual property, commercial, patenting, privacy-related, legal and contractual restrictions, etc.):			
		Restricted access (RE): Access to limited and identified external entities		If **RE,** specify why (intellectual property, commercial, patenting, privacy-related, legal and contractual restrictions, etc.):			
		Open Access (OA): Data available in an open repository		If **OA** after an embargo period, specify:	*yyyy/mm/dd*		
				If **OA**, specify the repository where the data are available:	Select	If "other" repository, specify:	
				If **OA**, do any standards apply for metadata definition for this data set?	Select	if "yes", specify:	If "no", ZENODO metadata (or similar) will apply
				If **OA**, which licence do you want to attribute to your dataset? (select from the list):	Select	If "other", specify:	
	Do the data in the dataset underlie scientific publication(s)?	Select		If "yes", reference of the publication(s) (title, journal):			
	Are the data or part of the data in the dataset available in NextGen deliverable(s)?	Select		If "yes", is/are the deliverable(s) public?	Select	Number and name of the deliverable(s)	

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4. Archiving, preservation and security	**Data of the dataset to be preserved after the end of the project:**	Select	If "part of data" or "none", please specify why and which part are to be preserved						
		Recommended preservation period after the end of the project:	Select	If "longer period", define:		Preserved data estimated volume (in MBs):			
		Where this dataset will be stored?	Select	Select	Select	If "other", specify:			
	Costs for archiving / storage:	Do you foresee costs for storage?	Select	How will these costs (if any) be covered?	Select	If "Other", specify:			
	Note: *- All items deposited on ZENODO will be archived and retained for the lifetime of the repository (at least for the next 20 years).* *- All items deposited on Fiware4Water website will be archived and retained for the lifetime of the website (5 years after the end of the project).*								
	Describe provisions for data security *(in particular in case of data underlying patent, etc.)*:								
	Information concerning sensitive data *(if applicable)*:								

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Appendix B: Zenodo Research Data Repository

The Zenodo Research Data Repository is recommended as data repository by the EC and is funded by the EC (via the OpenAIRE projects), CERN and donations. It is hosted by CERN, embedded in its IT department.

The Zenodo platform allows the deposition of all kinds of digital content: publications, dataset, software, multimedia etc. The types of content are illustrated in the table below.

1. Type of content	
	☐ Publication
	☐ Poster
	☐ Presentation
	☐ Dataset
	☐ Image
	☐ Video/Audio
	☐ Software
	☐ Lesson
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Additionally, all published data are provided with a Digital Object Identifier (DOI). The datasets once they are published, they remain fixed over their lifetime, whereas metadata can change. Basic information with regard to the DOI and the publication are illustrated in the table below.

2. Basic information	
	Digital Object Identifier (DOI) *Did your publisher already assign a DOI to your upload?* *If yes, indicate at in the box aside.* *If not, ZENODO will automatically register a new DOI for your upload. A DOI allows others to easily and unambiguously cite your upload.*
	Publication Date *
	Title *
	Authors *
	Name
	Description * *Describe the document that will be uploaded on ZENODO.* *If the document uploaded is a dataset, specify the related publications if there are. Also explain how the dataset uploaded can be reused by others.*
	Version
	Language
	Keywords *
	Additional notes

Finally, it is possible to have various access levels as illustrated in the table below. The

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Commission's approach is: “As open as possible, as closed as necessary”.

3. Licence

Select the access rights properties of your upload by ticking the relevant box.
If relevant, complete the column at the right.

Access rights		Details
Open access	☐	Creative Commons Attribution 4.0
If yes, select a license in the right column	☐	Creative Commons Attribution
	☐	Creative Commons Attribution – Non-commercial 4.0
	☐	Creative Commons Attribution – Non-Commercial – No Derivatives
	☐	Creative Commons Attribution Share –Alike 4.0
Embargoed Access	☐	YYYY-MM-DD
If an embargoed access is applicable, indicate in the right column the date when your upload will be made publicly available and its license.	☐	Creative Commons Attribution 4.0
	☐	Creative Commons Attribution – No Derivatives
	☐	Creative Commons Attribution – Non-commercial 4.0
	☐	Creative Commons Attribution – Non-Commercial – No Derivatives
	☐	Creative Commons Attribution Share –Alike 4.0
		For more information: http://opendefinition.org/od/2.1/en/
Restricted Access	☐	*Specify the conditions under which you grant users access to the files in your upload. User requesting access will be asked to justify how they fulfil the conditions. Based on the justification, you decide who to grant/deny access. You are not allowed to charge users for granting access to data hosted on Zenodo.*
Closed Access	☐	

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Appendix C: Consent Form for Publishing Data

CONSENT FORM

Title of Project: **NextGen: Towards the Next Generation of Water Systems and Services for the Circular Economy**

Researcher in charge: **[Name/Affiliation]**

In the context of NextGen, it is expected that most of the data produced or collected in the framework of the project will be openly accessible (refer to D7.1_Data Management Plan).

The data will be made available online through the WWW service. Thus, in order to discover, visualize or download the data only a common browser will be required from the user. The format of downloadable files will be (solely or additionally) in an open standard such as CSV and PDF. Tools to access these files will be freely available in the internet.

With this consent form, I agree to allow researchers of the NextGen project to publish the baseline data that I have provided for D1.1 via the open data web, the Zenodo Research Data Repository.

Thank you for your cooperation!

Name & e-mail of researcher	Date	Signature

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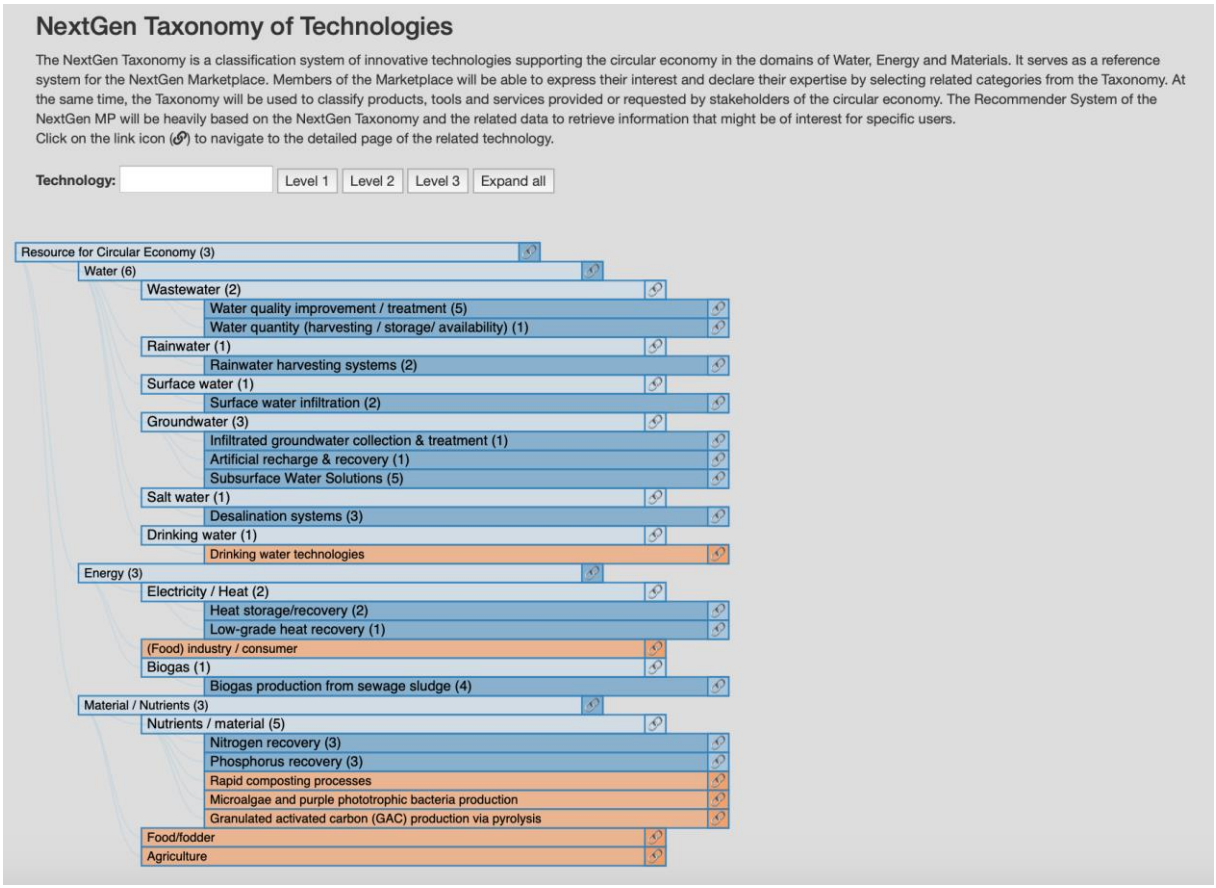
Appendix D: Taxonomy of technologies



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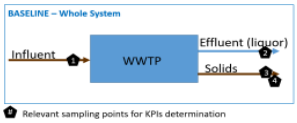
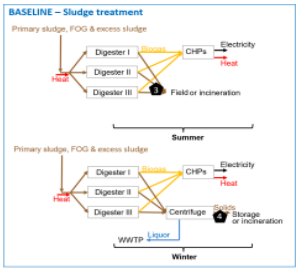
Appendix E: Case study baseline & NextGen system

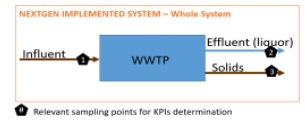
A) Material element

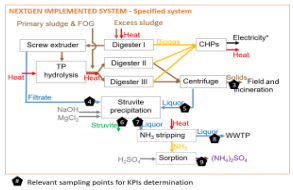
SHORT SITE DESCRIPTION
In Braunschweig, the NextGen technologies for material recovery comprise: a thermal pressure hydrolysis between the digestion stages, (3) struvite production for the ammonium sulfate solution production unit. In terms of nutrient recovery, the relevant KPI's are: (1) the nitrogen recovery rate related to the (a) the effluent to the WWTP and (b) the effluent to the recovery unit [%], (2) the phosphorus recovery rate related to the (a) the effluent to the WWTP and (b) the effluent to the recovery unit [%]. In order to determine those KPIs, the following parameters (within each analyzed) in the sources of the project.
Not all data are required; only the data that are currently available
Notes: "Whole system" means the global system in which the NextGen circular economy solution will be integrated (e.g. WWTP) "Specified system" means the part of the whole plant with the CE NextGen technologies/solutions (e.g. nutrient recovery units).





BASELINE - CURRENT SYSTEM											
Parameter		Sampling point			Units	Mean	Min	Max	Standard deviation	Frequency and number of measurements	Comments
Flow rates	Wastewater to the WWTP	#1	Flowrate		m^3/a	10.685.200	9.561.080	12.302.960	1.193.865	yearly average values of 6 years (2013-2018)	2013-2018
	Effluent from WWTP	#2	Flowrate		m^3/a	10.130.850	8.900.500	12.245.600	1.446.054	yearly average values of 6 years (2013-2018)	2013-2018
	Summer: Digestate to field	#3	Massflow		m^3/a	17.525	5.374	33.810	14.499	yearly average values of 6 years (2013-2018)	In Summer, the digestate is directly applied in the field without further dewatering
	Winter: Solids from WWTP to Storage -> field	#4	Massflow		t/a	1.305	1.274	1.336	41	yearly average values of 2 years (2017-2018) since incineration is in operation	2017-2018
	Summer & Winter: Solids from WWTP to Incineration	#3 & #4	Massflow		t/a	1.388	1.677	1.099	1.005	yearly average values of 2 years (2017-2018) there was no operation before	2017-2018
N- & P-concentrations & TS and VS contents	Wastewater to the WWTP (= the primary filtrate, = after land trap	#1		TP	mg(P)/l	11	9	12	1	yearly (average) values of (8) years	2013-2018
				TN	mg(N)/l	74	67	79	4	yearly (average) values of (8) years	2013-2018
				Filterable substances	mg/L	277	233	327	34	yearly (average) values of (8) years	2013-2018
				COD_{tot}	mg/L	778	684	836	55	yearly (average) values of (8) years	2013-2018
				COD_{filt}	mg/L	401	361	438	26	yearly (average) values of (8) years	2013-2018
				TS_{tot}	mg/L	544	474	596	40	yearly (average) values of (8) years	2013-2018
				VS_{tot}	%TS	95	92	99	3	yearly (average) values of (8) years	2013-2018
	Effluent from WWTP	#2		TP	mg(P)/l	0,7	0,54	0,83	0,11	yearly (average) values of (8) years	2013-2018
				TN	mg(N)/l	12	10	14	1	yearly (average) values of (8) years	2013-2018
				Filterable substances	mg/L	11	8	19	4	yearly (average) values of (8) years	2013-2018
				COD_{tot}	mg/L	42	37	46	3	yearly (average) values of (8) years	2013-2018
				COD_{filt}	mg/L	33	31	35	1	yearly (average) values of (8) years	2013-2018
				TS_{tot}	mg/L	33	28	42	5	yearly (average) values of (8) years	2013-2018
				VS_{tot}	%TS	85	65	91	10	yearly (average) values of (8) years	2013-2018
	Summer: Digestate to field	#3		TP	g(P-O_4)/l (kgTS)	75	71	79	3	yearly (average) values of (8) years	2013-2018
				TN	g(N)/l (kgTS)	75	66	97	12	yearly (average) values of (8) years	2013-2018
				TS	%	2,6	2,4	3	0,2	yearly (average) values of (8) years	2013-2018
				VS	%TS	70	69	71	1	yearly (average) values of (8) years	2013-2018
	Winter: Solids from WWTP to Storage -> field	#4		TP	g(P-O_4)/l (kgTS)	75	75	75	0	yearly (average) values of (2) years	2017-2018
				TN	g(N)/l (kgTS)	59	58	60	1	yearly (average) values of (2) years	2017-2018
				TS	%	24	23	24	0,3	yearly (average) values of (2) years	2017-2018
				VS	%TS	70	69	70	1	yearly (average) values of (2) years	2017-2018
	Summer & Winter: Solids from WWTP to Incineration	#4		TP	g(P-O_4)/l (kgTS)	75	75	75	0	yearly (average) values of (2) years	2017-2018
				TN	g(N)/l (kgTS)	59	58	60	1	yearly (average) values of (2) years	2017-2018
				TS	%	24	23	24	0,3	yearly (average) values of (2) years	2017-2018
				VS	%TS	70	69	70	1	yearly (average) values of (2) years	2017-2018





NEXTGEN IMPLEMENTED SYSTEM										
Parameter		Sampling point		Units	Mean	Min-Max		Standard deviation	Frequency and number of measurements	Comments
Flow rates	Wastewater to the WWTP	#1	Flowrate	m^3/a						
	Effluent from WWTP	#2	Flowrate	m^3/a						
	Solids from WWTP to field	#3	Massflow	m^3/a						
	Solids from WWTP to incineration	#3	Massflow	m^3/a						
	Filtrate from Screw extruder to the struvite reactor	#4	Flowrate	m^3/d						
	Liquor from centrifuge to the struvite reactor	#5	Flowrate	m^3/d						
	Struvite production	#6	Production Rate of the recycle	kgTS/d						
	Liquor from struvite reactor	#7	Flowrate	m^3/d						
	Liquor from the NH_3 stripping unit	#8	Flowrate	m^3/d						
	Ammonium Sulfate solution production	#9	Production Rate	m^3/d						
N- & P-concentrations & TS and VS contents	Wastewater to the WWTP	#1		TP	mg(P)/l					
				TN	mg(N)/l					
				TS	mg/L					
				VS	%TS					
	Effluent from WWTP	#2		TP	mg(P)/l					
				TN	mg(N)/l					
				TS	mg/L					
				VS	%TS					
	Solids from WWTP	#3		TP	g(P)/l (kgTS)					
				TN	g(N)/l (kgTS)					
				TS	%					
				VS	%TS					
	Filtrate from Screw extruder to the struvite reactor	#4		TP	g(P)/l					
				TN	g(N)/l					
				TS	%					
				VS	%TS					
	Liquor from centrifuge to the struvite reactor	#5		TP	g(P)/l					
				TN	g(N)/l					
				TS	%					
				VS	%TS					
	Struvite production	#6		TP	g(P)/l (kgTS)					
				TN	g(N)/l (kgTS)					
				TS	%					
				VS	%TS					
	Liquor from struvite reactor	#7		TP	g(P)/l					
				TN	g(N)/l					
				TS	%					
				VS	%TS					
	Liquor from the NH_3 stripping unit	#8		TP	mg(P)/l					
				TN	mg(N)/l					
				TS	%					
				VS	%TS					
	Ammonium Sulfate solution production	#9		TN	kg(N)/l					
				TS	%					
				VS	%TS					

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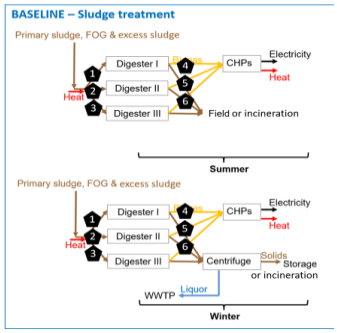
B) Energy element

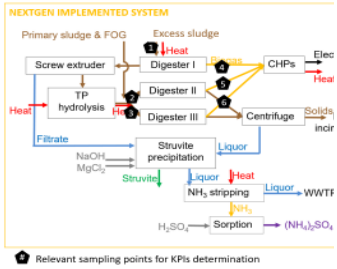
SHORT SITE DESCRIPTION
In Braunschweig, the NextGen Technologies for Energy Recovery comprise: a two-stage digestion system including thermal pressure hydrolysis between the two digestion stages. In thermal energy recovery, the relevant KPIs are: the methane yield of both digesters. In order to determine those KPIs, the following parameters will have to be analysed in the course of the project.

Not all data are required; only the data that are currently available

Notes:
"Whole system" means the global system in which the NextGen circular economy solution will be integrated (e.g. WWTP)
"Specified system" means the part of the whole plant with the CE NextGen technologies/solutions (e.g. nutrient recovery units).

BASELINE - CURRENT SYSTEM										
Parameter		Sampling point		Units	Mean	Min	Max	Standard deviation	Frequency and number of measurements	Comments
Parameters	Digester II	#1	Organic Loading Rate to Digester II	kgVS/(m³·d)	0.900	0.600	0.900			
		Digester 1	Digester Volume	m³	1 000	1 000	1 000			
		#4	Gas Production Rate	Nm³/h	2.20	1.50	3.10	0.20	continuous flow measurement	2013-2018
		#4	Methane Content	%	60.0	60.0	61.0	0.5	continuous flow measurement	2017-2018
		Calculated	Methane Yield	Nm³CH₄/(kgVS)	0.210	0.120	0.270			
	Digester II	#2	Organic Loading Rate to Digester II	kgVS/(m³·d)	0.40	0.40	0.60	0.03		
		Digester II	Digester Volume	m³	4 500	4 500	4 500			
		#5	Gas Production Rate	Nm³/h	1.40	1.20	3.00	0.10	continuous flow measurement	2013-2018
		#5	Methane Content	%	60.0	60.0	62.0	0.5	continuous flow measurement	2017-2018
		Calculated	Methane Yield	Nm³CH₄/(kgVS)	0.320	0.190	0.500			
	Digester III	#3	Organic Loading Rate to Digester III	kgVS/(m³·d)	0.400	0.400	0.600	0.900		
		Digester III	Digester Volume	m³	4 500	4 500	4 500			
		#6	Gas Production Rate	Nm³/h	1.30	1.20	3.10	0.03	continuous flow measurement	2013-2018
		#6	Methane Content	%	61.0	61.0	61.0	0	continuous flow measurement	2017-2018
		Calculated	Methane Yield	Nm³CH₄/(kgVS)	0.240	0.158	0.290			
	All		Total Organic Loading Rate	kgVS/(m³·d)	0.450	0.400	0.900			
		Digesters	Digester Volumes	m³	1.0000	1.0000	1.0000			
			Gas Production Rate of All Digesters	Nm³/h	1.700	1.130	1.62	0.20	continuous flow measurement	2013-2018
			Methane Content	%	61.0	61.0	61.0	0.5	continuous flow measurement	2017-2018
		Calculated	Methane Yield	Nm³CH₄/(kgVS)	0.268	0.218	0.248			
WITH IMPLEMENTED NEXTGEN SYSTEM										
Parameters	Digester III (1st stage)	#1	Organic Loading Rate to Digester II	kgVS/(m³·d)						
		Digester 1	Digester Volume	m³						
		#4	Gas Production Rate	Nm³/d						
		#4	Methane Content	%						
		Calculated	Methane Yield	Nm³CH₄/(kgVS)	#DIV/0!					
	Digester II (2nd stage)	#2	Organic Loading Rate to Digester II	kgVS/(m³·d)						
		Digester II	Digester Volume	m³						
		#5	Gas Production Rate	Nm³/d						
		#5	Methane Content	%						
		Calculated	Methane Yield	Nm³CH₄/(kgVS)	#DIV/0!					
	Digester III (2nd stage)	#3	Organic Loading Rate to Digester III	kgVS/(m³·d)						
		Digester III	Digester Volume	m³						
		#6	Gas Production Rate	Nm³/d						
		#6	Methane Content	%						
		Calculated	Methane Yield	Nm³CH₄/(kgVS)	#DIV/0!					





Relevant sampling points for KPIs determination

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C) Water element

SITE DESCRIPTION: Athens (EL)		
Objectives	**Metodologies**	**Technologies**
Produce water from urban wastewater with a sewer mining modular unit for urban green irrigation, agricultural irrigation and non-potable uses (cleaning, fire protection) if wastewater treatment with membrane bioreactor and disinfection)	Coverage of water demand with purified wastewater. The parameters to be measured in the water produced by the sewer mining unit are presented below: TSS (mg/L), COD (mg/L), BOD5 (mg/L), TP (mg/L), TN, NH4-N+ (mg/L), EC (mg/L), Turbidity (NTU), Total Coliforms (cfu/100ml), Faecal Coliforms (cfu/100ml), E.Coli (cfu/100ml)	Sewer mining modular unit (membrane bioreactor and disinfection)

Not all data has to be filled out; only the data that you have at the moment

Notes:
- Mean value corresponds to average of minimum one year of data (*e.g.* 2018 data, if possible)
- Please, if you consider it, insert an Excel file with the most relevant data (or upload the file in the sharepoint)

NextGen Athens Pilot system

Parameter			Units	Mean value for 2018	Standard deviation	Frequency of the measurements	Summer mean value	Standard deviation	Winter mean value	Standard deviation	Considered years for the analysis	Comments
Water yield of the system	Influent to the current sewer mining modular unit (MBR & disinfection)	Flowrate	m^3/d	25								
	Effluent from the current sewer mining modular unit (MBR & disinfection)	Flowrate	m^3/d	25								
Water quality	Influent to the sewer mining modular unit (MBR & disinfection)	COD	mgO_2/l	531	114							
		BOD_5	mgO_2/l	253	74							
		pH	upH	7,5	0,5							
		CE	mS/cm									
		TSS	mg/l	247	78							
		Turbidity	NTU									
		Total nitrogen	mgN/l	116	16							
		N-NH4+	mgN/l	90	5							
		Total phosphorus	mgP/l	12	1							
		Other										
		Other										
	Effluent from the sewer mining modular unit (MBR & disinfection)	COD	mgO_2/l									
		BOD_5	mgO_2/l									
		pH	upH									
		CE	mS/cm									
		TSS	mg/l									
		Turbidity	NTU									
		Total nitrogen										
		N-NH4+	mgN/l									
		Total phosphorus	mgP/l									
		E.coli	CFU/100ml									
		Total Coliforms	CFU/100ml									
		Faecal Coliform	CFU/100ml									
		Other										
		Other										
Energy consumption	Current sewer mining modular unit (MBR & disinfection)	MBR	kWh/m^3									
		Disinfection treatment	kWh/m^3									
		Other										
		Other										
Reagents & materials required	Current sewer mining modular unit (MBR & disinfection)	Nutrients	g/m^3									
		Anticscaling agents	g/m^3									
		Disinfection agents	g/m^3									Which ones?
		Other										
		Other										
Waste produced	Current sewer mining modular unit (MBR & disinfection)	Sludge produced	g/m^3									
		Membranes	m^2/m^3									Type of membranes used m^3 of changed membrane per m^3 of treated water
		Other										
		Other										
		Other										

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