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REMOVAL/EMISSION PREDICTIONS OF WASTEWATER TREATMENT FOR EXPOSURE ASSESSMENT AND PRTRS - SUMMARY AND COMPILATION OF RESPONSES FROM 2012 OECD SURVEY

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REMOVAL/EMISSION PREDICTIONS OF WASTEWATER TREATMENT FOR EXPOSURE ASSESSMENT AND PRTRS - SUMMARY AND COMPILATION OF RESPONSES FROM 2012 OECD SURVEY

IOMC
INTER-ORGANIZATION PROGRAMME FOR THE SOUND MANAGEMENT OF CHEMICALS
A cooperative agreement among FAO, ILO, UNDP, UNEP, UNIDO, UNITAR, WHO, World Bank and OECD

Environment Directorate
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
Paris 2014

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FOREWORD

At a joint meeting of the OECD Task Force for Exposure Assessment (TFEA) and the OECD Task Force for Pollutants Release and Transfer Registers (TFPRTR) held in October 2011, members agreed to launch a joint project to compile information on the current methodologies, tools and models used for estimating substance-specific removal/emissions from wastewater treatment systems. Canada, Japan, the Netherlands, the United States, and the European Chemicals Agency (ECHA) volunteered to participate in this project.

To support this project, a survey of members represented on both Task Forces was carried out in 2012. The key results of the survey - provided in detail in this report - include:

- the identification and descriptions of seven models used for regulatory assessment purposes (SimpleTreat, STPWIN, STP Model, WATER9, ASTreat, TOXCHEM and STP-EX);
- descriptions of issues associated with the use of these models;
- descriptions of various completed or on-going projects to address these issues; and
- a range of measured removal/emission data.

This information will help potential users identify appropriate models and methodologies for estimating substance-specific releases or removal from wastewater treatment systems, and could support efforts to improve these models and tools.

The document was reviewed and approved by the TFEA and the TFPRTR in November 2013. The Joint Meeting declassified the document in April 2014.

This document is published under the responsibility of the Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology of the OECD.

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1. BACKGROUND

Estimating substance-specific releases from wastewater treatment (WWT) systems is a challenging area due to the mixture of various substances from various sources, the different conditions of treatment systems and the diversity of treatment techniques. But, such estimates are important for the determination of substance-specific exposure in the environment, and this document has been developed to support such determinations.

Estimates of releases from WWT systems are needed for many Pollutant Release and Transfer Register (PRTR) systems. A PRTR is a national or regional environmental database or inventory of hazardous chemical substances and pollutants released to air, water and soil, and transferred off-site for treatment or disposal. Many cover wastewater treatment facilities.

Estimates of the removal of pollutants by wastewater treatment systems is also an important source of information that can be used to help improve the efficiency of such systems.

An emerging issues in this area is estimating releases or removal of micropollutants. "Micropollutants" is a term for substances that are released to and exist in the environment at very low concentrations and cause adverse effects on human health or the environment. There is an important need to assess exposures to such pollutants, which may originate from pharmaceauticals, pesticides, biocides, industrial chemicals or other chemical substances that are released into the environment. As there is a wide variety of micropollutants, applying estimation techniques of substance-specific releases or removal can be a practical step to support exposure assessments.

At a joint meeting of the OECD Task Force for Exposure Assessment (TFEA) and the OECD Task Force for Pollutants Release and Transfer Registers (TFPRTR) held in October, 2011, members agreed to launch a joint project to compile the current methodologies, tools and models used by members for estimating substance-specific removal/emissions from wastewater treatment systems. A team, led by Canada, and supported by Japan, the Netherlands, the United States, and the European Chemicals Agency (ECHA), has carried out this project.

The first task of the team was to develop a questionnaire to collect relevant information from member countries. The main objectives of this survey were to:

a) share experiences, information, and knowledge related to wastewater treatment removal/emission predictions between members of the TFEA and TFPRTR;

b) identify priority issues related to wastewater treatment removal/emission predictions from the different jurisdictions and programs; and

c) use the survey findings to inform the development of future projects related to improving/advancing the predictions of wastewater treatment removal/emissions.

The questionnaire was sent to TFEA and TFPRTR members in July, 2012 and all responses were received by the end of September, 2012. An initial summary of these responses was presented by Canada at the TFEA annual meeting from 5-7 October, 2012 in Budapest, Hungary. The presentation at the meeting was shared with the TFPRTR in 2012. The final report of the survey results (i.e., this report) was agreed by the TFEA at its 5th meeting on 14-15 November 2013 and by the TFPRTR at its 16th meeting on 18-19 November in 2013.

2. QUESTIONNAIRE

The questionnaire asked members of the task forces for the following types of information:

- methodologies used to estimate substance-specific removal/emissions from wastewater treatment systems;
- publically available tools and models for estimating substance-specific removal efficiency of wastewater treatment systems;
- other additional tools and models;
- priority issues and projects to estimate removal or emission of wastewater treatment systems;
- empirical data on wastewater treatment removal/emission and databases for these data; and
- information on biosolids or related data sources.

A copy of the questionnaire and a compilation of responses can be found in Appendices I and II, respectively.

Section 3 provides a summary of the responses provided by eight TFEA members, five TFPRTR members and two other respondents.

3 SUMMARY OF SURVEY RESPONSES

The survey identified two kinds of methodologies: 1) use of generic guidance documents such as emission scenario documents, and 2) use of empirical measurements such as use of OECD Test Guidelines.

Seven models were identified for regulatory uses (SimpleTreat, STPWIN, STP Model, WATER9, ASTreat, TOXCHEM and STP-EX).

The survey also identified the following priority issues: model input parameters (e.g. default parameters, biodegradation rate and solids-water partition coefficient), variability in wastewater treatment and model-difficult chemicals.

Twelve respondents have projects to collect data on emission/removal from the open literature monitoring projects/programmes or operating conditions of waste water treatment systems. Respondents also indicated that seven projects also collect data on the operating conditions of treatment systems.

The results from this survey can help a potential user identify an available methodology, model or data that can be used to estimate removal/emission from WWT systems, as well as identify possible activities that could improve estimations of removal/emissions from WWT systems or fill data gaps.

3.1 **Respondents**

Table 1 provides a list of the respondents to the survey along with their affiliated task forces. (Note: two respondents (the *French National Institute for Industrial Environment and Risks* and the *Water Industry Research at Plymouth University* in the United Kingdom) did not provide information on their affiliated taskforces.

Table 1. List of Survey Respondents

No	Respondent	Task Force	
		TFEA	TFPRTRs
1	AstraZeneca (BIAC*), United Kingdom	X	
2	Brussels instituut voor Milieubeheer, Brussels Capital Region, Belgium		X
3	Vlaamse Milieumaatschappij (VMM), Flemish Region, Belgium		X
4	Environment Canada and Health Canada, Canada	X	
5	Ministerio del Medio Ambiente, Chile		X
6	French National Institute for Industrial Environment and Risks (INERIS), France	--	--
7	National Institute of Health, Italy	X	
8	Ministry of the Environment, Japan		X
9	Climate and Pollution Agency (Klif), State of the Environment, Norway		X
10	Swedish Chemicals Agency, Sweden	X	
11	Unilever (BIAC), United Kingdom	X	
12	The National Institute for Public Health and the Environment (RIVM), the Netherlands	X	
13	USEPA**, Chemical Engineering Branch (CEB), United States	X	
14	USEPA, Exposure Assessment Branch (EAB), United States	X	
15	Water Industry Research at Plymouth University (BIAC), United Kingdom	--	--

*BIAC: The Business and Industry Advisory Committee.

** United States Environmental Protection Agency.

3.2 **Methodologies**

Part 2 of the survey focused on methodologies used to estimate chemical removal/emissions from wastewater treatment systems. Respondents listed methodologies that include the use of monitoring data, modelled data, guidance documents, and/or a combination of methods. The most frequently reported methods can be grouped into two general categories:

a. use of generic guidance documents (e.g. emission scenario documents, E-PRTR guidance document); or

b. use of empirical measurements from, for example:

i: lab-scale sewage treatment simulation tests (e.g. OECD Test Guideline 303);

ii: monitoring programs or projects in full-scale sewage treatment systems;

iii: treatability studies in the published literature; and

iv: respiration inhibition tests.

Despite some overlap in responses, in general, the responses varied greatly. As a result, it is recommended that the entire compilation of responses listed in Appendix II be consulted.

3.3 **Publically available tools and models**

Part 3 of the survey focused on the frequency of use of the following publicly available models for estimating efficiency of removal by wastewater treatment systems:

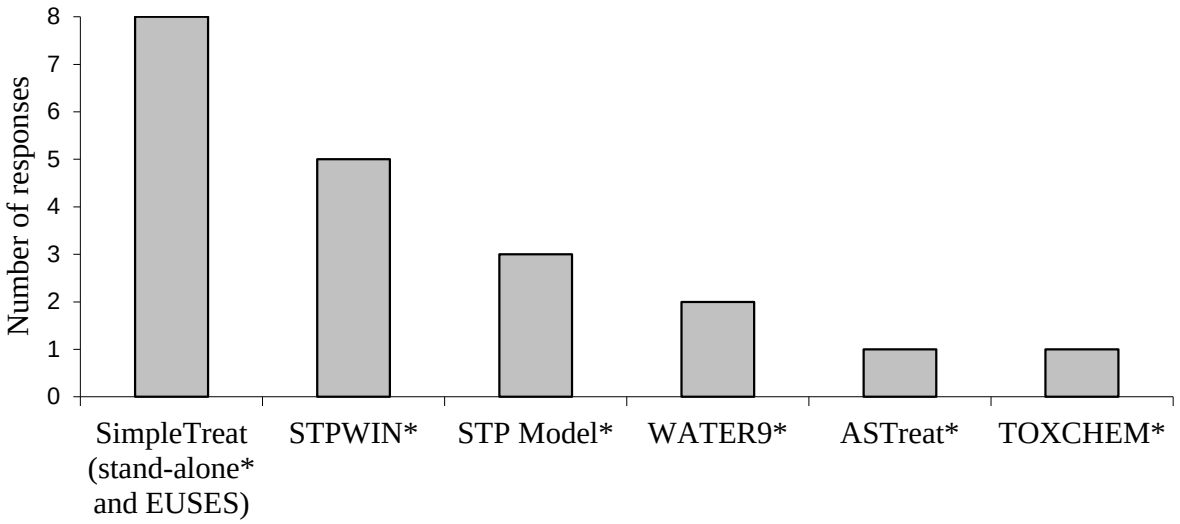
- SimpleTreat (stand-alone),
- SimpleTreat (part of EUSES),
- ASTreat,
- STP Model,
- STPWIN,
- TOXCHEM, and
- Water9.

(The responses to this question are summarized in Figure 1.)

Respondents were also asked to indicate if the default plant conditions in the models are used and if their organisation conducted any validation studies of these models.

Most respondents use empirical data (e.g. physical-chemical property data) for model inputs, and respondents generally modify the default parameters of the models (e.g. sludge retention time) to tailor the outputs to specific cases, however this is not universal.

Figure 1. Figure 1. Model usage by respondents.



The total number of respondents reporting model usage is 8. No TFPRTR member reported using any of the models. The asterisks represent models that were reported to have had validation studies conducted.

3.4 **Other tools and models**

Three additional tools and models (other than those described in Section 3.3) were reported to be used (or recommended) by the respondents (Table 2).

Table 2. Tools and models used or recommended other than those described in Section 3.3.

Model or Tool	Description
STP-EX	The model is developed by the University of Windsor, Canada, and is based on STP Model v2.11 (developed by Trent University, Canada). The model can estimate removal efficiencies for three types of treatment systems: primary, secondary and lagoons. The model also takes into consideration some ionizing properties of chemicals.
TEOTIL	Estimates the presence of phosphorous and nitrogen at distances from discharge points.
Mathematical relationship	Simple formula to estimate emission factors from Henry's Law constant and Kow.

Three respondents indicated they are developing models or are refining existing models:

- USEPA(CEB):
    - The CEB is in the process of examining treatment efficiency data provided in Toxic Release Inventory reports for reporting years 2004 through 2010. The CEB plans to

compile treatment efficiency data and potentially develop correlations based on certain types of treatment methods, industries, chemical groups, and geographical location.

Note: this response was reported in the survey under Section 3.6 “Data and databases” but is listed here as it relates to ‘tool development’.

- The Netherlands
  - The Netherlands is currently updating “SimpleTreat.” Areas of focus include enlarging and defining the applicability domain of the model, and developing new regressions for the estimation of sludge-water partitioning of ionisable substances. The Netherlands also reported on the development of a probabilistic spreadsheet version of the SimpleTreat model for a more realistic representation of the variability of raw sewage characteristics, STP design and operational parameters, and of the uncertainty of chemical input properties. The Netherlands has been collaborating with other organisations (e.g. with Unilever/BIAC) to refine specific calculation routines in SimpleTreat,.
  - In addition, the Netherlands (RIVM) and Germany (UBA) are collaborating to update SimpleTreat including in the above mentioned areas, and to develop additional guidance on how to apply SimpleTreat. They are considering adding relevant process descriptions for nano-particles.

3.5 **Issues and projects**

Respondents to part 5 of the survey identified priority issues related to six areas of wastewater treatment removal/emission predictions:

- model input parameters,
- municipal sewage treatment types,
- on-site industrial wastewater treatment types,
- variability and geographic distribution in wastewater treatment plant operations and conditions, chemical types, and
- other issues (i.e. that models may not be appropriate for all substances).

These issues are identified in Table 3. Furthermore, some respondents have on-going, completed or planned projects to address one or more of the issues identified (see table 4 in Annex for more information).

Table 3. Planned, ongoing or completed projects conducted by respondents* to address priority issues with estimating chemical removal/emissions from wastewater treatment systems

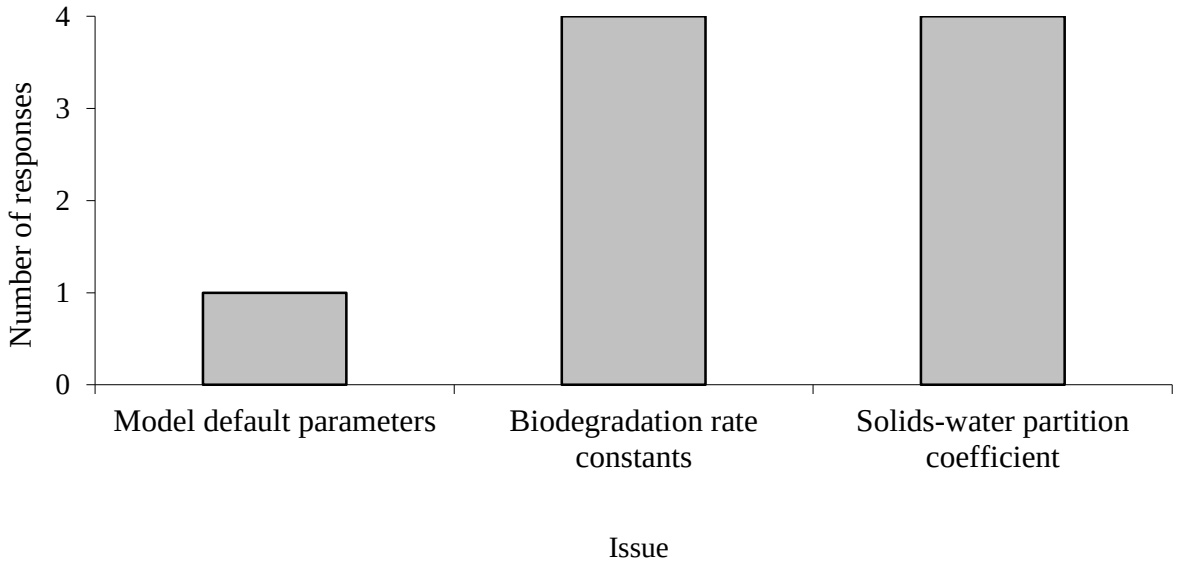
Priority issues concerning:	Project identified that addresses issue							
	AZ	Ca	NL	Se	UN	USEPA CEB	USEPA EAB	UK WIR
Model input parameters								
Model default parameters			X		X			
Biodegradation rate constants			X					
Solids-water partition coefficient			X		X			
Municipal sewage treatment type								
Variability of treatment types is not well represented in models		X	X		X			X
On-site industrial wastewater treatment types								
Knowledge of on-site treatment is poor				X		X		
Variability in wastewater treatment								
Difference in hydraulic retention time								
Difference in biological treatment	X							
Different operating conditions (e.g. temperature)			X		X			
Different removal rates for the same chemical								X
Chemical Types								
Antimicrobial compounds								
Complex substances								
Degradation products								
Ionizing substances	X		X		X			
Mixtures								
Nanoparticles			X					
Surfactants		X	X		X			
Pharmaceuticals				X				X
Polymers							X	
Other Issues								
Models may not be appropriate for all substances								

*AZ=AstraZeneca, Ca=Canada, NL=Netherlands with contributions from e.g. Unilever, Se=Sweden, USEPA CEB and EAB=Chemical Engineering Branch and Exposure Assessment Branch, respectively, at United States Environmental Protection Agency, UK WIR=Water Industry Research at Plymouth University in United Kingdom, UN=Unilever

3.5.1 *Model input parameters*

Figure 2 lists the number of responses for each of three main model input issues (model default parameters, biodegradation rate constants and solids-water partition coefficient).

Figure 2. Main issues identified by respondents related to model input parameters.



3.5.2 *Municipal sewage treatment types*

The primary issue with sewage treatment types identified by the respondents is the wide range of treatment types available and that this variability is not well represented in models. For example, models do not currently account for tertiary treatment units, lagoon systems, or biological treatments other than activated sludge. There may be other types of treatment processes that are also not accounted for in the models.

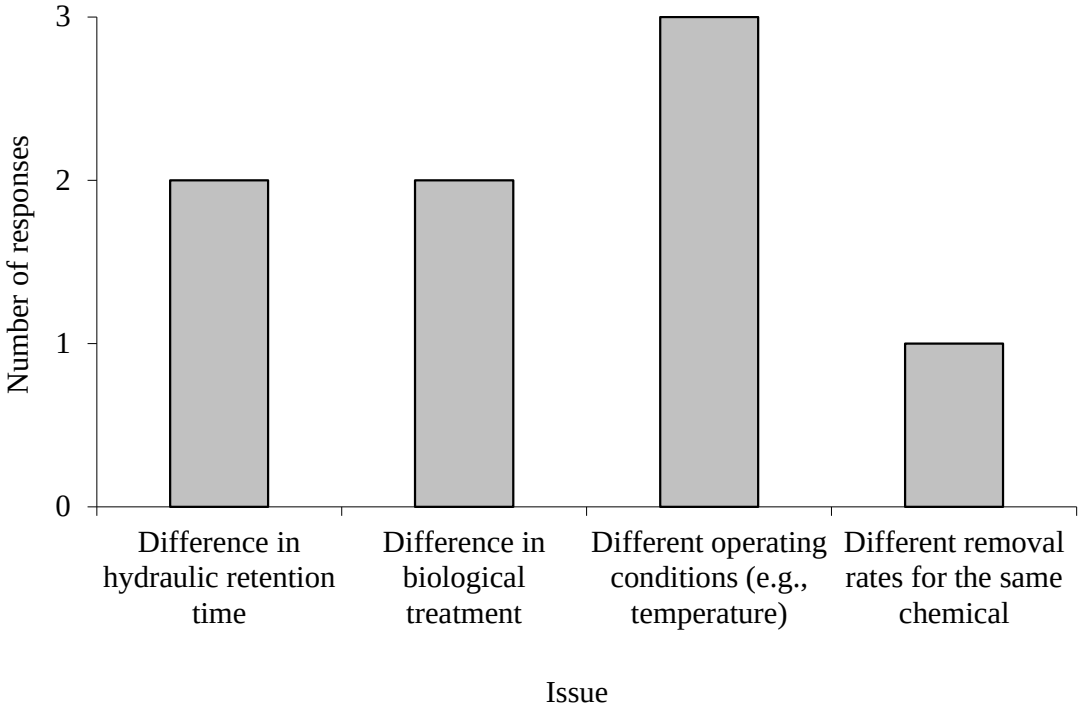
3.5.3 *On-site industrial wastewater treatment types*

It appears that the respondents had little information on the efficiencies of on-site industrial waste treatment systems. Furthermore, it is likely that some treatment types exist for which no models have been developed.

3.5.4 *Variability and geographic distribution in wastewater treatment operations and conditions*

Figure 3 lists the number of responses for each of four main issues with respect to variability in wastewater treatment.

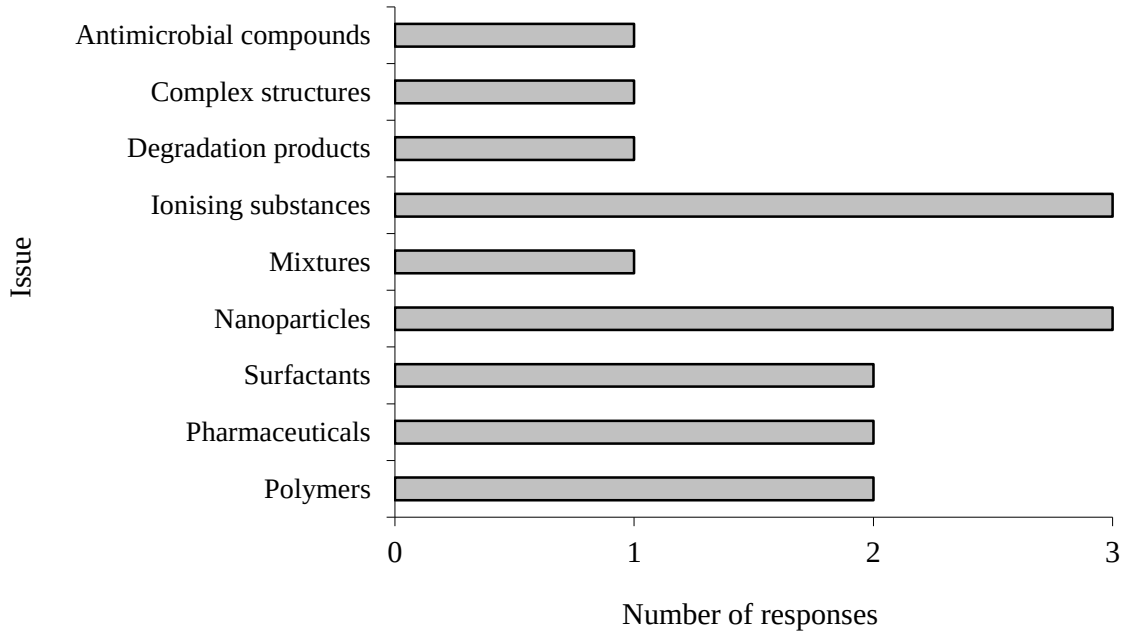
Figure 3. Main issues with respect to variability in wastewater treatment across facilities.



3.5.5 ***Chemical types***

Figure 4 lists the number of responses for each of the important chemical classes under the issue of chemical types.

Figure 4. Main chemical classes identified by respondents as being priorities with respect to improving estimates of removal/emissions from wastewater treatment systems.



3.5.6 *Other issues*

The primary "other" issue identified in addition to those listed above is that the current models used for estimating the removal/emission values from wastewater treatment systems are not appropriate for all chemicals or system operating conditions. For example, the models assume that biodegradation in wastewater treatment systems will be first order, however many chemicals do not follow this biodegradation pattern.

3.6 **Data and databases**

Part 6 of the survey is intended to identify any members that are collecting or have collected empirical wastewater treatment removal/emission data (either from published literature or from monitoring programs) and the associated wastewater treatment system conditions of municipal and/or industrial wastewater treatment systems in their jurisdictions.

In Part 6 of the survey, respondents were asked if they:

- are collecting (or have collected) publications on measured removal/emissions from wastewater,
- are generating (or have generated) such data,
- are collecting (or have collected) the operating conditions of municipal and/or industrial wastewater treatment systems in their jurisdiction, and
- are willing share these data.

The responses to this part of the survey are reported in Table 4.

Table 4. Respondents who are collecting (or have collected) removal/emission data from published literature or from monitoring projects/programs for the purpose of developing or maintaining a database.

Respondent	Data from published literature	Data from monitoring projects/programs	Data on operating conditions of treatment systems
AstraZeneca (BIAC)	--	Yes	--
Belgium Brussels	--	Yes	Yes
Belgium Flanders	Yes	Yes	Yes
Canada	Yes	Yes	Yes
Chile	--	--	--
France	--	Yes	--
Italy	--	--	--
Japan	Yes	Yes	--
Norway	Yes	Yes	Yes
Sweden	Yes	Yes	Yes
Unilever (BIAC)	Yes	Yes	--
The Netherlands	Yes	Yes	--
USEPA (CEB)	--	Yes	--
USEPA (EAB)	Yes	Yes	Yes
WIR at Plymouth (BIAC)	Yes	Yes	Yes

3.7 **Biosolids**

Respondents were asked to provide data on biosolids farm and/or forest land applications, as well as methods, tools and/or models used for estimating human and environmental exposure to such applications. Certain biosolids specific data and/or their sources were provided by a number of respondents; however, it appears that there is a degree of uncertainty associated with estimating human or environmental exposure via biosolids. The USEPA (EAB) reported a project intended to address this issue.

4 APPENDIX I. BLANK QUESTIONNAIRE

Questionnaire for OECD 2012 TFEA/TFPRTR Survey on Wastewater Removal/Emission Estimation

4.1 Introduction

On October 5, 2011, the TFEA (Task Force for Exposure Assessment) and TFPRTR (Task Force for Pollutants Release and Transfer Registers) met at a joint session and had an opportunity to discuss issues related to estimating chemical removal and/or emissions from wastewater treatment systems. Environment Canada proposed that a survey be conducted to determine the current status among TFEA and TFPRTR members on the methodologies, tools and models used under regulatory programs for exposure assessments or PRTR (Pollutants Release and Transfer Registers) for estimating removal and/or emissions from wastewater treatment systems. The findings from the survey will allow each member to benefit from the experiences and knowledge of others in the area of wastewater removal/emission estimation. The findings will also be used to identify important issues for future project development and collaborations among members. The proposal was accepted by the two task forces.

4.2 Instructions for completing the questionnaire

The methodologies, tools and models described in this survey pertain to either industrial wastewater treatment installations or municipal sewage treatment systems and are applicable to micropollutants (discrete chemical substances) rather than conventional pollutants (e.g., BOD).

One member country can provide one or multiple responses, depending on the number and complexity of relevant programs in the country.

If you wish to refer us to technical experts who can respond to any follow-up questions, please provide their names and coordinates.

1 – Contact information

Name of respondent:
Email:
Phone:
Country:
Organization:
Task Force (select one, if applicable): ☐ Exposure Assessment (EA) or ☐ Pollutants Release and Transfer Registers (PRTRs)

2 – Methodologies

a) In Table 1 provide a list of methodologies (approaches, practices, methods, test guidelines and techniques) used for or in conjunction with estimating chemical removal/emissions from wastewater treatment systems during your exposure assessments conducted by your organization

or recommended by your PRTR program. Note that computer tools and models are excluded from this section as they are surveyed in Sections 3 and 4.

b) For each methodology listed in Table 1, provide a brief description, including the title of the source document, specify the relevant section/chapter(s), and indicate if it can be shared or not.

c) Please attach electronic copies of the documents listed in Table 1 if they can be shared.

Table 1 – Information on methodologies

Methodology	Brief description	Reference/guidance document title	Section/chapter no. and title	If it can be shared (yes or no)	Web link (if available) and technical contact(s)

3 – Publicly Available Tools and Models

a) Please indicate if you or your program uses or recommends for using any of the publicly available models listed in Table 2 for estimating chemical removal/emissions from wastewater treatment systems. Describe the frequency of use (or recommendation for use) as high, medium or low, or as primary or secondary model. Also indicate if the default plant conditions in a model (mainly, sizes and residence times of clarifiers and aeration tanks) are used and if any validation study was conducted in the past by your organization.

Table 2 – Frequency of use of publicly available models

Model	Version *	Origin	Used or not used (Yes or No)	Frequency of use if used (high/medium/low)	Are model default plant conditions used (Yes or No)	Validation study conducted (Yes or No)	Web link and technical contact
SimpleTreat (stand-alone spreadsheet)	3.0	RIVM, The Netherlands					
SimpleTreat (part of EUSES)	3.1	RIVM, The Netherlands					
ASTreat	1.0	Procter & Gamble, US					
STP Model	2.11	Trent University, Canada					
STPWIN	4.1	US EPA					
TOXCHEM	4.0	Hydromantis Inc., Canada					
WATER9	3.0	US EPA					

*Specify the version of each model you are using. The versions provided in the column are merely those used by Canada.

a) Please describe in a general term how model inputs are derived or determined.

4 – Other Tools and Models

a) In Table 3, please list the names of tools/models used or recommended other than those described in Table 2 above. For each tool/model, please provide a brief description, key reference documents, and major input parameters. Also indicate if any validation study was conducted in the past by your organization.

Table 3 – Info on other tools and models

Name of tool/ model	Brief description	Reference documents	Input parameters	Output parameters	Validation study conducted (Yes or No)	Can it be shared?	Web link (if available) and technical contact(s)

b) Please send us the tools/models listed in Table 3 and any related reference documents if they can be shared.

c) Indicate if you are developing or refining any models and, if yes, describe the focus of this development or refinement.

5 – Issues and Projects

Please list any issues with estimating chemical removal/emissions from wastewater treatment systems that you would like addressed and explain the nature of each issue, your interim solutions and any current or planned projects to resolve those issues that you may be involved with or be collaborating on. The issues are grouped into the following categories:

a) Model input parameters (Table 4)

b) Municipal sewage treatment types (Table 5)

c) On-site industrial wastewater treatment types (Table 6)

d) Variability and geographic distribution in wastewater treatment plant operations and conditions (Table 7)

e) Chemical types (Table 8)

f) Other issues (Table 9)

Table 4 – Issues concerning model input parameters

Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)	Technical contact(s)

Table 5 – Issues concerning municipal sewage treatment types

Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)	Technical contact(s)

Table 6 – Issues concerning on-site industrial wastewater treatment types

Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)	Technical contact(s)

Table 7 – Issues concerning variability and geographic distribution in wastewater treatment plant operations and conditions

Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)	Technical contact(s)

Table 8 – Issues concerning chemical types

Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)	Technical contact(s)

Table 9 – Other issues

Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)	Technical contact(s)

6 – Data and Databases

a) Do you have, or are you in the process of collecting, publications on measured removal/emissions from wastewater treatment? Yes or No.

   i. If yes, would you be able or willing to share these publications for the purpose of supporting model validation/development work? Yes or No.

b) Has your organization generated, or in the process of generating, measured removal/emissions from wastewater treatment systems? Yes or No.

   i. If yes, would you be able or willing to share these data or databases for the purpose of supporting model validation/development work? Yes or No.

c) Do you have, or are you in the process of collecting, the operating conditions of municipal and/or industrial wastewater treatment systems in your jurisdiction? Yes or No.

   i. If yes, would you be able or willing to share these data or databases for the purpose of supporting model validation/development work? Yes or No.

7 – Biosolids

a) If available, please provide your country's data on biosolids farm and/or forest land application. The data may include the percentage disposed of by land application out of the total biosolids generated from sewage treatment systems, the water content of the land applied biosolids, land application methods (e.g. spray for liquid, spread for solids), and maximum application rate (kg per km2) and frequency (number of times per year) allowed under regulations.

b) If available, please provide methods, tools and/or models you have used or are aware of for estimating human and/or ecological exposure resulting from biosolids land application. The compartments implicated can include soil, plants, air, groundwater, and surface water.

c) Please describe any issues you have encountered in relation to the estimation of human and/or ecological exposure via biosolids land application.

8 – Comments

Please provide any additional comments that you may have.

APPENDIX II. COMPILATION OF RESPONSES

The following tables are a compilation of the responses to the questionnaire. The contact information such as e-mail addresses is not compiled in the Appendix.

1 –Respondent information

No.	Country	Organization	TFEA	TFPRTR
1	UK	AstraZeneca	X	
2	Belgium	Brussels instituut voor Milieubeheer		X
3	Belgium	Vlaamse Milieumaatschappij (VMM)		X
4	Canada	Environment Canada and Health Canada	X	
5	Chile	Ministerio del Medio Ambiente		X
6	France	INERIS, Evaluation en Ecotoxicologie (EVEC)		
7	Italy	National Institute of Health	X	
8	Japan	Ministry of the Environment		X
9	Norway	Climate and Pollution Agency (Klif)		
10	Sweden	Swedish Chemicals Agency	X	
11	UK	Unilever	X	
12	Netherlands	Laboratory for Ecological Risk Assessment (RIVM)	X	
13	US	USEPA, Chemical Engineering Branch (CEB)	X	
14	US	USEPA, Exposure Assessment Branch (EAB)	X	
15	UK	Water Industry Research at Plymouth University		

2 – Methodologies

a) Table 1 provides a list of methodologies (approaches, practices, methods, test guidelines and techniques) used for or in conjunction with estimating chemical removal/emissions from wastewater treatment systems during exposure assessments conducted by the organizations or recommended by their PRTR program. Note that computer tools and models are excluded from this section as they are surveyed in Sections 3 and 4.

b) For each methodology listed in Table 1, brief descriptions are provided, including the title of the source document, the relevant section/chapter(s), and whether the information can be shared or not.

Table 1 – Information on methodologies

Respondent	Methodology	Brief description	Reference / guidance document title	Section / chapter no. and title	If it can be shared (yes or no)	Web link (if available)
Belgium-Brussels	Use of E-PRTR document					
Belgium-Flanders	ERW database containing substance purification yields and loads to surface water.	The ERW database is filled with data companies and UWWTP's annually report in their IMJV (Integraal Milieujaarverslag).	Praktische handleiding voor het invoeren van het deelformulier „Wateremissie" via het IMJV-internetloket.	Not applicable	Yes	handleiding-wateremissie *http://imjv.milieuinfo.be/Delen van het IMJV/wateremissie/handleiding-wateremissie*
	Measured purifications yields and loads to surface water.	Concentrations of substances and flow rates are determined at in- and outlet of different UWWTP's. From these data purification yields and loads to surface water are calculated.	For example: Monitoring program of Polycyclic Aromatique Hydrocarbons on urban wastewater treatment plants.	Monitoring programme / Results	Yes	WEISS *http://weiss.vmm.be/*
Canada	Method for estimating removal values of polymers from	The method consists of using data in a published manuscript to derive wastewater removal values for polymers in secondary sewage	Ecological Assessment of Polymers: Strategies for Product Stewardship and Regulatory Programs, edited by J.D. Hamilton and R. Sutcliffe, 1997.	Chapter 10 – Environmental Assessment of Polymers under the U.S. Toxic Substances Control Act (R.S. Boethling and J.V.	Yes. Note that the chapter authors are from the US EPA	

Respondent	Methodology	Brief description	Reference / guidance document title	Section / chapter no. and title	If it can be shared (yes or no)	Web link (if available)
	wastewater treatment systems	treatment systems.		Nabholz).		
	Method for estimating removal values of chemicals from wastewater treatment systems.	A database of empirical wastewater removal values for chemicals is being populated. Information in the database can be mined based on structural similarity which enables searching for structural analogues. Empirical removal data for analogous substances can be compared to model predictions.	Not applicable	Not applicable	Yes (publically available data only)	
	Approach for using multiple computer models to predict wastewater removal values of chemicals	The approach consists of a procedure to select a single removal value from the outputs of 3 major computer models that are commonly used in exposure assessments. The selected value would be used in the exposure assessment.	Environment Canada protocol for determining wastewater treatment removal efficiency based on model predictions (internal document).	Not applicable	Yes	
Chile	No information					
France	Database of STP	Available for conventional pollutants	Circular of the French Ministry for the environment,	NA	To be confirmed	

Respondent	Methodology	Brief description	Reference / guidance document title	Section / chapter no. and title	If it can be shared (yes or no)	Web link (if available)
	emission levels (concentrations and mass flows)	and, soon, for micropollutants (Water Framework Directive priority substances and others - for all STP of more than 10 000 p.e.)	September 29th, 2010			
Italy	No information					
Japan	Estimation method of amounts of chemical substances released from sewage treatment plants which the operator uses in order to estimate PRTR data	Methods for estimation of amounts of released chemical substances by (1) effluent measurements (30 substances which the operator are obligated to notify) or (2) emission factors and wastewater inflow to sewage treatment plants. (substances other than 30) The detail of emission factor setting for (2) is as follows: (2) - 1 Measured values are used for calculation of emission factors (34 substances) . (2) - 2 Simple estimation equation is used for calculation of	Guideline (draft) regarding confirmation of amounts of chemical substances released from sewage treatment plants and development of chemicals management plans	2. confirmation of amounts of chemical substances released from sewage treatment plants	*Yes(only in Japanese)*	*www.mlit.go.jp/common/000149571.pdf*

Respondent	Methodology	Brief description	Reference / guidance document title	Section / chapter no. and title	If it can be shared (yes or no)	Web link (if available)
		emission factors (398 substances).				
	A method of the screening assessment under Chemical Substance Control Law for estimating the emission amounts of chemicals in the sewage treatment plants.	In the screening assessment under the CSCL, the emission amounts to public water bodies in four use categories (#13 Washing and cleaning products (II), #20 Biocidal products (III), #14 Polishes and wax blends, #22 Air fresheners, deodorizers) are estimated using the coverage rate of sanitary wastewater treatment (84.8%) and the removal rate (67%), for substances classified as ready biodegradability. The numerical value of removal rate(67%) is the minimum rate calculated by Simple Treat 3.0 model (the STP model used for the risk assessment of the EU-TGD) in the condition of “pass levels within 28 days in a test on "Ready biodegradability", “10-	・The Screening Assessment Methods under the Chemical Substances Control Law in Japan ・The details of the Screening Assessment Methods under the Chemical Substances Control Law in Japan	3.3(6) p.16,L35～p.17,L3 3.5(2) p.51,L16～p.53,L7	Yes (only in Japanese) Yes (only in Japanese)	*http://search.e-gov.go.jp/servlet/PcmFileDownload?seqNo=0000071389* *www.meti.go.jp/committee/kagakubusshitsu/anzentaisaku/kentou/002_s05_00.pdf*

Respondent	Methodology	Brief description	Reference / guidance document title	Section / chapter no. and title	If it can be shared (yes or no)	Web link (if available)
		day window criterion is not fulfilled."				
Netherlands-RIVM	OECD 303A simulation test	Measured removal from a lab-scale continuously fed activated sludge reactor with sludge recirculation	OECD guidelines for the testing of chemicals.	Section 3. Test No. 303A: Simulation test – aerobic sewage treatment	yes	*www.oecd-ilibrary.org/;jsessionid=b8te2nc52jtip.delta*
	Measured data in full scale sewage treatment plants (STPs)	Guidelines for interpretation of data from scientific literature, monitoring campaigns (e.g. WFD) and databases	EU TGD for chemical risk assessment	EU TGD, part II, section 2.3.7.1	yes	*http://ihcp.jrc.ec.europa.eu/our_activities/public-health/risk_assessment_of_Biocides/doc/tgd/tgdpart2_2ed.pdf*
Norway	No information					
Sweden	No information					
USEPA-CEB	User-Defined Loss Rate Model	Model uses treatment efficiency for on-site treatment installations; treatment efficiencies are provided by PMN submitters; in the absence of treatment efficiency data 1) internal reports are referenced to identify a similar scenario or 2) if no internal reports	1) ChemSTEER 2) Chemical Engineering Branch (CEB) Manual for the Preparation of Engineering Assessments	*1.* ChemSTEER Estimation Methods and Models 2a) Carbon Adsorption Report 2b) Use of Oil/Water Separators in Drum Reconditioning and Transportation Vessel-Cleaning Facilities	1) Yes 2) Yes	1)Yes *www.epa.gov/oppt/exposure pubschemsteer.htm* 2)No

Respondent	Methodology	Brief description	Reference / guidance document title	Section / chapter no. and title	If it can be shared (yes or no)	Web link (if available)
		addressing a similar scenario exist a 0% treatment efficiency is used				
	Industry specific Waste Treatment Methods	Some of the US ESDs or generic scenarios contain waste treatment information	Chemical Engineering Branch (CEB) Compilation of Generic Scenarios	1-Appendix A of Biotech GS (contains inactivation efficiency default value in the absence of inactivation efficiency) 2-Use of Metalworking Fluids ESD (contains default removal efficiencies for chemical precipitation, oil/water separation, and ultrafiltration. 3-Formulation and Application of Thermal and Carbonless Copy Paper Coatings ESD (contains default removal efficiencies for BOD, COD, TSS and VSS). 4-Chemicals Used in Oil Well Production ESD (uses low Kow to estimate partition between water and oil; data provided for oil well chemicals).	Yes	Yes (partial set) *www.epa.gov/oppt/exposure/pubs/guidance.htm*

Respondent	Methodology	Brief description	Reference / guidance document title	Section / chapter no. and title	If it can be shared (yes or no)	Web link (if available)
				5-Automobile OEM Coating Overspray Loss Model (contains default solid removal efficiency from captured mist) 5-Electroplating Rinse Water Loss Model & Electroplating Spent Bath Disposal Model (contains default wastewater treatment efficiency for suspended solids and organic compounds).		
USEPA-EAB	Wastewater Treatment Simulation Testing	Conduct bench scale testing to estimate removal in full scale treatment systems	OCSPP Guideline 835.3220 (Porous Pot Test); OCSPP Guideline 835.3280 (Simulation Tests to Assess the Biodegradability of Chemicals Discharged in Wastewater, 314B: Test for biodegradation in activated sludge); OCSPP Guideline 835.3240 (Simulation Test – Aerobic Sewage Treatment: A. Activated Sludge Units)	Entire document	Yes	*www.epa.gov/ocspp/pubs/frs/publications/Test_Guidelines/series835.htm*
	Estimation of removal using Physical-chemical properties	Use of high/low threshold values for critical p-chem properties (e.g. VP, HLC, Log P, sludge biodegradation half-life	None			

Respondent	Methodology	Brief description	Reference / guidance document title	Section / chapter no. and title	If it can be shared (yes or no)	Web link (if available)
	and biodegradation data	to estimate removal				
	Use of existing treatability Studies	Conduct literature searches for treatability studies on structurally related chemicals	Scientific literature, EPA reports, EPA databases (see question 6)			See question 6
	Activated Sludge Respiration Inhibition (ASRI)	Used to determine toxicity of a chemical substance to activated sludge micro-organisms; also used to indicate appropriate test concentrations to use if conducting a ready biodegradability test. May identify concerns for low removal at high concentrations.	OECD 209			*www.oecdbookshop.org/oecd/display.asp?K=5LMQCR2K7RG4&DS=Test-No.-209-Activated-Sludge-Respiration-Inhibition-Test*
	Modified Activated Sludge Respiration Inhibition Test	Serves the same purpose as the Activated Sludge Respiration Inhibition Test (see description above), but is appropriate for sparingly soluble chemicals	OCSPP 850.6800 (Public draft) and OCSPP 850.3300 (final version published July 2012)			*www.epa.gov/ocspp/pubs/frs/publications/Test_Guidelines/series850.htm*

Respondent	Methodology	Brief description	Reference / guidance document title	Section / chapter no. and title	If it can be shared (yes or no)	Web link (if available)
	Activated Sludge Sorption Isotherm (ASSI)	Used to determine the potential of a chemical substance to be removed in wastewater treatment by sorption to activated sludge.	835.1110 (Activated Sludge Sorption Isotherm)			*www.epa.gov/ocspp/pubs/frs/publications/Test_Guidelines/series835.htm*
UK-AstraZeneca	No information					
UK-Water Industry Research	Removal for micropollutants	Whilst at Atkins we designed and managed a £30million project to determine the sources, fate during treatment and effluent quality for numerous metals, pharmaceuticals and priority organics – see attached first paper from the project. There is available a large amount of practical removal (influent/effluent) measured data including influent, primary, secondary, tertiary and pilot tertiary treatment	*www.ukwir.org/site/web/news/news-items/ukwir-chemicals-investigation-programme*		Yes – available on line now – further data may be available from UKWIR – but needs a formal request	UKWIR: *www.ukwir.org/site/web/content/contact-us*

3 – Publicly Available Tools and Models

a) Table 2 indicates whether a program uses or recommends any of the publicly available models listed for estimating chemical removal/emissions from wastewater treatment systems. The Table also describes the frequency of use of a model (or recommendation for use) as high, medium or low, or as a primary or secondary model. It also indicates if the default plant conditions in a model (mainly, sizes and residence times of clarifiers and aeration tanks) are used and if an organisation conducted a validation study.

Table 2 – Frequency of use of publicly available models

Respondent	Model	Used or not used (Yes or No)	Frequency of use if used (high/medium/low)	Are model default plant conditions used (Yes or No)	Validation study conducted (Yes or No)	Web link
Belgium-Brussels	SimpleTreat (stand-alone spreadsheet)	No				
	SimpleTreat (part of EUSES)	No				
	ASTreat	No				
	STP Model	No				
	STPWIN	No				
	TOXCHEM	No				
	WATER9	No				
Belgium - Flanders	SimpleTreat (stand-alone spreadsheet)	No	Not applicable	Not applicable	No	
	SimpleTreat (part of EUSES)	No	Not applicable	Not applicable	No	
	ASTreat	No	Not applicable	Not applicable	No	
	STP Model	No	Not applicable	Not applicable	No	
	STPWIN	No	Not applicable	Not applicable	No	
	TOXCHEM	No	Not applicable	Not applicable	No	
	WATER9	No	Not applicable	Not applicable	No	
Canada	SimpleTreat (stand-alone spreadsheet)	Yes	High	No except those fixed in the model	Yes	
	SimpleTreat (part of EUSES)	No	Not applicable	Not applicable	No	
	ASTreat	Yes	High	No	Yes	
	STP Model	Yes	High	No	Yes	
	STPWIN	Yes	High	No	No	
	TOXCHEM	No	Not applicable	Not applicable	Yes	
	WATER9	No	Not applicable	Not applicable	Yes	

Respondent	Model	Used or not used (Yes or No)	Frequency of use if used (high/medium/low)	Are model default plant conditions used (Yes or No)	Validation study conducted (Yes or No)	Web link
Chile	No information					
France	SimpleTreat (stand-alone spreadsheet)	Yes	low	yes	No? (possibly done some years ago)	
	SimpleTreat (part of EUSES)	Yes	High	Yes (unless specific data are available)	No	
	ASTreat	No				
	STP Model	Yes	Low	yes		
	STPWIN	Yes	Low	yes		
	TOXCHEM	No				
	WATER9	No				
Italy	SimpleTreat (stand-alone spreadsheet)	Yes	High	Yes	No	
	SimpleTreat (part of EUSES)	Yes	High	Yes	No	
	ASTreat	No				
	STP Model	No				
	STPWIN	Yes	Low	Yes	No	
	TOXCHEM					
	WATER9	No				
Japan	SimpleTreat (stand-alone spreadsheet)	No				
	SimpleTreat (part of EUSES)	No				
	ASTreat	No				
	STP Model	No				
	STPWIN	No				
	TOXCHEM	No				
	WATER9	No				
Netherlands-RIVM	SimpleTreat (stand-alone spreadsheet)	Yes (version 3.1	High	No except those fixed in the model	Yes	

Respondent	Model	Used or not used (Yes or No)	Frequency of use if used (high/medium/low)	Are model default plant conditions used (Yes or No)	Validation study conducted (Yes or No)	Web link
		instead of 3.0)				
	SimpleTreat (part of EUSES)	No				
	ASTreat	No				
	STP Model	No				
	STPWIN	No				
	TOXCHEM	No				
	WATER9	No				
UK-Unilever	SimpleTreat (stand-alone spreadsheet)	Yes (version 3.1 instead of 3.0)	High	No except those fixed in the model	Yes	
	SimpleTreat (part of EUSES)	No				
	ASTreat	No				
	STP Model	No				
	STPWIN	No				
	TOXCHEM	No				
	WATER9	No				
Norway	SimpleTreat (stand-alone spreadsheet)	No				
	SimpleTreat (part of EUSES)	No				
	ASTreat	No				
	STP Model	No				
	STPWIN	No				
	TOXCHEM	No				
	WATER9	No				
Sweden	SimpleTreat (stand-alone spreadsheet)	No	Not applicable	Not applicable	No	
	SimpleTreat (part of EUSES)	Yes	High	Normally	No	

Respondent	Model	Used or not used (Yes or No)	Frequency of use if used (high/medium/low)	Are model default plant conditions used (Yes or No)	Validation study conducted (Yes or No)	Web link
	ASTreat	No	Not applicable	Not applicable	No	
	STP Model	No	Not applicable	Not applicable	No	
	STPWIN	Yes	High	No	No	
	TOXCHEM	No	Not applicable	Not applicable	No	
	WATER9	No	Not applicable	Not applicable	No	
USEPA-CEB	SimpleTreat (stand-alone spreadsheet)	No	N/A	N/A	N/A	N/A
	SimpleTreat (part of EUSES)	No	N/A	N/A	N/A	N/A
	ASTreat	No	N/A	N/A	N/A	N/A
	STP Model	No	N/A	N/A	N/A	N/A
	STPWIN	No	N/A	N/A	N/A	N/A
	TOXCHEM	No	N/A	N/A	N/A	N/A
	WATER9	No	N/A	N/A	N/A	N/A
USEPA-EAB	SimpleTreat (stand-alone spreadsheet)	Rarely	low	Yes	No	
	SimpleTreat (part of EUSES)	Rarely	low	Yes	No	
	ASTreat	No	NA	NA		
	STP Model	Yes				
	STPWIN	Yes	high	Yes	Yes[1] (Internal evaluation and comparison to other available models conducted)	*www.epa.gov/oppt/exposure/pubs/episuite.htm*
	TOXCHEM	No	NA	NA	No	
	WATER9	Yes – for estimation of emis	High by users outside EPA	Generally the model is configured to represent the treatment design of a specific	Yes	TBD

Respondent	Model	Used or not used (Yes or No)	Frequency of use if used (high/medium/low)	Are model default plant conditions used (Yes or No)	Validation study conducted (Yes or No)	Web link
		sions to air		facility		
UK-AstraZeneca	SimpleTreat (stand-alone spreadsheet)	Yes	low	yes	Yes	
	SimpleTreat (part of EUSES)	Yes	medium	yes	No	
	ASTreat	No	N/A	N/A	Yes	
	STP Model	No	N/A	N/A	Yes	
	STPWIN	No	N/A	N/A	No	
	TOXCHEM	Yes	medium	no	Yes	
	WATER9	No	Not applicable	Not applicable	Yes	
UK-Water Industry Research	SimpleTreat (stand-alone spreadsheet)	Yes	Low	Amended by CIP data	Yes	
	SimpleTreat (part of EUSES)	No				
	ASTreat	No				
	STP Model	No				
	STPWIN	No				
	TOXCHEM	No				
	WATER9	Yes	Occasionally	Yes	No	

3 – Publicly Available Tools and Models (cont'd)

b) This table provides descriptions of how model inputs are derived or determined.

Respondent	General Description on How Model Inputs Are Derived or Determined
Belgium-Brussels	-
Belgium-Flanders	-
Canada	In our New and Existing Substances Programs, the model inputs for plant operating conditions are derived from the equipment specifications and operating conditions of one typical Canadian activated sludge sewage treatment. These inputs are used to estimate the removal values for the substance of interest from secondary treatment plants. The primary clarifier specifications and the associated operating conditions of the same typical Canadian activated sludge plant are used as model inputs for estimating the removal values for the substance of interest that could be expected from primary treatment plants. The model inputs for the physical chemical properties of substance of interest are either

Respondent	General Description on How Model Inputs Are Derived or Determined
	measured values (provided by stakeholders or found in academic literature), estimates from (Q)SAR-based models (e.g. EPISUITE), read-across data, analogue data or other established methods.
Chile	-
France	-
Italy	The model inputs for a substance's physical chemical properties are either measured values found in the literature or provided by stakeholders, or estimates using QSAR-based models (e.g. EPISUITE), read across data, analogue data or other established methods.
Japan	-
Netherlands-RIVM	The STP parameters represent a conventional activated sludge plant with primary sedimentation, activated sludge and secondary clarifier. Physicochemical properties are determined according to EUSES guidelines. The basic input dataset includes Molecular Weight, Henry's law constant, Kow and a first-order biodegradation rate assigned based on screening biodegradability tests (e.g. OECD 301-302).
Norway	Data are retrieved from official statistics covering discharges from all wastewater treatment plants above 2 000 pe. Klif enter some of these data into a databank and the Norwegian Bureau of Statistics keeps a more detailed dataset. Simple overviews of discharge of phosphorous are published annually and are available for the Public. The Norwegian Water Research Institute has developed a model for discharge and impact from discharge area to Sea for Phosphorous and Nitrogen. For heavy metals and organic pollutants we only measure concentrations in sludge.
Sweden	Models are used for risk assessment of mainly organic substances. Risk assessment activities on EU level are using the SimpleTreat module in the EUSES model. For the "Safety Assessment" within REACH the registered companies are free to use any models.
USEPA-CEB	-
USEPA-EAB	Default treatment plant design and operating parameters are used. Measured p-chem properties and biodegradation rate constants are used where available. When not available, the EPA EPISuite™ model is used to estimate p-chem properties necessary for input. Biodegradation rate constants/ half-lives for activated sludge are estimated using the results of predictive models for ready biodegradability (see *www.epa.gov/oppt/exposure/pubs/halflife.htm* for description)
UK-AstraZeneca	Plant characteristics (tank sizes, operation parameters) are usually sourced from the specific plants, or default parameters are chosen representing European averages e.g. SimpleTreat set up, literature. Regarding chemical-specific parameters the volatilization of pharmaceuticals is usually assumed to be low (set low Henry's law constant); the adsorption coefficient (sludge) is either measured directly or found from literature sources, or determined using estimation methods based on log(kow) or log(dow); the 1st order biodegradation rate can be optimized for in the model if we have influent/effluent concentrations, or can be estimated from OECD301 data or from QSARs e.g. BIOWIN (EPA).
UK-Water Industry Research	A study was commissioned by Unilever to better model neutral and ionizing organic chemicals used a combination of default data amended with CIP data for gross parameters such as BOD, TSS rem in primary tank etc. for SimpleTreat. Validation between the model and observed CIP data was generally good for most organic priority chemicals.

4 – Other Tools and Models

a) Table 3 lists the names of tools/models used or recommended other than those described in Table 2 above. For each tool/model, brief descriptions, names of key reference documents, and major input parameters are also provided, as well as whether any validation study was conducted.

Table 3 – Information on the Use of Other Tools and Models

Respondent	Name of tool or model (if any)	Brief description	Reference documents	Input parameters	Output parameters	Validation study conducted (Yes or No)	Can it be shared?	Web link (if available)
Belgium-Brussels	None							
Belgium-Flanders	None							
Canada	STP-EX	The model is developed by the University of Windsor, Canada, and is based on STP Model v2.11 (developed by Trent University, Canada). The model can estimate removal efficiencies for three types of treatment systems: primary, secondary and lagoons. The model	R. Seth, E. Webster, and D. Mackay, "Continued development of a mass balance model of chemical fate in a sewage treatment plant," Water Research 42, 595-604 (2008).	1. Molecular weight 2. Henry's law constant 3. Vapour pressure 4. Water solubility 5. Octanol-water partition coefficient 6. Ionization dissociation constant 7. Biodegradation half-life 8. Wastewater flow 9. Surface area of each primary, secondary or lagoon unit 10. Depth of each primary,	1. Removal by primary clarifier 2. Removal by activated sludge aerator and secondary clarifier 3. Removal breakdown between biodegradation, sludge sorption and volatilization	No	Contact Rajesh Seth at University of Windsor for STP-EX	*www.uwindsor.ca/engineering/civil/dr-seth*

Respondent	Name of tool or model (if any)	Brief description	Reference documents	Input parameters	Output parameters	Validation study conducted (Yes or No)	Can it be shared?	Web link (if available)
		also takes into consideration some ionizing properties of chemicals.		secondary or lagoon unit				
Chile	None							
France	None							
Italy	None							
Japan	Simple estimation equation	Simple formula to estimate emission factors from Henry's constant and Kow	Guideline (draft) regarding confirmation of amounts of chemical substances released from sewage treatment plants and development of a chemicals management plan					*www.mlit.go.jp/common/000149571.pdf* (only in Japanese)
Netherlands-RIVM	None							
UK-Unilever	None							
Norway	TEOTIL	Discharge to waterbodies		Phosphorous and nitrogen from treatment plants (and other sources like	P+N in distances from the discharge point	Yes	Yes(?)	

Respondent	Name of tool or model (if any)	Brief description	Reference documents	Input parameters	Output parameters	Validation study conducted (Yes or No)	Can it be shared?	Web link (if available)
				agriculture and industries)				
Sweden	None							
USEPA-CEB	None							
USEPA-EAB	None							
UK-AstraZeneca	None							
UK-Water Industry Research	None							

4 – Other Tools and Models (cont'd)

b) This table describes whether respondents are developing or refining any models and, if so, it describes the focus of this development or refinement.

Respondent	Development or Refinement of any Models (Yes or No) and the related Description (if Yes)
Belgium-Brussels	No
Belgium-Flanders	No
Canada	Currently, there is no model development effort at Environment Canada. However, we are developing a database of empirical wastewater treatment plant removal values in order to compliment model predictions. The database can be mined based on structural similarity which enables searching for structural analogues.
Chile	No
France	No
Italy	No
Japan	No
Netherlands-Radboud University and UK-Unilever	A collaboration between Unilever (Antonio Franco, Oliver Price, Todd Gouin) and Radboud University (Dik van de Meent) was initiated in autumn 2011 to refine SimpleTreat with two objectives: *1)* Enlarge and define the applicability domain of SimpleTreat: new regressions for the estimation of sludge-water partitioning of ionisable substances have been incorporated. *2)* To develop a probabilistic spreadsheet version of the model for a more realistic

Respondent	Development or Refinement of any Models (Yes or No) and the related Description (if Yes)
	representation of the variability of raw sewage characteristics, STP design and operational parameters, and of the uncertainty of chemical input properties. In particular, recommendations will be provided on the use of higher tier biodegradation tests (OECD 303A, OECD 314B) in SimpleTreat, using a probabilistic approach.
Norway	No
Sweden	There is no model development effort at the Swedish Chemicals Agency.
USEPA-CEB	No
USEPA-EAB	No
UK-AstraZeneca	No
UK-Water Industry Research	Have been working with Unilever to refine SimpleTreat.

5 – Issues and Projects

This table lists issues associated with estimating chemical removal/emissions from wastewater treatment systems that a respondent would like addressed, and explains the nature of each issue, the respondents interim solutions and any current or planned projects to resolve those issues that they may be involved with, including collaborations with other organisations. The issues are grouped into the following categories:

a) **Model input parameters** (Table 4)

Table 4 - Issues concerning model input parameters

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
Belgium-Brussels	-	-	-	-	-
Belgium-Flanders	-	-	-	-	-
Canada	Biodegradation half lives in secondary treatment plants	The computer models we are using require biodegradation half-life as an input for estimating removal by biodegradation in secondary treatment plants. There is little measured data for this input	If OECD 301A to F ready biodegradation test results are available, we derive biodegradation half lives for secondary plants from these results according to a US EPA draft method (http://1.usa.gov/HbGdBU).	Over the past several years, we have compiled literature data in an effort to develop empirical relationships between activated sludge biodegradation half-life and degradation probability predicted by	High

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
		and the methods used in our programs are semi-quantitative only.	If OECD 301 A to F test results are not available, we derive biodegradation half lives using the BioWin3 and 5 method outlined in the EPISuite help file.	EPIWIN. The success of this effort is limited. We are currently in the process of seeking new solution to this issue.	
	Solids-water partition coefficient	Some of the computer models we are using require the solids-water partition coefficient as an input to estimate removal by sludge adsorption. We do not have methods specifically developed for sludge adsorption.	Our interim solution is to use a wastewater solids-water partition coefficient (Ksw) estimated from a substance's octanol-water partition coefficient (Kow). log(Ksw)=0.58log(Kow)+1.14. This equation is from Dobbs, R. A.; L.Wang; and R. Govind, Environmental Science and Technology 23, 1092 (1989).	We currently do not have any specific project to address this issue.	
Chile	-	-	-	-	-
France	-	-	-	-	-
Italy	-	-	-	-	-
Japan	-	-	-	-	-
Netherlands-RIVM	Biodegradation half lives in secondary treatment plants	The semi-quantitative method recommended in EUSES for the determination of biodegradation half lives for use in SimpleTreat (from results of OECD 301A) is in many cases	No interim solution. SimpleTreat estimates are often considered a realistic worst case scenario.	A validation study has been performed to evaluate the use of higher tier biodegradation tests (OECD 314b, OECD 303A) in SimpleTreat, using a probabilistic approach	

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
		too conservative.			
	SimpleTreat default parameters	SimpleTreat parameterization reflects European STPs of ~20 years ago.	No interim solution. SimpleTreat estimates are often considered a realistic worst case scenario.	An updated, probabilistic parameterization has been implemented in SimpleTreat	
Norway	-	-	-	-	--
Sweden	Solids-water partition coefficient	The EUSES model use log Kow to calculate a Koc value. However, that does not fit for ionized organic substances.	The calculated default value can be replaced with an experimental value.		medium
USEPA-CEB	-	-	-	-	-
USEPA-EAB	Estimation of activated sludge biodegradation rate constants	Few chemical specific activated sludge biodegradation rate constants available	Follow EPA guidance for estimation from ready/inherent biodegradation tests	None	medium-high
	P chem properties for charged compounds	Sorptive removal is not well predicted by available p-chem properties (e.g. quaternary ammonium compounds)	Use mw, charge density and analogs for guidance	none	medium
	P chem properties for reactive compounds	Sorptive removal is not well predicted by available p-chem properties	Assume reactivity results in binding to solids and removal by settling	None	medium
UK-AstraZeneca	Biodegradation half lives in secondary treatment plants	There is little measured data for this input and the regulatory tests for		We currently do not have any specific project to address this issue.	High

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
		pharmaceuticals do not lend themselves to accurately calculating these.			
	Solids-water partition coefficient	There have been few validation studies to relate the data obtained in laboratory partitioning tests (or estimation from Kow) with the observed removal in WWTPs.	Commonly this parameter is measured in our risk assessments. Where it is not, it is estimated from a substance's octanol-water partition coefficient (Kow).	We currently do not have any specific project to address this issue.	
UK-Water Industry Research	-	-	-	-	-

5 – Issues and Projects (cont'd)

This table lists issues associated with estimating chemical removal/emissions from wastewater treatment systems that a respondent would like addressed, and explains the nature of each issue, the respondents interim solutions, and any current or planned projects to resolve those issues that they may be involved with, including collaborations with other organisations. The issues are grouped into the following categories:

b) Municipal sewage treatment types (Table 5)

Table 5 - Issues concerning municipal sewage treatment plants

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
Belgium-Brussels	-	-	-	-	-
Belgium-Flanders	-	-	-	-	-
Canada	Estimating removal values from	Lagoons represent a large fraction of wastewater	A model that can estimate removal values from	We currently intend to validate the model and also	High

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
	lagoon systems	treatment systems in Canada and therefore play an important role in our exposure assessments. However, we do not have a good understanding of the substances in lagoon systems, particularly with respect to degradation mechanisms and rates. In addition, lagoon operations are much less standardized than primary or secondary treatment plants. Lagoons discharge in various modes and are subject to a large temperature variation. Removal by volatilization can be suppressed during winter when there is ice coverage. All these make lagoon removal predictions difficult.	lagoons, STP-EX developed by University of Windsor (Canada) is currently being tested and used.	characterize the Canadian lagoon operations.	
Chile	-	-	-	-	-
France	-	-	-	-	-
Italy	-	-	-	-	-
Japan	-	-	-	-	-
Netherlands-RIVM	Variability of treatment	SimpleTreat represent the most common design	No interim solution	No project	

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
	units and STP types	scenario (activated sludge). Attached biomass treatments and tertiary treatment units are not represented in SimpleTreat			
UK-Unilever	Variability of treatment units and STP types	SimpleTreat represents the most common design scenario (activated sludge). Attached biomass treatments and tertiary treatment units are not represented in SimpleTreat	No interim solution	No project	
Norway	-	-	-	-	-
Sweden	-	-	-	-	-
USEPA-CEB	-	-	-	-	-
USEPA-EAB	Treatment types other than activated sludge in place	Possibly other treatment types in place for which models are not readily available	Assume Activated Sludge treatment is used, or other assumptions	None at present	low
UK-AstraZeneca	-	-	-	-	-
UK-Water Industry Research	Phosphorus	Minimizing effluent concentrations sustainably	Fe dosing	Ongoing	High

5 – Issues and Projects (cont'd)

This table lists issues associated with estimating chemical removal/emissions from wastewater treatment systems that a respondent would like addressed, and explains the nature of each issue, the respondents interim solutions, and any current or planned projects to resolve those issues that they may be involved with, including collaborations with other organisations. The issues are grouped into the following categories:

c) On-site industrial wastewater treatment types (Table 6)

Table 6 - Issues concerning on-site industrial waste water treatment plants

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
Belgium-Brussels	-	-	-	-	-
Belgium-Flanders	-	-	-	-	-
Canada	Estimating removal values from oil-water separators	Many industrial facilities have on-site wastewater treatment before discharging to sewer. The on-site treatment often contains an oil-water separator for oily wastewater. Hydrophobic chemicals encountered in our assessments are expected to partition substantially to oil, but we no validated methods to estimate the removal by the oil-water separation mechanism are available. Equally, no reliable method is known that addresses the removal of surfactant compounds from oil-water separators.	We don't have interim solutions, but are in the process of finding one.	No project has been established yet to address the issue of the removal by oil-water separators.	
Chile	-	-	-	-	-
France	-	-	-	-	-
Italy	-	-	-	-	-
Japan	-	-	-	-	-
Netherlands	Municipal	Is SimpleTreat	No interim solution	No project	

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
RIVM	vs. industrial wastewater	applicable for estimating removal for industrial wastewater			
UK-Unilever	Municipal vs. industrial wastewater	Is SimpleTreat applicable for estimating removal for industrial wastewater	No interim solution	No project	
Norway	-	-	-	-	-
Sweden	Local treatment of land fill leakage water	Leakage water from landfill shall in Sweden be treated locally before release to the water recipient. Different treatment techniques have been developed. It is now time to evaluate the effectiveness of such of plants.		Swedish treatments plants for landfills will be evaluated during 2012. Reductions in concentration before and after treatments are measured for at broad number of relevant hazardous substances. The reduction in biological effect of the waste water is also measured.	?
USEPA-CEB	Treatment Efficiency	No methods or models exist to estimate treatment efficiency based on treatment and pollutant type.	If the on-site industrial wastewater treatment is controlled by the PMN submitter, the treatment efficiency provided by the submitter is used in potential release calculations. If no information on treatment efficiency can be made available or identified, then 0% treatment efficiency is assumed.	EPA is in the process of examining treatment efficiency data provided in the TRI reports for reporting years 2004 through 2010. These reports contain removal efficiency information for a variety of chemical substances and treatment operations. EPA is compiling treatment efficiency	Medium

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
			If the on-site industrial wastewater treatment is not controlled by the PMN submitter, then 0% treatment efficiency is assumed. This can be refined on a case by case basis depending on documentation and data provided.	data and potentially developing correlations based on certain types of treatment methods, industries, chemical groups and geographical location.	
				Also, there is an activity under OECD WPMN SG8 to gather information on disposal and waste treatment for nanomaterials.	Medium
USEPA-EAB	Estimation of release from onsite treatment	Presence of other treatment types in place for which models are not readily available.	Require documentation supporting removal claims	None	medium
UK-AstraZeneca	-	-	-	-	-
UK-Water Industry Research	-	-	-	-	-

5 – Issues and Projects (cont'd)

This table lists issues associated with estimating chemical removal/emissions from wastewater treatment systems that a respondent would like addressed, and explains the nature of each issue, the respondents interim solutions, and any current or planned projects to resolve those issues that they may be involved with, including collaborations with other organisations. The issues are grouped into the following categories:

d) Variability and geographic distribution in wastewater treatment plant operations and conditions (Table 7)

Table 7 - Issues concerning variability and geographic distribution in WWTP operations and conditions

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
Belgium-Brussels	-	-	-	-	-
Belgium-Flanders	-	-	-	-	-
Canada	Hydraulic retention time	The removal by biodegradation in secondary treatment systems is a strong function of the hydraulic retention time in a bioreactor. This retention time varies from plant to plant. The removal is therefore expected to vary across sites, which is a key factor for substances with wide-spread consumer releases. Accommodating this variation in removal estimates requires a large amount of time and is not practical.	The removal value for a substance is modeled using the hydraulic retention time in a typical secondary plant in Toronto (Canada). The removal value for this plant is used as a representative value for all other secondary plants located at different sites.	An idea of using a probabilistic approach has been discussed, but no project has been established at this time.	
	Removal by biological treatment other than activated sludge	Many biological treatment systems used in Canada are not activated sludge, but no method is available for estimating the removal by these systems. These systems include	The removal estimated for activated sludge is currently used for any other biological treatment.	No project is planned yet.	

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
		trickling filter, biological contactor, and oxidation ditch, among others.			
Chile	-	-	-	-	-
France	-	-	-	-	-
Italy	-	-	-	-	-
Japan	-	-	-	-	-
UK-Unilever	Variability of conditions in activated sludge plants	Large variability of model parameters is expected across STPs.	No interim solution.	A modified probabilistic model parameterization is designed to cover the variability across activated sludge STPs in Europe. A SimpleTreat parameterization for China is being developed in collaboration with a PhD student at Lancaster University and the Chinese Academy of Sciences	
Norway	-	-	-	-	-
Swedwn	-	-	-	-	-
USEPA-CEB	-	-	-	-	-
USEPA-EAB	Impact of climate, operating temperatures, influent strength, composition on removal of chemicals in wastewater treatment	Impact of regional differences in WWTP location on treatability and release of a chemical are not well documented	Assume no differences in removal due to the factors listed	None	low
UK-	Hydraulic			Currently AZ has	

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
AstraZeneca	retention time			no projects ongoing but we are also interested in the sludge retention time, as this has been reported to have a significant effect on trace chemical removal. The relative importance of the SRT & HRT in relationship to trace organic removal may be of interest.	
	Removal by biological treatment other than activated sludge			AZ currently has 2 PhD studentships investigating the fate of pharmaceuticals in different types of biotreatment (anaerobic and biological nutrient removal). These are due to complete in early 2013.	
UK-Water Industry Research	Removal rates	Explaining large variability in removal rates for the same chemical	Uncertainty quantified	CIP data to be further analysed	High

5 – Issues and Projects (cont'd)

This table lists issues associated with estimating chemical removal/emissions from wastewater treatment systems that a respondent would like addressed, and explains the nature of each issue, the respondents interim solutions, and any current or planned projects to resolve those issues that they may be involved with, including collaborations with other organisations. The issues are grouped into the following categories:

e) Chemical types (Table 8)

Table 8 - Issues concerning chemical types

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
Belgium-Brussels	-	-	-	-	-
Belgium-Flanders	-	-	-	-	-
Canada	Ionizing substances	Ionizing substances (typically cationics) can bind to solids via electrostatic interaction in addition to hydrophobicity driven binding. Therefore, using the historical approach of considering only hydrophobic partitioning (i.e. logKow) for estimating the removal of these compounds could underestimate the removal by sludge.	The models listed in Tables 2 and 3 are used without considering the ionizing aspect of these substances. The one exception is STP-EX which takes into consideration some ionizing properties.	No project is planned yet.	
	Surfactants	Experimental logKow measurements for surfactants are sometimes unreliable due to their amphipathic properties. In the cases, the logKow (i.e. perceived hydrophobicity) becomes an unreliable input into the wastewater removal models.	Read across and analogue data have been used to provide removal estimates.	A project is ongoing to compile wastewater removal data of chemicals found in academic literature. The associated chemical structures are also compiled. The intent of the project is to provide more read across and analogue data. The project is treated as a high priority.	High
	Polymers	The method listed	Zero removal is	No project is	

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
		in Table 1 is semi-quantitative only. The guideline values provided by the method (given in some cases as ranges) are insufficient for assessments where using the upper or lower boundaries of the range would result in different assessment outcomes. In addition, the method only provides estimates for removal by sludge adsorption and does not give guidance on removal for biodegradable polymers. Furthermore, certain polymers are water soluble and the use of the method is not considered appropriate for these polymers since they do not precipitate out via clarification.	assumed when a polymer is determined to be water soluble and non-biodegradable.	planned yet.	
	Nano-particles	There is little understanding of a substance's fate through a wastewater treatment system. Nanoparticles are	Zero removal is assumed for nanoparticles.	No project is planned yet.	

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
		expected to behave differently from conventional substances although they have the same chemical composition. No method is currently available.			
Chile	-	-	-	-	-
France	-	-	-	-	-
Italy	-	-	-	-	-
Japan	-	-	-	-	-
UK-Unilever	Ionisable substances	The Kow-based regression equations implemented in SimpleTreat for the estimation of the organic carbon-water partition coefficients (Koc) are not applicable to ionisable substances.	According the EU TGD, measured values for the organic carbon-water partition coefficient are recommended for ionisable chemicals.	The species specific regression model proposed by Franco et al. (2009) for acids have been successfully tested with sludge KOC data. Another regression was derived for bases from recent literature data (ECETOC 2012, in preparation).	
	Surfactants	Most surfactants are ionizable substances but, measured data available for this chemical class is limited. They are therefore not sufficiently represented in the calibration set for the Koc regressions derived for ionizable substances. This issue is critical for	Read across and analogue data are used to provide removal estimates.	The collection of literature Koc data is continuing with focus on ionisable surfactants.	

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
		cationic surfactants, for which strong electrical adsorption is likely.			
	Other complex substances	Complex structures such as multivalent ionics, transchelating chemicals (metallorganic salts) and nanomaterials fall outside the model applicability domain	No interim solution in place.	No activity started	
Norway	-	-	-	-	-
Sweden	Pharmaceuticals	Residues of pharmaceuticals have been identified in outgoing waste water and sludge in our national monitoring program. *www.naturvardsverket.se/upload/02_tillstandet_i_miljon/Miljoovervakning/rapporter/miljogift/B2014_NV_Screen_2010_Pharma.pdf*	The Swedish Environmental Protection Agency (EPA) has evaluate how these substances could be reduced at the treatment plant.	The national research programme "MistraPharma" (2008-2015) will recommend techniques to improve the wastewater treatment of pharmaceuticals.	medium
USEPA-CEB	Efficiency of on-site treatment for a given chemical.	Lack of data or methods to estimate treatment efficiency of treatment system for a given chemical.	Assume zero efficiency if no data or supporting information is available.	EPA is in the process of examining treatment efficiency data provided in the TRI reports for reporting years 2004 through 2010. These reports contain removal	Medium

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
				efficiency information for a variety of chemical substances and treatment operations. EPA is compiling treatment efficiency data and potentially developing correlations based on certain types of treatment methods, industries, chemical groups and geographical location.	
				Also, there is an activity under OECD WPMN SG8 to gather information on disposal and waste treatment for nanomaterials.	Medium
USEPA-EAB	Polymers (nonfluorinated)	Uncertainty in ability to accurately estimate removal. Problematic for dispersible, nonbiodegradable lower mw polymers/oligomers	Assume high removal by sorption and settling for high molecular weight (>1000) ionic polymers (esp polycationic) can be approximated by suspended solids removal. Assume some sorbed substances escape WWTP in effluent	None	
	Fluorortelomer based polymers	Hydrophobic and oleophobic properties lead to uncertainty predicting removal. How to predict formation	Assume they behave as other high molecular weight polymers	activated sludge biodegradation testing of representative compounds	

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
		and release of degradation products of concern (perfluorocarboxylic acids)			
	Engineered Nano-materials	Few studies to establish estimation methods	Assume worst case for release to water (100% pass through) or land (100% sorbed to land applied sludge)	none	moderate
	Mixtures	Biota often has substrate preferences. For example, many organisms will consume ethanol before benzene. This preference distorts apparent kinetics.	Assume all biodegradable substrates are biodegraded nonpreferentially	none	low
	Degradation Products	How to address the rates of transformation of parent to degradation products and subsequent treatment/release of the products	Use of professional judgement to estimate yields and treatability of products	none	moderate
	Anti-microbial Pesticides	There are no models available for estimating biodegradation of antimicrobial pesticides in wastewater treatment. Current OPPT QSAR models in EPIWEB are based largely on ready biodegradability	In the absence of data, assume no removal during wastewater treatment or use OPPT QSAR program for the subset of antimicrobial pesticides that are not that toxic (assuming the chemical structure fits within the	Ultimately, as data is collected on antimicrobials, biodegradation QSAR models can be improved. OPP plans to work with OPPT to determine which antimicrobial pesticide chemicals would be good candidates for QSAR.	High

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
		test results. Such QSAR models are not designed to consider the effects of chemicals (e.g. antimicrobial pesticides) which are used to inhibit or kill microorganisms. Thus, QSAR estimates of biodegradation rates of antimicrobial pesticides that are highly toxic to activated sludge microorganisms are likely to underpredict the persistence of these chemicals.	current applicability domain).		
UK-AstraZeneca	Ionizing substances			Currently AZ has a PhD studentship to investigate the mechanistic understanding of the partitioning of ionic pharmaceuticals to biosolids. In addition AZ is partners in an ECETOC task force to review the environmental risk assessment of ionisable substances.	
	Nano-particles	There is little understanding of a substance's fate through a wastewater	To be on the safe side, zero removal is assumed for nanoparticles.	No project is planned yet.	

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
		treatment system. Nanoparticles are expected to behave differently from conventional substances although they have the same chemical composition. No method is currently available.			
UK-Water Industry Research	Pharmaceuticals	New EQS derived by EU for DCF, E2, EE2 – very low required 95%+ removal efficiency – EE2 removal currently variable and generally only ~40%	Further research	On-going	High

5 – Issues and Projects (cont'd)

This table lists issues associated with estimating chemical removal/emissions from wastewater treatment systems that a respondent would like addressed, and explains the nature of each issue, the respondents interim solutions, and any current or planned projects to resolve those issues that they may be involved with, including collaborations with other organisations. The issues are grouped into the following categories:

f) Other issues (Table 9)

Table 9 - Other issues

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
Belgium-Brussels	-	-	-	-	-
Belgium-Flanders	-	-	-	-	-
Canada	Modelling	The primary	Read across and	A scoping study is	

Respondent	Issue	Nature of issue	Interim solutions	Projects to resolve issues	Level of priority (high, medium or low)
	approach	models we currently use (STP, SimpleTreat and ASTreat) are all based on the mass balance approach. The approach has experienced difficulties in dealing with complicated chemical structures. This triggers a question as to whether there are other viable approaches.	analogue data are used when a substance is found model difficult.	being initiated to explore the possibility of using non-mass balance approaches in characterizing wastewater removal.	
Chile	-	-	-	-	-
France	-	-	-	-	-
Italy	-	-	-	-	-
Japan	-	-	-	-	-
Netherlands-RIVM	-	-	-	-	-
UK-Unilever	-	-	-	-	-
Norway	-	-	-	-	-
Sweden	-	-	-	-	-
USEPA-CEB	-	-	-	-	-
USEPA-EAB	-	-	-	-	-
UK-AstraZeneca	Modelling approach	The models typically consider simple 1st-order biodegradation and there is usually no alternative – is this always appropriate?			
UK-Water Industry Research	Modelling approach	Modelling metals removal?	Total metal loss rather than dissolved	Unknown	Med

6 - Data and Databases

This table summarises responses to Part 6 of the survey, in which respondents were asked if they:

- are collecting (or have collected) publications on measured removal/emissions from wastewater,
- are generating (or have generated) such data,
- are collecting (or have collected) the operating conditions of municipal and/or industrial wastewater treatment systems in their jurisdiction, and
- are willing share these data.

Table 10 – Data and databases

Respondent	**Possession of or currently in collecting measured publications on removal/emissions from wastewater treatment (Yes or No)**	**To share these available publications (Yes or No)**	**Generation of measured removal/emissions from wastewater treatment systems (Yes or No)**	**To share the available generating data (Yes or No)**	**Collection of the operating conditions of wastewater treatment systems (Yes or No)**	**To share the available information (Yes or No)**
Belgium-Brussels	No	N.A.	Yes	Yes	Yes	?
Belgium-Flanders	Yes	Yes	Yes	Yes	Yes	Yes
Canada	Yes	In support of our assessment work, we have collected a small number of academic manuscripts that report measured wastewater removal values. Currently, information for about 170 chemicals, with an average of ~3 removal measurements for each chemical, has	Yes	In Canada, concentrations in municipal wastewater influents, effluents and sludge have been measured for many chemical substances under the Chemicals Management Plan. The types of the treatment	Yes	We have the operating conditions of many sewage treatment systems in Canada. They can be shared.

Respondent	Possession of or currently in collecting measured publications on removal/emissions from wastewater treatment (Yes or No)	To share these available publications (Yes or No)	Generation of measured removal/emissions from wastewater treatment systems (Yes or No)	To share the available generating data (Yes or No)	Collection of the operating conditions of wastewater treatment systems (Yes or No)	To share the available information (Yes or No)
		been collected. These publications can be shared with others. Canada can also add similar data from other TFEA/TFPRTR members in order to build a more complete dataset that could be useful for read-across, model development or model validation.		systems covered include primary, secondary and lagoons. The data can be shared.		
Chile	No	N.A.	No	N.A.	No	N.A.
France	-	-	Yes	The French Ministry of Environment imposed to all French waste water treatment systems of more than 10 000 p.e. to analyze concentrations and mass flows of a list of micropolluants in their effluent discharge (cf. Circular of the French Ministry for the environment, September 29th,	-	-

Respondent	Possession of or currently in collecting measured publications on removal/emissions from wastewater treatment (Yes or No)	To share these available publications (Yes or No)	Generation of measured removal/emissions from wastewater treatment systems (Yes or No)	To share the available generating data (Yes or No)	Collection of the operating conditions of wastewater treatment systems (Yes or No)	To share the available information (Yes or No)
				2010) INERIS, which is a technical institute (French public research body of an industrial and commercial character), working on the problematic of micropollutants discharge in water bodies, will be responsible for analyzing the results of this national campaign.		
Italy	-	-	-	-	-	-
Japan	Yes	A guideline (draft) was published on the website concerning confirmation of amounts of chemical substances released from sewage treatment plants and development of a chemicals management plan. *www.mlit.go.jp/common/000149571.pdf*	Yes	A guideline (draft) was published on the website concerning confirmation of amounts of chemical substances released from sewage treatment plants and development of a chemicals	No	No (Information on processing system in each municipal wastewater treatment system is collected.)

Respondent	Possession of or currently in collecting publications on measured removal/emissions from wastewater treatment (Yes or No)	To share these available publications (Yes or No)	Generation of measured removal/emissions from wastewater treatment systems (Yes or No)	To share the available generating data (Yes or No)	Collection of the operating conditions of wastewater treatment systems (Yes or No)	To share the available information (Yes or No)
		(Only in Japanese)		management plan. *www.mlit.go.jp/common/000149571.pdf* (Only in Japanese)		
UK-Unilever	Yes	An in-depth validation study with 10 test chemicals was carried out as part of SimpleTreat refinement: these include tonalide, permethrin, decamethylcyclopentasiloxane, triclosan, ibuprofen, trimethoprim, linear alkylbenzene sulfonate, benzalkonium chloride, ethylenediaminetetraacetic acid, and zinc pyrithione. The work is to be published soon.	Yes, via two PhD students	Yes	No	N.A.
Norway	Yes	Yes	Yes	Not applicable	Yes	Yes
Sweden		In Sweden, data from other surveys than national monitoring (see 6b) is collected in a		In Sweden, concentrations in municipal wastewater effluents and		We have information about the treatment techniques

Respondent	Possession of or currently in collecting publications on measured removal/emissions from wastewater treatment (Yes or No)	To share these available publications (Yes or No)	Generation of measured removal/emissions from wastewater treatment systems (Yes or No)	To share the available generating data (Yes or No)	Collection of the operating conditions of wastewater treatment systems (Yes or No)	To share the available information (Yes or No)
		public database and can be shared.		sludge have been measured for many substances (87 respectively 146) under the Swedish national monitoring programme. Further, in Sweden since year 2000, there is a national screening programme of new chemicals in the environment. In between this programme, approximately 600 substances have been measured in M-WWTP sludge, 260 substances in influents and 480 in effluent water. Data and reports from both national monitoring programme and screening programme are		for many STP in Sweden. The data can be shared.

Respondent	Possession of or currently in collecting publications on measured removal/emissions from wastewater treatment (Yes or No)	To share these available publications (Yes or No)	Generation of measured removal/emissions from wastewater treatment systems (Yes or No)	To share the available generating data (Yes or No)	Collection of the operating conditions of wastewater treatment systems (Yes or No)	To share the available information (Yes or No)
				collected in a public national database and can be shared. The database is in Swedish.		
USEPA-CEB	No	N.A.	Yes	EPA is in the process of examining treatment efficiency data provided in Toxic Release Inventory reports for reporting years 2004 through 2010. These reports contain removal efficiency information for a variety of chemical substances and treatment operations. EPA plans to compile treatment efficiency data and potentially develop correlations based on certain types of	No	N.A.

Respondent	Possession of or currently in collecting publications on measured removal/emissions from wastewater treatment (Yes or No)	To share these available publications (Yes or No)	Generation of measured removal/emissions from wastewater treatment systems (Yes or No)	To share the available generating data (Yes or No)	Collection of the operating conditions of wastewater treatment systems (Yes or No)	To share the available information (Yes or No)
				treatment methods, industries, chemical groups, and geographical location.		
USEPA-EAB	Yes	Yes. Some examples include: Office of Research and Development RREL Treatability database *http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=9100W3VG.txt* EPA-821-B-03-001 Effluent Guidelines, Metal Products and Machinery *Final Rule Development Document* Section 12 Table 12-1 *http://water.epa.gov/scitech/wastetech/guide/mpm/upload/tddfinal.pdf*	Yes	Contact the EPA Office of Water, Office of Science and Technology[1].	Yes	Contact the EPA Office of Water, Office of Science and Technology[2].
UK-AstraZeneca	No	N.A.	Yes	We have measured	No	N.A.

[1] The information on the contact person was removed for publication.

Respondent	Possession of or currently in collecting publications on measured removal/emissions from wastewater treatment (Yes or No)	To share these available publications (Yes or No)	Generation of measured removal/emissions from wastewater treatment systems (Yes or No)	To share the available generating data (Yes or No)	Collection of the operating conditions of wastewater treatment systems (Yes or No)	To share the available information (Yes or No)
				influent and effluent concentrations of a range of Pharmaceuticals and Personal Care Products (PPCPs) at 2 municipal STPs in local river catchments for a research project – before and after activated sludge and trickling filter systems in the same plant to assess relative differences in removals. These could be made available.		
UK-Water Industry Research	Yes	UKWIR hold a vast amount of data now – check the contact details.	Yes	-[2]	Yes	Again the CIP did this for 28 WwTW.

7 – Biosolids

Respondents were asked to provide data on biosolids farm and/or forest land applications (e.g. percentage applied out of the total generation, issues associated with estimating human and environmental exposure

[2] The information on the contact person was removed for publication.

via biosolids), as well as methods, tools and/or models used for estimating human and environmental exposure to such applications. This table includes the responsesTable 11 - Biosolids

Respondent	**Biosolids Data**	**Methods, tools and/or models used to estimate the human/ecological exposure resulting from biosolids land application**	**Related issues encountered for the estimates**
Belgium-Brussels	In the Brussels Capital Region, there's no application of biosolids on land.		
Belgium-Flanders	In Flanders the farm and/or forest land application of biosolids is not allowed!	N.A.	N.A
Canada	In Canada, about 40% of the biosolids generated are land applied. We currently do not have data on the water content of biosolids. Biosolids are applied by spraying if they are liquid or spreading if they are solids. The maximum application rate via single or multiple applications is regulated by provinces, varying from 8-22 tonne/ha within a period of 5 years to 25 tonne/ha within a period of 3 years.	We use a tiered approach to ecological exposure in biosolids-amended soil. In low tiers, we assume that a chemical introduced into soil via land application is not subject to degradation, volatilization, leaching, or soil run off. The chemical concentration in soil is then estimated based on the maximum allowed application rate over a period of 10 years within the top 20 cm of soil. In high tiers, a model (BASL4) developed by Trent University (Canada) is used and major losses (degradation, volatilization, leaching and soil run off) are accounted for in model calculations.	In our ecological exposure assessments, we do not have a detailed understanding on bioavailability in sludge for different types of chemicals (i.e., ionizing substances, surfactants, and metals). As a conservative practice, we assume any given type of chemicals in soil is 100% bioavailable.
Chile	-	-	-
France	INERIS produced a literature review of the research projects on the problematic of micropollutants in sludges issued from urban wastewater treatment system. This report treats of the following thematics : - Characterization of micropollutants in sludge - Substances potentially present in sludge - Fate of micropollutants during sludge treatment processes, - Transfers of	-	-

Respondent	Biosolids Data	Methods, tools and/or models used to estimate the human/ecological exposure resulting from biosolids land application	Related issues encountered for the estimates
	micropollutants in the environment after application of sewage sludge (soil, plants, aquatic environments, animals and air) - Health risks and environmental impacts.		
Italy	-	-	-
Japan	The transfer of chemical substances to the farmland from sewage sludge is not estimated.	-	-
Netherlands-RIVM	-	-	-
UK-Unilever	-	-	-
Norway	55% of the sludge is used in agriculture, 10% in parks and along roads, 10% for production of soil improving products, 8% is used as top soil for landfills, 2% is contaminated and will be deposited. The remaining 15 % is unaccounted for ("Other purposes"). Agriculture mostly means production of grains. Only minor volumes are used for tree-production. The land application method is "spread for solids", at a maximum rate of 4 tons/da with an interval of at least 10 years. (1 da is 1 000 m^2)	Each wastewater treatment plant above 2 000 pe has to monitor heavy metals in the sludge 3-12 times/year. Every 5 year a National survey is carried out, covering some 10 treatment plants. Then organic pollutants are monitored. All sludge that is to be used for any purpose will have to be stabilized and homogenized. All sludge will have to be monitored for (7 different) heavy metals and meet the threshold values to be used as for designated purposes (different classes for different use).	The content of pollution in the sludge has been steadily decreasing over the last 20 years with a few temporarily exceptions (like flame retardants).
Sweden	Based on data from 2010, the annual production of STP sludge in Sweden is 203 520 tonnes dry substance. Approximately 78 % of the sludge generated during 2010 was land applied. 25 % resp. 1	Normally we use the generic scenario in the EUSES model. In a higher tier measured soil concentrations may replace calculated concentrations.	We have the same issues as mention in the Canadian answer ("In our ecological exposure assessments, we do not have a good handle on

Respondent	Biosolids Data	Methods, tools and/or models used to estimate the human/ecological exposure resulting from biosolids land application	Related issues encountered for the estimates
	% was used within agriculture and forestry, 32 % was used as filling material (construction soil to roads, golf course, etc.) and 20 % was used as cover on landfills.		bioavailability for different types of chemicals (i.e. ionizing substances, surfactants, and metals). As a conservative practice, we assume any given type of chemicals in soil is 100% bioavailable.”).
USEPA-CEB	N.A.	N.A.	N.A.
USEPA-EAB	EPA does not collect this information. However this type of information has been collected by the North East Biosolids and Residuals Association (NEBRA) in A National Biosolids Regulation, Quality, End Use & Disposal Survey (2007). *www.nebiosolids.org/uploads/pdf/NtlBiosolidsReport-20July07.pdf*	There are on-going joint efforts by the Office of Water, Office of Pesticides Programs, and the Office of Pollution Prevention and Toxics to develop tools and models for estimating human and ecological exposure resulting from biosolids land application. The products are in development and have not yet been released for use[3].	Uncertainty in determining the source concentration.
UK-AstraZeneca	Sludge production and disposal in the UK: The UK produces 1.5 Million dry tonnes of sewage sludge per annum for use and disposal (see Table 9[4]). Landfill, which was always the less preferable option, is now used less due to increasing restrictions, lack of site availability and costs. So in simple terms, at present, sludges may be treated and used on land or vastly	We have used the approaches in the EU Technical Guidance Document on Risk Assessment of Chemicals (EC, 2003) and have been adopted in the REACH guidance.	The tools for estimating adsorption to soil and uptake into plants are based typically on hydrophobic interactions (based on kow). These are not appropriate for ionisable compounds. Where there are data gaps (e.g. kd for soil) estimation methods are used that

[3] The information on the contact person was removed for publication.

[4] The table 9 is available after this table.

Respondent	Biosolids Data	Methods, tools and/or models used to estimate the human/ecological exposure resulting from biosolids land application	Related issues encountered for the estimates
	reduced in volume by thermal destruction processes, principally incineration, with consequent disposal of ash (LeBlanc et al. 2008). The option most used in England and Wales is recycling to agricultural land as a fertiliser and soil conditioner. The term used for treated sludge used in accordance with legislation is 'biosolids'. Anglian, Southern, South West and Welsh water companies all dispose greater than 90% of their sludge to farmland. Sludge production and disposal for 2005 (LeBlanc, et al., 2008)		introduce uncertainty in the predictions. There are very few data on the ecotoxicity of pharmaceuticals to terrestrial organisms, which are exposed from biosolids application of contaminated sludge.
UK-Water Industry Research	In UK, about 70% of the biosolids generated are land applied. CIP data also includes sludge levels – UKWIR have also published other research on this: *www.ukwir.org/reports/11-rg-07-23/94185* *www.ukwir.org/reports/10-rg-07-19/93587*	See UKWIR PAH report: *www.ukwir.org/reports/11-rg-07-23/94185*	Lack of decent data

Water Company	Total Sludge	Used on Nonagricultural Land	Used on Agriculture Land	Disposed to Landfill	Incineration and other thermal destruction processes	Other
	(dt)	%	%	%	%	%

The table referenced by UK-AstraZeneca

Anglian	1 640 000	4.6	94.0	1.4	0.0	0
Northumbrian	66 000	5.8	67.1	1.3	0.0	25.8
Severn Trent	210 000	10.6	73.9	0.0	15.5	0.0
Southern	105 000	0.0	98.9	1.1	0.0	0.0
South West	57 000	0.0	99.3	0.7	0.0	0.0
Thames	264 000	9.1	60.3	0.0	30.5	0.0
United Utilities	22 800	17.2	64.9	0.1	17.8	0.0
Welsh	72 000	4.5	95.0	0.5	0.0	0.0
Wessex	68 000	18.6	81.4	0.0	0.0	0.0
Yorkshire	135 000	6.3	20.1	1.0	65.6	4.6
England and Wales	1 369 000	7.8	71	0.5	17.7	2.0
UK	1 509 000	5.2	67	1.5	19.5	1.8

Note: dt – dry tonnes

8 – Comments

This table includes any additional comments provided by respondents.

Respondent	Comments
Belgium-Brussels	None
Belgium-Flanders	None
Canada	It may be difficult to validate model predictions using measured concentrations around a wastewater treatment plant. The difficulty can arise from any of the following: • Both concentration and flow vary, while measurements only reflect a few points in time. • Measurements for influents and effluents may not be performed with a good hydraulic match, resulting in unmatched influent and effluent samples for removal calculations. • The plant conditions at the time of measurements may not be the same as those specified in a model, making model predictions less relevant. To overcome this difficulty, well controlled conditions as achieved in a lab-scale or pilot-scale system may be more appropriate for model validation.
Chile	None
France	None
Italy	None
Japan	None
UK-Unilever	There has recently been a 30 million GBP study conducted by the UK water industry (UKWIR) that has collected (1) effluent monitoring data from 150 plants across the UK (>220,000 data points) for a range of chemicals and operating conditions of a AS plants (2) influent, effluent, sludge for 28 plants (3) the impact of tertiary treatment technology on chemical removal (Gardner M. et al. 2012. The significance of hazardous chemicals in wastewater treatment works effluents. *Sci Total Environ* (in press)). We have used some of this data to help parameterize a probabilistic version of SimpleTreat.
Norway	None
Sweden	The STP module the EUSES model do not simulate the variations in wastewater temperature between winter and summer periods that occurs in more extreme parts of Europe (the south and north parts). Further, this variation leads to difficulties in evaluating how representative measured concentrations are. The relative low temperature in northern parts of Sweden causes limitation for implementation of nitrogen reduction techniques.
USEPA-CEB	None
USEPA-EAB	None
UK-AstraZeneca	It may be difficult to validate model predictions using measured concentrations around a wastewater treatment plant. Measurements in the field reflect spot samples and so it is difficult to calibrate models based on these data. Also it is commonly observed that sewage treatment removal of organic contaminants is vastly variable in time and between treatment plants of similar operational characteristics. The bacteria/micro-organisms are variable, adaptable and can be sensitive to chemical load. To overcome this difficulty, well controlled conditions as achieved in a lab-scale or pilot-scale system may be more appropriate for model validation.
UK-Water Industry Research	None