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Abbreviations and Acronyms

BOD	Biochemical Oxygen Demand
BSP	Bio-Solar Purification
CoA	Certificate of Authorisation
cBOD	Carbonaceous Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DOA	Description of Activities
ELV	Emission Limiting Value
EPA	Environmental Protection Agency
GUI	Graphical User Interface
MLSS	Mixed Liquor Suspended Solids
NH ₄	Ammonium
NH ₃	Ammonia
IOT	Internet of Things
(T)N	(Total) Nitrogen
PE	Population Equivalent
SS	Suspended Solids
MCU	Monitoring and Control Unit
TMM	Technology Maintenance Module
UV	Ultra Violet

Executive Summary

Contaminated water from inadequate waste water management poses one of the greatest health challenges as it restricts social and economic development, increases poverty through costs to health care and endangers the environment (UNEP, 2010).

The aim of the INNOQUA Project is to progress, towards commercialisation, the development of a fully ecological modular sanitation system that integrates individual low cost, sustainable and biologically based technologies. The system will offer flexible waste water treatment solutions to suit a variety of target markets in developed and developing countries.

This report, Deliverable 2.1 (D2.1), is the first from the Project's Work Package (WP) 2 – Technical Specifications and Technology Optimisation - and is one of the first technical reports of the Project. The aim of the report is to define the standard for the performance expectations of the integrated INNOQUA system as well as the requirements for its maintenance and shut-down prevention. The optimum operational parameters of the individual INNOQUA technologies are well described to serve as a guide for the early model design in WP3. The details of the project's 13 proposed demonstration sites and details the expected waste water effluent physical, chemical and microbiological characteristics and the local requirements for its treatment. The report also presents details of the proposed waste water reuse at the demonstration sites and describes the related specification for the proposed reuse.

The particular requirements in terms of effluent quality at the demonstration sites will serve to define the minimum efficiency of the INNOQUA system. In general, there is good consistency, with some notable exceptions, in terms of the physical, chemical and microbial regulatory requirements for treated waste water effluent to be discharged from the demonstration sites.

The requirements with respect to reuse of treated waste water are far less comprehensive and non-existent in a number of demonstration sites. Water reuse is proposed at six of the demonstration sites and regulation is available at just three of these. A key element in the waste water reuse regulation is intended reuse purpose and it was found that there is little consistency in defining intended reuse purpose in different countries to allow comprehensive comparison.

This document, presents the required specifications in term of available standards to inform the developing INNOQUA system.

Some of the key information points highlighted within this report include the following:

- There is an absence of regulation in some demonstration site countries with regard to the reuse of treated waste water. Thus alternative, equivalent standards in other countries may need to be considered;
- Significant variation in expected organic loading from domestic waste water expected at the demonstration sites with particularly high organic loads expected at some locations;
- The treatment of agricultural waste water due to its high organic load will require careful consideration
- The presence of pathogens, which can be resistant to some forms of disinfection at the demonstration sites;

- Potential contamination from cholera and amoebae outbreaks identified in Africa
- The possibility of power interruptions at demonstration sites;
- The limited data connectivity at a number of demonstration sites;
- The requirement/preference at some of the demonstration sites that the system be below-ground.

In addition, the country-specific environmental and infrastructural factors that have been identified represent real life target characteristics for various markets that a developing system should seek to accommodate. Although beyond for the original scope of this deliverable, this country-specific data and its subsequent assessment in relation to INNOQUA were included here at this early project stage to better inform the emerging system design.

1 Introduction

The aim of the INNOQUA Project is to progress, towards commercialisation, the development of a fully ecological sanitation solution that integrates individual low cost, sustainable and biologically based technologies. The INNOQUA Project commenced in June 2016 (M01) and this report, Deliverable 2.1 (D2.1), is the first from the Project's Work Package (WP) 2 – Technical Specifications and Technology Optimisation and is one of the first technical reports of the Project.

1.1 Work Package 2 Objectives

The goal of WP2 is firstly to define as comprehensively as possible, early on, technical, logistical and performance requirements of the individual INNOQUA technologies that will combine to be an integrated modular solution. The requirements will inform the development of a robust early model from which future the prototype design and development will evolve. Ultimately, the goal of WP2 is to satisfy Project Milestone MS1 in defining the System Specifications and Requirements. The Project Milestones, Deliverables and Work Packages are fully described in Annex 1 (Part A) of the European Commission Grant Agreement Number – 689817- INNOQUA Description of Activities (DOA) documentation (European Commission, 2016).

1.2 The Role of Deliverable D2.1

The goal of D2.1 is to provide a comprehensive report of the requirements from each of the demonstration sites with respect to effluent standards and operational parameters and the technology providers with respect to optimum conditions and infrastructure. In addition, to present the results of the team's initial work in defining key contributors to the development of an integrated design solution for the system. D2.1 will serve as a record of the design framework to inform later iterations. D2.1 presents the output from Project Tasks T2.1 and T2.2;

- T2.1 Expected Quality of the Effluent
- T2.2 Maintenance, shut-down prevention and restart of microbiological activity requirements

1.3 Relationship with other Activities in the Project

As one of the first technical reports of the project, this deliverable has a pivotal role in the technical development of the INNOQUA integrated system and by providing the framework for the early model system specification. Figure 1-1 below outlines the interaction between WP2 deliverables (and other Work Packages).

D2.1 provides the physico-chemical and microbiological targets the INNOQUA integrated system will aim to achieve. In the framework of WP2, this provides the basis for defining the engineering and structural specifications of the emerging system (D2.2). At the end of WP2, D2.3 will finally provide

all the requirements for the development of an early model (to be developed in WP3) which will answer market needs (identified in WP1). All this work will inform WP4 which will aim at testing the system and WP5 which will demonstrate the system in its real environment. WP6 and WP7 are “global” focusing respectively on Exploitation and Dissemination/Communication.

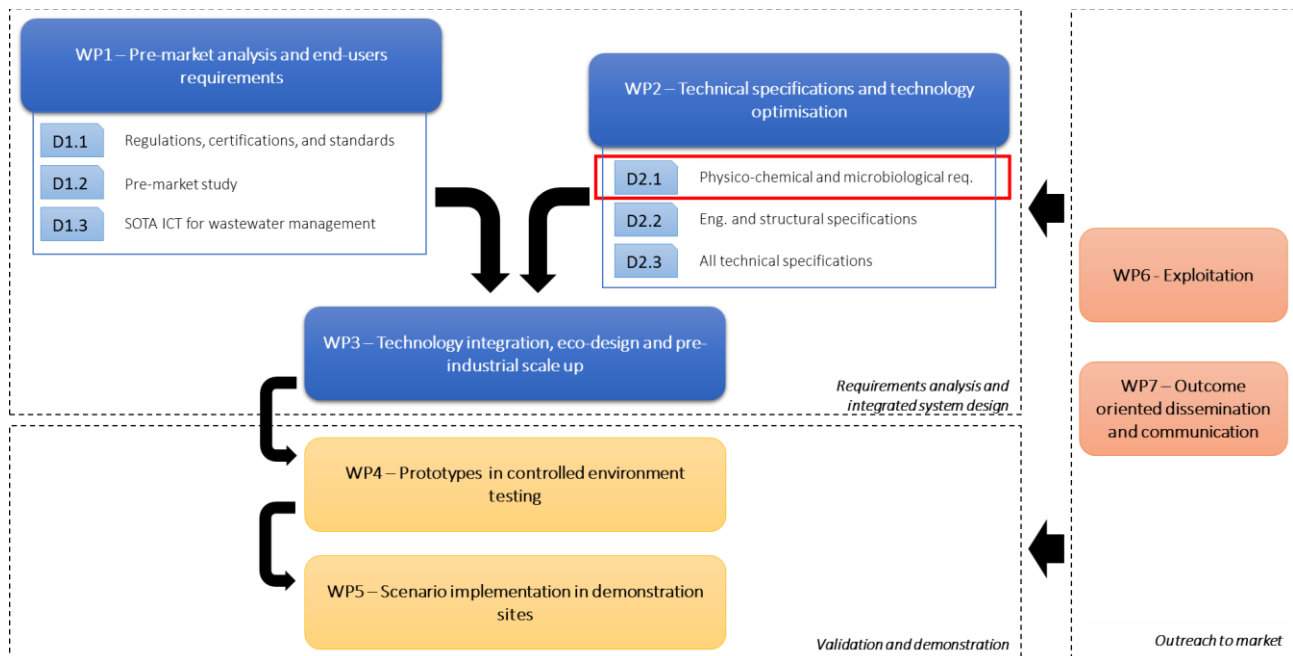


Figure 1-1 Links between Work Packages

1.4 Approach to the Development of D2.1

To progress the development of Project Tasks T2.1 and T2.2, NUIG prepared a number of templates to facilitate the collection of data relating to the following in a standardized way;

- The Characteristics of the Demonstration Sites;
- The Expected Environmental Loading and Effluent Requirements at each of Demonstration Sites;
- The Technology Requirements for the four INNOQUA Technologies.

The spreadsheets templates were uploaded to the Project Emdesk in M03 and relevant partners requested to complete these. Weekly WP2 meetings commenced in M04.

1.5 Document Outline

In line with the requirements of the DOA, WP Descriptions, this report undertakes the following;

- Documents the expected physico-chemical and microbiological characteristics of wastewater to be treated at each of the 13 project demonstration sites;
- Details the relevant wastewater discharge regulations and associated requirements for each of the 13 project demonstration sites and their representative markets;
- Presents a brief description of the individual technologies that will integrate to form the

integrated INNOQUA system and their expected efficiency, describing the maintenance and shut-down prevention requirements for each;

- Reviews the objectives with respect to the efficiency of the integrated INNOQUA system as well as the likely maintenance, shut-down prevention and restart of microbiological activity requirements.

In particular, this document provides key information to inform the integrated INNOQUA Technology in the following Chapters;

Chapter 2 Expected Wastewater Characteristics at INNOQUA Demonstration Sites details typical characteristics at each of the proposed demonstration sites from climatic conditions to site access arrangement as well as describing the chemical, physical and microbial parameters of waste water expected at the sites;

Chapter 3 Effluent Requirements at the INNOQUA Demonstration Sites describes the chemical, physical and microbial requirements of treated waste water to be discharged at the sites as well as the requirements where they exist in the demonstration site country for treated waste water that is to be reuse; This Chapter also presents regulations for the reuse of treated waste water from a number of countries where such legislation has been comprehensively developed and that will serve as a reference for reuse standards in the absence of such in a country where reuse is proposed at the demonstration site.

Chapter 4 INNOQUA Technologies outlines details of each of the four individual INNOQUA Technologies in terms of their reported removal efficiency, specific maintenance requirements, measures to prevent shut-down and factors effecting the re-start of microbial activity following restart.

Chapter 5 Towards an Integrated INNOQUA System presents the likely efficiency objectives as defined by the demonstration sites, where such information has been made available, and the reported removal efficiencies offered by the four individual INNOQUA Technologies. Consideration of the requirements of the individual technologies in terms maintenance requirements, measures to prevent shut-down and factors effecting the re-start of microbial activity following restart in terms of the integrated technology is also provided in Chapter 5.

2 Expected Wastewater Characteristics at INNOQUA Demonstration Sites

2.1 Introduction

The INNOQUA demonstration sites were selected to represent the diversity of end-use environments of the integrated technology. For ease of reference, the demonstration sites as described in the DOA are listed below in Table 2-1. Specific information relating to the characteristics of each demonstration site was provided by the INNOQUA Demonstration Site Partners and this is given in Appendix A. The importance of this information is described in Section 2.3 following.

Relevant characteristics of wastewater to be considered at each of the demonstration sites are outlined in Section 2.4 below and the site specific expected wastewater characteristics are given in Appendix B.

2.2 The Demonstration Sites

The 13 demonstration sites are listed in Table 2-1 below, 11 of these are fully operational sites and 2 are in controlled conditions to allow the validation of the performance of the prototype system. A brief description of the particular application environment represented by each of the INNOQUA demonstration sites is also given. The demonstration sites represent a variety of scenarios and environments and therefore potential markets for the INNOQUA system as well as providing particular real world challenges in which to prove the technology and inform design development.

Table 2-1 INNOQUA Demonstration Sites

Ref	Country	Partner	Conditions	Application	Description
1.	Ireland	NUIG	Controlled	Performance Validation	Research Facility
2.	Spain	UDG	Controlled	Performance Validation	Research Facility
3.	Ireland-Agri	NUIG	Operational	Industrial - Farming	Dairy and Cattle Farm
4.	France	LBT	Operational	Industrial – Aquaculture	Aquaculture Facility
5.	Italy	DE5	Operational	Domestic	1 Unit Domestic House
6.	France	NBK	Operational	Domestic-Commercial	Offices
7.	UK-Scotland	SW	Operational	Domestic	13 Unit Domestic Housing Complex (Detached)

8.	Turkey	EKO	Operational	Domestic	8 Unit Domestic Housing Complex (Detached) & Office/Support House
9.	Romania	RITMIC-ECOIND	Operational	Domestic-Commercial	Tourist Pension for 13 persons and Restaurant (100 cap)
10.	Ecuador	GYA-UCU	Operational	Domestic	Residential Apartment Complex – 4 apartments 350 sqm gfa
11.	Peru	CUSM	Operational	Domestic-Educational	Classrooms at CUSM
12.	Tanzania	BORDA	Operational	Domestic-Educational	Domestic Housing Units/Training Centre (30 persons)
13.	India	BORDA	Operational	Domestic Units	Domestic Housing Units

 Prototype Demonstration Sites

2.3 Demonstration Site Characteristics

Details of the physical, geographical and infrastructural characteristics of each of the demonstration sites have been provided by each of the Demonstration Site Partners for their site and this information is presented in Appendix A.

Details of the demonstration site characteristics were collated with reference to the following;

Contacts

Details of responsible persons at the demonstration site and those to be contacted in the event of a breakdown complaint or unexpected occurrence are important considerations for the operational stage. In addition, whether the site remote and unmanned or is generally occupied is relevant to access and maintenance.

Location Geography and Climate

The climatic conditions of the demo sites are important considerations and will directly affect the operation of some of the INNOQUA Technologies. The geographic location of the demo sites is an important consideration in arranging the delivery of the INNOQUA system. It is likely that the systems will be transported by cargo ship and road to the demonstration sites.

Planning and Regulation

The existing use of the site and the associated planning permissions should be reviewed to ensure that the installation of the INNOQUA system is compliant with existing planning and other local regulation.

Site Access

This is an important consideration for both the initial access for installation and also the ongoing for on-site inspection and test monitoring.

Services

The availability of electricity, data connectivity and/or telephone communication is critical to the identification of suitable monitoring and control infrastructure for the demo sites.

Preliminary Design of Installation

Demonstration Site Partners are prompted to consider preliminary design aspects such as initial layouts and whether the units will be installed above or below ground. This information will help to inform the developing design and highlight likely issues that should be addressed at an early stage in the project in particular in relation to planning and regulation or that may impact on a design assumption such as access or utilities.

2.3.1 Summary

A summary of key characteristics of the demonstration sites are given in Table 2-2 to Table 2-4 below.

Table 2-2 Climatic Conditions at Demonstration Sites

Ref	Demo Site Country	Min Temp (observed) (°C)	Max Temp (observed) (°C)	Annual Rainfall (mm)	Average Rainfall in Wettest Month (mm)
1.	Ireland	-7.9	25.6	1,400	350 (Dec/Jan)
2.	Spain	5	26	737	110 (Oct)
3.	Ireland-Agri	-7.9	25.6	1,400	350 (Dec/Jan)
4.	France	-0.5	26.6	697	73 (May)
5.	Italy	0.3	37	697	73 (Oct)
6.	France-NBK	5	27	1,200	120 (Nov)
7.	UK-Scotland	-10	25	750	76 (Oct)
8.	Turkey	-24	41	669	89 (Oct)
9.	Romania	-30	32	600	100 (June)
10.	Ecuador	9	21	1,013	149 (Apr)
11.	Peru	5	27	95	40 (Feb)
12.	Tanzania	18	32	1,145	270 (April)
13.	India	20	38	839	241 (Sept)

The extremes in climatic conditions (see Table 2-3) that are likely to be experienced at some of the demonstration sites, while providing robust test environments representative of the target markets, may have implications for some of the INNOQUA Technologies and present particular operational challenges to be overcome.

In particular, extreme lows in temperature of between -10° and -30° Celsius degrees that may be experienced in Scotland, Romania and Turkey will cause freezing of water and without preventative measures, such as insulation or sufficient buried depth, will likely impact negatively the microbial activity. Similarly extreme highs in temperature of up to 38° to 41° Celsius degrees that may be experienced in Romania or India need to be considered as they represent operational and design challenges.

The high levels of rainfall (>1,000 mm per annum.) experienced in a number of the demonstration sites will likely impact the influent concentrations especially in locations where a combined sewerage

system exists. In addition, intense rainfall events such as those typical of tropical climates, may have the potential to intensify such issues.

Table 2-3 Power and Communication at Demonstration Sites

Ref	Demo Site Country	Electricity (Voltage) Proximity	Regular Power Interruption	Mobile Data	Fixed Data	Telephone Line
1.	Ireland	230v (Onsite)	No	3G	No	No
2.	Spain	TBC* (50m)	-	-	-	-
3.	Ireland-Agri	230v (Onsite)	No	3G	No	No
4.	France	230v (Onsite)	No	3G	Yes	Yes
5.	Italy	380v (20m)	No	3G	Yes	Yes
6.	France-NBK	220v (10m)	No	3G, 4G, GPRS	Wireless broadband, Yes	Yes
7.	UK-Scotland	230v /110v (5m)	TBC	GPRS	No	No
8.	Turkey	380v (Onsite)	No	3G, 4G	Yes	No
9.	Romania	380v /220v AC (Onsite)	No	4G	Yes	Yes
10.	Ecuador	110v/220v (Onsite)	No	3G	Wireless Broadband	Yes
11.	Peru	220v (50m)	TBC	Yes	Yes	Yes
12.	Tanzania	220v (50m)	Yes	3G, 4G	No	No
13.	India	240v (3.5m)	Yes	Yes	Yes	Yes

* To be confirmed (TBC)

The availability and consistency of energy and data connectivity i.e. linkage to the internet are considerations for any emerging design. Table 2-3 summarises some of the key related aspects at the demonstration sites. Based on Table 2-3, consideration of employing solar pumping solutions and onsite generators as well as local data storage are necessary.

Table 2-4 Site Setup Details

Ref	Demo Site Country	Occupancy of Site	Nearest Urban Centre	Urban Centre Proximity	Access Road	Unit Surface/Buried
1.	Ireland	Unmanned	Tuam	2 km	Good	Surface
2.	Spain	Unmanned	Girona	9 km	Good	Surface
3.	Ireland-Agri	Unmanned	Tuam	2 km	Good	Surface
4.	France	Manned	La Canourgue	4 km	Good	Surface
5.	Italy	Manned	Pescara	76 km	Poor/ Narrow	Buried
6.	France-NBK	Manned	Anglet	2 km	Good	Pref. Buried
7.	UK-Scotland	Unmanned	Narin	8 km	Good	Surface
8.	Turkey	Manned	Sinop	27 km	Good	Buried
9.	Romania	Manned	Suceava	15 km	To be constructed	Buried
10.	Ecuador	Manned	Quito	0 km	Good	Surface
11.	Peru	Manned	Hunter	4 km	Good	Pref. Buried
12.	Tanzania	Manned	Dar es Salaam	0 km	Good	TBC
13.	India	TBC	Bangalore	25 km	Good	Both Possible

Factors to help identify maintenance and initial access logistics at the demonstration sites are summarised in

Table 2-4 Table 2-4 The demonstration sites represent typical conditions and requirements in target markets. The road linkage with the demonstration site in Italy is likely to present some challenges in terms of initial installation. The requirement and/or preference that any system be buried as identified (to date) by five of the demonstration sites is noted and will impact specification of tank design and maintenance activities.

2.4 Expected Wastewater Characteristics

The details of the expected wastewater characteristics at each of the demonstration sites were provided by Demonstration Site Partners and are given in detail in Appendix B. The information was collated by completion by each demonstration site INNOQUA partner an Environmental Loading and Effluent Requirement Spreadsheet for their site. The information is based on average recorded data from the site and supplemented where necessary. The following influent information was collected for each site, in each case an average, maximum and minimum value for each of the following characteristics was collated (Table 2-5);

Table 2-5 Expected Wastewater Influent Characteristics

Parameter	Unit
Average Influent Flow Volume	(m ³ /day)
Population Equivalent	(Number of persons equivalent)
Basis of PE (volumetric)	(m ³ /PE day)
Basis of PE (solid matter)	(mg SS/PE day)
Basis of PE (organic)	(mg BOD ₅ /PE day)
Basis of PE (organic)	(mg COD/PE day)
Basis of PE (total nitrogen)	(mg N/PE day)
Basis of PE (total Kjeldahl Nitrogen)	(mg N/PE day)
Basis of PE (total ammonium-nitrogen)	(mg N/PE day)
Basis of PE (total phosphorous)	(mg P/PE day)
pH	
Water temperature	(°C)
COD concentration	(mg COD/Litre)
BOD ₅ concentration	(mg BOD ₅ /Litre)
Total Nitrogen	(mg N/Litre)
Total Kjeldahl Nitrogen	(mg N/Litre)
Total Ammonium	(mg NH ₄ -N/Litre)
Total Ammonia	(mg NH ₃ -N/Litre)
Total oxidised nitrogen	(mg NO _x -N/Litre)
Total phosphorous	(mg P/Litre)
Total ortho-phosphorous	(mg PO ₄ -P/Litre)

There are often uncertainties due to some factors that may significantly influence the treatment system. The information regarding the nature of these factors was also gathered for each demonstration site. Full details for each site are given in Appendix B.

Table 2-6 Potential Factors Effecting Wastewater Influent Characteristics

Parameter	
1.	Is the site likely to be subject to any variations that will likely impact on the influent (e.g. season issues associated with storm water that might impact on influent composition; industrial discharges; periods of seasonal inactivity – i.e. no influent) If so Describe
2.	Are there likely to be fats, oils and greases present in the influent? If so to what degree
3.	Are there likely to be large solid matter present in the influent? (organic or non-organic)
4.	Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)
5.	Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)
6.	Are there likely to be any specific key pathogens present in the influent?
7.	Is the site likely to be subject to any variations that will likely impact on the influent (e.g. season issues associated with storm water that might impact on influent composition; industrial discharges; periods of seasonal inactivity – i.e. no influent) If so Describe
8.	Are there likely to be fats, oils and greases present in the influent? If so to what degree
9.	Are there likely to be large solid matter present in the influent? (organic or non-organic)
10.	Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)
11.	Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)
12.	Are there likely to be any specific key pathogens present in the influent?

2.4.1 Summary

A summary of key expected wastewater characteristics of the demonstration sites are given in Table 2-7 to Table 2-9 below.

Table 2-7 Expected Influent Loadings at Demonstration Sites

Ref	Country	Average Influent Flow Volume (m ³ /day)	Basis of PE (volumetric) (m ³ /PE day)	Basis of PE (mg SS/PE day)	Basis of PE (organic) (mg BOD ₅ /PE day)	Population Equivalent (PE) (Volumetric)
1.	Ireland	1.80	0.180	45,000	60,000	10
2.	Spain	2.40	0.240	60,061	60,061	10
3.	Ireland-Agri	1.65	0.180	45,000	60,000	9.5
4.	France	8	0.150	70,000	60,000	50
5.	Italy	1.20	0.200	11,000	82,000	6

6.	France-NBK	0.75	0.150	70,000	60,000	5
7.	UK-Scotland	8	0.200	-	60,000	40
8.	Turkey	3.10	0.141	107,500	49,500	22
9.	Romania	2.40	0.080	-	-	30
10.	Ecuador	2	0.200	-	-	10
11.	Peru	22.50	0.087	11,596	92,164	260
12.	Tanzania	2.40	0.035	-	-	68
13.	India	10.80	0.060	-	40,000	180

There is significant variation between the volumetric basis of PE in the demonstration sites among the European demonstration site countries reporting within the range 0.141 – 0.240 m³/day (except for Romania) and the non-European countries in range 0.035 – 0.060 m³/day. The BOD₅ basis of PE also shows a considerable variation with over the demonstration site countries, with most consistent in the European countries. Figure 2-1 and Figure 2-2 show graphically the variation in the basis of PE for the demonstration site countries.

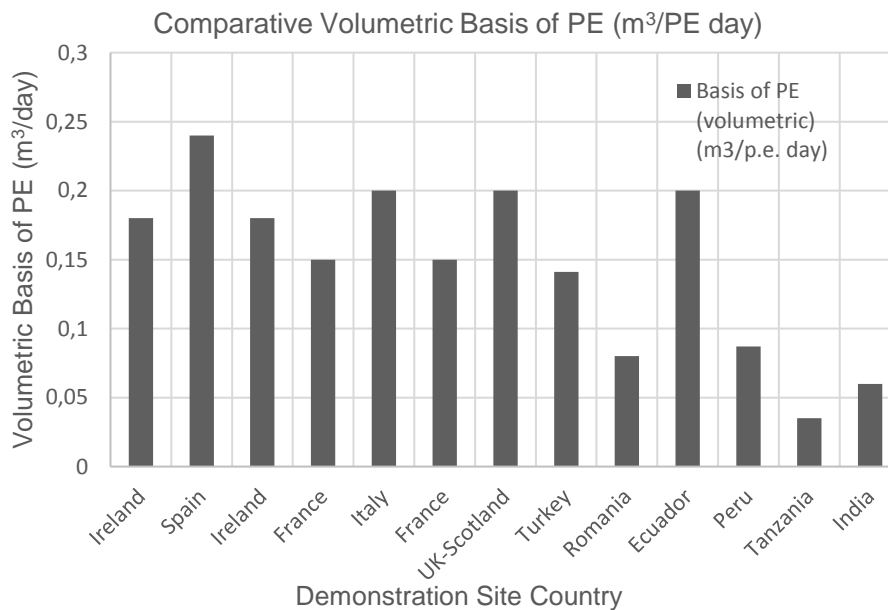


Figure 2-1 Comparative Volumetric Basis of PE (m³/PE day)

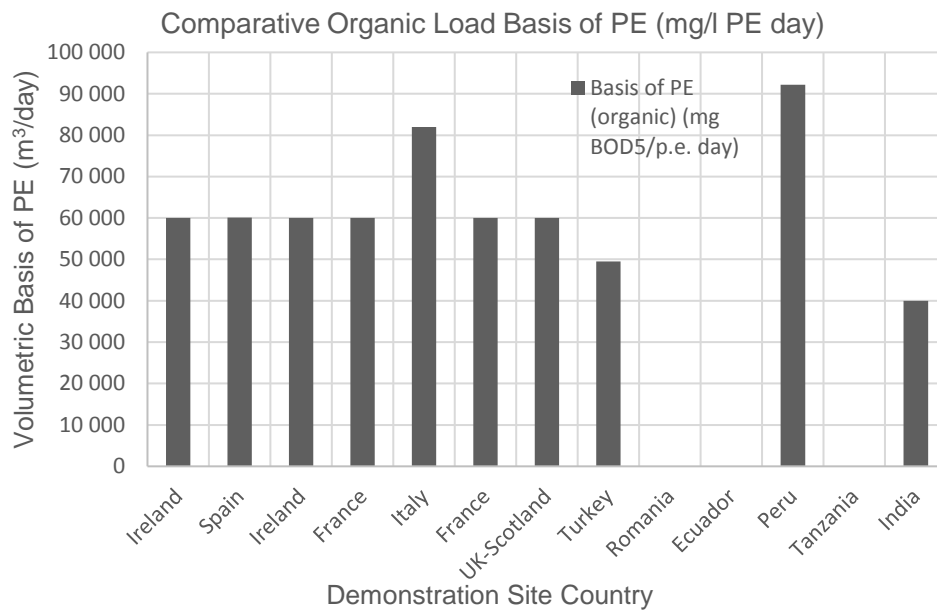


Figure 2-2 Comparative Organic Loading Basis of PE (mg/l PE day)

Table 2-8 Expected Influent Characteristic Summary at Demo Sites 1 of 2

Ref	Country	pH	Water Temperature (°C)	Suspended Solids (mg SS/Litre)	COD (mg COD/Litre)	BOD ₅ (mg BOD ₅ /Litre)
1.	Ireland	7.5	13	564	525	466
2.	Spain	TBC	TBC	TBC	TBC	TBC
3.	Ireland-Agri	7.5	14	1,000	4,000	2,000
4.	France	7.5	15	-	700	350
5.	Italy	7.1	17	-	-	-
6.	France-NBK	7.5	-	-	800	270
7.	UK-Scotland	-	-	400	600	300
8.	Turkey	7.5	15.5	220	500	220
9.	Romania	-	23	225	437	280
10.	Ecuador	7.2	-	195	250	94
11.	Peru	8.2	20.5	134	872	1,065
12.	Tanzania	-	-	-	-	-
13.	India	7.5	27	250	550	225

Table 2-9 Expected Influent Characteristic Summary at Demo Sites 2 of 2

Ref	Country	Total Nitrogen (mg N/Litre)	Total Ammonium (mg NH ₄ ⁻ /Litre)	Total Ammonia (mg NH ₃ -N/Litre)	Total Phosphorous (mg P/Litre)	Total Ortho-Phosphorous (mg PO ₄ -P/Litre)
1.	Ireland	45.2	-	20	9.74	-
2.	Spain	TBC	TBC	TBC	TBC	TBC
3.	Ireland-Agri	200	130	-	40	40
4.	France	90	50	-	10	7
5.	Italy	20	-	-	6	-
6.	France-NBK	-	-	-	27	-
7.	UK-Scotland	-	-	30	15	-
8.	Turkey	40	26	25	8	5.6
9.	Romania	71	-	27	14	-
10.	Ecuador	-	-	-	5.2	-
11.	Peru	856	-	-	-	-
12.	Tanzania	-	-	-	-	-
13.	India	200	100	-	40	-

As expected, high influent organic loads will arise from the agricultural and aquaculture sites in Ireland and France (ref. 3 and 4)

Table 2-8 Expected Influent Characteristic Summary at Demo Sites 1 of 2 (Table 2-1); however, very high loading is also shown as a characteristic of the influent at the demonstration site in Peru. It is unclear the source of such expected high levels at the Peruvian demonstration site.

Very high nitrogen and ammonium levels are also given for the expected influent composition at the Indian and Peruvian demonstration sites. High values are also expected at the Irish agricultural demonstration site which is consistent with animal waste; It is unclear the basis of the high content in other sites.

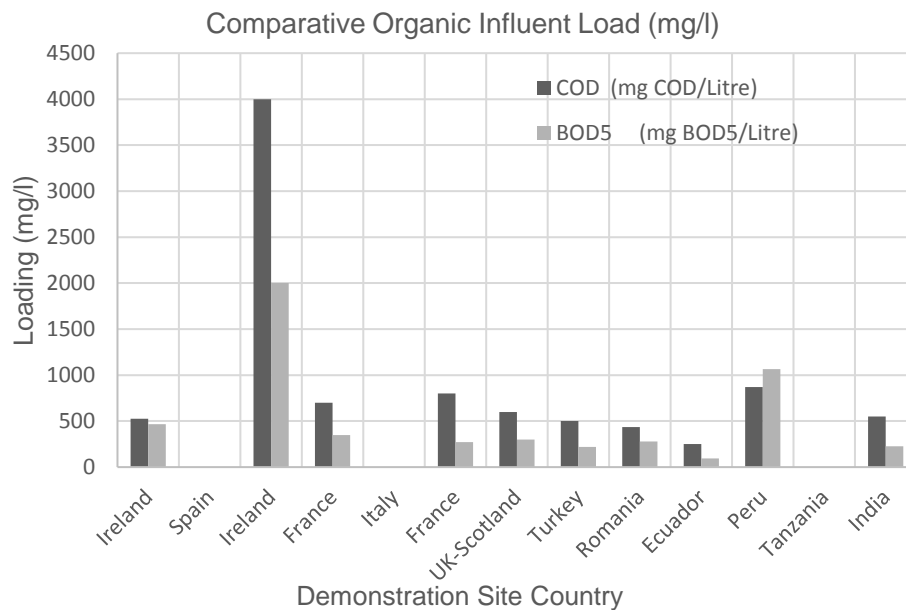


Figure 2-3 Comparative Expected Influent Organic Loading

2.5 Conclusions

The INNOQUA demonstration sites are presented in terms of their infrastructure and environment. The variation in particular in ICT infrastructure is an important issue for the development of the monitoring and control units and requires the provision of adequate local storage. In addition, the likelihood of power interruptions at some demonstration sites highlights the need for consideration of alternative power supplies (i.e. solar, battery, back-up generator).

The requirement or preference of a number of demonstration sites to locate the units underground is an important design consideration that is highlighted particularly for T2.3 Structural Specification. The prototype demonstration sites at UDG, Spain and NUIG, Galway will serve for testing the potential logistics of transport and initial setup difficulties and could also be used to investigate simulate the range of power, ICT and access infrastructure needed at the demonstration sites.

There are considerable differences in the volumetric and, to a lesser extent, BOD₅ loads (based on PE). This is an important design consideration for sizing the tank units, pumps etc. A volumetric (m³/PE day) basis of PE for the project should be agreed, similarly for the BOD₅ (mg/l) basis of the PE

The expected physico-chemical content of the influent is largely similar among the demonstration sites with the exception of the Irish agricultural site (ref. 3 Table 2-1) and the Peruvian and Indian

demonstration sites. High BOD, COD, Ammonia and Nitrogen content come from animal waste and, following primary settlement, the dairy soiled water (Ruane, E, et al., 2012) that will be subject to treatment in the INNOQUA system is likely to be far less concentrated. Additional influent characterisation is recommended at the Indian and Peruvian demonstration sites to determine the consistency of the high loadings.

Given that almost all of the demonstration sites will receive primarily municipal/domestic wastewater, it is expected that the concentration of fats/oils/grease will present the typically range found in urban wastewater, which is 50-100 mg/L (US EPA, 1992).

Other factors identified that may potentially affect the influent wastewater to the INNOQUA unit include pathogens such as cryptosporidium, norovirus, which are present in any of the demonstration sites. With contamination from cholera and amoebae outbreaks identified in Africa, from a public health perspective, it is necessary to establish measures to deal with such pathogens, especially in sites where water reuse is proposed.

Demonstration sites that experience rainy seasons or heavy rainfall coupled with combined surface and foul water collection systems identify dilution of influent as a potential factor that will effect influent concentration and volume so monitoring of influent or rainy season protocols may be necessary to counter any negative implication.

The NUIG WRF Demonstration site in Galway, Ireland receives influent from a municipal stream that also accepts landfill leachate, water treatment alum sludge and septic tank waste. Although, the delivery of leachate and alum is controlled, shock loadings can occur.

3 Effluent Requirements at INNOQUA Demonstration Sites

3.1 Introduction

The Project DOA Task 2.1 seeks to identify the expected quality of effluent at each of the demonstration sites. In particular, the physico-chemical and microbiological requirements for 1) treated wastewater effluent to be discharge and 2) water reuse. The effluent discharge details and effluent requirements (maximum, minimum, average and % reduction) were provided by Demonstration Site Partners and are given in detail in Appendix C. The information was collated by completion of an Environmental Loading and Effluent Requirement Spreadsheet for each site.

3.2 Effluent Discharge Details

The following effluent discharge details were collected for each site;

Table 3-1 Effluent Discharge Details

Parameter
Description of Proposed Effluent Outfall Arrangement at Demonstration Site
Details of Existing Effluent Discharge Consents (If Any) at the Site
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge
Details of the legislation or regulation under which the discharge consent is or will be granted
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse
Description of Proposed Effluent Outfall Arrangement at Demonstration Site
Details of Existing Effluent Discharge Consents (If Any) at the Site
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge
Details of the legislation or regulation under which the discharge consent is or will be granted

3.2.1 Summary

Some of the key information relating to the arrangements for treated wastewater is given in Table 3-2 below for each of the demonstration sites, where such arrangements have not yet been identified TBC is entered.

Table 3-2 Treated Effluent Discharge/Reuse Details - Summary at Demo Sites

Ref	Country	Effluent Outfall Arrangement	Reuse of Treated Effluent	Proposed Reuse	Water Reuse Legislation Existing
1.	Ireland	Inflow line of adj. Treatment Plant	No	-	No
2.	Spain	TBC	No	-	Yes
3.	Ireland-Agri	Agricultural waste holding tank onsite	Yes	Opt 1: Land spreading Fertiliser Opt 2: Yard Cleaning	No
4.	France	TBC	No	--	Yes
5.	Italy	Opt 1: discharged to ground; Opt 2: discharged to tank final disposal @ WWTP	No	-	Yes
6.	France-NBK	Public network / municipal WWTP for full treatment	Yes	Onsite irrigation of plants (Not edible plants)	Yes
7.	UK-Scotland	Inflow line of existing Treatment Plant	No	No – test potential reuse for grey water / sub potable purposes	No
8.	Turkey	Opt 1: Reused as irrigation water Opt 2: Septic tank onsite	Yes	Irrigation of shrubbery/nursery ground. (Not edible plants)	Yes
9.	Romania	The effluent water will be discharged in the nearby river	No	-	Yes
10.	Ecuador	As existing to Public network	Yes	Irrigation of a vegetation facade onsite (Not edible plants)	Yes
11.	Peru	Opt 1: Reused as irrigation water Opt 2: Septic tank onsite	Yes	Onsite irrigation (Plant type TBC i.e. edible plants)	Yes
12.	Tanzania	TBC	Yes	Agricultural reuse on site. Watering of Banana plants	No
13.	India	Existing open nala which connects to treatment plant	No	-	Yes

At each of the demonstration sites where outfall arrangements have been identified, connection to an existing wastewater treatment facility is possible or proposed.

Water reuse is proposed at six of the demonstration sites, the main proposed re-use is for irrigation. At the agricultural demonstration site in Ireland, the use of treated waste water for the following will

also be considered: washing of yards and outhouses and as dilute fertilizer with potential use during restricted spreading season.

Water reuse regulation, where it exists, is generally related to the nature of the intended reuse with more onerous requirements for reuse water for situations where contact with humans or food chain is expected. This is further discussed in Section 3.3 below.

3.3 Treated Wastewater Effluent Requirements

Details of the requirements for treated wastewater in terms of the following physical and chemical characteristics were collated for each demonstration site.

Table 3-3 Treated Wastewater Effluent Requirements

Parameter	Unit
pH	
Dissolved oxygen	(mg O ₂ /Litre)
Water temperature	(°C)
COD concentration	(mg BOD/Litre)
BOD ₅ concentration	(mg BOD ₅ /Litre)
Total Nitrogen	(mg N/Litre)
Total Kjeldahl Nitrogen	(mg N/Litre)
Total ammonium	(mg NH ₄ -N/Litre)
Total oxidised nitrogen	(mg NO _x -N/Litre)
Total phosphorous	(mg P/Litre)
Total ortho-phosphorous	(mg PO ₄ -P/Litre)
Parameter (Additional Requirements)	
Parameter	
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc	
Other Parameters (e.g. alkalinity etc)	

3.3.1 Summary

Key information relating to the requirements for treated wastewater to be discharged from each demonstration site is summarised in Table 3-4 and Table 3-5 below. The discharge limiting values have been identified by each demonstration site partner by review of existing discharge licence limits or relevant legislation as described in D1.1 – Regulation, Certification and Standard Review Report (INNOQUA, 2016).

Where treated wastewater is proposed to be reused at a demonstration site, the main requirements, where these exist in a demonstration site country, which must be met by the treated water are listed in Table 3-7, Table 3-8 and Table 3-9.

Table 3-4 Treated Effluent for Discharge Limiting Values - Summary at Demo Sites 1 of 2

Ref	Country	Suspended Solids (mg SS/L)	pH	Dissolved oxygen (mg O ₂ /L)	Water Temp (oC)	COD (mg COD/L)	BOD ₅ (mg BOD ₅ /L)	cBOD (mg BOD/L)
1.	Ireland	15	8	-	25	125	-	15
2.	Spain	35	-	-	-	125	25	-
3.	Ireland-Agri	35	-	-	-	125	25	-
4.	France	35	8.5	12	30	125	25	-
5.	Italy	25	8	-	-	100	20	-
6.	France-NBK	30	-	-	-	125	35	-
7.	UK-Scotland	35	8	-	20	125	25	-
8.	Turkey	30	9	-	-	-	30	-
9.	Romania	35	7.5	-	35	125	25	-
10.	Ecuador	13	-	-	-	200	100	-
11.	Peru	-	8.5	4	+3*	40	15	-
12.	Tanzania	-	8	-	26	394	-	-
13.	India	-	9.5	-	+5**	50	10	-

*Limiting value is + or -3°C of receiving waters

** Limiting value is +5°C of receiving waters

Table 3-5 Treated Effluent for Discharge Limiting Values Summary at Demo - 2 of 2

Ref	Country	Total Nitrogen (mg N/Litre)	Total Ammonium (mg NH ₄ -N/Litre)	Total Ammonia (mg NH ₃ -N/Litre)	Total Phosphorous (mg P/Litre)	Total Ortho-phosphorous (mg PO ₄ -P/Litre)
1.	Ireland	15	-	1	2	0.2
2.	Spain	-	-	-	-	-
3.	Ireland-Agri	-	-	-	-	-
4.	France	15	<5	-	2	<2
5.	Italy	15	-	-	2	-
6.	France-NBK	15	-	-	2	-
7.	UK-Scotland	25	-	-	-	-
8.	Turkey	-	-	-	-	-

9.	Romania	-	-	2	1	-
10.	Ecuador	50	30	-	10	-
11.	Peru	-	-	-	-	-
12.	Tanzania	-	-	-	-	-
13.	India	10	5	-	-	-

In terms of limiting values of chemical parameters, the graph below in Figure 3-1 highlights the disparity between requirements in Tanzania and Ecuador and those in the other demonstration site countries where EU Waste Water Directive 91/271/EEC has been implemented. The effluent quality requirements at the demonstration sites in Peru and India are the most onerous.

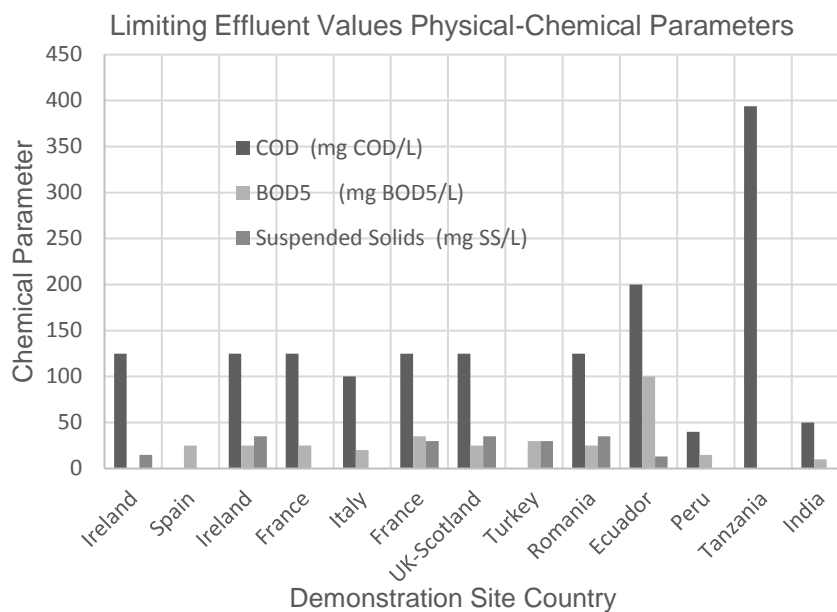


Figure 3-1 Limiting Effluent Values Chemical Parameters

Table 3-6 below shows the minimum % reduction in parameters required at the demonstration sites, these values are generally superseded by the limiting values given in Table 3-4 and Table 3-5 above.

Table 3-6 Effluent Requirements Minimum % Reduction in Parameters

Ref	Country	SS	COD	BOD ₅	Nitrogen	Phosphorous
1.	Ireland	90%	75%	70%	70%	80%
2.	Spain	90%	75%	70%	70%	80%
3.	Ireland-Agri	n/a	n/a	n/a	n/a	n/a
4.	France	90%	75%	80%	70%	80%
5.	Italy	90%	75%	70%	70%	80%
6.	France	90%	75%	70%	70%	80%
7.	UK-Scotland	95%	95%	95%	95%	80%

8.	Turkey	-	-	-	-	-
9.	Romania	-	-	-	-	-
10.	Ecuador	-	-	-	-	-
11.	Peru	-	-	-	-	-
12.	Tanzania	-	-	-	-	-
13.	India	92%	91%	96%	95%	95%

Where percentage reduction in loading is given for effluent in Table 3-6 above, there is general consistency across the demonstration sites with all requirements between 70% and 95%. In terms of required % reduction in load, the requirements in UK-Scotland and India are the most onerous. The Tables au-dessous identify the limiting values i.e. the maximum acceptable values that must be attained for treated waste water to be reused for the intended purpose, as described in au-dessus Table 3-2, in the demonstration site country.

In EU member states, a number of countries have developed comprehensive standards specifically for water reuse practices in particular in Cyprus, France, Greece, Italy and Spain where the standards are included as regulations in national legislation (Alcalde, Sanz & Gawlik, 2014). Where, in the case of Ireland, no requirements or relevant legislation exist for treated waste water reuse in a country, the standards that apply in a nearby county for similar or same end-use may be considered for application. The standards that are applicable in Spain and in Italy for re-use of treated waste water for the purposes considered for the Irish agricultural demo site are given in Table 3-10 to 3-12, inclusive.

Table 3-7 Treated Effluent for Specified Reuse (as per Table 3-2) Physico-Chemical Limiting Values - Summary at Demo Sites 1 of 2

Ref	Country	Suspended Solids (mg SS/L)	pH	Dissolved oxygen (mg O ₂ /L)	Water Temp (°C)	COD (mg COD/L)	BOD ₅ (mg BOD ₅ /L)	cBOD (mg BOD/L)
3.	Ireland-Agri	-	-	-	-	-	-	-
6.	France ¹	15	-	-	-	60	15	-
8.	Turkey ²	30	6.9	-	-	-	< 30	-
10.	Ecuador ³	-	6.9	3	-	-	-	-
11.	Peru ⁴							

¹ Reuse of urban wastewater is framed by the ruling of the September 26th 2016 for systems with a capacity above 1,2kg of BOD₅,

² Communiqué on Wastewater Treatment Plant Technical Procedures (20.03.2010 No: 27527)". In this regulation, Annex 7, Table E7.1

³ TULAS, Libro VI, Anexo 1: norma de calidad ambiental y de descarga de efluentes : recurso agua

⁴ Environment General Act – ‘Ley General del Ambiente (Ley N° 28611) and Measures for the Implementation of the Dumping Adjustment and Wastewater Reuse Programme - ‘Medidas para la Implementación del Programa de Adecuación de Vertimientos y Reúso de Agua Residual - PAVER (R.J. N° 274-2010-ANA)’

12.	Tanzania						
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Table 3-8 Treated Effluent for Specified Reuse (as per Table 3-2) Reuse Physico-Chemical Limiting Values - Summary at Demo Sites 2 of 2

Ref	Country	Total Nitrogen (mg N/Litre)	Total Ammonium (mg NH ₄ -N/Litre)	Total Ammonia (mg NH ₃ -N/Litre)	Total phosphorous (mg P/Litre)	Total ortho-phosphorous (mg PO ₄ -P/Litre)
3.	Ireland-Agri	-	-	-	-	-
6.	France	-	-	-	-	-
8.	Turkey	-	-	-	-	-
11.	Peru					
10.	Ecuador	-	-	-	-	-
12.	Tanzania	-	-	-	-	-

Table 3-9 Treated Effluent for Specified Reuse (as per Table 3-2) Microbial Limiting Values - Summary at Demo Sites

Ref	Country	Escherichia coli (cfu/100ml)	Faecal enterococci (log reduction)	Total coliforms (cfu/100ml)	Legionella sp. (cfu/l)	Salmonella sp.	Free Chlorine
3.	Ireland-Agri	-	-	-	-	-	-
6.	France	10 ⁵	Log 2	-	-	-	-
8.	Turkey	< 200	-	-	-	-	>1mg/L
10.	Ecuador			1,000			
11.	Peru	-	-	-	-	-	-
12.	Tanzania	-	-	-	-	-	-

The information given in the Tables au-dessus is a summary of key physical, chemical and microbial limits required by the relevant water reuse legislation, for complete requirements the regulations should be reviewed. In particular, it is noted that there are extensive limiting values with respect to the presence of metals in the Ecuadorian waste water reuse regulations and additional pathogen analyses may be required on a case by case basis in Turkey.

Regulation with respect to waste water reuse does not exist in Ireland and is also not available for Peru and Tanzania. The proposed reuse of waste water at the Irish, Peruvian and Tanzania demonstration sites is described above in Table 3-2. The legislation for the proposed reuse that is available in Spain, Italy and Greece is summarised below.

- In Spain, legislation relating to treated waste water reuse is given by Ministry of Environment, Ministry of Agriculture, Food and Fisheries, Spain, Legal Framework for the Reuse of Wastewater, RD 1620/2007, (2007) Appendix 1.A – Agricultural Uses, Quality 2.2b.
- In Italy, the following legislation applies; DM 185/2003 Technical measures for reuse of wastewater Ministry of Environment, Ministry of Agriculture and Ministry of Public Health.

- In Greece, CMD No 145116 Measures, limits and procedures for reuse of treated wastewater Ministry of Environment Energy and Climate Change provide regulation.

Table 3-10 Treated Effluent for Reuse as Specified - Physico-Chemical Limiting Values - Summary of Available Regulations Spain, Italy, Greece 1 of 2 (Refs TBI)

Ref	Country	Suspended Solids (mg SS/L)	pH	Dissolved oxygen (mg O ₂ /L)	Water Temp (°C)	COD (mg COD/L)	BOD ₅ (mg BOD ₅ /L)	cBOD (mg BOD/L)
Irrigation of Private Gardens								
2	Spain	10	-	-	-	-	-	-
5	Italy							
-	Greece							
Irrigation of crops for human consumption where water does not come in direct contact with edible part of plant which are not eaten raw								
2	Spain	35	-	-	-	-	-	-
5	Italy							
-	Greece							
Irrigation of Pasture Land for milk-producing or meat producing animals-Spain /Irrigation of restricted access lands -Greece								
2	Spain	35						
5	Italy	-	-					
-	Greece	≤10 for 80% of samples					≤10 for 80% of samples	
Process and Cleaning Water except for use in the food industry								
2	Spain	35						
5	Italy							
-	Greece							
Irrigation – non-specific								
2	Spain							
5	Italy	10	6-9.5			100	20	
-	Greece	≤10 for 80% of samples					≤10 for 80% of samples	

Table 3-11 Treated Effluent for Reuse as Specified - Physico-Chemical Limiting Values - Summary of Available Regulations Spain, Italy, Greece 2 of 2

Ref	Country	Total Nitrogen (mg N/Litre)	Total Ammonium (mg NH ₄ -N/Litre)	Total Ammonia (mg NH ₃ -N/Litre)	Total phosphorous (mg P/Litre)	Total ortho-phosphorous (mg PO ₄ -P/Litre)	Turbidity (NTU)
Irrigation of Private Gardens							
2	Spain	-	-	-	-	-	2
5	Italy	-	-	-	-	-	-
-	Greece	-	-	-	-	-	-
Irrigation of crops for human consumption where water does not come in direct contact with edible part of plant which are not eaten raw							
2	Spain	-	-	-	-	-	No Limit
5	Italy	-	-	-	-	-	-
-	Greece	-	-	-	-	-	-
Irrigation of Pasture Land for milk-producing or meat producing							
2	Spain						-
5	Italy						
-	Greece						
Process and Cleaning Water except for use in the food industry							
2	Spain						
5	Italy						
-	Greece						
Irrigation – non-specific							
2	Spain						
5	Italy	15	-	2			
-	Greece						≤2

Table 3-12 Treated Effluent for Reuse as Specified (as per Table 3-2) Microbial Limiting Values - Summary of Available Regulations Spain, Italy, Greece

Ref	Country	Escherichia coli (cfu/100ml)	Intestinal Nematodes (eggs/10L)	Faecal enterococci (log reduction)	Total coliforms (cfu/100ml)	Legionella sp. (cfu/l)	Salmonella sp.
Irrigation of Private Gardens							
2	Spain	0	1			100	
5	Italy						
-	Greece						
Irrigation of crops for human consumption where water does not come in direct contact with edible part of plant which are not eaten raw							
2	Spain	1,000	1				Absence
5	Italy						
-	Greece	≤5 for 80% of samples ≤50 for 95% of samples					
Irrigation of Pasture Land for milk-producing or meat producing							
2	Spain	1,000	1				Absence
5	Italy						
-	Greece						
Process and Cleaning Water except for use in the food industry							
2	Spain	10,000	-			100	
5	Italy						
-	Greece	≤200					
Irrigation – non-specific							
2	Spain						
5	Italy	100					Absence
-	Greece	≤5 for 80% of samples ≤50 for 95% of samples					

Conclusions

Of the 13 demonstration sites, outfall arrangements have been identified allow effluent treated by the INNOQUA integrated system to be diverted to an alternative treatment system. A number of sites have yet to identify the intended treated effluent discharge arrangements and in the case of Romania, the discharge will be to a nearby river.

The physico-chemical standards for direct discharge of treated waste water are presented above. In terms of limiting values of chemical parameters, the limiting values in Tanzania and Ecuador were identified as being least onerous in terms of BOD₅ and COD, while the requirements for treated waste water for discharge at the demonstration sites in Peru and India were found to be most onerous.

The limiting value of total Ammonium (mg NH₄-N/Litre) and total Ammonia (mg NH₃-N/Litre) in treated waste water for discharge is identified for six sites, at three sites, an Ammonia (mg NH₃-N/Litre) limit of ≤2 exists and at 2 sites, a total Ammonium (mg NH₄-N/Litre) limit of ≤ 5, with Ecuador citing a maximum level of total Ammonium of 30 mg NH₄-N/Litre.

Water reuse is to be investigated at six of the demonstration sites, in general, the intended reuse defines the required standard to be met by the treated waste water. Regulation in terms of treated waste water reuse is not available for all of the countries of demonstration sites where it is intended to reuse treated waste water. Available regulation from Spain, Italy and Greece was reviewed to determine suitable limiting physical, chemical and microbial characteristics. This is in addition to review of that for demonstration site countries where water reuse is proposed as part of INNOQUA and regulation is in place. It is clear from the legislation that the elimination or substantial reduction of pathogens is required in all reuse cases. The most comprehensive guidance in terms of reuse were found to be that in Spanish and French legislation and it is considered that these will be most appropriate for application to sites in the absence of local treated waste water reuse legislation.

4 The INNOQUA Treatment Technologies

An overview of each of the four Technologies to be integrated to form the INNOQUA System is presented in this Section. In particular, four technologies, listed in Table 4-1 below, are discussed in this report with specific reference to the following:

- Expected capacity of each technology in treating wastewater
- Maintenance requirements for each technology
- Shut-down prevention requirements for each technology

Table 4-1 INNOQUA Treatment Technologies

Technology	Partner
Lumbrifilter	LBT
Daphniafilter	UDG
Bio-Solar Purification	HPT
Ultra Violet	BUV

4.1 Lumbrifilter Technology

The Lumbrifilter is a wastewater treatment system specifically design for treating wastewaters from small populations including housing estates, villages, and hotels. The lumbrifilter acts as the secondary treatment step in a wastewater treatment process following the removal of solid matter in the primary treatment stage (typically by fine screening).

In the Lumbrifilter, wastewater is passed through an active layer (AL) of wood chips. On top of this layer, an earthworm population is provided with a specific support material to allow the population develop (specific lombri-substrate already well mineralized) – **Erreur ! Source du renvoi introuvable.** and **Erreur ! Source du renvoi introuvable.** In normal operation the system is dosed with wastewater periodically throughout the day. Aeration is achieved through passive means (non-mechanical) which can be maintained by periodic scraping of solids matter from the surface of the filter as required.



Figure 4-1 earthworms used in the Lumbrifilter

Figure 4-2 view to the top surface of the filter

4.1.1 Efficiency of Lumbrifilter

Table 4-2 summarises the expected removal capacity of the Lumbrifilter based on previous site scale pilot tests. The system is design to efficiently removal organic-carbon and suspended solids. It can also achieve relatively high removal rates of total nitrogen and pathogens such as e-coli and enterococci. The system however has in studies to date shown limited capacity for nitrification.

Table 4-2 Typical results from a Lumbrifilter pilot scale trial from a commercial site in Combaillaux, France (LIFE03 ENV/F/000257, 2005)

Parameter	Input Plant	Output Lumbrifilter		Standards
	Average value	Average value	Efficiency (%)	Vulnerable areas (concentration / %)
Total Suspended Solids (mg/L)	329	22	93.19	Maximum 35 mg/l or 90% of efficiency
COD (mg/L)	737	84	88.58	Maximum 125 mg/l or 75% of efficiency
BOD ₅ (mg/L)	329	8	97.52	Maximum 25 mg/l or 80% of efficiency
TN (mg/L)	93	25	73.12	Maximum 15 mg/l or 70% of efficiency
TKN (mg/L)	93	5		
NO ₃ -N (mg/L)	<1	20		
NO ₂ -N (mg/L)	<1	<1		
TP (mg/L)	10	9	17.59	Maximum 2 mg/l or 80% of efficiency
E. Coli (germs/100ml)	20178692	1374712	93.19	Maximum 200 germs/100ml (Class A) & 1000 germs/100ml (Class B)
Entérocoques (germs/100ml)	4738923	255056	94.62	Maximum 1000 germs/100ml

4.1.2 Maintenance Requirements

Table 4-3 Details the maintenance requirements of the Lumbrifilter

Maintenance / Monitoring	Frequency & Requirements
Approximate initial start-up time/start-up time following maintenance	Between one and three months
Start-up process (e.g. biomass seeding, worms etc)	3000 - 5000 earthworms/m ² surface plan used to seed the system earthworm species. Eisenia andrei or/and Eisenia fetida typical used
Details of routine inspection monitoring requirements (testing, visual inspections etc access for same)	Visual inspection once a week to determine the state of operation of the equipment. Each month check sprinkler nozzles
Describe likely frequency of routine inspection monitoring requirements	Once a week
Details of routine maintenance requirements (e.g. cleaning, removal of sludge etc access for same)	Every four months requirements of wood chips to maintain the level of the lumbrifilter
Describe likely frequency of Routine maintenance required	Every four months
Any other details regarding ideal operating ranges for the technology	For small lumbrifilters it will be necessary to use the prototype test period to test the maintenance requirements of the tests. Our experience (Combaillaux) is linked to a collective system During the trial period, to study in each (site) case to bring improvement in maintenance
Any other detailed restrictions regarding ideal operating ranges for the technology	During the prototype period, the maintenance schedule will be reviewed to optimise for particular scenarios

4.1.3 Shut-down Prevention Requirements

In the event of a reduction or cessation in influent flow to the lumbrifilter, the earthworms will be unaffected for a period of two weeks and potentially up to a month, provided that the moisture content of the substrate is maintained at more than 60%.

In the case of a permanent lumbrifilter installation, it is recommended that two parallel lumbrifilter systems, each providing 50% of overall capacity required at the site, be installed. The systems should be provided with alternating watering; this is proposed as a shut-down prevention measure to secure the system operation. In the case of a small experimental pilot, one lumbrifilter is sufficient. Testing carried out to-date indicates that a single lumbrifilter can withstand excess loading for approximately ten days. However, such excess loading demands additional maintenance intervention i.e. scraping of the surface daily. This maintenance process can be automated e.g. in the case of the lumbrifilter system at Combaillaux in France an automatically controlled surface scraper was installed at the unit, see image Figure 4-3. A simplified equivalent system is proposed for INNOQUA demonstration.

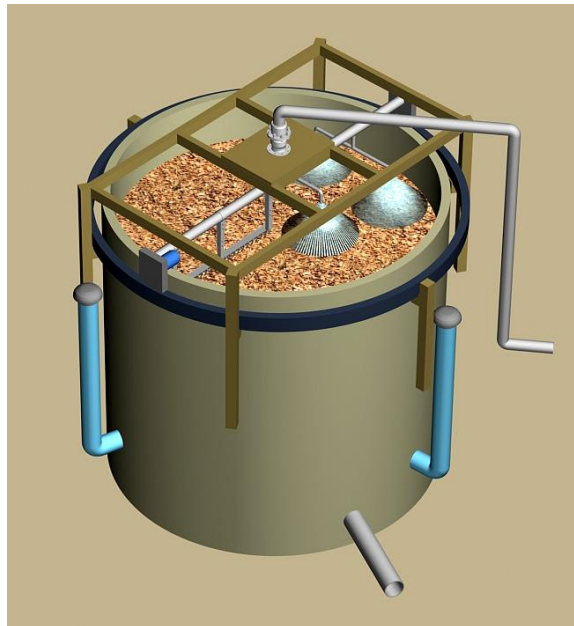


Figure 4-3 Lumbrifilter with Maintenance Scraper

4.1.4 Details of Re-start of Microbial Activity after Shut-down

In general, compared to activated sludge systems, the lumbrifilter is less sensitive to toxic shocks due to the relatively short contact time between the wastewater and the biomass and due to the protective effects of the biofilm. It is also less sensitive to load surges. It should be noted that sensitivity to outside temperature can be significant and affect system operation. Ideal operating conditions are between 15°C and 20°C (water temperature). The minimum and maximum recommended operating conditions are between 5°C and 30°C (water temperature).

4.2 Daphniafilter Technology

The Daphniafilter is a technology designed for the biological tertiary treatment of domestic wastewater (or wastewaters that are similar). The technology (Figure 4-4) leverages the filtration activity of filter feeder organisms (i.e. zooplankton, mainly *daphnia magna* and other cladocera) (Figure 4-5). These organisms can use the remaining particles and compounds in the secondary effluent (mainly nutrients, emerging and priority pollutants and pathogen microorganisms) as food, at a low cost and without the use of chemicals.



Figure 4-4 Daphniafilter Test Setup at UDG



Figure 4-5 Daphnia on 1mm square grid

The Lumbrifilter effluent will comprise suspended solids of varying particle size. The larger particles (above 30-40 μm) are not suitable food for Daphnia and will settle out within the daphniafilter. Hence, the Daphniafilter is a biological filter which also works as a secondary clarifier.

4.2.1 Efficiency of Daphniafilter

The Daphniafilter efficiency has been tested at the optimum range of temperatures and for Daphnia concentrations between 25 Daphnia/L and 70 Daphnia/L. Considering the substrate ingestible for Daphnia (i.e. particles below 35 μm), the particle removal efficiency ranged between from 12% and 52% at an hydraulic retention time (HRT) of 24 hr. For HRTs of 12 hr, the particle removal efficiency ranged between 11% and 38%. Decreasing to between 6 and 18% at HRTs of 6 hr. Typical suspended solids removal rates at optimal temperature range and HRT were found to be around 2 ml SM/L.hr.Daphnia

However, Daphnias can be affected by other environmental factors besides temperature. Ideal operating conditions are between 18°C and 23°C (water temperature). The minimum and maximum recommended operating conditions are between 10 °C and 25 °C (water temperature); tests have shown that above 26 °C, the decay rate of the daphnia is increased significantly. In preliminary inhibition tests, Daphnia has been found to be sensitive to ammonium concentration. At

concentrations up to 25 mg NH₄-N/L, limited on Daphnia activity was observed, with less than a 10% activity reduction observed at 25 mg NH₄-N/L (compared to the control without ammonium). However, the filtration activity was almost completely suppressed when Daphnia were exposed to 50 mg NH₄-N/L. Thus, the performance and effluent characteristics of the Lumbrifilter must be considered. In this sense, other tests with Daphnias exposed to different nitrite, nitrate and phosphorus concentrations will be carried out during the first stage of the project. Also, the impacts of pH will be assessed.

The Daphniafilter was previously tested as a tertiary treatment in Empuriabrava (Spain) to improve the quality of treated wastewater. The efficiencies obtained in this pilot-scale test are compiled in Table 4.4. It has to be noted that in INNOQUA the Daphniafilter is implemented after the Lumbrifilter and, hence, the efficiency of the system in such conditions must be tested again. In this case, the design of the Daphniafilter has been adapted in order to ensure the settling and removal of the SS in the range above the edible size for Daphnia (>35 µm).

Table 4-4 Efficiency of Daphniafilter from Pilot scale tests Empuriabrava (Spain)

Parameter	Influent	Effluent	Efficiency* (%)
	Average value	Average value	
Total Suspended Solids (mg/L)			99*
COD (mg/L)			-
BOD ₅ (mg/L)			-
TN (mg/L)			47
TKN (mg/L)			-
NO ₃ -N (mg/L)			-
NO ₂ -N (mg/L)			-
TP (mg/L)			58
E. Coli (germs/100ml)			1.5 log CFU/100 mL
Entérocoques (germs/100ml)			1.5 log CFU/100 mL

*Efficiency of removal of the edible particles for Daphnia (2.5-500µm).

It should be noted that to date laboratory tests with Daphnia treating domestic effluent wastewater from the Lumbrifilter showed no negative impacts on performance. For this tests, an effluent sample from the Lumbrifilter was collected during its discharge. In lab, Daphnia were directly applied to the sample in order to test possible negative impacts of the Lumprifilter effluent characteristics (pH 7.85; 3.4 mg NH₄⁺-N L⁻¹; mg 0.07 NO₂⁻-N L⁻¹; mg 16.9 mg NO₃⁻-N L⁻¹; 12.05 mg P-PO₄³⁻ L⁻¹; total COD of INNOQUA - D2.1 – Effluent Physico-Chemical and Microbial Specification v7

119 mg O₂ L⁻¹) on daphnia. More tests has to be performed during the project (task 2.5 in WP2) in order to ensure a good tolerance of daphnia to the expected and potential range of effluent values from Lumbrifilter.

4.2.2 Maintenance Requirements

In order to maintain proper conditions inside the Daphniafilter, the sludge settled will be removed periodically from the bottom of the tank. Growth of algae and filamentous algae must be prevented, and this biomass removed if present. Aerobic conditions must be guaranteed, especially in case of mechanical failure (no feeding).

Table 4-5 Details the maintenance requirements of the Daphniafilter

Maintenance / Monitoring	Frequency & Requirements
Approximate initial start-up time/start-up time following maintenance	1 week (at optimal temperature).
Start-up process (e.g. biomass seeding, worms etc)	A minimum of 50 Daphnia L ⁻¹ must be considered for inoculation.
Details of routine inspection monitoring requirements (testing, visual inspections etc access for same)	Visual inspection daily of the Daphnia and the flow into the system Influent values (pH, N compounds)
Describe likely frequency of routine inspection monitoring requirements	Daily
Details of routine maintenance requirements (e.g. cleaning, removal of sludge etc access for same)	<ul style="list-style-type: none"> • Purge of the settled solids. Frequency depending on influent SS. Expected once a month. • Check for homogeneous vertical flow in the tank (adjustment of effluent leveling when required) • Check biofilm characteristics (thickness)
Describe likely frequency of Routine maintenance required	Weekly/monthly
Any other details regarding ideal operating ranges for the technology	To be tested during prototyping. Temperature into the range of 10-25°C, avoid >26°C
Any other detailed restrictions regarding ideal operating ranges for the technology	To be tested during prototyping. Maximum flow velocities in daphniafilter must be respected to avoid impact on daphnia. Nitrite presence to be avoided in the influent.

4.2.3 Shut-down Prevention Requirements

Under aerobic conditions, Daphnia can tolerate up to two weeks periods without feeding. Relatively short shut downs are not problematic for the system, which can be restarted again without any specific intervention - assuming the conditions in the Daphniafilter have not changed dramatically (e.g. temperature, pH, etc). In the case of long shut-down periods, the settled matter must be removed to to avoid high oxygen consumption due to excess organic carbon in the system. Thus an external air supply may be necessary and some substrate (such as spirulina) periodically supplied.

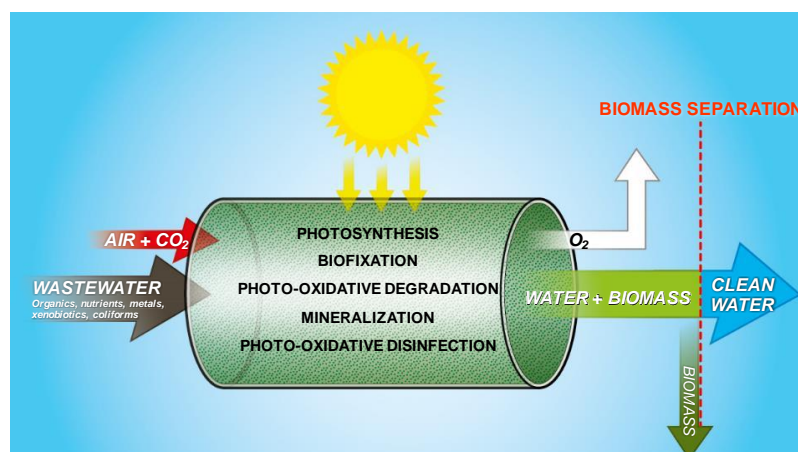
4.2.4 Details of Re-start of Microbial Activity after Shut-down

Daphnia have a resistance strategy to ensure survival after long term periods with non-favourable conditions whereby they produce eggs. Females continuously produce broods of eggs, however under non-favourable conditions, the eggs produced are protected by an *ephippium* and can last for longer periods, until favourable conditions are recovered again. Thus, the population should be recoverable after a breakdown period one normal system operation has resumed. Where a rapid restart is required (after a long term shut-down), re-inoculation with new active Daphnia should be considered.

4.3 Bio-Solar Purification Technology

Bio-Solar Purification is an advanced oxidation wastewater treatment combining micro-aeration through vacuum airlift and oxygen production through photosynthesis. This advanced oxidation leads to following;

- complete mineralization of dissolved and particulate organic matter
- non-biodegradable organic compounds photo-degradation through light exposure and high oxygen concentration
- NH_4 , NO_x and PO_4 assimilation by photosynthetic microflora enhanced by CO_2 injection to avoid limiting effect of CO_2 concentration
- metallic compounds biofixation in the photosynthetic biomass
- photo-oxidative disinfection and removal of most of fecal contamination indicators such as coliforms and fecal enterococci



BSP technology = natural advanced oxidation using photosynthesis

Figure 4-6 BSP Technology

Bio-Solar purification is performed on pretreated wastewater after screening, primary decantation, reed bed filter or lumbrifilter.

Bio-Solar Purification needs a special reactor to allow the following:

- expose water to natural or artificial sunlight during lighted phase of treatment

- circulate and move water permanently
- inject and dissolve air during dark phase and to inject and dissolve CO₂ enriched air during lighted phase
- remove excess oxygen produced during lighted phase and to remove excess CO₂ produced during dark phase

A tank design reactor is proposed for incorporation to the INNOQUA where wastewater is exposed indirectly to sun or artificial light through light wells

In this system, water moving, air + CO₂ injection and O₂ removal are performed by a vacuum air-lift (patented) situated in the tank or outside the tank.

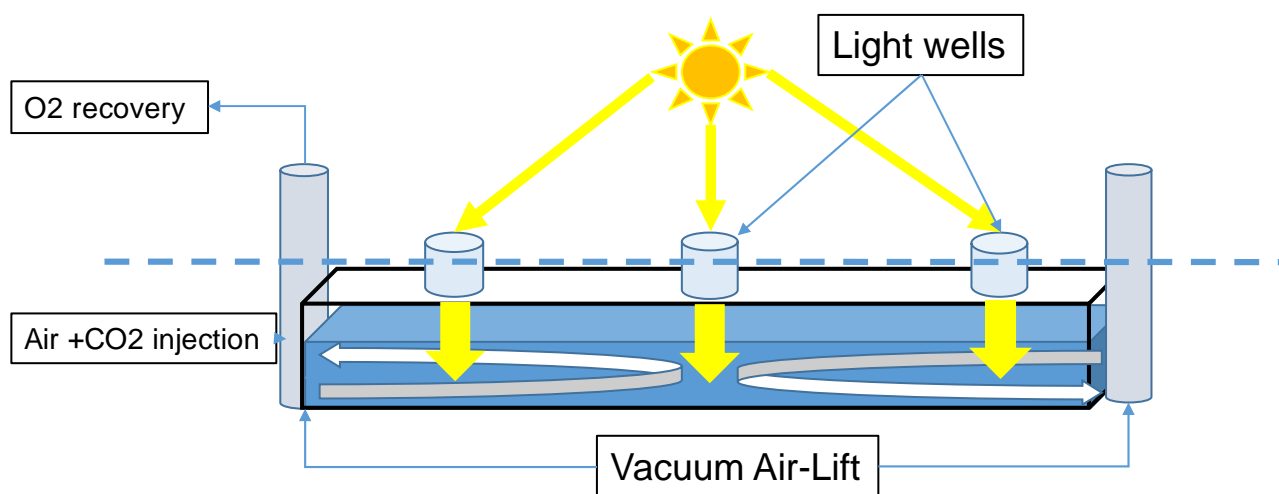


Figure 4-7 Tank Design Reactor for BSP Technology

4.3.1 Efficiency of BSP treatment

Results obtained on domestic wastewater after screening and primary decantation with a residence time of 8 hours corresponding to lighted phase duration in a tubular reactor (September 2015, south of France).

Table 4-5 Heliopure BSP Water Treatment Performances

Parameters	Input BSP unit	Output BSP unit	Removal Performances
Escheerichia Coli (coliforms)	2.8E+07	<60	5.7 log (99.997%)
Fecal Enterococci	3.5E+06	<60	4.7 log
Total Organic Carbon (mg/L)	210	7.8	96%
BOD ₅ (mg/L)	500	3	99%
COD (mg/L)	1050	32	97%
Suspended solids (mg/L)	450	17	96%
Total Phosphorous (P mg P/L)	10.65	1.75	80%
Total Kjeldhal Nitrogen (mg N/L)	73.44	23.35	68%
Ammonia (ml N)	42.9	0.5	98%

The results above comply with class A water quality for reuse (crop irrigation) according French regulation.

4.3.2 Maintenance Requirements

The process is controlled through pH measurement coupled to CO₂ enrichment in the vacuum air-lift during the enlightened phase; photosynthetic activity increases pH while CO₂ injection decreases pH in the water being treated. During the “dark phase” CO₂ enrichment is not efficient as photosynthesis is not performed.

Cleaning of tank is required every 3 or 4 months, however this does not require shut-down of the system. Cleaning of Air and CO₂ injectors in vacuum air-lift pump is required every 6 months and requires shut-down of vacuum airlift for one hour. Cleaning of vacuum airlift column is required as is cleaning of air circuit annually and a shut-down of vacuum airlift system is necessary for 1 day. Cleaning of external surfaces such as light wells should be carried out as necessary in case fouling by sand or dust.

4.3.3 Shut-down Prevention Requirements

After an initial start-up period (2 to 7 days), the BSP process can treat water continuously for many years providing that the system is not emptied. The BSP can function during periods of time without ongoing influent monitoring as long as the influent does not contain great concentrations of hazardous chemical products or chlorine (unlikely in domestic wastewaters). The pH regulation is automated via CO₂ enriched air injection. Normally CO₂ enriched air comes from pre-treatment as lumbrifilter is covered or buried. For piloting we can use pure CO₂ bottles. In that case, CO₂ tank replacement must be anticipated if the BSP is left unattended for more than a week.

Scenarios that may result in a shut-down of the system are listed in Table 4-6 Shut-down Scenario and Prevention Measures, the measures that are proposed to prevent such occurrences are also described

Table 4-6 Shut-down Scenario and Prevention Measures

Shut-down Scenario	Shut-down Prevention Measure
Chemical toxicity of wastewater containing too much chlorine or great concentrations of hazardous chemicals products.	Should such a shut-down it is necessary to empty the system and then restart it in 2 to 7 days.
Electrical shutdown that stops vacuum pump or wastewater feeding pump	Use of backup energy source e.g. renewable and/or local energy sources (solar, wind, biogas, generator)
Damage to vacuum pump	Preventative maintenance schedule

4.4 Ultra Violet (UV) Disinfection

UV light is a naturally occurring component of solar radiation. It falls in the region between visible light and X-Rays in the electromagnetic spectrum. Generally, UV light is considered as falling between wavelengths of 100 nm and 400 nm, however UV can be categorised even further into separate regions.

Although there is varying opinion in literature as to the exact boundaries of these regions, they are generally considered to be: Far UV (or vacuum) 100 nm – 220 nm, UV-C 220nm – 290nm, UV-B 290nm – 320nm and UV-A 320nm – 400nm. Of these, UV-C is recognised as having significant ‘germicidal’ properties. UV-C light is almost entirely filtered out by the Earth’s atmosphere, so to utilise its germicidal properties it is artificially generated using commercially produced UV lamps.



Figure 4-8 Example of Ultraviolet Disinfection Chamber

UV light damages the DNA in bacteria, viruses, moulds and some protozoa, leaving them unable to perform cellular functions and multiply. UV is particularly highly effective against Cryptosporidium and Giardia – organisms resistant to chlorine that are a major risk to human health. Another advantage of UV is the absence of taste and odour.

UV lamps contain a small amount of mercury, either in a free state within the lamp tube or embedded within the tube's surface. When electricity is applied to the lamp electrode, electrons flow between them, vaporizing the mercury which, when bombarded with electrons, emits UV light.

The exact wavelengths emitted depend on the vacuum pressure within the lamp tube itself. Low pressure (LP) UV lamps are evacuated to relatively 'low' pressures (between 1-10 Pa) and emit UV-C light at a single wavelength of approximately 254 nm. Medium pressure (MP) lamps are evacuated at a 'medium' pressure and emit a broader spectrum of UV light, with higher intensities between around 254 – 265 nm.

Low pressure and so called 'Amalgam' lamps are twice as efficient at converting electrical energy into UV-C light compared to medium pressure lamps. However, medium pressure lamps emit far more UV-C energy per unit length over a wider wavelength than low pressure or amalgam lamps. Various considerations therefore need to be taken into account when choosing which of these lamps is suitable for a given application.

4.4.1 Efficiency of UV Treatment

Every cell of a living organism contains DNA (except many viruses, which only contain RNA), which allows the cell to function and reproduce. UV-C light is able to penetrate the cells of microorganisms and disrupt the structure of their DNA molecules. This prevents the microorganism from surviving and/or reproducing, rendering it inactive and no longer pathogenic.

While this may seem a very simple principle process, many barriers exist that can potentially stop the UV-C light effectively penetrating the target organism's cells. For this reason, it is important that a UV reactor system is carefully selected to ensure these barriers do not affect performance. A UV application requires an average UV dose. UV dose is the amount of UV energy per unit area that falls on a surface. It is calculated as follows: $\text{Dose} = \text{Intensity} \times \text{Residence Time (mJ/cm}^2\text{)}$. Table 4-7 summarises typical UV doses recommended for inactivation of various pathogens.

Table 4-7 Recommended UV dose for the inactivation of microbes (mJ/cm²; EPA, 2011)

Target	Log Inactivation							
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Protozoa								
<i>Giardia</i> cysts ¹	1.5	2.1	3.0	5.2	7.7	11	15	22
<i>Cryptosporidium</i> oocysts ¹	1.6	2.5	3.9	5.8	8.5	12	15	22
Viruses								
"Viruses" ¹	39	58	79	100	121	143	163	186
Adenovirus type 40 ²		56		111		167		
Poliovirus ²		7		15		22		30
Adenovirus type 41 ³								112
Hepatitis ³								21
Coxsackievirus B5 ³								36
Poliovirus type 1 ³								27
Rotavirus SA11 ³								36
Bacteria								
<i>B. subtilis</i> spores ¹		28						62
<i>E.coli</i> ¹		3						8.4
<i>Streptococcus faecalis</i> ²		9						30
<i>Vibrio cholerae</i> ²		2						9
<i>Enterobacter cloacae</i> ³								10 (33)
<i>Enterocolitica faecum</i> ³								17 (20)
<i>Campylobacter jejuni</i> ³								4.6
<i>Clostridium perfringens</i> ³								23.5
<i>E.coli</i> 0157:H7 ³								6 (25)
<i>E.coli</i> wild type ³								8.1
<i>Klebsiella pneumoniae</i> ³								20 (31)
<i>Legionella pneumophila</i> ³								9.4
<i>Mycobacterium smegmatis</i> ³								20 (27)
<i>Pseudomonas aeruginosa</i> ³								11 (19)
<i>Salmonella typhi</i> ³								8.2
<i>Shigella dysenteriae</i> ATTC29027 ³								3.0
<i>Streptococcus faecalis</i>								11.2
<i>Vibrio cholerae</i>								2.9 (21)

¹USEPA UV Manual 2006b; ²Hijnen *et. al.*, (2006); ³Bolton and Cotton (2008)- values in brackets include photo reactivation data.

4.4.2 Maintenance Requirements

All wet parts of the UV systems are easily accessible and regular service can be performed by general maintenance staff trained by Berson’s commissioning engineers without the need for lifting equipment. The following tasks must be performed in accordance with the maintenance and inspection schedule – typically on an annual basis (Table 4-8).

Table 4-8 Typical annual maintenance requirements UV systems

Affected components	Required work
Quartz tube	Clean
UV sensor	Clean
Manual cleaning	Check wear parts, rings and seals
Automatic cleaning	Check wear parts, rings and seals
Lamps	Check service hours and replace if necessary

Additionally every 3 years the following maintenance should be carried out (Table 4-9)

Table 4-9 Preventative maintenance requirements UV systems

Affected components	Required work
Quartz tube	Replace
Manual cleaning	Replace wear parts, rings and seals
Automatic cleaning	Replace wear parts, rings and seals
PT-100	Replace the flat gasket

4.4.3 Shut-down Prevention Requirements

If the system is going to be out of operation for more than two weeks, the UV disinfection unit needs to be shut down (Table 4-10).

Table 4-10 Shut-down Prevention Requirements

Parts affected	Required work
Shutoff devices	Shut off the inlets and outlets
UV disinfection unit	Switch the UV disinfection unit off at the emergency OFF main switch
	Empty the UV disinfection unit
	If not used for water, rinse the disinfection chamber with fresh water And then drain again
	Fill the disinfection chamber with fresh water

4.5 Summary

From the information presented in the preceding sections, a summary of the outer limits of the operating conditions of the proposed INNOQUA technologies is presented in Table 4-11.

Table 4-11 Identified Requirements/Restrictions on Influent Waste Water to INNOQUA Technologies

Specific Requirements/Restrictions on Incoming Wastewaters	Lumbrifilter	Daphniafilter	BSP	Pulse UV
Concentration of nutrients in wastewater above which operation of technology is negatively effected	800 mg/l BOD ₅ 2,000 mg/l COD	P > 5-7 ppm. Cu > 0.01 ppm. N > 250 mg NO ³ /l. Salinities > 3.0 ppt	-	-
Restricted detergents or other disinfecting agents (i.e. the presence of which operation of technology is negatively affected)	No for usual household disinfectants detergents etc	Extremely sensitive to copper, zinc, pesticides, detergents, bleaches.	Hypochlorite	-
Minimum temperature of incoming wastewater (i.e. temp below which operation of technology is negatively affected) (°C)	5	10	10	5
Optimal temperature range of incoming waste water (°C - °C)	15 – 20	18 - 23	25	15 - 20
Maximum temperature of incoming waste water (i.e. temp above which operation of technology is negatively affected) (°C)	30	25	40	45
Is technology operable in direct sunlight	No	No	Indirect sunlight through light wells	Yes
Limiting pH value of incoming waste water (upper limit)	9	9.5	11	
Optimal pH value range of incoming wastewater	7 – 8		8	
Limiting pH value of incoming waste water (Lower Limit)	6		6	
Limiting dissolved oxygen in incoming waste water (mg/L)	2 - 4		no limits	

The expected physical and chemical characteristics given in Chapter 2 of this report are considered in terms of the limits indicated in the Table above.

The range of expected influent water temperatures at the demonstration sites is 13°C – 27°C which is generally within the most onerous range from the table above of 10°C – 25°C. Additional testing may be necessary to confirm the maximum upper limit of water temp of 25°C at the daphnia filter.

The range of expected influent water pH at the demonstration sites is 7.1 – 8.2 which is within the range of most technologies and generally meets the prevailing optimum pH operating range of 7 - 8. Additional testing may be necessary to confirm the maximum upper limit of water temp of 25°C at the daphnia filter.

The lumbrifilter operating range upper limit for BOD₅ and COD is given as 800 mg BOD₅/l and 2,000 mg COD/l, respectively. With the exception of the agricultural demonstration site in Ireland and the Peruvian demonstration site, all of the demonstration sites expect effluent of BOD₅ and COD content less than or (in the case of in the case of France) at this upper limit). Additional, testing may be required at the Peruvian demonstration site to clarify these high anticipated organic load levels. In the case of the agricultural demonstration site in Ireland, the waste water to be treated will be liquor arising from primary settlement, which in itself, is likely to dramatically reduce the BOD₅ and COD concentrations. This will be the subject of testing to clarify.

5 Towards an Integrated INNOQUA System

In line with Project Task 2.1, the objectives with respect to the efficiency of the Integrated INNOQUA system are presented here as well as the likely maintenance, shut-down prevention and restart of microbiological activity requirements of the integrated system. The modular nature of the proposed INNOQUA solution facilitates the flexibility to suit the various target markets. In general three options are considered

- The INNOQUA **Base System** comprising Lumbrifilter + Daphniafilter + Monitoring and Control Unit;
- The INNOQUA **Advanced System** comprising Lumbrifilter + Daphniafilter + UV Disinfection + Monitoring and Control Unit;
- The INNOQUA **Sunny System** comprising Lumbrifilter + BSP + UV Disinfection + Monitoring and Control Unit;

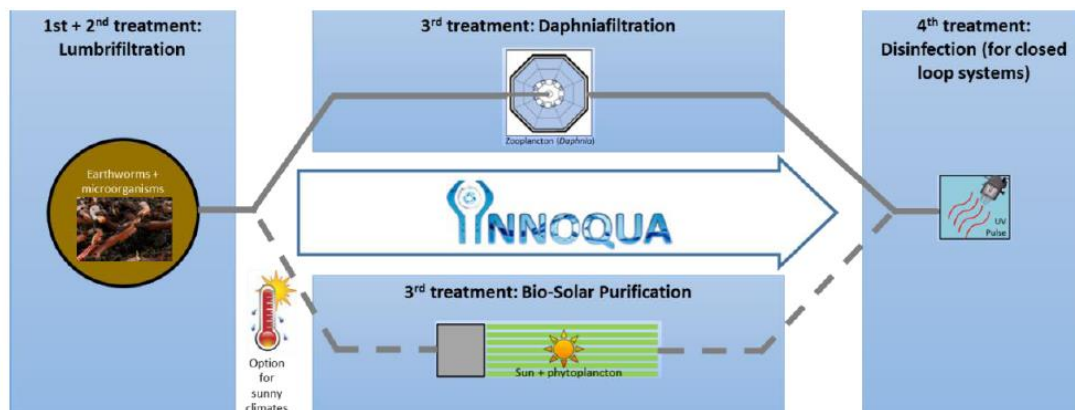


Figure 5-1 INNOQUA Concept

5.1 Efficiency Objectives - Integrated Treatment INNOQUA System

The performance requirements of the integrated INNOQUA system will as a minimum be required to meet the limiting values at the demonstration site for which they are intended. The effluent requirements have been identified in Chapter 3.

The following Tables compare the required removal efficiencies at each of the demonstration sites for treated wastewater to be discharged, as outlined in Table 3-6 Effluent Requirements Minimum % Reduction in Parameters, with proven removal efficiencies offered by the individual INNOQUA Technologies; outlined in Chapter 4, Table 4-2, Table 4-4, Table 4-5 and Table 4-7.

Where a proven removal efficiency offered by an individual INNOQUA Technology does not meet the required removal efficiency, the value is shown shaded in the Tables below. It is noted that the removal efficiency results offered by each of the individual technologies are preliminary and based on historical tests, additional testing will be carried out to determine the efficiency of the technologies in series.

Table 5-1 Required Suspended Solids (SS) (mg/L) Reduction Efficiency and INNOQUA Technology Efficiency

Ref	Country	Required Removal Efficiency	Removal Efficiency of INNOQUA Technologies			
		SS	Lumbrifilter	Daphnia Filter	BioSolar Purification	UV Disinfection
1.	Ireland	90%	93.19%	99%	96%	-
2.	Spain	90%	93.19%	99%	96%	-
3.	Ireland-Agri	n/a				
4.	France	90%	93.19%	99%	96%	-
5.	Italy	90%	93.19%	99%	96%	-
6.	France	90%	93.19%	99%	96%	-
7.	UK-Scotland	95%	93.19%	99%	96%	-
8.	Turkey	-	-	-	-	-
9.	Romania	-	-	-	-	-
10.	Ecuador	-	-	-	-	-
11.	Peru	-	-	-	-	-
12.	Tanzania	-	-	-	-	-
13.	India	92%	93.19%	99%	96%	-

As noted in Chapter 4, there is general agreement in the required SS removal efficiency at each of the European demonstration sites in terms of reduction in suspended solids requirement. The required reduction at each site given in Table 5-1 is well matched and in most cases exceeded by the expected performance of the INNOQUA Technologies.

Table 5-2 Required Carbon Oxygen Demand (COD) (mg/L) Reduction Efficiency and INNOQUA Technology Efficiency

Ref	Country	Required Removal Efficiency	Removal Efficiency of INNOQUA Technologies			
		COD	Lumbrifilter	Daphnia Filter	BioSolar Purification	UV Disinfection
1.	Ireland	75%	88.58%	-	97%	-
2.	Spain	75%	88.58%	-	97%	-
3.	Ireland-Agri	n/a				
4.	France	75%	88.58%	-	97%	-
5.	Italy	75%	88.58%	-	97%	-
6.	France	75%	88.58%	-	97%	-

7.	UK-Scotland	95%	88.58%	-	97%	-
8.	Turkey	-	-	-	-	-
9.	Romania	-	-	-	-	-
10.	Ecuador	-	-	-	-	-
11.	Peru	-	-	-	-	-
12.	Tanzania	-	-	-	-	-
13.	India	91%	88.58%	-	97%	-

Similar to SS, the required reduction in COD at each site as given in Table 5-2 is well matched and in most cases exceeded by the expected performance of the INNOQUA Technologies

Table 5-3 Required Biochemical Oxygen Demand (BOD₅) (mg/L) Reduction Efficiency and INNOQUA Technology Efficiency

Ref	Country	Required Removal Efficiency	Removal Efficiency of INNOQUA Technologies			
		BOD ₅	Lumbrifilter	Daphnia Filter	BioSolar Purification	UV Disinfection
1.	Ireland	70%	97.52%	-	99%	-
2.	Spain	70%	97.52%	-	99%	-
3.	Ireland-Agri	n/a				
4.	France	80%	97.52%	-	99%	-
5.	Italy	70%	97.52%	-	99%	-
6.	France	70%	97.52%	-	99%	-
7.	UK-Scotland	95%	97.52%	-	99%	-
8.	Turkey	-	-	-	-	-
9.	Romania	-	-	-	-	-
10.	Ecuador	-	-	-	-	-
11.	Peru	-	-	-	-	-
12.	Tanzania	-	-	-	-	-
13.	India	96%	97.52%	-	99%	-

For BOD₅, the required reduction at each site as given in Table 5-3 is exceeded by the expected performance of the INNOQUA Technologies

Table 5-4 Required Nitrogen (N) (mg/L) Reduction Efficiency and INNOQUA Technology Efficiency

Ref	Country	Required Removal Efficiency	Removal Efficiency of INNOQUA Technologies			
			BOD ₅	Lumbrifilter	Daphnia Filter	BioSolar Purification
1.	Ireland	70%	73.12%	47%	68%*	-
2.	Spain	70%	73.12%	47%	68%*	-
3.	Ireland-Agri	n/a				
4.	France	70%	73.12%	47%	68%*	-
5.	Italy	70%	73.12%	47%	68%*	-
6.	France	70%	73.12%	47%	68%*	-
7.	UK-Scotland	95%	73.12%	47%	68%*	-
8.	Turkey	-	-	-	-	-
9.	Romania	-	-	-	-	-
10.	Ecuador	-	-	-	-	-
11.	Peru	-	-	-	-	-
12.	Tanzania	-	-	-	-	-
13.	India	95%	73.12%	47%	68%*	-

*(TKN) Total Kjeldhal Nitrogen

For Nitrogen, the required reduction at each site as given in Table 5-4 is provided only by the performance of the BSP Technology.

Table 5-5 Required Phosphorous (P) (mg/L) Reduction Efficiency and INNOQUA Technology Efficiency

Ref	Country	Required Removal Efficiency	Removal Efficiency of INNOQUA Technologies			
			P	Lumbrifilter	Daphnia Filter	BioSolar Purification
1.	Ireland	80%	17.59%	58%	80%	-
2.	Spain	80%	17.59%	58%	80%	-
3.	Ireland-Agri	n/a				
4.	France	80%	17.59%	58%	80%	-
5.	Italy	80%	17.59%	58%	80%	-
6.	France	80%	17.59%	58%	80%	-
7.	UK-Scotland	80%	17.59%	58%	80%	-
8.	Turkey	-	-	-	-	-

9.	Romania	-	-	-	-	-
10.	Ecuador	-	-	-	-	-
11.	Peru	-	-	-	-	-
12.	Tanzania	-	-	-	-	-
13.	India	95%	17.59%	58%	80%	-

In the case of phosphorous, the required reduction at each site as given in Table 5-5 is provided only by the performance of the BSP Technology.

The following outlines the current proposals for application of each system at the identified demonstration sites, these will subject to review.

Table 5-6 Potential INNOQUA Systems at Demonstration Sites

Ref.	Country	INNOQUA Technology*				Comment
		Lumbri	Daphnia	BSP	UV	
1.	Ireland	✓	✓	x	✓	Controlled test facility – low levels of solar may be unsuitable for BSP
2.	Spain	✓	✓	✓	✓	Controlled test facility
3.	Ireland-Agri	✓	X	X	✓	Core technology to treat and UV for re-use
4.	France-NBK	✓	✓	X	✓	
5.	Italy	✓	✓	✓	X	
6.	France	✓	✓	✓	X	
7.	UK-Scotland	✓	X	✓	X	
8.	Turkey	✓	✓	✓	✓	
9.	Romania	✓	X	✓	X	
10.	Ecuador	✓	✓	✓	✓	
11.	Peru	✓	✓	✓	✓	
12.	Tanzania	✓	✓	✓	✓	Sunny climate and proposed re-use
13.	India	✓	✓	✓	X	

*Suitable monitoring and control is required at each site

5.2 Maintenance - Integrated INNOQUA System

All INNOQUA technologies require maintenance to ensure performance, durability and operation, these requirements for the individual technologies are described in Chapter 4. The lumbrifilter and daphniafilter require visual inspection once a week to check the state of living organisms, the BSP system also requires visual inspection, once per day during start-up and once per week during the day-to-day operation, and finally the UV Pulse requires monthly cleaning of the quartz sleeve and monitoring depending of water quality.

All these routine tasks, which require human intervention, can incur inconsistencies and human error. The INNOQUA project proposes the integration of these maintenance tasks in the Monitoring and Control Unit (MCU) through the Technology Maintenance Module (TMM) minimizing these possible points of failure. The TMM can manage and trigger maintenance rules linked to maintenance notifications or actions. The maintenance notifications advise INNOQUA users of a required maintenance task through MCU Graphical User Interface (GUI) prompt (e.g. ‘a visual inspection of the daphnia population is required...’).

The automation of maintenance actions is also envisaged to perform operations related to routine or required maintenance (e.g. activate the motor responsible for stirring of the lumbricomposter...). This maintenance module will be managed by using MCU Graphical User Interface (GUI) which will allow the following;

- (i) create/read/update/delete maintenance rules;
- (ii) list the executed maintenance notifications/actions;
- (iii) shows the active maintenance notifications/actions.

The list of general consideration to be taken into account by the TMM are presented in the Table 5-7. It is important to note that the requirements from 21 to 30 are aligned with the first draft of maintenance rules extracted from Chapter **Erreur ! Source du renvoi introuvable.** of this report and these may be subject to revision in the course of the INNOQUA project in particular following the prototyping and demonstration activities to be carried out during WP4.

Table 5-7 Technology Maintenance Module requirements

N.	F/NF*	Description
1	F	The MCU GUI allows to create rules to trigger maintenance notifications/actions (e.g. if condition then action/notification)
2	F	The MCU GUI allows to Create/Read/Update/Delete maintenance and their linked notifications/actions.
3	F	The MCU GUI allows to list the executed maintenance notifications/actions.
4	F	The MCU GUI shows the active maintenance notifications/actions.
5	F	The maintenance notifications/actions are triggered by scheduled tasks (scheduled rules) or the assessment of new measured values (threshold rules) (e.g. if it is first day of month then ... or pH value is greater than 9 then ...)
6	NF	The maintenance rules are defined for start-up and/or day-to-day of each technology
7	NF	The threshold rules are comprised of an observation (e.g. daphnia tank temperature, lumbrifilter inflow water ph, ...), a condition (>, >=, <, <=, ==) and a proceeding (notification or action)
8	NF	The scheduled rules are comprised of a scheduling (daily, weekly...) and a proceeding (notification or action)
9	NF	The scheduled rules support multiple temporal scales such as daily, weekly, monthly, annual, ...

10	NF	The action consists of a electric device (e.g. suction pump of the Daphnia tank) and a behaviour (e.g. switch on) which will be transformed on an electrical signal (e.g. analogical or digital)
11	NF	The notification consists of a human-readable message
12	F	The rules are evaluated constantly on background by the TMM checking new measurements or scheduling tasks
13	NF	The MCU GUI should to be accessible from multiples devices such as laptop, mobile phone
14	NF	The TMM should to be deployed in IoT infrastructure
15	NF	Ensure a high availability of the TMM
16	NF	Ensure a high robustness facing unwanted situations (e.g. measurements of a sensor are not received)
17	NF	The new measurements shall be analysed in near real-time
18	NF	Ensure the scalability of the system (e.g. new sensors, new maintenance rules, ...)
19	NF	The responsiveness of the TTM should not exceed one minute once the new measures has been read by the MCU
20	NF	The usability of the software should be fomented by using status visibility, consistency of the views, error prevention, efficiency of use, aesthetic and minimalist design, avoid irrelevant information, avoid unnecessary steps, provide error messages using plain language indicating the problem and constructively suggest a solution
21	F	Notify once a week that the lumbrifilter requires a visual inspection
22	F	Notify once every four months that the lumbrifilter requires more forest wood chips to maintain the level of the biofilter
23	F	Notify once a week that the lumbrifilter requires a visual inspection
24	F	Notify once a month that the lumbri-composter should to be stirred
25	F	Notify once a month that sprinkler nozzles of the lumbrifilter should to be checked
26	F	Notify once every week that the daphnia tanks requires a visual inspection for Daphnia control
27	F	Notify once every week that the daphnia tanks requires cleaning
28	F	Notify once every week that the light wells of the bio-solar technology should to be cleaned
29	F	Notify once every day that the water circulation and gas exchange system of the bio-solar technology requires visual inspection during start-up
30	F	Notify once every week that the water circulation and gas exchange system of the bio-solar technology requires visual inspection during day-to-day

(* F – Functional/NF – Non-functional)

5.3 Shut-down Prevention - Integrated INNOQUA System

The use of living organisms in the INNOQUA solution and other environmental technologies brings with it some particular requirements to ensure the survival of these organisms, e.g., as outlined in Chapter 4, the worms of the lumbrifilter and the daphnia are sensitive to temperature, pH and dissolved oxygen. In addition, BSP is sensitive to temperature and pH and UV operation is only likely to suffer under extreme conditions.

The INNOQUA project proposes to integrate in the MCU a centralised Shutdown Prevention Module (SPM) to monitor and analyse constantly the technologies state to avoid failure/shut-down events that may negatively affect the systems and in particular the living organisms. The SPM will be designed to manage and execute shut-down rules that are linked to notifications or actions. Such notifications will advise INNOQUA users of a shut-down prevention action and its reasons through MCU GUI (e.g. show a shutdown alert when the temperature of the daphnia tank exceed or equal 25°C). Recommended actions are focused on performing operations to effect a shutdown (e.g. close a solenoid valve to avoid the inflow water). Finally, this SPM module will allow the following;

- (i) create/read/update/delete shutdown rules linked with notification/actions;
- (ii) list the triggered shutdown notifications/actions;
- (iii) shows the active shutdown notifications/actions.

Below, Table 5-8 lists the general considerations to be taken into account by the shut-down prevention module. In the same way of previous section, this table also contains a first draft of the rules (From 19 to 39). These are likely to be modified following prototype and demonstration site test in WP4. The addition of controllable devices in the final INNOQUA design will also likely refine the rules.

Table 5-8: Shutdown Prevention Module requirements (F – Functional/NF – Non-functional)*

N.	F/NF*	Description
1	F	The MCU GUI allows to create rules to trigger shut-down prevention notifications/actions (e.g. if condition then action/notification)
2	F	The MCU GUI allows to Create/Read/Update/Delete shut-down prevention rules and their associated notifications/actions
3	F	The MCU GUI allows to list the triggered shut-down prevention notifications/actions
4	F	The MCU GUI shows the active shut-down prevention notifications/actions
5	F	The shutdown prevention notifications/actions are triggered by the assessment of measured values by the MCU (e.g. if pH of lumbrifilter is greater than 11 then ...)
6	F	The shutdown prevention rules are defined for start-up and/or day-to-day of each technology
7	NF	The rules are comprised of an observation (e.g. daphnia tank temperature, lumbrifilter inflow water ph, ...), a condition (>, >=, <, <=, ==) and a proceeding (notification or action)

8	NF	The action consists of a variable (e.g. solenoid valve previous) and a behaviour (e.g. switch off the solenoid valve) which will be transformed on an electrical signal (e.g. analogical or digital)
9	NF	The notification consists of a human-readable message
10	F	The rules are evaluated constantly on background by the SPM checking new measurements
11	NF	The MCU GUI should to be accessible from multiples devices such as laptop, mobile phone
12	NF	The SPM module should to be deployed in IoT infrastructure
13	NF	Ensure a high availability of the SPM module
14	NF	Ensure a high robustness facing unwanted situations (e.g. measurements of a sensor are not received)
15	NF	The new measurements shall be analysed in near real-time
16	NF	Ensure the scalability of the system (e.g. new sensors, new maintenance rules, ...)
17	NF	The responsiveness of the SPM module should not exceed one minute once the new measures has been read by the MCU
18	NF	The usability of the software should be fomented by using status visibility, consistency of the views, error prevention, efficiency of use, aesthetic and minimalist design, avoid irrelevant information, avoid unnecessary steps, provide error messages using plain language indicating the problem and constructively suggest a solution
19	F	Notify a prevention shut-down if the inflow water temperature of the lumbrifilter exceeds o reaches 5°C
20	F	Notify a prevention shut-down if the inflow water temperature of the lumbrifilter does not reach 30°C
21	F	Notify a prevention shut-down if the inflow water temperature of the lumbrifilter exceeds o reaches a pH of 6
22	F	Notify a prevention shut-down if the inflow water temperature of the lumbrifilter does not reach a pH of 9
23	F	Notify a prevention shut-down if the inflow water temperature of the lumbrifilter exceeds o reaches a dissolved oxygen concentration of 4 mg/L
24	F	Notify a prevention shut-down if the inflow water temperature of the lumbrifilter does not reach a dissolved oxygen concentration of 2 mg/L
25	F	Notify a prevention shut-down if the inflow water temperature of the lumbrifilter exceeds o reaches 5°C
26	F	Notify a prevention shut-down if the inflow water temperature of the lumbrifilter does not reach 30°C
27	F	Notify a prevention shut-down if the inflow water temperature of the daphniafilter exceeds o reaches 10°C
28	F	Notify a prevention shut-down if the inflow water temperature of the daphniafilter does not reach 25°C

29	F	Notify a prevention shut-down if the inflow water temperature of the daphniafilter exceeds o reaches a pH of 6
30	F	Notify a prevention shut-down if the inflow water temperature of the daphniafilter does not reach a pH of 9.5
31	F	Notify a prevention shut-down if the inflow water salinity concentration of the daphniafilter exceeds o reaches 3ppm
32	F	Notify a prevention shut-down if the inflow water phosphorus concentration of the daphniafilter exceeds o reaches 7ppm
33	F	Notify a prevention shut-down if the inflow water phosphorus concentration of the daphniafilter does not reach 5ppm
34	F	Notify a prevention shut-down if the inflow water cupric concentration of the daphniafilter exceeds o reaches 0.01ppm
35	F	Notify a prevention shut-down if the inflow water ammonia concentration of the daphniafilter exceeds o reaches 250mg NO ₃ /l
36	F	Notify a prevention shut-down if the inflow water temperature of the bio-solar technology exceeds o reaches 10
37	F	Notify a prevention shut-down if the inflow water temperature of the bio-solar technology does not reach 40
38	F	Notify a prevention shut-down if the inflow water pH of the bio-solar technology exceeds o reaches 11
39	F	Notify a prevention shut-down if the inflow water pH of the bio-solar technology does not reach 6

(* F – Functional/NF – Non-functional)

5.4 Restart of Microbiological Activity - Integrated INNOQUA System

The restart of microbiological activity is particular to each technology and this is not integral to the MCU. Restart requires initialising the scheduling of the maintenance rules of the technology and executing operations particular to start-up activities; these will likely require additional monitoring monitoring reduced flow etc etc. The module responsible for perform these actions is the Restart Module (RM) which will also be integrated in the MCU as the previous modules (see preceding sections)

Table 5-9 lists the general considerations to be taken into account by RM.

Table 5-9 Restart Module requirements

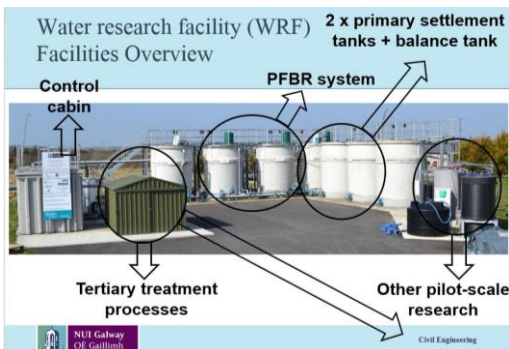

N.	F/NF*	Description
1	NF	The MCU incorporates the RM through the MCU GUI
2	NF	The restart of each technology is launched separately by the user (only for lumbrifilter, daphniafilter and bio-solar technology)
3	F	The restart of a technology initializes the scheduled maintenance tasks linked to this technology
4	F	The restart of a technology changes the state of technology from day-to-day operation to start-up
5	NF	The RM is accessible from multiples devices such as laptop, mobile phone through MCU GUI
6	NF	The RM module is deployed in IoT infrastructure
7	NF	Ensure a high availability of the RM
8	NF	Ensure a high robustness facing unwanted situations (e.g. unstable values of the scheduling)
9	NF	Ensure the scalability of the system (e.g. new technologies integrated in the MCU)
10	NF	The responsiveness of the RM module should not exceed one minute once the restart has been launched
11	NF	The usability of the software should be fomented by using status visibility, consistency of the views, error prevention, efficiency of use, aesthetic and minimalist design, avoid irrelevant information, avoid unnecessary steps, provide error messages using plain language indicating the problem and constructively suggest a solution

(* F – Functional/NF – Non-functional)

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Appendix A - Demonstration Site Characteristics


1. NUI Galway Controlled Demo Site (Ireland)	
Name of Partner(s) Responsible for Demonstration Site	NUIG
Name and Country of Demonstration Site	NUIG Water research Facility (WRF) Tuam, Galway, Ireland
Will the Site be permanently manned/occupied (describe)	The WRF is not permanently manned however is directly adjacent to the Tuam Municipal Wastewater Facility
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	During test periods, out of hours contact details will be provided to the Tuam Municipal Wastewater Facility
Description of Proposed Demonstration Site (Include Photos/Images)	<p>WRF is a full scale test facility for innovative water, wastewater and waste treatment technologies. The WRF is located on the site of the Tuam Wastewater Treatment Plant (TWWTP), Co. Galway, and can treat a side-stream of the TWWTP influent for a population equivalent to a town of up to 400 people. For more info http://www.nuigalway.ie/engineering-informatics/civil-engineering/facilities/fullscalefacilitiesoutdoorunits/nuigalwayeparesearchfacility/</p> 
Location Geography and Climate	
Demonstration Site Address	Killaloony, Tuam, County Galway, Ireland
Geographical Location	The WRF is located on the outskirts of Tuam, Co Galway. Tuam is the second largest settlement in County Galway and has a population of over 8,000. It is situated in the west of Ireland, approximately 30 km north of Galway city and 190 km west of the Country Capital Dublin.
Annual Average Rainfall (mm/year)	1,400 mm/year (based on mapping mean annual rainfall from Met Eireann 1981 - 2010)
Annual Temperature Range (Min - Max degrees C)	
Description of Existing Terrain	Generally flat agricultural land 

Planning & Regulation	
Current Use of Site	NUIG Research Facility
Current Occupant of Site	NUIG
Owner of Site	NUIG
Details of Existing Planning Permission If Any	Water Research Facility
Limitations on Usage of Site (If Any)	n/a
Description of Adjacent Environment	Mainly agricultural lands, some light industry to the north and
Distance to Nearest Building/Development	Directly adjacent to Tuam Municipal WWTP
Nature of Building/Development Nearest to Installation Site	Municipal Wastewater treatment facility
Is it Intended that the installation of the Innoqua Treatment Technology be a permanent installation	No however this is not precluded
Details of Existing Effluent Discharge Consents If Any	Not required as no direct effluent discharge water course /groundwater - Effluent discharges to the influent stream of the municipal treatment plant
Is Planning Consent Required for Installation on the Demonstration Site	Existing Planning Consent
Description (including likely timeframe) of Any Planning Consent Required	n/a
Name of Planning Authority and Reference of Regulation Requiring Planning	Galway County Council
Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	n/a
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	n/a
Details of Existing Effluent Discharge Consents (If Any) at the Site	Galway County Council as part of planning consent to discharge to sewer connection to TWWTP influent mains
Will Additional/new Effluent Discharge Consents Be required	no
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge	n/a
Name of Authorising/Certification Body	n/a
Site Access	
How is the site accessed (access road width, is it public or private, is it paved and off easily traversable gradient etc)	Access via public road paved easily traversable
Detail any potential limitations to transport of units unto the site by truck and/or crane	none
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	30 km north of Galway city

Services (Water, Electricity and Communications)	
Is Mains Electricity Currently at Site	Yes
What is the distance to electrical supply	onsite
What is the Voltage of the Electrical supply	230 Volt
Is there an issue with load shedding/power interruptions	no
Is there fixed telephone line	yes
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	Yes 2G, 3G, 4G although variable signal strength ref http://opensignal.com/networks/ireland/3-coverage
Preliminary Design of Installation	
Is the Unit to be above or below ground	Above ground
Onsite ground conditions (soil type / location of rock etc)	TBC
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	Unit to be connected to influent line of Tuam WWTP
Access arrangements;	Public Road


2. UDG Controlled Demonstration Site (Spain)	
Name of Partner(s) Responsible for Demonstration Site	UdG (University of Girona)
Name and Country of Demonstration Site	Spain
Will the Site be permanently manned/occupied (describe)	Not permanently. Management checked every day. Monitored
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	Quart city WWTP (situated 5km distance between WWTPs)
Description of Proposed Demonstration Site (Include Photos/Images)	Waste water treatment plant situated in Llambilles town. It is designed to fulfil the requirements of 1153 PE with a daily flow of 277m ³ . It has not a primary treatment. Inflow goes directly to a secondary treatment with activated sludge process.
Location Geography and Climate	
Demonstration Site Address	Waste water treatmet station. Carrer de les Conques, 1. 17243-Llambilles
Geographical Location	North East of Spain. 100km North East from Barcelona
Annual Average Rainfall (mm/year)	737 mm/year
Description of Existing Terrain	
Planning & Regulation	
Current Use of Site	
Current Occupant of Site	
Owner of Site	Agència Catalana de l'Aigua (ACA)
Details of Existing Planning Permission If Any	
Limitations on Usage of Site (If Any)	
Description of Adjacent Environment	Situated close to farms and agricultural fields. Next to Bugantó stream
Distance to Nearest Building/Development	100 m
Nature of Building/Development Nearest to Installation Site	industry
Is it Intended that the installation of the INNOQUA Treatment Technology be a permanent installation	yes
Details of Existing Effluent Discharge Consents If Any	Innoqua discharge will be recirculated to the inflow of the secondary treatment of the WWTP
Is Planning Consent Required for Installation on the Demonstration Site	yes
Description (including likely timeframe) of Any Planning Consent Required	
Name of Planning Authority and Reference of Regulation Requiring Planning	ACA
Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	ACA
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	ACA
Details of Existing Effluent Discharge Consents (If Any) at the Site	

Will Additional/new Effluent Discharge Consents Be required	
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge	
Name of Authorising/Certification Body	
Site Access	
How is the site accessed (access road width, is it public or private, is it paved and off easily traversable gradient etc)	Paved road. Easily accessible and close to the main road from Girona to Llambilles
Detail any potential limitations to transport of units unto the site by truck and/or crane	
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	
Services (Water, Electricity and Communication)	
Is Mains Electricity Currently at Site	Yes
What is the distance to electrical supply	50 m maximum
What is the Voltage of the Electrical supply	
Is there an issue with load shedding/power interruptions	
Is there fixed telephone line	
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	
Preliminary Design of Installation	
Is the Unit to be above or below ground	above ground
Onsite ground conditions (soil type / location of rock etc)	
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	
Schematic Arrangement for Installation Works Effluent Outfall	





3. Privately Operated Farm – Operational Demo Site (Ireland)	
Name of Partner(s) Responsible for Demonstration Site	NUIG
Name and Country of Demonstration Site	Private Dairy and Cattle Farm Craughwell, County Galway
Will the Site be permanently manned/occupied (describe)	Yes, although not by Project Participants
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	Contact NUIG Project Team
Description of Proposed Demonstration Site (Include Photos/Images)	200 acre approx. Cattle and Dairy Farm Craughwell, Co. Galway.
	
Location Geography and Climate	
Demonstration Site Address	Craughwell, Co. Galway
Geographical Location	West of Ireland, 50km East of Galway City and NUIG
Annual Average Rainfall (mm/year)	1,400 mm/year (based on mapping mean annual rainfall from Met Eireann 1981 - 2010)
Annual Temperature Range (Min - Max degrees C)	
Description of Existing Terrain	Generally flat agricultural land
Planning & Regulation	
Current Use of Site	Working Farm
Current Occupant of Site	Private Citizen known to Research Team
Owner of Site	As above
Details of Existing Planning Permission If Any	Agricultural and Domestic Activities
Limitations on Usage of Site (If Any)	n/a
Description of Adjacent Environment	Agricultural and Residential Environment
Distance to Nearest Building/Development	200m
Nature of Building/Development Nearest to Installation Site	residential
Is it Intended that the installation of the INNOQUA Treatment Technology be a permanent installation	No

Details of Existing Effluent Discharge Consents If Any	Dairy Farm discharging waste to waste holding tank on site – emptied by slurry spreading in accordance with regulations
Is Planning Consent Required for Installation on the Demonstration Site	No
Description (including likely timeframe) of Any Planning Consent Required	n/a
Name of Planning Authority and Reference of Regulation Requiring Planning	n/a
Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	n/a
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	No Consent applicable but regulation Statutory Instrument S.I. No. 31 of 2014 [European Union (Good Agricultural Practice for Protection of Waters) Regulations 2014] applies
Details of Existing Effluent Discharge Consents (If Any) at the Site	As above
Will Additional/new Effluent Discharge Consents Be required	No

Site Access	
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge	No
Name of Authorising/Certification Body	n/a
How is the site accessed (access road width, is it public or private, is it paved and off easily traversable gradient etc)	Easily traversable public road and paved farm tracks
Detail any potential limitations to transport of units unto the site by truck and/or crane	No
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	Craughwell 5 km
Services (Water, Electricity and Communications)	
Is Mains Electricity Currently at Site	Yes
What is the distance to electrical supply	Adjacent
What is the Voltage of the Electrical supply	230 Volts
Is there an issue with load shedding/power interruptions	No
Is there fixed telephone line	Adjacent
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	3G
Preliminary Design of Installation	
Is the Unit to be above or below ground	Above, Lumbrifilter Unit only
Onsite ground conditions (soil type / location of rock etc)	
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	Outfall to waste holding tank
Schematic Arrangement for Installation Works Effluent Outfall	Single 10 PE system to be installed above ground adjacent milking parlour

4. Aquaculture Facility - Operational Demo Site (France)	
Name of Partner(s) Responsible for Demo Site	EPLEFPA (Teaching Local Public Establishment for Agricultural and Vocational Training)
Name and Country of Demonstration Site	France
Will the Site be permanently manned/occupied (describe)	Yes, educational site and breeding and rearing of fish
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	Alarm system in case of failure, sms message
Description of Proposed Demonstration Site (Include Photos/Images)	
Location Geography and Climate	
Demonstration Site Address	Lycée Louis PASTEUR / EPLEFPA de la Lozere / Chemin Fraissinet / 48500 La Canourgue
Geographical Location	Approximately 0.5 km northeast of the municipality of La Canourgue and 160 km north of the city of Montpellier
Annual Average Rainfall (mm/year)	Over the year, the total average sum of precipitation is 697 mm. The wettest month is May
Annual Temperature Range (Min - Max degrees C)	The hottest month of the year is that of July with a max temperature of 26.6 °C. The coldest month of the year is that of January with a min temperature of -0.5 °C.
Description of Existing Terrain	The sites to host lumbrifiltration and lumbri-composting devices are on flat terrain and out flood risk
Planning & Regulation	
Current Use of Site	Aquaculture Farm source of Frézal
Current Occupant of Site	Lycée Louis Pasteur - aquaculture site of La Canourgue
Owner of Site	Public Establishment (State - Region)
Details of Existing Planning Permission If Any	
Limitations on Usage of Site (If Any)	Architectural patrimony classified site
Description of Adjacent Environment	Prairies, forestry and agricultural parcels
Distance to Nearest Building/Development	About 200 meters
Nature of Building/Development Nearest to Installation Site	College and a group of houses
Is it Intended that the installation of the INNOQUA Treatment Technology be a permanent installation	YES, for the treatment and recycling of wastewater and sludge of aquaculture and aquaponic
Details of Existing Effluent Discharge Consents If Any	TBC
Is Planning Consent Required for Installation on the Demonstration Site	TBC
Description (including likely timeframe) of Any Planning Consent Required	TBC
Name of Planning Authority and Reference of Regulation Requiring Planning	TBC

Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	TBC
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	TBC
Details of Existing Effluent Discharge Consents (If Any) at the Site	TBC
Will Additional/new Effluent Discharge Consents Be required	TBC
Description (incl timeframe) of Additional Consent for Additional/New Effluent Discharge	TBC
Name of Authorising/Certification Body	TBC
Site Access	
How is the site accessed (access road width, is it public or private, is it paved and off easily traversable gradient etc)	Easy local road access
Detail any potential limitations to transport of units unto the site by truck and/or crane	No problems accessing within the site to the places of installation of the lumbrifiltration and lumbricomposting. Roads mostly paved, width 3 meters
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	La Canourgue, the nearest commercial centre is 600 meters away, local road
Services (Water, Electricity and Communication)	
Is Mains Electricity Currently at Site	YES
What is the distance to electrical supply	From 10 to 15 meters
What is the Voltage of the Electrical supply	230 Volts AC and 400 Volts AC
Is there an issue with load shedding/power interruptions	No
Is there fixed telephone line	Yes
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	ADSL, RTC, Cable, Wi-Fi
Preliminary Design of Installation	
Is the Unit to be above or below ground	Above ground (Lumbrifiltration and lumbricomposting)
Onsite ground conditions (soil type / location of rock etc)	Soil composed of limestone, sandstone and granite
Summary	<p>No need for excavation, filling only a small pond of 12 x 7 meters for lombr aquaculture and aquaponics sludge</p> <p>no existing installations to dismantle or relocate</p> <p>YES, construction of two sheds, one for lumbrifiltration (6 x 4 meters) and lumbricomposting (8 x 4 meters) required</p>

5. Domestic Building – Operational Demo Site (Italy)	
Name of Partner(s) Responsible for Demo Site	DE5 Services SRL
Name and Country of Demonstration Site	Single Family House - Italy
Will the Site be permanently manned/occupied (describe)	Now it is under construction, but as soon as the construction phase is finished the house will be sold. The new propriety will sign an agreement to allow the possibility to have the INNOQUA system installed.
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	Day to day follow up by the Demonstration site Manager
Description of Proposed Demonstration Site (Include Photos/Images)	<p>The Demo site is a single family housing unit placed in Vasto (Abruzzo region). It is currently under construction. This house is located in a protected natural area near the Adriatic coast.</p>    
Location Geography and Climate	
Demonstration Site Address	Strada statatale 16 Adriatica - Vasto (Italy)
Geographical Location	In the eastern part of the Italy, It is distant 280 km from Rome, It is located on the coast, overlooking the Adriatic sea, about 70 Km from Pescara.
Annual Average Rainfall (mm/year)	73.02
Annual Temperature Range (Min - Max degrees C)	37.00 °C (MAX) / 0.3°C (MIN)
Description of Existing Terrain	Rocky
Planning & Regulation	
Current Use of Site	The demo site is under construction - Residential building
Current Occupant of Site	None
Owner of Site	DE5
Details of Existing Planning Permission If Any	Already available the construction permission released by the municipality of Vasto
Limitations on Usage of Site (If Any)	The space to install the INNOQUA system is limited and already fixed. The Innoqua system will be installed under a road ramp (more detail of the available space will follow as soon as possible)
Description of Adjacent Environment	Costal environment, both on the left and right side of the house there are not accessible proprieties. Behind the house there is the public road: Strada statale 16 Adriatica.
Distance to Nearest Building/Development	Around the demo site there are isolated groups of houses. The distance from the nearest city center about 1,5 Km
Nature of Building/Development Nearest to Installation Site	Residential building
Is it Intended that the installation of the INNOQUA Treatment Technology be a permanent installation	Yes

Details of Existing Effluent Discharge Consents If Any	No
Is Planning Consent Required for Installation on the Demonstration Site	None
Description (including likely timeframe) of Any Planning Consent Required	No
Name of Planning Authority and Reference of Regulation Requiring Planning	Municipality of Vasto - PUC (municipal development plan) - D.Lgs 152/06 (unique environmental Text)
Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	None
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	Municipality of Vasto / Provincia di Chieti
Details of Existing Effluent Discharge Consents (If Any) at the Site	Yes if we would like to implement the discharge of the effluent below the ground. The competent authority for this is the Provincia di Chieti (L.R. 29 Luglio 2010 n. 3, art. 4)
Will Additional/new Effluent Discharge Consents Be required	No
Description (incl timeframe) of Additional Consent for Additional/New Effluent Discharge	None
Name of Authorising/Certification Body	Municipality of Vasto
Site Access	
How is the site accessed	Public road, 3,50 m width, paved, not easily traversable gradient
Detail any potential limitations to transport of units unto the site by truck and/or crane	Road width 3,50 m - there will be the necessity of a small Truck with crane
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	Vasto marina - 1,5 Km distance to the demo site - good connection with the Statal road n. 16 (SS16)
Services (Water, Electricity and Communication)	
Is Mains Electricity Currently at Site	Yes
What is the distance to electrical supply	20 m
What is the Voltage of the Electrical supply	380V
Is there an issue with load shedding/power interruptions	No
Is there fixed telephone line	There will be when the construction phase finished
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	There will be when the construction phase finished
Preliminary Design of Installation	
Is the Unit to be above or below ground	Below the ground - under a road ramp
Onsite ground conditions (soil type / location of rock etc)	Rocks
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	

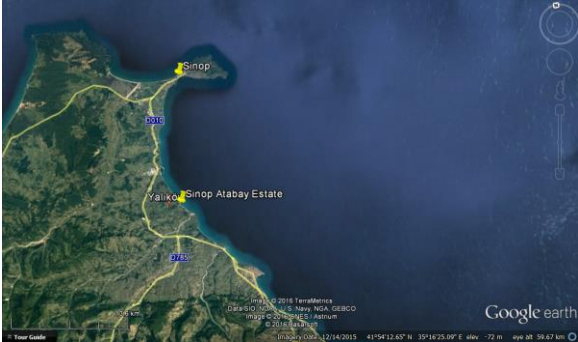

<p>Schematic Arrangement for Installation Works Effluent Outfall</p>	
<p>Summary</p>	<p>The installation will be in a closed space under a road ramp (Excavation are required). No dismantling or relocation of existing installations are required No relocation of extg utilities req'd The connection to the public network will be realized only for: (i) water, (ii) electricity, (III) telephone. In this area doesn't exist a public sewage network. Foundation are needed for the system It could be better to bring the INNOQUA system components and tanks before the construction of the road ramp</p>

6. Domestic/Commercial Building – Operational Demo Site (France)	
Name of Partner(s) Responsible for Demo Site	Nobatek (NBK)
Name and Country of Demonstration Site	France
Will the Site be permanently manned/occupied (describe)	The building is the Nobatek headquarter. It is occupied almost all days in the year and is used every day between 8 am and 8 pm.
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	Day to day follow up by the Demonstration site Manager (work on site)
Description of Proposed Demonstration Site (Include Photos/Images)	
Location Geography and Climate	
Demonstration Site Address	67 rue de Mirambeau, 64600 ANGLET, France
Geographical Location	extreme south west part of the country (close to the Spanish border)
Annual Average Rainfall (mm/year)	app. 1200 mm/year
Annual Temperature Range (Min - Max degrees C)	-5°C to +27°C
Description of Existing Terrain	Generally Flat
Planning & Regulation	
Current Use of Site	Tertiary - Office
Current Occupant of Site	Nobatek
Owner of Site	Nobatek
Details of Existing Planning Permission If Any	TBC
Limitations on Usage of Site (If Any)	No
Description of Adjacent Environment	
Distance to Nearest Building/Development	2m of the building (Nobatek headquarter), 2m of a road
Nature of Building/Development Nearest to Installation Site	Tertiary - Office
Is it Intended that the installation of the INNOQUA Treatment Technology be a permanent installation	No (at least for the moment) - The Innoqua technology will be used only during the project.
Details of Existing Effluent Discharge Consents If Any	
Is Planning Consent Required for Installation on the Demonstration Site	A priori No - TBC
Description (including likely timeframe) of Any Planning Consent Required	-
Name of Planning Authority and Reference of Regulation Requiring Planning	Anglet City Council
Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	A priori not needed - TBC
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	TBC
Details of Existing Effluent Discharge Consents (If Any) at the Site	TBC
Will Additional/new Effluent Discharge Consents Be required	Yes probably - TBC
Description (incl timeframe) of Additional Consent for Additional/New Effluent Discharge	TBC
Name of Authorising/Certification Body	TBC

Site Access	
How is the site accessed (access road width, is it public or private, is it paved and off easily traversable gradient etc)	Public road large enough for any truck (5 meter width) with classical bitumen
Detail any potential limitations to transport of units unto the site by truck and/or crane	No limitations, Huge construction works have been recently using this road
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	Anglet, 0,5 km, road links: same as access road (5m width and classical bitumen)
Services (Water, Electricity and Communication)	
Is Mains Electricity Currently at Site	Yes
What is the distance to electrical supply	5-10 m
What is the Voltage of the Electrical supply	220
Is there an issue with load shedding/power interruptions	No
Is there fixed telephone line	Yes
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	Wireless broadband, 3G, 4G, GPRS
Preliminary Design of Installation	
Is the Unit to be above or below ground	Below would be better but both is feasible
Onsite ground conditions (soil type / location of rock etc)	Soil characteristics: - From 0 to 30 cm: Vegetable earth and silt - From 30 cm to 90 cm: Grey to brown clay - From 90 cm to 1,50 m: Brown to beige clay - From 1,50 m to 2 m: Grey to white clayey sand
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	The idea is to plug (with a by-pass) the INNOQUA system on the existing effluent outfall (which then discharge into the sewage network)
Schematic Arrangement for Installation Works Effluent Outfall	See Figure
<u>Describe with aid of sketches outline of site works that may be required to facilitate the installation Consider the Following:</u>	See Figure

7. Domestic Housing Collective – Operational Demo Site (Scotland)	
Name of Partner(s) Responsible for Demo Site	Scottish Water (SW)
Name and Country of Demonstration Site	Littlemill Waste Water Treatment Works, Scotland
Will the Site be permanently manned/occupied (describe)	No the current site is an unmanned with 1 weekly visits. We can review this for the Innoqua pilot plant
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	Inform our customer contact centre with details of trial and contact details: Follow Scottish Water procedure for customer complaints
Description of Proposed Demonstration Site (Include Photos/Images)	Littlemill Village Small Rural community in the highlands (13 houses, all residential) Aerated SAF package plant (foul only) – high OPEX
Location Geography and Climate	
Demonstration Site Address	A939, Littlemill, IV12 5QL
Geographical Location	In Northern Scotland 150 miles north of Edinburgh
Annual Average Rainfall (mm/year)	750mm
Annual Temperature Range (Min - Max degrees C)	.-10C to 25C
Description of Existing Terrain	Generally flat
Planning & Regulation	
Current Use of Site	Wastewater Treatment
Current Occupant of Site	Scottish Water
Owner of Site	Scottish Water
Details of Existing Planning Permission If Any	
Limitations on Usage of Site (If Any)	Electrical capacity to be investigated
Description of Adjacent Environment	Field to the East, South and North, The village of Littlemill will to the West of the site across the A939 road
Distance to Nearest Building/Development	Roughly 50 meters
Nature of Building/Development Nearest to Installation Site	Domestic Home
Is it Intended that the installation of the INNOQUA Treatment Technology be permanent	No
Details of Existing Effluent Discharge Consents If Any	Regulatory consent 20/35/25
Is Planning Consent Required for Installation on the Demonstration Site	Wastewater Treatment
Description (including likely timeframe) of Any Planning Consent Required	TBC
Name of Planning Authority and Reference of Regulation Requiring Planning	TBC
Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	TBC
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	TBC
Details of Existing Effluent Discharge Consents (If Any) at the Site	Regulatory consent 20/35/25
Will Additional/new Effluent Discharge Consents Be required	No, to outflow from INNOQUA will be diverted back to existing works inlet
Description (incl timeframe) of Additional Consent for Additional/New Effluent Discharge	N/A

Name of Authorising/Certification Body	SEPA
Site Access	
How is the site accessed (access road width, is it public or private, is it paved and off easily traversable gradient etc)	The site is accessed via the A939 which is an A classed tarmac road. Roughly 5 meters wide
Detail any potential limitations to transport of units unto the site by truck and/or crane	None
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	Narin 5 miles
Services (Water, Electricity and Communication)	
Is Mains Electricity Currently at Site	Yes
What is the distance to electrical supply	5 meters
What is the Voltage of the Electrical supply	230v / 110v
Is there an issue with load shedding/power interruptions	TBC
Is there fixed telephone line	No
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	GPRS, No 3G / 4G
Preliminary Design of Installation	
Is the Unit to be above or below ground	Above ground
Onsite ground conditions (soil type / location of rock etc)	Firm hard standing
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	Effluent outfall to be discharge to the inlet of existing works
Schematic Arrangement for Installation Works Effluent Outfall	TBC
Summary	Some soil may need to be removed and additional hard standing put down All installations for INNOQUA will be above ground incl Above ground hoses / pipes. Construction of Hard standing tarmac. Additional foundations may be required.



8. Domestic Housing Complex – Operational Demo Site (Turkey)	
Name of Partner(s) Responsible for Demo Site	Ekodenge
Name and Country of Demonstration Site	Sinop Atabay Estate
Will the Site be permanently manned/occupied (describe)	Yes
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	The maintenance staff is living on grounds
Description of Proposed Demonstration Site (Include Photos/Images)	<p>A private residential compound of 8 detached houses, a social building, support staff housing, near the Black sea coast. The construction of the site has been recently finalised. The sewage lines are connected to a central defecating or treatment system. The site is aiming an ecological approach with energy and water efficiency and use of renewables. The site hosts a full time technician to support the implementation and monitoring activities.</p>  
Location Geography and Climate	
Demonstration Site Address	Yalıköy Köyü/ Sinop
Geographical Location	Northern Turkey, Black Sea Coast, approximately 27 kms away from Sinop City Center
Annual Average Rainfall (mm/year)	668.60 mm (1981 - 2010 average)
Annual Temperature Range (Min - Max degrees C)	14C (max average: 30.3C, max observed: 41C - min average: -3C, min observed: -24.4C)
Description of Existing Terrain	Sloping at 8%
Planning & Regulation	
Current Use of Site	Construction, unoccupied
Current Occupant of Site	None (in 1-2 years 8 household (+2 for support staff) will occupy the site)
Owner of Site	Privately owned
Details of Existing Planning Permission If Any	Construction permit exist from Secretary General of Special Provincial Administration
Limitations on Usage of Site (If Any)	No limitations
Description of Adjacent Environment	10 m wide coastline next to Black Sea, there exist some green spaces which needs irrigation
Distance to Nearest Building/Development	Yalıköy Village about 1 km away
Nature of Building/Development Nearest to Installation Site	The village spreads out with groups of houses away from each other.

Is it Intended that the installation of the INNOQUA Treatment Technology be permanent	Yes
Details of Existing Effluent Discharge Consents If Any	None (currently a temporary septic tank is installed)
Is Planning Consent Required for Installation on the Demonstration Site	No
Description (including likely timeframe) of Any Planning Consent Required	N/A
Name of Planning Authority and Reference of Regulation Requiring Planning	N/A
Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	N/A
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	None (currently a temporary septic tank is installed)
Details of Existing Effluent Discharge Consents (If Any) at the Site	Will depend on the quality of treated effluent and potential for valorization for irrigation
Will Additional/new Effluent Discharge Consents Be required	The site will become operation in 1-2 years, therefore, a need for wastewater treatment will arise
Description (incl timeframe) of Additional Consent for Additional/New Effluent Discharge	None (currently a temporary septic tank is installed)
Name of Authorising/Certification Body	N/A
Site Access	
How is the site accessed (access road width, is it public or private, is it paved and off easily traversable gradient etc)	Asphalt pavement up to 1 km away from the site, for the rest there exist a stabilized road
Detail any potential limitations to transport of units unto the site by truck and/or crane	None
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	Sinop
Services (Water, Electricity and Communication)	
Is Mains Electricity Currently at Site	Yes
What is the distance to electrical supply	On site
What is the Voltage of the Electrical supply	380V, three phase
Is there an issue with load shedding/power interruptions	None, still a generator will be installed
Is there fixed telephone line	No, can be connected if necessary
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	Yes (3G, 4G and wireless)
Preliminary Design of Installation	
Is the Unit to be above or below ground	Below base on the wishes of the residents
Onsite ground conditions (soil type / location of rock etc)	Clay with low water retention, 6 m marl layer starts with no water retention
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	The outlet of the INNOQUA system is envisioned to be reused as irrigation water, if not it will be diverted to the septic tank. Still open to discussion

Summary	Excavation required, excavated soil can be spread on site No removal of extg installations necessary Required connections to/from INNOQUA system are electricity, data, raw wastewater, treated waste irrigation and a by-pass line to the septic tank Foundation required but minimal An access road to the location where INNOQUA system will be installed is necessary
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9. Tourist Accommodation Building – Operational Demo Site (Romania)	
Name of Partner(s) Responsible for Demo Site	RMC
Name and Country of Demonstration Site	Tourist Pension, Suceava, Lisesti Village, Romania.
Will the Site be permanently manned/occupied (describe)	Yes, the site will be in permanent use
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	No need to. The existing site is a simple septic tank collecting wastewater from a number of objectives and sending them to the Ilisasca River nearby.
Description of Proposed Demonstration Site (Include Photos/Images)	A small Pension (accommodating up to 15 persons at a time) and the ISA Restaurant that, occasionally organizes parties with up to 100 participants.
Location Geography and Climate	
Demonstration Site Address	Village Lisesti, County Suceava, Romania SIRUTA Code: 147679
Geographical Location	450kmN from Bucharest
Annual Average Rainfall (mm/year)	The rainfall here averages 600 mm but in the last 15 years wild variations have been recorded (400-800mm per year)
Annual Temperature Range (Min - Max degrees C)	Yearly average: 7.9 Celsius. Min, max: -30 ... +32 Deg Celsius.
Description of Existing Terrain	Flat
Planning & Regulation	
Current Use of Site	Pension & Restaurant
Current Occupant of Site	RMC
Owner of Site	RMC
Details of Existing Planning Permission If Any	
Limitations on Usage of Site (If Any)	
Description of Adjacent Environment	
Distance to Nearest Building/Development	1km
Nature of Building/Development Nearest to Installation Site	
Is it Intended that the installation of the INNOQUA Treatment Technology be permanent	YES
Details of Existing Effluent Discharge Consents If Any	Permit from local Water Authority
Is Planning Consent Required for Installation on the Demonstration Site	Yes from local Communal Hall. 2-4 weeks needed to get the permit
Description (including likely timeframe) of Any Planning Consent Required	Permit from local Water Authority. 1 month to get the permit From local Communal Hall.
Name of Planning Authority and Reference of Regulation Requiring Planning	Water Authority, Suceava County Local Communal Hall Lisesti
Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	N/A
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	N/A
Details of Existing Effluent Discharge Consents (If Any) at the Site	Permit from local Water Authority
Will Additional/new Effluent Discharge Consents Be required	N/A
Description (incl timeframe) of Additional Consent for Additional/New Effluent Discharge	N/A

Name of Authorising/Certification Body	Water Authority, Suceava County Local Communal Hall Lisesti
Site Access	
How is the site accessed (access road width, is it public or private, is it paved and off easily traversable gradient etc)	Access road operational to existing site. The location of the pilot site requires a 50m access road.
Detail any potential limitations to transport of units unto the site by truck and/or crane	no
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	15 km E from Suceava, the County Capital City.
Services (Water, Electricity and Communication)	
Is Mains Electricity Currently at Site	yes
What is the distance to electrical supply	50m
What is the Voltage of the Electrical supply	Triphase 380V and AC 220V available as well
Is there an issue with load shedding/power interruptions	no
Is there fixed telephone line	yes
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	4G, Broadband INTERNET, Wireless
Preliminary Design of Installation	
Is the Unit to be above or below ground	Underground
Onsite ground conditions (soil type / location of rock etc)	Common agricultural soil, no hard rock
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	Effluent to be discharged in the existing sewerage network
Summary	TBC

10. Domestic Residential Building (Apartments) – Operational Demo Site (Equador)	
Name of Partner(s) Responsible for Demo Site	Grace Yopez Arquitectura (GYA)
Name and Country of Demonstration Site	Casa Armero, Ecuador
Will the Site be permanently manned/occupied (describe)	Yes, site permanently occupied by 4 families
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	GYA has its house and office installed within the site, hence we will insure all maintenance issues at any time
Description of Proposed Demonstration Site (Include Photos/Images)	<p>Casa Armero is a traditional large house located in a residential area in the city centre of Quito. Initially occupied by one family, its location in the city lead to its transformation to a multi family building. Today 4 families live in 4 different apartments: 350 sqm approx.</p> <div style="display: flex; justify-content: space-around;">   </div>
Location Geography and Climate	
Demonstration Site Address	Armero Oe 7-261 y El Oro, 170521 Quito, Ecuador
Geographical Location	Center of Quito
Annual Average Rainfall (mm/year)	1,013mm
Annual Temperature Range (Min - Max degrees C)	9 - 21°C
Description of Existing Terrain	The ground is almost flat in the garden but the house location is in a sloping street
Planning & Regulation	
Current Use of Site	Multi family housing
Current Occupant of Site	Four families, 10 persons
Owner of Site	Member of partner organization
Details of Existing Planning Permission If Any	
Limitations on Usage of Site (If Any)	
Description of Adjacent Environment	Residential neighbourhood composed of similar multi family housing and apartments buildings
Distance to Nearest Building/Development	10m
Nature of Building/Development Nearest to Installation Site	residential neighbourhood composed of similar multi family housing and apartments buildings
Is it Intended that the installation of the INNOQUA Treatment Technology be permanent	Yes this is intention
Details of Existing Effluent Discharge Consents If Any	The site is connected to the city sewage network (compulsory in this area).
Is Planning Consent Required for Installation on the Demonstration Site	no
Description (including likely timeframe) of Any Planning Consent Required	N/A
Name of Planning Authority and Reference of Regulation Requiring Planning	N/A

Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	N/A
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	N/A
Details of Existing Effluent Discharge Consents (If Any) at the Site	N/A
Will Additional/new Effluent Discharge Consents Be required	no
Description (incl timeframe) of Additional Consent for Additional/New Effluent Discharge	N/A
Name of Authorising/Certification Body	N/A
Site Access	
How is the site accessed (access road width, is it public or private, is it paved and off easily traversable gradient etc)	Direct access through large public paved road
Detail any potential limitations to transport of units unto the site by truck and/or crane	The street being several meters above the garden and/or separated by a tall wall, a small crane should be necessary
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	The site is located in the urban centre
Services (Water, Electricity and Communication)	
Is Mains Electricity Currently at Site	yes
What is the distance to electrical supply	-
What is the Voltage of the Electrical supply	110V (traditional voltage in Ecuador) or 220V (now available for specific uses, this is the case in the pilot site)
Is there an issue with load shedding/power interruptions	no
Is there fixed telephone line	yes
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	3G network, or even broadband access through wifi of GYA office located within the site
Preliminary Design of Installation	
Is the Unit to be above or below ground	Preferentially below the ground
Onsite ground conditions (soil type / location of rock etc)	TBC
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	Connection to the city network
Summary	Excavation in the current garden no moving or dismantling of extg installations required

11. Domestic Educational Building (Classrooms etc) – Operational Demo Site (Peru)	
Name of Partner(s) Responsible for Demo Site	Universidad Catolica de Santa Maria (UCSM)
Name and Country of Demonstration Site	Peru
Will the Site be permanently manned/occupied (describe)	Part of the University campus, and it is in the countryside of the city. It is occupied all days in the year from 7 am and 6 pm. February is holidays, but the place is always under care of guardians
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	Manager (work on site, otherwise there is direct communication with the Main Campus located less than 20 minutes.
Description of Proposed Demonstration Site (Include Photos/Images)	TBC
Location Geography and Climate	
Demonstration Site Address	Universidad Catolica de Santa Maria, campus Huasacache, Hunter, Arequipa, PERU
Geographical Location	South west part of the country, located in the Andes at 2213 meters A.S.L.
Annual Average Rainfall (mm/year)	95 mm
Annual Temperature Range (Min - Max degrees C)	5°C to 27°C
Description of Existing Terrain	TBC
Planning & Regulation	
Current Use of Site	Classrooms, Farmfield
Current Occupant of Site	UCSM
Owner of Site	UCSM
Details of Existing Planning Permission If Any	No
Limitations on Usage of Site (If Any)	No
Description of Adjacent Environment	Countryside
Distance to Nearest Building/Development	about 50 m.
Nature of Building/Development Nearest to Installation Site	Greenhouses classrooms
Is it Intended that the installation of the INNOQUA Treatment Technology be permanent	Yes
Details of Existing Effluent Discharge Consents If Any	TBC
Is Planning Consent Required for Installation on the Demonstration Site	TBC
Description (including likely timeframe) of Any Planning Consent Required	TBC
Name of Planning Authority and Reference of Regulation Requiring Planning	TBC
Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	TBC
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	TBC
Details of Existing Effluent Discharge Consents (If Any) at the Site	TBC
Will Additional/new Effluent Discharge Consents Be required	TBC

Description (incl timeframe) of Additional Consent for Additional/New Effluent Discharge	TBC
Name of Authorising/Certification Body	TBC
Site Access	
How is the site accessed	There is an access road (7 m), public, and it is not paved.
Detail any potential limitations to transport of units unto the site by truck and/or crane	During the rainy season, rain could create an overflow of water in a river, which is close to this campus. This isolates the place, but just for a few hours. This problem will be overcome, because a bridge will be constructed in the following months
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	Hunter, about 4 km.
Services (Water, Electricity and Communication)	
Is Mains Electricity Currently at Site	Yes
What is the distance to electrical supply	20-50 m.
What is the Voltage of the Electrical supply	220
Is there an issue with load shedding/power interruptions	TBC
Is there fixed telephone line	Yes
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	Yes
Preliminary Design of Installation	
Is the Unit to be above or below ground	Below would be better, but both is feasible
Onsite ground conditions (soil type / location of rock etc)	TBC
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	TBC
Summary	TBC

12. Domestic Educational Building (Meeting Room) – Operational Demo Site (Tanzania)	
Name of Partner(s) Responsible for Demo Site	BORDA
Name and Country of Demonstration Site	Uhai wa mazingira na watu (UMAWA) Faecal Sludge Treatment Plant, Dar es Salaam, Tanzania, Africa.
Will the Site be permanently manned/occupied (describe)	The site is operated 6 days a week
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	The operator is trained to operate the plant and do small repairs, a BORDA unit is supporting maintenance activities. There are no office hours.
Description of Proposed Demonstration Site (Include Photos/Images)	The site is UMAWA's faecal sludge treatment plant (FSTP), The NGO UMAWA is a service provider who collects faecal sludge within the surrounding community and discharges it into the FSTP BORDA's training centre (small meeting hall for 20 -30 participants) is also located on the compound
Location Geography and Climate	
Demonstration Site Address	Kigamboni, Dar es Salaam
Geographical Location	East Tanzania in the city of Dar es Salaam
Annual Average Rainfall (mm/year)	1145 mm/year
Annual Temperature Range (Min - Max degrees C)	18-32 Degrees Celsius
Description of Existing Terrain	
Planning & Regulation	
Current Use of Site	Fecal sludge treatment plant (FSTP)
Current Occupant of Site	Operator & UMAWA
Owner of Site	Operator
Details of Existing Planning Permission If Any	Permission exists
Limitations on Usage of Site (If Any)	non
Description of Adjacent Environment	middle income housing,school
Distance to Nearest Building/Development	10 m
Nature of Building/Development Nearest to Installation Site	Housing, BORDA's training centre (small meeting hall for 20 -30 participants)
Is it Intended that the installation of the INNOQUA Treatment Technology be permanent	no
Details of Existing Effluent Discharge Consents If Any	http://www.tzdpq.or.tz/fileadmin/migrated/content/uploads/National_Environmental_Standards_Compendum.pdf
Is Planning Consent Required for Installation on the Demonstration Site	TBC
Description (including likely timeframe) of Any Planning Consent Required	TBC
Name of Planning Authority and Reference of Regulation Requiring Planning	EWURA, NEMC
Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	TBC
Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	TBC
Details of Existing Effluent Discharge Consents (If Any) at the Site	Waste water is kept on site and re-used for agricultural purposes

Will Additional/new Effluent Discharge Consents Be required	no
Description (incl timeframe) of Additional Consent for Additional/New Effluent Discharge	TBC
Name of Authorising/Certification Body	TBC
Site Access	
How is the site accessed	accessible through a non-paved dirt road
Detail any potential limitations to transport of units unto the site by truck and/or crane	truck access guaranteed, crane probably
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	within the urban centre
Services (Water, Electricity and Communication)	
Is Mains Electricity Currently at Site	Yes
What is the distance to electrical supply	10 m
What is the Voltage of the Electrical supply	220 V
Is there an issue with load shedding/power interruptions	Yes as general within Dar es Salaam
Is there fixed telephone line	No
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	3G even 4G depends on network provider
Preliminary Design of Installation	
Is the Unit to be above or below ground	TBC
Onsite ground conditions (soil type / location of rock	loamy sand
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	TBC
Summary	TBC

13. Domestic Buildings – Operational Demo Site (India)	
Name of Partner(s) Responsible for Demo Site	BORDA
Name and Country of Demonstration Site	Beedi Workers Colony, Bangalore, India.
Will the Site be permanently manned/occupied (describe)	The site is operated 6 days a week
Maintenance/Emergency Arrangements Office Hours (Plan for responding to and resolving reports of odours, leaks, breakdowns)	The operator is trained to operate the plant and do small repairs, a BORDA unit is supporting maintenance activities. There are no office hours.
Description of Proposed Demonstration Site (Include Photos/Images)	The Beedi Workers Colony (BWC) is a southwest of Bangalore City. The BWC is a group housing project of the government for the Economically Weaker Section of people engaged in Beedi making. (Beedi is South Asian type of cigarette filled with tobacco wrapped in a tendu leaf and fixed by a thread). The BWC has about 770 houses, where 120 houses.
Location Geography and Climate	
Demonstration Site Address	Beedi Workers Colony, Kengeri Satellite Town, Bangalore
Geographical Location	25 km southwest of Bangalore City
Annual Average Rainfall (mm/year)	839 (Indian Meteorological Data, 2009-2014 average)
Annual Temperature Range (Min - Max degrees C)	20- 38
Description of Existing Terrain	The terrain is sloping towards south of the Colony
Planning & Regulation	
Current Use of Site	Residential
Current Occupant of Site	Residential
Owner of Site	Association of Beedi Workers (ABW)
Details of Existing Planning Permission If Any	No
Limitations on Usage of Site (If Any)	No
Description of Adjacent Environment	Households and private residential layouts
Distance to Nearest Building/Development	10 meters
Nature of Building/Development Nearest to Installation Site	Households and private residential layouts
Is it Intended that the installation of the INNOQUA Treatment Technology be permanent	Yes
Details of Existing Effluent Discharge Consents If Any	Refer to link. http://www.cpcb.nic.in/GeneralStandards.pdf These standards are in the process of being revised. The proposed revision is attached.
Is Planning Consent Required for Installation on the Demonstration Site	Consent has to be taken from Association of Beedi Workers (ABW), the owners of the land and colony. Consent need not be taken from the Pollution Control Board or Municipality as this is a research project.
Description (including likely timeframe) of Any Planning Consent Required	Not required
Name of Planning Authority and Reference of Regulation Requiring Planning	Consent has to be taken from Association of Beedi Workers (ABW), the owners of the land and colony. Consent need not be taken from the Pollution Control Board or Municipality as this is a research project.
Description (including likely timeframe) of Any Additional Authorisation/Certification Necessary	Not required

Name of Authorising/Certification Body and Reference of Regulation Requiring Authorisation/Certification	Not required
Details of Existing Effluent Discharge Consents (If Any) at the Site	Refer to link. http://www.cpcb.nic.in/GeneralStandards.pdf These standards are in the process of being revised. The proposed revision is attached.
Will Additional/new Effluent Discharge Consents Be required	No
Description (incl timeframe) of Additional Consent for Additional/New Effluent Discharge	Not required
Name of Authorising/Certification Body	Not Applicable
Site Access	
How is the site accessed	5m wide road is being constructed and paved.
Detail any potential limitations to transport of units unto the site by truck and/or crane	No issues
Nearest Urban Centre (Name of Town or City, distance to site and description of road links)	Bangalore
Services (Water, Electricity and Communication)	
Is Mains Electricity Currently at Site	Yes
What is the distance to electrical supply	3.5 meters
What is the Voltage of the Electrical supply	240 V
Is there an issue with load shedding/power interruptions	Yes
Is there fixed telephone line	Yes
Is there Access to ICT if so describe (GPRS, 3G, 4G, wireless broadband etc)	Yes
Preliminary Design of Installation	
Is the Unit to be above or below ground	Both the cases are possible
Onsite ground conditions (soil type / location of rock)	Red soil
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	There is simplified sewer system to collect the wastewater from 120 households and currently it is being treated in DEWATS. The treated wastewater is being collected and reused for growing vegetables. The excess treated water is disposed into an open drain. The remaining households are not connected to DEWATS as the location of DEWATS was higher. The wastewater from these households currently flows in to open drains and it is proposed to connect them to the sewerage network of the city. The treated wastewater can be disposed into nearby open drain.
Summary	Relaying of sewer lines (repairs/and to ensure slope), constructing inspection chambers and for installation of LumbriFilter and Bio Solar filter required.

Appendix B – Demonstration Site Environmental Requirements (Influent)

1. NUI Galway Controlled Demo Site (Ireland)			
Name of Partner(s) Responsible for Demonstration Site	NUIG		
Name and Country of Demonstration Site	NUIG Water Research Facility		
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	1.8m ³	-	-
Population Equivalent (Number of persons equivalent)	20	-	-
Basis of PE (volumetric) (m ³ /PE.day)	0.18	0.2	0.15
Basis of PE (solid matter) (mg SS/PE.day)	45,000	70,000	20,000
Basis of PE (organic) (mg BOD5/PE.day)	40,000	60,000	20,000
Basis of PE (organic) (mg COD/PE.day)	105,000	160,000	50,000
Basis of PE (total nitrogen) (mg N/PE.day)	10,500	17,000	4,000
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)	-	-	-
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)	-	-	-
Basis of PE (total ammonium NH ₃) (mg N/PE.day)	4,000	6,000	2,000
Basis of PE (total phosphorous) (mg P/PE.day)	1,600	2,400	800
pH	7.5	8	7.2
Water temperature (°C)	12	18	3
Suspended solids (mg SS/Litre)	564	1158	-
COD concentration (mg COD/Litre)	1101	2356	-
BOD5 concentration (mg BOD5/Litre)			-
cBOD concentration (mg cBOD/Litre)	466	1042	-
Total Nitrogen (mg N/Litre)	45.2	139	-
Total Kjeldahl Nitrogen (mg N/Litre)	-	-	-
Total Ammonium (mg NH ₄ -N/Litre)	-	-	-
Total Ammonia (mg NH ₃ -N/Litre)	20	30	10
Total oxidised nitrogen (mg NO _x -N/Litre)	-	-	-
Total phosphorous (mg P/Litre)	9.74	21.2	-
Total ortho-phosphorous (mg PO ₄ -P/Litre)			
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent - If so Describe	The plant accepts landfill Leachate/Alum sludge (from water treatment plant) and Septic Tank waste which if not controlled intake can cause shock loading		
Are there likely to be fats, oils and greases present in the influent? If so to what degree	Yes likely Content in Urban Wastewater 50-100mg/L fats/oils/grease		
Are there likely to be large solid matter present in the influent? (organic or non-organic)	Nothing Untypical of urban type wastewater		
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)	Alum		
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)	-		
Are there likely to be any specific key pathogens present in the influent?	Potentially yes		

2. UDG Controlled Demonstration Site (Spain)			
Name of Partner(s) Responsible for Demonstration Site	UdG		
Name and Country of Demonstration Site	Spain		
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	277		
Population Equivalent (Number of persons equivalent)	1153		
Basis of PE (volumetric) (m ³ /PE.day)	0.24		
Basis of PE (solid matter) (mg SS/PE.day)	60,061		
Basis of PE (organic) (mg BOD5/PE.day)	60,061		
Basis of PE (organic) (mg COD/PE.day)	120,121		
Basis of PE (total nitrogen) (mg N/PE.day)	14,415		
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)			
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)			
Basis of PE (total ammonium NH ₃) (mg N/PE.day)			
Basis of PE (total phosphorous) (mg P/PE.day)	2,402		
pH			
Water temperature (°C)			
Suspended solids (mg SS/Litre)			
COD concentration (mg COD/Litre)			
BOD5 concentration (mg BOD5/Litre)			
cBOD concentration (mg cBOD/Litre)			
Total Nitrogen (mg N/Litre)			
Total Kjeldahl Nitrogen (mg N/Litre)			
Total Ammonium (mg NH ₄ -N/Litre)			
Total Ammonia (mg NH ₃ -N/Litre)			
Total oxidised nitrogen (mg NO _x -N/Litre)			
Total phosphorous (mg P/Litre)			
Total ortho-phosphorous (mg PO ₄ -P/Litre)			
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent - If so Describe			
Are there likely to be fats, oils and greases present in the influent? If so to what degree			
Are there likely to be large solid matter present in the influent? (organic or non-organic)			
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)			
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)			
Are there likely to be any specific key pathogens present in the influent?			

3. Privately Operated Farm – Operational Demo Site (Ireland)			
Name of Partner(s) Responsible for Demonstration Site			
Name and Country of Demonstration Site			
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day) ⁵	1.8		
Population Equivalent (Number of persons equivalent)	10		
Basis of PE (volumetric) (m ³ /PE.day)	0.18		
Basis of PE (solid matter) (mg SS/PE.day)			
Basis of PE (organic) (mg BOD5/PE.day)			
Basis of PE (organic) (mg COD/PE.day)			
Basis of PE (total nitrogen) (mg N/PE.day)			
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)			
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)			
Basis of PE (total ammonium NH ₃) (mg N/PE.day)			
Basis of PE (total phosphorous) (mg P/PE.day)			
pH	7.5		
Water temperature (°C)	14		
Suspended solids (mg SS/Litre)	1,000	1,500	500
COD concentration (mg COD/Litre)	4,000.	6,000	2,000
BOD5 concentration (mg BOD5/Litre)	2,000	3,200	2,000
cBOD concentration (mg cBOD/Litre)	1,500		
Total Nitrogen (mg N/Litre)	200	400	100
Total Kjeldahl Nitrogen (mg N/Litre)	180		
Total Ammonium (mg NH ₄ -N/Litre)	130		
Total Ammonia (mg NH ₃ -N/Litre)			
Total oxidised nitrogen (mg NO _x -N/Litre)	< 10		
Total phosphorous (mg P/Litre)	40	50	30
Total ortho-phosphorous (mg PO ₄ -P/Litre)	40	50	30
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent - If so Describe	Rainfall –cleaning		
Are there likely to be fats, oils and greases present in the influent? If so to what degree	Milk		
Are there likely to be large solid matter present in the influent? (organic or non-organic)	potentially		
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)	no		
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)	no		
Are there likely to be any specific key pathogens present in the influent?	Animal waste so potentially yes		

⁵ Animal waste p

4. Aquaculture Facility - Operational Demo Site (France)			
Name of Partner(s) Responsible for Demonstration Site	LMT		
Name and Country of Demonstration Site	Aquaculture Facility France		
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	8.0	10.0	4.0
Population Equivalent (Number of persons equivalent)	50	60	25
Basis of PE (volumetric) (m ³ /PE.day)	0.15	0.200	0.100
Basis of PE (solid matter) (mg SS/PE.day)	70,000		
Basis of PE (organic) (mg BOD ₅ /PE.day)	60,000		
Basis of PE (organic) (mg COD/PE.day)	120,000		
Basis of PE (total nitrogen) (mg N/PE.day)	16,000		
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)	15,000		
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)	8,000	12,000	3,000
Basis of PE (total phosphorous) (mg P/PE.day)	4		
pH	7.5	8.5	6.5
Water temperature (°C)	15	25	5
Suspended solids (mg SS/Litre)			
COD concentration (mg COD/Litre)	700	1000	400
BOD5 concentration (mg BOD5/Litre)	350	500	200
cBOD concentration (mg cBOD/Litre)			
Total Nitrogen (mg N/Litre)	90	110	70
Total Kjeldahl Nitrogen (mg N/Litre)	90	110	70
Total Ammonium (mg NH ₄ -N/Litre)	50	80	20
Total Ammonia (mg NH ₃ -N/Litre)			
Total oxidised nitrogen (mg NO _x -N/Litre)	<1	<1	<1
Total phosphorous (mg P/Litre)	10	12	8
Total ortho-phosphorous (mg PO ₄ -P/Litre)	7	9	5
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent (e.g. season issues associated with storm water that might impact on influent composition; industrial discharges; periods of seasonal inactivity – i.e. no influent) If so Describe	The lumbrifiltration process is designed for separate networks (not to mix them with rain), despite that statement, 20 to 30% of rainwater fall into the sanitary sewer. Indicative values for average treatment plants. Moreover, to avoid seasonal variations in climate (temperature, direct sunlight, rain, snow, etc.), the lumbrifilter be under shelter (not freeze well ventilated) and out of any flood zone.		
Are there likely to be fats, oils and greases present in the influent? If so to what degree	Essentially domestic oils		
Are there likely to be large solid matter present in the influent? (organic or non-organic)	In domestic sewage, always there solids greater than one millimetre. A rotary screen of a millimetre mesh should be used.		

<p>Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)</p>	<p>In domestic sewage, there is the presence of a trace amount of heavy metals and organic inhibitors, their existence does not affect the level of the overall functioning of lumbrifilter.</p>
<p>Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)</p>	<p>In principle, there is no risk of nitrification inhibitors in domestic wastewater</p>
<p>Are there likely to be any specific key pathogens (e.g. cryptosporidium, norovirus etc.) present in the influent?</p>	<p>In domestic sewage, there is always the presence of pathogens, the use of a UV treatment is required in post processing.</p>

5. Domestic Building – Operational Demo Site (Italy)			
Name of Partner(s) Responsible for Demonstration Site	DE5 SERVICES SRL		
Name and Country of Demonstration Site	Single Domestic House, Vasto (CH) - Italy		
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	0.00	0.00	0.00
Population Equivalent (Number of persons equivalent)	6		
Basis of PE (volumetric) (m ³ /PE.day)	0.2	-	-
Basis of PE (solid matter) (mg SS/PE.day)	11,000		
Basis of PE (organic) (mg BOD5/PE.day)	82,000		
Basis of PE (organic) (mg COD/PE.day)	115,000		
Basis of PE (total nitrogen) (mg N/PE.day)			
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)	12,000		
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)	3,000		
Basis of PE (total ammonium NH ₃) (mg N/PE.day)	7,000		
Basis of PE (total phosphorous) (mg P/PE.day)	4,000		
pH	6,8 - 7,4		
Water temperature (°C)		18° / 20°	14°/15°
Suspended solids (mg SS/Litre)	100		
COD concentration (mg COD/Litre)	250		
BOD5 concentration (mg BOD5/Litre)	100		
cBOD concentration (mg cBOD/Litre)			
Total Nitrogen (mg N/Litre)	20		
Total Kjeldahl Nitrogen (mg N/Litre)			
Total Ammonium (mg NH ₄ -N/Litre)			
Total Ammonia (mg NH ₃ -N/Litre)			
Total oxidised nitrogen (mg NO _x -N/Litre)			
Total phosphorous (mg P/Litre)	6		
Total ortho-phosphorous (mg PO ₄ -P/Litre)			
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent (e.g. season issues associated with storm water that might impact on influent composition; industrial discharges; periods of seasonal inactivity – i.e. no influent) If so Describe	none		
Are there likely to be fats, oils and greases present in the influent? If so to what degree	minor presence		
Are there likely to be large solid matter present in the influent? (organic or non-organic)	minor presence		
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)	none		
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)	none		
Are there likely to be any specific key pathogens present in the influent?	none		

6. Domestic/Commercial Building – Operational Demo Site (France)			
Name of Partner(s) Responsible for Demonstration Site	NBK		
Name and Country of Demonstration Site	Nobatek Offices, France		
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	0.75*	0.8	0.5
Population Equivalent (Number of persons equivalent)	5		
Basis of PE (volumetric) (m ³ /PE.day)	0.15		
Basis of PE (solid matter) (mg SS/PE.day)	70,000	105,000	45,000
Basis of PE (organic) (mg BOD5/PE.day)	60,000	75,000	30,000
Basis of PE (organic) (mg COD/PE.day)	120,000	150,000	90,000
Basis of PE (total nitrogen) (mg N/PE.day)			
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)	15,000	15,000	3,750
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)	-	-	-
Basis of PE (total ammonium NH ₃) (mg N/PE.day)	4,000	4,000	750
Basis of PE (total phosphorous) (mg P/PE.day)			
pH	7.5		
Water temperature (°C)			
Suspended solids (mg SS/Litre)			
COD concentration (mg COD/Litre)	800	1,000	600
BOD5 concentration (mg BOD5/Litre)	270	500	300
cBOD concentration (mg cBOD/Litre)	15	100	25
Total Nitrogen (mg N/Litre)			
Total Kjeldahl Nitrogen (mg N/Litre)	15	100	25
Total Ammonium (mg NH ₄ -N/Litre)			
Total Ammonia (mg NH ₃ -N/Litre)			
Total oxidised nitrogen (mg NO _x -N/Litre)			
Total phosphorous (mg P/Litre)	27	27	5
Total ortho-phosphorous (mg PO ₄ -P/Litre)			
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent (e.g. season issues associated with storm water that might impact on influent composition; industrial discharges; periods of seasonal inactivity – i.e. no influent) If so Describe	Rainfall are generally consistent thru the year ranging from 66mm/month to 170mm/month. Building is closed during the firsts two weeks of August. Building is generally occupied five day per week and there is no water consumption on Saturday and Sunday.		
Are there likely to be fats, oils and greases present in the influent? If so to what degree	Unlikely		
Are there likely to be large solid matter present in the influent? (organic or non-organic)	Nothing untypical of urban type water		
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)	Nothing untypical of urban type water		
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)	Nothing untypical of urban type water		
Are there likely to be any specific key pathogens present in the influent?	Nothing untypical of urban type water		

*Building is occupied 5 days per week corresponding to 0,75 m³/day for 7 days ~ 0,5m³/day

7. Domestic Housing Collective – Operational Demo Site (Scotland)			
Name of Partner(s) Responsible for Demonstration Site	Scottish Water		
Name and Country of Demonstration Site			
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	8		
Population Equivalent (Number of persons equivalent)	40		
Basis of PE (volumetric) (m ³ /PE.day)			
Basis of PE (solid matter) (mg SS/PE.day)			
Basis of PE (organic) (mg BOD5/PE.day)			
Basis of PE (organic) (mg COD/PE.day)			
Basis of PE (total nitrogen) (mg N/PE.day)			
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)			
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)			
Basis of PE (total ammonium NH ₃) (mg N/PE.day)			
Basis of PE (total phosphorous) (mg P/PE.day)			
pH			
Water temperature (°C)			
Suspended solids (mg SS/Litre)	400	600	200
COD concentration (mg COD/Litre)	600	1000	450
BOD5 concentration (mg BOD5/Litre)	300	530	250
cBOD concentration (mg cBOD/Litre)			
Total Nitrogen (mg N/Litre)			
Total Kjeldahl Nitrogen (mg N/Litre)			
Total Ammonium (mg NH ₄ -N/Litre)			
Total Ammonia (mg NH ₃ -N/Litre)	30	75	20
Total oxidised nitrogen (mg NO _x -N/Litre)			
Total phosphorous (mg P/Litre)	15	25	6
Total ortho-phosphorous (mg PO ₄ -P/Litre)			
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent (e.g. season issues associated with storm water that might impact on influent composition; industrial discharges; periods of seasonal inactivity – i.e. no influent) If so Describe	No. The site is a foul only site. There is no surface water or storm flow to the site		
Are there likely to be fats, oils and greases present in the influent? If so to what degree	Little amounts from households - Low extent		
Are there likely to be large solid matter present in the influent? (organic or non-organic)	Some ragging likely to be present		
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)	Very Little amounts		
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)	No		
Are there likely to be any specific key pathogens present in the influent?			

8. Domestic Housing Complex – Operational Demo Site (Turkey)			
Name of Partner(s) Responsible for Demonstration Site	Ekodenge		
Name and Country of Demonstration Site*	Sinop Atabay Estate / TURKEY		
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	3.1	5.3	1.2
Population Equivalent (Number of persons equivalent)	22	34	10
Basis of PE (volumetric) (m ³ /PE.day)	0.141	0.155	0.116
Basis of PE (solid matter) (mg SS/PE.day)	107,500	145,000	70,000
Basis of PE (organic) (mg BOD5/PE.day)	49,500	54,000	45,000
Basis of PE (organic) (mg COD/PE.day)	87,300	102,600	72,000
Basis of PE (total nitrogen) (mg N/PE.day)	9,000	12,000	6,000
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)	8,850	12,000	5700
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)	5,400	7200	3600
Basis of PE (total ammonium NH ₃) (mg N/PE.day)	6,566	8,754	4,377
Basis of PE (total phosphorous) (mg P/PE.day)	2,550	4500	600
pH	7.5	8.5	6.5
Water temperature (°C)	15.5	21	10
Suspended solids (mg SS/Litre)	220	350	100
COD concentration (mg COD/Litre)	500	1000	250
BOD5 concentration (mg BOD5/Litre)	220	400	110
cBOD concentration (mg cBOD/Litre)	293	533	147
Total Nitrogen (mg N/Litre)	40	85	20
Total Kjeldahl Nitrogen (mg N/Litre)	40	85	20
Total Ammonium (mg NH ₄ -N/Litre)	26	53	13
Total Ammonia (mg NH ₃ -N/Litre)	25	50	12
Total oxidised nitrogen (mg NO _x -N/Litre)	-	-	-
Total phosphorous (mg P/Litre)	8	15	4
Total ortho-phosphorous (mg PO ₄ -P/Litre)	5.6	10.5	2.8
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent	The site is located near the seaside and is expected to serve for its owners especially during the summer times. Therefore, peak wastewater generation is expected to occur during July-August period. Since the site is a collection of only 8 detached houses a separated sewer collection system (without surface runoff collection) is implemented. So storm water will not affect the influent flow. The wastewater collection system is not receiving any wastewater from other sources (e.g. industrial wastewater).		
Are there likely to be fats, oils and greases present in the influent? If so to what degree	The pollutant characteristics of the wastewater will expected to resemble		

	domestic wastewater characteristics. In other words between 50-100 mg/L oil and grease might be expected depending on the seasonal and daily fluctuations.
Are there likely to be large solid matter present in the influent? (organic or non-organic)	No
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)	No
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)	No
Are there likely to be any specific key pathogens present in the influent?	No

*The site will become operational in 1-2 years time. Currently there is no wastewater generation. So information provided are estimates.

9. Tourist Accommodation Building – Operational Demo Site (Romania)			
Name of Partner(s) Responsible for Demonstration Site	RMC		
Name and Country of Demonstration Site	Romania		
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	2.4	6	1
Population Equivalent (Number of persons equivalent)	30	100	5
Basis of PE (volumetric) (m ³ /PE.day)			
Basis of PE (solid matter) (mg SS/PE.day)			
Basis of PE (organic) (mg BOD5/PE.day)			
Basis of PE (organic) (mg COD/PE.day)			
Basis of PE (total nitrogen) (mg N/PE.day)			
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)			
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)			
Basis of PE (total ammonium NH ₃) (mg N/PE.day)			
Basis of PE (total phosphorous) (mg P/PE.day)			
pH			
Water temperature (°C)	23	28	18
Suspended solids (mg SS/Litre)	225	estimated 800	
COD concentration (mg COD/Litre)	437	estimated 600	
BOD5 concentration (mg BOD5/Litre)	280	estimated 350	
cBOD concentration (mg cBOD/Litre)			
Total Nitrogen (mg N/Litre)	71	estimated 100	
Total Kjeldahl Nitrogen (mg N/Litre)			
Total Ammonium (mg NH ₄ -N/Litre)			
Total Ammonia (mg NH ₃ -N/Litre)	27	estimated 35	
Total oxidised nitrogen (mg NO _x -N/Litre)			
Total phosphorous (mg P/Litre)	14	Estimated 20	
Total ortho-phosphorous (mg PO ₄ -P/Litre)			
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent (e.g. season issues associated with storm water that might impact on influent composition; industrial discharges; periods of seasonal inactivity – i.e. no influent) If so Describe	Daily variations. The max number of persons on the platform are present from 07:00 to 16:00 hours. During receptions taking place at the RMC Restaurants waste water rate generations takes place between, typically 18:00 - 24:00 hours Seasonal. Variations. During the cold season the number of employees drops to approx 40 per day and the restaurant		

	is open only for receptions occasionated by Christmas, Easter, Wedding parties and the like.
Are there likely to be fats, oils and greases present in the influent? If so to what degree	
Are there likely to be large solid matter present in the influent? (organic or non-organic)	No
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)	There are no measurements but there is a very remote possibility
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)	There are no measurements but there is a very remote possibility
Are there likely to be any specific key pathogens present in the influent?	There are no measurements but there is a very remote possibility

10. Domestic Residential Building (Apartments) – Operational Demo Site (Ecuador)			
Name of Partner(s) Responsible for Demonstration Site	GYA		
Name and Country of Demonstration Site	Casa Armero, Ecuador		
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	10 person living in the site > 10 PE = 2m ³ /day		
Population Equivalent (Number of persons equivalent)	10	12	4 (e.g. during holiday periods)
Basis of PE (volumetric) (m ³ /PE.day)	0.2		
Basis of PE (solid matter) (mg SS/PE.day)			
Basis of PE (organic) (mg BOD ₅ /PE.day)			
Basis of PE (organic) (mg COD/PE.day)			
Basis of PE (total nitrogen) (mg N/PE.day)			
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)			
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)			
Basis of PE (total ammonium NH ₃) (mg N/PE.day)			
Basis of PE (total phosphorous) (mg P/PE.day)			
pH	7.2		
Water temperature (°C)	-		
Suspended solids (mg SS/Litre)		247	144
COD concentration (mg COD/Litre)		293	205
BOD ₅ concentration (mg BOD ₅ /Litre)		118	71
cBOD concentration (mg cBOD/Litre)		-	-
Total Nitrogen (mg N/Litre)		-	-
Total Kjeldahl Nitrogen (mg N/Litre)		-	-
Total Ammonium (mg NH ₄ -N/Litre)			
Total Ammonia (mg NH ₃ -N/Litre)			

Total oxidised nitrogen (mg NO _x -N/Litre)			
Total phosphorous (mg P/Litre)		5.8	4.5
Total ortho-phosphorous (mg PO ₄ -P/Litre)			
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent. If so Describe			
Are there likely to be fats, oils and greases present in the influent? If so to what degree			
Are there likely to be large solid matter present in the influent? (organic or non-organic)			
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)			
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)			
Are there likely to be any specific key pathogens present in the influent?			

11. Domestic Educational Building (Classrooms etc) – Operational Demo Site (Peru)			
Name of Partner(s) Responsible for Demonstration Site	UCSM		
Name and Country of Demonstration Site	Fundo Huasacache - Peru		
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	≈ 22,5	13,5 + X	13.5
Population Equivalent (Number of persons equivalent)	260	265	3
Basis of PE (volumetric) (m ³ /PE.day)	0.0865		
Basis of PE (solid matter) (mg SS/PE.day)	11,596.15		
Basis of PE (organic) (mg BOD ₅ /PE.day)	92,163.46		
Basis of PE (organic) (mg COD/PE.day)	75,497.80		
Basis of PE (total nitrogen) (mg N/PE.day)	74,062.21		
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)	74,062.21		
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)	NM		
Basis of PE (total ammonium NH ₃) (mg N/PE.day)	10,451.25		
Basis of PE (total phosphorous) (mg P/PE.day)	956.25		
pH	8.18		
Water temperature (°C)	20.5		
Suspended solids (mg SS/Litre)	134		
COD concentration (mg COD/Litre)	872.419		
BOD ₅ concentration (mg BOD ₅ /Litre)	1065		
cBOD concentration (mg cBOD/Litre)	NM		
Total Nitrogen (mg N/Litre)	855.83		
Total Kjeldahl Nitrogen (mg N/Litre)	855.83		
Total Ammonium (mg NH ₄ -N/Litre)	NM		
Total Ammonia (mg NH ₃ -N/Litre)	120.77		
Total oxidised nitrogen (mg NO _x -N/Litre)	NM		
Total phosphorous (mg P/Litre)	11.05		
Total ortho-phosphorous (mg PO ₄ -P/Litre)	NM		

Factors Effecting Influent	
Is the site likely to be subject to any variations that will likely impact on the influent . If so Describe	The site is likely to be subject to variations impacting on the influent due to academic periods and holiday periods. Academic periods go from early march until mid july; and from mid august until mid december. Holiday periods go from mid december until early march; and from mid july until mid august. During holiday periods the influent flow might be reduced by 80-90% approx. January and February represent the rainy season, however during recent years, rainfalls have decreased considerably
Are there likely to be fats, oils and greases present in the influent? If so to what degree	It is likely to find oils and fats due to the small food court that is present on campus, however, not on a significant basis. In fact, in the analysis performed this week, 390 mg were found per litre of residual water sample. (390.00 mg/L)
Are there likely to be large solid matter present in the influent? (organic or non-organic)	Nothing untypical
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)	It is likely to find metals present in the influent. In the residual water analysis performed this week aluminum (0,486 mg/L), boron (0,488 mg/L), calcium (50,150 mg/L), iron (0,354 mg/L), potassium (40,220 mg/L), lithium (0,102 mg/L), magnesium (12,090 mg/L), manganese (0,076 mg/L), sodium (95,350 mg/L), phosphorus (11,05 mg/L), silicon (23,870 mg/L) and zinc (0,189 mg/L) were found.
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)	It is likely to find nitrification inhibitors due to farmlands and also due to lab activities conducted by students from the programme of agricultural engineering. This amount is yet to be estimated.
Are there likely to be any specific key pathogens present in the influent?	It is likely to find bacteria such as Escherichia coli, Legionella, Salmonella, Yersinia; virus such as norovirus and rotavirus; protozoos such as Cryptosporidium, Entamoeba and Giardia. However, confirmatory studies are yet to be performed.

12. Domestic Educational Building (Meeting Room) – Operational Demo Site (Tanzania)			
Name of Partner(s) Responsible for Demonstration Site	Borda		
Name and Country of Demonstration Site	Tanzania		
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	2.4		
Population Equivalent (Number of persons equivalent)	68		
Basis of PE (volumetric) (m ³ /PE.day)	-		
Basis of PE (solid matter) (mg SS/PE.day)	-		
Basis of PE (organic) (mg BOD5/PE.day)	-		
Basis of PE (organic) (mg COD/PE.day)	-		
Basis of PE (total nitrogen) (mg N/PE.day)	-		
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)	-		
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)	-		
Basis of PE (total ammonium NH ₃) (mg N/PE.day)	-		
Basis of PE (total phosphorous) (mg P/PE.day)	-		
pH	-		
Water temperature (°C)	26		
Suspended solids (mg SS/Litre)	-		
COD concentration (mg COD/Litre)	-		
BOD5 concentration (mg BOD5/Litre)	-		
cBOD concentration (mg cBOD/Litre)	-		
Total Nitrogen (mg N/Litre)	-		
Total Kjeldahl Nitrogen (mg N/Litre)	-		
Total Ammonium (mg NH ₄ -N/Litre)	-		
Total Ammonia (mg NH ₃ -N/Litre)	-		
Total oxidised nitrogen (mg NO _x -N/Litre)	-		
Total phosphorous (mg P/Litre)	-		
Total ortho-phosphorous (mg PO ₄ -P/Litre)	-		
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent (e.g. season issues associated with stormwater that might impact on influent composition; industrial discharges; periods of seasonal inactivity – i.e. no influent) If so Describe	In the rainy season, there is more wastewater, since rain water is flowing in the pit latrines. Therefore, the wastewater is also more diluted. This also causes a higher demand of the service provider for pit emptying.		
Are there likely to be fats, oils and greases present in the influent? If so to what degree	Unknown, but there is a high possibility of minor FOG inflow		
Are there likely to be large solid matter present in the influent? (organic or non-organic)	Depending on the client. The service provider tries to get solid waste out before the pit emptying. Additionally there is a grid at the inlet of the		

	treatment plant, which prevents big solid waste from entering the system.
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)	Unknown, mostly household waste water from pit latrines, but could be containing metals.
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)	unknown
Are there likely to be any specific key pathogens present in the influent?	Yes, the municipality is using the service provider in regions with cholera and amoebae outbreaks, perhaps also norovirus.

13. Domestic Buildings – Operational Demo Site (India)			
Name of Partner(s) Responsible for Demonstration Site	Borda		
Name and Country of Demonstration Site	Beedi Workers Colony, Bangalore, India.		
Parameter	Average	Max	Min
Average Influent Flow Volume (m ³ /day)	10.8		
Population Equivalent (Number of persons equivalent)	180		
Basis of PE (volumetric) (m ³ /PE.day)	0.06		
Basis of PE (solid matter) (mg SS/PE.day)			
Basis of PE (organic) (mg BOD ₅ /PE.day)	40,000		
Basis of PE (organic) (mg COD/PE.day)	80,000		
Basis of PE (total nitrogen) (mg N/PE.day)			
Basis of PE (total Kjeldahl Nitrogen) (mg N/PE.day)			
Basis of PE (total ammonium-nitrogen) (mg N/PE.day)	580		
Basis of PE (total ammonium NH ₃) (mg N/PE.day)			
Basis of PE (total phosphorous) (mg P/PE.day)	580		
pH	7.5	8	7
Water temperature (°C)	27	29	25
Suspended solids (mg SS/Litre)	250	300	200
COD concentration (mg COD/Litre)	550	600	500
BOD ₅ concentration (mg BOD ₅ /Litre)	225	250	200
cBOD concentration (mg cBOD/Litre)			
Total Nitrogen (mg N/Litre)	200		
Total Kjeldahl Nitrogen (mg N/Litre)	120	170	100
Total Ammonium (mg NH ₄ -N/Litre)	100		
Total Ammonia (mg NH ₃ -N/Litre)			
Total oxidised nitrogen (mg NO _x -N/Litre)			
Total phosphorous (mg P/Litre)	40	70	20
Total ortho-phosphorous (mg PO ₄ -P/Litre)			
Factors Effecting Influent			
Is the site likely to be subject to any variations that will likely impact on the influent - If so Describe	During heavy rains, storm water intrusion can be expected		
Are there likely to be fats, oils and greases present in the influent? If so to what degree	No		
Are there likely to be large solid matter present in the influent? (organic or non-organic)	Yes, Solid waste- plastic cover, napkins etc		
Are there likely to be metals present in the influent? (List type and likely concentration in particular any biological inhibitors)	No		
Are there likely to be nitrification inhibitors (not listed above) present in the influent? (List type and likely concentration)	No		
Are there likely to be any specific key pathogens present in the influent?	No		

Appendix C – Demonstration Site Environmental Requirements (Effluent)

1. NUI Galway Controlled Demo Site (Ireland)			
Name of Partner(s) Responsible for Demonstration Site		NUIG	
Name and Country of Demonstration Site		NUIG Water Research Facility	
Effluent Discharge Details			
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		Wastewater Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007) and Environmental Protection Agency (EPA) http://www.epa.ie/ Wastewater discharge licensing programme. The Environmental Protection Agency (EPA), Statutory Body responsible for licencing, monitoring compliance and reporting	
Description of Proposed Effluent Outfall Arrangement at Demonstration Site		Effluent is discharged to influent stream of adjacent WWTP for full treatment	
Details of Existing Effluent Discharge Consents (If Any) at the Site		Full planning permission based on above discharge arrangements in place	
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		Wastewater Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007) and Environmental Protection Agency (EPA) http://www.epa.ie/ Wastewater discharge licensing programme. The Environmental Protection Agency (EPA), Statutory Body responsible for licencing, monitoring compliance and reporting	
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge		n/a	
Details of the legislation or regulation under which the discharge consent is or will be granted		n/a	
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted		n/a	
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse		No Reuse intended, treatment validation demo site	
Describe the particular quality requirements for the intended reuse and the legislative framework relating		-	
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)	-	15	-
pH	-	9	7
Dissolved oxygen (mg O2/Litre)	-	-	-
Water temperature (oC)	-	25	-
COD concentration (mg COD/Litre)	-	125	-
BOD5 concentration (g BOD5/Litre)	-	-	-

cBOD concentration (mg cBOD/Litre)	-	15	-
Total Nitrogen (mg N/Litre)	-	15	-
Total Kjeldahl Nitrogen (mg N/Litre)	-	-	-
Total Ammonium (mg NH ₄ -N/Litre)	-	-	-
Total Ammonia (mg NH ₃ -N/Litre)	-	1	-
Total oxidised nitrogen (mg NO _x -N/Litre)	-	-	-
Total phosphorous (mg P/Litre)	-	2	-
Total ortho-phosphorous (mg PO ₄ -P/Litre)	-	0.2	0.5
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	-		
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	-		
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc	-		
Other Parameters (e.g. alkalinity etc)	-		

2. UDG Controlled Demonstration Site (Spain)			
Name of Partner(s) Responsible for Demonstration Site		UdG	
Name and Country of Demonstration Site		Spain	
Effluent Discharge Details			
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		TBC	
Description of Proposed Effluent Outfall Arrangement at Demonstration Site		Innoqua discharge will be recirculated to the inflow of the secondary treatment of the WWTP	
Details of Existing Effluent Discharge Consents (If Any) at the Site		n/a	
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		n/a	
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge		n/a	
Details of the legislation or regulation under which the discharge consent is or will be granted		n/a	
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted			
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse		no	
Describe the particular quality requirements for the intended reuse and the legislative framework relating			
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)	-	-	-
pH	-	-	-
Dissolved oxygen (mg O ₂ /Litre)	-	-	-
Water temperature (oC)	-	-	-
COD concentration (mg COD/Litre)	-	-	-
BOD5 concentration (g BOD ₅ /Litre)	-	-	-
cBOD concentration (mg cBOD/Litre)	-	-	-
Total Nitrogen (mg N/Litre)	-	-	-
Total Kjeldahl Nitrogen (mg N/Litre)	-	-	-
Total Ammonium (mg NH ₄ -N/Litre)	-	-	-

Total Ammonia (mg NH ₃ -N/Litre)	-	-	-
Total oxidised nitrogen (mg NO _x -N/Litre)	-	-	-
Total phosphorous (mg P/Litre)	-	-	-
Total ortho-phosphorous (mg PO ₄ -P/Litre)	-	-	-
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	Controlled Site		
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	-		
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc	-		
Other Parameters (e.g. alkalinity etc)	-		

3. Privately Operated Farm – Operational Demo Site (Ireland)			
Name of Partner(s) Responsible for Demonstration Site		NUIG	
Name and Country of Demonstration Site		Privately Owned Dairy and Cattle Farm Galway	
Effluent Discharge Details			
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		Waste Management (Use of Sewage Sludge in Agriculture) Regulations 1988 and and its Amendment Regulations and the European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2010 (S.I. No. 610 of 2010) ⁶	
Description of Proposed Effluent Outfall Arrangement at Demonstration Site		Outfall to holding tank onsite	
Details of Existing Effluent Discharge Consents (If Any) at the Site		n/a	
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		As above	
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge		n/a	
Details of the legislation or regulation under which the discharge consent is or will be granted		n/a	
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted		n/a	
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse		Yes, Intended re-uses to be investigated are <ul style="list-style-type: none"> • Irrigation & fertilizing • Yard/Outhouse Cleaning • Reducing nitrate load to allow spreading during prohibited spreading season 	
Describe the particular quality requirements for the intended reuse and the legislative framework relating		n/a	
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)	n/a	n/a	n/a
pH	n/a	n/a	n/a
Dissolved oxygen (mg O ₂ /Litre)	n/a	n/a	n/a

⁶ <http://www.irishstatutebook.ie/eli/2007/si/820/made/en/print?q=820> S.I. No. 820 of 2007 Waste Management (Collection Permit) Regulations 2007 (S.I. No. 820 of 2007) and amendments 2008
http://www.irishstatutebook.ie/eli/1998/si/148/made/en/print?num=148&years=1998&search_type=si Waste Management (Use of Sewage Sludge in Agriculture) Regulations, 1998 and amendments 2001

Water temperature (oC)	n/a	n/a	n/a
COD concentration (mg COD/Litre)	n/a	n/a	n/a
BOD5 concentration (g BOD5/Litre)	n/a	n/a	n/a
cBOD concentration (mg cBOD/Litre)	n/a	n/a	n/a
Total Nitrogen (mg N/Litre)	n/a	n/a	n/a
Total Kjeldahl Nitrogen (mg N/Litre)	n/a	n/a	n/a
Total Ammonium (mg NH ₄ -N/Litre)	n/a	n/a	n/a
Total Ammonia (mg NH ₃ -N/Litre)	n/a	n/a	n/a
Total oxidised nitrogen (mg NO _x -N/Litre)	n/a	n/a	n/a
Total phosphorous (mg P/Litre)	n/a	n/a	n/a
Total ortho-phosphorous (mg PO ₄ -P/Litre)	n/a	n/a	n/a
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	n/a		
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	n/a		
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc	n/a		
Other Parameters (e.g. alkalinity etc)	n/a		

4. Aquaculture Facility - Operational Demo Site (France)			
Name of Partner(s) Responsible for Demonstration Site		LMT	
Name and Country of Demonstration Site		Aquaculture Facility France	
Effluent Discharge Details			
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		TBC	
Description of Proposed Effluent Outfall Arrangement at Demonstration Site		TBC	
Details of Existing Effluent Discharge Consents (If Any) at the Site		TBC	
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		TBC	
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge		TBC	
Details of the legislation or regulation under which the discharge consent is or will be granted		TBC	
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted		TBC	
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse		TBC	
Describe the particular quality requirements for the intended reuse and the legislative framework relating		TBC	
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)	329		
pH	7.5	8.5	6.5
Dissolved oxygen (mg O ₂ /Litre)	10	12	8
Water temperature (oC)	20	30	10
COD concentration (mg COD/Litre)		125	
BOD ₅ concentration (g BOD ₅ /Litre)		25	
cBOD concentration (mg cBOD/Litre)			
Total Nitrogen (mg N/Litre)		15	
Total Kjeldahl Nitrogen (mg N/Litre)		<15	
Total Ammonium (mg NH ₄ -N/Litre)		<5	

Total Ammonia (mg NH ₃ -N/Litre)			
Total oxidised nitrogen (mg NO _x -N/Litre)		<10	
Total phosphorous (mg P/Litre)		2	
Total ortho-phosphorous (mg PO ₄ -P/Litre)		<2	
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	E. Coli (germs/100ml) Maximum 200 germs/100ml (Class A) & 1000 germs/100ml (Class B)		
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	e-coli, coliformes fécaux, norovirus, cryptosporidium. Any type of pathogen must be eliminated. Need to use the UV at the outlet of the water treatment		
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc	Metals : 0.01 to 0.5 mg/l ; Pharmaceuticals 0.01 to 20 µg/l		
Other Parameters (e.g. alkalinity etc)	turbidity of water		

5. Domestic Building – Operational Demo Site (Italy)			
Name of Partner(s) Responsible for Demonstration Site	DE5 SERVICES SRL		
Name and Country of Demonstration Site	Single Domestic House, Vasto (CH) - Italy		
Effluent Discharge Details			
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply	D. Lgs. 152/2006		
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	Solution 1: the discharged point is the ground; Solution 2: the effluent will be stored in a tank and than it will be sent to an external wastewater treatment plant		
Details of Existing Effluent Discharge Consents (If Any) at the Site	None		
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply	Municipality of Vasto - PUC (municipal development plan)		
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge	D. Lgs. 152/2006		
Details of the legislation or regulation under which the discharge consent is or will be granted	-		
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted	-		
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse	None		
Describe the particular quality requirements for the intended reuse and the legislative framework relating	-		
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)	25	-	-
pH	7	8	6
Dissolved oxygen (mg O ₂ /Litre)	-	-	-
Water temperature (oC)	-	-	-
COD concentration (mg COD/Litre)	-	100	-
BOD ₅ concentration (g BOD ₅ /Litre)	-	20	-
cBOD concentration (mg cBOD/Litre)	-	-	-

Total Nitrogen (mg N/Litre)	-	15	-
Total Kjeldahl Nitrogen (mg N/Litre)	-	-	-
Total Ammonium (mg NH ₄ -N/Litre)	-	-	-
Total Ammonia (mg NH ₃ -N/Litre)	-	-	-
Total oxidised nitrogen (mg NO _x -N/Litre)	-	-	-
Total phosphorous (mg P/Litre)	-	2	-
Total ortho-phosphorous (mg PO ₄ -P/Litre)	-	-	-
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	-		
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	faecal coliforms		
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc	none		
Other Parameters (e.g. alkalinity etc)	none		

6. Domestic/Commercial Building – Operational Demo Site (France)			
Name of Partner(s) Responsible for Demonstration Site	NBK		
Name and Country of Demonstration Site	Nobatek Offices, France		
Effluent Discharge Details			
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply	-		
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	Effluent is discharged to public general network to municipal WWTP for full treatment		
Details of Existing Effluent Discharge Consents (If Any) at the Site	No consent needed because discharge is achieved into general sewage network		
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply	-		
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge	-		
Details of the legislation or regulation under which the discharge consent is or will be granted	If it discharges into general network: no regulation under 20 PE (in Anglet)		
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted	-		
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse	Reuse treated water for onsite irrigation of plants		
Describe the particular quality requirements for the intended reuse and the legislative framework relating	-		
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)	-	30	-
pH	-	-	-
Dissolved oxygen (mg O ₂ /Litre)	-	-	-
Water temperature (°C)	-	-	-
COD concentration (mg COD/Litre)	-	-	-
BOD ₅ concentration (g BOD ₅ /Litre)	-	35	-
cBOD concentration (mg cBOD/Litre)	-	-	-
Total Nitrogen (mg N/Litre)	-	-	-
Total Kjeldahl Nitrogen (mg N/Litre)	-	-	-
Total Ammonium (mg NH ₄ -N/Litre)	-	-	-

Total Ammonia (mg NH ₃ -N/Litre)	-	-	-
Total oxidised nitrogen (mg NO _x -N/Litre)	-	-	-
Total phosphorous (mg P/Litre)	-	-	-
Total ortho-phosphorous (mg PO ₄ -P/Litre)	-	-	-
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)			
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)			
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc			
Other Parameters (e.g. alkalinity etc)			

7. Domestic Housing Collective – Operational Demo Site (Scotland)			
Name of Partner(s) Responsible for Demonstration Site		Scottish Water	
Name and Country of Demonstration Site		Scotland	
Effluent Discharge Details			
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		Water Framework Directive, Water Environment and Water Services (Scotland) Act 2003 (WEWS Act). Controlled Activity Regulations (CAR)	
Description of Proposed Effluent Outfall Arrangement at Demonstration Site		The final effluent is current discharge by pipe into the Muckle Burn at national grid reference NH914503. The INNOQUA system however will discharge back to the head of the existing STW	
Details of Existing Effluent Discharge Consents (If Any) at the Site		5 day BOD at 20C 25mg/l. Total Ammoniacal Nitrogen 25mg/l. Suspended solids 35mg/l. Total Hydrocarbons 5mg/l. Zinc - no more than 250mg/l Phenolic compounds (As C6, H5, OH) - no more than 20mg/l	
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		Licence Requirements as above	
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge		Not required	
Details of the legislation or regulation under which the discharge consent is or will be granted		n/a	
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted			
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse		NO - we will test the final effluent for the potential to reuse for grey water / sub potable purposes but not actually implement it. We are keen however to demonstrate potable water at the back end of the system	
Describe the particular quality requirements for the intended reuse and the legislative framework relating		Not required	
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)		35mg/l	
pH		8	6
Dissolved oxygen (mg O2/Litre)			
Water temperature (oC)		20C	
COD concentration (mg COD/Litre)		125mg/l	

BOD5 concentration (g BOD5/Litre)		25mg/l	
cBOD concentration (mg cBOD/Litre)			
Total Nitrogen (mg N/Litre)		25mg/l	
Total Kjeldahl Nitrogen (mg N/Litre)			
Total Ammonium (mg NH4-N/Litre)			
Total Ammonia (mg NH3-N/Litre)			
Total oxidised nitrogen (mg NOx-N/Litre)			
Total phosphorous (mg P/Litre)			
Total ortho-phosphorous (mg PO4-P/Litre)			
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	or Littlemill look at refer to Inland water values		
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	E-Coli, Cryptosporidium, intestinal enterococci		
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc	Zinc - no more than 250ug/l Phenolic compounds (As C6, H5, OH) - no more than 20ug/l		
Other Parameters (e.g. alkalinity etc)	Not stated		

8. Domestic Housing Complex – Operational Demo Site (Turkey)	
Name of Partner(s) Responsible for Demonstration Site	Ekodenge
Name and Country of Demonstration Site*	Sinop Atabay Estate / TURKEY
Effluent Discharge Details	
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply	<p>Following legislations have to be evaluated depending on the technical features (e.g. configurations, treatment efficiencies) and expected effluent characteristics of INNOQUA system.</p> <ul style="list-style-type: none"> - Regulation on Water Pollution Control (Su Kirliliği Kontrolü Yönetmeliği - 31.12.2004 No: 25687) - Communique on Wastewater Treatment Plant Technical Procedures (Atıksu Arıtma Tesisleri Teknik Usuller Tebliği - 20.03.2010 No: 27527) - Circular of Wastewater Treatment / Deep Sea Discharge Project Approval (Atıksu Arıtma /Derin Deniz Deşarjı Tesisi Proje Onayı Genelgesi - 04.03.2014) - Regulation on Environmental Permit and Licence (Çevre İzin ve Lisans Yönetmeliği 10.09.2014 No: 29115)
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	The outlet of the INNOQUA system is envisioned to be reused as irrigation water, if not it will be diverted to the septic tank. Still open to discussion.
Details of Existing Effluent Discharge Consents (If Any) at the Site	According to the Article 32 of the Regulation on Water Pollution Control (Su Kirliliği Kontrolü Yönetmeliği 31.12.2004 No: 25687) no discharge consent is required currently. Because the population of the site is going to be under 84 person equivalent. So the domestic wastewaters (if not to be treated) need to be collected in leak proof septic tanks which are to be constructed in accordance with the "Regulations on Wells to be Constructed at Locations not feasible for a Sewer System" and transported to a wastewater treatment plant.
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply	As stated above, currently no treatment or discharge consent is required since the population of the site is going to be under 84 person equivalent. However, voluntary implementation of the INNOQUA system and subsequent water reuse practice will require several legislations (listed above) to be complied. Abovelisted legislations are going to be evaluated in detail during the course of the project.
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge	The major purpose of the INNOQUA system is to supply irrigation water for shrubbery/nursery ground. In other words irrigation requirements on the related legislations must be complied. Major legislation regarding the use of treated wastewater on irrigation is "the Communique on Wastewater Treatment Plant Technical Procedures (Atıksu Arıtma Tesisleri Teknik Usuller Tebliği - 20.03.2010 No: 27527)". In this regulation, Annex 7, Table E7.1 describes the technical requirements of the treated water (Class B) to be used for irrigation purposes.
Details of the legislation or regulation under which the discharge consent is or will be granted	Details (including frequency/type/reporting body) of compliance monitoring/sampling is presented in Regulation on Water Pollution Control (Su Kirliliği Kontrolü Yönetmeliği - 31.12.2004 No: 25687) and Communique on Wastewater Treatment Plant Technical Procedures (Atıksu Arıtma Tesisleri Teknik Usuller Tebliği - 20.03.2010 No: 27527).
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation	<p>Following legislations have to be evaluated depending on the technical features (e.g. configurations, treatment efficiencies) and expected effluent characteristics of INNOQUA system.</p> <ul style="list-style-type: none"> - Regulation on Water Pollution Control (Su Kirliliği Kontrolü Yönetmeliği - 31.12.2004 No: 25687)

under which the discharge consent is or will be granted	<ul style="list-style-type: none"> - Communiqué on Wastewater Treatment Plant Technical Procedures (Atıksu Arıtma Tesisleri Teknik Usuller Tebliği - 20.03.2010 No: 27527) - Circular of Wastewater Treatment / Deep Sea Discharge Project Approval (Atıksu Arıtma /Derin Deniz Deşarjı Tesisi Proje Onayı Genelgesi - 04.03.2014) - Regulation on Environmental Permit and Licence (Çevre İzin ve Lisans Yönetmeliği 10.09.2014 No: 29115)
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse	The outlet of the INNOQUA system is envisioned to be reused as irrigation water, if not it will be diverted to the septic tank. Still open to discussion.
Describe the particular quality requirements for the intended reuse and the legislative framework relating	According to the Article 28 of the Regulation on Water Pollution Control (Su Kirliliği Kontrolü Yönetmeliği 31.12.2004 Official Gazette No: 25687) the wastewaters, which are treated so as to comply with the quality criteria for the irrigation water specified in the "Communiqué on Wastewater Treatment Plant Technical Procedures" of the Regulation on Water Pollution Control, are encouraged to be used as irrigation water. The pre-treatment operations and necessary monitoring shall be carried out in accordance with the "Communiqué on Wastewater Treatment Plant Technical Procedures". Whether large amounts of wastewater is in compliance with such purposes shall be determined by a commission to be composed of representatives of the governorate General Directorate of Environment and Urbanization, provincial Agriculture Directorate and Regional Directorate of Forestry and Water Affairs.

Effluent Requirements

Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)	-	30	-
pH	-	9	6
Dissolved oxygen (mg O ₂ /Litre)	-	-	-
Water temperature (oC)	-	-	-
COD concentration (mg COD/Litre)	-	-	-
BOD ₅ concentration (g BOD ₅ /Litre)	-	30	-
cBOD concentration (mg cBOD/Litre)	-	-	-
Total Nitrogen (mg N/Litre)	-	-	-
Total Kjeldahl Nitrogen (mg N/Litre)	-	-	-
Total Ammonium (mg NH ₄ -N/Litre)	-	-	-
Total Ammonia (mg NH ₃ -N/Litre)	-	-	-
Total oxidised nitrogen (mg NO _x -N/Litre)	-	-	-
Total phosphorous (mg P/Litre)	-	-	-
Total ortho-phosphorous (mg PO ₄ -P/Litre)	-	-	-

Additional Effluent Requirements (where applicable)	
Parameter	Details
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	-
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	Fecal Coliforms < 200 col/100 mL (Some other analyses may be required)
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc	-
Other Parameters (e.g. alkalinity etc)	Free Chlorine > 1 mg/L

9. Tourist Accommodation Building – Operational Demo Site (Romania)			
Name of Partner(s) Responsible for Demonstration Site		RMC	
Name and Country of Demonstration Site		Romania	
Effluent Discharge Details			
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		Legislation: Government Decision 188/2002, 352/2005; 2110/2007. Values for various effluent parameters are given in Annexes to the mentioned regulations (NTPA-001; NTPA-002)	
Description of Proposed Effluent Outfall Arrangement at Demonstration Site		The effluent water will be discharged in the nearby river	
Details of Existing Effluent Discharge Consents (If Any) at the Site		Authorization from relevant local authorities	
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		Probably will not be necessary.	
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge		For urban waters going directly in water bodies, the NTPA-001 norm includes: Max values mg/dm ³ : Suspended solids 35, BOD 25, COD 125, , Ammonia 2, Phosphorus 1. For urban waters going into the sewerage system and from here to the city wastewater treatment facility, the Norm is NTPA-002 (Max values mg/dm ³ : Suspended solids 350, BOD 300, COD 500, , Ammonia 30, Phosphorus 5)	
Details of the legislation or regulation under which the discharge consent is or will be granted		n/a	
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted		See the EXCEL File Demo Site Characteristics for seasonal temperature variations and other details	
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse			
Describe the particular quality requirements for the intended reuse and the legislative framework relating		No reuse envisaged for the time being	
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)		35	
pH		6.6...8.5	
Dissolved oxygen (mg O ₂ /Litre)			
Water temperature (oC)		35	
COD concentration (mg COD/Litre)		125	

BOD5 concentration (g BOD5/Litre)		25	
cBOD concentration (mg cBOD/Litre)			
Total Nitrogen (mg N/Litre)			
Total Kjeldahl Nitrogen (mg N/Litre)			
Total Ammonium (mg NH ₄ -N/Litre)			
Total Ammonia (mg NH ₃ -N/Litre)		2	
Total oxidised nitrogen (mg NO _x -N/Litre)			
Total phosphorous (mg P/Litre)		1	
Total ortho-phosphorous (mg PO ₄ -P/Litre)			
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)			
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)			
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc			
Other Parameters (e.g. alkalinity etc)			

10. Domestic Residential Building (Apartments) – Operational Demo Site (Ecuador)			
Name of Partner(s) Responsible for Demonstration Site		GYA	
Name and Country of Demonstration Site		Casa Armero, Ecuador	
Effluent Discharge Details			
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		Two main laws for Ecuador: - Ley organica de recursos hydricos, usos y aprovechamiento del agua (2014) - Texto unificado de legislacion secundaria (TULAS - revised as TULSMA in 2015)- Libro VI, Anexo 1: Norma de calidad Ambiental y de descarga de efluentes - recurso agua	
Description of Proposed Effluent Outfall Arrangement at Demonstration Site		Outfall in the current wastewater network	
Details of Existing Effluent Discharge Consents (If Any) at the Site		no permission required but necessary to organize a monitoring of the effluent discharge	
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		n/a	
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge		n/a	
Details of the legislation or regulation under which the discharge consent is or will be granted		n/a	
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted		Monitoring and sampling required, but exact monitoring parameters to be agreed with the "control" authority	
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse		TBC	
Describe the particular quality requirements for the intended reuse and the legislative framework relating		-	
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)	-	220	-
pH	-	9	5
Dissolved oxygen (mg O ₂ /Litre)	-	-	-
Water temperature (oC)	-	40	-
COD concentration (mg COD/Litre)	-	500	-
BOD ₅ concentration (g BOD ₅ /Litre)	-	250	-
cBOD concentration (mg cBOD/Litre)	-	-	-
Total Nitrogen (mg N/Litre)	-	40	-

Total Kjeldahl Nitrogen (mg N/Litre)	-	-	-
Total Ammonium (mg NH ₄ -N/Litre)	-	-	-
Total Ammonia (mg NH ₃ -N/Litre)	-	-	-
Total oxidised nitrogen (mg NO _x -N/Litre)	-	-	-
Total phosphorous (mg P/Litre)	-	15	-
Total ortho-phosphorous (mg PO ₄ -P/Litre)	-	-	-
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	-		
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	-		
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc	-		
Other Parameters (e.g. alkalinity etc)			

11. Domestic Educational Building (Classrooms etc) – Operational Demo Site (Peru)	
Name of Partner(s) Responsible for Demonstration Site	UCSM
Name and Country of Demonstration Site	Fundo Huasacache - Peru
Effluent Discharge Details	
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply	<p>There are two main laws in Peru: Law 29338: Ley de Recursos Hídricos (March, 2009) - This law (Law of Water Resources) aims to regulate the use and integrated management of water, the performance of the state and individuals in this management, as well as the assets associated with this. D.S. N° 015-2015-MINAM. Estándares Nacionales de Calidad Ambiental (ECA) para Agua (December 2015) – Here, Environmental Quality Standards (ECA) for Water are described, since they are a mandatory benchmark in the design and implementation of all environmental management tools at the national level.</p>
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	The outlet of the INNOQUA system is envisioned to be reused as irrigation water, if not it will be diverted to the septic tank. Still open to discussion
Details of Existing Effluent Discharge Consents (If Any) at the Site	-
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply	-
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge	-
Details of the legislation or regulation under which the discharge consent is or will be granted	National regulation indicates that: Holders of the Wastewater Treatment Plant are required to conduct monitoring of their effluents, in accordance with the Monitoring Program approved by the Ministry of Housing, Construction and Sanitation. It will only be considered valid if the monitoring is performed under the Monitoring Protocol established by the Ministry of Housing, Construction and Sanitation, conducted by accredited Laboratories with the National Institute for Consumer Protection and Intellectual Property -. INDECOPI "
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted	<p>There are two main laws in Peru: Law 29338: Ley de Recursos Hídricos (March, 2009) - This law (Law of Water Resources) aims to regulate the use and integrated management of water, the performance of the state and individuals in this management, as well as the assets associated with</p>

	<p>this. D.S. Nº 015-2015-MINAM. Estándares Nacionales de Calidad Ambiental (ECA) para Agua (December 2015) – Here, Environmental Quality Standards (ECA) for Water are described, since they are a mandatory benchmark in the design and implementation of all environmental management tools at the national level.</p>		
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse	<p>Yes, as previously mentioned, it is envisioned to be used for irrigation since approximately 40% of total water use at the campus is destined for farmlands and cattle</p>		
Describe the particular quality requirements for the intended reuse and the legislative framework relating	<p>Water for irrigation needs to comply with the Environmental Quality Standards (ECA) for water, within Category 3 (Water for irrigation and animal drinking), sub-category D1 (Water for irrigation of low and high stem plants)</p>		
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)	-	-	-
pH	-	8.5	6.5
Dissolved oxygen (mg O ₂ /Litre)	-	-	4
Water temperature (oC)	Δ3	-	-
COD concentration (mg COD/Litre)	-	40	-
BOD ₅ concentration (g BOD ₅ /Litre)	-	15	-
cBOD concentration (mg cBOD/Litre)	-	-	-
Total Nitrogen (mg N/Litre)	n/a	n/a	n/a
Total Kjeldahl Nitrogen (mg N/Litre)	n/a	n/a	n/a
Total Ammonium (mg NH ₄ -N/Litre)	n/a	n/a	n/a
Total Ammonia (mg NH ₃ -N/Litre)	n/a	n/a	n/a
Total oxidised nitrogen (mg NO _x -N/Litre)	n/a	n/a	n/a
Total phosphorous (mg P/Litre)	n/a	n/a	n/a
Total ortho-phosphorous (mg PO ₄ -P/Litre)	n/a	n/a	n/a
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	<p>Yes, legislation requires specific microbiological and parasitological parameters, such as total coliforms</p>		

Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	(1000 MPN/100ml), thermotolerant coliforms (1000 MPN/100ml), intestinal enterococci (20 MPN/100ml), Escherichia coli (100 MPN/100ml), and helminths (less than 1 egg/Litre)
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc	Yes, legislation requires specific parameters for inorganic compounds
Other Parameters (e.g. alkalinity etc)	Yes, legislation requires specific parameters for inorganic compounds

12. Domestic Educational Building (Meeting Room) – Operational Demo Site (Tanzania)			
Name of Partner(s) Responsible for Demonstration Site	Borda		
Name and Country of Demonstration Site	Tanzania		
Effluent Discharge Details			
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply	Environmental Management (Water Quality standards) Regulations, 2007 (Discharge standards on p. 4-6 in D1_1___BORDA_Innoqua1_Tanzania (1) vDT.doc). But due to lack of manpower, financial resources and other logistical challenges, law enforcement has been weak. The effluent of this site must not fulfil the regulations since it is not discharged in open water body but reused on site		
Description of Proposed Effluent Outfall Arrangement at Demonstration Site	-		
Details of Existing Effluent Discharge Consents (If Any) at the Site	Not Required		
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply	Not Required		
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge	Not Required		
Details of the legislation or regulation under which the discharge consent is or will be granted	Not Required		
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted	-		
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse	Agricultural reuse on site. Watering of Banana plants		
Describe the particular quality requirements for the intended reuse and the legislative framework relating	-		
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)			
pH	8		
Dissolved oxygen (mg O ₂ /Litre)			
Water temperature (°C)	26		
COD concentration (mg COD/Litre)	394		
BOD ₅ concentration (g BOD ₅ /Litre)	Data not available		

cBOD concentration (mg cBOD/Litre)	Data not available		
Total Nitrogen (mg N/Litre)	Data not available		
Total Kjeldahl Nitrogen (mg N/Litre)	Data not available		
Total Ammonium (mg NH ₄ -N/Litre)	Data not available		
Total Ammonia (mg NH ₃ -N/Litre)	Data not available		
Total oxidised nitrogen (mg NO _x -N/Litre)	Data not available		
Total phosphorous (mg P/Litre)	Data not available		
Total ortho-phosphorous (mg PO ₄ -P/Litre)	Data not available		
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	Not required		
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	Not required		
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc	Not required		
Other Parameters (e.g. alkalinity etc)	Not required		

13. Domestic Buildings – Operational Demo Site (India)			
Name of Partner(s) Responsible for Demonstration Site		Borda	
Name and Country of Demonstration Site		Beedi Workers Colony, Bangalore, India.	
Effluent Discharge Details			
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		Compliance with effluent reuse/discharge standards	
Description of Proposed Effluent Outfall Arrangement at Demonstration Site		The outfall from treatment system is proposed to discharged to the existing open nala which connects to treatment plant	
Details of Existing Effluent Discharge Consents (If Any) at the Site		Not Required	
Briefly Describe and list the Regulations, Legislation or other with which Wastewater Discharge from the demo site must comply		Not Required	
Description (including timeframe) of Any Additional Authorisation/Consent Necessary for Additional/New Effluent Discharge		Not Required	
Details of the legislation or regulation under which the discharge consent is or will be granted		Not required	
Details (including frequency/type/reporting body) of compliance monitoring/sampling required by the legislation or regulation under which the discharge consent is or will be granted		Compliance with effluent reuse/discharge standards	
Is it intended that treated wastewater will be reused? If so, provide details of intended reuse		No	
Describe the particular quality requirements for the intended reuse and the legislative framework relating		BOD<10 mg/l	
Effluent Requirements			
Parameter	Average	Max	Min
Suspended solids (mg SS/Litre)	20		
pH	7.5	9.5	6.5
Dissolved oxygen (mg O ₂ /Litre)			
Water temperature (°C)	Shall not exceed 5°C above the receiving water temp	-	-
COD concentration (mg COD/Litre)	50		
BOD ₅ concentration (g BOD ₅ /Litre)	10		
cBOD concentration (mg cBOD/Litre)	NA		

Total Nitrogen (mg N/Litre)	10		
Total Kjeldahl Nitrogen (mg N/Litre)	NA		
Total Ammonium (mg NH ₄ -N/Litre)	5		
Total Ammonia (mg NH ₃ -N/Litre)	NA		
Total oxidised nitrogen (mg NO _x -N/Litre)	NA		
Total phosphorous (mg P/Litre)	5		
Total ortho-phosphorous (mg PO ₄ -P/Litre)	NA		
Additional Effluent Requirements (where applicable)			
Parameter	Details		
Required effluent pathogen numbers or log removal (measured as MPN or CFU/100ml or similar)	<100 MPN/100ml		
Required pathogens to be eliminated (e.g. e-coli, faecal coliforms, norovirus, cryptosporidium etc)	E.coli		
Required effluent concentrations for specific compounds such as metals, pharmaceuticals, hormones etc			
Other Parameters (e.g. alkalinity etc)			