1. EMISSIONS FROM SEWAGE TREATMENT

1.1. Summary

Base Year: 2008
Up-to-date 2008 sewage datasets were obtained from WRc and were used to estimate emissions from sewage in the LAEI 2008.

Projection Years: 2011 and 2015
The up-to-date 2008 sewage datasets obtained from WRc were used as the base year dataset to project sewage emissions to 2011 and 2015.

1.2. 2008 emission estimation methodology

WRc provided the entire emission estimates for all the pollutants included in LAEI. The methodology for the 2008 Emissions from sewage treatment within Greater London is a commercially restricted document. Therefore only the summary is provided in this document.

The LAEI covers the following gaseous emissions:
- Oxides of nitrogen (NO_X);
- Sulphur dioxide (SO_2);
- Carbon monoxide (CO);
- Non-methane volatile organic carbon (NMVOC);
- Carbon dioxide (CO_2);
- Benzene;
- 1,3-butadiene;
- PM_{10};
- $PM_{2.5}$;
- Methane (CH_4);
- Nitrous oxide (N_2O);

With the co-operation of Thames Water Utilities Limited (TWUL) that owns and operates the eight sewage treatment works in Greater London, WRc has collected data that has been used to estimate values for LAEI. A spreadsheet was developed to input the data and calculate emission estimates from sewage treatment works for the LAEI for 2008. WRc followed the general approach defined by the EMEP/CORINAIR Emissions Inventory Handbook (2007)[1] for estimating emissions. The approach that WRc followed for each wastewater treatment works (WWTW) was as follows:

[1]The EMEP EEA Air Pollutant Emission Inventory Guidebook (June 2009) has superseded the EMEP/CORINAIR Atmospheric Emission Inventory Guidebook (2007), but the latest version was found not to add further value to the 2007 version in relation to emissions from the activities considered for this study. The 2007 version has been used for this study.

a) Identify the activities that occur on the WWTW;
b) Identify the SNAP97[2] codes that are associated with each particular activity.

The SNAP97 codes relevant to this study are listed in Table 1;
c) Obtain relevant activity data for each WWTW for 2008;
d) Obtain relevant emission factors (EF) for gaseous species and energy usage for each activity. Some gaseous species listed under LAEI were not expected to be present for particular activities or will be negligible;
e) Calculate emissions for LAEI; and
f) Produce an output of results for the LAEI.

Table 1: Relevant SNAP 97 codes

SNAP97 Code	Description
30103	Combustion in manufacturing industry - Combustion in boilers, gas turbines and stationary engines - Combustion plants < 50 MW (boilers).
30105	Combustion in manufacturing industry - Combustion in boilers, gas turbines and stationary engines - Stationary engines.
60502	Solvent and other product use - Use of HFC, N2O, NH3, PFC and SF6 - Refrigeration and air conditioning equipment.
80800	Other mobile sources and machinery – Industry.
90205	Waste treatment and disposal - Waste incineration - Incineration of sludge from waste water treatment.
091001 091002	Waste treatment and disposal - Other waste treatment - Waste water treatment in industry (091001), residential and commercial sectors (091002).

The inclusions and exclusions shown in Table 2 were applied during the process of estimating the emissions for LEGGI and LAEI.

[2] The EMEP EEA Air Pollutant Emission Inventory Guidebook (June 2009) uses a different system for categorising different types of activity compared with the SNAP97 codes and less categories are used. It was decided to use the SNAP97 codes which allow a greater breakdown of activities. If necessary, the values derived for the SNAP97 codes could be aggregated to produce the values for the categories set down in the 2009 version of the guidebook.

Table 2: Inclusions and exclusions for estimations of emissions for LAEI

Inventory	Inclusions	Exclusions
LAEI	Imported natural gas; Fuel oil used on site; Combustion processes; Non-CO2 gases from oxidation of organic material in wastewater treatment, anaerobic digestion of sludge and sludge thermal destruction.	Sewage sludge or ash transport and disposal; Screenings and grit transport disposal; Imported electricity; Manufacture and transport of chemicals used at the WWTWs; Emissions from water bodies receiving effluents; Short cycle carbon dioxide emissions.

1.3. Key assumptions

The following paragraphs describe important assumptions which are at the basis of the proposed calculations:

- An emission outputs are calculated on a calendar year basis;
- Due to lack of detailed data, all energy produced by combined heat and power (CHP) plants and sludge powered generators (SPG) is assumed to be renewable. This may not correspond to reality where fossil fuels such as gas oil and natural gas can be used in the combustion processes. This assumption may slightly affect the calculations of emission estimates from CHP plants and SPGs;
- The load on each works has been assumed to be equal to the average figure of 60 g BOD / pe/ day (where BOD is the load expressed as Biochemical Oxygen Demand, and pe is the population equivalent discharging to the WWTW);
- Emissions related to the production of heat energy from CHP plants have been zero rated. This is in accordance with the accounting requirements of the Carbon Reduction Commitment (CRC) and is only applicable to the amount of heat that is exported to another company. This assumption could slightly affect the calculations for energy use.

1.4. The uncertainty of emission estimates

The uncertainty associated to the emission estimates provided in this report has not been calculated. Each emission estimate carries a degree of uncertainty, depending on both the activity data and the emission factors (EF). If more complex calculations are used, other factors too will be affected by error to some extent (e.g. the calorific value of fuels).
Most of the data used in the calculations carried out for this study did not have an uncertainty figure associated to them. For instance, the EFs published by Defra / DECC do not include information on uncertainty, nor most of the data provided by TWUL.

However, should GLA decide to investigate the uncertainty associated with emissions from sewage treatment, it is recommended that the General Guidance Chapter on 'Uncertainties' (Chapter 5) of the EMEP / EEA Guidebook (2009) be followed.

The energy use data for the eight WWTW within Greater London are shown anonymously in the Table 3.

Table 3: Summary of total energy use for all wastewater treatment works within Greater London

Wastewater treatment totals by WWTW	Energy use: imported + on-site electricity and heat (kWh/yr)	On-site fuel (incl. biogas and sludge) combustion (kWh/yr)	Greenhouse Gases (kg CO_2e/yr)
WWTW1	113,471,376	415,760,614	83,739,125
WWTW2	75,193,382	172,640,863	56,982,968
WWTW3	64,249,584	125,850,763	60,624,167
WWTW4	19,335,079	45,110,503	17,120,761
WWTW5	12,084,658	0	8,789,573
WWTW6	34,401,196	52,413,524	30,208,908
WWTW7	11,878,543	23,500,620	12,669,191
WWTW8	11,266,318	13,382,291	15,575,290
TOTAL	341,880,136	848,659,178	285,709,983

For the purpose of spatially analysing and allocating sewage emission estimates across the study area at 1 km x 1km spatial resolutions, the UK Ordnance Survey National Grid Reference System was used as the geographical reference system.

1.5. Projection Years: 2011 and 2015

Projections of atmospheric emissions from sewage were based on future water consumption and hence demand. One of the greatest impacts on demand will be population change. The GLA draft Water Strategy[3] proposes that London's population is steadily growing, and is expected to rise from the present 7.56 million to between 8.79 and 9.11 million by 2031. Based on GLA figures, over period 2009 to 2015 there will be an increase in population of approximately 450,000 within the greater London region. This constitutes approximately 0.06% increase, approximately 0.00975% increase p.a. This increase in population inevitably brings with it an increase in sewage flow. This equates to an increase in flow of approximately 4 million m^3/year in 2010 and 26 million m^3/year by 2015.

The 5 year plan, which fits within this remit suggests there is a common acceptance that the economic downturn will result in a number of fundamental shifts in underlying economic activity that will affect our business over the 2010 to 2015 period. Reduced levels of both population growth and new housing

[3] http://www.london.gov.uk/mayor/environment/water/docs/draft-water-strategy.pdf

development have the direct effect of lowering our growth and revenue forecasts. This has not been considered in the forecast.

In order to project the energy consumption of the 8 WWTW, it was assumed, at the most simple level, based on population increase of 0.00975% pa that energy consumption will increase by 0.00975% p.a.

References

DECC, The Scottish Government, DOENI, Welsh Assembly Government (2009). The Carbon Reduction Commitment – User Guide. Draft Version, March 2009. http://www.defra.gov.uk/environment/climatechange/uk/business/crc/comply.htm#userguide

Defra / DECC (2009). 2009 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting. http://www.defra.gov.uk/environment/business/reporting/pdf/20090717-guidelines-ghg-conversion-factors.pdf

Draft Statutory Instruments (2009). The Carbon Reduction Commitment Order 2010. Draft May 2009.

EA (2007). EA Carbon Calculator. http://www.ea-transactions.co.uk/business/sectors/37543.aspx

EA (2009). Pollution Inventory. http://www.environment-agency.gov.uk/business/topics/pollution/32254.aspx

EC (2000). Waste Incineration Directive. Directive 2000/76/EC.

GLA (2008a). London Atmospheric Emission Inventory 2004; Emission Estimation Methodology Manual. Greater London Authority, February 2008.

GLA (2008b). London Energy and Greenhouse Gas Inventory 2004-2005; Methodology Manual. Greater London Authority, November 2008.

Hobson, J., Palfrey, R., Sivil, D., Palfrey, E., Day, M. (1996). Control Measures to Limit Methane Emissions from Sewage and Sludge Treatment and Disposal. WRc, Report No. DoE 4118.

IPCC (1996). Climate Change 1995. The Science of Climate Change. Contribution of Working Group 1 to the Second Assessment Report of the Intergovernmental Panel on Climate Change. (Ed. Houghton, J. T.), Cambridge University Press.

IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. H.S. Eggleston, L. Buendia, K. Miwa, T. Ngara, K. Tanabe (Eds.). IPCC/OECD/IEA/IGES, Hayama, Japan.

NAEI (2007). Emission Factors Database (Emission Factors used in the UK's National Atmospheric Emission Inventory). http://www.naei.org.uk/emissions/selection.php

Ofwat (2009). June Return. http://www.ofwat.gov.uk/regulating/junereturn/jrlatestdata/

Palfrey, R., Hobson, J., Lloyd, W. (1999). Measurements of Gas Emissions from Sewage and Sludge Collection, Treatment and Recycling. WRc report Ref. UC 3417 for Thames Water.

UKWIR (2008). Carbon Accounting in the UK Water Industry; Methodology for Estimating Operational Emissions. UKWIR report Ref. No. 08/CL/01/5.

UKWIR (2009). Workbook for Estimating Operational GHG Emissions – Version 3 – April 2009. UKWIR report Ref. No. 09/CL/01/9.

UNECE/EMEP TFEIP (2007). EMEP/CORINAIR Emission Inventory Guidebook – 2007. Technical report No. 16/2007. European Environment Agency, December 2007.

UNECE/EMEP TFEIP (2009). EMEP/EEA Air Pollutant Emission Inventory Guidebook – 2009. Draft Technical report /2009. European Environment Agency, June 2009.