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WITHIN THE ENERGY, ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

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REPORT

No. 1.1, July 2003

WP 1, Deliverable D1
Construction of a control panel for rehabilitation: Selection of a listing of rehab PIs

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CARE

CARE-S - Computer Aided REhabilitation of Sewer networks

CARE – S

Computer Aided REhabilitation of Sewer networks

Decision Support Tools for Sustainable Water Network Management

WP1 - Construction of a control panel of performance indicators for rehabilitation

Report No. 1

Selection of a listing of Performance Indicators for Rehabilitation

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1 INTRODUCTION

1.1 – General

CARE-S – *Computed aided rehabilitation of sewer networks* is a project funded by the 5th EU Framework Programme. It started in October 2002 and will be finished by October 2005.

The project goal is to establish a rational framework for decision-making support on sewer network rehabilitation. CARE-S aims to develop an integrated and systematic methodology for rehabilitation. The final goal is to improve the structural and functional reliability of the wastewater networks (e.g. risk of infiltration and exfiltration, collapse and blockage due to pipe deterioration, hydraulic overloading resulting in flooding and/or receiving water pollution). The main deliverable will be a Decision Support System (CARE-S prototype) to enable municipal engineers to establish and maintain effective management of their sewer networks: *rehabilitate the right sewer at the right time by using the right rehabilitation technique at a minimum total cost, before serious failures occur* (pro-active approach).

The project is divided into ten Working Packages (WP), as follows:

- WP1: Construction of a control panel of performance indicators (PIs) for rehabilitation;
- WP2: Description and validation of structural conditions;
- WP3: Description and validation of hydraulic performance and their environmental impacts;
- WP4: Rehabilitation technology information system;
- WP5: Socio-economic impacts of rehabilitation strategies;
- WP6: Multi-criteria rehabilitation decision support;
- WP7: Wastewater network rehabilitation manager (CARE-S prototype);
- WP8: Testing and validation of the CARE S prototype;
- WP9: Presentation and dissemination of results;
- WP10: Administration and co-ordination.

LNEC is responsible for the WP1, also having contributions in other working packages, namely in the area of urban water engineering. The social ecological group is strongly involved in the activities of WP5.

This is the first milestone report and refers to the Task 1.1 of Working Package (WP1) briefly described below.

This report corresponds to delivery D1 – *Control Panel of Performance Indicators Report*.

1.2 – Description of Working Package 1 (WP1)

The WP1 is divided in three tasks, each being described by a specific objective, schedule, deliverables and methodology. These have been refined since the initial proposal according to contributions from other partners.

TASK 1.1 – CHOICE OF PERFORMANCE INDICATORS

Objective: Selection of a set of PIs considered being relevant for the rehabilitation of sewer systems.

Methodology:

a) Identification of CARE-S specific objectives with regard to the use of PI in the scope of rehabilitation of sewer networks;

b) Proposal by LNEC of a first set of pre-selected rehab PIs, based on the IWA-PI system [1] covering aspects of hydraulic, environmental, structural, economical and social performance.

c) Evaluation of the selected PIs, by partners and end-users, by means of a questionnaire

d) Establishment of a set of PIs for further testing and implementation in the rehabilitation manager (WP1 and WP7).

Deliverables: Listing of CARE- S rehab PIs, including report.

Schedule: 1 October 2002- 30 May 2003.

TASK 1.2 – TEST OF PERFORMANCE INDICATORS ON CITIES

Objective: Development of a software tool (PI- tool WW) for PI assessment and field-testing by the end-users.

Methodology:

a) Development of the software (PI-tool WW) based on the experience of the PI-tool developed under CARE-W project;

b) Preparation of a wastewater database (software input data) to be send and fulfilled by end-users;

c) Collect key utility and external information

d) Field-testing of the rehab PIs in the volunteer end-users;

e) Reception of replies and report presentation;

f) Preparation of overall report with global trends and eventual thresholds.

Deliverables: PI-tool WW software and User Manual; results on the rehab PI field-testing.

Schedule: 1 June 2003- 31 May 2004.

Note: further to the developments of CARE-W PI-tool, and decision that a similar development will be made by LNEC to CARE-S, the time schedule for this task will last for 12 months instead of the 6 months (initial proposal). This will allow for the development of the software at an earlier stage (first 3 months) and further intensive field-testing, including iterative feedback and refinement of the results (9 months).

TASK 1.3 – PREDICTABLE PERFORMANCE INDICATORS

Objectives: Identification of predictable PIs, based on the results of field-testing and interface with other relevant Working Packages, namely WP3, WP6 and WP7(*).

Methodology:

a) Identification of predictable rehab PIs;

b) Refinement of the predictable rehab PIs;

(*) Predictable PIs are those for which temporal development can be expressed as a function of explanatory variables. Those PIs are of special interest because they can be predicted and thus, used to evaluate rehabilitation measures in terms of the expected development of the respective PI.

Deliverables: Report of control panel of predictable rehab PIs.

Schedule: 31 December 2003 - 31 May 2004.

1.3 Partners contributions to WP1

According to the proposal amendment, dated from February 2003, and further to the Coordinator request, discussion and agreement, from the initial 38 man-months allocated to WP1, 4 were transferred from LNEC to WP6 and WP7, in order to improve the links between these three work packages. Therefore, a total amount of 34 man-months (instead of the initial 38) are allocated to WP1, 16 of them from LNEC´s team.

SINTEF /NTNU, Brno University, Cemagref, Dresden University, Alborg University, WRc, Bologna University, Ferrara University and Clabsa have 2 persons-months each.

The following activities have been planned for collaborating partners:

- Reply to questionnaire “CARE-S-Part2-Dec2002.doc”;
- Comment the preliminary listing of rehab PI;
- Support to the respective end-users in response to the questionnaire referred above.

Added contribution is expected from partners and end-users regarding:

- Participation in the extensive field-testing of the rehab PIs in volunteer end-users (Task 1.2)
- Comment and support regarding the proposal of predictable PIs (Task 1.3).

1.4 – Structure and Contents of the Report

As referred previously this is the first report of WP1 and describes the activities carried out under Task 1.1.

After this introduction, section2 introduce relevant aspects regarding performance indicators namely why use PIs, the IWA manual on PIs for wastewater services and the PI concepts.

Section 3 refers specifically to the objectives of using PIs in the scope of CARE-S and the PI requirements for rehabilitation and section 4 presents in detail the activities of Task 1.1 of WP1.

In section 5 the questionnaire structure, the data processing and the results are presented and discussed and in section 6 the main outcomes from the Ferrara meeting regarding WP1 is briefly described.

In section 7, and further to previous developments, the CARE-S rehab PI listing as well as the complementary UI and EI data are presented.

In section 8 a reference is made to the progress on the draft glossary of rehab terms and, finally, in section 9 the activities foreseen for the next milestone is anticipated.

The text is complemented by a set of eleven comprehensive Appendices that contains a lot of detailed information, including graphics and charts.

2 PERFORMANCE INDICATORS

2.1 Why use performance indicators

Irrespective as to whether it is a private company or a public municipal service supplier, any undertaking needs to strive for high degrees of efficiency and effectiveness to achieve its management goals. In addition, other stakeholders, such as regulators or customers require assurance that the undertaking is performing appropriate.

Performance Indicators (PIs) may be considered as providing key information needed to define the efficiency and effectiveness of the delivery of services by an undertaking. Efficiency is the extent to which the resources of an undertaking are utilised to provide the service, for example, maximising service delivery for the minimum use of available (possibly natural) resources. Effectiveness is the extent to which declared or imposed, objectives, such as levels of service, (specifically and realistically defined) are achieved. PIs may also be considered as providing information for 'metric' benchmarks – quantitative comparative assessment of performance. The actual comparison of performance between similar service provision is undertaken via 'process' benchmarking – examining business processes, comparing the activities of different organisations and seeking to identify best practices.

A performance indicator may thus be used as a quantitative (or in some cases qualitative) measure of a particular aspect of an undertaking's performance or standard of service. PIs may be used to compare performance historically, or against some pre-defined target. PIs may be used by a wide range of stakeholders in evaluating the performance of the undertaking, including internal evaluation within the undertaking itself.

2.2 The IWA Framework of Performance Indicators for Wastewater Services

Increasing diversity in the provision of services for water supply and wastewater disposal, together with greater accountability for the quality of those services, necessitate scrutiny using assessment systems that are consistent, transparent and auditable. Whilst a number of countries worldwide have well defined and regulated systems for evaluating the performance of water service providers, this is by no means global. It is within this context that the International Water Association (IWA) has developed systems of performance indicators (PIs) for water supply and wastewater services. The lessons from the on going testing of the water supply PI system have been used to inform the development of the manual on performance Indicators for wastewater services (Matos *et al.* 2003). The approach to the specification, selection and usage of the PIs is generic to both water supply and wastewater services. Although the particular PIs recommended for use for performance assessment of each of the two systems are not the same.

The IWA PI systems are intended to provide objective and comprehensive management tools for undertakings and other stakeholders involved in any aspect of water and wastewater service provision. The PIs have been developed independently from the level of economic development, or type of Institutional system in which the undertaking operates, and allow globally diverse economic, demographic, cultural and climatic characteristics to be acknowledged. The PIs cover a wide range of activities comprising: management, personnel, financial, physical, operational, environmental and quality of service aspects. The PIs for wastewater systems and associated procedures presented in the Manual are expected to undergo further development through wide-scale pilot testing.

Trends in PIs with time may show historically improving or deteriorating performance in time for remedial measures to be taken before major problems occur in service delivery. PIs require a lot of data. Hence they can also provide the incentive for good monitoring, data recording and processing, and help decision makers focus scarce resource allocations into the key areas where data needs to be collected.

Whilst it is envisaged that the performance indicators developed in the scope of IWA manuals will be utilised primarily by the service providers (wastewater undertakings) they can be of use to a wide range of stakeholders namely policy making bodies and regulatory agencies, financial bodies, consumers and their representative bodies, quality certifying organisations, auditors and economic regulators and multi-lateral organisations.

2.3 The PI concept

Performance Indicators (PIs) are typically expressed as ratios between variables; these may be commensurate (e.g. %) or non-commensurate (e.g. €/m^3). It is important to comply with a range of requirements for the definition of the PIs. Individual PIs should be unique and collectively appropriate for representing all the relevant aspects of wastewater undertaking performance in a true and unbiased way, thus reflecting the managing activity. They are also required to be applicable to undertakings with different characteristics and stages of development. Furthermore, it is important that PIs are clearly defined, with a concise meaning and a unique interpretation for each indicator, easy to understand even by non-specialists, easily verifiable (auditable), self-explanatory and always related to well-defined areas and periods of time.

Each performance indicator should contribute to the expression of the level of actual performance achieved in a certain area and during a given period of time, allowing for a clear comparison with targeted objectives and simplifying an otherwise complex analysis.

The interpretation of performance of an undertaking cannot be assessed adequately without taking the context in which it operates into account, as well as the most relevant characteristics of the system and of the region.

As described in more detail in chapter 7 the set of selected PIs should be complemented by “utility information” (UI) focusing on data provided by the undertaking related to type of wastewater infrastructure and service provided (i.e. the physical assets, technology used and type of customer), and “external information” (EI) allowing for a better understanding of the demographic, economic, geographical and environmental context.

Both utility and external data contain descriptive information that is helpful for the interpretation of the PIs.

3 PERFORMANCE INDICATORS IN THE SCOPE OF CARE-S

3.1 General

According to the methodology, the WP1 activities start with the identification of CARE-S specific objectives with regard to the use of PI for rehabilitation of sewer networks, and the pre-selection of a related set of indicators, based on the IWA Manual.

The specific objectives are:

- To help in the characterisation of the sewer network in terms of hydraulic, environmental and structural conditions, making more evident the weakness and vulnerability of certain areas (sectors, clusters, etc), demonstrating the need to intervene with rehab planning and concrete measures;
- To provide key information to support a more pro-active approach in terms of rehabilitation, rather then reacting further to dysfunctions and crisis;
- To allow for the performance evolution assessment, comparing the results achieved at a given time with those achieved in previous periods, or comparing the results actually achieved with preset targets or with reference values that have been agreed;

- To allow for simpler, objective and more structured monitoring effects of rehabilitation management decisions (including socio-economics aspects);
- To facilitate the comparison of state condition/ performance/investment at different locations or sub-systems inside a given undertaking, or compare, with similar undertakings, thus providing key information to promote future performance improvements.

The selection of a preliminary set of rehab PIs based on the IWA system has taken into consideration the above-mentioned aspects. The results from the questionnaire followed by further discussions with partners and end-users lead to the inclusion of a few more indicators (see chapters 5 and 6).

It is the conviction of the authors that further links and discussions with related work packages teams (WP3, W6 and WP7 among others) and, specifically, the PIs pilot testing within a quite wide and interesting group of end-users, will show up and clarify aspects to be eventually improved.

3.2 The PI requirements

The rehab indicators to be selected in the framework of the CARE-S project should comply with the following requirements [1]:

a) to represent the relevant rehabilitation aspects of the wastewater undertaking's performance, allowing for a global representation of the system by a reduced number of performance indicators;

b) to be suitable for representing those aspects in a true and unbiased way;

c) to be clearly defined, with a concise meaning and a unique interpretation for each indicator;

d) to include only non-overlapping performance indicators;

e) to require measuring equipment that is affordable, the need for sophisticated and expensive equipment being avoided;

f) to be auditable, which is specially important when the performance indicators are to be used by external bodies (i.e. regulators) that may need to check the results reported;

g) to be easy to understand, even by non-specialists e.g. users, wherever possible;

h) to refer to a well-defined period of time;

i) to refer to well-defined geographical areas;

j) to be applicable to undertakings with different characteristics and stages of development;

k) to be as few as possible, avoiding the inclusion of non-essential aspects.

4 DESCRIPTION OF TASK 1.1 OF WORKING PACKAGE 1

According to the CARE-S initial proposal, complemented by further discussions, the methodological approach for WP1 (task 1.1) undertaken by LNEC, included the following main steps:

- Pre-selection of a preliminary set of 35 rehab PIs, derived from the IWA system and based on considerations referred to above;
- Discussion with partners and end-users of pre-selected rehab PIs, including:
  - Mailing to all partners and end-users of the questionnaire "CARE-S_Part2-Dec2002.doc" regarding the PIs proposal;

- Reception of replies from all recipients;

- Analysis of collected information including:
  - Analysis of questionnaire replies on “relevance” and “assessment” of PIs (“CARE-S-Part2- Dec2002.doc”);
  - analysis of suggestions, from partners and end-users, regarding new relevant rehab PI in the framework of CARE-S;
- Presentation of the questionnaire results and further discussions at the Ferrara project meeting;
- Set up of a CARE-S rehab PI listing and related UI and EI.
- An additional task that LNEC was committed to carry out following the first project meeting held in Dresden, was the preparation of a first draft of a *glossary of technical terms* related to rehabilitation, aiming at to be improved and enriched along the project with further contributions.

In the next sections a brief description is made of the main outcome of the activities mentioned above. Reference is made, whenever appropriate for a better understanding of the outputs, to the correspondent appendices, which included in general detailed information.

5 QUESTIONNAIRE ANALYSIS AND RESULTS

5.1 Questionnaire structure and contents

The questionnaire (Part 2) prepared by LNEC ´s urban water team included a set of 35 indicators selected from the pre-final version of the IWA system of performance indicators for wastewater services. This set included 15 operational indicators, 3 physical indicators, 4 environmental indicators, 8 quality of service indicators and 5 economical and financial indicators.

The questionnaire structure and contents is presented in Appendix 1. The main questions raised were:

- How relevant is each indicator, based on the classification: essential, important, useful, and irrelevant;
- How is the knowledge /perception of the assessment of the indicator (assessed/ not assessed);
- Comments, suggestions, proposals for new PIs were also requested.

In Appendix 2 a summary of the number of answers received to the several questions from Partners and End-users are given.

In Appendix 7 the list of comments, suggestions and PI proposals are systematized.

5.2 Participating Partners and End-Users

The questionnaire was sent out to 15 Partners and 19 End-users as described and illustrated in the figure below.

The 15 Partners are: Sintef, NTNU, Alborg University, Cemagref-Engees, WRc, Marne-la-Vallée University, Dresden University, Brno University, Budapest University, Bologna University, Ferrara University, Palermo University, Clabsa, LNEC and CSIRO.

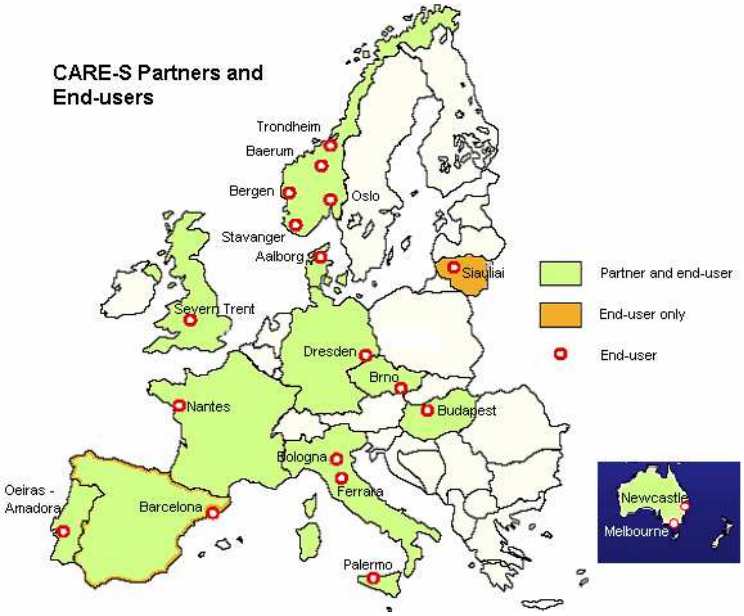
Four of them replied in association (Sintef together with NTNU, and Bologna University together with Ferrara University), making 13 questionnaire-results.

The 19 End-users, answered individually, leading to 19 answers as follows: Trondheim, Bergen, Baerun, Stavanger, Oslo (in Norway), Siurliai (Lituania), Aalborg (Sweden), Severn-Trent(UK), Nantes (France), Dresden (Germany), Budapest (Hungary), Brno (Check Republic), AGAC, AMAP and ACOSEA (Italy), Clabsa (Barcelona), Oeiras-Amadora (Portugal) and Newcastle and Melbourne (Australia).

The questionnaire was sent out during the first week of December 2002 being the deadline for replying 31 January 2003. However, several answers were received during February and March 2003, just before the Ferrara meeting.

The results (including all the answers received) were presented and discussed at the meeting. A very late questionnaire, arrived in April from Budapest Vaziviz, was also processed and included in the results of the present report.

The final sample includes then 13 answers from Partners and 20 answers from end-users.



5.3 Data Processing

Input data from the questionnaires were collected and stored in an excel file for further processing.

The data processing included the following main tasks:

- Statistical analysis of the relevance given to each PI, using the different clusters (Partners, End-users, and the total sample);
- Statistical analysis of the assessment/no assessment of PIs, using the different clusters (Partners, End-users, and the total sample);
- Relative ranking of the PIs based on Pareto histograms, for the category "relevance", according to the following group of answers: essential + important; useful, irrelevant/not applicable;
- Relative ranking of the PIs, based on Pareto histograms, for the category "assessment" according to the following group of answers: "Assessed" and "not assessed";

- A comparative and global evaluation (including all PIs) as regard “relevance” and “assessment”, for the clusters Partners and End-users separately;
- Results, expressed in graphics and charts, are presented in Appendices 3, 4, 5, and 6.

The main considerations and conclusions that arise from the results are briefly presented in the following chapters.

5.4 Analysis of the relevance given to each PI

Figures presented in Appendix 3 show different group of bars representing the percentage and number of answers regarding the “relevance” given to each PI.

Partners, end-users and the total sample are presented in separate for each PI to allow for a better understanding of the main differences.

The following considerations arise from the results:

Operational indicators: In general, the operational indicators proposed are considered by a clear majority of partners and end-users (60% to 90%) as being “essential” or “important”. Exception, among the fifteen operational PIs, are three indicators related to manhole replacement, manhole covers replacement and service connections replacement.

Physical indicators: the physical indicators are considered, in general, by a majority of partners and end-users (50% to 70%) as being “essential” or “important”.

Environmental indicators: three of the environmental indicators (those dealing with surcharging of sewers) are considered by a majority of partners and end-users (50% to 70%) as being “essential” or “important”. Exception is the indicator related to sediments in sewers, which are considered relevant or important by close to 25% of end-users and 30% of partners.

Quality of Service indicators: in general, the quality of service indicators dealing with the service itself (namely flooding of properties) are considered by the majority of partners and end-users (60%-70%) as being “essential” or “important”. The indicators dealing with complaints (namely blockage and flooding complaints) are considered “relevant” by only 15% of partners and end-users and “important” by 25-30 % of them.

Financial indicators: financial indicators are considered in general by a clear majority of partners and end-users (50% to 90%) as being “essential” or “important”.

5.5 Analysis of replies on PI assessment

Operational indicators: In general, the operational indicators are considered “assessed” by a clear majority of partners and end-users (50% to 95%). Exceptions, among the fifteen operational PIs, are the indicators related to infiltration, inflow and exfiltration were the expectancy of assessment is clearly low: between 5% and 20% of the answers.

Physical indicators: the physical indicators are considered “assessed” by 30% to 40% of the partners and end-users. The behaviour seems to be very similar between the two clusters.

Environmental indicators: the environmental indicators are considered “assessed” by 45 % to 55% of the partners and by 20% to 45% of the end-users. The expectancy shows in this case a different behaviour between partners and end-users.

Quality of Service indicators: in general, quality of service indicators is considered assessed by 45% to 85% of end-users and by 55% to 95% of partners. End-users tend to be less optimistic then partners regarding the assessment of indicators dealing with the service itself (e.g. flooding of properties) and more optimistic then partners regarding “complaints of the service”.

Financial indicators: financial indicators are considered both from partners and end-users easy to assess. Partners and end-users are very in line, specifically regarding "investment" PIs. Light differences are shown as regards to "costs" PIs. Answers vary from 90% to 100%.

5.6 New rehab PIs proposed

There were several suggestions for new PIs, from both partners and end-users. However some were in fact not conceptually PIs according to the PIs requirements, but "utility" or "external" information.

The following suggestions regarding new PIs were considered for further discussion and agreement:

- Repeat blockages
- Divide "Number of blockages /100 km" in two indicators:
  - Number of blockages occurred in the sewer system /100 km"
  - Number of blockages occurred in pumping stations /100 km"
- Repeat flooding affecting properties/ 100km
- Reflect in a new PI the structural condition of sewers (discuss concept of critical sewers)

Also aspects regarding the consideration (or not) of PIs related to "maintenance of sewers " were considered to deserve further discussion.

5.7 Discussion of results

The main conclusions that can be drawn from the results of the questionnaire are as follows:

- There is, in general, a clear validation of the LNEC´s proposal regarding the pre-selected set of 35 rehab PIs. In fact all PIs have got the classification of "essential" or "important" at least by 2 Entities. Pareto histograms show up that the lowest twenty-five percent PIs ranked as "essential or important" are highly ranked as "useful". Attention must also be drawn to the fact that the lowest ranked "essential or important" PIs are, in general, considered to be easily "assessed".
- Partners and End-users are "two clusters" that appears to have their own characteristics and behaviour regarding PIs. Therefore it was clearly worthwhile to involve End-users in a so early stage.
- In general Partners tend to over-estimate the importance of PIs in comparison with End-users
- In general Partners tend to be "more optimistic" than End-Users concerning the the PI assessment
- Partners and End-users are particularly in-line regarding relevance of the following families of PIs: failures (flooding/ blockages), financial, surcharging of sewers, and complaints (flooding and blockages)
- The families of PIs that are at the same time ranked as "essential or important" and "difficult to assess" are those dealing with the following aspects: Inflow/Infiltration/Exfiltration; surcharging of sewers; overflows discharges. In fact these topics address 60% of the answers and represent, therefore, clear areas to improve within CARE-S. Close links with the EU project APUSS, dealing specifically with infiltration and exfiltration in sewers seems to be very convenient.

Proposals of new PIs, as well as UI and EI information, were listed to be discussed at the Ferrara meeting. The outcome is summarized below.

6 MAIN OUTCOMES FROM THE FERRARA MEETING

The main objectives regarding WP1, as presented at Ferrara meeting were:

- To finalise the PIs selection based on the questionnaire results and discussion;
- To discuss the complementary data: Utility Information (UI) and External Information (EI)
- To clarify the links, the fluxes of information and interfaces between WP1 and other WPs (1-7)
- To agree on follow up – 2nd milestone, including the PI -Tool WW development and testing

Fruitful plenary and working-groups discussions took place, the main outcome being the following:

PI selection:

PI (wOp24) – "% of manholes covers replaced" was decided to be moved to UI data and deleted as PI;

6 new PIs were added to the initial set:

Repeat blockages locations / 100 km sewer (new Op)

Nº Blockages / 100 km divided in two indicators (new Op)

Repeat flooding affecting properties /100Km (new Qs)

Duration of overflows (h)/ Nº overflow devices (new En)

Unit running costs for maintenance, cleaning and repair (€)/Inhab/ year (new sub Fi)

Length of sewers cleaned /100 km (new Op)

Furthermore it was decided that no additional PI would be added related to "criticality" of sewers. WRc (WP7) will give guidance regarding a "trigger procedure" for inspection /rehab priorities. Corrosion aspects will be tackled in WP2. WP1 will collect UI regarding potential effect related to industry (% industrial sewage and nº industrial connections will be collected). WP1 will not ask for data related to composition of sewage.

UI and EI listing:

Based on several discussions the listing of UI and EI presented in section 7 (7.3 and 7.4) were agreed.

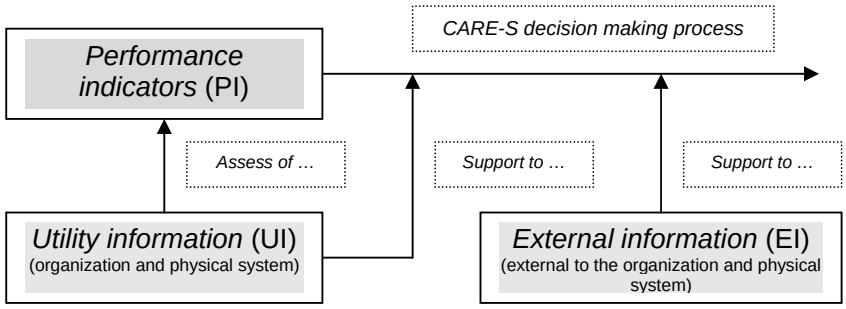
7 CARE-S REHAB PI LISTING

7.1 General

At this stage it is possible to define a CARE-S rehab listing of performance indicators, as well as the corresponding utility information and external information needed to a better understanding of the PIs, according to the following concepts:

- As referred above, *performance indicators* (PI) are ratio between values of identical or different nature, expressing the performance of the undertaking regarding a given point of view relevant in the rehabilitation framework.
- The *utility information* (UI) is the set of data that is directly related to the activity of the utility (organization and its physical system) and is under its direct control. It is used either for the assessment of the selected PI (as PI input variables) or for the CARE-S decision making process.

- The *external information* (EI) is the set of data that cannot be directly influenced by the utility (external to the organization and to its physical system) but that is critical for establishing the rehab diagnosis or for support to the CARE-S decision-making process (e.g. rain fall, temperature, ground slope, type of soil, etc.).



7.2 Performance indicators

The following set of PIs is proposed for rehabilitation planning in the framework of CARE-S project.

Note that new codes were given to the PIs selected in the scope of CARE-S project (e.g. sEn1, sOp1). In the tables below a reference is made to the correspondent IWA PI codes, when applicable.

The PIs in blue colour corresponds to those that were proposed and agreed as new rehab PIs in the scope of CARE-S.

REHAB PERFORMANCE INDICATORS

ENVIRONMENTAL INDICATORS (sEn)	
Wastewater	**IWA PI**
sEn1 - Overflow discharge frequency (Nº/overflow device/year)	wEn3
sEn2 - Overflow discharge volume (m^3/overflow device/year)	wEn4
sEn3 - Duration of overflow discharge ((hours)/overflow device/year)	-
sEn4 - Overflow discharge related to rainfall (%/year)	wEn5
Sediments	
sEn5 - Sediments from sewers (ton/km sewer/year)	wEn12
PHYSICAL INDICATORS (sPh)	
Sewers	
sPh1 - Surcharging in gravity sewers in dry weather (%)	wPh5
sPh2 - Surcharging in gravity sewers in wet weather (%)	wPh6
sPh3 - High sewer surcharging (%)	wPh7

OPERATIONAL INDICATORS (sOp)

Sewer Cleaning	
sOp1 - Sewer cleaning (%/year)	wOp2
Sewer Rehabilitation	
sOp2 - Sewer rehabilitation (%/year)	wOp21
sOp3 - sewer renovation (%/year)	wOp22
sOp4 - sewer replacement or renewal (%/year)	wOp23
sOp5 - Manhole chambers replacement, renewal, renovation or repair (%/year)	wOp25
sOp6 - Service connection rehabilitation (%/year)	wOp27
Inflow / Infiltration / Exfiltration (I/I/E)	
sOp7 - Inflow / Infiltration / Exfiltration (I/I/E) (%)	wOp30
sOp8 - Inflow (m^3/km/year)	wOp31
sOp9 – Infiltration (m^3/km/year)	wOp32
sOp10 - Exfiltration(m^3/km/year)	wOp33
Failures	
sOp11 - Sewer blockages (Nº/100 km sewer/year)	wOp34
sOp12 - Sewer blockage locations (Nº/100 km sewer/year)	wOp35
sOp13 - repeat sewer blockage locations (Nº/100 km sewer/year)	-
sOp14 – Pumping station blockages (Nº/100 km sewer/year)	wOp36
sOp15 – Flooding from sanitary or combined sewers (Nº/100 km sewer/year)	wOp37
sOp16 – Flooding locations in sanitary or combined sewers (Nº/100 km sewer/year)	-
sOp17 - Repeat flooding locations in sanitary or combined sewers	-
sOp18 - Surface flooding (Nº/100 km sewer/year)	wOp39
sOp19 - Sewer collapses (Nº/100 km sewer/year)	wOp40

QUALITY OF SERVICE INDICATORS (sQS)

Flooding	
sQS1 - Flooding affecting properties from sanitary or combined sewers in dry weather (Nº/1000 properties/year)	wQS10
sQS2 - Flooding affecting properties from sanitary or combined sewers in wet weather (Nº/1000 properties/year)	wQS11
sQS3 - Surface water flooding of properties in wet weather (Nº/1000 properties/year)	wQS14
Interruptions	
sQS4 - Interruption of wastewater collection and transport services (%)	wQS15
Complaints	
sQS5 – Blockage complaints (Nº /1000 inhab./year)	wQS20
sQS6 - Flooding complaints (Nº /1000 inhab./year)	wQS21
sQS7 - Pollution incidents complaints (Nº /1000 inhab./year)	wQS22
sQS8 – Odour complaints (Nº /1000 inhab./year)	wQS23

ECONOMIC AND FINANCIAL INDICATORS (sFi)	
Costs	
(*) sFi1 - Unit total cost per length of sewer (€/km sewer/year)	wFi6
(*) sFi2 - Unit running cost per length of sewer (€/km sewer/year)	wFi8
(*) sFi3 - unit running cost for maintenance, cleaning and repair per length of sewer (€/km sewer/year)	-
Investment	
(*) sFi4 - Unit investment (€/km sewer/year)	wFi27
sFi5 - investments for new assets and reinforcement of existing assets (%)	wFi28
sFi6 - investments for asset replacement and renovation (%)	wFi29
(*) *Note that if these costs are referred to inhabitants, than this indicator shall be expressed in €/inhabitant/year*	

Appendix 8 presents tables with a detailed description of each PI, with the CARE-S code and, when applicable, the correspondent IWA PI code, title, unit, concept and processing rule.

To make it clear to the reader, a table is presented at the end of Appendix 8, with the correspondence among: the CARE-S rehab PI codes - the questionnaire PI codes - and the related IWA PI codes.

7.3 Utility information

The following UI variables are needed either to assess the selected rehab PIs (as PI input variables) or to support the CARE-S decision-making process.

Note that units and correspondence to the IWA PI variables or Context Information (CI) are referred.

The UI variables that are not used for assessing the rehab PIs but eventually useful to support the interpretation of PI results and support decision are presented in blue colour:

REHAB UTILITY INFORMATION

ENVIRONMENTAL DATA	IWA PI
• Sewer sediments – (ton)	wA20
• Number of overflow discharges - (Nº)	wA24
• Volume of overflow discharges - (m^3)	wA25
• Duration of overflow discharges - (hours)	-
• Rainfall volume - (m^3)	wA26
PHYSICAL ASSETS DATA	
• Catchment area - (km2)	CI
• impermeable catchment area - (km2)	CI
• Total sewer length - (km)	wC1
• combined sewers length - (km)	CI

• sanitary sewers length - (km)	CI
• stormwater sewers length - (km)	CI
• pump mains length - (km)	CI
• other sewers length - (km)	CI
• Tidal sewers - (km)	CI
• Expansion of sewer network - (km/year)	CI
• Sewer materials	CI
• clay sewers - (km)	CI
• asbestos cement sewers - (km)	CI
• concrete sewers - (km)	CI
• polyvinyl chlorine sewers - (km)	CI
• polyethylene sewers - (km)	CI
• iron sewers - (km)	CI
• steel sewers - (km)	CI
• stone sewers - (km)	CI
• brick sewers - (km)	CI
• other known material sewers - (km)	CI
• unknown material sewers - (km)	CI
• Sewer diameters or equivalent	CI
• Dia ≤ 150 mm - (km)	CI
• 150 < Dia ≤450 mm - (km)	CI
• 450 < Dia ≤ 900 mm - (km)	CI
• 900 < Dia ≤ 1200 mm - (km)	CI
• 1200 < Dia ≤ 2200 mm - (km)	CI
• Dia > 2200 mm - (km)	CI
• Unknown diameter - (km)	CI
• Sewer age	CI
• sewers laid after 1995 - (km)	CI
• sewers laid between 1985 and 1994 inclusive - (km)	CI
• sewers laid between 1975 and 1984 inclusive - (km)	CI
• sewers laid between 1950 and 1974 inclusive - (km)	CI
• sewers laid between 1925 and 1949 inclusive - (km)	CI
• sewers laid before 1925 - (km)	CI
• unknown age sewers - (km)	CI
• Sewers location	
• under flexible roadway – (Code UFR)	-
• under rigid roadway – (Code URR)	-
• under sidewalk – (Code USW)	-
• under green areas – (Code UGA)	-
• Sewers installation depth – (m)	
• Sewers trench width – (m)	-
• Bedding soil type	

• categories to be defined – (alphanumeric)	-
• Backfilling soil type	
• categories to be defined – (alphanumeric)	-
• Average closeness to trees – (m)	-
• Type of joints	
• rigid joints – (Code RJ)	-
• flexible joints – (Code FJ)	-
• Surcharged sewers in dry weather – (m)	wC2
• Surcharged sewers in wet weather – (m)	wC3
• Highly surcharged sewers – (m)	wC4
• Overflow devices - (Nº)	wC19
• Manhole chambers - (Nº)	wC21
• Gully pots - (Nº)	wC22
• Connected properties - (Nº)	wC28
• Service connections - (Nº)	wC29
• domestic connections - (Nº)	CI
• industrial connections - (Nº)	CI

Wastewater Storage

• Storage tanks - (Nº)	wC23
• Total storage volume - (m^3)	CI
• Sewer system pumping stations - (Nº)	wC9
• Pumped wastewater - (m^3)	CI

Technological Resources Computerised information systems (IT=Information Technology**)**

• Routine use of Information Technology to support	
• inspection – (yes/no)	CI
• maintenance – (yes/no)	CI
• customer complaints – (yes/no)	CI
• updated mapping - (km)	CI
• digital mapping - (km)	CI

OPERATIONAL DATA

• Sewer cleaning - (km)	wD2
• Sewer rehabilitation - (km)	wD25
• Sewer renovation - (km)	wD26
• Sewer replacement - (km)	wD27
• Manhole chamber replacement, renewal, renovation or repair - (Nº)	wD29
• Replacement of manhole covers - (Nº)	wOp26
• Service connection replacement or renewal - (Nº)	wD31
• Inflow volume - (m^3)	wD35

• Infiltration volume - (m^3)	wD36
• Exfiltration volume - (m^3)	wD37
• Sewer blockages - (Nº)	wD38
• Sewer blockage locations - (Nº)	wD39
• Repeat sewer blockage locations - (Nº)	-
• Pumping station blockages - (Nº)	wD40
• Floodings from sanitary or combined sewers - (Nº)	wD41
• Flooding locations from sanitary or combined sewers - (Nº)	-
• Repeat flooding locations from sanitary or combined sewers - (Nº)	-
• Surface floodings - (Nº)	wD43
• Sewer collapses - (Nº)	wD44

DEMOGRAPHY (AND CUSTOMER) DATA

• Resident population – (Inhab.)	wE1
• Resident population connected to SE – (Inhab.)	wE4
• Resident population served by on-site systems – (Inhab.)	CI
• Collected sewage - (m^3)	wF1
• Industrial wastewater - (m^3)	CI

QUALITY OF SERVICE DATA

• Dry weather flooding of properties from sanitary sewers - (Nº)	wF2
• Wet weather flooding of properties from sanitary sewers - (Nº)	wF3
• Wet weather surface flooding of properties - (Nº)	wF6
• Wastewater service interruptions - (Nº)	wF7
• Blockage complaints - (Nº)	wF13
• Flooding complaints - (Nº)	wF14
• Pollution complaints - (Nº)	wF15
• Odour complaints - (Nº)	wF16

ECONOMIC AND FINANCIAL DATA

• Total costs – (€)	wG5
• External services costs – (€)	wG10
• Running costs – (€)	wG6
• Running cost for maintenance, cleaning and repair – (€)	-
• Investment in tangible assets – (€)	wG30
• Investments for new assets and reinforcement of existing assets – (€)	wG31
• Investments for assets replacement and renovation – (€)	wG32

TIME DATA

• Assessment period – (days)	wH1

Appendix 9 presents tables with UI variables detailed information, based on the CARE S code number, title, unit of expression, time period, variable type, definition, processing rule and additional comments.

7.4 External information

The following EI are proposed for establishing the rehab diagnosis or for support the CARE-S decision-making process rehabilitation planning (units are referred and the new EI which are not referred as IWA CI, but specifically proposed for CARE-S, are presented in blue):

REHAB EXTERNAL INFORMATION

DEMOGRAPHY AND ECONOMICS

- Population density - (Inhab./km2)
- Current population growth rate - (%/year)
- Gross National Product per capita - (€ per capita/year)
- Inflation rate - (%/year)

ENVIRONMENT

- Yearly rainfall
  - average yearly rainfall - (mm/year)
  - maximum yearly rainfall - (mm/year)
  - minimum yearly rainfall - (mm/year)
- Short duration rainfall
  - availability of local statistical data - (yes/no)
  - 10 min, 10 year return period - (mm/year)
  - 60 min, 10 year return period - (mm/year)
- Air temperature
  - daily average air temperature - ºC
  - daily maximum air temperature - ºC
  - daily minimum air temperature - ºC
- Topography
  - maximum altitude -(m)
  - minimum altitude - (m)
- Receiving bodies
  - ocean – (yes/no)
  - estuaries, bays and other coastal waters - (yes/no)
  - rivers - (yes/no)
  - streams - (yes/no)
  - lakes, ponds, reservoirs or closed bays - (yes/no)
  - wetlands - (yes/no)
  - soil - (yes/no)
- Special protected areas - (yes/no)

- special protected area - (km2)

SEWER SYSTEM AGRESSIVE FACTORS

Geotechnical conditions

- Sewer seat stability - (yes/no)

Seismic conditions

- Maximum soil movement due to soil liquefaction - (mm)
- Maximum angular deflection in joints - (º)
- Maximum axial displacement in joints - (mm)

Traffic class

- High volume - (code HV)
- Normal volume - (code NV)
- Low volume - (code LV)

Interference with other infrastructures

- Risk to be affected by other infrastructures works - (yes/no)

Appendix 10 presents tables with the title, unit and concept for each external information variable.

8 GLOSSARY OF TECHNICAL TERMS RELATED TO REHABILITATION

A first draft of a glossary of rehab terms was prepared by LNEC in December 2002. This draft included mainly a set of definitions referred in European Standards (EN) dealing with rehabilitation. Some additional definitions from WRc Rehabilitation Manual were also incorporated.

The first draft of the glossary was recently up-dated, including a set of additional terms dealing mainly with rehab techniques terminology (see Appendix 11).

It is expected that partners and end-users will contribute with amendments, comments and suggestions to improve the glossary. Terminology related to rehab socio-economic aspects is likely to built in by WP5, in a near future.

9 NEXT ACTIVITIES

In this report a CARE-S rehab listing is proposed, with a set of performance indicators, part of them obtained directly from the IWA system and some new, resulting from partners and end-users proposals and discussion, specific for the rehabilitation analysis. They are complemented by the necessary utility information and external information data.

According to the project planning and the adjustments agreed in the last meetings, the next activities would be (Task 1.2):

- Development of the software PI-tool WW (June- August 2003)
- Preparation and launching of the wastewater database (PI-tool WW input data) to the end-users (September 2003)
- Collect key utility and external information (October 2003-November 2003)
- Field-testing of the rehab PIs in the volunteer end-users (December 2003-January 2004);
- Reception of replies and report presentation (February-April 2004);

- Preparation of overall report with global trends and eventual thresholds (May 2004).

The expected *Deliverables* are:

- PI-tool WW software and User´s Manual (September 2003)
- Report including the overall results of the rehab PI field-testing.

10 REFERENCES

[1] MATOS, R.; ASHLEY, R.; CARDOSO, A.; DUARTE, P.; MOLINARI, A.; SCHULZ, A. (2003) – *Performance indicators for wastewater services*, Manual of Best Practice Series, IWA Publishing, London, ISBN 1 900222 18 3 (200 pp.).

Lisbon, June 2003

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Research Assistant

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Maria do Céu Almeida

Research Officer

Appendix 1

Questionnaire (Part2) regarding the selection of relevant IWA PI in the framework of CARE – S

Joint Partner Questionnaire

QUESTIONNAIRE FOR PARNERTS AND END-USERS

Part 2 – Performance Indicators

December 2002

INTRODUCTION

CARE-S Aims

The objective of the CARE-S project is to establish a rational framework for sewer network rehabilitation decision-making. CARE-S aims to analyse the structural and functional reliability of wastewater networks at minimum cost and disturbance. The ultimate product will be a Decision Support System (DSS) that will enable municipal engineers to establish and maintain effective management of their sewer networks. In other words: Rehabilitate the right sewer at the right time by using the right rehabilitation technique at a minimum total cost, and before serious failures occur (pro-active approach).

The CARE-S project has been sub-divided into a number of Work Packages (WP) which have specific objectives and target outputs. These work packages are as follows:

- WP1: Performance Indicators for rehabilitation
- WP2: Description and validation of structural condition
- WP3: Description and validation of hydraulic performance
- WP4: Rehabilitation technology information system
- WP5: Socio-economic consequences
- WP6: Decision support system (DSS)
- WP7: Wastewater network rehabilitation manager

Aims of this questionnaire

The questionnaire contained in this report has been produced on behalf of a number of partners of the CARE-S consortium. The partners leading WP1, 3, 4, 5, 6 and 7 have produced requests for information relevant to their individual work packages. These questions have been collated by WRc (lead partner for WP7) and have been presented in this document.

Our aim is to have a co-ordinated data collection effort directed at all the CARE-S partners and associated end users to avoid the duplication of effort in providing information.

Two questionnaires have been produced: one for partners of the CARE-S project and another for end-users. *This questionnaire is for completion by the end users*.

Please complete as much of this questionnaire as possible and return the entire questionnaire (including Section 2) to Joanne Hulance (hulance_j@wrcplc.co.uk) by 31.01.2003. Please send a copy to Roger Hurley (hurley_r@wrcplc.co.uk).

If you have any queries regarding this document or the information we are requesting please contact Joanne Hulance or Roger Hurley at WRc.

Details of Person Completing Questionnaire

Name: _____

Organisation: _____

Contact Details

Tel: _____

Fax: _____

Email: _____

PERFORMANCE INDICATORS FOR WASTEWATER NETWORKS

Introduction

This section of the questionnaire seeks answers to two questions about each of the proposed CARE-S performance indicators:

- How relevant is the indicator?
- Will it be difficult to assess the indicator?

Definitions of the indicators and the variables used in the definitions are given in Appendices 1 and 2 to this questionnaire. Partners should read these before completing the questionnaire.

Relevance of the PI: This question aims to assess how relevant each performance indicator included in the CARE-S rehab PI systems is for the specific case of the partner/end-user, from the point of view of the information it contains, regardless of the feasibility of assessing it. Please tick (✔) one of the options in columns 4 to 8 for each indicator.

Expected PI assessment difficulties: Please tick (✔) *either* column 9 *or* column 10 for each PI. If you expect to assess it, tick column 9. If, due to lack of data, you do not expect to assess it, tick column 10.

If you have ticked column 9 (you expect to assess the indicator) we shall assume that there are no problems with data collection. If you have ticked column 10 (you do not expect to assess it) please add a short explanation of the difficulties in column 11.

Proposal of new PIs: Please add in the last rows (coloured) of the questionnaire, below the heading "*New PIs*" new indicators you might find useful, important or essential for CARE-S.

Please complete Section 2 of the questionnaire and return it with Section 1.3 before 31.01.2003 to: rmatos@lnec.pt and macardoso@lnec.pt.

We remind you that individual and identified results will not be made available to other organisations or published in any form. Only anonymous and/or statistical results will be reported.

LNEC's team thank you in advance for your participation.

1	2	3	4	5	6	7	8	9	10	11
Performance Indicator	**Unit**	**Code**	**Essential**	**Important**	**Useful**	**Irrelevant**	**Not applicable**	**PI expected to be assessed**	**PI not expected to be assessed due to lack of data**	**Expected PI assessment difficulties? (give a short explanation)**
EXAMPLE: Service connection rehabilitation	(% / year)	wOp25			✔				✔	*Yes. WC31 (total number of service connections) – Difficult to assess in several cases*
OPERATIONAL INDICATORS										
Sewer Rehabilitation										
Sewer rehabilitation	% / year	wOp20								
Sewer relining	% / year	wOp21								
Sewer replacement or renewal	% / year	wOp22								
Manholes replaced, renewed or relined	% / year	wOp23								
Replacement of manhole covers	% / year	wOp24								
Service connection rehabilitation	% / year	wOp25								
Inflow/Infiltration (I / I)										
Inflow / Infiltration / Exfiltration	% / year	wOp28								
Inflow	m3 / km	wOp29								
Infiltration	m3 / km	wOp30								
Exfiltration	m3 / km	wOp31								
Failures										
Blockages	No. / 100km / year	wOp32								
Blockage locations	No. / 100km / year	wOp33								
Flooding from sanitary sewers	No. / 100km / year	wOp34								
Surface water flooding	No. / 100km / year	wOp35								

1	2	3	4	5	6	7	8	9	10	11
Performance Indicator	**Unit**	**Code**	**Essential**	**Important**	**Useful**	**Irrelevant**	**Not applicable**	**PI expected to be assessed**	**PI not expected to be assessed due to lack of data**	**Expected PI assessment difficulties? (give a short explanation)**
Sewer collapses	No. / 100km / year	wOp36								
PHYSICAL INDICATORS										
Surcharging in sewers in dry weather	% / year	wPh5								
Surcharging in sewers in wet weather	% / year	wPh6								
High sewer surcharging	% / year	wPh7								
ENVIRONMENTAL INDICATORS										
Wastewater										
Intermittent overflow discharge frequency	No. / overflow device / year	wEn3								
Intermittent overflow discharge volume	m3 / overflow device / year	wEn4								
Intermittent overflow discharge related to rainfall	% / year	wEn5								
Solid Residues										
Sediment from sewers	Ton / km of sewer / year	wEn6								
QUALITY OF SERVICE INDICATORS										
Service										
Flooding of properties from sanitary sewers in dry weather	No. / 1000 properties / year	wQS11								
Flooding of properties from sanitary sewers in wet weather	No. / 1000 properties / year	wQS12								
Surface water flooding of properties in wet weather	No. / 1000 properties / year	wQS13								
Interruption of wastewater collection and transport services	% / year	wQS14								

1	2	3	4	5	6	7	8	9	10	11
Performance Indicator	**Unit**	**Code**	**Essential**	**Important**	**Useful**	**Irrelevant**	**Not applicable**	**PI expected to be assessed**	**PI not expected to be assessed due to lack of data**	**Expected PI assessment difficulties? (give a short explanation)**
Complaints										
Blockage complaints	No. / 1000 inhabitant / year	wQS18								
Flooding complaints	No. / 1000 inhabitant / year	wQS19								
Pollution incident complaints	No. / 1000 inhabitant / year	wQS20								
Odour complaints	No. / 1000 inhabitant / year	wQS21								
FINANCIAL INDICATORS[1]										
Annual costs										
Unit total costs	€ / inhabitant / year	wFi4								
Unit running cost	€ / inhabitant / year	wFi5								
Annual investment										
Unit investment	€ / p.e. / year	wFi19								
Annual investment for new assets and expansion of existing asset capacity	%	wFi20								
Annual investments for assets refurbishment or replacement	%	wFi21								
NEW PIs										
Insert proposals for new Pis here:										
						-	-			

[1] In the IWA PI manual the monetary unit adopted is US$.

1	2	3	4	5	6	7	8	9	10	11
Performance Indicator	**Unit**	**Code**	**Essential**	**Important**	**Useful**	**Irrelevant**	**Not applicable**	**PI expected to be assessed**	**PI not expected to be assessed due to lack of data**	**Expected PI assessment difficulties? (give a short explanation)**
						-	-			
						-	-			
						-	-			
						-	-			… extend table if necessary

APPENDIX 1
LIST OF INDICATORS

CARE-S WP 1 – 1.1 – Choice of Performance Indicators (PI)

Preliminary list (selected by LNEC) regarding relevant IWA PI in the framework of CARE-S

(Total number of PI: 35)

6.1 ENVIRONMENTAL INDICATORS (wEn)

WASTEWATER	*wEn3*	Intermittent overflow discharge frequency *(no./overflow device)*	Number of overflow discharges / number of overflow devices *wEn3 = wA27 / wC20*
	wEn4	Intermittent overflow discharge volume *(m3/overflow device)*	Total volume of overflow discharges / number of overflow devices *wEn4 = wA28 / wC20*
	wEn5	Intermittent overflow discharge related to rainfall *(%)*	Total volume of overflow discharges / total volume of annual rainfall x 100 *wEn5 = wA28 / wA24*
SOLID RESIDUES	*wEn6*	Sediments from sewers *(ton/km sewer)*	Drained weight of sediments removed from sewers / total sewer length *wEn6 = wA13 / wC1*

6.3 PHYSICAL INDICATORS (wPh)

SEWERS	*wPh5*	Surcharging in sewers in dry weather *(%)*	Length of sewer where surcharging has occurred during dry weather / total sewer length x 100 *wPh5 = wC2 / wC1 x 100*
	wPh6	Surcharging in sewers in wet weather *(%)*	Length of sewer where surcharging has occurred during wet weather / total sewer length x 100 *wPh6 = wC3 / wC1 x 100* *This information may be obtained either by monitoring or by hydraulic modelling using real rainfall data.*

	wPh7	High sewer surcharging *(%)*	Length of sewer where high degree surcharging has occurred / total sewer length x 100 *wPh7 = wC4 / wC1 x 100* *High degree surcharging means water above the pipe crown.*

6.4 OPERATIONAL INDICATORS (wOp)

SEWERAGE REHABILITATION	*wOp20*	Sewer rehabilitation *(%)*	Length of sewers rehabilitated / total sewer length x 100 *wOp20 = wD25 / wC1 x 100*
	wOp21	--- Sewers relining *(%)*	Length of sewers relined / total sewer length *wOp21 = wD26 / wC1 x 100*
	wOp22	--- Sewers replacement or renewal *(%)*	Length of sewers replaced or renewed / total sewer length *wOp22 = wD27 / wC1 x 100*
	wOp23	Manholes replaced, renewed or relined *(%)*	Number of manholes replaced, renewed or relined / total number of manholes x 100 *wOp23 = wD28 / wC22 x 100* *Replacement and renewal of manhole covers only are not included.*
	wOp24	Replacement of manhole covers *(%)*	Number of manhole covers replaced / total number of maholes x 100 *wOp24 = wD29 / wC22 x 100*
	wOp25	Service connection rehabilitation *(%)*	Number of service connections replaced or renewed / total number of service connections x 100 *wOp25 = wD30 / wC31 x 100*
INFLOW / INFILTRATION (I/I)	*wOp28*	Inflow/Infiltration/Exfiltration (I/I/E) *(%)*	Volume of water entering sewers, from groundwater and wrong connections less the leakage from sewers into the ground / (collected sewage + inflow + infiltration - exfiltration) x 100 *wOp28 = (wD34 + wD35 - wD36) / (wA2) x 100*
	wOp29	Inflow *m3/km*	Volume of water entering sewers from wrong connections / total sewer length *wOp29 = wD34 / wC1*

	wOp30	Infiltration *m3/km*	Volume of water entering sewers from groundwater / total sewer length *wOp30 = wD35 / wC1*	
	wOp31	Exfiltration *m3/km*	Volume of leakage from sewers into the ground / total sewer length *wOp31 = wD36 / wC1*	
FAILURES	*wOp32*	Blockages *(No./100 km)*	Number of blockages / total sewer length x 100 *wOp32 = wD37 / wC1 x 100* *Pumping station blockages should be included. Include blockages in service connections only where these are the responsibility of the wastewater undertaking.*	
	wOp33	Blockage locations *(No./100 km)*	Number of individual locations where blockages occured / total sewer length x 100 *wOp33 = wD38 / wC1 x 100* *Locations where frequent blockages occured should only be accounted once. Pumping stations where blockages occured should be included. Include blockage locations in service connections only where these are the responsibility of the wastewater undertaking.*	
	wOp34	Flooding from sanitary sewers *(No./100 km)*	Number of flooding incidents related to sanitary sewers / total sewer length x 100 *wOp34 = wD39 / wC1 x 100* *Include only incidents related to sanitary sewers under responsibility of the wastewater undertaking.*	
	wOp35	Surface water flooding *(No./100 km)*	Number of surface water flooding incidents / total sewer length x 100 *wOp35 = wD40 / wC1 x 100* *These include only surface water flooding due to inadequacy of storm drainage system (combined sewers included) under the responsibility of the wastewater undertaking. Inadequacy relates to all causes (e.g. design, operation, etc.).*	
	wOp36	Sewer collapses *(No./100 km)*	Number of sewer collapses / total sewer length x 100 *wOp36 = wD41 / wC1 x 100* *Does not include collapses on service connections.*	

6.5 QUALITY OF SERVICE INDICATORS (wQS)

SERVICE	*wQS11*	Flooding of properties from sanitary sewers in dry weather *(n.º/1000 properties)*	Number of properties affected by flooding from sanitary sewers in dry weather / number of connected properties x 1000 *wQS11 = wF3 / wC30 x 1000* *Only flooding from sanitary sewers under the responsibility of the wastewater undertaking should be included. Flooding may affect properties that are not connected to the sewer network. These should be included.*
	wQS12	Flooding of properties from sanitary sewers in wet weather *(n.º/1000 properties)*	Number of properties affected by flooding from sanitary sewers in wet weather / number of connected properties x 1000 *wQS12 = wF4 / wC30 x 1000* *Only flooding from sanitary sewers under the responsibility of the wastewater undertaking should be included. Flooding may affect properties that are not connected to the sewer network. These should be included.*
	wQS13	Surface water flooding of properties in wet weather *(n.º/1000 properties)*	Number of properties affected by surface water flooding in wet weather / number of connected properties x 1000 *wQS13 = wF5 / wC30 x 1000* *Include only surface water flooding due to inadequacy of the storm drainage system (including combined sewers) under the responsibility of the wastewater undertaking. (Inadequacy related to all causes)*
	wQS14	Interruption of wastewater collection and transport services *(%)*	[Sum] (Number of properties affected by sewerage discontinuity or interruption x duration of interruptions in hours) / (number of connected properties x 24 x 365) X 100 *wQS14 = wF6 / (wC30 x 24 x 365) x 100*
COMPLAINTS	*wQS18*	Blockage complaints *(No. /1000 inhab.)*	Number of complaints as a result of blockages / population served x 1000 *wQS18 = wF12 / wE1 x 1000* *Only complaints relating to the system under the responsibility of the wastewater undertaking should be accounted for.*
	wQS19	Flooding complaints *(No. /1000 inhab.)*	Number of complaints as a result of flooding / population served x 1000 *wQS19 = wF13 / wE1 x 1000* *Only complaints relating to the system under the responsibility of the wastewater undertaking should be accounted for.*

	wQS20	Pollution incidents complaints *(No. /1000 inhab.)*	Number of complaints as a result of pollution incidents / population served x 1000 *wQS20 = wF14 / wE1 x 1000* *Only complaints relating to the system under the responsibility of the wastewater undertaking should be accounted for.*
	wQS21	Odour complaints *(No. /1000 inhab.)*	Number of complaints as a result of odours / population served x 1000 *wQS21 = wF15 / wE1 x 1000* *Only complaints relating to the system under the responsibility of the wastewater undertaking should be accounted for.*

6.6 ECONOMIC AND FINANCIAL INDICATORS (wFi)

ANNUAL COSTS	*wFi4*	Unit total cost *(US$/inhab.)*	[(WWT+SE)annual running costs + (WWT+SE)annual capital costs] / total population served by the undertaking *wFi4 = wG4 / wE1 or wFi4 = (wG5 + wG6) / wE1* *If these costs are referred just to sewer systems, then this indicators shall be expressed in US$/km of sewer. In that case, processing rule is wFi4 = wG4 / wC1*
	wFi5	Unit running cost *(US$/inhab.)*	(WWT+SE)annual running costs / total population served by the undertaking *wFi5 = wG5 / wE1* *If these costs are referred just to sewer systems, then this indicators shall be expressed in US$/km of sewer. In that case, processing rule is wFi5 = wG5 / wC1*
ANNUAL INVESTMENT	*wFi19*	Unit investment *(US$/p.e.)*	Annual cost of investments (expenditures for sewers, plants and equipments) over the last three years / population equivalent served by the undertaking *wFi19 = wG26 / wE6 / 3* *This indicator can vary significantly from year to year and its analysis shall focus on a period longer than the evaluated one.*
	wFi20	Annual investments for new assets and expansion of existing asset capacity *(%)*	Cost of investments for new assets and expansion of existing asset capacity / total cost of the investments x 100 *wFi20 = wG28 / wG26 x 100* *Only added capacity investment shall be accounted for.*

wFi21	Annual investments for asset refurbishment or replacement	Cost of investments for the refurbishment or replacement ("like for like") of existing assets / cost of the investments x 100	
		(%)	*wFi21 = wG29 / wG26 x 100*
			"like for like" means that it will provide the same functionality.

APPENDIX 2
LIST OF VARIABLES

CARE-S WP 1 – 1.1 – Choice of Performance Indicators (PI)

List of variables used for the assessment of the preliminary PI selected in the framework of CARE-S

Total number of variables: 44

ENVIRONMENTAL DATA

wA2	WASTEWATER TREATED	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm].*yy	VALID VALUES: >= 0
DEFINITION: Wastewater treated by WWTP or by on-site sanitation facilities that are under the responsibility of the wastewater undertaking.		
PROCESSING RULE:		
COMMENT:		

wA13	SEWER SEDIMENTS	
UNIT OF EXPRESSION: **ton DS**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm].*yy	VALID VALUES: >= 0
DEFINITION: Drained weight of sediments removed from sewers.		
PROCESSING RULE:		
COMMENT:		

wA24	ANNUAL RAINFALL	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm].*yy	VALID VALUES: >= 0
DEFINITION: Annual volume of rainfall in the total catchment area.		
PROCESSING RULE:		
COMMENT:		

wA27	NUMBER OF OVERFLOW DISCHARGES	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of overflow discharges occurred.		
PROCESSING RULE:		
COMMENT:		

wA28	VOLUME OF OVERFLOW DISCHARGES	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total volume of overflow discharges occurred.		
PROCESSING RULE:		
COMMENT:		

PHYSICAL ASSETS DATA

wC1	TOTAL SEWER LENGTH	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total length of sewers managed by the undertaking.		
PROCESSING RULE: PHYSICAL ASSETS DATA		
COMMENT: *Service connections excluded.*		

wC2	SURCHARGED SEWERS IN DRY WEATHER	
UNIT OF EXPRESSION: **m**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewer where surcharging has occurred during dry weather.		
PROCESSING RULE:		
COMMENT: *Service connections excluded.*		

wC3	SURCHARGED SEWERS IN WET WEATHER	
UNIT OF EXPRESSION: **m**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewer where surcharging has occurred during wet weather.		
PROCESSING RULE:		
COMMENT: *Service connections excluded.*		

wC4	HIGHLY SURCHARGED SEWERS	
UNIT OF EXPRESSION: **m**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewer where high degree surcharging has occurred.		
PROCESSING RULE:		
COMMENT: *High degree surcharging means water above the pipe crown. Service connections excluded.*		

wC20	OVERFLOW DEVICES	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of overflow devices in the sewer system.		
PROCESSING RULE:		
COMMENT:		

wC22	MANHOLES	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of manholes in the sewer system.		
PROCESSING RULE:		
COMMENT:		

wC30	CONNECTED PROPERTIES	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of properties connected to the sewer system managed by the undertaking.		
PROCESSING RULE:		
COMMENT:		

wC31	SERVICE CONNECTIONS	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Total number of service connections.		
PROCESSING RULE:		
COMMENT:		

OPERATIONAL DATA

wD25	SEWER REHABILITATION	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers rehabilitated or renewed.		
PROCESSING RULE:		
COMMENT: *This variable includes not only wD26 and wD27 but also the length of sewers rehabilitated with other techniques.*		

wD26	SEWER RELINING	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewer relined.		
PROCESSING RULE:		
COMMENT: *Service connections excluded.*		

wD27	SEWER REPLACEMENT AND RENEWAL	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Sewer length replaced or renewed by trenchless techniques.		
PROCESSING RULE:		
COMMENT:		

wD28	MANHOLE REPLACEMENT, RENEWAL OR RELINING	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of manholes replaced, renewed or relined.		
PROCESSING RULE:		
COMMENT:		

wD29	MANHOLE COVERS REPLACEMENT	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of manhole covers replaced.		
PROCESSING RULE:		
COMMENT:		

wD30	SERVICE CONNECTION REPLACEMENT OR RENEWAL	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of service connections replaced or renewed.		
PROCESSING RULE:		
COMMENT:		

wD34	INFLOW VOLUME	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Volume of water entering sewers from wrong connections.		
PROCESSING RULE:		
COMMENT:		

wD35	INFILTRATION VOLUME	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Volume of water entering sewers from groundwater.		
PROCESSING RULE:		
COMMENT:		

wD36	EXFILTRATION VOLUME	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Volume of leakage from sewers into the ground.		
PROCESSING RULE:		
COMMENT:		

wD37	BLOCKAGES	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of sewer blockages.		
PROCESSING RULE:		
COMMENT: *Pumping station blockages shall be included. Does not include blockages on sewer connections.*		

wD38	BLOCKAGE LOCATIONS	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of individual locations where blockages occured.		
PROCESSING RULE:		
COMMENT:		

wD39	FLOODINGS FROM SANITARY SEWERS	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of foul floodings occurred.		
PROCESSING RULE:		
COMMENT: *Include only incidents related to sanitary sewers under responsibility of the wastewater undertaking.*		

wD40	SURFACE WATER FLOODINGS	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of surface water floodings occurred.		
PROCESSING RULE:		
COMMENT: *These include only surface water flooding due to inadequacy of storm drainage system (combined sewers included) under the responsibility of the wastewater undertaking. Inadequacy relates to all causes (e.g. design, operation, etc.).*		

wD41	SEWER COLLAPSES	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of sewer collapses.		
PROCESSING RULE:		
COMMENT: *Does not include collapses on sewer connections.*		

DEMOGRAPHY (AND CUSTOMER) DATA

wE1	POPULATION SERVED	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Total population living on a permanent basis in the area under the wastewater undertaking responsibility and, when applicable, those contributing to imported wastewater.		
PROCESSING RULE:		
COMMENT:		

wE6	POPULATION EQUIVALENT SERVED	
UNIT OF EXPRESSION: **p.e.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Total population producing wastewater that is either collected or treated by the wastewater undertaking, including imported wastewater and industrial contributions expressed in population equivalent.		
PROCESSING RULE: DEMOGRAPHY (AND CUSTOMER) DATA		
COMMENT:		

QUALITY OF SERVICE DATA

wF3	DRY WEATHER FLOODING OF PROPERTIES FROM SANITARY SEWERS	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of properties affected by flooding from sanitary sewers in dry weather.		
PROCESSING RULE:		
COMMENT:		

wF4	WET WEATHER FLOODING OF PROPERTIES FROM SANITARY SEWERS	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of properties affected by flooding from sanitary sewers in wet weather.		
PROCESSING RULE:		
COMMENT:		

wF5	WET WEATHER SURFACE WATER FLOODING OF PROPERTIES	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of properties affected by surface water flooding in wet weather.		
PROCESSING RULE:		
COMMENT:		

wF6	WASTEWATER SERVICE INTERRUPTIONS	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: [Sum] (Number of properties affected by sewerage discontinuity (or interruption) x duration of interruptions in hours).		
PROCESSING RULE:		
COMMENT:		

wF12	BLOCKAGE COMPLAINTS	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of complaints as a result of blockages.		
PROCESSING RULE:		
COMMENT: *This variable includes all direct, telephone, and written complaints related to blockages.*		

wF13	FLOODING COMPLAINTS	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of complaints as a result of flooding.		
PROCESSING RULE:		
COMMENT: *This variable includes all direct, telephone, and written complaints related to flooding occurences.*		

wF14	POLLUTION COMPLAINTS	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of complaints as a result of pollution incidents.		
PROCESSING RULE:		
COMMENT: *This variable includes all direct, telephone, and written complaints related to pollution incidents.*		

wF15	ODOUR COMPLAINTS	
UNIT OF EXPRESSION: **No.**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of complaints as a result of odours.		
PROCESSING RULE:		
COMMENT: *This variable includes all direct, telephone, and written complaints related to odours.*		

wG4	ANNUAL COSTS	
UNIT OF EXPRESSION: **US$/year**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total annual costs, including capital and running costs.		
PROCESSING RULE:		
COMMENT: *Exchange rate of local currencies shall be referred to the end of the year.*		

FINANCIAL DATA

wG5	ANNUAL RUNNING COSTS	
UNIT OF EXPRESSION: **US$/year**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total annual operations and maintenance costs + internal manpower costs - capitalised costs of self-constructed assets.		
PROCESSING RULE:		
COMMENT: *This definition has, on aggregate level, to be equivalent to the sum of the NET disaggregated values allocated at the numerator of the indicators figuring the composition of annual running costs per type of cost. Exchange rate of local currencies shall be referred to the end of the year.*		

wG6	ANNUAL CAPITAL COSTS	
UNIT OF EXPRESSION: **US$/year**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total annual net interest and depreciation (based on book values).		
PROCESSING RULE:		
COMMENT: *The net value of interest has to be considered, being the interest income a reduction in capital costs and not a revenue. Exchange rate of local currencies shall be referred to the end of the year.*		

wG26	AVERAGE INVESTMENT IN TANGIBLE ASSETS OVER THE LAST THREE YEARS	
UNIT OF EXPRESSION: **US$/year**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Average annual costs of the investments in tangible assets (expenditures for sewers, plants and equipment) including capilalised costs of self constructed tangible assests over the last three years.		
PROCESSING RULE:		
COMMENT: *Tangible assets include investment for supporting buildings, vehicles, etc. Exchange rate of local currencies shall be referred to the end of the year.*		

wG28	ANNUAL INVESTMENTS FOR NEW ASSETS	
UNIT OF EXPRESSION: **US$/year**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total cost of the investments in tangible assets during the year that constitute a new development for the service including capitalised costs of self constructed assets.		
PROCESSING RULE:		
COMMENT: *Exchange rate of local currencies shall be referred to the end of the year.*		

wG29	ANNUAL INVESTMENTS FOR ASSETS REPLACEMENT	
UNIT OF EXPRESSION: **US$/year**	PERIOD: *[dd.mm].*yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total cost of the investments related to existing assets during the year (i.e., maintaining the existing infrastructure at the same level) including capitalised costs of self-constructed replaced assets.		
PROCESSING RULE:		
COMMENT: *Exchange rate of local currencies shall be referred to the end of the year.*		

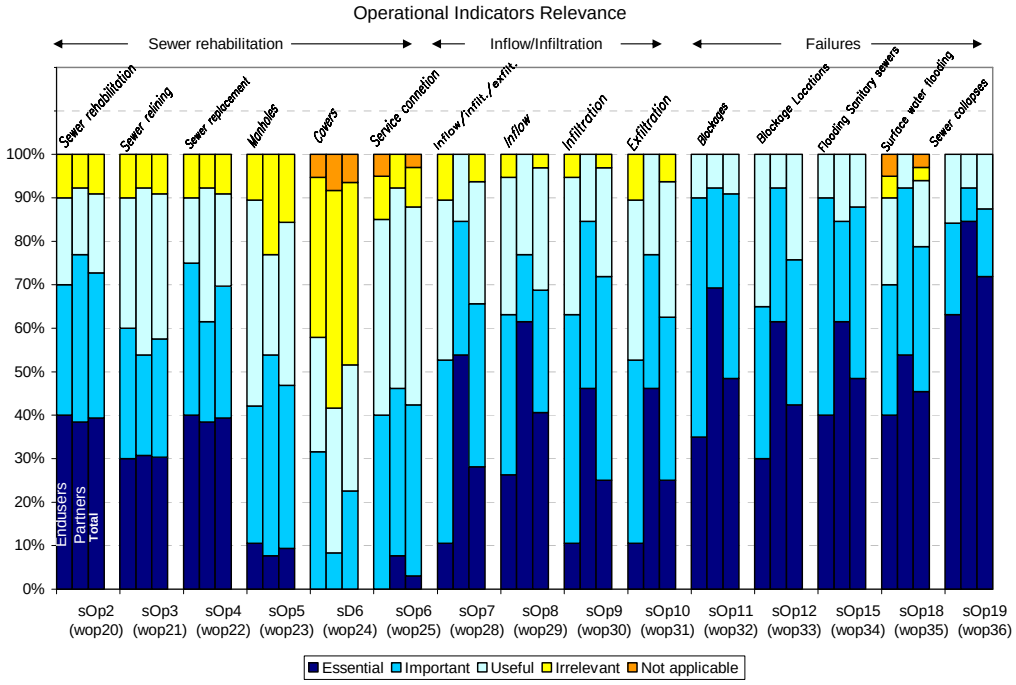
Appendix 2

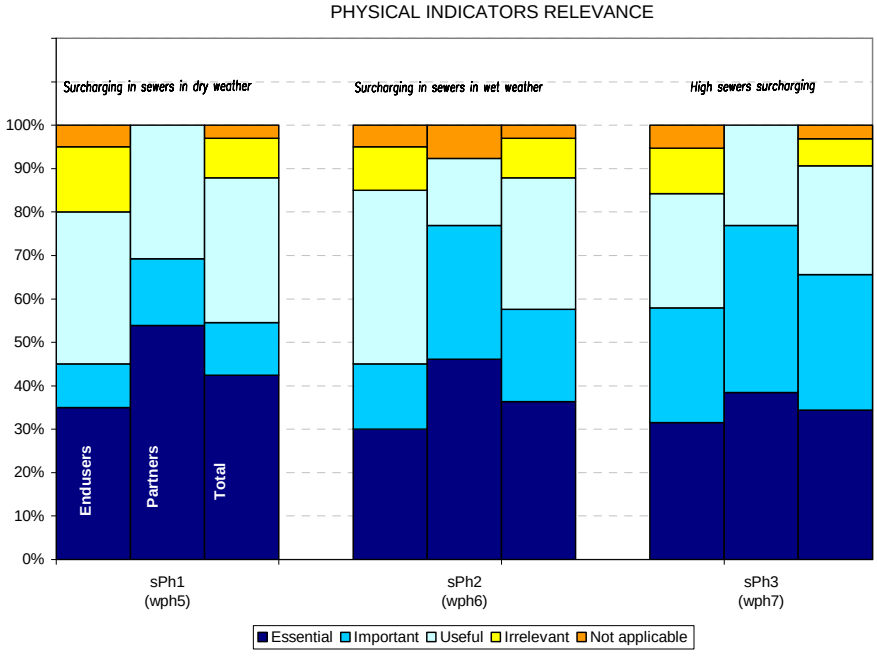
Synthesis of the number of answers to the Questionnaire

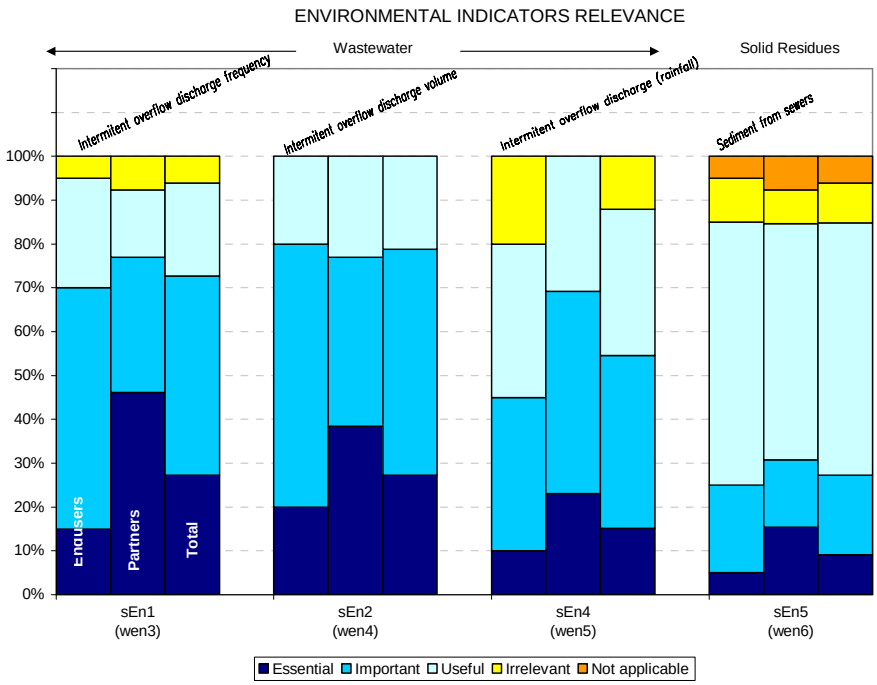
	RELEVANCE			ASSESSMENT		
PI	ENDUSERS	PARTNERS	TOTAL	ENDUSERS	PARTNERS	TOTAL
sOp2(wop20)	20	13	33	18	10	28
sOp3(wop21)	20	13	33	17	10	27
sOp4(wop22)	20	13	33	18	10	28
sOp5(wop23)	19	13	32	19	10	29
sD6(wop24)	19	12	31	19	9	28
sOp6(wop25)	20	13	33	18	10	28
sOp7(wop28)	19	13	32	17	9	26
sOp8(wop29)	19	13	32	19	10	29
sOp9(wop30)	19	13	32	19	10	29
sOp10(wop31)	19	13	32	18	10	28
sOp11(wop32)	20	13	33	19	10	29
sOp12(wop33)	20	13	33	18	10	28
sOp15(wop34)	20	13	33	19	10	29
sOp18(wop35)	20	13	33	18	10	28
sOp19(wop36)	19	13	32	18	10	28
sPh1(wph5)	20	13	33	17	10	27
sPh2(wph6)	20	13	33	17	10	27
sPh3(wph7)	19	13	32	16	9	25
sEn1(wen3)	20	13	33	17	10	27
sEn2(wen4)	20	13	33	18	10	28
sEn4(wen5)	20	13	33	16	10	26
sEn5(wen6)	20	13	33	18	10	28
sQS1(wqs11)	20	13	33	18	10	28
sQS2(wqs12)	20	13	33	18	10	28
sQS3(wqs13)	19	13	32	16	10	26
sQS4(wqs14)	19	13	32	16	9	25
sQS5(wqs18)	20	13	33	19	10	29
sQS6(wqs19)	20	13	33	18	10	28
sQS7(wqs20)	20	13	33	18	10	28
sQS8(wqs21)	19	13	32	17	10	27
sFi1(wfi4)	19	13	32	19	10	29
sFi2(wfi5)	17	13	30	17	10	27
sFi4(wfi19)	19	13	32	17	10	27
sFi5(wfi20)	19	13	32	17	10	27
sFi6(wfi21)	20	13	33	18	10	28

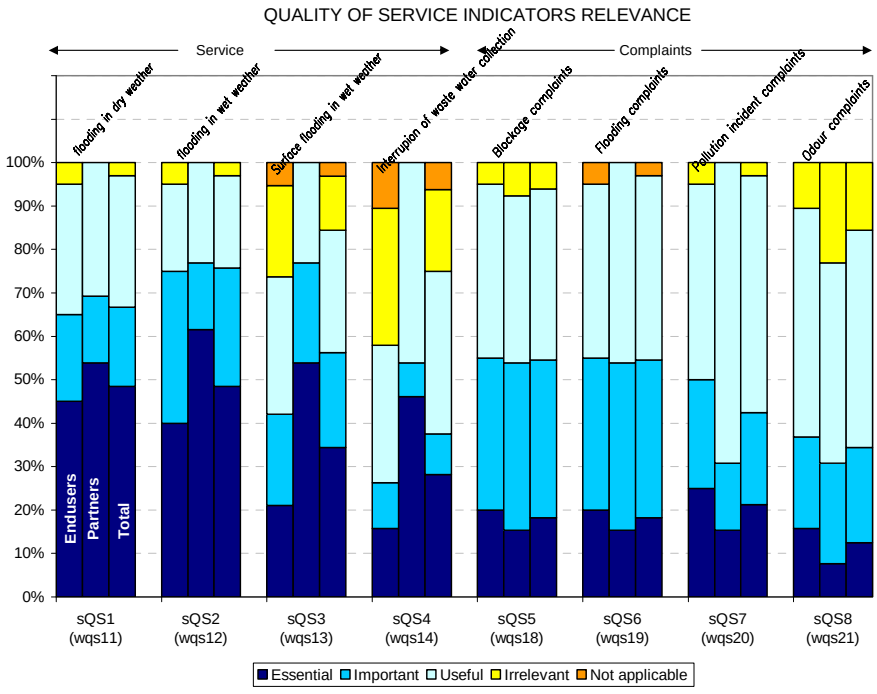
Appendix 3

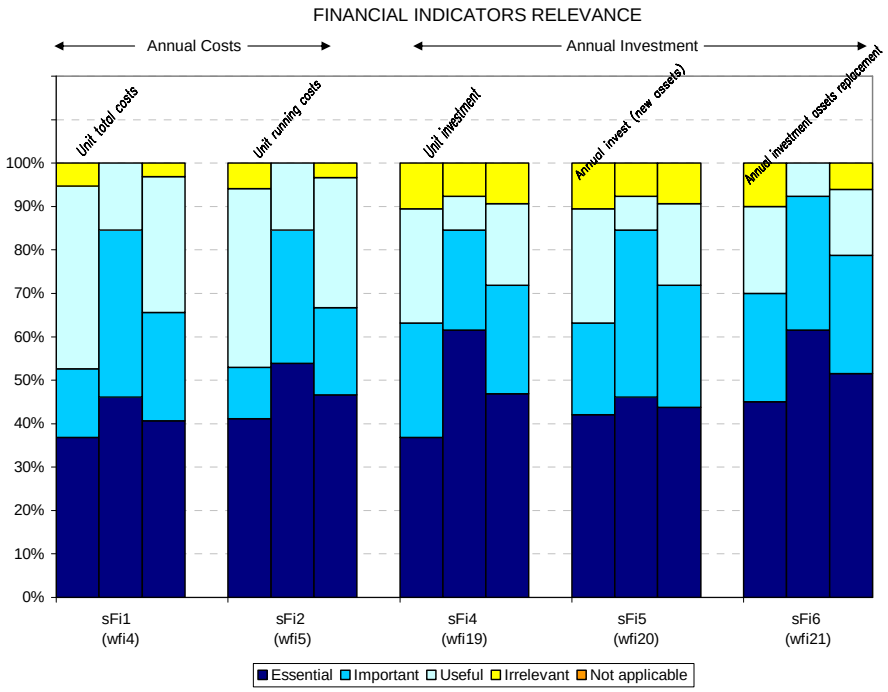
Results on the relevance given to each PI (by group of PIs)


Operational Indicators Relevance
Sewer rehabilitation
Inflow/Infiltration
Failures
Sewer rehabilitation
Sewer relining
Sewer replacement
Manholes
Covers
Service connection
Inflow/infilt./exfilt.
Inflow
Infiltration
Exfiltration
Blockages
Blockage Locations
Flooding Sanitary sewers
Surface water flooding
Sewer collapses
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Endusers
Partners
Total
sOp2 (wop20)
sOp3 (wop21)
sOp4 (wop22)
sOp5 (wop23)
sD6 (wop24)
sOp6 (wop25)
sOp7 (wop28)
sOp8 (wop29)
sOp9 (wop30)
sOp10 (wop31)
sOp11 (wop32)
sOp12 (wop33)
sOp15 (wop34)
sOp18 (wop35)
sOp19 (wop36)
Essential
Important
Useful
Irrelevant
Not applicable


PHYSICAL INDICATORS RELEVANCE
Surcharging in sewers in dry weather
Surcharging in sewers in wet weather
High sewers surcharging
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Endusers
Partners
Total
sPh1 (wph5)
sPh2 (wph6)
sPh3 (wph7)
Essential
Important
Useful
Irrelevant
Not applicable


ENVIRONMENTAL INDICATORS RELEVANCE
Wastewater
Solid Residues
Intermitent overflow discharge frequency
Intermitent overflow discharge volume
Intermitent overflow discharge (rainfall)
Sediment from sewers
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Endusers
Partners
Total
sEn1 (wen3)
sEn2 (wen4)
sEn4 (wen5)
sEn5 (wen6)
Essential
Important
Useful
Irrelevant
Not applicable

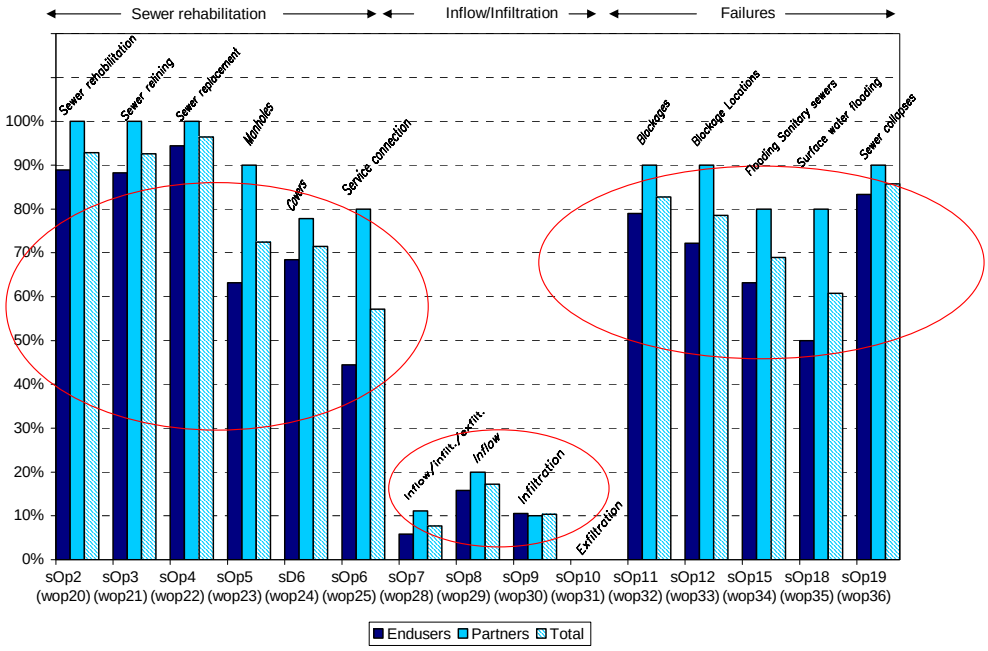

QUALITY OF SERVICE INDICATORS RELEVANCE
Service
Complaints
flooding in dry weather
flooding in wet weather
Surface flooding in wet weather
Interrupion of waste water collection
Blockage complaints
Flooding complaints
Pollution incident complaints
Odour complaints
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Endusers
Partners
Total
sQS1 (wqs11)
sQS2 (wqs12)
sQS3 (wqs13)
sQS4 (wqs14)
sQS5 (wqs18)
sQS6 (wqs19)
sQS7 (wqs20)
sQS8 (wqs21)
Essential
Important
Useful
Irrelevant
Not applicable


FINANCIAL INDICATORS RELEVANCE
Annual Costs
Annual Investment
Unit total costs
Unit running costs
Unit investment
Annual invest (new assets)
Annual investment assets replacement
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
sFi1 (wfi4)
sFi2 (wfi5)
sFi4 (wfi19)
sFi5 (wfi20)
sFi6 (wfi21)
Essential
Important
Useful
Irrelevant
Not applicable

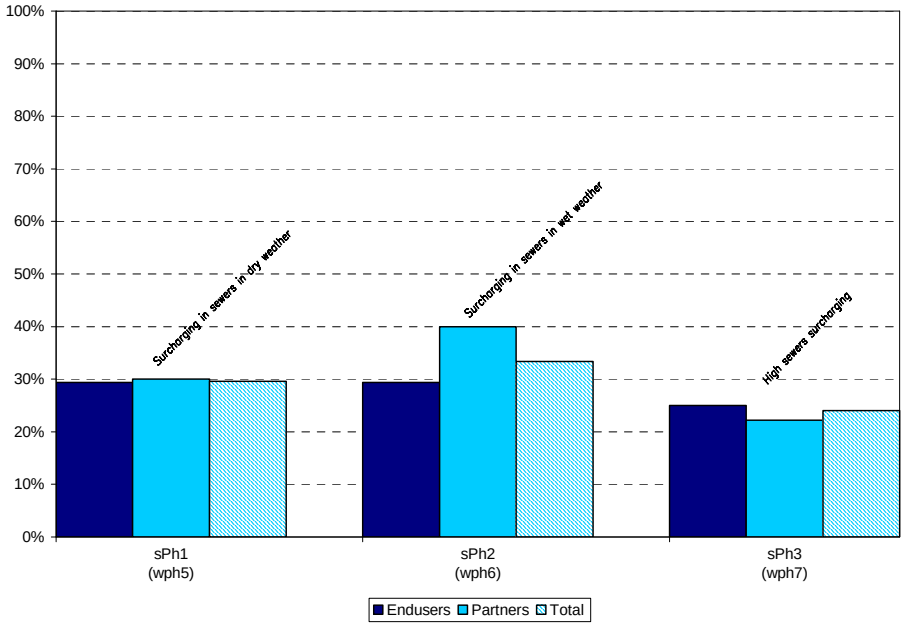
Appendix 4

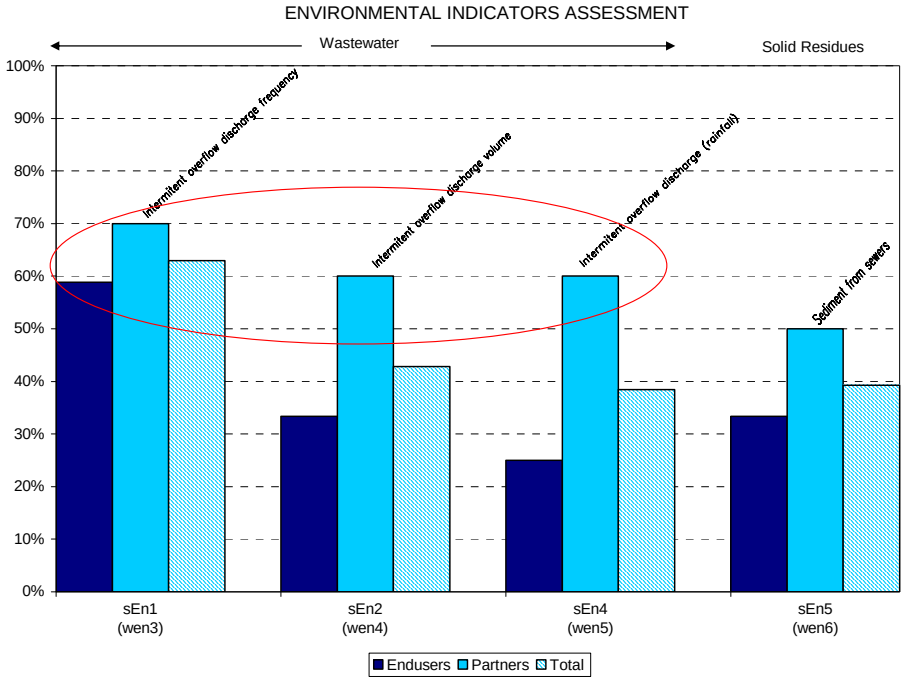
Results on the PI assessed or not assessed (by group of PIs)

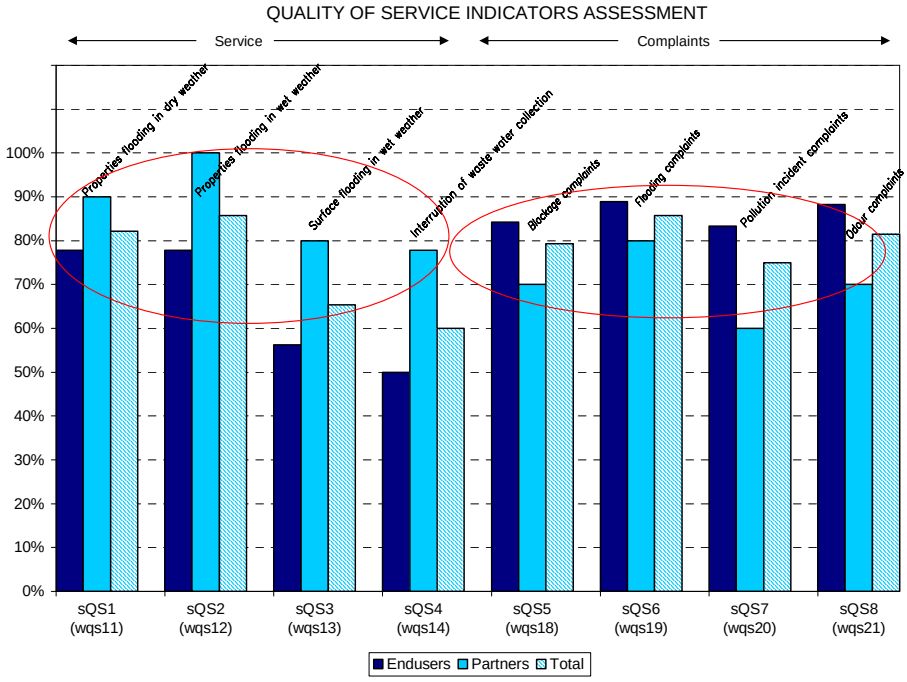
OPERATIONAL INDICATORS ASSESSMENT



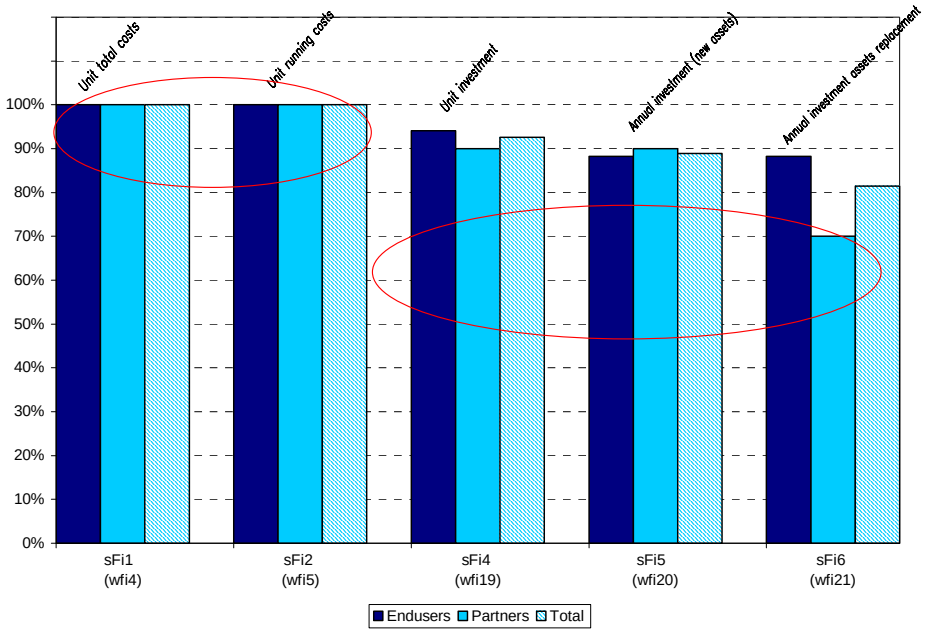
PHYSICAL INDICATORS ASSESSMENT




ENVIRONMENTAL INDICATORS ASSESSMENT
Wastewater
Solid Residues
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Intermitent overflow discharge frequency
Intermitent overflow discharge volume
Intermitent overflow discharge (rainfall)
Sediment from sewers
sEn1 (wen3)
sEn2 (wen4)
sEn4 (wen5)
sEn5 (wen6)
Endusers
Partners
Total

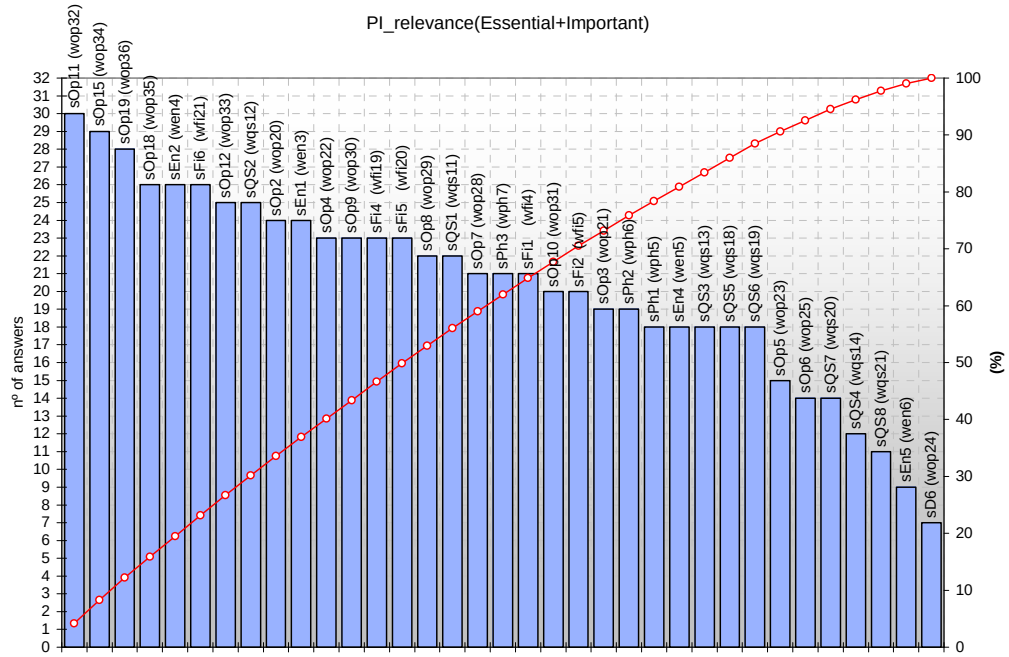

QUALITY OF SERVICE INDICATORS ASSESSMENT
Service
Complaints
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Properties flooding in dry weather
Properties flooding in wet weather
Surface flooding in wet weather
Interruption of waste water collection
Blockage complaints
Flooding complaints
Pollution incident complaints
Odour complaints
sQS1 (wqs11)
sQS2 (wqs12)
sQS3 (wqs13)
sQS4 (wqs14)
sQS5 (wqs18)
sQS6 (wqs19)
sQS7 (wqs20)
sQS8 (wqs21)
Endusers
Partners
Total

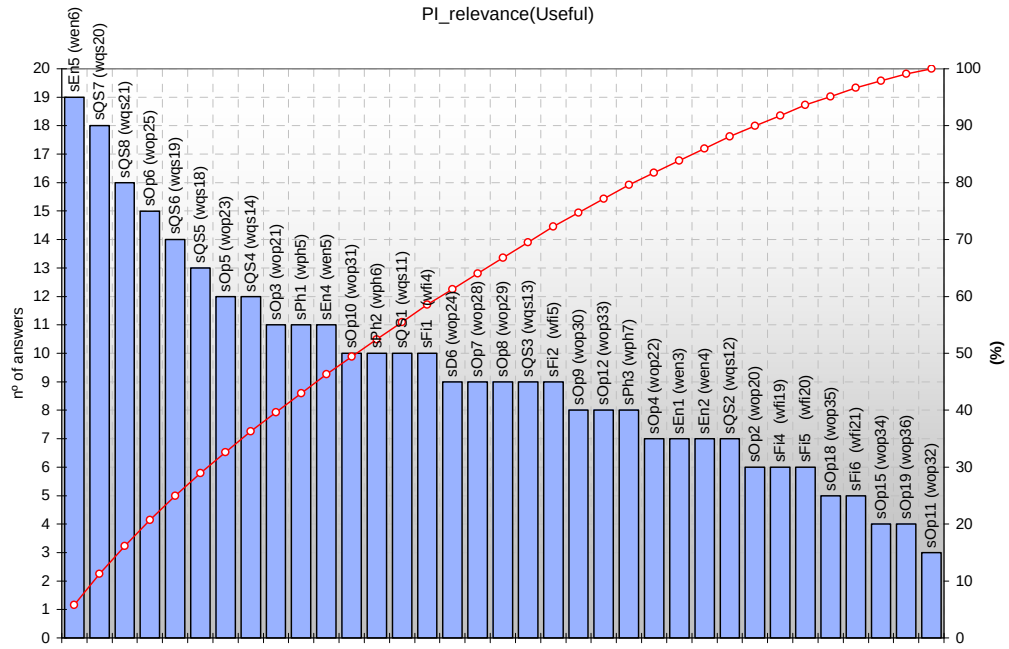
FINANCIAL INDICATORS ASSESSMENT

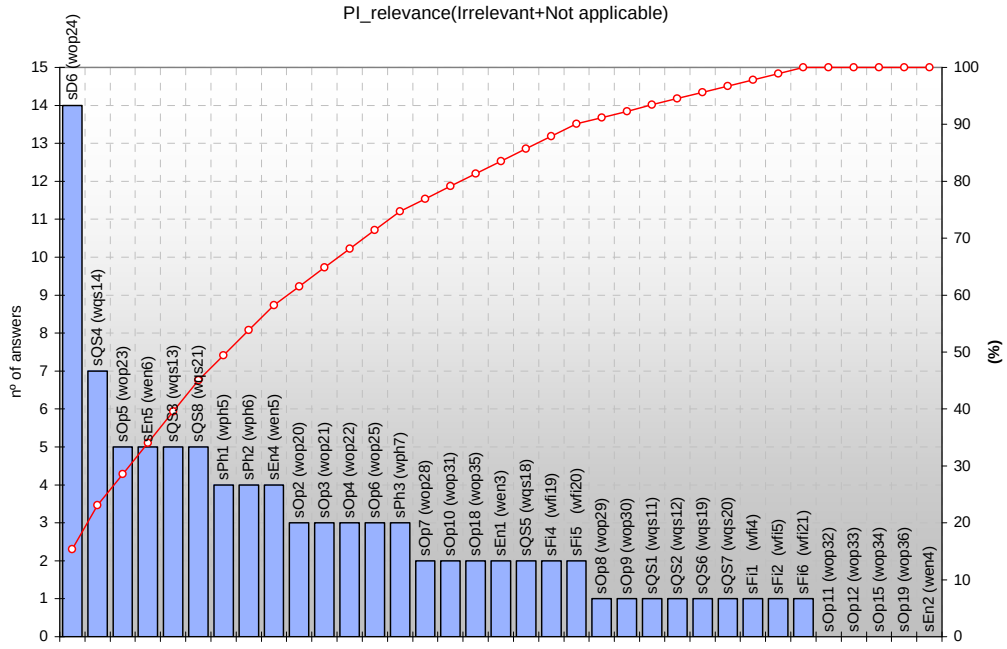


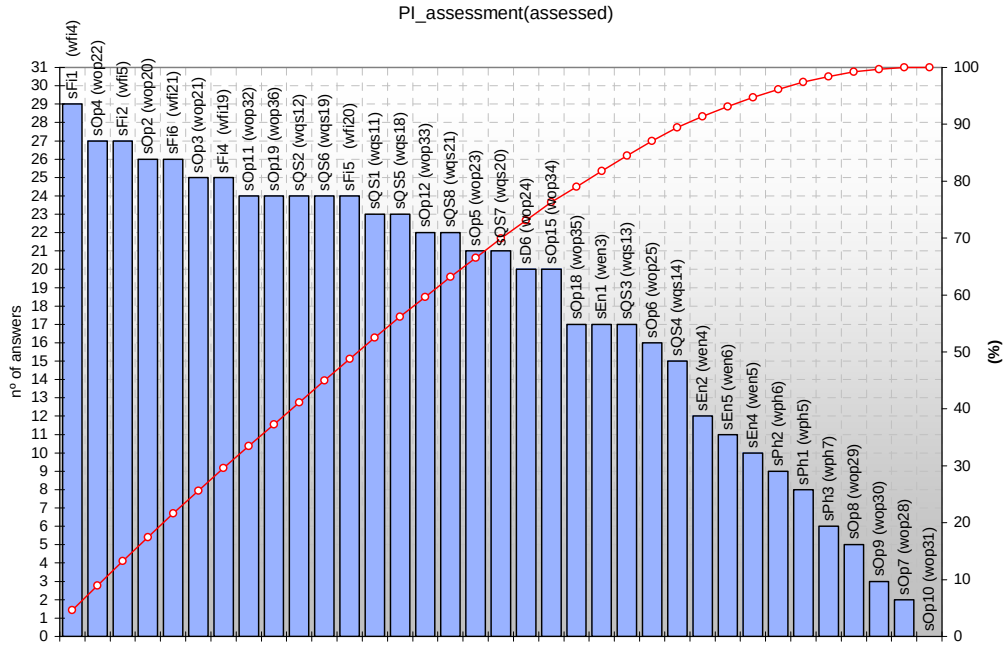
Appendix 5

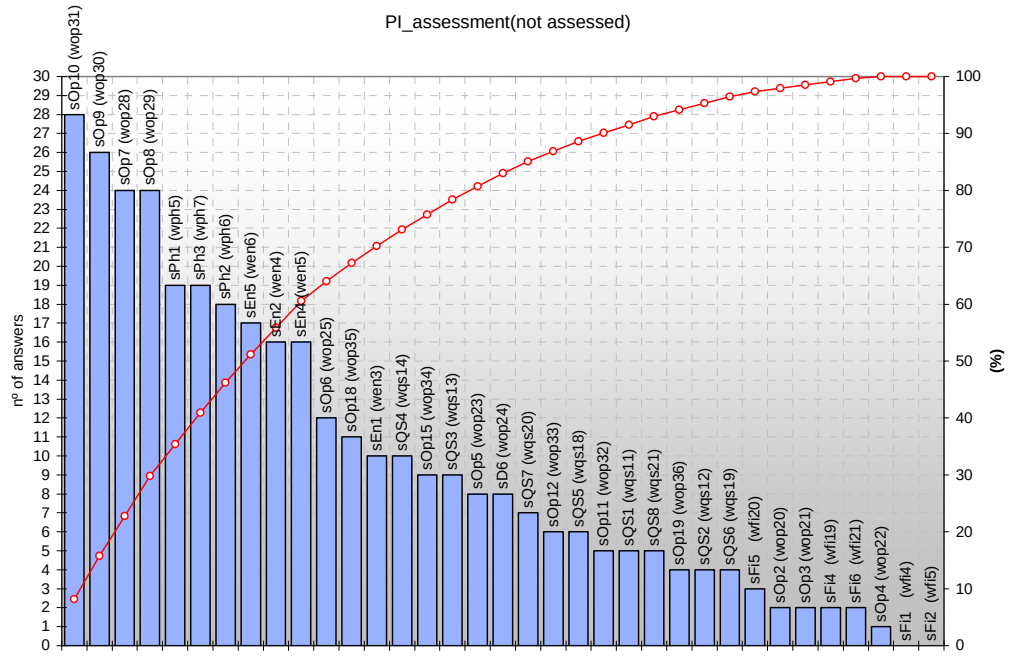
PI ranking based on Pareto charts


PI_relevance(Essential+Important)
nº of answers
(%)
sOp11 (wop32)
sOp15 (wop34)
sOp19 (wop36)
sOp18 (wop35)
sEn2 (wen4)
sFi6 (wfi21)
sOp12 (wop33)
sQS2 (wqs12)
sOp2 (wop20)
sEn1 (wen3)
sOp4 (wop22)
sOp9 (wop30)
sFi4 (wfi19)
sFi5 (wfi20)
sOp8 (wop29)
sQS1 (wqs11)
sOp7 (wop28)
sPh3 (wph7)
sFi1 (wfi4)
sOp10 (wop31)
sFi2 (wfi5)
sOp3 (wop21)
sPh2 (wph6)
sPh1 (wph5)
sEn4 (wen5)
sQS3 (wqs13)
sQS5 (wqs18)
sQS6 (wqs19)
sOp5 (wop23)
sOp6 (wop25)
sQS7 (wqs20)
sQS4 (wqs14)
sQS8 (wqs21)
sEn5 (wen6)
sD6 (wop24)


PI_relevance(Useful)
nº of answers
(%)
sEn5 (wen6)
sQS7 (wqs20)
sQS8 (wqs21)
sOp6 (wop25)
sQS6 (wqs19)
sQS5 (wqs18)
sOp5 (wop23)
sQS4 (wqs14)
sOp3 (wop21)
sPh1 (wph5)
sEn4 (wen5)
sOp10 (wop31)
sPh2 (wph6)
sQS1 (wqs11)
sFi1 (wfi4)
sD6 (wop24)
sOp7 (wop28)
sOp8 (wop29)
sQS3 (wqs13)
sFi2 (wfi5)
sOp9 (wop30)
sOp12 (wop33)
sPh3 (wph7)
sOp4 (wop22)
sEn1 (wen3)
sEn2 (wen4)
sQS2 (wqs12)
sOp2 (wop20)
sFi4 (wfi19)
sFi5 (wfi20)
sOp18 (wop35)
sFi6 (wfi21)
sOp15 (wop34)
sOp19 (wop36)
sOp11 (wop32)

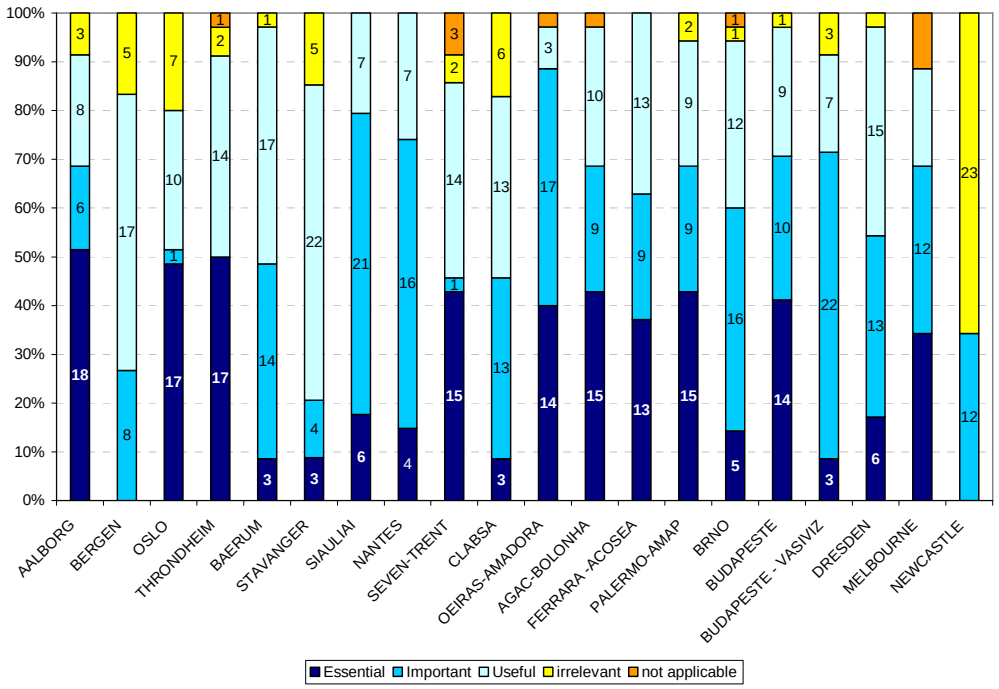

PI_relevance(Irrelevant+Not applicable)
nº of answers
(%)
sD6 (wop24)
sQS4 (wqs14)
sOp5 (wop23)
sEn5 (wen6)
sQS3 (wqs13)
sQS8 (wqs21)
sPh1 (wph5)
sPh2 (wph6)
sEn4 (wen5)
sOp2 (wop20)
sOp3 (wop21)
sOp4 (wop22)
sOp6 (wop25)
sPh3 (wph7)
sOp7 (wop28)
sOp10 (wop31)
sOp18 (wop35)
sEn1 (wen3)
sQS5 (wqs18)
sFi4 (wfi19)
sFi5 (wfi20)
sOp8 (wop29)
sOp9 (wop30)
sQS1 (wqs11)
sQS2 (wqs12)
sQS6 (wqs19)
sQS7 (wqs20)
sFi1 (wfi4)
sFi2 (wfi5)
sFi6 (wfi21)
sOp11 (wop32)
sOp12 (wop33)
sOp15 (wop34)
sOp19 (wop36)
sEn2 (wen4)


PI_assessment(assessed)
nº of answers
(%)
sFi1 (wfi4)
sOp4 (wop22)
sFi2 (wfi5)
sOp2 (wop20)
sFi6 (wfi21)
sOp3 (wop21)
sFi4 (wfi19)
sOp11 (wop32)
sOp19 (wop36)
sQS2 (wqs12)
sQS6 (wqs19)
sFi5 (wfi20)
sQS1 (wqs11)
sQS5 (wqs18)
sOp12 (wop33)
sQS8 (wqs21)
sOp5 (wop23)
sQS7 (wqs20)
sD6 (wop24)
sOp15 (wop34)
sOp18 (wop35)
sEn1 (wen3)
sQS3 (wqs13)
sOp6 (wop25)
sQS4 (wqs14)
sEn2 (wen4)
sEn5 (wen6)
sEn4 (wen5)
sPh2 (wph6)
sPh1 (wph5)
sPh3 (wph7)
sOp8 (wop29)
sOp9 (wop30)
sOp7 (wop28)
sOp10 (wop31)


PI_assessment(not assessed)
nº of answers
(%)
sOp10 (wop31)
sOp9 (wop30)
sOp7 (wop28)
sOp8 (wop29)
sPh1 (wph5)
sPh3 (wph7)
sPh2 (wph6)
sEn5 (wen6)
sEn2 (wen4)
sEn4 (wen5)
sOp6 (wop25)
sOp18 (wop35)
sEn1 (wen3)
sQS4 (wqs14)
sOp15 (wop34)
sQS3 (wqs13)
sOp5 (wop23)
sD6 (wop24)
sQS7 (wqs20)
sOp12 (wop33)
sQS5 (wqs18)
sOp11 (wop32)
sQS1 (wqs11)
sQS8 (wqs21)
sOp19 (wop36)
sQS2 (wqs12)
sQS6 (wqs19)
sFi5 (wfi20)
sOp2 (wop20)
sOp3 (wop21)
sFi4 (wfi19)
sFi6 (wfi21)
sOp4 (wop22)
sFi1 (wfi4)
sFi2 (wfi5)

Appendix 6

Partners and End - Users global comparison as regards relevance and assessment of PIs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THRONDHEIM
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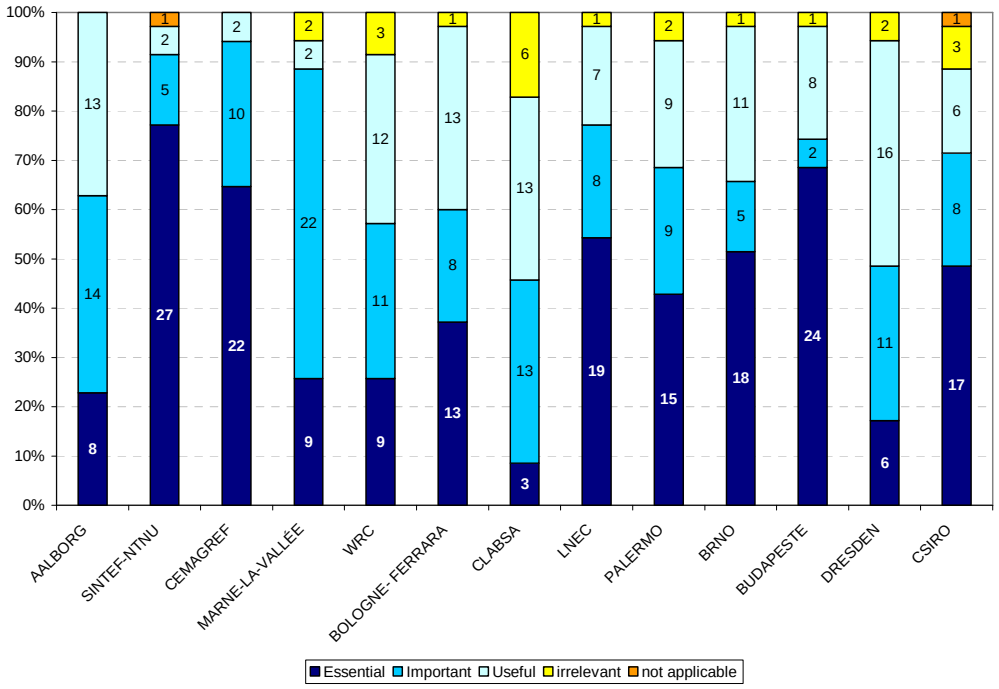
STAVANGER
SIAULIAI
NANTES
SEVEN-TRENT
CLABSA
OEIRAS-AMADORA
AGAC-BOLONHA
FERRARA -ACOSEA
PALERMO-AMAP
BRNO
BUDAPESTE
BUDAPESTE - VASIVIZ
DRESDEN
MELBOURNE
NEWCASTLE
Essential
Important
Useful
irrelevant
not applicable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BOLOGNE- FERRARA
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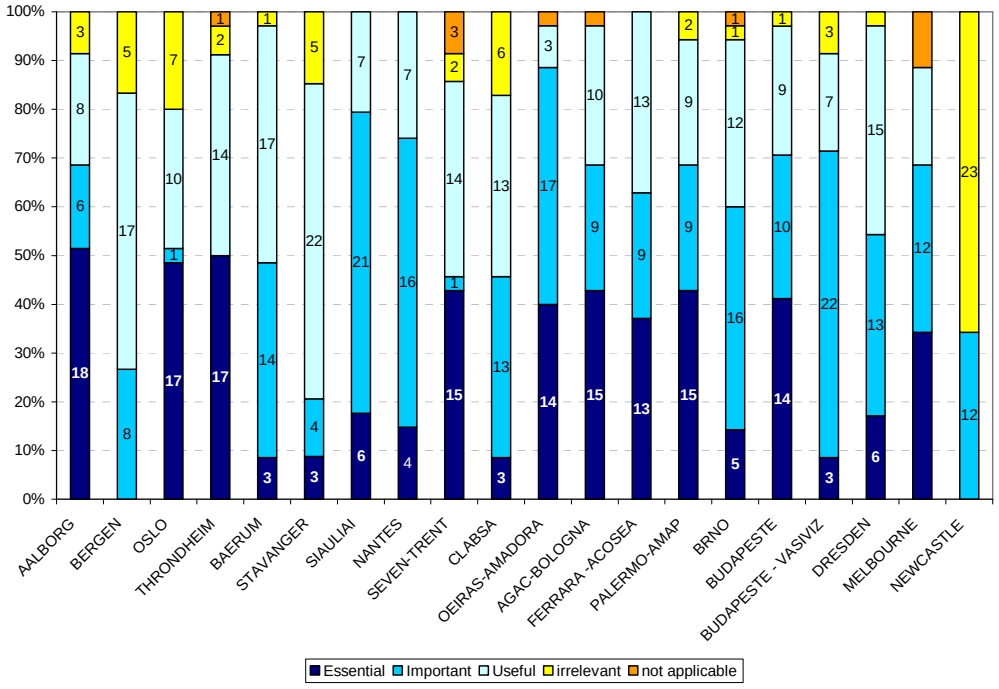
PALERMO
BRNO
BUDAPESTE
DRESDEN
CSIRO
Essential
Important
Useful
irrelevant
not applicable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AGAC-BOLOGNA
FERRARA -ACOSEA
PALERMO-AMAP
BRNO
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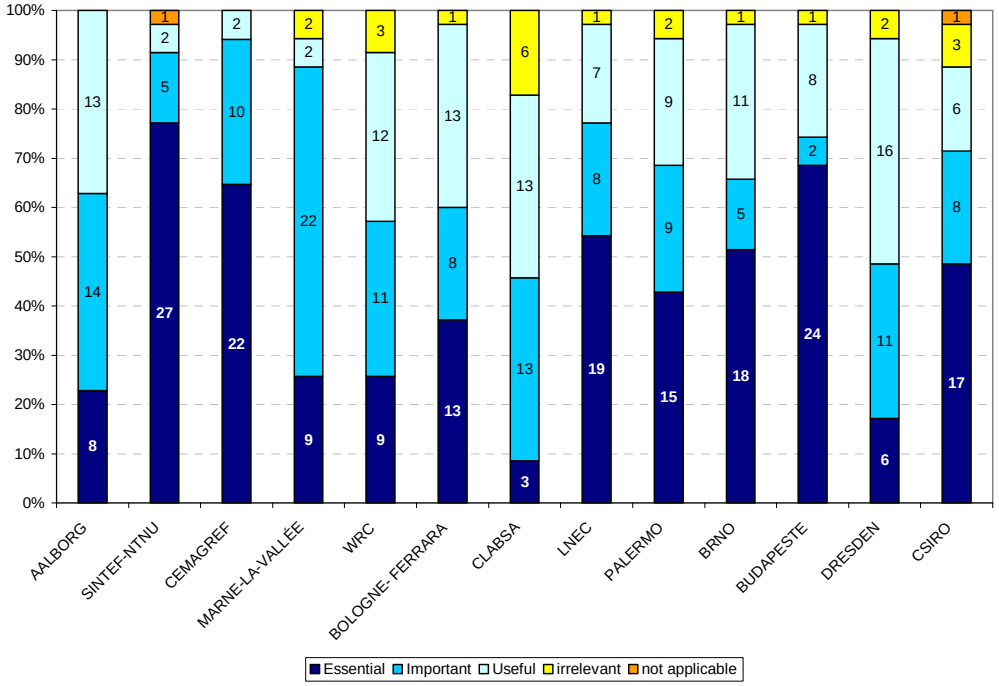
BUDAPESTE - VASIVIZ
DRESDEN
MELBOURNE
NEWCASTLE
Essential
Important
Useful
irrelevant
not applicable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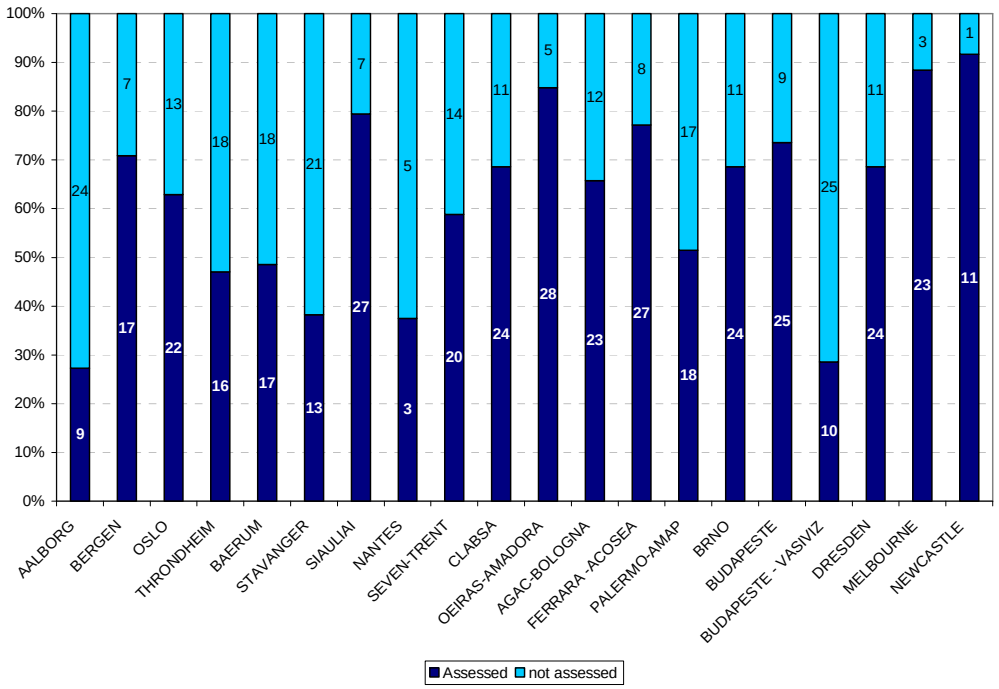
BRNO
BUDAPESTE
DRESDEN
CSIRO
Essential
Important
Useful
irrelevant
not applicable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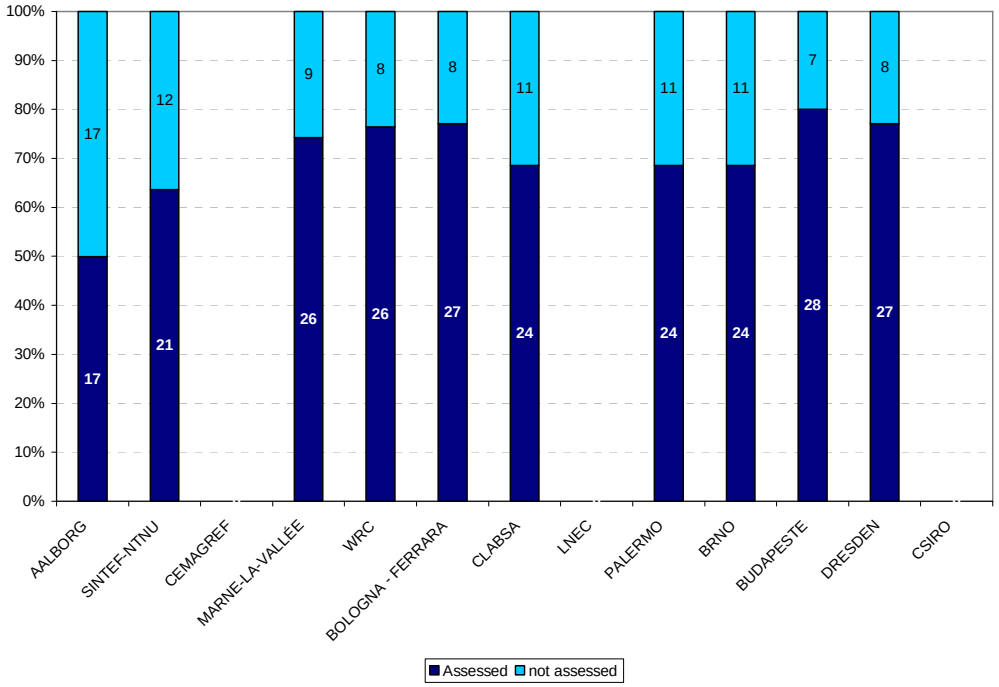
STAVANGER
SIAULIAI
NANTES
SEVEN-TRENT
CLABSA
OEIRAS-AMADORA
AGAC-BOLOGNA
FERRARA -ACOSEA
PALERMO-AMAP
BRNO
BUDAPESTE
BUDAPESTE - VASIVIZ
DRESDEN
MELBOURNE
NEWCASTLE
Assessed
not assessed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SINTEF-NTNU
CEMAGREF
MARNE-LA-VALLÉE
WRC
BOLOGNA - FERRARA
CLABSA
LNEC
PALERMO
BRNO
BUDAPESTE
DRESDEN
CSIRO
Assessed
not assessed

Appendix 7

List of comments, suggestions and new PIs proposals

ENDUSERS

PI	Aalborg	Bergen	Oslo
Wop20			
Wop21			
Wop22			
Wop23			
Wop24	Not readily accessible		
Wop25	Privately owned		No register with these information
Wop28		Not able to obtain necessary informatiom for the city. Data is relevant locally for renewal planning.	Have data for one year (with a average rainfall)
Wop29	Not related to individual sewer stretches, only as totals for whole catchments	ditto	
Wop30	Not related to individual sewer stretches, only as totals for whole catchments	ditto	
Wop31	Not readily accessible	ditto	
Wop32	Not readily accessible		
Wop33	Not readily accessible		
Wop34	Not readily accessible		We know that our register is not complete
Wop35	Not readily accessible		
Wop36	Not readily accessible		

PI	Aalborg	Bergen	Oslo
Wph5	Not readily accessible	Not able to obtain necessary data	
Wph6	Not readily accessible		
Wph7	Not readily accessible		
WEn3	Registered for a few selected overflow structures	Data will be obtained in the future	
WEn4	Not readily accessible	ditto	
WEn5	Not readily accessible	ditto	
WEn6	Not readily accessible	Sediments collected at sewage treatment plants.	
WQs11	Not readily accessible	Weather not registered. Use wOp34	We know that our register is not complete
WQs12	Not readily accessible	Weather not registered. Use wOp34	
WQs13	Not readily accessible	use only Wop35	
WQs14	Not readily accessible	Data dificult to obtain	
WQs18	Not readily accessible		
WQs19	Not readily accessible		
WQs20	Not readily accessible		
WQs21	Not readily accessible		

PI	Aalborg	Bergen	Oslo
WFi4			
WFi5			
WFi19		Prefer unit investment per inhabitant as for the 2 previous indicators.	
WFi20	Not readily accessible		
WFi21	Not readily accessible		
new PI	Rodents		
new PI	corrosion		
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			

PI	Throndheim	Stavanger	Siauliai
Wop20			
Wop21			
Wop22			
Wop23			
Wop24		Manhole covers can be replaced by others	
Wop25	not available since they are not the responsibility of the municipality	there are a lack of reports from rehabilitation on servide connections	
Wop28		no data exists	It is not possible to measure according to exfiltration and infiltration
Wop29	a lot of undesirable water are entering the sewer network from wrong connections ect., but this is hard to assess	no data exists	
Wop30	not very relevant for the whole network in Trondheim due to a lot of clay around the pipes, but can be interesting to assess for some local conditions (sectors)	no data exists	
Wop31		no data exists	
Wop32	Gemini VA database		
Wop33			
Wop34	basement flooding is only reported in cases of compensation for damage	Often only reported to incuranse company	
Wop35	this problem is more a case for the road authorities, for them to keep inlets open for ice etc. in the winter time	No registration	
Wop36	Gemini VA database, reported as breaks	Registrated if it blocks the pipes or is reported as a flooding of sewage.	

PI	Throndheim	Stavanger	Siauliai
Wph5	Not relevant in Trondheim, since the combined system is dimensioned for wet weather conditions	No registration	
Wph6	Definition surcharging and of wet weather?	No registration	
Wph7	Can only be detected when basement flooding occurs, and they are not always reported. but when basement flooding occurs, this tells about the capacity of the sewer network and can leads to actions to improve the network	?	
WEn3	Reports only hours of the overflow in action.		
WEn4	The volume of the overflow differ a lot, so that hours detected does not directly tell about the volume	A system for registration will be in function in two years.	
WEn5	Do not have rainfall data for the whole city and data about the overflow volumes. A new PI for overflows is suggest at the end	Assumes all intermitted overflows are related to rainfall.	
WEn6	Performs flushing of the network regularly, but has not jet assessed the volume of sediments.	No registration	
WQs11	Definition of flooding? In basement? Can get some data from the insurance companies, but to complete, would be nice to have.	only reported in cases of economic loss	
WQs12	ditto	only reported in cases of economic loss	
WQs13		No data	
WQs14	No problem since it seldom occurs. When the work is done, it is a long time until next time	No data	
WQs18	Most problems are due to service connections, and has not been registered since the municipality is not responsible. Data will be collected in the future.Difficult to distinguish between wQS18 and wQS19	We are trying to registrate all complaints	
WQs19	Have some data on basement flooding, will get more in the future Definition problems Difficult to distinguish between wQS18 and wQS19	We are trying to registrate all complaints	
WQs20	Register some complaints	We are trying to registrate all complaints	
WQs21	NB! text in PI and UI are not the same	We are trying to registrate all complaints	

PI	Throndheim	Stavanger	Siauliai
WFi4	Should be split in two PI's for WWT and networks. NB! given as US$ in appendix		
WFi5	Should be split in two PI's for WWT and networks NB! given as US$ in appendix		
WFi19	Some investment are not included here, due to private investors, see wFi20		
WFi20	Should be split in two PI's. New assets are basicly build by private investors in connection with new housing. Expansion of exisiting asset capasity could be included in wFi21, since this is often a rehab. criteria		
WFi21			
new PI	Intermitent overflow discharge related to people connected and rain (hours*capita/population)		
new PI	Flooding (nº/100 persons)		
new PI	Interruptions in pumping stations (nº/stations/year)		
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			

PI	Nantes	Seven-Trent	Clabsa
Wop20	per category of pipe	Available from DGJR, Table 12	
Wop21		Available from DGJR, Table 12	
Wop22			
Wop23			
Wop24			
Wop25			
Wop28			WD34,35,36 very difficult to measure
Wop29			WD34 very difficult to measure
Wop30			WD35 very difficult to measure
Wop31			WD36 very difficult to measure
Wop32			if blockage is partial, could not notice in short term
Wop33		May be possible	WD38 unknown unless CCTV inspection be done. Can assess trough extrapolation
Wop34	considering all flooding causes mixed	Internal flooding Only	WD39 incidences register exists?
Wop35		Internal flooding Only	W40 incidences register exists?
Wop36			

PI	Nantes	Seven-Trent	Clabsa
Wph5			
Wph6			
Wph7			
WEn3			WA27 only measured with real-time limnimeter or accurate simulation
WEn4			WA28 only measured with real-time limnimeter or accurate simulation
WEn5	duration of overflow shoul also be considered		WA28 only measured with real-time limnimeter or accurate simulation
WEn6			
WQs11		Internal flooding due to blockage, etc	
WQs12			
WQs13	not possible to distinguish between various causes of flooding(either problems on gully pots, or on pipes..)		
WQs14			
WQs18			
WQs19			
WQs20			
WQs21			

PI	Nantes	Seven-Trent	Clabsa
WFi4			
WFi5			
WFi19			
WFi20			
WFi21			
new PI			Sewer age (years)
new PI			Materials used in sewer construction
new PI			Construction method for sewer
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			

PI	Oeiras - Amadora	Agac - Bolonha	Palermo - Amap
Wop20			Only few years of data are available
Wop21	In our services the “relining” solution is not used so far		Only few years of data are available
Wop22			Only few years of data are available
Wop23			Only few years of data are available
Wop24			Only few years of data are available
Wop25		Our firm doesn’t menage with service connections	Only few years of data are available
Wop28		Difficult to evaluate and lack of data	Yes. wD34, wD35 and wD36 (Inflow Volume, Infiltration Volume, Exfiltration Volume) – Only possible in a few downstream sections where discharge measures exist
Wop29		Difficult to evaluate and lack of data	Yes. wD34, wD35 and wD36 (Inflow Volume, Infiltration Volume, Exfiltration Volume) – Only possible in a few downstream sections where discharge measures exist
Wop30		Difficult to evaluate and lack of data	Yes. wD34, wD35 and wD36 (Inflow Volume, Infiltration Volume, Exfiltration Volume) – Only possible in a few downstream sections where discharge measures exist
Wop31		Difficult to evaluate and lack of data	Yes. wD34, wD35 and wD36 (Inflow Volume, Infiltration Volume, Exfiltration Volume) – Only possible in a few downstream sections where discharge measures exist
Wop32			
Wop33			
Wop34	Currently our services has records (both from flooding of sanitary sewers and surface) together. A new software application should be developed to make easier the assessment of these data separately.		
Wop35			
Wop36	Observation: check if “per 100 Km” is a good denominator		

PI	Oeiras - Amadora	Agac - Bolonha	Palermo - Amap
Wph5	Although the data necessary to assess this group of PIs is not yet available there is a strong interest in providing it in a near future	Lack of data and monitoring.	Yes. wC2 (Surcharged sewers in dry weather) – Difficult to assess the variable without direct inspection of the sewer pipe
Wph6	Although the data necessary to assess this group of PIs is not yet available there is a strong interest in providing it in a near future	Lack of data and monitoring. We are running network models	Yes. wC3 (Surcharged sewers in wet weather) – Difficult to assess the variable without direct inspection of the sewer pipe
Wph7	Although the data necessary to assess this group of PIs is not yet available there is a strong interest in providing it in a near future	Lack of data and monitoring. We are running network models	Yes. wC4 (Highly surcharged sewers) – Difficult to assess the variable without direct inspection of the sewer pipe
WEn3		The measurements systems are sophisticated, expensive and difficult to manage	Yes. wA27 (Number of overflow discharges) – Lack of data
WEn4		The measurements systems are sophisticated, expensive and difficult to manage	Yes. wA28 (Volume of overflow discharges) – Lack of data
WEn5		The measurements systems are sophisticated, expensive and difficult to manage	Yes. wA28 (Volume of overflow discharges) – Lack of data
WEn6	Data not yet available but not difficult to assess in a near future	Lack of data	Yes. wA13 (Sewer sediments) – Lack of data
WQs11			
WQs12			
WQs13			
WQs14			
WQs18	There is not yet available a systematic assessment of complaints but it will not be difficult to do it in a near future		
WQs19	There is not yet available a systematic assessment of complaints but it will not be difficult to do it in a near future		
WQs20	There is not yet available a systematic assessment of complaints but it will not be difficult to do it in a near future		
WQs21	There is not yet available a systematic assessment of complaints but it will not be difficult to do it in a near future		

PI	Oeiras - Amadora	Agac - Bolonha	Palermo - Amap
WFi4			
WFi5			
WFi19			
WFi20			
WFi21			
new PI		Sewer density (km/km2) - Total sewer length/total connected area	
new PI		Population served (km/inhabitants) - Total sewer length/total connected inhabitants	
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			

PI	Brno	Budapeste	Budapeste - Vasiviz
Wop20			Each rehabilitation indicator is very small, because of lack of money
Wop21			
Wop22			
Wop23			Only very few
Wop24			
Wop25			
Wop28	Lack of data		
Wop29	Lack of data		
Wop30	Lack of data		
Wop31	Lack of data		
Wop32			
Wop33			
Wop34			Data exist only if the event is reported
Wop35			We have data only as event
Wop36			Our data regards to the numbers as events

PI	Brno	Budapeste	Budapeste - Vasiviz
Wph5		M/year or km/year would be "important"	
Wph6		" "	That would be good, if we had data on it
Wph7	Lack of data	" "	That would be good, if we had data on it
WEn3	Lack of data		Very rare, only in case of big precipitation
WEn4	Lack of data		No measurement
WEn5	Lack of data		
WEn6			Only in a few locations have we data
WQs11			
WQs12			Numbers are registered
WQs13	We do not register this data		We have no surface system (otherwise it would be important)
WQs14	We do not register this data		Generally the service is continuous, supplied by sniffing trucks
WQs18			We have registration only on numbers, not as rate
WQs19			We have registration only on numbers, not as rate
WQs20	We do not register this data		We have registration only on numbers, not as rate
WQs21			We have registration only on numbers, not as rate

PI	Brno	Budapeste	Budapeste - Vasiviz
WFi4			
WFi5			
WFi19			No registration in that form, but can be calculated
WFi20			Data is collectable, but we do not use it
WFi21			Data is collectable, but we do not use it
new PI	sewer network monitoring (km/year)		
new PI	pipe cleaning (km/year)		
new PI	material		
new PI	diameter (mm)		
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			

PI	Dresden	Melbourne	Newcastle
Wop20			
Wop21			
Wop22			
Wop23			
Wop24			
Wop25			
Wop28			
Wop29		Not able to provide accurate data	More resolution needed for modelling – say m3/100m
Wop30		Not able to provide accurate data	More resolution needed for modelling – say m3/100m
Wop31		Not able to provide accurate data	More resolution needed for modelling – say m3/100m
Wop32		Include all blockages that the utility is responsible	More resolution needed for modelling – say m3/100m
Wop33			More resolution needed for modelling – say m3/100m
Wop34			More resolution needed for modelling – say m3/100m
Wop35		Separet systems	More resolution needed for modelling – say m3/100m
Wop36			More resolution needed for modelling – say m3/100m

PI	Dresden	Melbourne	Newcastle
Wph5			
Wph6			More resolution needed for modelling – need metric for each individual device not an agency average
Wph7		All Emergency Relief structures have telemetry	More resolution needed for modelling – need metric for each individual device not an agency average
WEn3			
WEn4			More resolution needed for modelling – need metric for each individual km not an agency average
WEn5			
WEn6			
WQs11			
WQs12			More resolution needed for modelling – need metric for each individual inhabitant not an agency average
WQs13			More resolution needed for modelling – need metric for each individual inhabitant not an agency average
WQs14			
WQs18			
WQs19			
WQs20			
WQs21			

PI	Dresden	Melbourne	Newcastle
WFi4			
WFi5			
WFi19			
WFi20			
WFi21			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			

PARTNERS

PI	Aalborg	Sintef_NTU	Cemagref
Wop20			
Wop21			Relining refers only to non structural operations (IWA approach), but the limit and the difference with structural operations is not explicit
Wop22		Historic records are not complete	
Wop23			
Wop24		should be replaced with replacement or maintenance of inlets	
Wop25		not the responsibility of the municipality	
Wop28		Assessed from CCTV inspections?	
Wop29		stormwater?	Difficult to assess in case of combined sewer (wet weather).
Wop30	Very difficult to assess for individual pipe streches. Possible only for whole catchments		Adding another measure in terms of volumes is also interesting : volume of water infiltrated/total volume of sewage water colle
Wop31	Very difficult to assess		
Wop32		From database GeminiVAPumping station blockages should be a separate PI	Without pumping station blockages (not linked to the sewer condition)Shouldn't we differentiate blockages occurring in sewer main from those occurring in houses connections
Wop33		From database Gemini VA as meters from manholes	
Wop34	Occurs very seldom in Denmark	To some extent, but not all.What is the definition of flooding – in the basement, ground level…?	
Wop35	Assessment based on information from the public	To some extent, but not all.What is the definition of flooding?	Difficult to interpret if we don't have a definition or a referential of what is storm drainage system adequacy. For instance, is there a standard on the minimum rain return period which must be drained without any flooding?("protection standard")
Wop36	Assessment based on information from the public	Have data from burst/leakage, but not collapses (?) have to use CCTV	

PI	Aalborg	Sintef_NTU	Cemagref
Wph5	Occurs very seldom in Denmark	PI lacks definition of both surcharge and weather condition and how to access	
Wph6	Difficult to know where it actually did occur	PI lacks definition of both surcharge and weather condition	Surcharging events in this case must take into account only rain events which are under the "protection standard".
Wph7	What is this?	PI lacks definition of weather condition and how to access	Definition not in accordance with the IWA definitions (draft of the 27/3/02)
WEn3	At a few selected CSOs	monitoring of overflows in some networks	Need to precise the legal standard for intermittent overflow discharges (if it exists).shouldn't we differentiate the indicator dealing with the combined part of the network and the one related to the storm part of the network
WEn4	Very difficult and imprecise to measure	monitoring of overflows in some networks	
WEn5	Very difficult and imprecise to measure	can be related to rainfall measurements- Overflow discharges can also be caused by snow and snow melting	
WEn6	Very difficult to keep track of the amounts and not very important to do so	PI lack information about how to obtain the amount of sediments. After flushing or from sandtraps?	
WQs11	This occurs extremely seldom in Denmark	not complete since not always reported – PI lack definition of flooding and weather conditions	Distinguish between the cases of flooding of properties with basements and those without basements ?
WQs12		not complete since not always reported – PI lack definition of flooding and weather conditions	Ibid?
WQs13	Assessment based on information from the public	not complete since not always reported – PI lack definition of flooding and weather conditions	Ibid ?As in case of Wop35, need a definition of what is a storm draining system adequacy.
WQs14	This occurs extremely seldom in Denmark	PI lacks definition of discontinuity/interruption, also from blockage?	
WQs18	Generally I do not expect complaints to be registered	Definition- How about blockage in service connection points	
WQs19	Generally I do not expect complaints to be registered	Uncomplete, and hard to know who is responsible in many cases	
WQs20	Generally I do not expect complaints to be registered	all complaints will be recorded from now on in the Gemini VA database	
WQs21	(e.g. odor) Generally I do not expect complaints to be registered	all complaints will be recorded from now on	

PI	**Aalborg**	**Sintef_NTU**	**Cemagref**
WFi4			The limit between operations and investments may not be realy explicit especially when we refer to relining. This should be defined clearly in common , unless there is already a standard definition to refer to
WFi5			
WFi19			Take the inhabitant as unit (at the denominator); or the p.e. for the two above financial indicators, to be homogenous
WFi20			
WFi21			
new PI	Odor complaints - Generally I do not expect complaints to be registered	Combined sewers, %/ network length	Length of cleaned sewer per year (%)
new PI	Rodents - Generally I do not expect complaints to be registered	Separate system, %/network length	Length of sewer being in water (table) all the year or partially during the year (%)
new PI	corroded sewer streches	Operational separate system, % of separate system length	Basement flooding in wet weather without surface flooding (Nº/Km/year)
new PI		monitoring of hydraulic conditions in the network	Average rehabilitation works duration (H/km/year)
new PI		monitoring of agressive water quality parameters, hydrogen sulphide, pH..?; monitoring of other water quality parametrs in the network, phosphorus, pH…?	Number of works sites (Nº/Km/year)
new PI		monitoring of discharge into receiving waters, sulphide, phosphorous, pH..?; monitoring of pollution in recipients; monitoring of water quality entering the tratment plant	Number of floodings and of intermitent overflows not in accordance with the standards in wet weather (%)
new PI		Breaks,burst, deformations, joint failures (cross-length failures), corrosion, failures in connections	Odour complaints (related to sewage transport) (Number/year)
new PI		CCTV inspection (km/year); nº of failures from CCTV inspection (nº/year);	Unit running cost linked to rehabilitation (€/inhabitant/year)
new PI		maintenance of sewer pipes; maintenance of storm water inlets	Unit running cost linked to maintenance and repair (€/inhabitant/year)
new PI		flooding costs caused by sewers; by stormwater; maintenance cost	

PI	Marne La Vallée	WRc	Clabsa
Wop20		The amount of sewer rehab work carried out varies greatly from year to year, so a single year's data may not be representative. We should collect data for more than one period (year 1, year2, year3, etc.) or average the data over a relatively long period (say 10 years).	
Wop21		-ditto-	
Wop22		-ditto-	
Wop23	It's not necessary	-ditto-	
Wop24	It's not necessary	-ditto-	
Wop25	Data is very difficult to access, even in big cities like Paris	-ditto-	
Wop28		-see notes below -	WD34,35,36 very difficult to measure
Wop29		Many UK sewer systems are 'mixed' (i.e. some 'combined' sewers and some 'foul'). It is only possible to measure inflow in the foul sewers and it is not cost-effective to do this on a routine basis. Therefore inflow monitoring is only done in response to a problem	WD34 very difficult to measure
Wop30		Infiltration can be measured at a high level (i.e. for an entire catchment) by measuring the treatment works inlet, but this is only useful for measuring problem catchments. You would then have to carry out flow monitoring within the catchment to identify where the inflow is occuring. This is only cost effective where the consequences of the infiltration are severe	WD35 very difficult to measure
Wop31	The estimation of the volume is very difficult	Impossible to measure	WD36 very difficult to measure
Wop32	We suppose that camera inspection has already been done	Pumping station blockages should be counted separately from sewer blockages. They are completely different in nature and mechanism and would distort the figures if included with sewer blockages. See proposal for additional indicator	If blockage is partial, could not notice in short term
Wop33		-ditto-	WD38 unknown unless CCTV inspection be done. Can assess trough extrapolation
Wop34		Note terminology: Replace sanitary sewer with foul sewer. This is an essential indicator, but we need more information on what is affected and the severity of the flooding (e.g. internal or external flooding of a private property, commercial/industrial premises, public space, etc). See proposal for additional indicator	WD39 incidences register exists?
Wop35		-ditto-	WD40 incidences register exists?
Wop36			

PI	Marne La Vallée	WRc	Clabsa
Wph5		Very difficult to measure	
Wph6		Irrelevant – combined sewers are expected to surcharge.	
Wph7		The definition 'High degree surcharging means water above the pipe crown' is confusing. Our definition of 'surcharging' is 'water above the pipe crown'. If your definition is correct, what is your definition of 'surcharging' ?	
WEn3		Averaging over a group of overflows significantly reduces the usefulness of the data. E.g. one overflow operating fifty times a year has a much greater impact on the environment than fifty overflows operanting once a year.	WA27 only measured with real-time limnimeter or accurate simulation
WEn4		-ditto-	WA28 only measured with real-time limnimeter or accurate simulation
WEn5			WA28 only measured with real-time limnimeter or accurate simulation
WEn6	Important for environmental issues but not really considered by end user	Ton/Tonne	
WQs11		See comments on wOp34, above.	
WQs12			
WQs13			
WQs14			
WQs18	Very important to have a detailed information		
WQs19			
WQs20			
WQs21			

PI	**Marne La Vallée**	**WRc**	**Clabsa**
WFi4		It would be useful to separete WWT costs from SEW costs.	
WFi5		ditto	
WFi19			
WFi20			
WFi21		See comments on Wop20 above.	
new PI	Information about the plant, the unit could be the energy consumption	Repeat blockages (Nº/100 km/year)	Sewer age (years)
new PI		Repeat blockages locations (Nº/100 km /year)	Materials used in sewer construction
new PI		Flooding locations (Nº/100 km/year)	Constructive method for sewer
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			

PI	Palermo	Brno	Budapeste
Wop20			
Wop21			
Wop22			
Wop23			
Wop24			
Wop25			
Wop28	Yes. wD34, wD35 and wD36 (Inflow Volume, Infiltration Volume, Exfiltration Volume) – Only possible in a few downstream sections where discharge measures exist	lack of data	Hard to measure
Wop29	Yes. wD34, wD35 and wD36 (Inflow Volume, Infiltration Volume, Exfiltration Volume) – Only possible in a few downstream sections where discharge measures exist	lack of data	Hard to measure
Wop30	Yes. wD34, wD35 and wD36 (Inflow Volume, Infiltration Volume, Exfiltration Volume) – Only possible in a few downstream sections where discharge measures exist	lack of data	Hard to measure
Wop31	Yes. wD34, wD35 and wD36 (Inflow Volume, Infiltration Volume, Exfiltration Volume) – Only possible in a few downstream sections where discharge measures exist	lack of data	Hard to measure
Wop32			
Wop33			
Wop34			
Wop35			
Wop36			

PI	Palermo	Brno	Budapeste
Wph5	Yes. wC2 (Surcharged sewers in dry weather) – Difficult to assess the variable without direct inspection of the sewer pipe		Hard to measure
Wph6	Yes. wC3 (Surcharged sewers in wet weather) – Difficult to assess the variable without direct inspection of the sewer pipe		Hard to measure
Wph7	Yes. wC4 (Highly surcharged sewers) – Difficult to assess the variable without direct inspection of the sewer pipe	lack of data	Hard to measure
WEn3	Yes. wA27 (Number of overflow discharges) – Lack of data	lack of data	
WEn4	Yes. wA28 (Volume of overflow discharges) – Lack of data	lack of data	
WEn5	Yes. wA28 (Volume of overflow discharges) – Lack of data	lack of data	
WEn6	Yes. wA13 (Sewer sediments) – Lack of data		
WQs11			
WQs12			
WQs13		We do not register this data	
WQs14		We do not register this data	
WQs18			
WQs19			
WQs20		We do not register this data	
WQs21			

PI	Palermo	Brno	Budapeste
WFi4			
WFi5			
WFi19			
WFi20			
WFi21			
new PI	Flushing factor (%) - ratio between max velocity (wet weather velocity) and min velocity (dry weather velocity)	material	
new PI	Peak flow factor (%) - ratio between max discharge (wet weather) and min discharge (dry weather)	diameter (mm)	
new PI	Damage (%) - ratio between annual costs for damage to private properties and activities and total annual investment	age os pipes/lifetime (years)	
new PI	Legal expenses connected to complaints (%) - Ratio between annual costs for legal activities connected to insufficient service level and the total annual investment	more information on combined sewer overflow	
new PI			
new PI			
new PI			
new PI			
new PI			
new PI			

Appendix 8

Detailed List of selected PIs for rehabilitation

ENVIRONMENTAL INDICATORS (sEn)

WASTEWATER	*sEn1*	Overflow discharge frequency *(Nº/overflow device/year)*	(Number of overflow discharges that occured during the assessment period x 365 / assessment period) / number of overflow devices at the reference date *sEn1 = (sA2 x 365 / sH1) / sC50* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*
	sEn2	Overflow discharge volume *(m3/overflow device/year)*	(Total volume of overflow discharges that occured during the assessment period x 365 / assessment period) / number of overflow devices at the reference date *sEn2 = (sA3 x 365 / sH1) / sC50* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*
	sEn3	Duration of overflow discharge *(hours/overflow device/year)*	(Duration of overflow discharges that occured during the assessment period x 365 / assessment period) / number of overflow devices at the reference date *sEn3 = (sA4 x 365 / sH1) / sC50* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.* *This indicator can be use in alternative to sEn2 when there is no measurement of overflow discharge volume available.*

	sEn4	Overflow discharge related to rainfall *(%/year)*	Total volume of overflow discharges / rainfall volume x 100, during the assessment period *sEn4 = sA3 / sA5 x 100* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year, in order to allow for comparisons with sEn2.*
SEDIMENTS	*sEn5*	Sediments from sewers *(ton/km sewer/year)*	(Drained weight of sediments removed from sewers during the assessment period x 365 / assessment period) / total sewer length at the reference date *sEn5 = (sA1 x 365 / sH1) / sC3* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*

PHYSICAL INDICATORS (sPh)

SEWERS	*sPh1*	Surcharging in gravity sewers in dry weather *(%)*	Length of gravity sewer where surcharging has occurred in dry weather during the assessment period / total sewer length at the reference date x 100 *sPh1 = sC47 / sC3 x 100* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*
	sPh2	Surcharging in gravity sewers in wet weather *(%)*	Length of gravity sewers where surcharging has occurred in wet weather during the assessment period / total sewer length at the reference date x 100 *sPh2 = sC48 / sC3 x 100* *This information may be obtained either by monitoring or by hydraulic modelling using real rainfall data.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*

	sPh3	High sewer surcharging *(%)*	Length of sewer where a high degree of surcharging has occurred in wet weather during the assessment period / total sewer length at the reference date x 100 *sPh3 = sC49 / sC3 x 100* *High degree of surcharging means water level at least 0.5 m above the pipe crown.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*
OPERATIONAL INDICATORS (sOp)			
SEWER CLEANING	*sOp1*	Sewer cleaning *(%/year)*	(Length of sewers cleaned during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp1 = (sD1 x 365 / sH1) / sC3 x 100* *Root cutting shall be included. Sewer cleaning refers to actions under a proactive management strategy. Curative cleaning of blockages is reflected in sOp11.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year.Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*
SEWER REHABILITATION	*sOp2*	Sewer rehabilitation *(%/year)*	(Length of defective sewers rehabilitated during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp2 = (sD2 x 365 / sH1) / sC3 x 100* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*

sOp3	- sewer renovation *(%/year)*	(Length of defective sewers renovated during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp3 = (sD3 x 365 / sH1) / sC3 x 100* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*
sOp4	- sewer replacement or renewal *(%/year)*	(Length of sewers replaced or renewed during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp4 = (sD4 x 365 / sH1) / sC3 x 100* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*
sOp5	Manhole chambers replacement, renewal, renovation or repair *(%/year)*	(Number of manhole chambers replaced, renewed, renovated or repaired during the assessment period x 365 / assessment period) / total number of manhole chambers at the reference date x 100 *sOp5 = (sD5 x 365 / sH1) / sC51 x 100* *Replacement of manhole covers only are not included.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*

	sOp6	Service connection rehabilitation *(%/year)*	(Number of service connections replaced or renewed during the assessment period x 365 / assessment period) / total number of service connections at the reference date x 100 *sOp6 = (sD7 x 365 / sH1) / sC54 x 100* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*
INFLOW / INFILTRATION / EXFILTRATION (I/I/E)	*sOp7*	Inflow / Infiltration / Exfiltration (I/I/E) *(%)*	Volume of water entering sewers, from groundwater and wrong connections less the leakage from sewers into the ground / (collected sewage + inflow + infiltration – exfiltration) x 100, during the assessment period *sOp7 = (sD8 + sD9 - sD10) / (sE4 + sD8 + sD9 - sD10) x 100* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
	sOp8	Inflow *(m3/km/year)*	(Volume of water entering sewers from wrong connections during the assessment period x 365 / assessment period) / total sewer length at the reference date *sOp8 = (sD8 x 365 / sH1) / sC3* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
	sOp9	Infiltration *(m3/km/year)*	(Volume of water entering sewers from groundwater during the assessment period x 365 / assessment period) / total sewer length at the reference date *sOp9 = (sD9 x 365 / sH1) / sC3* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*

	sOp10	Exfiltration *(m3/km/year)*	(Volume of leakage from sewers into the ground during the assessment period x 365 / assessment period) / total sewer length at the reference date *sOp10 = (sD10 x 365 / sH1) / sC3* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
FAILURES	*sOp11*	Sewer blockages *(Nº/100 km sewer/year)*	(Number of blockages in sewers that occurred during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp11 = (sD11 x 365 / sH1) / sC3 x 100* *Pumping station blockages shall not be included. Include blockages in service connections only where these are the responsibility of the wastewater undertaking.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
	sOp12	Sewer blockage locations *(Nº/100 km sewer/year)*	Number of individual locations in sewers where blockages occured during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp12 = (sD12 x 365 / sH1) / sC3 x 100* *Locations where frequent blockages occured should only be accounted once; pumping station blockages shall not be included. Include blockage locations in service connections only where these are the responsibility of the wastewater undertaking.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*

sOp13	- repeat sewer blockage locations *(Nº/100 km sewer/year)*	Number of individual locations in sewers where repeat blockages occured during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp13 = (sD13 x 365 / sH1) / sC3 x 100* *Locations where blockages occured more than once; pumping station blockages shall not be included. Include blockage locations in service connections only where these are the responsibility of the wastewater undertaking.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
sOp14	Pumping station blockages *(Nº/pumping station/year)*	(Number of blockages that occurred in pumping stations during the assessment period x 365 / assessment period) / number of pumping stations at the reference date *sOp14 = (sD14 x 365 / sH1) / sH1 x 100* *Pumping station blockages include blockages in pumps and valves. Sewer blockages shall not be included.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
sOp15	Flooding from sanitary or combined sewers *(Nº/100 km sewer/year)*	(Number of flooding incidents related to sanitary or combined sewers during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp15 = (sD15 x 365 / sH1) / sC3 x 100* *Include only incidents related to sanitary or combined sewers that are the responsibility of the wastewater undertaking.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*

sOp16	Flooding locations in sanitary or combined sewers *(Nº/100 km sewer/year)*	(Number of flooding locations in sanitary or combined sewers during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp16 = (sD16 x 365 / sH1) / sC3 x 100* *Include only incidents related to sanitary or combined sewers that are the responsibility of the wastewater undertaking.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
sOp17	- Repeat flooding locations in sanitary or combined sewers	(Number of repeat flooding locations in sanitary or combined sewers during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp17 = (sD17 x 365 / sH1) / sC3 x 100* *Include only incidents related to sanitary or combined sewers that are the responsibility of the wastewater undertaking.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
sOp18	Surface flooding *(Nº/100 km sewer/year)*	(Number of surface flooding incidents during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp18 = (sD18 x 365 / sH1) / sC3 x 100* *These include only surface flooding due to inadequacy of storm drainage system (combined sewers included) that is the responsibility of the wastewater undertaking. Inadequacy relates to all causes (e.g. design, operation, etc.).* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*

sOp19	Sewer collapses *(Nº/100 km sewer/year)*	(Number of sewer collapses during the assessment period x 365 / assessment period) / total sewer length at the reference date x 100 *sOp19 = (sD19 x 365 / sH1) / sC3 x 100* *Does not include collapses on service connections.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*

QUALITY OF SERVICE INDICATORS (sQS)

FLOODING	*sQS1*	Flooding affecting properties from sanitary or combined sewers in dry weather *(n.º/1000 properties/year)*	(Number of properties affected by flooding from sanitary or combined sewers in dry weather, during the assessment period x 365 / assessment period) / number of connected properties at the reference date x 1000 *sQS1 = (sF1 x 365 / sH1) / sC53 x 1000* *Only flooding from sanitary or combined sewers that are the responsibility of the wastewater undertaking should be included. Flooding may affect properties that are not connected to the sewer system. These should be included.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*
	sQS2	Flooding affecting properties from sanitary or combined sewers in wet weather *(n.º/1000 properties/year)*	(Number of properties affected by flooding from sanitary or combined sewers in wet weather, during the assessment period x 365 / assessment period) / number of connected properties at the reference date x 1000 *sQS2 = (sF2 x 365 / sH1) / sC53 x 1000* *Only flooding from sanitary or combined sewers that are the responsibility of the wastewater undertaking should be included. Flooding may affect properties that are not connected to the sewer system. These should be included.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*

	sQS3	Surface water flooding of properties in wet weather *(n.º/1000 properties/year)*	(Number of properties affected by surface flooding in wet weather, during the assessment period x 365 / assessment period) / number of connected properties at the reference date x 1000 *sQS3 = (sF3 x 365 / sH1) / sC53 x 1000* *Include only surface water flooding due to inadequacy of the storm drainage system (including combined sewers) that are the responsibility of the wastewater undertaking. (Inadequacy related to all causes).* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year, but it is recommended that it be used only where data for the variables have been collected for at least a year. Where it has been used for shorter time periods, special consideration is required when used for comparisons, either internal or external to the undertaking.*
INTERRUPTIONS	*sQS4*	Interruption of wastewater collection and transport services *(%)*	Sum, for the assessment period, of the number of properties affected by service interruption multiplied by the respective duration of interruptions in hours / (number of connected properties at the reference date x 24 x assessment period) x 100 *sQS4 = sF4 / (sC53 x 24 x sH1) x 100* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
COMPLAINTS	*sQS5*	Blockage complaints *(Nº /1000 inhab./year)*	(Number of complaints as a result of blockages, during the assessment period x 365 / assessment period) / resident population at the reference date x 1000 *sQS5 = (sF5 x 365 / sH1) / sE1 x 1000* *Only complaints relating to the system that is the responsibility of the wastewater undertaking should be accounted for.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*

	sQS6	Flooding complaints *(Nº /1000 inhab./year)*	(Number of complaints as a result of flooding, during the assessment period x 365 / assessment period) / resident population at the reference date x 1000 *sQS6 = (sF6 x 365 / sH1) / sE1 x 1000* *Only complaints relating to the system that is the responsibility of the wastewater undertaking should be accounted for.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
	sQS7	Pollution incidents complaints *(Nº /1000 inhab./year)*	(Number of complaints as a result of pollution incidents, during the assessment period x 365 / assessment period) / resident population at the reference date x 1000 *sQS7 = (sF7 x 365 / sH1) / sE1 x 1000* *Only complaints relating to the system that is the responsibility of the wastewater undertaking should be accounted for.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
	sQS8	Odour complaints *(Nº /1000 inhab./year)*	(Number of complaints as a result of odours, during the assessment period x 365 / assessment period) / resident population at the reference date x 1000 *sQS8 = (sF8 x 365 / sH1) / sE1 x 1000* *Only complaints relating to the system that is the responsibility of the wastewater undertaking should be accounted for.* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.*
ECONOMIC AND FINANCIAL INDICATORS (sFi)			

COSTS	*sFi1*	Unit total cost per length of sewer *(€/km sewer/year)*	[(Running costs plus capital costs, related to sewer system, during the assessment period) x 365 / assessment period] / total sewer length at the reference date *sFi1 = (sG1 x 365 / sH1) / sC3* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.* *If these costs are referred to inhabitants, than this indicator shall be expressed in €/inhabitant, in this case in the processing rule sC3 shall be replaced by sE2*
	sFi2	Unit running cost per length of sewer *(€/km sewer/year)*	(Running costs related to sewer system during the assessment period x 365 / assessment period) / total sewer length at the reference date *sFi2 = (sG3 x 365 / sH1) / sC3* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.* *If these costs are referred to inhabitants, than this indicator shall be expressed in €/inhabitant, in this case in the processing rule sC3 shall be replaced by sE2*
	sFi3	- unit running cost for maintenance, cleaning and repair per length of sewer *(€/km sewer/year)*	(Running costs related to maintenance, cleaning and repair of sewer system during the assessment period x 365 / assessment period) / total sewer length at the reference date *sFi3 = (sG4 x 365 / sH1) / sC3* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This indicator may be assessed for periods shorter than one year, but special consideration is required when used for comparisons, either internal or external to the undertaking.* *If these costs are referred to inhabitants, than this indicator shall be expressed in €/inhabitant, in this case in the processing rule sC3 shall be replaced by sE2*

INVESTMENT	*sFi4*	Unit investment *(€/km sewer/year)*	(Cost of investments (expenditures for sewers, treatment plants and equipments) during the assessment period x 365 / assessment period) / total sewer length at the reference date *sFi4 = (sG5 x 365 / sH1) / sC3* *Note that " x 365 / assessment period" is a unit conversion expression and is not intended to be considered as extrapolation.* *This PI may be assessed for periods shorter than one year but the resulting values can be misleading. Thus it is recommended to be assessed using annual data for periods of more than one year. Where it has been used for shorter time periods, special attention shall be paid when this PI is used for comparisons, either internal or external to the undertaking.* *If these costs are referred to inhabitants, than this indicator shall be expressed in €/inhabitant, in this case in the processing rule sC3 shall be replaced by sE2*
	sFi5	- investments for new assets and reinforcement of existing assets *(%)*	Cost of investments for new assets and reinforcement of existing assets / total cost of the investments x 100, during the assessment period *sFi5 = sG6 / sG5 x 100* *Only added capacity investment shall be accounted for.* *This PI may be assessed for periods shorter than one year but the resulting values can be misleading. Thus it is recommended to be assessed using annual data for periods of more than one year. Where it has been used for shorter time periods, special attention shall be paid when this PI is used for comparisons, either internal or external to the undertaking.*
	sFi6	- investments for asset replacement and renovation *(%)*	Cost of investments for the replacement and renovation ("like for like") of existing assets / total cost of the investments x 100, during the assessment period *sFi6 = sG7 / sG5 x 100* *"like for like" means that it will provide the same functionality.* *This PI may be assessed for periods shorter than one year but the resulting values can be misleading. Thus it is recommended to be assessed using annual data for periods of more than one year. Where it has been used for shorter time periods, special attention shall be paid when this PI is used for comparisons, either internal or external to the undertaking.*

Final Rehab PI Code	Questionnaire Rehab PI Code	IWA PI Code
sEn	**wEn**	**wEn**
sEn1	wEn3	wEn3
sEn2	wEn4	wEn4
sEn3	none	none
sEn4	wEn5	wEn5
sEn5	wEn6	wEn12
sPh	**wPh**	**wPh**
sPh1	wPh5	wPh5
sPh2	wPh6	wPh6
sPh3	wPh7	wPh7
sOp	**wOp**	**wOp**
sOp1	none	wOp2
sOp2	wOp20	wOp21
sOp3	wOp21	wOp22
sOp4	wOp22	wOp23
sOp5	wOp23	wOp25
sOp6	wOp25	wOp27
sOp7	wOp28	wOp30
sOp8	wOp29	wOp31
sOp9	wOp30	wOp32
sOp10	wOp31	wOp33
sOp11	wOp32	wOp34
sOp12	wOp33	wOp35
sOp13	none	none
sOp14	none	wOp36
sOp15	wOp34	wOp37
sOp16	none	none
sOp17	none	none
sOp18	wOp35	wOp39
sOp19	wOp36	wOp40
sQs	**wQs**	**wQs**
sQs1	wQs11	wQs10
sQs2	wQs12	wQs11
sQs3	wQs13	wQs14

sQs4	wQs14	wQs15
sQs5	wQs18	wQs20
sQs6	wQs19	wQs21
sQs7	wQs20	wQs22
sQs8	wQs21	wQs23
Final Rehab PI Code	**Questionnaire Rehab PI Code**	**IWA PI Code**
sFi	**WFi**	**wFi**
sFi1	wFi4	wFi6
sFi2	wFi5	wFi8
sFi3	none	none
sFi4	wFi19	wFi27
sFi5	wFi20	wFi28
sFi6	wFi21	wFi29

Appendix 9

Detailed List of selected Utility Information for rehabilitation

ENVIRONMENTAL DATA

sA1	SEWER SEDIMENTS	
UNIT OF EXPRESSION: **ton**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Drained weight of sediments removed from sewers during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sEn5*		USED FOR VARIABLES: *none*

sA2	NUMBER OF OVERFLOW DISCHARGES	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of overflow discharges that occured during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sEn1*		USED FOR VARIABLES: *none*

sA3	VOLUME OF OVERFLOW DISCHARGES	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total volume of overflow discharges that occured during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sEn2, sEn4*		USED FOR VARIABLES: *none*

sA4	DURATION OF OVERFLOW DISCHARGES	
UNIT OF EXPRESSION: **hours**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Sum, for all overflow devices, of the duration of each overflow discharge that occured during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sEn3*		USED FOR VARIABLES: *none*

sA5	RAINFALL VOLUME	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Volume of rainfall in the catchment area during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sEn4*		USED FOR VARIABLES: *none*

PHYSICAL ASSETS DATA

sC1	CATCHMENT AREA	
UNIT OF EXPRESSION: **km2**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Extent of area receiving the waters feeding a part or the totality of a drain runoff or channel/sewer network		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC2	IMPERMEABLE CATCHMENT AREA	
UNIT OF EXPRESSION: **km2**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Area within the catchment area that is impermeable		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC3	TOTAL SEWER LENGTH	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total length of sewers managed by the undertaking at the reference date.		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *sEn5, sPh1, sPh2, sPh3, sOp1, sOp2, sOp3, sOp4, sOp8, sOp9, sOp10, sOp11, sOp12, sOp13, sOp15, sOp16, sOp17, sOp18, sOp19, sFi1, sFi2, sFi3, sFi4*	USED FOR VARIABLES: *none*	

sC4	COMBINED SEWERS LENGTH	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of combined sewers managed by the undertaking at the reference date		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC5	SANITARY SEWERS LENGTH	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sanitary sewers managed by the undertaking at the reference date		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC6	STORMWATER SEWERS LENGTH	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of stormwater sewers managed by the undertaking at the reference date		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC7	PUMP MAINS LENGTH	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of pump mains managed by the undertaking at the reference date		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC8	OTHER SEWERS LENGTH	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of other sewers (e.g. small-bore sewers, settled sewers, etc.) managed by the undertaking at the reference date		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC9	TIDAL SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers subject to tidal influence		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC10	EXPANSION OF SEWER NETWORK	
UNIT OF EXPRESSION: **km/year**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Annual increase in sewer length that is the responsibility of the wastewater undertaking (house connections excluded)		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC11	CLAY SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of clay sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC12	ASBESTOS CEMENT SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of asbestos sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC13	CONCRETE SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of concrete sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC14	POLYVINYL CHLORINE SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of polyvinyl chlorine (PVC) sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC15	POLYETHYLENE SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of polyethylene sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC16	IRON SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of iron sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC17	STEEL SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of steel sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC18	STONE SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of stone sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC19	BRICK SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of brick sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC20	OTHER KNOWN MATERIAL SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of other known material sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC21	UNKNOWN MATERIAL SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of unknown material sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC22	SEWER DIAMETER OR EQUIVALENT ≤ 150 MM	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers with diameter ≤ 150 mm		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC23	150 < SEWER DIAMETER OR EQUIVALENT ≤ 450 MM	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers with 150 mm < diameter ≤ 450 mm		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC24	450 < SEWER DIAMETER OR EQUIVALENT ≤ 900 MM	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers with 450 mm < diameter ≤ 900 mm		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC25	900 < SEWER DIAMETER OR EQUIVALENT ≤ 1200 MM	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers with 900 mm < diameter ≤ 1200 mm		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC26	1200 < SEWER DIAMETER OR EQUIVALENT ≤ 2200 MM	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers with 1200 mm < diameter ≤ 2200 mm		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC27	SEWER DIAMETER OR EQUIVALENT > 2200 MM	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers with diameter > 2200 mm		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC28	UNKNOWN DIAMETER	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers with unknown diameters		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC29	SEWERS LAID AFTER 1995	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers laid after 1995 inclusive		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC30	SEWERS LAID BETWEEN 1985 AND 1994 INCLUSIVE	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers laid between 1985 and 1994 inclusive		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC31	SEWERS LAID BETWEEN 1975 AND 1984 INCLUSIVE	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers between 1975 and 1984 inclusive		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC32	SEWERS LAID BETWEEN 1950 AND 1974 INCLUSIVE	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers between 1950 and 1974 inclusive		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC33	SEWERS LAID BETWEEN 1925 AND 1949 INCLUSIVE	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers laid between 1925 and 1949 inclusive		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC34	SEWERS LAID BEFORE 1925	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers laid before 1925		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC35	UNKNOWN AGE SEWERS	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of unknown age sewers		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC36	SEWERS LOCATED UNDER FLEXIBLE ROADWAY	
UNIT OF EXPRESSION: **Code UFR**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES:
DEFINITION: Sewer located under flexible roadway		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC37	SEWERS LOCAT UNDER RIGID ROADWAY	
UNIT OF EXPRESSION: **Code URR**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES:
DEFINITION: Sewer located under rigid roadway		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC38	SEWERS LOCAT UNDER SIDEWALK	
UNIT OF EXPRESSION: **Code USW**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES:
DEFINITION: Sewer located under sidewalk		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC39	SEWERS LOCAT UNDER GREEN AREAS	
UNIT OF EXPRESSION: **Code UGA**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES:
DEFINITION: Sewer located under green areas		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC40	SEWERS INSTALLATION DEPTH	
UNIT OF EXPRESSION: **m**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Average sewers installation depth from the pavement to the crown of the sewer (pipe crown is the top of the sewer / external; the top of the sewer inside the pipe is termed ‘soffit’).		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC41	SEWERS TRENCH WIDTH	
UNIT OF EXPRESSION: **m**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Sewer trench installation width		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC42	BEDDING SOIL TYPE (CATEGORIES TO BE DEFINED)	
UNIT OF EXPRESSION: **Alphanumeric**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES:
DEFINITION: Soil type where the sewer is bedded according to categories to be defined		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC43	BACKFILLING SOIL TYPE (CATEGORIES TO BE DEFINED)	
UNIT OF EXPRESSION: **Alphanumeric**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES:
DEFINITION: Soil type backfilling the sewer according to categories to be defined		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC44	AVERAGE CLOSENESS TO TREES	
UNIT OF EXPRESSION: **m**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Average distance between the sewers and the trees		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC45	RIGID JOINTS	
UNIT OF EXPRESSION: **Code RJ**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES:
DEFINITION: Sewer with rigid joints		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sC46	FLEXIBLE JOINTS	
UNIT OF EXPRESSION: **Code FJ**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES:
DEFINITION: Sewer with flexible joints		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS:		USED FOR VARIABLES: *none*

sC47	SURCHARGED SEWERS IN DRY WEATHER	
UNIT OF EXPRESSION: **m**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewer where surcharging has occurred in dry weather, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *sPh1*		USED FOR VARIABLES: *none*

sC48	SURCHARGED SEWERS IN WET WEATHER	
UNIT OF EXPRESSION: **m**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewer where surcharging has occurred in wet weather, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *sPh2*		USED FOR VARIABLES: *none*

sC49	HIGHLY SURCHARGED SEWERS	
UNIT OF EXPRESSION: **m**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewer where high degree of surcharging has occurred in wet weather.		
PROCESSING RULE: Input data		
COMMENT: High degree surcharging means water at least 0.5 m above the pipe crown (pipe crown is the top of the sewer / external; the top of the sewer inside the pipe is termed 'soffit'). Service connections excluded.		
USED FOR INDICATORS: *sPh3*	USED FOR VARIABLES: *none*	

sC50	OVERFLOW DEVICES	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of overflow devices in the sewer system, at the reference date.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sEn1, sEn2, sEn3*	USED FOR VARIABLES: *none*	

sC51	MANHOLE CHAMBERS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of manhole chambers in the sewer system at the reference date.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sOp5*	USED FOR VARIABLES: *none*	

sC52	GULLY POTS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of gully pots in the sewer system at the reference date.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC53	CONNECTED PROPERTIES	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of properties connected to the sewer system managed by the undertaking, at the reference date.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sQS1, sQS2, sQS3, sQS4*	USED FOR VARIABLES: *none*	

sC54	SERVICE CONNECTIONS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Total number of service connections at the reference date.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sOp6*	USED FOR VARIABLES: *none*	

sC55	DOMESTIC CONNECTIONS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of service connections from residential properties/buildings		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC56	INDUSTRIAL CONNECTIONS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of service connections from industrial facilities without industrial pre-treatment		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC57	STORAGE TANKS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of storage tanks (in or off line) in the sewer system at the reference date.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC58	TOTAL STORAGE VOLUME	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total volume of storage tanks (in or off line) in the sewer system		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC59	SEWER SYSTEM PUMPING STATIONS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Total number of sewer system pumping stations at the reference date.		
PROCESSING RULE: Input data		
COMMENT: This variable does not include pumping stations in wastewater treatment plants.		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC60	PUMPED WASTEWATER	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Annual volume of pumped wastewater		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC61	INFORMATION TECHNOLOGY FOR INSPECTION	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES:
DEFINITION: Routine use of IT to support inspection activities (specify CCTV, when applicable)		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC62	INFORMATION TECHNOLOGY FOR MAINTENANCE	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES:
DEFINITION: Routine use of IT to support maintenance activities		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC63	INFORMATION TECHNOLOGY FOR CUSTOMER COMPLAINTS	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES:
DEFINITION: Routine use of IT to support customer service quality and network performance appraisal		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC64	INFORMATION TECHNOLOGY FOR UPDATED MAPPING	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of mapped sewers with a capture tolerance compatible to a scale 400 p.p.m. / total sewer length		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sC65	DIGITAL MAPPING	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of digitised sewers with a capture tolerance compatible to a scale 400 p.p.m. / total sewer length		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

OPERATIONAL DATA

sD1	SEWER CLEANING	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers cleaned for prevention of clogging and blockage during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Sewer cleaning refers to actions under proactive management strategy. Root cutting shall be included. Curative cleaning due to blockage is reflected in sOp11.		
USED FOR INDICATORS: *sOp1*	USED FOR VARIABLES: *none*	

sD2	SEWER REHABILITATION	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewers rehabilitated or renewed during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: This variable includes not only sD3 and sD4 but also the length of sewers rehabilitated with other techniques. For the assessment of this variable, only the length of defect shall be considered.		
USED FOR INDICATORS: *sOp2*	USED FOR VARIABLES: *none*	

sD3	SEWER RENOVATION	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Length of sewer renovated (e.g. relined) during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *sOp3*	USED FOR VARIABLES: *none*	

sD4	SEWER REPLACEMENT	
UNIT OF EXPRESSION: **km**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Sewer length replaced (or renewed) during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Service connections excluded.		
USED FOR INDICATORS: *sOp4*	USED FOR VARIABLES: *none*	

sD5	MANHOLE CHAMBER REPLACEMENT, RENEWAL, RENOVATION OR REPAIR	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of manhole chambers replaced, renewed, renovated or repaired during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sOp5*		USED FOR VARIABLES: *none*

sD6	REPLACEMENT OF MANHOLE COVERS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: (Number of manhole covers replaced during the assessment period		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*		USED FOR VARIABLES: *none*

sD7	SERVICE CONNECTION REPLACEMENT OR RENEWAL	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of service connections replaced or renewed during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sOp6*		USED FOR VARIABLES: *none*

sD8	INFLOW VOLUME	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Volume of water entering sewers from wrong connections during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Wrong connections include incorrect connections to the sewer system (e.g. direct surface runoff and entry through manhole covers to sanitary sewers).		
USED FOR INDICATORS: *sOp7, sOp8*		USED FOR VARIABLES: *none*

sD9	INFILTRATION VOLUME	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Volume of water entering sewers from groundwater during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sOp7, sOp9*		USED FOR VARIABLES: *none*

sD10	EXFILTRATION VOLUME	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Volume of leakage from sewers into the ground during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sOp7, sOp10*		USED FOR VARIABLES: *none*

sD11	SEWER BLOCKAGES	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of blockages that occured in sewers during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Pumping station blockages shall not be included. Include blockages in service connections only where these are the responsibility of the wastewater undertaking.		
USED FOR INDICATORS: *sOp11*	USED FOR VARIABLES: *none*	

sD12	SEWER BLOCKAGE LOCATIONS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of individual locations in sewers where blockages occured during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Locations where frequent blockages occured shall only be accounted once; pumping station blockages shall not be included. Include blockage locations in service connections only where these are the responsibility of the wastewater undertaking.		
USED FOR INDICATORS: *sOp12*	USED FOR VARIABLES: *none*	

sD13	REPEAT SEWER BLOCKAGE LOCATIONS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of individual locations in sewers where repeat blockages occured during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Locations where frequent blockages occured shall only be accounted once; pumping station blockages shall not be included. Include blockage locations in service connections only where these are the responsibility of the wastewater undertaking.		
USED FOR INDICATORS: *sOp13*	USED FOR VARIABLES: *none*	

sD14	PUMPING STATION BLOCKAGES	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of blockages that occured in pumping stations during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Pumping station blockages include blockages in pumps and valves. Sewer blockages shall not be included. If blockages occur more than once in a pumping station, this shall be accounted for as many times as the number of blockages.		
USED FOR INDICATORS: *sOp14*	USED FOR VARIABLES: *none*	

sD15	FLOODINGS FROM SANITARY OR COMBINED SEWERS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of sanitary floodings that occured during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Include only incidents related to sanitary or combined sewers that are the responsibility of the wastewater undertaking.		
USED FOR INDICATORS: *sOp15*	USED FOR VARIABLES: *none*	

sD16	FLOODING LOCATIONS FROM SANITARY OR COMBINED SEWERS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of flooding locations in sanitary or combined sewers during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Include only incidents related to sanitary or combined sewers that are the responsibility of the wastewater undertaking.		
USED FOR INDICATORS: *sOp16*	USED FOR VARIABLES: *none*	

sD17	REPEAT FLOODING LOCATIONS FROM SANITARY OR COMBINED SEWERS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of repeat flooding locations in sanitary or combined sewers during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Include only incidents related to sanitary or combined sewers that are the responsibility of the wastewater undertaking.		
USED FOR INDICATORS: *sOp17*	USED FOR VARIABLES: *none*	

sD18	SURFACE FLOODINGS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of surface floodings that occured during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: These include only surface flooding due to inadequacy of storm drainage system (combined sewers included) that is the responsibility of the wastewater undertaking. Inadequacy relates to all causes (e.g. design, operation, etc.).		
USED FOR INDICATORS: *sOp18*	USED FOR VARIABLES: *none*	

sD19	SEWER COLLAPSES	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of sewer collapses that occured during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: Does not include collapses on sewer connections.		
USED FOR INDICATORS: *sOp19*	USED FOR VARIABLES: *none*	

DEMOGRAPHY (AND CUSTOMER) DATA

sE1	RESIDENT POPULATION	
UNIT OF EXPRESSION: **Inhab.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Total population living permanently in the area that is the responsibility of the wastewater undertaking, at the reference date.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sQS5, sQS6, sQS7, sQS8*		USED FOR VARIABLES: *none*

sE2	RESIDENT POPULATION CONNECTED TO SE	
UNIT OF EXPRESSION: **Inhab.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Resident population connected to the sewer systems managed by the undertaking, at the reference date.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *This variable is used in the indicators sFi1, sFi2, sFi3, sFi4 when the costs are referred to inhabitants*		USED FOR VARIABLES: *none*

sE3	RESIDENT POPULATION SERVED BY ON-SITE SYSTEMS	
UNIT OF EXPRESSION: **Inhab.**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Resident population served by on-site systems managed by the undertaking (e.g. septic tanks, reed beds)		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS:		USED FOR VARIABLES: *none*

sE4	COLLECTED SEWAGE	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Collected sewage by the sewer system.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sOp7*	USED FOR VARIABLES: *none*	

sE5	INDUSTRIAL WASTEWATER	
UNIT OF EXPRESSION: **m3**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 1
DEFINITION: Volume of collected industrial wastewater, during the assessment period		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

QUALITY OF SERVICE DATA

sF1	DRY WEATHER FLOODING OF PROPERTIES FROM SANITARY SEWERS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of properties affected by flooding from sanitary sewers in dry weather, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sQS1*	USED FOR VARIABLES: *none*	

sF2	WET WEATHER FLOODING OF PROPERTIES FROM SANITARY SEWERS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of properties affected by flooding from sanitary sewers in wet weather, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sQS2*		USED FOR VARIABLES: *none*

sF3	WET WEATHER SURFACE FLOODING OF PROPERTIES	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of properties affected by surface flooding in wet weather, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sQS3*		USED FOR VARIABLES: *none*

sF4	WASTEWATER SERVICE INTERRUPTIONS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Sum, for the assessment period, of the number of properties affected by service interruption multiplied by the respective duration of interruptions in hours.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sQS4*		USED FOR VARIABLES: *none*

sF5	BLOCKAGE COMPLAINTS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of complaints as a result of blockages, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: This variable includes all direct, telephone, and written complaints related to blockages.		
USED FOR INDICATORS: *sQS5*	USED FOR VARIABLES: *none*	

sF6	FLOODING COMPLAINTS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of complaints as a result of flooding, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: This variable includes all direct, telephone, and written complaints related to flooding occurences.		
USED FOR INDICATORS: *sQS6*	USED FOR VARIABLES: *none*	

sF7	POLLUTION COMPLAINTS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of complaints as a result of pollution incidents, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: This variable includes all direct, telephone, and written complaints related to pollution incidents.		
USED FOR INDICATORS: *sQS7*	USED FOR VARIABLES: *none*	

sF8	ODOUR COMPLAINTS	
UNIT OF EXPRESSION: **Nº**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Number of complaints as a result of odours, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT: This variable includes all direct, telephone, and written complaints related to odours.		
USED FOR INDICATORS: *sQS8*	USED FOR VARIABLES: *none*	

ECONOMIC AND FINANCIAL DATA

sG1	TOTAL COSTS	
UNIT OF EXPRESSION: **€**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total costs, including capital and running costs, regarding the wastewater service, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sFi1*	USED FOR VARIABLES: *none*	

sG2	EXTERNAL SERVICES COSTS	
UNIT OF EXPRESSION: **€**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: The net value (obtained by negative apportionment of related capitalised costs of self-constructed assets) of total costs of external services (i.e. outsourcing), external manpower costs included, regarding the wastewater service, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *none*	USED FOR VARIABLES: *none*	

sG3	RUNNING COSTS	
UNIT OF EXPRESSION: €	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total operation and maintenance costs and internal manpower costs, excluding the capitalised costs of self-constructed assets, regarding the wastewater service, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sFi2*		USED FOR VARIABLES: *none*

sG4	RUNNING COST FOR MAINTENANCE, CLEANING AND REPAIR	
UNIT OF EXPRESSION: €	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Part of the total running costs related to maintenance, cleaning and repair , during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sFi3*		USED FOR VARIABLES: *sG3*

sG5	INVESTMENT IN TANGIBLE ASSETS	
UNIT OF EXPRESSION: €	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total cost of the investments in tangible assets (expenditures for sewers, treatment plants and equipment), including capitalised cost of self-constructed tangible assets, regarding the wastewater service, during the assessment period.		
PROCESSING RULE: Input data or sG5=sG6+sG7		
COMMENT:		
USED FOR INDICATORS: *sFi4, sFi5, sFi6*		USED FOR VARIABLES: *none*

sG6	INVESTMENTS FOR NEW ASSETS AND REINFORCEMENT OF EXISTING ASSETS	
UNIT OF EXPRESSION: €	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total cost of the investments in tangible assets that constitute a new development for the service (new assets and reinforcement of existing assets), including capitalised cost of self-construction, regarding the wastewater service		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sFi5*	USED FOR VARIABLES: *sG5*	

sG7	INVESTMENTS FOR ASSETS REPLACEMENT AND RENOVATION	
UNIT OF EXPRESSION: €	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: >= 0
DEFINITION: Total cost of the investments related to the replacement and renovation of existing assets (“like for like”, i.e., maintaining approximately the same functionality of existing infrastructure), including capitalised cost of self-construction (apportionment of as for related to the refurbishment or replacement of tangible assets), regarding the wastewater service, during the assessment period.		
PROCESSING RULE: Input data		
COMMENT:		
USED FOR INDICATORS: *sFi6*	USED FOR VARIABLES: *sG5*	

TIME DATA

sH1	ASSESSMENT PERIOD	
UNIT OF EXPRESSION: **days**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy	VALID VALUES: Integer
DEFINITION: Period of time adopted for the assessment of data (variables, PI and CI).		
PROCESSING RULE: Input data		
COMMENT: The CARE-S Rehab PIs aim to be assessed annually and therefore it is highly recommended that the year is used as the reference assessment period. However, since the undertakings may need to track the evolution of their performance within the year, the PI system is prepared to accommodate other assessment periods for most indicators. In this case, and in order to ensure unit coherence and allow for PI comparison, all the PI expressed in terms of time are formulated in such a way that the values calculated for other assessment periods are converted into annual values. Attention is drawn to the fact that the behaviour of most variables is not uniform during the year, due to random or seasonal effects, or to activity planning. All comparisons based on PI assessed from non-annual data must take this fact into consideration, in order to avoid any bias.		
USED FOR INDICATORS: *sEn1, sEn2, sEn3, sEn5, sOp1, sOp2, sOp3, sOp4, sOp5, sOp6, sOp8, sOp9, sOp10, sOp11, sOp12, sOp13, sOp14, sOp15, sOp16, sOp17, sOp18, sOp19, sQS1, sQS2, sQS3, sQS4, sQS5, sQS6, sQS7, sQS8, sFi1, sFi2, sFi3, sFi4*		USED FOR VARIABLES: *none*

Appendix 10

Detailed list of selected External Information for rehabilitation

DEMOGRAPHY AND ECONOMICS

POPULATION DENSITY	
UNIT OF EXPRESSION: **Inhab./km2**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Resident population / area that is the responsibility of the wastewater undertaking	
COMMENT:	

CURRENT POPULATION GROWTH RATE	
UNIT OF EXPRESSION: **% per year**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: (Population variation during the last ten years / population in first year of this period x 10)	
COMMENT: In fast growing areas a 5-year period should be adopted.	

GROSS NATIONAL PRODUCT PER CAPITA	
UNIT OF EXPRESSION: **€ per capita/year**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Gross National Product / total country population	
COMMENT: Use the official figure.	

INFLATION RATE	
UNIT OF EXPRESSION: **%/year**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Annual percentage change in consumer price index in the country	
COMMENT: Use the official figure.	

ENVIRONMENT

AVERAGE YEARLY RAINFALL	
UNIT OF EXPRESSION: **mm/year**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Yearly average rainfall	
COMMENT: Provide the average figures over the past 30 years or the longest continuous period. These statistics relate to the area of service with the wastewater system area.	

MAXIMUM YEARLY RAINFALL	
UNIT OF EXPRESSION: **mm/year**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Yearly maximum rainfall assessed as the annual maximum	
COMMENT: Provide the average figures over the past 30 years or the longest continuous period. These statistics relate to the area of service with the wastewater system area.	

MINIMUM YEARLY RAINFALL	
UNIT OF EXPRESSION: **mm/year**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Yearly minimum rainfall assessed as the annual minimum	
COMMENT: Provide the average figures over the past 30 years or the longest continuous period. These statistics relate to the area of service with the wastewater system area.	

AVAILABILITY OF LOCAL STATISTICAL DATA FOR SHORT DURATION RAINFALL	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION:	
COMMENT: (If "Yes", answer the two following items)	

10 MIN DURATION RAINFALL , 10 YEAR RETURN PERIOD	
UNIT OF EXPRESSION: **mm/year**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Maximum intensity for 10 min duration and 10 year return period (value obtained from IDF curves)	
COMMENT: Based on the longest time series available	

60 MIN DURATION RAINFALL, 10 YEAR RETURN PERIOD	
UNIT OF EXPRESSION: **mm/year**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Maximum intensity for 60 min duration and 10 year return period (value obtained from IDF curves)	
COMMENT: Based on the longest time series available	

DAILY AVERAGE AIR TEMPERATURE	
UNIT OF EXPRESSION: **ºC**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Daily average air temperature of the year	
COMMENT: Give the average over the past 30 years or the longest continuous period.	

DAILY MAXIMUM AIR TEMPERATURE	
UNIT OF EXPRESSION: **ºC**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Average air temperature for the hottest day of the year	
COMMENT: Give the average over the past 30 years or the longest continuous period.	

DAILY MINIMUM AIR TEMPERATURE	
UNIT OF EXPRESSION: **ºC**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Average air temperature for the coldest day of the year	
COMMENT: Give the average over the past 30 years or the longest continuous period.	

MAXIMUM ALTITUDE	
UNIT OF EXPRESSION: **m**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Maximum elevation above sea level within the wastewater system area that is the responsibility of the wastewater undertaking	
COMMENT:	

MINIMUM ALTITUDE	
UNIT OF EXPRESSION: **m**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Minimum elevation above sea level within the wastewater system area that is the responsibility of the wastewater undertaking	
COMMENT:	

RECEIVING BODIES - OCEAN	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION:	
COMMENT:	

RECEIVING BODIES - ESTUARIES, BAYS AND OTHER COASTAL WATERS	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION:	
COMMENT:	

RECEIVING BODIES - RIVERS	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION:	
COMMENT:	

RECEIVING BODIES - STREAMS	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION:	
COMMENT:	

RECEIVING BODIES - LAKES, PONDS, RESERVOIRS OR CLOSED BAYS	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION:	
COMMENT:	

RECEIVING BODIES - WETLANDS	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION:	
COMMENT:	

RECEIVING BODIES - SOIL	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION:	
COMMENT:	

SPECIAL PROTECTED AREAS	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION:	
COMMENT:	

SPECIAL PROTECTED AREA	
UNIT OF EXPRESSION: **km2**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: If “yes”, total area classified as special protected area	
COMMENT:	

SEWER SYSTEM AGRESSIVE FACTORS

Geotechnical Conditions

SEWER SEAT STABILITY	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Existence of good seat stability conditions of the soil below the sewers	
COMMENT:	

Seismic Conditions

MAXIMUM SOIL MOVEMENT DUE TO SOIL LIQUEFACTION	
UNIT OF EXPRESSION: **mm**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Forecasted maximum soil movement due to soil liquefaction in seismic conditions	
COMMENT:	

MAXIMUM ANGULAR DEFLECTION IN JOINTS	
UNIT OF EXPRESSION: **°**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Forecasted maximum angular deflection in pipe joints in seismic conditions	
COMMENT:	

MAXIMUM AXIAL DISPLACEMENT IN JOINTS	
UNIT OF EXPRESSION: **mm**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Forecasted maximum axial displacement in pipe joints in seismic conditions	
COMMENT:	

Traffic Class

HIGH VOLUME	
UNIT OF EXPRESSION: **code HV**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Heavy traffic conditions in the pavement above the pipes	
COMMENT:	

NORMAL VOLUME	
UNIT OF EXPRESSION: **code NV**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Normal traffic conditions in the pavement above the pipes (Average Daily Traffic of Comercial Vehicles between 50 and 2000)	
COMMENT:	

LOW VOLUME	
UNIT OF EXPRESSION: **code LV**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Light traffic conditions in the pavement above the pipes (Average Daily Traffic of Comercial Vehicles below 50)	
COMMENT:	

Interference with other infrastructures

RISK TO BE AFFECTED BY OTHER INFRASTRUCTURES WORKS	
UNIT OF EXPRESSION: **yes/no**	PERIOD: *[dd.mm]*.yy-1 – *[dd.mm]*.yy
DEFINITION: Significant risk of the pipes to be affected by other infrastructures works	
COMMENT:	

Appendix 11

Draft of Glossary of Technical Terms (2nd version)

Aquifer → Water-bearing stratum within the earth's crust [EN 752-1][2].

Backdrop manhole → Manhole with a connection, by means of a vertical pipe, at or just above invert, from a drain or sewer at a higher level [EN 752-1].

Backwater level → Sewerage level predicted or occurring in a drain or sewer system upstream of a given control section [EN 752-1].

Base flow → Sustained or dry-weather flows not directly generated by rainfall. It commonly constitutes flows generated by domestic and industrial discharge and also infiltration.

Benching → Near horizontal surface adjacent to the channel in a manhole or inspection chamber, or large sewer [EN 13508-2]

Branch (of a sewer network): → A number of pipes connected in series that form part of a sewerage system [DGSHERS 2002][3].

Catchment area → Area draining to a drain, sewer or watercourse [EN 752-1].

CCTV → Closed circuit television [SRM 2001][4].

Chamber → Part of a manhole or inspection chamber providing working space above channel [EN 13508-2]

Chamber unit → Component part of a manhole or inspection chamber manufactured as a single entity to be joined with other chamber units [EN 13508-2]

Cleaning ball → Spherical device, having an indented surface, designed to be carried through a drain or sewer by the flow to facilitate removal of sediments [EN 752-1].

[2] EN752-1 (1995) – Drain and sewers outside buildings – Part 1: Generalities and definitions
[3] DGSHERS – Development of Guidelines for the Structural, Hydraulic and Environmental Rehabilitation of Sewers. http://www.hi.ihe.nl/srguide/een_frame.html (2002)
[4] WRc - Sewerage Rehabilitation Manual – Part 2 (2001)

Close-fit → Situation of the installed pipe, such that an interference fit may be created between the outside of the pipe and the inside of the existing pipe, allowing only an annulus resulting from shrinkage and tolerances [DGSHERS 2002]

Collection system → In waste water, a system of conduits, generally underground pipes, which receives and conveys sanitary waste water and/or storm water [DGSHERS 2002]

Combined sewer overflow; stormwater overflow → Device, on a combined or partially separate sewer system or at a sewage treatment works that relieves the system of excess flow [EN 752-1].

Combined system → Sewer system designed to carry both wastewater and surface water in the same pipeline(s) [EN 752-1].

Common trench → Trench in which more than one pipe is located [EN 752-1].

Confined space → Space with restricted ventilation where special safety precautions may need to be taken [EN 752-1].

Connection → General term used for the location at which one pipeline joins another pipeline or a manhole inspection chamber [EN 13508-2]

Control section → Section of a drain or sewer system where hydraulic conditions are known and where any change in those conditions influences the upstream and/or downstream water levels [EN 752-1].

Cracks → Crack lines visible along the length and/or circumference [SRM 2001].

Critical sewer → Sewers with the most significant consequences in the event of structural failure [SRM 2001].

Detention tank → Tank or reservoir for the temporary storage of sewage [EN 752-1].

Domestic wastewater → Wastewater discharged from kitchens, laundry rooms, lavatories, bathrooms, toilets and similar facilities [EN 752-1].

Drain → Pipeline, usually underground, designed to carry wastewater and/or surface water from a source to a sewer [EN 752-1].

Drain system → Network of pipelines and ancillary works that conveys wastewater and/or surface water to a cesspool, sewer system or other place of disposal [EN 752-1].

Drainage service → Natural or artificial system for the draining of a catchment area [EN 752-1].

Dry weather flow → Rate of flow in a drain or sewer system in specified dry weather conditions [EN 752-1].

Dry well → Dry chamber forming part of a pumping station and containing pumping equipment, normally used in conjunction with a wet well [DGSHERS 2002]

Element → Component or group of components of a drain or sewer system which form a structural entity. For example a length of sewer between two manholes, a manhole or an inspection chamber [DGSHERS 2002]

Employing authority → Organisation which owns or is responsible for the inspection of a drain or sewer system [DGSHERS 2002]

Exfiltration → Escape of sewage (flow) from a drain or sewer system into surrounding ground [EN 752-1].

Extraneous water → Unwanted flow in a drain or sewer system [EN 752-1].

Flooding → Condition where wastewater and/or surface water escapes from or cannot enter a drain or sewer system and either lies on the surface or enters buildings (see also surface flooding) [EN 752-1].

Flow Attenuation → The process of reducing the peak flow rate in a sewer system by redistributing the same volume of flow over a longer period of time [SRM 2001].

Flow Reduction → The process of decreasing flows into a sewer system or removing a proportion of the flow already in a sewer system

[SRM 2001].

Flow simulation → Modeling of flows in drain or sewer systems [EN 752-1].

Flow survey (sewers) → Collection of data of the hydraulic behaviour of the network at a series of selected pints. Ultrasonic flow gauges are usually used. Rain gauges are also used if flow response to rainfall is being collected [DGSHERS 2002].

Flushing → Use of a temporary substantially increased flow to facilitate removal of obstructions or sediments from drains or sewers [EN 752-7[5]].

Fractures → Cracks visibly open along the length and/or circumference with the pieces still in place [SRM 2001].

Gradient → Ratio between the vertical and the horizontal projections of a pipe length [EN 752-1].

Gravity system → Drain or sewer system where flow is caused by the force of gravity and where the pipeline is designed normally to operate partially full [EN 752-1].

Gross solids → Solids, usually organic in nature, either floating, suspended or deposited which have a polluting effect on the receiving water. Often restricted to visible solids with one dimension greater than 25mm [DGSHERS 2002].

Groundwater → Water present in the sub-surface strata [EN 752-1].

Grouting → Process of filling voids around the lining system.

Gully → A structure to permit the entry of surface runoff into the sewer system.

It is usually fitted with a grating and a grit trap

Infiltration → Ingress of groundwater into a drain or sewer system [EN 752-1].

[5] EN752-7 (1998) – Drain and sewers outside buildings – Part 7: Maintenance and Operations

Inlet → (1) A connection between the catchment area and a drain or sewer for the admission of surface or storm water

(2) A structure at the entrance end of a conduit

(3) The upstream end of any structure through which water may flow [DGSHERS 2002].

Inspection chamber → Chamber with a removable cover constructed on a drain or sewer that provides access from surface level only, but does not permit entry of a person [EN 752-1].

Invert → Lowest point of the internal surface of the barrel of a pipe or channel at any cross section [EN476:1997].

Inverted siphon → Length of gravity drain or sewer that is lower than upstream or downstream lengths to allow the pipeline to pass below an obstacle, and which consequently operates under pressure [EN 752-1].

Jetting → Use of high pressure water jetting equipment to facilitate removal of obstructions or sediments from drains or sewers.

Joint → Location at which the ends of two adjacent pipe units are joined together longitudinally [EN 13508-2]

Junction → Connection made using a prefabricated junction pipe unit [EN 13508-2]

Landing → Intermediate rest platform used to limit the height of a run of steps in manhole [EN 13508-2]

Lateral → Any pipe connected to a sewer [DGSHERS 2002].

Liner → Lining pipe after installation [DGSHERS 2002].

Lining pipe → Pipe to be inserted for renovation purposes [DGSHERS 2002].

Lining system → Lining pipe and all relevant fittings for insertion into an existing pipeline for the purposes of renovation [DGSHERS 2002].

Maintenance → Routine work undertaken to ensure the continuing performance of drain and sewer systems [EN 752-1].

Manhole → Chamber with a removable cover constructed on a drain or sewer to permit entry by personnel [EN 752-1].

Node → Manhole, inspection chamber, outfall, rodding eye or other significant intermediate point [EN 13508-2]

Outfall → Final length of pipeline from which sewage is discharged to a treatment works or receiving water [EN 752-1].

Overflow → The intentional or unintentional discharge of sewage to the environment prior to treatment.

Partially separate system → A sewer system, normally of two pipelines, where one pipeline carries wastewater together with a designed volume of surface water and the other pipeline carries the balance of the surface water [EN 752-1].

Pipe unit → Component part of a drain or sewer manufactured as a single entity and intended to be joined with other pipe units [EN 13508-2]

Pipe unit length → Length of a manufactured pipe unit used in the construction of a pipeline [EN 13508-2]

Pipeline → Assembly of pipes, fittings, masonry and in situ concrete units and joints between manholes or other structures [EN 13508-2]

Pipeline length → Continuous section of drain or sewer between two adjacent nodes [EN 13508-2]

Pumping installation → Pumping station together with any associated rising main(s) [EN 752-7].

Pumping station → Building, structures and equipment used to transfer sewage through a rising main or otherwise to raise the sewage [EN 752-7].

Ramp manhole → Manhole with a steeply inclined pipe or channel from a drain

or sewer at a higher level [EN 752-1].

Receiving water → Any body of water such as the sea, a river, stream or lake as well as an aquifer into which drain or sewer systems discharge [EN 752-1].

Rehabilitation → All measures for restoring or upgrading the performance of existing drain and sewer systems [EN 752-1].

Rehabilitation All aspects of upgrading the performance of existing sewer systems. Structural rehabilitation includes repair, renovation and renewal. Hydraulic rehabilitation covers replacement, reinforcement, flow reduction or attenuation and occasionally renovation [SRM 2001]

Reinforcement → The provision of an additional sewer, which in conjunction with an existing sewer increases overall flow capacity [SRM 2001].

Relevant authority → Organizations with appropriate statutory powers of control [EN 752-1].

Renewal → Construction of a new sewer, on or off the line of an existing sewer, the basic function and capacity of the new sewer being similar to those of the old [SRM 2001].

Renovation → Work incorporating all or part of the original fabric of the drain or sewer by means of which its current performance is improved [EN 752-5[6]].

Renovation → Methods by which the performance of a length of sewer is improved by incorporating the original sewer fabric, but excluding maintenance operations such as root or silt removal.[SRM 2001].

Repair → Rectification of local damage [EN 752-5].

Repair → Rectification of damage to the structural fabric of the sewer and the reconstruction of short lengths, but not the reconstruction of the whole of the pipeline [SRM 2001].

[6] EN752-5 (1997) – Drain and sewers outside buildings – Part 1: Rehabilitation

Replacement → Construction of a new drain or sewer, on or off the line of an existing drain or sewer, the function of the new drain or sewer incorporating that of the old [EN 752-5].

Replacement Construction of a new sewer, on or off the line of an existing sewer. The function of the new sewer will incorporate that of the old, but may also include improvement or development work [SRM 2001]

Rising main → Pipe through which sewage is pumped [EN 752-1].

Rodding → Use of appropriate device on the end of flexible rods to facilitate removal of obstructions (or sediments) from drains or sewers [EN 752-7].

Runoff → Water from precipitation which flows off a surface to reach a drain, sewer or receiving water [EN 752-1].

Runoff coefficient → Factor dependent on the ground catchment, and by which the rainwater quantity per unit of time is multiplied in order to indicate the flow expected to be carried to the drain or sewer system [EN 752-1].

Sanitary sewer → A sewer that carries liquid and water-borne wastes from residences, commercial buildings, industrial plants, and institutions, together with relatively small quantities of ground, storm, and surface waters that are not admitted intentionally [DGSHERS 2002].

Self-cleansing → Ability of the flow in a drain or sewer to carry away solid particles, which would otherwise be deposited in the pipe [EN 752-1].

Separate system → Sewer system, normally of two pipelines, one carrying wastewater and the other surface water [EN 752-1].

Septic sewage → Anaerobic sewage containing sulphides [EN 752-1].

Sewage → Wastewater and/or surface water conveyed by a drain or sewer [EN 752-1].

Sewer → Pipeline or other construction, usually underground, designed to carry wastewater and/or surface water from more than one source [EN 752-1].

Sewer system → Network of pipelines and ancillary works which conveys wastewater and/or surface water from drains to a treatment works or other place of disposal [EN 752-1].

Shaft → Upper part of a manhole or inspection chamber between the adjusting construction and the chamber

Siphon → A closed conduit, a portion of which lies above the hydraulic grade line, resulting in a pressure less than atmospheric and requiring a vacuum within the conduit to start flow. A siphon utilises atmospheric pressure to effect or increase the flow of water through the conduit [DGSHERS 2002].

Social costs → Costs incurred by society as a result of sewerage works and for which water service companies have no direct responsibility. These include unclaimed business losses due to road closures, and the cost of extended journey times due to traffic diversions [SRM 2001].

Soffit → The highest point on the internal bore of a pipe (opposite: invert).

Stakeholder → Individuals and organisations who share an interest in, and responsibility for, solving community problems or the operation of a company [DGSHERS 2002].

Structural condition → State of a drain or sewer in matters relating to the integrity of its fabric [EN 752-5].

Surcharge → Condition in which wastewater and/or surface water is held under pressure within a gravity drain or sewer system, but does not escape to the surface to cause flooding [EN 752-1].

Surface flooding → Condition where wastewater and/or surface water escapes from, or cannot enter, a drain or sewer system and either lies on the surface or enters buildings from the surface (see also

flooding) [EN 752-1].

Surface water → Water from precipitation, which has not seeped into the ground and which is discharged to the drain or sewer system directly from the ground or from exterior building surfaces [EN 752-1].

Tank sewer → Oversized sewer, which acts as a detention tank [EN 752-5].

Taper → Part of manhole or inspection chamber where the cross sectional area changes gradually [EN 13508-2]

Total cost → Aggregate cost of a scheme over its design life, being the sum of the construction, operating and maintenance costs all calculated at the same time base [EN 752-1].

Trade effluent → Wastewater discharge resulting wholly, or in part, from any industrial or commercial activity [EN 752-1].

Utility services → Services provided to customers and industry such as gas, electricity, telephone, cable TV and water [EN 752-1].

Vortex manhole → Circular manhole within which a large difference in level is accommodated by the sewage entering tangentially and descending helically [DGSHERS 2002].

Wastewater → Water changed by use and discharged to a drain or sewer system [EN 752-1].

Wet well → Chamber forming a part of a sewage pumping station into which sewage discharges prior to pumping. It can include submersible pumping equipment and pipework [DGSHERS 2002].

Winching → Use of a bucket or other device pulled through a drain or sewer to facilitate removal of sediments (or obstructions) [EN 752-7].

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Work Package 1, Task 1.1, Deliverable D1

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