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Biennial Review of 40 CFR Part 503 as Required under the Clean Water Act Section 405(d)(2)(C)

Biosolids Biennial Report Nº 8
(Reporting Period 2018–2019)

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U.S. Environmental Protection Agency
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This document can be downloaded from EPA's website at http://www.epa.gov/biosolids.

Definition of Biosolids

For the purposes of this biennial review, "biosolids" is used to mean sewage sludge, as defined in Title 40 of the Code of Federal Regulations (CFR) Part 503:

Sewage sludge is solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and a material derived from sewage sludge. Sewage sludge does not include ash generated during the firing of sewage sludge in a sewage sludge incinerator or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works (40 CFR § 503.9(w)).

Terms in italics are defined as follows:

> ***Domestic sewage*** is waste and wastewater from humans or household operations that is discharged to or otherwise enters a treatment works (40 CFR § 503.9(g)).
>
> ***Industrial wastewater*** is wastewater generated in a commercial or industrial process (40 CFR § 503.9(n)).
>
> ***Treatment works*** is either a federally owned, publicly owned, or privately owned device or system used to treat (including recycle and reclaim) either domestic sewage or a combination of domestic sewage and industrial waste of a liquid nature (40 CFR § 503.9(aa)).

Taken together, these definitions mean that biosolids, or sewage sludge, for the purposes of 40 CFR Part 503, are the residues from treatment of domestic sewage, whether that domestic sewage is combined with industrial wastewater or not. It does not include sludge originating from treatment of industrial wastes in the absence of domestic sewage.

Executive Summary

During the biennial review process, the U.S. Environmental Protection Agency (EPA) collected and reviewed publicly available information for (1) pollutants in biosolids that were newly identified during the literature search timeframe (2018-2019) for Biennial Report Nº 8; and (2) pollutants in biosolids that were previously identified in EPA national sewage sludge surveys conducted in 1988, 2001, and 2009 and/or in previous biennial reviews. Information was collected on the occurrence, fate and transport of these pollutants in the environment and their effects on human health and ecological receptors. The types of information collected are needed to conduct risk assessments.

As a result of a literature search, EPA found 18 new articles that provide relevant data on chemical pollutants that may occur in biosolids in the United States. The articles identified 116 new chemicals in biosolids: 50 polychlorinated biphenyls (PCBs) (39 congeners, 10 homologs and total PCBs); four pesticides; 19 flame retardants; eight perfluoroalkyl substances (PFAS); three antibiotics; one metal; two inorganics; and 29 other organics. The articles also identified new data for 48 chemicals that were previously identified in biosolids. Concentration data for biosolids were found for 61 of the 116 new chemicals and for 34 chemicals identified in previous biennial reviews.

EPA searched additional data sources for data needed for risk assessment. Human health toxicity values were found in multiple sources for four of the new chemicals and 112 previously identified chemicals. Ecological toxicity data were found for 63 newly identified chemicals and 71 previously identified chemicals in the ECOTOX database. Additional ecological toxicity data were found for 99 of the newly identified chemicals in the Estimation Programs Interface (EPI) Suite™ (U.S. EPA 2017). Physical-chemical properties were identified for 102 new chemicals and five previously identified chemicals. Bioconcentration or bioaccumulation factors were identified for one new chemical in the literature; for 99 new chemicals in EPI Suite; and for 40 new chemicals in peer-reviewed databases maintained by Arnot and Gobas (2006), Environment and Climate Change Canada (2006), and Oak Ridge National Laboratory (2020).

Two of the new articles provided relevant data for microbial pollutants that may occur in U.S. biosolids. Review of these articles identified five new microbial pollutants in biosolids and data for five previously identified microbial pollutants.

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1 Introduction

Section 405(d) of the Clean Water Act (CWA) requires the U.S. Environmental Protection Agency (EPA) to review sewage sludge regulations every two years to identify any additional pollutants that may occur in biosolids and to set regulations for those pollutants if sufficient scientific evidence shows they could harm, or present a risk to, human health or the environment. EPA's biennial review process is intended to assist in fulfilling this CWA requirement. The data gleaned from the process are analyzed to determine whether they are sufficient to be used for assessing potential risk. Reports documenting the findings of the biosolids biennial reviews are posted to EPA's website for 2005 (Biennial Report Nº 1), 2007 (Biennial Report Nº 2), 2009 (Biennial Report Nº 3), 2011 (Biennial Report Nº 4), 2013 (Biennial Report Nº 5), 2015 (Biennial Report Nº 6), and 2017 (Biennial Report Nº 7) (see https://www.epa.gov/biosolids/biennial-reviews-sewage-sludge-standards).

Once additional pollutants that may occur in biosolids are identified, EPA assesses the pollutants to determine whether they pose a risk to human health or the environment. EPA is currently developing a prioritization process and screening model to evaluate pollutants found in biosolids for potential risk. The screening results will be used to make informed decisions about the need to perform more refined risk assessments or to address data gaps or uncertainties. EPA is also developing a probabilistic risk assessment modeling framework to conduct more refined assessments of pollutants that fail the screening process.

Addressing potential risk from pollutants identified in biosolids is the top priority for EPA's Biosolids Program. EPA continues to make significant progress in building capacity to assess pollutants by developing the required tools and data, and expects to begin risk evaluations once review of its screening model has been completed.

Biennial Report Nº 8 provides the approach used and the results of EPA's 2018–2019 biosolids biennial review.

2 Approach for the 2018–2019 Biennial Review

Every two years, EPA collects and reviews publicly available information about pollutants that have been found in biosolids in the United States. The types of data gleaned from the biennial reviews and presented here are needed to conduct risk assessments.

- **Occurrence and Concentration**. Both the ability to detect a given pollutant in biosolids and the determination of the concentration at which that pollutant is present are highly dependent on the existence of analytical methods for the pollutant in the biosolids matrix.
- **Toxicity to Human Health.** These data include values such as reference doses (RfDs), reference concentrations (RfCs), cancer slope factors (CSFs), and inhalation unit risks (IURs).
- **Toxicity to Ecological Receptors**. These data include values such as lethal dose, lethal concentration, and chronic endpoints related to survival, growth, and reproduction.
- **Environmental Fate and Transport**. These data are necessary for assessing exposure and include various physical-chemical properties as well as bioconcentration or bioaccumulation factors (BCFs and BAFs, respectively), which describe the tendency of a chemical to move from one medium (e.g., soil) to another (e.g., plant matter).

2.1 Two-Phase Literature Search and Review

The 2018–2019 biennial review process consisted of a series of steps designed to effectively search for and review data on chemical and microbial pollutants and was divided into the following phases (Figure 1):

- **Phase 1. Search for Pollutant Occurrence**. EPA conducted a search of open literature published from January 2018 through December 2019 for papers that provided evidence of the occurrence of chemical or microbial pollutants in biosolids in the United States and Canada. EPA reported available concentration data for both newly found and previously found chemicals in biosolids. EPA did not search the open literature for the 10 metals already regulated under 40 CFR Part 503: arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc.
- **Phase 2. Searches for Data Collection**. For newly identified chemicals found in biosolids, EPA conducted additional literature searches not limited to 2018–2019 and collected data for environmental fate and transport, and human health and ecological effects. For chemicals previously found to occur in biosolids, based on EPA national sewage sludge surveys and previous biennial reviews, EPA collected environmental fate and transport data if those data also were included in literature identified in phase 1 of the 2018–2019 search. The literature search for human toxicity data was not limited to 2018–2019 reporting period while the literature search for ecological toxicity data was limited to 2018–2019. No additional literature searches were conducted for microbial pollutants.

In the Phase 2 search, for *newly* identified chemicals, EPA typically does not limit the time period for the search for human health toxicity data in the databases or for ecological toxicity information in the ECOTOXicology knowledgebase (ECOTOX). Also, for data on chemicals *previously* identified in past biennial reviews, data sources are searched within the 2018–2019 time period. For the 2018-2019 biennial review, EPA took this approach for the ecological toxicity information search but took a slightly different approach for the human health toxicity data search. For the 2018-2019 biennial review, EPA updated the human toxicity data sources searched to be consistent with other human health effects assessments conducted by the EPA's Office of Water. Therefore, for Biennial Report Nº 8we did not limit the review search period to 2018-2019 for human toxicity data for *previously* identified chemicals.

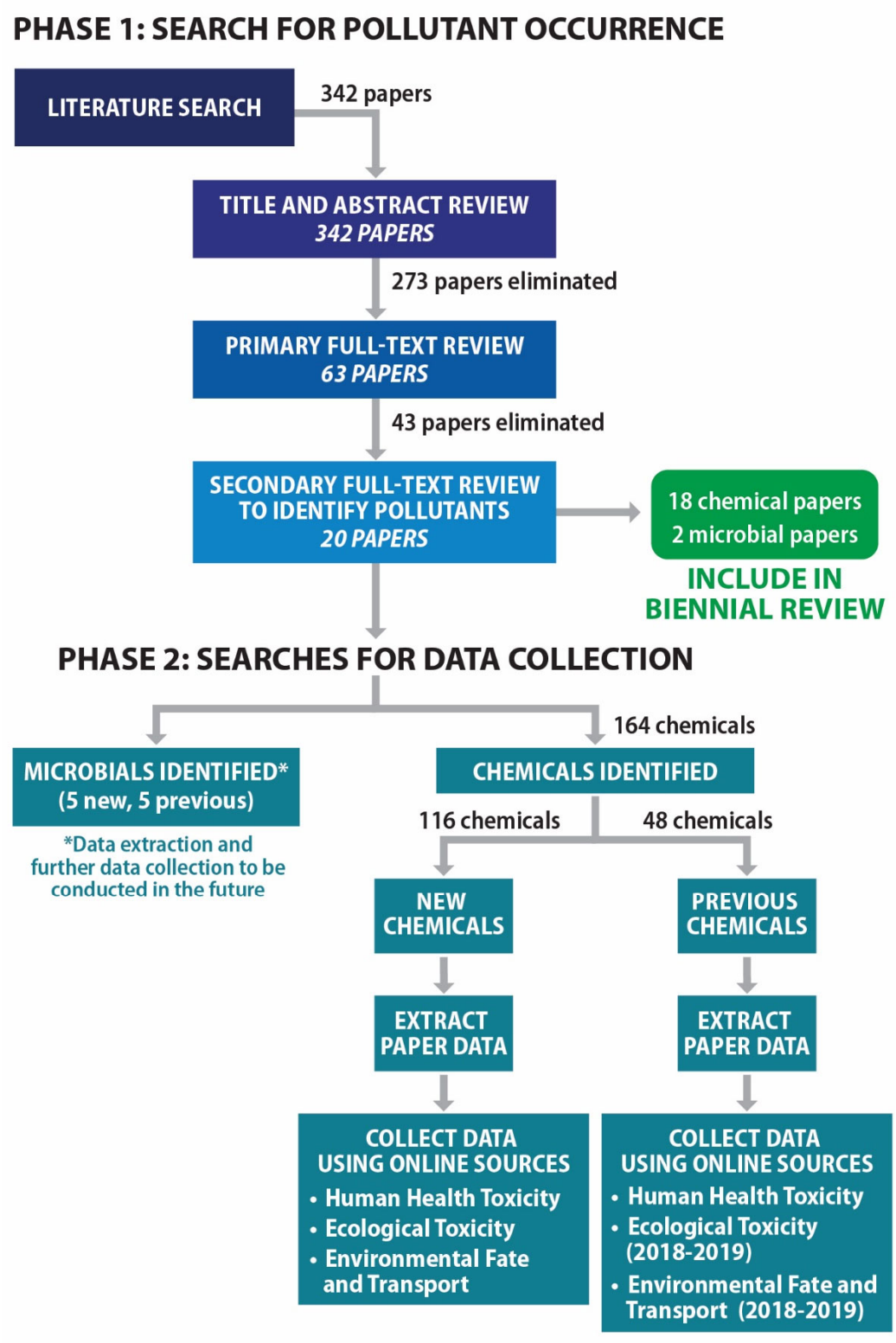

Figure 1. Overview of the 2018–2019 Biennial Review Process.

2.2 Literature Identification and Review

2.2.1 Literature Search for Pollutant Occurrence

EPA conducted a literature search for articles published in peer-reviewed, English language-based journals. The search, conducted for the period of January 2018 through December 2019, focused on identifying data published in electronically or print since the previous biennial review search period ended in December 2017. The bibliographic databases searched for the current review included ProQuest, PubMed, and Web of Science. Conference abstracts, reports, comments, letters, and editorials were excluded.

For chemical pollutants, health-related keywords were combined with chemical-related keywords and land application keywords. Geographical search terms were used to restrict the searches to studies conducted in the United States and Canada. Asterisks at the end of a search term broadened the search by returning results of that term with any relevant ending. Specifically, to be identified as a candidate, a paper had to have at least one biosolids-related keyword, one chemical keyword, one land application keyword, one health-related keyword, and one geographic keyword, based on the following search strings:

- ***Biosolids-related keywords***: sewage sludge OR biosolids OR treated sewage OR sludge treatment OR sewage treatment

  AND

- ***Land application-related keywords***: land application OR farm OR agriculture OR soil

  AND

- ***Chemical-related keywords***: pollutant* OR toxic* OR chemical OR constituent OR contaminant* OR metal* OR dioxin* OR inorganic* OR organic* OR flame retardant* OR pharmaceutical* OR steroid* OR hormone* OR antibiotic* OR (personal care product*)

  AND

- ***Property-related eywords***: occurrence OR concentration OR effect* OR propert* OR fate OR transport OR health

  AND

- ***Geographical keywords***: United States OR Canada OR USA OR U.S.A. OR U.S. OR US

For microbial pollutants, health-related keywords were combined with microbial pollutant-related keywords and land application keywords. Land-application keywords were retained because 40 CFR § 503.32(b)(5) includes site restrictions specific to land application of Class B biosolids that allow time for environmental conditions to further reduce pathogen levels. Geographical search terms were used to restrict the searches to studies conducted in the United States and Canada. Specifically, to be identified as a candidate, a paper had to have at least one biosolids-related keyword, one land application-related keyword, one microbial pollutant-related keyword, one property-related keyword, and one geographic keyword, based on the following search strings:

- ***Biosolids-related keywords***: sewage sludge OR biosolids OR treated sewage OR sludge treatment OR sewage treatment

  AND

- ***Land application-related keywords***: land application OR farm OR agriculture OR soil

AND

- ***Microbial pollutant-related keywords***: pathogen* OR Salmonella OR microb*

  AND

- ***Property-related keywords***: occurrence OR concentration OR effect OR propert* OR fate OR transport OR health

  AND

- ***Geographical keywords***: United States OR Canada OR USA OR U.S.A. OR U.S. OR US

2.2.2 Occurrence Literature Selection and Review

For the papers identified in the chemical and microbial literature searches for the occurrence of pollutants in biosolids (Phase 1), EPA first screened the citation titles and eliminated papers based on their titles if it was possible to determine the papers did not provide relevant data for pollutants that might occur in U.S. biosolids. Studies not related to biosolids or not conducted in the United States or Canada were eliminated from further evaluation.

For the remaining papers, EPA reviewed their abstracts and eliminated papers based on the following five criteria:

1. Endpoints are not pollutant-specific (i.e., overall effects of biosolids on plant growth, crop yield, soil microbe community, or soil nutrients).
2. The medium evaluated is not primarily sewage sludge, as defined in 40 CFR Part 503, including:
    a. influent and effluent wastewater;
    b. industrial sewage sludge (e.g., pulp and paper mill residuals);
    c. activated carbon;
    d. activated sludge;
    e. biochar; and
    f. biosolids compost.
3. Only an analytical method or effectiveness-of-treatment method is described and no data are provided on pollutant concentration in biosolids.
4. The study was conducted outside of the United States. or Canada.

Finally, EPA reviewed the full text of remaining papers. During this review, additional papers were eliminated based on the five exclusion criteria outlined previously. Papers were also eliminated based on the following three criteria:

1. Only spiked concentration data were reported.
2. There was no evidence of the occurrence of new pollutants in biosolids AND no new data were reported for previously identified chemicals.
3. The only reported data were for metals in biosolids that are already regulated (i.e., arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium and zinc).

Appendix A provides abstracts of the papers retained after full-text review for chemical pollutants (18 papers) and microbial pollutants (two papers).

2.3 Chemical Data Collection

Information on pollutants in biosolids was collected on their occurrence and concentration, fate and transport, and their human health and ecological effects. This section provides detailed information. Appendix B provides a complete list of new and previously identified pollutants in biosolids.

2.3.1 Human Health Toxicity Value Sources and Selection

EPA uses human health effects information to assess the potential risk from pollutants that occur in biosolids. Specifically, EPA uses RfD and RfC values to evaluate noncancer risk associated with oral and inhalation exposures, respectively. Oral CSF and IUR values are used to evaluate risk from carcinogens associated with oral and inhalation exposures, respectively. These four values were searched for and obtained for existing and newly identified chemicals found in biosolids during this review for Biennial Report Nº 8. The search for human toxicity data was not time-limited for this biennial review.

EPA's Integrated Risk Information System (IRIS) is considered the preferred source for human health toxicity values for most EPA risk assessments and was the primary source of toxicity values for this review (U.S. EPA 2020a).

IRIS does not contain toxicity values for all chemicals and some chemicals with a toxicity value in IRIS do not necessarily have all four of the values EPA uses for risk assessments (RfD, RfC, CSF, and IUR) Therefore, EPA conducted a search of peer-reviewed, publicly available sources to obtain oral toxicity values (RfD or CSF) and the inhalation toxicity values (RfC or IUR) for potential use in biosolids risk assessments. EPA also searched for toxicological assessments from EPA program offices, other national and international programs, and state programs. The following data sources were searched:

- **Human Health Benchmarks for Pesticides (HHBPs)**: EPA Office of Pesticide Programs risk assessments for pesticides using health effects data submitted during the pesticide registration process (U.S. EPA 2020b).
- **Provisional Peer-Reviewed Toxicity Values (PPRTVs)** PPRTVs are peer reviewed toxicity values that address chronic and sub-chronic exposure. EPA's Office of Research and Development (ORD) develops PPRTVs in support of EPA's Superfund Program.(U.S. EPA 2020c).
- **Health Effects Support Documents (HESDs)**: EPA's Office of Science and Technology (within EPA's Office of Water) develops toxicity values for chemicals in drinking water in these peer-reviewed documents (U.S. EPA 2020e).
- **Agency for Toxic Substances and Disease Registry (ATSDR)**: ATSDR develops oral and inhalation minimum risk levels (MRLs) that are oral noncancer toxicity values equivalent to RfDs and RfCs, respectively (ATSDR 2020).
- **California Environmental Protection Agency (CalEPA)**: CalEPA develops reference exposure levels that are noncancer toxicity values equivalent to RfDs or RfCs, and cancer potency factors that are equivalent to CSFs or IURs (CalEPA 2015).
- **Health Canada**: Health Canada develops guidelines and technical documents with tolerable daily in-take values that are noncancer toxicity values used in risk evaluation (Health Canada 2020).

2.3.2 Ecological Toxicity Value Sources and Selection

To evaluate the potential for ecological risks from biosolids, EPA assesses direct contact and ingestion pathways for aquatic and terrestrial species. For the direct contact exposure pathway, species assemblages (or communities) are assessed in soil, sediment, and surface water where they are assumed to be exposed through direct contact with the contaminated medium. For the ingestion pathway, species are assumed to ingest contaminated food and prey from biosolids-treated agricultural fields and from farm ponds that receive runoff from biosolids-treated fields. The ecological toxicity values are expressed in terms of media concentration (e.g., milligrams [mg] per liter [L] for surface water and mg/kilograms [kg] for soil) for the direct contact pathway and in terms of dose (mg/kg/day) for the ingestion pathway.

ECOTOXicology Knowledgebase (ECOTOX)

ECOTOX (U.S. EPA 2020d) is a comprehensive database providing single chemical environmental toxicity data on aquatic life, terrestrial plants and wildlife. For known chemicals, the search was limited to data added to ECOTOX from studies published in 2018–2019. For newly identified chemicals in biosolids, the search was not time-limited.

To be included in ECOTOX, studies must meet the following ECOTOX applicability criteria:

- The toxic effects are related to single-chemical exposure.
- A biological effect on live, whole organisms is reported.
- Chemical test concentrations are reported.
- There is an explicit duration of exposure.
- Toxicology information is reported for the chemical of concern.
- The paper is published in the English language.
- The paper is available as a full article (not an abstract).
- The paper is publicly available.
- The paper is the primary source of the data.
- A calculated endpoint is reported or can be calculated using reported or available information.
- Treatment(s) are compared to an acceptable control.
- The location of the study (e.g., laboratory versus field) is reported.
- The tested species is reported (with recognized nomenclature).

EPA considered studies from the open literature papers in ECOTOX potentially relevant for inclusion in its risk assessments.

Ecological Structure Activity Relationships

EPA also searched for ecotoxicity data in the Estimation Programs Interface (EPI Suite), a group of physical-chemical property and environmental fate estimation programs developed by EPA and Syracuse Research Corporation (U.S. EPA 2017). EPI Suite contains predicted values generated by the Ecological Structure Activity Relationships (ECOSAR) program (U.S. EPA 2017). EPA extracted the following ECOSAR data for this biennial review for newly identified chemicals:

- Chemical class
- Organism common name
- Duration
- Endpoint
- Predicted value

For previously identified chemicals, no new data were available in EPI Suite; it was last updated in 2017. Data contained in EPI Suite prior to 2017 were captured in the 2016-2017 biennial review process for Biennial Report Nº 7.

2.3.3 Environmental Fate and Transport Data

EPA uses risk assessment models that require physical-chemical properties and transfer factors to estimate the potential for chemical transport and uptake from agricultural lands amended with biosolids.

Physical-Chemical Properties

EPA's preferred source for physical-chemical properties is EPI Suite, (U.S. EPA 2017). It uses available physical-chemical inputs to estimate physical-chemical properties and bioconcentration factors (BCFs)bioaccumulation factors (BAFs). EPI Suite sometimes uses more than one method to estimate a property. In some of these cases, results for both methods were extracted. Physical-chemical properties extracted from EPI Suite for chemicals newly identified during this biennial review include the following:

- Molecular weight
- Solubility
  - Method 1: based on log K_{ow}
  - Method 2: estimated using a "fragment constant" method
- Vapor pressure
- Henry's law constant
  - Method 1: group contribution
  - Method 2: bond contribution
- Log octanol-water partition coefficients (log K_{ow})
- Soil-water partition coefficient (K_{oc})
  - Method 1: Sabljic molecular connectivity method
  - Method 2: based on log K_{ow}
- Degradation rates in air, water, and soil
- Air overall OH degradation rate constant
- Air overall ozone degradation rate
- Air fraction sorbed to airborne particulates
  - Method 1: Junge-Pankow/Mackay average
  - Method 2: based on K_{oa}
- Fugacity in air, water, and soil
- Advection in air, water, and soil

EPA also searched for and extracted data from the Oak Ridge National Laboratory (ORNL) Risk Assessment Information System (RAIS) database (ORNL 2020) for several additional parameters that are not available in EPI Suite. These parameters include the following:

- Diffusivities in air and water
- Soil-water partition coefficient (K_d)
- Organic carbon partition coefficient (F_{oc})

Uptake and Transfer Factors

For many organic chemicals, the plant and animal product uptake and transfer factors can be estimated using empirical relationships between the transfer factor and log K_{ow}. BCFs are preferred

over estimated transfer factors if available. If some physical-chemical property data were available, fish BCFs and BAFs were estimated using EPI Suite, and the following data were searched for and extracted during this biennial review:

- Log BCF (regression-based estimate)
- Log BCF and BAF (Arnot-Gobas upper, mid, and lower trophic; Arnot and Gobas 2006)

EPA also searched for and extracted species-specific, field-measured BAFs and laboratory-measured BCFs from two peer-reviewed, publicly available databases—Arnot and Gobas (2006) and Environment and Climate Change Canada (2006)—as well as bioaccumulation values published by ORNL (2020). These sources are routinely used by EPA in risk-based assessments. These data included the following:

- Log BCF or BAF
- Organism scientific name
- Organism common name

The ORNL RAIS database (ORNL 2020) contains additional uptake and transfer data, which were also searched for and extracted. These include the following:

- Diffusivities in air and water
- Soil-to-dry plant uptake
- Soil-to-wet plant uptake
- Beef transfer coefficient
- Milk transfer coefficient
- Soil-water partition coefficient (K_d)
- Organic carbon partition coefficient (F_{oc})

3 Results from the 2018–2019 Biosolids Biennial Review

During the 2018–2019 biennial review, EPA identified 18 articles that met the eligibility criteria for chemicals. Review of these articles identified 116 new chemicals that occur in biosolids (see Table 1): 50 polychlorinated biphenyls (PCBs) (39 congeners, 10 homologs, and total PCB); four pesticides; 19 flame retardants; eight perfluoroalkyl substances (PFAS); three antibiotics; one metal; two inorganics; and 29 other organics. These articles also provided new or additional data on 48 previously identified chemicals (see Table 2). Of the 18 papers, 12 identified or provided data on new chemicals and 15 provided data on previously identified chemicals. Abstracts for all the articles are provided in Appendix A. Data identified from all sources EPA reviewed include the following:

- Concentration data for 61 newly identified chemicals and 34 previously identified chemicals (see Appendix C).
- Human health toxicity data for four newly identified chemicals and 112 previously identified chemicals (see Appendix D).
- ECOTOX records for 63 newly identified chemicals and 71 previously identified chemicals (see Appendix E).
- ECOSAR toxicity data for 99 newly identified chemicals (see Appendix E).
- BAFs and BCFs for 99 newly identified chemicals (see Appendix F).
- Physical-chemical property data for 102 newly identified chemicals and five previously identified chemicals (see Appendix G).

3.1 Chemicals Newly Identified in the 2018–2019 Biennial Review

Table 1 lists the 116 chemicals newly identified as occurring in biosolids in the 2018-2019 biennial review[1].

Concentration data for 61 newly identified chemicals were extracted from the reviewed literature. These data are provided in Appendix C. Additional chemicals were detected in biosolids, but concentration values were not extracted because either the values were reported only in graphical form, the values were tentatively identified values, or the occurrence of the chemical was noted in the paper but concentration data were not provided. The chemicals for which concentration values were not collected include 55 newly identified chemicals (39 PCB congeners, 10 PCB homologs, and six PFAS).

Human health toxicity values were found for four chemicals newly identified in biosolids during this review period. Data were found in four different sources (ATSDR, CalEPA, IRIS, and PPRTV). These values are reported in Appendix D.

Ecotoxocoty data were found in published studies for 63 newly identified chemicals in ECOTOX (U.S. EPA 2020d). The results are presented in Appendix E, Table E-1. These papers will require further evaluation for relevance for inclusion in risk assessments.

Ecotoxicity data from EPI Suite were identified for 99 newly identified chemicals. These values are provided in Appendix E, Table E-3.

BAFs were available from the papers reviewed for one of the newly identified chemicals. These values are provided in Table F-1 in Appendix F. BAFs and BCFs were reported by trophic level for 99 of the newly identified chemicals in EPI Suite, but the values are not species-specific. They are provided in Table F-2 in Appendix F. Additionally, species-specific, field-measured BAFs and laboratory-measured BCFs were found in peer-reviewed databases published by Arnot and Gobas (2006), Environment and Climate Change Canada (2006), and ORNL (2020) for 40 of the newly identified chemicals; these data are provided in Tables F-1 and F-3.

Table G-1 in Appendix G presents the physical-chemical properties for 31 of the newly identified chemicals as obtained from the papers reviewed.

[1] Table 1 includes 39 PCB congeners, 10 PCB homologs, and total PCBs, which were reported in Needham and Ghosh 2019. Needham and Ghosh (2019) used an adapted version of U.S. EPA SW-846 method 8082A for PCB analysis which provides procedures for determining a selected group of the 209 possible PCB congeners representing the most common congeners historically used in Aroclor commercial mixtures. They measured 129 commonly detected PCB congeners in their study, of which some were reported as the sum of two congeners per method 8082A. Total PCB concentrations were calculated as the sum of the PCB congeners/congener groups representing the most common congeners historically used in the Aroclor commercial mixtures detected using method 8082A. Additionally, the authors reported concentrations of 10 PCB homologs detected in biosolids using their results from method 8082A. Some of the PCB congeners in Table 2 are also part of the PCB homologs and total PCB, and thus they could be considered triple counted.

Additionally, physical-chemical properties were extracted from EPI Suite and ORNL for 99 of the newly identified chemicals, and are provided in Tables G-2 through G-5 in Appendix G. As described in Section 2.2.3, no new data for previously identified chemicals were available.

Table 1. Chemicals Newly Identified in Biosolids in the 2018–2019 Reporting Period and Types of Data Available

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
2,2',3,3',4,4',5,6'-Octachlorobiphenyl	42740-50-1	PCB	✖	✖	I	K
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	PCB	✖	✖	H I	K M N
2,2',3,3',4,4'-Hexachlorobiphenyl	38380-07-3	PCB	✖	✖	H I	K M
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	PCB	✖	✖	I	K M
2,2',3,3',4,5-Hexachlorobiphenyl	55215-18-4	PCB	✖	✖	I	K
2,2',3,3',4,6-Hexachlorobiphenyl	61798-70-7	PCB	✖	✖	I	K
2,2',3,3',5,5',6-Heptachlorobiphenyl	52663-67-9	PCB	✖	✖	I	K
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	PCB	✖	✖	I	K M
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	PCB	✖	✖	I	K M
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	PCB	✖	✖	H I	K M N
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	PCB	✖	✖	H I	K M
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	PCB	✖	✖	I	K M
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	PCB	✖	✖	H I	K M
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	PCB	✖	✖	I	K M
2,2',3,5-Tetrachlorobiphenyl	70362-46-8	PCB	✖	✖	I	K
2,2',3,6-Tetrachlorobiphenyl	70362-45-7	PCB	✖	✖	I	K
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	PCB	✖	✖	H I	K M
2,2',4,4'-Tetrachlorobiphenyl	2437-79-8	PCB	✖	✖	H I	K M
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	PCB	✖	✖	H I	K M
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	PCB	✖	✖	H I	K M
2,2',4,5-Tetrachlorobiphenyl	70362-47-9	PCB	✖	✖	H I	K
2,2',4,6'-Tetrachlorobiphenyl	68194-04-7	PCB	✖	✖	I	K
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	PCB	✖	✖	H I	K M
2,2',6-Trichlorobiphenyl	38444-73-4	PCB	✖	✖	H I	K
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	38051-10-4	Other organics	✔	✖	H I	J K

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
2,2'-Dichlorobiphenyl	13029-08-8	PCB	✗	✗	H I	K M
2,3,3',4,4',5,6-Heptachlorobiphenyl	41411-64-7	PCB	✗	✗	H I	K
2,3,3',4,4',6-Hexachlorobiphenyl	74472-42-7	PCB	✗	✗	I	K
2,3,3',4',5,6-Hexachlorobiphenyl	74472-44-9	PCB	✗	✗	I	K
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	PCB	✗	✗	I	K M
2,3,4'-Trichlorobiphenyl	38444-85-8	PCB	✗	✗	H I	K M
2,3,6-Trichlorobiphenyl	55702-45-9	PCB	✗	✗	I	K
2,3',6-Trichlorobiphenyl	38444-76-7	PCB	✗	✗	I	K
2,3-Dichlorobipheny	16605-91-7	PCB	✗	✗	H I	K M
2,4',5-Trichlorobiphenyl	16606-02-3	PCB	✗	✗	H I	K M
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	Other organics	✓	✗	H I	K L M
2,4'-Dichlorobiphenyl	34883-43-7	PCB	✗	✗	H I	K M
2,4-Di-tert-butylphenol (2,4-DTBP)	96-76-4	Other organics	✓	✗	I	K L
2,4-Di-tert-pentylphenol (2,4-DTPP)	120-95-6	Other organics	✓	✗	I	K
2,5-Di-tert-butylphenol (2,5-DTBP)	5875-45-6	Other organics	✓	✗	I	K L M
2,6-Dichlorobiphenyl	33146-45-1	PCB	✗	✗	I	K
2-Butoxy-, hydrogen phosphate ethanol	14260-97-0	Other organics	✓	✗	I	J K
2-Chlorobiphenyl	2051-60-7	PCB	✗	✗	H I	K
2-Ethylhexyl diphenyl phosphate	1241-94-7	Flame retardant	✓	✗	H I	J K L M
2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	PFAS	✓	✗	H	✗
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	Other organics	✓	✗	✗	✗
3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-Henicosafluorododecyl 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl hydrogen phosphate	1158182-60-5	PFAS	✓	✗	✗	✗
3,4,4'-Trichlorobiphenyl	38444-90-5	PCB	✗	✗	H I	K
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-	4221-80-1	Other organics	✓	✗	I	K

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
dimethylethyl)phenyl ester benzoic acid						
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)	96-69-5	Other organics	✔	✖	I	K
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)	118-82-1	Other organics	✔	✖	I	K
4,4',4''-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol	1843-03-4	Other organics	✔	✖	I	K
4-Chlorobiphenyl	2051-62-9	PCB	✖	✖	H I	K N
4-(Butan-2-yl)-2,6-di-tert-butylphenol	17540-75-9	PFAS	✔	✖	I	K
6:2 Fluorotelomer phosphate diester	57677-95-9	PFAS	✖	✖	H	✖
6:2 Fluorotelomer sulfonic acid	27619-97-2	PFAS	✖	✖	H I	K
6:2/8:2 Fluorotelomer phosphate diester (diPAPs)	943913-15-3	PFAS	✖	✖	✖	✖
8:2 Fluorotelomer phosphate diester	678-41-1	PFAS	✖	✖	H	✖
8:2 Fluorotelomer sulfonic acid	39108-34-4	PFAS	✖	✖	I	K
Ammelide	645-93-2	Other organics	✔	✖	I	J K
Ammeline	645-92-1	Other organics	✔	✖	H I	J K
Amoxicillin	26787-78-0	Antibiotic	✔	✖	H I	K
Ampicillin	69-53-4	Antibiotic	✔	✖	H I	K
Bis(1,3-dichloropropan-2-yl) hydrogen phosphate	72236-72-7	Flame retardant	✔	✖	✖	J
Bis(1-cloropropan-2-yl) hydrogen phosphate	789440-10-4	Flame retardant	✔	✖	✖	✖
Bis(2-chloroethyl) phosphate	3040-56-0	Other organics	✔	✖	I	J K
Bis(2-ethylhexyl) phosphate	298-07-7	Other organics	✔	✖	H I	J K L M
Bis(2-methylphenyl) hydrogen phosphate	35787-74-7	Other organics	✔	✖	I	J K
Bisphenol A bis(diphenyl phosphate) (BDP)	5945-33-5	Other organics	✔	✖	✖	J
Cesium	7440-46-2	Metals	✔	✖	H	K
Cresyl diphenyl phosphate (CDPP)	26444-49-5	Flame retardant	✔	✖	H I	J K L M
Cyanuric acid	108-80-5	Other organics	✔	✖	H I	J K
Decachlorobiphenyl	2051-24-3	PCB	✖	✖	H I	K M
Dibutyl ester phosphoric acid	107-66-4	Other organics	✔	✖	H I	J K

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
Dichlorobiphenyl	25512-42-9	PCB	✗	✗	I	K M
Diethyl hydrogen phosphate	598-02-7	Flame retardant	✓	✗	H I	J K
Diisobutyl hydrogen phosphate	6303-30-6	Other organics	✓	✗	I	J K
Diphenyl phosphate (DPHP)	838-85-7	Other organics	✓	✗	I	J K
Dipropyl ester phosphoric acid	1804-93-9	Other organics	✓	✗	I	J K
Fipronil amide	205650-69-7	Pesticides	✓	✗	H	✗
Fipronil desulfinyl	205650-65-3	Pesticides	✓	✗	H	✗
Fipronil sulfide	120067-83-6	Pesticides	✓	✗	H	✗
Fipronil sulfone	120068-36-2	Pesticides	✓	✗	H	✗
Heptachlorobiphenyl	28655-71-2	PCB	✗	✗	I	K
Hexachlorobiphenyl	26601-64-9	PCB	✗	✗	H I	K M
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	Flame retardant	✓	✗	H I	J K L M N
Melamine	108-78-1	Other organics	✓	✗	H I	J K L M
Monochlorobiphenyl	27323-18-8	PCB	✗	✗	H I	K
Nalidixic acid	389-08-2	Antibiotic	✓	✗	H I	K
Nonachlorobiphenyl	53742-07-7	PCB	✗	✗	I	K
Octachlorobiphenyl	55722-26-4	PCB	✗	✗	H I	K
Pentachlorobiphenyl	25429-29-2	PCB	✗	✗	H I	K
Polycarbonate (PC)	25766-59-0	Other organics	✓	✗	✗	✗
Polychlorinated biphenyl (PCB)	1336-36-3	PCB	✓	A E F	H I	J K M N
Polyethylene terephthalate (PET)	25038-59-9	Other organics	✓	✗	✗	✗
Resorcinol bis(diphenyl phosphate) (RDP)	57583-54-7	Flame retardant	✓	✗	H I	J K
Sodium perfluorodecanesulfonate (PFDS)	2806-15-7	PFAS	✗	✗	✗	✗
Sulfate	14808-79-8	Inorganics	✓	✗	I	K
Sulfur	7704-34-9	Inorganics	✓	✗	H	K N
Terephthalic acid (TPA)	100-21-0	Other organics	✓	✗	✗	✗
Tert-butylphenyl diphenyl phosphate	56803-37-3	Flame retardant	✓	✗	H I	J K L
Tetrabutyl ethylidenebisphenol (AO22E46)	35958-30-6	Other organics	✓	✗	I	K
Tetrachlorobiphenyl	26914-33-0	PCB	✗	✗	H I	K M
Tributyl phosphate	126-73-8	Flame retardant	✓	C	H I	J K L M N

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
Trichlorobiphenyl	25323-68-6	PCB	✗	✗	I	K M
Triethyl phosphate (TEP)	78-40-0	Flame retardant	✓	✗	H I	J K L M
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)	36443-68-2	Other organics	✓	✗	I	K
Triisobutyl phosphate	126-71-6	Flame retardant	✓	✗	H I	J K
Trimethyl phosphate (TMP)	512-56-1	Flame retardant	✓	C	H I	J K L M N
Trimethylsilanol (TMS)	1066-40-6	Other organics	✓	✗	I	K
Tripropyl phosphate	513-08-6	Flame retardant	✓	✗	H I	J K
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	Flame retardant	✓	✗	H I	J K L M N
Tris(2-chloroisopropyl) phosphate	13674-84-5	Flame retardant	✓	C	H I	J K L M N
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	Flame retardant	✓	C	H I	J K L M N
Tris(4-tert-butylphenyl) phosphate	78-33-1	Flame retardant	✓	✗	I	J K
Tris(methylphenyl) phosphate	1330-78-5	Flame retardant	✓	✗	H I	J K

✓ = Literature data (Table C-1)
✗ = No data were found
A = IRIS (Table D-1)
B = HHBP (Table D-2)
C = PPRTV (Table D-3)
D = HESD (Table D-4)
E = ATSDR (Table D-5)
F = CalEPA (Table D-6)
G = Health Canada (Table D-7)
H = ECOTOX (Table E-1)
I = ECOSAR values in EPI Suite (Table E-3)
J = Literature (Tables F-1, G-1)
K = EPI Suite (Tables F-2, G-2, G-3, G-4)
L = Environment and Climate Change Canada (BCF/BAF only) (Table F-1)
M = Arnot and Gobas (BCF/BAF only) (Table F-1)
N = ORNL RAIS (Tables F-3, G-5)

3.2 New data for Chemicals Identified in Previous Biennial Reviews

In addition to reporting newly identified chemicals in biosolids, EPA reviewed the literature for new (i.e., published after the previous biennial review period January 2016-December 2017) concentration data, physical-chemical properties, human health and ecological toxicity data, and environmental fate and transport data for chemical pollutants previously identified in biosolids. Appendix B provides a complete list of these chemicals. Table 2 shows previously identified chemicals for which new data were found, along with the types of data available for the chemicals.

Concentration data for 34 previously identified chemicals were available in the reviewed literature. These data are provided in Appendix C. Additional chemicals were detected in biosolids, but concentration values were not collected because either the concentration values were reported only in graphical form, the values were tentatively identified values, or the occurrence of the chemical was

noted in the paper but concentration data were not provided. The chemicals for which concentration values were not collected include 14 previously identified chemicals (12 PFAS and two PCBs).

All seven sources EPA reviewed (ATSDR, CalEPA, Health Canada, HESD, HHBP, IRIS, and PPRTV) contained one or more human health toxicity value for 112 previously identified chemicals. These values are reported in Appendix D.

Papers published in ECOTOX (U.S. EPA 2020d) from 2018-2019 were found for 71 previously identified chemicals. The results are presented in Appendix E, Table E-2. These papers will require further evaluation for relevance for inclusion in risk assessments.

Table G-1 in Appendix G presents the physical-chemical properties for five of the previously identified chemicals as obtained from the papers reviewed.

There were no new data available since the last reporting period (i.e., after 2017) from the following sources: EPI Suite (U.S. EPA 2017), ORNL (2020), Arnot and Gobas (2006), and Environment and Climate Change Canada (2006).

Table 2. Previously Identified Chemicals with Data Found in the 2018–2019 Reporting Period and Types of Data Available

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
(+/-)-Verapamil	52-53-9	Drugs	✖	✖	H	✖
1-(p-Chlorobenzoyl)-5-methoxy-2-methyl-Indole-3-acetic acid	53-86-1	Drugs	✖	✖	H	✖
1,2,3,4,6,7,8,9-Octabromodibenzofuran	103582-29-2	Dioxins/Furans	✖	✖	✖	✖
1,2,3,4,6,7,8-Heptabromodibenzofuran	107555-95-3	Dioxins/Furans	✖	✖	✖	✖
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	Dioxins/Furans	✖	F	✖	✖
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	Dioxins/Furans	✖	F	✖	✖
1,2,3,4,7,8-Hexachlorodibenzodioxin	39227-28-6	Dioxins/Furans	✖	F	✖	✖
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	Dioxins/Furans	✖	✖	✖	✖
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	Dioxins/Furans	✖	F	✖	✖
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	Dioxins/Furans	✖	A F	✖	✖
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	Dioxins/Furans	✖	A F	✖	✖
1,2,3,7,8-Pentabromodibenzo-p-dioxin	109333-34-8	Dioxins/Furans	✖	✖	✖	✖
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	Dioxins/Furans	✖	F	✖	✖
1,3-Dichlorobenzene	541-73-1	Volatile organic	✖	E	✖	✖

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
1,4-Dichlorobenzene	106-46-7	Volatile organic	✖	A E F	✖	✖
				✖	H	
17beta-Estradiol	50-28-2	Drugs	✖	✖	H	✖
				A E	H	
2,2',4,4',5,5'-Hexabromodiphenyl ether	68631-49-2	PBDEs	✖	A	✖	✖
				E	✖	
2,2',4,4'-Tetrabromodiphenyl ether	5436-43-1	PBDEs	✖	✖	H	✖
				F	✖	
2,3,3',4,4',5'-Hexachlorobiphenyl	69782-90-7	PCB	✖	F	✖	✖
				F	✖	
2,3,3',4,4'-Pentachlorobiphenyl	32598-14-4	PCB	✖	F	✖	✖
				F	✖	
2,3,4,4',5-Pentachlorobiphenyl	74472-37-0	PCB	✖	F	✖	✖
				F	✖	
2',3,4,4',5-Pentachlorobiphenyl	65510-44-3	PCB	✖	F	✖	✖
				✖	✖	
2,3,4,6,7,8-Hexachlorodibenzo[b,d]furan	60851-34-5	Dioxins/Furans	✖	F	✖	✖
				E F	✖	
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	Dioxins/Furans	✖	F	✖	✖
				A E F	H	
2,4,5-Trichlorophenol	95-95-4	Pesticides	✖	A C	✖	✖
				A C E G	✖	
2,4-Dichlorophenoxyacetic acid	94-75-7	Pesticides	✖	A	H	✖
				A C	✖	
2-Methylnaphthalene	91-57-6	Other organics	✖	A C	✖	✖
				✖	✖	
3,3',4,4',5,5'-Hexachlorobiphenyl	32774-16-6	PCB	✖	F	✖	✖
3,3',4,4'-Tetrachlorobiphenyl	32598-13-3	PCB	✖	F	✖	✖

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
3,3',5,5'-Tetrabromobisphenol A	79-94-7	Flame retardant	✗	✗	H	✗
3,4,4',5-Tetrachlorobiphenyl	70362-50-4	PCB	✗	F	✗	✗
4-(1,1,3,3-Tetramethylbutyl)phenol	140-66-9	Other organics	✗	✗	H	✗
4-Chloroaniline	106-47-8	Other organics	✗	A C	✗	✗
Acetaminophen	103-90-2	Drugs	✗	✗	H	✗
Acetic acid	64-19-7	Drugs	✗	✗	H	✗
Acetone	67-64-1	Volatile organic	✗	A E	H	✗
Acetophenone	98-86-2	Drugs	✗	A C	H	✗
Aluminum	7429-90-5	Metals	✓	C E	✗	✗
Ammonium	14798-03-9	Inorganics	✓	✗	✗	✗
Anhydroerythromycin A	23893-13-2	Drugs	✗	✗	✗	✗
Anthracene	120-12-7	PAHs	✗	A C E	✗	✗
Antimony	7440-36-0	Metals	✗	A E G	✗	✗
Arsenic	7440-38-2	Metals	✗	A E F	✗	✗
Aspirin	50-78-2	Drugs	✗	✗	H	✗
Azithromycin	83905-01-5	Antibiotic	✓	✗	✗	✓
Barium	7440-39-3	Metals	✓	A E G	✗	✗
Benz(a)anthracene	56-55-3	PAHs	✗	C F	H	✗
Benzo(a)pyrene	50-32-8	PAHs	✗	A F G	H	✗
Benzo(b)fluoranthene	205-99-2	PAHs	✗	F	H	✗
Benzo(k)fluoranthene	207-08-9	PAHs	✗	F	✗	✗
Benzoic acid	65-85-0	Pesticides	✗	A C	✗	✗
Beryllium	7440-41-7	Metals	✓	E F	✗	✗
Bisphenol A	80-05-7	Drugs	✓	A	H	✗
Boron	7440-42-8	Inorganics	✓	A D E G	✗	✗
Butylated hydroxytoluene	128-37-0	Other organics	✓	C	H	✗
Butylparaben	94-26-8	Antimicrobial	✗	✗	H	✗
Cadmium	7440-43-9	Metals	✓	A E F	✗	✗
Caffeine	58-08-2	Drugs	✗	✗	H	✗
Calcium	7440-70-2	Metals	✓	✗	✗	✗
Carbamazepine	298-46-4	Drugs	✗	✗	H	✗

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
Carbon tetrachloride	56-23-5	Volatile organic	✗	A E F G	✗	✗
				A E F	H	
Chromium	7440-47-3	Metals	✓	✗	✗	✗
				F	✗	
Ciprofloxacin	85721-33-1	Antibiotic	✓	✗	✗	✓
				✗	H	
Clotrimazole	23593-75-1	Drugs	✗	✗	H	✗
				✗	H	
Cobalt	7440-48-4	Metals	✓	C E	✗	✗
				E F G	✗	
Cyanide	57-12-5	Inorganics	✗	A F	✗	✗
				✗	H	
DEET	134-62-3	Pesticides	✗	E	✗	✗
				A E F	H	
Dibutyl phthalate	84-74-2	Other organics	✗	A	H	✗
				A F G	H	
Diclofenac	15307-86-5	Drugs	✗	✗	H	✗
				G	H	
Dimethyl phthalate	131-11-3	Other organics	✗	✗	H	✗
				C E	H	
Erythromycin	114-07-8	Antibiotic	✓	✗	✗	✗
				A E F G	✗	
Ethylparaben	120-47-8	Antimicrobial	✗	✗	H	✗
				✗	H	
Fluoranthene	206-44-0	PAHs	✗	A C	✗	✗
Furosemide	54-31-9	Drugs	✗	✗	H	✗
Heptachlor epoxide B	1024-57-3	Pesticides	✗	A	✗	✗
Ibuprofen	15687-27-1	Drugs	✗	✗	H	✗

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
Lead	7439-92-1	Metals	✗	F	✗	✗
				✗	✗	
Manganese	7439-96-5	Metals	✓	A D E F G	✗	✗
				A E F G	✗	
Methylparaben	99-76-3	Other organics	✗	✗	H	✗
				A E	✗	
m-Xylene	108-38-3	Volatile organic	✗	F G	✗	✗
				A D E F	H	
Nickel	7440-02-0	Metals	✗	A E F	✗	✗
				A E	✗	
Nitrite	14797-65-0	Inorganics	✓	A E	✗	✗
				C	✗	
Nitrogen	7727-37-9	Inorganics	✓	✗	✗	✗
				A F	✗	
N-Nitrosodiethylamine	55-18-5	Other organics	✗	A F	✗	✗
				A C F	✗	
N-Nitrosodiphenylamine	86-30-6	Other organics	✗	A F	H	✗
				A F	✗	
Oxolinic acid	14698-29-4	Antibiotic	✓	✗	✗	✗
				F G	H	
Oxytetracycline	79-57-2	Antibiotic	✓	B	✗	✗
				C F	✗	
Pentabromodiphenyl ether	32534-81-9	PBDEs	✗	A	✗	✗
				A	✗	
Perfluorobutanesulfonate	45187-15-3	PFAS	✗	✗	H	✗
				C	H	
Perfluorobutanoic acid (PFBA)	375-22-4	PFAS	✗	✗	H	✗
Perfluorododecanoic acid (PFDoDA)	307-55-1	PFAS	✗	✗	H	✗

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
Perfluorohexanesulfonate	108427-53-8	PFAS	✖	✖	H	✖
				E	H	
Perfluorohexanoic acid (PFHxA)	307-24-4	PFAS	✖	✖	H	✖
				✖	H	
Perfluorooctanesulfonamide (PFOSA)	754-91-6	PFAS	✖	✖	H	✖
				D E G	H	
Perfluorooctanoic acid (PFOA)	335-67-1	PFAS	✖	D E G	H	✖
				✖	H	
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	PFAS	✖	✖	✖	✖
				✖	H	
Perfluoroundecanoic acid (PFUnDA)	2058-94-8	PFAS	✖	✖	H	✖
				A E F	H	
Phosphorus	7723-14-0	Inorganics	✔	A E	✖	✖
				✖	✖	
Potassium perfluorooctanesulfonate	2795-39-3	PFAS	✖	✖	H	✖
				✖	H	
p-Xylene	106-42-3	Volatile organic	✖	F G	✖	✖
				A	H	
Rubidium	7440-17-7	Metals	✖	C	✖	✖
				A E F	✖	
Silver	7440-22-4	Metals	✔	A	✖	✖
				✖	✖	
Styrene	100-42-5	Other organics	✖	A E F	✖	✖
				A F G	H	
Tetracycline	60-54-8	Antibiotic	✖	✖	✖	✖
				C	✖	
Thiabendazole	148-79-8	Pesticides	✖	B	✖	✖

Chemical	CAS number	Category	Concentration data	Human health toxicity data	Ecological toxicity data	Environmental fate and transport data
Toluene	108-88-3	Volatile organic	✗	A E F G	✗	✗
Tonalide	21145-77-7	Fragrance	✗	✗	H	✗
Triclocarban	101-20-2	Antimicrobial	✓	✗	✗	✗
Triclosan	3380-34-5	Drugs	✗	B	H	✗
Trimethoprim	738-70-5	Antibiotic	✗	✗	H	✗
Triphenyl phosphate	115-86-6	Flame retardant	✓	✗	H	✓
Tris(2-butoxyethyl) phosphate	78-51-3	Flame retardant	✓	E	H	✓
Tris(2-chloroethyl) phosphate	115-96-8	Flame retardant	✓	C E	H	✓
Vanadium	7440-62-2	Metals	✓	C E	✗	✗
Warfarin	81-81-2	Drugs	✗	A	✗	✗
Zinc	7440-66-6	Metals	✗	A E	✗	✗

✓ = Literature data (Tables C-1, G-1)
✗ = No data were found
A = IRIS (Table D-1)
B = HHBP (Table D-2)
C = PPRTV (Table D-3)
D = HESD (Table D-4)
E = ATSDR (Table D-5)
F = CalEPA (Table D-6)
G = Health Canada (Table D-7)
H = ECOTOX (Table E-2)

3.3 Microbial Pollutants Identified in the 2018–2019 Biennial Review

EPA identified two articles that met the eligibility criteria for microbial pollutants (abstracts of the articles are provided in Appendix A). Review of the articles identified five newly identified microbial pollutants in biosolids and provided potentially useful data on five previously identified microbial pollutants. Table 3 lists these microbial pollutants.

Table 3. Microbial Pollutants Identified during the Biosolids Biennial Review for the 2018–2019 Reporting Period

Name	Category	New or previous	Reference
Clostridium perfringens	Bacteria	New	Murray et al. 2019
Enterococcus spp.	Bacteria	New	Murray et al. 2019
Fecal coliforms	Bacteria	New	Murray et al. 2019
Total coliforms	Bacteria	New	Murray et al. 2019
Yersinia spp.	Bacteria	New	Murray et al. 2019
Adenovirus	Virus	Previous	Abd-Elmaksound et al. 2019
Aeromonas spp.	Bacteria	Previous	Murray et al. 2019
Antibiotic-resistant gene targets	Bacteria	Previous	Murray et al. 2019
Escherichia coli	Bacteria	Previous	Murray et al. 2019

Enterovirus	Virus	Previous	Abd-Elmaksound et al. 2019

4 Conclusions

EPA collected and reviewed publicly available information on the occurrence, human health and ecological effects, and fate and transport in the environment of pollutants that have been found in U.S. biosolids during the reporting period 2018-2019. The information collected and presented in Biennial Report Nº 8 is needed to conduct risk assessments.

EPA identified 18 new articles that provide relevant data for chemical pollutants that may occur in U.S. biosolids. Review of the 18 articles identified 116 new chemicals in biosolids: 50 polychlorinated biphenyls (PCBs) (39 congeners, 10 homologs, and total PCBs); four pesticides; 19 flame retardants; eight perfluoroalkyl substances (PFAS); three antibiotics; one metal; two inorganics; and 29 other organics. These articles also identified new data for 48 chemicals that were previously identified in biosolids. Concentration data in biosolids were found for 61 new chemicals and for 34 chemicals identified in a previous biennial review. Human health toxicity values were found for four of the new chemicals and 112 previously identified chemicals. ECOTOX (U.S. EPA 2020d) contained published studies containing data for 63 newly identified chemicals and 71 previously identified chemicals. Additional ecotoxicity data were found in EPI Suite for 99 newly identified chemicals. Physical-chemical properties were identified in the literature for 31 new chemicals and five chemicals previously identified in biosolids, and in EPI Suite for 99 new chemicals. BCFs or BAFs were identified in the literature for one new chemical; in EPI Suite for 99 new chemicals; and in Arnot and Gobas (2006), Environment and Climate Change Canada (2006), or ORNL (2020) for 40 new chemicals.

In addition, the articles identified five new microbial pollutants in biosolids, and potentially useful data on five previously identified microbial pollutants.

Assessing the potential risk for pollutants identified in biosolids is the top priority for EPA's Biosolids Program. EPA continues to make significant progress in building capacity to assess pollutants by developing the necessary tools and data. EPA expects to begin risk screening of pollutants found in biosolids once review of its screening tool has been completed.

For additional information about EPA's Biosolids Program, please visit the website at: http://epa.gov/biosolids.

5 References

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Appendix A Abstracts for Papers Reviewed for the 2018–2019 Biennial Review

Abd-Elmaksoud, S., N. Castro-del Campo, C. Gerba, I. Pepper, and K. Bright. 2019. Comparative assessment of BGM and PLC/PRF/5 cell lines for enteric virus detection in biosolids. *Food and Environmental Virology* 11:32–39.

The BGM cell line is required for the detection of enteric viruses in biosolids through a total culturable viral assay (TCVA) by the United States Environmental Protection Agency. In the present study, BGM and PLC/PRF/5 cell lines were evaluated for TCVA and for their use in determining the incidence of adenoviruses and enteroviruses in raw sludge and Class B biosolids. Six raw sludge and 17 Class B biosolid samples were collected from 13 wastewater treatment plants from seven U.S. states. Samples were processed via organic flocculation and concentrate volumes equivalent to 4 g total solids were assayed on BGM and PLC/PRF/5 cells. Cell monolayers were observed for cytopathic effect (CPE) after two 14-d passages. Cell lysates were tested for the presence of adenoviruses and enteroviruses by PCR or RT-PCR. The PLC/PRF/5 cells detected more culturable viruses than the BGM cells by CPE (73.9% versus 56.5%, respectively). Fifty-two percent of the samples were positive for CPE using both cell lines. No viruses were detected in either cell line by PCR in flasks in which CPE was not observed. No adenoviruses were detected in 13 CPE-positive samples from BGM lysates. In contrast, of the 17 samples exhibiting CPE on PLC/PRF/5 cells, 14 were positive for adenoviruses (82.4%). In conclusion, PLC/PRF/5 cells were superior for the detection of adenoviruses in both raw sludge and Class B biosolids. Thus, the use of BGM cells alone for TCVA may underestimate the viral concentration in sludge/biosolid samples.

Kim Lazcano, R., C. de Perre, M.L. Mashtare, and L.S. Lee. 2019. Per- and polyfluoroalkyl substances in commercially available biosolid-based products: The effect of treatment processes. *Water Environment Research* 91:1669–1677.

Per- and polyfluoroalkyl substances (PFAS) have been used in a variety of consumer and industrial products and are known to accumulate in sewage sludge due to sorption and their recalcitrant nature. Treatment processes ensure safe and high-quality biosolids by reducing the potential for adverse environmental impacts such as pathogen levels; however, they have yet to be evaluated for their impact on the fate of PFAS. The objective of this study was to compare PFAS concentrations in four commercially available biosolid-based products that received different types of treatments: heat treatment, composting, blending, and thermal hydrolysis. Seventeen perfluoroalkyl acids (PFAAs) were quantified using liquid chromatography with tandem quadrupole time-of-flight mass spectrometry followed by screening for 30 PFAA precursors. Treatment processes did not reduce PFAA loads except for blending, which served only to dilute concentrations. Several PFAA precursors were identified with 6:2 and 8:2 fluorotelomer phosphate diesters in all samples pre- and post-treatment.

Li, S., R. Li, Y. Tang, and G. Chen. 2019. Microwave-induced heavy metal removal from dewatered biosolids for cost-effective composting. *Journal of Cleaner Production* 241:1–9.

Urbanization and population growth have resulted in the accumulation of heavy metals in biosolids, and these metals act as potent environmental contaminants. In this study, a novel microwave-mediated method of extracting heavy metals from dewatered biosolids was developed. With an electromagnetic power of 140 W for a contact time of 10 s, microwave irradiation effectively induced the immobilization of heavy metals. The treated biosolids were subsequently mixed with acetic acid, sulfuric acid, or ethylenediaminetetraacetic acid (EDTA) for heavy metal extraction. The

biosolids in this study were contaminated by different heavy metals, including Cd, Cu, Fe, Pb, Ni, and Zn. Among them, the concentrations of Cd (94.3 ± 14.2 mg/kg) and Pb (888.7 ± 79.8 mg/kg) were considerably above the limits allowed for land application. Conventional extraction methods were found to be insufficient in lowering heavy metal contents below regulation limits, while the microwave-mediated method efficiently increased heavy metal removal by as much as ~3x. After the biosolids were treated, Cd and Pb concentrations decreased to 80.2 ± 2.7 and 159.8 ± 22.1 mg/kg, respectively. The treated biosolids and their products were eligible for land application as an alternative treatment. The microwave-mediated method also lowered the demand for extractants. Using a reduced concentration of sulfuric acid, acetic acid, or EDTA, at least 90% of Cu, 70% of Zn and Pb, 45% of Fe, and 20% of Ni were simultaneously removed from the contaminated biosolids. Cost analyses revealed that the microwave-mediated method could decrease the net total cost of biosolid handling by as much as 62.7%. Considering its simplicity, cost-effectiveness, and minimal environmental impacts, the proposed method offers a promising solution to the problem of heavy metal accumulation in biosolids.

Lozano, N., C.P. Rice, M. Ramirez, and A. Torren. 2018. Fate of triclocarban in agricultural soils after biosolid applications. *Environmental Science Pollution Research* 25:222–232.

Triclocarban [N-(4-chlorophenyl)-N-(3,4-dichlorophenyl) urea] (TCC) is an antimicrobial agent utilized in a variety of consumer products. It is released into domestic wastewaters and, upon treatment, it is known to accumulate in biosolids. This study examines the occurrence of TCC in biosolids and its long-term fate in biosolid-treated soils. TCC levels in the biosolids from a large wastewater treatment plant (WWTP) over 2 years showed little variability at 18,800 ± 700 ng g^{-1} dry wt. (mean ± SEM). Surface soil samples (top 10 cm) were collected from 26 commercial farms located in northern VA, US that had received biosolid applications from the WWTP. Samples were grouped as farms receiving no biosolids, farms with a single biosolid application, and those receiving multiple biosolid applications from 1992 to 2006. Our results illustrate that TCC soil residues remained years after biosolid application. The two most important parameters controlling TCC topsoil concentrations were the biosolid application rate and the period since the last application. No TCC removal was observed in farms where the time since biosolid application was between 7 and 9 months. TCC concentration analyzed 7 and 8 years after biosolid applications were 45.8 ± 6.1 and 72.4 ± 15.3 ng g^{-1} dry wt., respectively, showing its persistence in soils and build-up upon multiple biosolid applications. A soil TCC half-life of 287.5 ± 45.5 days was estimated.

Lu, Z., S.A. Smyth, and A.O. De Silva. 2019. Distribution and fate of synthetic phenolic antioxidants in various wastewater treatment processes in Canada. *Chemosphere* 219:826–835.

Synthetic phenolic antioxidants (SPAs) are of emerging concern due to their potential environmental risks. However, the environmental occurrence and fate of SPAs are poorly understood. In this study, 13 SPAs were analyzed in 70 liquid and 21 solid samples from 12 wastewater treatment plants (WWTPs) in 2016 to investigate the distribution and composition of SPAs in different wastewater treatment processes in Canada. Wastewater samples were liquid-liquid extracted and biosolids were treated using ultrasonic assisted solvent extraction. SPAs were analyzed by ultra-performance liquid chromatography-tandem mass spectrometry. The concentrations of total SPAs were in the ranges of 71–3193 ng/L in influent, less than method quantification limits (MQLs)–520 ng/L in effluent, and 479–4794 ng/g in biosolids (dry weight (dw)). SPAs were effectively removed (median > 75%) from the liquid stream in most WWTPs. In one aerated lagoon and two primary treatment sites, low removal efficiency (median 26%–43%) was observed for 4-tert-octylphenol(4-tOP). These results indicate that wastewater effluent is a vector for SPAs, including the endocrine disruptor 4-tOP, to aquatic environments. The mass balance approximation found major removal mechanisms are sludge

sorption/separation and degradation. A preliminary risk assessment suggested that most SPAs in WWTP effluent were unlikely to pose eco-toxicological risks to aquatic organisms in the receiving waters. Future research should evaluate the environmental risks of SPAs associated with land application of biosolids and investigate the occurrence and fate of the degradation products of these contaminants.

Magee, H.Y., M.M. Maurer, A. Cobos, B.F.G. Pycke, A.K. Venkatesan, D. Magee, M. Scotch, and R.U. Halden. 2018. U.S. nationwide reconnaissance of ten infrequently monitored antibiotics in municipal biosolids. *Science of the Environment* 643:460–467.

Ten infrequently monitored antibiotics in biosolids were examined in archived American sewage sludges (n = 79) collected as part of the 2006/2007 U.S. Environmental Protection Agency (EPA) Targeted National Sewage Sludge Survey. This study inspected the occurrence of amoxicillin, ampicillin, erythromycin, furazolidone [proxy metabolite: 3-(2-nitrobenzylidenamino)-2-oxazolidinone (NP-AOZ)], nalidixic acid, oxolinic acid, oxytetracycline, spiramycin, sulfadimidine, and sulfadimethoxine in sewage sludges after nearly a decade in frozen storage. Six antibiotics were detected at the following average concentrations (ng/g dry weight): amoxicillin (1.0), nalidixic acid (19.1), oxolinic acid (2.7), erythromycin (0.6), oxytetracycline (4.5), and ampicillin (14.8). The remaining four were not detected in any samples (<method detection limit, ng/g dry weight): sulfadimethoxine (<0.5), sulfadimidine (<1.0), spiramycin (<2.0), and NP-AOZ (<20.0). This study provides the first data on spiramycin, NP-AOZ, and nalidixic acid in U.S. sewage sludges. This study also provides new data on the losses of 5 antibiotics during long term frozen storage (−20 °C) in comparison to the 2006/2007 U.S. EPA Targeted National Sewage Sludge Survey.

Menzies, J., K. Casteel, K. Wehmeyer, M. Lam, and K. McDonough. 2019. Probabilistic exposure assessment of DEEDMAC using measured effluent and sludge concentrations from 41 wastewater treatment plants across the United States. *Science of the Total Environment* 684:247–253.

The cationic surfactant diethyldialkylester dimethyl ammonium chloride (DEEDMAC) is an active ingredient in liquid fabric softeners and, as such, is disposed of down the drain after consumer use. A monitoring program was conducted across the continental United States to measure the concentration of DEEDMAC in the effluent and sludge from 41 wastewater treatment plants (WWTPs). The concentration in the effluent ranged from 32.4 to 2660 ng/L, with a mean and standard deviation of 232 ± 450 ng/L. The concentration in the sludge ranged from 0.707 to 314 mg/kg dw, with a mean and standard deviation of 29.2 ± 50 mg/kg dw. The distribution of measured effluent concentrations was combined with a distribution of mixing zone dilutions factors to predict the distribution of DEEDMAC concentrations in mixing zones and sediments under mean flow and 10-year, 7 consecutive day lowest flow (7Q10 low flow) conditions. Additionally, the distribution of measured sludge concentrations was combined with a distribution of land applied sludge volumes and US tilling practices to obtain a predicted distribution of DEEDMAC concentrations in sludge amended soils. The 90th percentile concentrations of DEEDMAC in mixing zones and sediments under mean flow conditions was 10.3 ng/L and 451 ng/kg, respectively. The 90th percentile concentration in sludge amended soils was 1.92 mg/kg. These predicted exposure concentrations were compared to published eco-toxicity data and showed that DEEDMAC has a wide margin of safety and poses negligible ecologic risk to aquatic, sediment, or terrestrial compartments.

Murray, R., Y.C Tien, A. Scott, and E. Topp. 2019. The impact of municipal sewage sludge stabilization processes on the abundance, field persistence, and transmission of antibiotic resistant bacteria and antibiotic resistance genes to vegetables at harvest. *Science of the Total Environment* 651:1680–1687.

Biosolids were obtained from four Ontario municipalities that vary in how the sewage sludge is treated. These included a Class B biosolids that was anaerobically digested, a Class A biosolids that were heat treated and pelletized (Propell), and two Class A biosolids that were stabilized using either the N-Viro (N-Rich) or Lystek (LysteGro) processes. Viable enteric indicator or pathogenic bacteria in the biosolids were enumerated by plate count, gene targets associated with antibiotic resistance or horizontal gene transfer were detected by PCR, and a subset of these gene targets were quantified by qPCR. Following application at commercial rates to field plots, the persistence of enteric bacteria and gene targets in soil was followed during the growing season. Carrots, radishes and lettuce were sown into the amended and unamended control plots, and the diversity and abundance of gene targets they carried at harvest determined. All three Class A biosolids carried fewer and less abundant antibiotic resistance genes than did the Class B biosolids, in particular the very alkaline N-Viro product (N-Rich). Following application, some gene targets (e.g. *int*1, *sul*1, *str*A/B, *aad*A) that are typically associated with mobile gene cassettes remained detectable throughout the growing season, whereas others (e.g. *erm*B, *erm*F, *bla*$_{OXA20}$) that are not associated with cassettes became undetectable within three weeks or less. At harvest a larger number of gene targets were detected on the carrots and radishes than in the lettuce. Overall, land application of Class A biosolids will entrain fewer viable bacteria and genes associated with antibiotic resistance into crop ground than will amendment with Class B biosolids.

Needham, T.P., and U. Ghosh. 2019. Four decades since the ban, old urban wastewater treatment plant remains a dominant source of PCBs to the environment. *Environmental Pollution* 246:390–397.

Despite the ban on new manufacture and commercial use of PCBs, municipal sewer systems continue to serve as ongoing secondary sources for contamination in receiving water bodies. Ongoing PCB sources have made it difficult to achieve desired recovery after implementation of sediment cleanup efforts. We report on a 16-month surveillance to determine the inputs, fate, and export of PCBs within a municipal waste collection/treatment system by strategic sampling of the freely dissolved and biosolids-associated PCBs. The total PCBs entering the treatment plant was found to be 170 g/day of which 100 g/day exited the plant associated with the biosolids and 5.2 g/day was discharged in the form of freely dissolved PCBs in the effluent. A net loss of 68 g/day was calculated for the plant, attributable to volatilization and biodegradation. Freely dissolved PCBs in the treated effluent was an order of magnitude higher than the water quality criteria for the protection of human health through fish consumption and found to be a major contributor to the dissolved concentration in the receiving river. Predicted bioaccumulation in fish from dissolved PCBs in the effluent exceeded the threshold for human consumption. The biosolids, currently land applied as fertilizer, contained an average PCB concentration of 760 mg/kg. The sludge produced in this treatment plant is processed in large anaerobic digesters and changes to the homolog distribution point to some microbial dechlorination. Application of biosolids to clean agricultural soil resulted in a 6-fold increase in PCB levels in the earthworm *E. fetida* which could be eliminated by the amendment of 1% by weight of activated carbon.

Onchoke, K.K., C.M. Franclemont, and P.W. Weatherford. 2018. Structural characterization and evaluation of municipal wastewater sludge (biosolids) from two rural wastewater treatment plants in East Texas, USA. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* 204:514–524.

Wastewater sludge (or) biosolids collected from two rural wastewater treatment plants (NWWTP, LWWTP) in East Texas, USA were characterized and evaluated via inductively coupled plasma optical emission spectrometry, scanning electron microscopy (SEM), energy dispersive X-ray

spectroscopy (EDX), thermogravimetric analysis, X-ray diffraction, Fourier transform infrared spectroscopy (FTIR), and ion chromatography. The proximate organic and inorganic compositions and spectroscopic characteristics of sewage sludge were determined. The results show that the concentrations of toxic metals Cd, Cr, Cu, Mo, Ni, Pb, Hg, and Zn meet USEPA guideline recommendations for land applications. Notably, metals concentrations in biosolids from NWWTP (Mn (700 ± 83) > Zn (422.5 ± 35.4 ppm) > Ba (319.5 ± 87 ppm) > Cu (240 ± 27 ppm) > B (107 ± 14 ppm) > V (24 ± 3.3 ppm) > Cr (20 ± 3.3 ppm) > Ni (16.7 ± 2.0 ppm) > Pb (16.8 ± 1.1 ppm) > As (11.99 ± 1.27 ppm) > Co (7.6 ± 0.7 ppm) > Mo (6.4 ± 1.4 ppm) > Hg (0.55 ± 0.24 ppm) > Cd (0.130 ± 0.109 ppm)) and LWWTP follow similar trends. Macro-elements concentrations in LWWTP follow the trend P (19,648 ± 169) > Fe (22,688 ± 2110) > Ca (9372 ± 163) > S (9010 ± 1009) > Al (12,538 ± 2116) > K (3514 ± 550) > Mg (33,370 ± 502) > Na (1511 ± 472). The Br^-, NO_3^-, NO_2^-, F^-, Cl^-, and SO_4^{2-} concentrations meet USEPA guidelines. Whereas biosolid particle sizes were in the range ~20 μm to 500 μm, mineralogical results show quartz and vermiculite to be major constituents with abundancies 12.94%, and 10.87% w/wt, respectively.

Sadaria, A.M., C.W. Labban, J.C. Steele, M.M. Maurer, and R.U. Halden. 2019. Retrospective nationwide occurrence of fipronil and its degradates in U.S. wastewater and sewage sludge from 2001–2016. *Water Research* 155:465–473.

The insecticide fipronil is under regulatory scrutiny worldwide for its toxicity to pollinators and aquatic invertebrates. We conducted the first U.S. nationwide, longitudinal study of sewage sludges for fiproles, i.e., the sum of fipronil and its major degradates (fipronil sulfone, sulfide, amide, and desulfinyl). Archived sludges (n = 109) collected in three campaigns over 15 years were analyzed by isotope dilution liquid chromatography tandem mass spectrometry, revealing ubiquitous fiprole occurrence (0.2–385.3 μg/kg) since 2001 and a significant increase (2.4 ± 0.3 fold; $p < 0.005$) both from 2001 to 2006/7 and from 2001 to 2015/6, but not a significant increase from 2006/7 to 2015/6 ($p = 0.275$). A geospatial analysis showed fiprole levels in municipal sludges to be uncoupled from agricultural use of fipronil on cropland surrounding sampled municipalities, thus pointing to non-agricultural uses (i.e., spot-on treatment and urban pest control) as a major source of fiprole loading to wastewater. Whereas anaerobic digestion was correlated with increases in fipronil sulfide at the expense of parental fipronil ($p < 0.001$), total fiprole levels in sewage sludges were similar regardless of the solids treatment approach applied ($p = 0.519$). Treatment plant effluent available from 12 facilities in 2015/6 contained fiproles at 0.3–112.9 ng/L, exceeding the United States Environmental Protection Agency (USEPA) aquatic invertebrate life benchmark for chronic fipronil exposure (11 ng/L) in 67% of cases. Whereas the USEPA identified fipronil in sludge only recently (2015), retrospective analyses and modeling conducted here show contaminant ubiquity and nationwide increases of fiprole mass (compared to 2001 levels) in U.S. municipal sludge (1140 ± 230 kg in 2015/6), and treated effluent nationwide (1970 ± 390 kg in 2015/6) over the past 15 years.

Sidhu, H., G. O'Conner, A. Ogram, and K. Kumar. 2019. Bioavailability of biosolids-borne ciprofloxacin and azithromycin to terrestrial organisms: Microbial toxicity and earthworm responses. *Science of the Total Environment* 650:18–26.

Information on bioavailability of two antibiotic trace organic chemicals (TOrCs), ciprofloxacin (CIP) and azithromycin (AZ), to terrestrial organisms is severely limited, especially in the biosolids context. Responses of two terrestrial organisms, earthworms and microbes, to a range of environmentally relevant concentrations of biosolids-borne CIP and AZ were assessed in laboratory incubation studies involving ^{3}H-labeled compounds. Earthworm assessments were based on the Earthworm Sub-chronic Toxicity Test (OCSPP 850.3100). Microbial impacts were assessed using respiration and reverse transcriptase-quantitative PCR (mRNA) analyses of nutrient (N and P)

cycling genes as toxicity markers. Antibiotic extractability and stability during incubations were assessed using sequential extractions with $CaCl_2$, methanol:water, and accelerated solvent extraction and analyses using thin layer chromatography. Subsample combustion, in addition to sequential extraction, recovered nearly 100% of the added antibiotic. The two compounds persisted (estimated half-lives ≥ 3 y), but extractable fractions (especially of CIP) decreased over time. Neither biosolids-borne antibiotic significantly impacted overall respiration or N and P cycling. Microbial toxicity responses were minimal; complementary DNA (cDNA) concentrations of ammonia oxidizing bacterial genes were affected, but only initially. Similarly, earthworms showed no apparent response related to toxicity to environmentally relevant (and much greater) concentrations of biosolids-borne CIP and AZ. Earthworms, however, accumulated both compounds, and the bioaccumulation factor (BAF) values (dry weight basis) were ~4 (CIP) and ~7 (AZ) in depurated worms and ~20 (CIP and AZ) in un-depurated worms. The microbial and earthworm responses strongly to moderately correlated with "bioaccessible" fractions of the target TOrCs. The results suggest that biosolids-borne CIP and AZ toxicity to terrestrial microbes and earthworms is minimal, but there is a potential for target TOrC entry into ecological food web.

Sidhu, H., G. O'Conner, and J. Kruse. 2019. Plant toxicity and accumulation of biosolids-borne ciprofloxacin and azithromycin. *Science of the Total Environment* 648:1219–1226.

Trace organic chemicals (TOrCs) in land applied biosolids can cause phytotoxicities and contaminate human and animal food chains. Information on phytotoxicity and phytoaccumulation of environmentally relevant concentrations of two antibiotic TOrCs, ciprofloxacin (CIP) and azithromycin (AZ), from biosolids-amended soils is limited. Greenhouse studies were conducted to assess the plant toxicity and accumulation of a range of environmentally relevant concentrations of biosolids-borne CIP and AZ in biosolids-amended soils. Separate studies assessed phytotoxicity potential of soil-borne CIP and AZ (soils directly spiked with the target antibiotics without biosolids) at concentrations much greater than those of environmental relevance in biosolids-amended soils. Both the biosolids-borne and the soil-borne antibiotic studies involved three plants (radish (*Raphanus sativus*), lettuce (*Lactuca sativa*), and tall fescue grass (*Festuca arundinacea*)) of different morphologies, physiologies, and chemical exposure scenarios. Phytotoxicity and phytoaccumulation from the biosolids-borne antibiotics were minimal at environmentally relevant concentrations, even in sand. The separate phytotoxicity experiments involving the soil-borne antibiotics revealed no observed adverse effect concentration (NOAEC) of 3.2 mg kg^{-1} (AZ) and 36.1 mg kg^{-1} (CIP) for the three plants grown in soils mimicking typical agricultural soils. These NOAEC values are about 100-fold greater than the antibiotic concentrations expected in biosolids-amended soils. NOAEC values under an unrealistic worst case where the antibiotics were directly spiked to sand (NOAEC = 3.2 mg kg^{-1} for AZ; and ≥0.36 mg kg^{-1} for CIP) were also greater than the environmentally relevant concentrations of the biosolids-borne antibiotics. The results suggest that land application of biosolids-borne CIP and AZ pose *De minimis* risks to plants. Point estimates of plant bioaccumulation factors (dry weight basis) were 0.01 (CIP) and 0.1 (AZ), suggesting minimal impacts of the target TOrCs on human and/or animal food chains.

Sidhu, H., E. D'Angelo, and G. O'Conner. 2019. Retention-release of ciprofloxacin and azithromycin in biosolids and biosolids-amended soils. *Science of the Total Environment* 650:173–183.

Ciprofloxacin (CIP) and azithromycin (AZ) are commonly prescribed antibiotics, often found at elevated concentrations in treated sewage sludge (biosolids), and could pose human and ecological risks when land applied. Limited retention-release data preclude assessing potential risks from the target antibiotics in biosolids and biosolids-amended soils. The present work assessed sorption-

desorption of CIP and AZ in biosolids and biosolids-amended soils using the "traditional" batch equilibration method. The batch equilibration method also included unamended soils for comparison. Release potentials of the biosolids-borne antibiotics were assessed via multiple desorption equilibrations in the presence of CaCl2, soils, PbCl2, or competing antibiotic (CIP versus AZ) solutions. Desorption kinetics of CIP from biosolids were also evaluated by the diffusive gradient in thin films technique (DGT), coupled with a diffusion transport-exchange model available in 2D-DIFs. Sorption of both antibiotics followed linear models with partitioning coefficient (K_d) values for CIP ranging between 40 and 334 L kg^{-1} in soils and 357 L kg^{-1} in biosolids, and values for AZ ranging between 11 and 202 L kg^{-1} in soils and 428 L kg^{-1} in biosolids. Antibiotic desorption from the biosolids was highly hysteretic (hysteresis coefficients b 0.003) and desorption of the biosolids-borne chemicals was extremely small (<3%) using any of the various desorption equilibration approaches. Desorption was hysteric in soils too; where desorption percentages were 4, 5, and 26% for CIP and 6, 32, and 50% for AZ in the silt loam soil, manured sand, and sand, respectively. CIP release from biosolids determined by DGT was also small (<1%), ascribed to low dissolved and labile concentrations in the solid phase and a small effective diffusion coefficient. Results obtained using equilibrium and dynamic approaches suggest that the target antibiotic bioaccessibilities from biosolids and finer-textured (typical agricultural) soils would be minimal and that biosolids (not soils) control desorption of the two biosolids-borne chemicals.

Silveira, M.L., G.A. O'Connor, Y. Lu, J.E. Erickson, C. Brandani, and M.M. Kohmann. 2019. Runoff and leachate phosphorus and nitrogen losses from grass-vegetated soil boxes amended with biosolids and fertilizer. *Journal of Environmental Quality* 48:1498–1506.

Recent evidence suggests an upward trend in surface water phosphorus (P) concentrations in many segments of Florida, including the upper basin of the St. Johns River, a region that currently receives about two-thirds of the state Class B biosolids land application. Concerns about water quality in this area are encouraging reexamination of the regulations governing biosolids programs. The objectives of this study were (i) to identify and thoroughly characterize the main biosolids sources routinely applied in the region, and (ii) to evaluate runoff and leachate N and P losses from a typical Florida Spodosol amended with biosolids or commercial inorganic fertilizer. Biosolids and inorganic fertilizer were surface applied uniformly at a rate equivalent to ~114 kg P ha^{-1}, which corresponded to a typical P load associated with nitrogen (N)-based biosolids application. Soluble reactive P (SRP) was the predominant form of P lost in runoff and leachate. Inorganic P fertilizer increased flow-weighted runoff total P concentrations nearly 60-fold relative to control treatment (0.4 vs. 22 mg P L^{-1} for control and fertilizer treatments, respectively). With exception of biological P removal (BPR) biosolids, all other tested biosolids yielded flow-weighted runoff P concentrations similar to untreated soils. Cumulative P and N losses (as a percentage of P and N applied) were greater from commercial inorganic fertilizer (~38% of P and 46% of N) than any biosolids source (3% of P and 6% of N). Results demonstrate the value of water-extractable P (WEP) as an indicator of biosolids P loss potential.

Vaughn, S.F., F.D. Dinelli, J.A. Kenar, M.A. Jackson, A.J. Thomas, and S.C. Peterson. 2018. Physical and chemical properties of pyrolyzed biosolids for utilization in sand-based turfgrass rootzones. *Waste Management* 76:98–105.

Biosolids are several forms of treated sewage sludge that are intended for use as soil conditioners for horticultural, agricultural and industrial crops. The objectives of this research were to determine the chemical and physical properties of biosolids pyrolyzed at several different temperatures, and their effect on perennial ryegrass seed germination and growth. Biosolids were thermally treated in an oxygen-free (nitrogen atmosphere) retort oven at 300, 400, 500, 700 and 900 °C. As pyrolysis

temperatures increased, bulk densities, total surface areas, micropore surface areas, % minerals and pH values of the pyrolyzed biosolids increased, while carbon percentage decreased compared to untreated biosolids. Fourier-transform infrared spectroscopy analysis showed decreased surface functionality as pyrolysis temperature increased. Perennial ryegrass (*Lolium perenne* L. 'Nui') plants were grown in mixtures of 10% (v/v) biosolids or 10% (v/v) of the various pyrolyzed biosolids and 90% coarse sand. Ryegrass plants grown in the biosolids and the 300 °C pyrolyzed biosolids mixture had the greatest shoot heights of any of the treatments after 4 weeks of growth. These results indicate that pyrolyzing biosolids at 300 °C would produce material with excellent potential as a long-term peat replacement for water and nutrient retention in sand-based rootzones.

Wang, Y., P. Kannan, R.U. Halden, and K. Kannan. 2019. A nationwide survey of 31 organophosphate esters in sewage sludge from the United States. *Science of the Total Environment* 655:446–453.

Organophosphate esters (OPEs) are used as flame retardants and plasticizers in a wide range of consumer products. Nevertheless, studies on the occurrence and inventory of OPEs in sewage sludge are limited. In this study, 20 OP triesters and 11 diesters were measured in 75 archived sewage sludge samples collected from 67 wastewater treatment plants (WWTPs) across the United States (US). The median concentrations of $\sum_{20}$OP-triesters and $\sum_{11}$OP-diesters in sludge were 1290 and 78.4 ng/g dry weight (dw), respectively. Sludge samples originating from the Western and Northeastern US contained higher concentrations of OP triesters than did those from the Midwestern and Southern US. Sludge samples from WWTPs with larger treatment capacity (>38 million liters per day) contained higher concentrations of OP diesters ($p < 0.05$). OP diesters in sludge originated from two sources, triester degradation and direct inputs. Land application of sludge to US soils was estimated to result in annual mass inputs of 12,400–14,900 kg/year of OP triesters and 663–796 kg/year of OP diesters. A hazard assessment was performed for 14 OPEs found in sludge, which suggested a low level of risk at the current land application practices of sludge.

Xu, S. 2019. Extraction and quantitative analysis of water, sediment, soil and biosolids for trace-level trimethylsilanol. *International Journal of Environmental Analytical Chemistry* 100(3):268–281.

Methylsilanols such as trimethylsilanol (TMS) are considered as the major hydrolytic degradation products of methylsiloxanes, a class of anthropogenic organometallic substances with a wide range of applications. The distribution of these silanols in various environmental compartments, therefore, could provide direct information on silanols' chemical fate and environmental exposure. Existing methods for the quantification of the silanols are not sensitive and robust enough for analyzing environmental media where trace and ultra-trace-level concentrations may be expected. In the present study, solid-phase extraction (SPE) and solvent extraction in combination with gas chromatography-mass spectrometry (GC/MS) were tested for analyzing water, sediment, soil and biosolids samples for TMS. ISOLUTE® ENV+ solid-phase sorbent was found to be most suitable for extraction of water samples for ultra-trace TMS, while direct solvent extraction worked for solids samples such as soil, sediment and biosolids. Coupling with an isotopic internal standard and SPE extraction, direct GC/MS analysis without derivatization can reach a method detection limit for TMS as low as 0.10 µg L^{-1} in water. The detection limits for solid samples varied from 0.21 ng g^{-1} ww (wet weights) to 10 ng g^{-1} ww, mostly limited by background concentrations of TMS in extraction solvents. It was also observed that prolonged sample storage may lead to a reduction in TMS concentrations, regardless of the concentrations of coexisting methylsiloxanes.

Zhang, J., L. Wang, R.U. Halden, and K. Kannan. 2019. Polyethylene terephthalate and polycarbonate microplastics in sewage sludge collected from the United States. *Environmental Science & Technology Letters* 6:650–655.

Microplastics (MPs) are emerging pollutants of public health and environmental concern. Sewage sludge is a sink for MPs that originate from domestic sources and can provide an indication of the magnitude of discharge of MPs by local populations. Nevertheless, reports of quantitative analysis of MPs present in sewage sludge are limited. In this study, 65 sewage sludge samples collected from sewage treatment plants (STPs) across the United States were analyzed for MPs originating from polyethylene terephthalate (PET) and polycarbonate (PC) using alkali-assisted thermal depolymerization and liquid chromatography−tandem mass spectrometry. PET and PC were detected in all sludge samples at concentrations (dry weight) in the ranges of 28−12000 μg/g (median of 370 μg/g) and 0.70−8400 μg/g (median of 5.9 μg/g), respectively. The concentrations of PET and PC varied, depending on the treatment capacity of the STPs. The annual environmental emission of MPs through sludge disposal was estimated at 3,700,000 kg/year for PET and 310,000 kg/year for PC. Our results provide a quantitative estimate of emission of MPs through land application of sludge.

Zhu, H., R.U. Halden, and K. Kannan. 2019. A nationwide survey of the occurrence of melamine and its derivatives in archived sewage sludge from the United States. *Environmental Pollution* 245:994–999.

Melamine-based resins are used extensively in laminates, plastics, coatings, glues, and dinnerware. Little is known, however, about the occurrence of melamine and its derivatives in the environment. In this study, a nationwide survey of melamine and its derivatives, namely ammeline, ammelide, and cyanuric acid, was conducted, using archived sewage sludge samples collected from 68 wastewater treatment plants in the United States (U.S.). The sum concentrations of four target compounds in sludge ranged from 34 to 1800 ng/g dry weight (dw), with a mean concentration of 240 ng/g dw; melamine (46%) and cyanuric acid (40%) collectively accounted for 86% of the total mass of analytes. No significant geographical variation in the concentrations of melamine and its derivatives in sewage sludge was found. The estimated emission of melamine and its derivatives via land-application of sludge was approximately 1600 kg/yr in the U.S. The hazard quotient values for melamine in sludge-amended soils ranged from 2.2×10^{-5} to 4.4×10^{-3}, indicating that the current levels of melamine in sludge pose a minimal risk to the soil environment.

Appendix B Pollutants Identified in Biosolids

Appendix C Concentrations of Chemicals Found in Biosolids

Appendix D Human Health Toxicity Values for Chemicals Found in Biosolids

Appendix E Ecological Toxicity Data

Appendix F Environmental Fate and Transport Data: Bioaccumulation and Bioconcentration Data

Appendix G Environmental Fate and Transport Data: Physical-Chemical Properties

Appendix B. Pollutants Identified in Biosolids

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
Chemical Pollutants			
(+)-Diltiazem	42399-41-7	Drugs	2005 BR
(+/-)-Verapamil	52-53-9	Drugs	2013 BR
(3alpha,5beta)-Cholestan-3-ol	516-92-7	Other organics	2009 TNSSS
(3beta,5alpha)-Stigmastan-3-ol	83-45-4	Other organics	2009 TNSSS
(4R,4aS,12aR)-7-Chloro-4-(dimethylamino)-1,10,11,12a-tetrahydroxy-6-methyl-3,12-dioxo-3,4,4a,5,12,12a-hexahydrotetracene-2-carboxamide--hydrogen chloride (1/1)	158018-53-2	Other organics	2009 TNSSS
1-(p-Chlorobenzoyl)-5-methoxy-2-methyl-Indole-3-acetic acid	53-86-1	Drugs	2005 BR
1,1'-Biphenyl, 2,2',4,4',6-pentabromo-	97038-97-6	PCB	2009 TNSSS
1,1'-Biphenyl, 2,3',4,4'-tetrabromo-	84303-45-7	PCB	2009 TNSSS
1,1'-Biphenyl, 2,4,4'-tribromo-	6430-90-6	PCB	2009 TNSSS
1,1'-Ethane-1,2-diylbis(pentabromobenzene)	84852-53-9	Flame retardant	2017 BR
1,2,3,4,6,7,8,9,10,10,11,11-dodecachloro-1,4,4a,5a,6,9,9a,9b-octahydro-1,4:6,9-dimethanodibenzofuran	31107-44-5	Dioxins/Furans	2017 BR
1,2,3,4,6,7,8,9-octabromodibenzofuran	103582-29-2	Dioxins/Furans	2015 BR
1,2,3,4,6,7,8-Heptabromodibenzofuran	107555-95-3	Dioxins/Furans	2015 BR
1,2,3,4,6,7,8-Heptabromodibenzo-p-dioxin	110999-47-8	Dioxins/Furans	2015 BR
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	Dioxins/Furans	1988 NSSS
1,2,3,4,7,8,9-Heptabromodibenzo[b,d]furan	161880-51-9	Dioxins/Furans	2015 BR
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	Dioxins/Furans	1988 NSSS
1,2,3,4,7,8-Hexabromodibenzofuran	129880-08-6	Dioxins/Furans	2015 BR
1,2,3,4,7,8-Hexabromodibenzo-p-dioxin	110999-44-5	Dioxins/Furans	2015 BR
1,2,3,4,7,8-Hexachlorodibenzodioxin	39227-28-6	Dioxins/Furans	1988 NSSS
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	Dioxins/Furans	1988 NSSS
1,2,3,4-tetrachlorodibenzo[b,d]furan	24478-72-6	Dioxins/Furans	1988 NSSS[1]
1,2,3,6,7,8-Hexabromodibenzofuran	107555-94-2	Dioxins/Furans	2015 BR
1,2,3,6,7,8-Hexabromodibenzo-p-dioxin	110999-45-6	Dioxins/Furans	2015 BR
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	Dioxins/Furans	1988 NSSS
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	Dioxins/Furans	1988 NSSS
1,2,3,7,8,9-Hexabromodibenzo[b,d]furan	161880-49-5	Dioxins/Furans	2015 BR
1,2,3,7,8,9-Hexabromodibenzo-p-dioxin	110999-46-7	Dioxins/Furans	2015 BR
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	Dioxins/Furans	1988 NSSS
1,2,3,7,8-Pentabromodibenzo[b,d]furan	107555-93-1	Dioxins/Furans	2015 BR
1,2,3,7,8-Pentabromodibenzo-p-dioxin	109333-34-8	Dioxins/Furans	2015 BR
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	Dioxins/Furans	1988 NSSS
1,2,5,6,9,10-Hexabromocyclododecane	3194-55-6	Flame retardant	2017 BR
1,2-Bis(2,4,6-tribromophenoxy)ethane	37853-59-1	Flame retardant	2017 BR
1,3,5-Trichlorobenzene	108-70-3	Volatile organic	2005 BR
1,3-Dichlorobenzene	541-73-1	Volatile organic	2005 BR
1,4-Dichlorobenzene	106-46-7	Volatile organic	1988 NSSS
1,7-Dimethylxanthine	611-59-6	Other organics	2005 BR
10-Hydroxy Amitriptyline Oxalate	1246833-15-7	Drugs	2013 BR
10-Hydroxyamitriptyline	1159-82-6	Drugs	2013 BR
17alpha-Estradiol	57-91-0	Drugs	2005 BR
17alpha-Ethinylestradiol	57-63-6	Drugs	2005 BR
17beta-Estradiol	50-28-2	Hormones	2005 BR
2,2'-(1,2-Ethanediyl)bis(5-aminobenzenesulfonic acid)	5136-34-5	Drugs	2005 BR

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
2,2',3,3',4,4',5,5',6,6'-decabromodiphenyl ether	1163-19-5	PBDEs	2009 BR
2,2',3,3',4,4',5,6'-Octachlorobiphenyl	42740-50-1	PCB	2019 BR
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	PCB	2019 BR
2,2',3,3',4,4'-Hexachlorobiphenyl	38380-07-3	PCB	2019 BR
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	PCB	2019 BR
2,2',3,3',4,5-Hexachlorobiphenyl	55215-18-4	PCB	2019 BR
2,2',3,3',4,6-Hexachlorobiphenyl	61798-70-7	PCB	2019 BR
2,2',3,3',5,5',6-Heptachlorobiphenyl	52663-67-9	PCB	2019 BR
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	PCB	2019 BR
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	PCB	2019 BR
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	PCB	2019 BR
2,2',3,4,4',5',6-Heptabromodiphenyl ether	207122-16-5	PBDEs	2009 TNSSS
2,2',3,4,4',5-Hexabromobiphenyl	67888-98-6	PCB	2009 TNSSS
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	PCB	2019 BR
2,2',3,4,4',6,6'-Heptabromodiphenyl ether	117948-63-7	PBDEs	2017 BR
2,2',3,4,4'-Pentabromodiphenyl ether	182346-21-0	PBDEs	2009 BR
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	PCB	2019 BR
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	PCB	2019 BR
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	PCB	2019 BR
2,2',3,5-Tetrachlorobiphenyl	70362-46-8	PCB	2019 BR
2,2',3,6-Tetrachlorobiphenyl	70362-45-7	PCB	2019 BR
2,2',4,4',5,5'-Hexabromobiphenyl	59080-40-9	Flame retardant	2005 BR
2,2',4,4',5,5'-Hexabromodiphenyl ether	68631-49-2	PBDEs	2009 TNSSS
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	PCB	2019 BR
2,2',4,4',5,6'-Hexabromodiphenyl ether	207122-15-4	PBDEs	2009 TNSSS
2,2',4,4',5-Pentabromodiphenyl ether	60348-60-9	PBDEs	2009 TNSSS
2,2',4,4'-Tetrabromodiphenyl ether	5436-43-1	PBDEs	2009 TNSSS
2,2',4,4'-Tetrachlorobiphenyl	2437-79-8	PCB	2019 BR
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	PCB	2019 BR
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	PCB	2019 BR
2,2',4,5-Tetrachlorobiphenyl	70362-47-9	PCB	2019 BR
2,2',4,6'-Tetrachlorobiphenyl	68194-04-7	PCB	2019 BR
2,2',4-Tribromodiphenyl ether	147217-75-2	PBDEs	2017 BR
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	PCB	2019 BR
2,2',6-Trichlorobiphenyl	38444-73-4	PCB	2019 BR
2,2',3,3',4,4',5,5',6-Nonabromodiphenyl ether	63387-28-0	PBDEs	2017 BR
2,2',3,3',4,4',5,6,6'-Nonabromodiphenyl ether	437701-79-6	PBDEs	2017 BR
2,2',3,3',4,4',5,6'-Octabromodiphenyl ether	446255-39-6	PBDEs	2017 BR
2,2',3,3',4,4',6,6'-Octabromodiphenyl ether	117964-21-3	PBDEs	2017 BR
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	38051-10-4	Other organics	2019 BR
2,2'-Dichlorobiphenyl	13029-08-8	PCB	2019 BR
2,3,3',4,4',5,5'-Heptachlorobiphenyl	39635-31-9	PCB	2001 NSSS
2,3,3',4,4',5',6-Heptabromodiphenyl ether	446255-30-7	PBDEs	2017 BR
2,3,3',4,4',5,6-Heptachlorobiphenyl	41411-64-7	PCB	2019 BR
2,3,3',4,4',5'-Hexachlorobiphenyl	69782-90-7	PCB	2001 NSSS
2,3,3',4,4',5-Hexachlorobiphenyl	38380-08-4	PCB	2001 NSSS
2,3,3',4,4',6-Hexachlorobiphenyl	74472-42-7	PCB	2019 BR
2,3,3',4,4'-Pentachlorobiphenyl	32598-14-4	PCB	2001 NSSS

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
2,3,3',4',5,6-Hexachlorobiphenyl	74472-44-9	PCB	2019 BR
2,3',4,4',5,5'-Hexachlorobiphenyl	52663-72-6	PCB	2001 NSSS
2,3,4,4',5-Pentachlorobiphenyl	74472-37-0	PCB	2001 NSSS
2,3',4,4',5-Pentachlorobiphenyl	31508-00-6	PCB	2001 NSSS
2',3,4,4',5-Pentachlorobiphenyl	65510-44-3	PCB	2001 NSSS
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	PCB	2019 BR
2,3,4,5,6-Pentabromoethylbenzene	85-22-3	Flame retardant	2017 BR
2,3,4,6,7,8-Hexabromodibenzo[b,d]furan	161880-50-8	Dioxins/Furans	2015 BR
2,3,4,6,7,8-Hexachlorodibenzo[b,d]furan	60851-34-5	Dioxins/Furans	1988 NSSS
2,3,4,7,8-Pentabromodibenzofuran	131166-92-2	Dioxins/Furans	2015 BR
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	Dioxins/Furans	1988 NSSS
2,3,4'-Trichlorobiphenyl	38444-85-8	PCB	2019 BR
2,3,6-Trichlorobiphenyl	55702-45-9	PCB	2019 BR
2,3',6-Trichlorobiphenyl	38444-76-7	PCB	2019 BR
2,3,7,8-Tetrabromodibenzofuran	67733-57-7	Dioxins/Furans	2015 BR
2,3,7,8-Tetrabromodibenzo-p-dioxin	50585-41-6	Dioxins/Furans	2015 BR
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	Dioxins/Furans	1988 NSSS[1]
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	Dioxins/Furans	1988 NSSS
2,3-Dichlorobiphenyl	16605-91-7	PCB	2019 BR
2,4',5-Trichlorobiphenyl	16606-02-3	PCB	2019 BR
2,4,5-Trichlorophenol	95-95-4	Pesticides	2015 BR
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	Other organics	2019 BR
2,4'-Dichlorobiphenyl	34883-43-7	PCB	2019 BR
2,4-Dichlorophenol	120-83-2	Pesticides	2017 BR
2,4-Dichlorophenoxyacetic acid	94-75-7	Pesticides	1988 NSSS
2,4-Di-tert-butylphenol (2,4-DTBP)	96-76-4	Other organics	2019 BR
2,4-Di-tert-pentylphenol (2,4-DTPP)	120-95-6	Other organics	2019 BR
2,5-Di-tert-butylphenol (2,5-DTBP)	5875-45-6	Other organics	2019 BR
2,6-Dichlorobiphenyl	33146-45-1	PCB	2019 BR
2,6-Di-tert-butylphenol	128-39-2	Other organics	2005 BR
2-Butoxy-, hydrogen phosphate ethanol	14260-97-0	Other organics	2019 BR
2-Chloro-4-phenylphenol	92-04-6	Other organics	2015 BR
2-Chlorobiphenyl	2051-60-7	PCB	2019 BR
2-Chloronaphthalene	91-58-7	Other organics	2005 BR
2-Ethylhexyl diphenyl phosphate	1241-94-7	Flame retardant	2019 BR
2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	PFAS	2019 BR
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	Other organics	2019 BR
2-Methylnaphthalene	91-57-6	Other organics	2005 BR
2-tert-Butyl-4-methoxyphenol	121-00-6	Other organics	2005 BR
3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-Henicosafluorododecyl 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl hydrogen phosphate	1158182-60-5	PFAS	2019 BR
3,3',4,4',5,5'-Hexachlorobiphenyl	32774-16-6	PCB	2001 NSSS
3,3',4,4',5-Pentachlorobiphenyl	57465-28-8	PCB	2001 NSSS
3,3',4,4'-Tetrachlorobiphenyl	32598-13-3	PCB	2001 NSSS
3,3',5,5'-Tetrabromobisphenol A	79-94-7	Flame retardant	2005 BR
3,4,4',5-Tetrachlorobiphenyl	70362-50-4	PCB	2001 NSSS
3,4,4'-Trichlorobiphenyl	38444-90-5	PCB	2019 BR

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
3,4-Dihydroxybenzoic acid	99-50-3	Drugs	2017 BR
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	4221-80-1	Other organics	2019 BR
3-Methylindole	83-34-1	Other organics	2009 TNSSS
4-(1,1,3,3-Tetramethylbutyl)phenol	140-66-9	Other organics	2007 BR[1]
4-(Butan-2-yl)-2,6-di-tert-butylphenol	17540-75-9	Other organics	2019 BR
4,4',4''-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol	1843-03-4	Other organics	2019 BR
4,4'-Dichlorocarbanilide	1219-99-4	Antimicrobial	2011 BR
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)	118-82-1	Other organics	2019 BR
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)	96-69-5	Other organics	2019 BR
4-Androstene-3,17-dione	63-05-8	Hormones	2009 TNSSS
4-Chloroaniline	106-47-8	Other organics	1988 NSSS
4-Chlorobiphenyl	2051-62-9	PCB	2019 BR
4-Dimethylaminoantipyrine	58-15-1	Drugs	2005 BR
4-Epianhydrochlortetracycline	81163-11-3	Antibiotic	2009 TNSSS
4-Epianhydrotetracycline	7518-17-4	Antibiotic	2009 TNSSS
4-Epianhydrotetracycline hydrochloride	4465-65-0	Antibiotic	2009 TNSSS
4-Epichlortetracycline	14297-93-9	Antibiotic	2009 TNSSS
4-epi-Oxytetracycline	14206-58-7	Antibiotic	2009 TNSSS
4-Hydroxybenzoic acid	99-96-7	Drugs	2017 BR
4-Nitrophenol	100-02-7	Drugs	2005 BR
4-Nonylphenol	104-40-5	Other organics	2005 BR
4-Nonylphenol diethoxylate	20427-84-3	Other organics	2007 BR
4-Nonylphenol, branched	84852-15-3	Other organics	2005 BR
4-Octylphenol	1806-26-4	Other organics	2007 BR
5-Aminosalicylic acid	89-57-6	Drugs	2005 BR
6:2 Fluorotelomer phosphate diester	57677-95-9	PFAS	2019 BR
6:2 Fluorotelomer sulfonic acid	27619-97-2	PFAS	2019 BR
6:2/8:2 Fluorotelomer phosphate diester (diPAPs)	943913-15-3	PFAS	2019 BR
8:2 Fluorotelomer phosphate diester	678-41-1	PFAS	2019 BR
8:2 Fluorotelomer sulfonic acid	39108-34-4	PFAS	2019 BR
Acetaminophen	103-90-2	Drugs	2005 BR
Acetic acid	64-19-7	Drugs	1988 NSSS
Acetone	67-64-1	Volatile organic	1988 NSSS
Acetophenone	98-86-2	Drugs	1988 NSSS
Albuterol	18559-94-9	Drugs	2005 BR
Alkylbenzenesulfonate, linear	42615-29-2	Other organics	2005 BR
Alprazolam	28981-97-7	Drugs	2013 BR
Aluminum	7429-90-5	Metals	1988 NSSS
Amitriptyline	50-48-6	Drugs	2013 BR
Amlodipine	88150-42-9	Drugs	2013 BR
Ammelide	645-93-2	Other organics	2019 BR
Ammeline	645-92-1	Other organics	2019 BR
Ammonium	14798-03-9	Inorganics	2007 BR
Amoxicillin	26787-78-0	Antibiotic	2019 BR
Amphetamine	300-62-9	Drugs	2007 BR
Ampicillin	69-53-4	Antibiotic	2019 BR
Androsterone	53-41-8	Drugs	2009 TNSSS

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
Anhydro-6-demethyltetracycline	4496-85-9	Antibiotic	2009 TNSSS
Anhydrochlortetracycline	4497-08-9	Antibiotic	2009 TNSSS
Anhydroerythromycin A	23893-13-2	Drugs	2007 BR
Anhydrotetracycline	1665-56-1	Antibiotic	2009 TNSSS
Anthracene	120-12-7	PAHs	1988 NSSS
Antimony	7440-36-0	Metals	1988 NSSS
Arsenic	7440-38-2	Metals	1988 NSSS
Aspirin	50-78-2	Drugs	2005 BR
Atenolol	29122-68-7	Drugs	2015 BR
Atorvastatin	134523-00-5	Drugs	2013 BR
Azithromycin	83905-01-5	Antibiotic	2007 BR
Barium	7440-39-3	Metals	1988 NSSS
Benz(a)anthracene	56-55-3	PAHs	1988 NSSS
Benzo(a)pyrene	50-32-8	PAHs	1988 NSSS
Benzo(b)fluoranthene	205-99-2	PAHs	1988 NSSS
Benzo(k)fluoranthene	207-08-9	PAHs	1988 NSSS
Benzoic acid	65-85-0	Pesticides	1988 NSSS
Benzoylecgonine	519-09-5	Drugs	2013 BR
Benztropine	86-13-5	Drugs	2013 BR
Benzyl 4-hydroxybenzoate	94-18-8	Other organics	2017 BR
Beryllium	7440-41-7	Metals	1988 NSSS
beta-Sitosterol	83-46-5	Drugs	2007 BR
Bezafibrate	41859-67-0	Drugs	2005 BR
Bis(1,3-dichloropropan-2-yl) hydrogen phosphate	72236-72-7	Flame retardant	2019 BR
Bis(1-chloropropan-2-yl) hydrogen phosphate	789440-10-4	Flame retardant	2019 BR
Bis(2-chloroethyl) phosphate	3040-56-0	Other organics	2019 BR
Bis(2-ethylhexyl) phosphate	298-07-7	Other organics	2019 BR
Bis(2-methylphenyl) hydrogen phosphate	35787-74-7	Other organics	2019 BR
Bisphenol A	80-05-7	Drugs	2007 BR
Bisphenol A bis(diphenyl phosphate) (BDP)	5945-33-5	Other organics	2019 BR
Bisphenol A Polycarbonate	25766-59-0	Other organics	2019 BR
Boron	7440-42-8	Inorganics	1988 NSSS
Butylated hydroxyanisole	25013-16-5	Other organics	2005 BR
Butylated hydroxytoluene	128-37-0	Other organics	2005 BR
Butylparaben	94-26-8	Antimicrobial	2017 BR
Cadmium	7440-43-9	Metals	1988 NSSS
Caffeine	58-08-2	Drugs	2005 BR
Calcium	7440-70-2	Metals	1988 NSSS
Campesterol	474-62-4	Other organics	2009 TNSSS
Carbadox	6804-07-5	Antibiotic	2005 BR
Carbamazepine	298-46-4	Drugs	2005 BR
Carbon tetrachloride	56-23-5	Volatile organic	2005 BR
Cefotaxime	63527-52-6	Antibiotic	2009 TNSSS
Cerium	7440-45-1	Metals	2005 BR
Cesium	7440-46-2	Metals	2019 BR
Chloroform	67-66-3	Volatile organic	1988 NSSS
Chlortetracycline	57-62-5	Antibiotic	2009 BR
Cholestan-3-ol, (3.beta.,5.alpha.)-	80-97-7	Other organics	2009 TNSSS
Cholesterol	57-88-5	Drugs	2005 BR

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
Chromium	7440-47-3	Metals	1988 NSSS
Chrysene	218-01-9	PAHs	1988 NSSS
Cimetidine	51481-61-9	Drugs	2005 BR
Ciprofloxacin	85721-33-1	Antibiotic	2005 BR
Clarithromycin	81103-11-9	Antibiotic	2007 BR
Clinafloxacin	105956-97-6	Antibiotic	2009 TNSSS
Clindamycin	18323-44-9	Antibiotic	2011 BR
Clofibric acid	882-09-7	Drugs	2005 BR
Clorophene	120-32-1	Pesticides	2015 BR
Clotrimazole	23593-75-1	Drugs	2011 BR
Cloxacillin	61-72-3	Antibiotic	2009 TNSSS
Cobalt	7440-48-4	Metals	1988 NSSS
Cocaine	50-36-2	Drugs	2013 BR
Codeine	76-57-3	Drugs	2005 BR
Copper	7440-50-8	Metals	1988 NSSS
Coprosterol	360-68-9	Other organics	2007 BR
Cotinine	486-56-6	Other organics	2005 BR
Cresyl diphenyl phosphate (CDPP)	26444-49-5	Flame retardant	2019 BR
Cyanide	57-12-5	Inorganics	1988 NSSS
Cyanuric acid	108-80-5	Other organics	2019 BR
Cyclophosphamide	50-18-0	Drugs	2005 BR
Decachlorobiphenyl	2051-24-3	PCB	2019 BR
Decamethylcyclopentasiloxane	541-02-6	Other organics	2015 BR
Dechlorane 603	13560-92-4	Flame retardant	2017 BR
Dechlorane Plus	13560-89-9	Flame retardant	2017 BR
DEET	134-62-3	Pesticides	2005 BR
Demeclocycline	127-33-3	Antibiotic	2009 TNSSS
Desmosterol	313-04-2	Other organics	2009 TNSSS
Di(2-ethylhexyl) phthalate	117-81-7	Other organics	2005 BR
Diazepam	439-14-5	Drugs	2005 BR
Dibutyl ester phosphoric acid	107-66-4	Other organics	2019 BR
Dibutyl phthalate	84-74-2	Other organics	1988 NSSS
Dichlorobiphenyl	25512-42-9	PCB	2019 BR
Dichloromethane	75-09-2	Volatile organic	1988 NSSS
Dichlorophen	97-23-4	Pesticides	2015 BR
Diclofenac	15307-86-5	Drugs	2011 BR
Diclofenac sodium	15307-79-6	Drugs	2005 BR
Diethyl hydrogen phosphate	598-02-7	Flame retardant	2019 BR
Digoxigenin	1672-46-4	Drugs	2009 TNSSS
Digoxin	20830-75-5	Drugs	2005 BR
Diisobutyl hydrogen phosphate	6303-30-6	Other organics	2019 BR
Dimethoate	60-51-5	Pesticides	1988 NSSS
Dimethyl 2,6-dimethyl-4-(2-nitrophenyl)-3,5-pyridinedicarboxylate	67035-22-7	Drugs	2009 TNSSS
Dimethyl phthalate	131-11-3	Other organics	1988 NSSS
Di-n-octyl phthalate	117-84-0	Other organics	1988 NSSS
Diphenhydramine	58-73-1	Drugs	2007 BR
Diphenyl phosphate (DPHP)	838-85-7	Other organics	2019 BR
Dipropyl ester phosphoric acid	1804-93-9	Other organics	2019 BR
D-Limonene	5989-27-5	Fragrance	2007 BR

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
Doxycycline	564-25-0	Antibiotic	2005 BR
Endosulfan I	959-98-8	Pesticides	1988 NSSS
Endosulfan II	33213-65-9	Pesticides	1988 NSSS
Enrofloxacin	93106-60-6	Antibiotic	2009 TNSSS
Epitetracycline	79-85-6	Antibiotic	2009 TNSSS
Epitetracycline hydrochloride	23313-80-6	Antibiotic	2009 TNSSS
Equilenin	517-09-9	Drugs	2009 TNSSS
Equilin	474-86-2	Drugs	2005 BR
Ergosterol	57-87-4	Drugs	2009 TNSSS
Erythromycin	114-07-8	Antibiotic	2005 BR
Estradiol benzoate	50-50-0	Drugs	2009 TNSSS
Estriol	50-27-1	Hormones	2005 BR
Estrone	53-16-7	Hormones	2005 BR
Ethylbenzene	100-41-4	Volatile organic	1988 NSSS
Ethylene glycol nonylphenyl ether	27986-36-3	Other organics	2007 BR
Ethylparaben	120-47-8	Antimicrobial	2017 BR
Fenofibric acid	42017-89-0	Drugs	2005 BR
Fenthion	55-38-9	Pesticides	2005 BR
Fipronil	120068-37-3	Pesticides	2011 BR
Fipronil amide	205650-69-7	Pesticides	2019 BR
Fipronil sulfide	120067-83-6	Pesticides	2019 BR
Fipronil sulfone	120068-36-2	Pesticides	2019 BR
Fipronil desulfinyl	205650-65-3	Pesticides	2019 BR
Floxacillin	5250-39-5	Antibiotic	2005 BR
Flumequine	42835-25-6	Antibiotic	2009 TNSSS
Fluoranthene	206-44-0	PAHs	1988 NSSS
Fluoride	16984-48-8	Inorganics	1988 NSSS
Fluoxetine	54910-89-3	Drugs	2005 BR
Furosemide	54-31-9	Drugs	2013 BR
Galaxolide	1222-05-5	Fragrance	2005 BR
Gemfibrozil	25812-30-0	Drugs	2005 BR
Glybenclamide	10238-21-8	Drugs	2013 BR
Heptachlor epoxide B	1024-57-3	Pesticides	1988 NSSS
Heptachlorobiphenyl	28655-71-2	PCB	2019 BR
Heptachlorodibenzofuran	38998-75-3	Dioxins/Furans	1988 NSSS
Heptachlorodibenzo-p-dioxin	37871-00-4	Dioxins/Furans	1988 NSSS
Hexabromobenzene	87-82-1	Flame retardant	2017 BR
Hexachlorobiphenyl	26601-64-9	PCB	2019 BR
Hexachlorodibenzofuran	55684-94-1	Dioxins/Furans	1988 NSSS
Hexachlorodibenzo-p-dioxin	34465-46-8	Dioxins/Furans	1988 NSSS
Hexanoic acid	142-62-1	Other organics	1988 NSSS
Hydrocodone	125-29-1	Drugs	2013 BR
Ibuprofen	15687-27-1	Drugs	2005 BR
Indole	120-72-9	Drugs	2007 BR
Iron	7439-89-6	Metals	1988 NSSS
Isochlortetracycline	514-53-4	Antibiotic	2009 TNSSS
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	Flame retardant	2019 BR
Ketoprofen	22071-15-4	Drugs	2005 BR
Lead	7439-92-1	Metals	1988 NSSS

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
Levonorgestrel	797-63-7	Drugs	2005 BR
Lincomycin	154-21-2	Antibiotic	2009 BR
Lomefloxacin	98079-51-7	Antibiotic	2009 TNSSS
Magnesium	7439-95-4	Metals	1988 NSSS
Manganese	7439-96-5	Metals	1988 NSSS
MDMA	42542-10-9	Drugs	2009 BR
Mefenamic acid	61-68-7	Drugs	2005 BR
Melamine	108-78-1	Other organics	2019 BR
Mercury	7439-97-6	Metals	1988 NSSS
Mestranol	72-33-3	Drugs	2005 BR
Metformin	657-24-9	Drugs	2009 TNSSS
Methamphetamine	537-46-2	Drugs	2007 BR
Methyl 3,4-dihydroxybenzoate	2150-43-8	Other organics	2017 BR
Methyl triclosan	4640-01-1	Antimicrobial	2017 BR
Methylparaben	99-76-3	Other organics	2017 BR
Metoprolol	51384-51-1	Drugs	2005 BR
Miconazole	22916-47-8	Drugs	2009 TNSSS
Minocycline	10118-90-8	Antibiotic	2009 TNSSS
Molybdenum	7439-98-7	Metals	1988 NSSS
Monochlorobiphenyl	27323-18-8	PCB	2019 BR
Monuron	150-68-5	Pesticides	2005 BR
Musk ketone	81-14-1	Fragrance	2005 BR
Musk Xylene	81-15-2	Fragrance	2005 BR
m-Xylene	108-38-3	Volatile organic	1988 NSSS
Nadolol	42200-33-9	Drugs	2005 BR
Nalidixic acid	389-08-2	Antibiotic	2019 BR
Naphthalene	91-20-3	PAHs	1988 NSSS
Naproxen	22204-53-1	Drugs	2005 BR
N-Demethyldiltiazem hydrochloride	130606-60-9	Drugs	2013 BR
N-Desmethyldiltiazem	86408-45-9	Drugs	2013 BR
Nickel	7440-02-0	Metals	1988 NSSS
Nitrate	14797-55-8	Inorganics	1988 NSSS
Nitrite	14797-65-0	Inorganics	1988 NSSS
Nitrofen	1836-75-5	Pesticides	1988 NSSS
Nitrogen	7727-37-9	Inorganics	2007 BR
N-Nitrosodibutylamine	924-16-3	Other organics	2015 BR
N-Nitrosodiethylamine	55-18-5	Other organics	2015 BR
N-Nitrosodimethylamine	62-75-9	Other organics	2015 BR
N-Nitrosodi-n-propylamine	621-64-7	Other organics	2015 BR
N-Nitrosodiphenylamine	86-30-6	Other organics	1988 NSSS
N-Nitrosopiperidine	100-75-4	Other organics	2015 BR
N-Nitrosopyrrolidine	930-55-2	Other organics	2015 BR
n-Nonylphenol	25154-52-3	Other organics	2005 BR
n-Octylphenol	67554-50-1	Other organics	2005 BR
Nonabromodiphenyl ether	63936-56-1	PBDEs	2017 BR
Nonachlorobiphenyl	53742-07-7	PCB	2019 BR
Norethindrone	68-22-4	Drugs	2005 BR
Norfloxacin	70458-96-7	Antibiotic	2005 BR
Norfluoxetine	83891-03-6	Drugs	2011 BR

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
Norgestimate	35189-28-7	Drugs	2009 TNSSS
Norverapamil	67018-85-3	Drugs	2013 BR
Octabromodibenzo-p-dioxin	2170-45-8	Dioxins/Furans	2015 BR
Octachlorobiphenyl	55722-26-4	PCB	2019 BR
Octachlorodibenzofuran	39001-02-0	Dioxins/Furans	1988 NSSS
Octachlorodibenzo-p-dioxin	3268-87-9	Dioxins/Furans	1988 NSSS
Ofloxacin	82419-36-1	Antibiotic	2009 TNSSS
Ormetoprim	6981-18-6	Antibiotic	2009 TNSSS
Oxacillin	66-79-5	Antibiotic	2009 TNSSS
Oxolinic acid	14698-29-4	Antibiotic	2009 TNSSS
Oxycodone	76-42-6	Drugs	2013 BR
o-Xylene	95-47-6	Volatile organic	1988 NSSS
Oxytetracycline	79-57-2	Antibiotic	2005 BR
Paroxetine	61869-08-7	Drugs	2013 BR
p-Cresol	106-44-5	Volatile organic	1988 NSSS
Penicillin G	61-33-6	Antibiotic	2009 TNSSS
Penicillin V	87-08-1	Antibiotic	2005 BR
Pentabromodiphenyl ether	32534-81-9	PBDEs	2009 BR
Pentachlorobiphenyl	25429-29-2	PCB	2019 BR
Pentachlorodibenzodioxin	36088-22-9	Dioxins/Furans	1988 NSSS
Pentachlorodibenzofuran	30402-15-4	Dioxins/Furans	1988 NSSS
Pentachloronitrobenzene	82-68-8	Pesticides	1988 NSSS
Perfluorobutanesulfonate	45187-15-3	PFAS	2013 BR
Perfluorobutanesulfonic acid (PFBS)	375-73-5	PFAS	2013 BR[3]
Perfluorobutanoic acid (PFBA)	375-22-4	PFAS	2013 BR
Perfluorodecanoic acid (PFDA)	335-76-2	PFAS	2013 BR
Perfluorododecanoic acid (PFDoDA)	307-55-1	PFAS	2013 BR
Perfluoroheptanoic acid (PFHpA)	375-85-9	PFAS	2013 BR
Perfluorohexanesulfonate	108427-53-8	PFAS	2013 BR
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	PFAS	2013 BR[2]
Perfluorohexanoic acid (PFHxA)	307-24-4	PFAS	2013 BR
Perfluorononanoic acid (PFNA)	375-95-1	PFAS	2013 BR
Perfluorooctanesulfonamide (PFOSA)	754-91-6	PFAS	2013 BR
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	PFAS	2013 BR
Perfluorooctanoic acid (PFOA)	335-67-1	PFAS	2013 BR
Perfluoropentanoic acid (PFPeA)	2706-90-3	PFAS	2013 BR
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	PFAS	2017 BR
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	PFAS	2017 BR
Perfluoroundecanoic acid (PFUdA)	2058-94-8	PFAS	2013 BR
Phenanthrene	85-01-8	PAHs	1988 NSSS
Phenazone	60-80-0	Drugs	2005 BR
Phenol	108-95-2	Drugs	1988 NSSS
Phosphate	14265-44-2	Inorganics	2005 BR
Phosphorus	7723-14-0	Inorganics	2007 BR
Polychlorinated biphenyl (PCB)	1336-36-3	PCB	2019 BR
Polyethylene glycol	25322-68-3	Drugs	2005 BR
Polyethylene terephthalate	25038-59-9	Other organics	2019 BR
Potassium	7440-09-7	Metals	2007 BR

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
Potassium perfluorooctanesulfonate	2795-39-3	PFAS	2013 BR
Progesterone	57-83-0	Hormones	2005 BR
Promethazine	60-87-7	Drugs	2013 BR
Propoxyphene	469-62-5	Drugs	2013 BR
Propranolol	525-66-6	Drugs	2005 BR
Propylparaben	94-13-3	Other organics	2017 BR
p-Xylene	106-42-3	Volatile organic	1988 NSSS
Pyrene	129-00-0	PAHs	1988 NSSS
Quinine sulfate	7778-93-0	Other organics	2005 BR
Ranitidine	66357-35-5	Drugs	2005 BR
Resorcinol bis(diphenyl phosphate) (RDP)	57583-54-7	Flame retardant	2019 BR
Roxithromycin	80214-83-1	Antibiotic	2007 BR
Rubidium	7440-17-7	Metals	2005 BR
Salicylic acid	69-72-7	Drugs	2005 BR
Sarafloxacin	98105-99-8	Antibiotic	2009 TNSSS
Selenium	7782-49-2	Metals	1988 NSSS
Sertraline	79617-96-2	Drugs	2013 BR
Silver	7440-22-4	Metals	1988 NSSS
Sodium	7440-23-5	Metals	1988 NSSS
Sodium perfluorodecanesulfonate (PFDS)	2806-15-7	PFAS	2019 BR
Sodium valproate	1069-66-5	Drugs	2005 BR
Stigmastan-3beta-ol	19466-47-8	Other organics	2007 BR
Stigmastanol	138126-65-5	Drugs	2007 BR[5]
Stigmasterol	83-48-7	Drugs	2009 TNSSS
Styrene	100-42-5	Other organics	1988 NSSS
Sulfachloropyridazine	80-32-0	Antibiotic	2009 TNSSS
Sulfadiazine	68-35-9	Antibiotic	2009 TNSSS
Sulfadimethoxine	122-11-2	Antibiotic	2009 BR
Sulfamerazine	127-79-7	Antibiotic	2005 BR
Sulfamethazine	57-68-1	Antibiotic	2005 BR
Sulfamethizole	144-82-1	Antibiotic	2009 TNSSS
Sulfamethoxazole	723-46-6	Antibiotic	2009 TNSSS
Sulfanilamide	63-74-1	Antibiotic	2009 TNSSS
Sulfasalazine	599-79-1	Antibiotic	2005 BR
Sulfate	14808-79-8	Inorganics	2019 BR
Sulfathiazole	72-14-0	Antibiotic	2009 TNSSS
Sulfur	7704-34-9	Inorganics	2019 BR
Terephthalic acid	100-21-0	Other organics	2019 BR
tert-Butylphenyl diphenyl phosphate	56803-37-3	Flame retardant	2019 BR
Testosterone	58-22-0	Hormones	2009 BR
Tetrabromodiphenyl ether	40088-47-9	PBDEs	2009 TNSSS[4]
Tetrabutyl ethylidenebisphenol (AO22E46)	35958-30-6	Other organics	2019 BR
Tetrachlorobiphenyl	26914-33-0	PCB	2019 BR
Tetrachlorodibenzodioxin	41903-57-5	Dioxins/Furans	1988 NSSS
Tetrachlorodibenzofuran	30402-14-3	Dioxins/Furans	1988 NSSS
Tetrachloroethylene	127-18-4	Volatile organic	2005 BR
Tetracycline	60-54-8	Antibiotic	2009 BR
Thallium	7440-28-0	Metals	1988 NSSS

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
Thiabendazole	148-79-8	Pesticides	2009 TNSSS
Tin	7440-31-5	Metals	1988 NSSS
Titanium	7440-32-6	Metals	1988 NSSS
Toluene	108-88-3	Volatile organic	1988 NSSS
Tonalide	21145-77-7	Fragrance	2007 BR
Triamterene	396-01-0	Drugs	2013 BR
Tributyl phosphate	126-73-8	Flame retardant	2019 BR
Trichlorfon	52-68-6	Pesticides	2005 BR
Trichlorobiphenyl	25323-68-6	PCB	2019 BR
Triclocarban	101-20-2	Antimicrobial	2007 BR
Triclosan	3380-34-5	Drugs	2005 BR
Triethyl phosphate (TEP)	78-40-0	Flame retardant	2019 BR
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)	36443-68-2	Other organics	2019 BR
Triisobutyl phosphate	126-71-6	Flame retardant	2019 BR
Trimethoprim	738-70-5	Antibiotic	2005 BR
Trimethyl phosphate (TMP)	512-56-1	Flame retardant	2019 BR
Trimethylsilanol (TMS)	1066-40-6	Flame retardant	2019 BR
Triphenyl phosphate	115-86-6	Flame retardant	2005 BR
Tripropyl phosphate	513-08-6	Flame retardant	2019 BR
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	Flame retardant	2019 BR
Tris(2-butoxyethyl) phosphate	78-51-3	Flame retardant	2005 BR
Tris(2-chloroethyl) phosphate	115-96-8	Flame retardant	2005 BR
Tris(2-chloroisopropyl) phosphate	13674-84-5	Flame retardant	2019 BR
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	Flame retardant	2019 BR
Tris(4-tert-butylphenyl) phosphate	78-33-1	Flame retardant	2019 BR
Tris(methylphenyl) phosphate	1330-78-5	Flame retardant	2019 BR
Tylosin	1401-69-0	Antibiotic	2005 BR
Valsartan	137862-53-4	Drugs	2013 BR
Vanadium	7440-62-2	Metals	1988 NSSS
Virginiamycin	11006-76-1	Antibiotic	2005 BR
Warfarin	81-81-2	Drugs	2009 TNSSS
Yttrium	7440-65-5	Metals	1988 NSSS
Zinc	7440-66-6	Metals	1988 NSSS
α-Dihydroequilin	651-55-8	Drugs	2009 TNSSS
Microbial Pollutants			
Aerobic endospores	NA	Bacteria	2013 BR
Aeromonas spp.	NA	Bacteria	2009 BR
Antibiotic-resistant bacteria (ARB) or Antibiotic-resistant genes (ARG)	NA	Bacteria	2013 BR
Clostridia spp.	NA	Bacteria	2007 BR
Clostridium perfringens	NA	Bacteria	2019 BR
Coronavirus HKU1	NA	Virus	2013 BR
Cosavirus	NA	Virus	2013 BR
Cryptosporidium parvum	NA	Protozoan parasite	2007 BR
Endotoxin	NA	Micrbial toxin	2007 BR
Enterovirus	NA	Virus	2009 BR
Enterococcus spp.	NA	Bacteria	2019 BR

Table B-1. Chemical and Microbial Pollutants Identified in Biosolids

Chemical	CAS number	Category	When identified
Escherichia coli	NA	Bacteria	2009 BR
Fecal coliforms	NA	Bacteria	2019 BR
Giardia spp.	NA	Protozoan parasite	2009 BR
Human adenoviruses	NA	Virus	2009 BR
Human norovirus	NA	Virus	2013 BR
Human polyomaviruses	NA	Virus	2011 BR
Klassevirus	NA	Virus	2013 BR
Listeria spp.	NA	Bacteria	2009 BR
Salmonella spp.	NA	Bacteria	2007 BR
Total coliforms	NA	Bacteria	2019 BR
Yersinia spp.	NA	Bacteria	2019 BR

Notes:

BR = Biennial Review

CAS = Chemical Abstracts Service

NA = Not applicable

NSSS = National Sewage Sludge Survey

PBDE = Polybrominated diphenyl ethers

PFAS = Per- and polyfluoroalkyl substances

TNSSS = Targeted National Sewage Sludge Survey

[1] = The class 'Total tetrachlorodibenzofurans' was analyzed in the 1988 NSSS. This is a specific chemical member of the class of tetrachlorodibenzofurans.

[2] = Chemicals in the PFAS family can exist in various ion states (e.g., acids, anions, cations). This is the acid state of perfluorohexanesulfonate.

[3] = Chemicals in the PFAS family can exist in various ion states (e.g., acids, anions, cations). This is the acid state of perfluorobutanesulfonate.

[4] = Two chemicals from the class 'Tetrabromodiphenyl ether' were analyzed in the 2009 TNSSS. This is the chemical class 'Tetrabromodiphenyl ether' that contain members of the family.

[5] = Members of the class 'Stigmastanol' were analyzed beginning in the 2007 Biennial Review. This is the chemical class 'Stigmastanol' that contain members of that family.

The list includes only chemicals identified through biennial reviews and sewage sludge surveys. This list does not include chemicals identified in the 2003 literature review conducted as part of of the EPA response to the 2002 National Research Council (NRC) report reviewing the biosolids regulation (68 FR 75531).

Appendix C. Concentrations of Chemicals Found in Biosolids

Table C-1. Concentrations of Newly and Previously Identified Chemicals in Biosolids for the 2018-2019 Biennial Review

Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
Tetrabutyl ethylidenebisphenol (AO22E46)	35958-30-6	New	Various	No	2016	57	ng/g, dw	median	Lu et al. 2019
Tetrabutyl ethylidenebisphenol (AO22E46)	35958-30-6	New	Various	No	2016	6.6	ng/g, dw	min	Lu et al. 2019
Tetrabutyl ethylidenebisphenol (AO22E46)	35958-30-6	New	Various	No	2016	86	ng/g, dw	max	Lu et al. 2019
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	New	Various	No	2016	<MQL	ng/g, dw	min	Lu et al. 2019
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	New	Various	No	2016	<MQL	ng/g, dw	max	Lu et al. 2019
2,4-Di-tert-butylphenol (2,4-DTBP)	96-76-4	New	Various	No	2016	341	ng/g, dw	median	Lu et al. 2019
2,4-Di-tert-butylphenol (2,4-DTBP)	96-76-4	New	Various	No	2016	91	ng/g, dw	min	Lu et al. 2019
2,4-Di-tert-butylphenol (2,4-DTBP)	96-76-4	New	Various	No	2016	924	ng/g, dw	max	Lu et al. 2019
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	4221-80-1	New	Various	No	2016	15	ng/g, dw	median	Lu et al. 2019
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	4221-80-1	New	Various	No	2016	33	ng/g, dw	max	Lu et al. 2019
2,4-Di-tert-pentylphenol (2,4-DTPP)	120-95-6	New	Various	No	2016	<MQL	ng/g, dw	min	Lu et al. 2019
2,4-Di-tert-pentylphenol (2,4-DTPP)	120-95-6	New	Various	No	2016	6.2	ng/g, dw	max	Lu et al. 2019
2,5-Di-tert-butylphenol (2,5-DTBP)	5875-45-6	New	Various	No	2016	<MQL	ng/g, dw	min	Lu et al. 2019
2,5-Di-tert-butylphenol (2,5-DTBP)	5875-45-6	New	Various	No	2016	<MQL	ng/g, dw	max	Lu et al. 2019
2-Ethylhexyl diphenyl phosphate	1241-94-7	New	Not specified	Yes	2006-2007	189	ng/g, dw	mean	Wang et al. 2019
2-Ethylhexyl diphenyl phosphate	1241-94-7	New	Not specified	Yes	2006-2007	32.3	ng/g, dw	median	Wang et al. 2019
2-Ethylhexyl diphenyl phosphate	1241-94-7	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
2-Ethylhexyl diphenyl phosphate	1241-94-7	New	Not specified	Yes	2006-2007	4030	ng/g, dw	max	Wang et al. 2019
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)	96-69-5	New	Various	No	2016	<MQL	ng/g, dw	min	Lu et al. 2019
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)	96-69-5	New	Various	No	2016	8.4	ng/g, dw	max	Lu et al. 2019
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)	118-82-1	New	Various	No	2016	<MQL	ng/g, dw	min	Lu et al. 2019
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol	1843-03-4	New	Various	No	2016	27	ng/g, dw	median	Lu et al. 2019
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol	1843-03-4	New	Various	No	2016	7.4	ng/g, dw	min	Lu et al. 2019
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol	1843-03-4	New	Various	No	2016	47	ng/g, dw	max	Lu et al. 2019
4-(Butan-2-yl)-2,6-di-tert-butylphenol	17540-75-9	New	Various	No	2016	<MQL	ng/g, dw	min	Lu et al. 2019
4-(Butan-2-yl)-2,6-di-tert-butylphenol	17540-75-9	New	Various	No	2016	86	ng/g, dw	max	Lu et al. 2019
Ammelide	645-93-2	New	Not specified	Yes	2006-2007	17	ng/g, dw	mean	Zhu et al. 2019
Ammelide	645-93-2	New	Not specified	Yes	2006-2007	9.1	ng/g, dw	median	Zhu et al. 2019
Ammelide	645-93-2	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Zhu et al. 2019
Ammelide	645-93-2	New	Not specified	Yes	2006-2007	170	ng/g, dw	max	Zhu et al. 2019
Ammeline	645-92-1	New	Not specified	Yes	2006-2007	19	ng/g, dw	mean	Zhu et al. 2019
Ammeline	645-92-1	New	Not specified	Yes	2006-2007	8.9	ng/g, dw	median	Zhu et al. 2019
Ammeline	645-92-1	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Zhu et al. 2019
Amoxicillin	26787-78-0	New	Not specified	Yes	2006-2007	1.0	ng/g, dw	mean	Magee et al. 2018
Amoxicillin	26787-78-0	New	Not specified	Yes	2006-2007	0.4	ng/g, dw	min	Magee et al. 2018
Amoxicillin	26787-78-0	New	Not specified	Yes	2006-2007	1.8	ng/g, dw	max	Magee et al. 2018
Ampicillin	69-53-4	New	Not specified	Yes	2006-2007	14.8	ng/g, dw	mean	Magee et al. 2018

Table C-1. Concentrations of Newly and Previously Identified Chemicals in Biosolids for the 2018-2019 Biennial Review

Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
Bis(1,3-dichloropropan-2-yl) hydrogen phosphate	72236-72-7	New	Not specified	Yes	2006-2007	81.7	ng/g, dw	mean	Wang et al. 2019
Bis(1,3-dichloropropan-2-yl) hydrogen phosphate	72236-72-7	New	Not specified	Yes	2006-2007	9.48	ng/g, dw	median	Wang et al. 2019
Bis(1,3-dichloropropan-2-yl) hydrogen phosphate	72236-72-7	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Bis(1,3-dichloropropan-2-yl) hydrogen phosphate	72236-72-7	New	Not specified	Yes	2006-2007	1880	ng/g, dw	max	Wang et al. 2019
Bis(1-Chloropropan-2-yl) hydrogen phosphate	789440-10-4	New	Not specified	Yes	2006-2007	2.13	ng/g, dw	mean	Wang et al. 2019
Bis(1-Chloropropan-2-yl) hydrogen phosphate	789440-10-4	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	median	Wang et al. 2019
Bis(1-Chloropropan-2-yl) hydrogen phosphate	789440-10-4	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Bis(1-Chloropropan-2-yl) hydrogen phosphate	789440-10-4	New	Not specified	Yes	2006-2007	62.9	ng/g, dw	max	Wang et al. 2019
Bis(2-chloroethyl) phosphate	3040-56-0	New	Not specified	Yes	2006-2007	5.08	ng/g, dw	mean	Wang et al. 2019
Bis(2-chloroethyl) phosphate	3040-56-0	New	Not specified	Yes	2006-2007	1.72	ng/g, dw	median	Wang et al. 2019
Bis(2-chloroethyl) phosphate	3040-56-0	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Bis(2-chloroethyl) phosphate	3040-56-0	New	Not specified	Yes	2006-2007	26.2	ng/g, dw	max	Wang et al. 2019
Bis(2-ethylhexyl) phosphate	298-07-7	New	Not specified	Yes	2006-2007	26.6	ng/g, dw	mean	Wang et al. 2019
Bis(2-ethylhexyl) phosphate	298-07-7	New	Not specified	Yes	2006-2007	7.31	ng/g, dw	median	Wang et al. 2019
Bis(2-ethylhexyl) phosphate	298-07-7	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Bis(2-ethylhexyl) phosphate	298-07-7	New	Not specified	Yes	2006-2007	366	ng/g, dw	max	Wang et al. 2019
2-Butoxy-, hydrogen phosphate ethanol	14260-97-0	New	Not specified	Yes	2006-2007	31.3	ng/g, dw	mean	Wang et al. 2019
2-Butoxy-, hydrogen phosphate ethanol	14260-97-0	New	Not specified	Yes	2006-2007	17.7	ng/g, dw	median	Wang et al. 2019
2-Butoxy-, hydrogen phosphate ethanol	14260-97-0	New	Not specified	Yes	2006-2007	3.21	ng/g, dw	min	Wang et al. 2019
2-Butoxy-, hydrogen phosphate ethanol	14260-97-0	New	Not specified	Yes	2006-2007	219	ng/g, dw	max	Wang et al. 2019
Bis(2-methylphenyl) hydrogen phosphate	35787-74-7	New	Not specified	Yes	2006-2007	4.57	ng/g, dw	mean	Wang et al. 2019
Bis(2-methylphenyl) hydrogen phosphate	35787-74-7	New	Not specified	Yes	2006-2007	0.15	ng/g, dw	median	Wang et al. 2019
Bis(2-methylphenyl) hydrogen phosphate	35787-74-7	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Bis(2-methylphenyl) hydrogen phosphate	35787-74-7	New	Not specified	Yes	2006-2007	305	ng/g, dw	max	Wang et al. 2019
Bisphenol A bis(diphenyl phosphate) (BDP)	5945-33-5	New	Not specified	Yes	2006-2007	<MDL	ng/g, dw	mean	Wang et al. 2019
Bisphenol A bis(diphenyl phosphate) (BDP)	5945-33-5	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	median	Wang et al. 2019
Bisphenol A bis(diphenyl phosphate) (BDP)	5945-33-5	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Bisphenol A bis(diphenyl phosphate) (BDP)	5945-33-5	New	Not specified	Yes	2006-2007	6.82	ng/g, dw	max	Wang et al. 2019
Cesium	7440-46-2	New	Not specified	No	June 2016-Sep 2017	5.78	mg/kg, dw	mean	Onchoke et al. 2018
Cesium	7440-46-2	New	Not specified	No	June 2016-Sep 2017	4.30	mg/kg, dw	mean	Onchoke et al. 2018
Cresyl diphenyl phosphate (CDPP)	26444-49-5	New	Not specified	Yes	2006-2007	23.3	ng/g, dw	mean	Wang et al. 2019
Cresyl diphenyl phosphate (CDPP)	26444-49-5	New	Not specified	Yes	2006-2007	3.81	ng/g, dw	median	Wang et al. 2019
Cresyl diphenyl phosphate (CDPP)	26444-49-5	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Cresyl diphenyl phosphate (CDPP)	26444-49-5	New	Not specified	Yes	2006-2007	357	ng/g, dw	max	Wang et al. 2019
Cyanuric acid	108-80-5	New	Not specified	Yes	2006-2007	95	ng/g, dw	mean	Zhu et al. 2019
Cyanuric acid	108-80-5	New	Not specified	Yes	2006-2007	63	ng/g, dw	median	Zhu et al. 2019
Cyanuric acid	108-80-5	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Zhu et al. 2019
Cyanuric acid	108-80-5	New	Not specified	Yes	2006-2007	920	ng/g, dw	max	Zhu et al. 2019
Dibutyl ester phosphoric acid	107-66-4	New	Not specified	Yes	2006-2007	1.99	ng/g, dw	mean	Wang et al. 2019
Dibutyl ester phosphoric acid	107-66-4	New	Not specified	Yes	2006-2007	1.20	ng/g, dw	median	Wang et al. 2019
Dibutyl ester phosphoric acid	107-66-4	New	Not specified	Yes	2006-2007	<MDL	ng/g, dw	min	Wang et al. 2019
Dibutyl ester phosphoric acid	107-66-4	New	Not specified	Yes	2006-2007	16.6	ng/g, dw	max	Wang et al. 2019

Table C-1. Concentrations of Newly and Previously Identified Chemicals in Biosolids for the 2018-2019 Biennial Review

Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
Diethyl hydrogen phosphate	598-02-7	New	Not specified	Yes	2006-2007	5.28	ng/g, dw	mean	Wang et al. 2019
Diethyl hydrogen phosphate	598-02-7	New	Not specified	Yes	2006-2007	3.44	ng/g, dw	median	Wang et al. 2019
Diethyl hydrogen phosphate	598-02-7	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Diethyl hydrogen phosphate	598-02-7	New	Not specified	Yes	2006-2007	50.6	ng/g, dw	max	Wang et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	29.2	mg/kg, dw	mean	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	0.707	mg/kg, dw	min	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	314	mg/kg, dw	max	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	62.78	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	16.84	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	27.50	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	18.48	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	28.18	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	17.66	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	59.37	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	20.97	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	39.56	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	46.15	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	2.37	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	18.62	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	5.22	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	7.32	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	6.98	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	20.08	mg/kg, dw	individual	Menzies et al. 2019

Table C-1. Concentrations of Newly and Previously Identified Chemicals in Biosolids for the 2018-2019 Biennial Review

Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	0.71	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	27.64	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	10.59	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	37.93	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	14.51	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	1.85	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	25.72	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	25.72	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	79.84	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	2.08	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	14.03	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	0.97	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	16.74	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	4.76	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	13.14	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	7.24	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	2.24	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	31.44	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	3.94	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	81.74	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	7.11	mg/kg, dw	individual	Menzies et al. 2019

Table C-1. Concentrations of Newly and Previously Identified Chemicals in Biosolids for the 2018-2019 Biennial Review

Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	1.03	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	51.91	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	18.56	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	30.62	mg/kg, dw	individual	Menzies et al. 2019
2-Hydroxy-N-(2-hydroxyethyl)-N,N-dimethyl-ethanaminium esters with C16-18 and C18-unsatd. fatty acids, chlorides (DEEDMAC)	1079184-43-2	New	Not specified	No	Jul-Nov 2017	313.96	mg/kg, dw	individual	Menzies et al. 2019
Diisobutyl hydrogen phosphate	6303-30-6	New	Not specified	Yes	2006-2007	10.3	ng/g, dw	mean	Wang et al. 2019
Diisobutyl hydrogen phosphate	6303-30-6	New	Not specified	Yes	2006-2007	5.27	ng/g, dw	median	Wang et al. 2019
Diisobutyl hydrogen phosphate	6303-30-6	New	Not specified	Yes	2006-2007	2.13	ng/g, dw	min	Wang et al. 2019
Diisobutyl hydrogen phosphate	6303-30-6	New	Not specified	Yes	2006-2007	130	ng/g, dw	max	Wang et al. 2019
Diphenyl phosphate (DPHP)	838-85-7	New	Not specified	Yes	2006-2007	33.5	ng/g, dw	mean	Wang et al. 2019
Diphenyl phosphate (DPHP)	838-85-7	New	Not specified	Yes	2006-2007	5.47	ng/g, dw	median	Wang et al. 2019
Diphenyl phosphate (DPHP)	838-85-7	New	Not specified	Yes	2006-2007	0.93	ng/g, dw	min	Wang et al. 2019
Diphenyl phosphate (DPHP)	838-85-7	New	Not specified	Yes	2006-2007	1680	ng/g, dw	max	Wang et al. 2019
Dipropyl ester phosphoric acid	1804-93-9	New	Not specified	Yes	2006-2007	1.12	ng/g, dw	mean	Wang et al. 2019
Dipropyl ester phosphoric acid	1804-93-9	New	Not specified	Yes	2006-2007	0.68	ng/g, dw	median	Wang et al. 2019
Dipropyl ester phosphoric acid	1804-93-9	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Dipropyl ester phosphoric acid	1804-93-9	New	Not specified	Yes	2006-2007	8.93	ng/g, dw	max	Wang et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2001	2.3	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2001	2.6	ug/kg, dw	median	Sadaria et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2001	0.9	ug/kg, dw	min	Sadaria et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2001	3.8	ug/kg, dw	max	Sadaria et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2006-2007	4.6	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2006-2007	4.0	ug/kg, dw	median	Sadaria et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2006-2007	0.4	ug/kg, dw	min	Sadaria et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2006-2007	18.7	ug/kg, dw	max	Sadaria et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2015-2016	3.7	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2015-2016	2.2	ug/kg, dw	median	Sadaria et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2015-2016	1.1	ug/kg, dw	min	Sadaria et al. 2019
Fipronil amide	205650-69-7	New	Class B	Yes	2015-2016	7.9	ug/kg, dw	max	Sadaria et al. 2019
Fipronil desulfinyl	205650-65-3	New	Class B	Yes	2001	0.5	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil desulfinyl	205650-65-3	New	Class B	Yes	2001	0.5	ug/kg, dw	median	Sadaria et al. 2019
Fipronil desulfinyl	205650-65-3	New	Class B	Yes	2001	0.2	ug/kg, dw	min	Sadaria et al. 2019
Fipronil desulfinyl	205650-65-3	New	Class B	Yes	2001	1.3	ug/kg, dw	max	Sadaria et al. 2019
Fipronil desulfinyl	205650-65-3	New	Class AA	Yes	2006-2007	1.5	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil desulfinyl	205650-65-3	New	Class AA	Yes	2006-2007	1.0	ug/kg, dw	median	Sadaria et al. 2019
Fipronil desulfinyl	205650-65-3	New	Class AA	Yes	2006-2007	0.3	ug/kg, dw	min	Sadaria et al. 2019

Table C-1. Concentrations of Newly and Previously Identified Chemicals in Biosolids for the 2018-2019 Biennial Review

Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
Fipronil desulfinyl	205650-65-3	New	Class AA	Yes	2006-2007	3.7	ug/kg, dw	max	Sadaria et al. 2019
Fipronil desulfinyl	205650-65-3	New	Class B	Yes	2015-2016	2.0	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil desulfinyl	205650-65-3	New	Class B	Yes	2015-2016	1.7	ug/kg, dw	median	Sadaria et al. 2019
Fipronil desulfinyl	205650-65-3	New	Class B	Yes	2015-2016	0.4	ug/kg, dw	min	Sadaria et al. 2019
Fipronil desulfinyl	205650-65-3	New	Class B	Yes	2015-2016	6.6	ug/kg, dw	max	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class AA	Yes	2001	16.4	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class AA	Yes	2001	10.2	ug/kg, dw	median	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class AA	Yes	2001	1.2	ug/kg, dw	min	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class AA	Yes	2001	113.4	ug/kg, dw	max	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class B	Yes	2006-2007	35.6	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class B	Yes	2006-2007	27.5	ug/kg, dw	median	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class B	Yes	2006-2007	1.5	ug/kg, dw	min	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class B	Yes	2006-2007	149.2	ug/kg, dw	max	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class B	Yes	2015-2016	27.5	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class B	Yes	2015-2016	21.0	ug/kg, dw	median	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class B	Yes	2015-2016	0.9	ug/kg, dw	min	Sadaria et al. 2019
Fipronil sulfide	120067-83-6	New	Class B	Yes	2015-2016	114.7	ug/kg, dw	max	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2001	18.3	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2001	11.6	ug/kg, dw	median	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2001	1.3	ug/kg, dw	min	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2001	56.0	ug/kg, dw	max	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2006-2007	53.4	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2006-2007	37.5	ug/kg, dw	median	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2006-2007	0.1	ug/kg, dw	min	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2006-2007	208.6	ug/kg, dw	max	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2015-2016	45.0	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2015-2016	40.0	ug/kg, dw	median	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2015-2016	2.2	ug/kg, dw	min	Sadaria et al. 2019
Fipronil sulfone	120068-36-2	New	Class B	Yes	2015-2016	110.1	ug/kg, dw	max	Sadaria et al. 2019
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	New	Not specified	Yes	2006-2007	243	ng/g, dw	mean	Wang et al. 2019
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	New	Not specified	Yes	2006-2007	31.0	ng/g, dw	median	Wang et al. 2019
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	New	Not specified	Yes	2006-2007	6150	ng/g, dw	max	Wang et al. 2019
Melamine	108-78-1	New	Not specified	Yes	2006-2007	110	ng/g, dw	mean	Zhu et al. 2019
Melamine	108-78-1	New	Not specified	Yes	2006-2007	37	ng/g, dw	median	Zhu et al. 2019
Melamine	108-78-1	New	Not specified	Yes	2006-2007	6.5	ng/g, dw	min	Zhu et al. 2019
Melamine	108-78-1	New	Not specified	Yes	2006-2007	1,300	ng/g, dw	max	Zhu et al. 2019
Nalidixic acid	389-08-2	New	Not specified	Yes	2006-2007	19.1	ng/g, dw	mean	Magee et al. 2018
Nalidixic acid	389-08-2	New	Not specified	Yes	2006-2007	9.4	ng/g, dw	min	Magee et al. 2018
Nalidixic acid	389-08-2	New	Not specified	Yes	2006-2007	33.2	ng/g, dw	max	Magee et al. 2018

Table C-1. Concentrations of Newly and Previously Identified Chemicals in Biosolids for the 2018-2019 Biennial Review

Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
Bisphenol A Polycarbonate	25766-59-0	New	Not specified	Yes	2006-2007	47	ug/g, dw	mean	Zhang et al. 2019
Bisphenol A Polycarbonate	25766-59-0	New	Not specified	Yes	2006-2007	5.9	ug/g, dw	median	Zhang et al. 2019
Bisphenol A Polycarbonate	25766-59-0	New	Not specified	Yes	2006-2007	0.70	ug/g, dw	min	Zhang et al. 2019
Bisphenol A Polycarbonate	25766-59-0	New	Not specified	Yes	2006-2007	840	ug/g, dw	max	Zhang et al. 2019
Polychlorinated biphenyl (PCB)[a]	1336-36-3	New	Not specified	No	2014-2015	790	ug/kg, dw	mean	2019
Polyethylene terephthalate (PET)	25038-59-9	New	Not specified	Yes	2006-2007	560	ug/g, dw	mean	Zhang et al. 2019
Polyethylene terephthalate (PET)	25038-59-9	New	Not specified	Yes	2006-2007	12,000	ug/g, dw	max	Zhang et al. 2019
Resorcinol bis(diphenyl phosphate) (RDP)	57583-54-7	New	Not specified	Yes	2006-2007	<MDL	ng/g, dw	mean	Wang et al. 2019
Resorcinol bis(diphenyl phosphate) (RDP)	57583-54-7	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	median	Wang et al. 2019
Resorcinol bis(diphenyl phosphate) (RDP)	57583-54-7	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Resorcinol bis(diphenyl phosphate) (RDP)	57583-54-7	New	Not specified	Yes	2006-2007	9.18	ng/g, dw	max	Wang et al. 2019
Sulfate	14808-79-8	New	Not specified	No	June 2016-Sep 2017	1.32	mg/L	mean	Onchoke et al. 2018
Sulfate	14808-79-8	New	Not specified	No	June 2016-Sep 2017	2.21	mg/L	mean	Onchoke et al. 2018
Sulfur	7704-34-9	New	Not specified	No	June 2016-Sep 2017	9010	mg/kg, dw	mean	Onchoke et al. 2018
Sulfur	7704-34-9	New	Not specified	No	June 2016-Sep 2017	15,912	mg/kg, dw	mean	Onchoke et al. 2018
Sulfur	7704-34-9	New	Class A	No	Not specified	11,100	mg/kg	individual	Vaughn et al. 2018
Tert-butylphenyl diphenyl phosphate	56803-37-3	New	Not specified	Yes	2006-2007	177	ng/g, dw	mean	Wang et al. 2019
Tert-butylphenyl diphenyl phosphate	56803-37-3	New	Not specified	Yes	2006-2007	40.2	ng/g, dw	median	Wang et al. 2019
Tert-butylphenyl diphenyl phosphate	56803-37-3	New	Not specified	Yes	2006-2007	0.56	ng/g, dw	min	Wang et al. 2019
Tert-butylphenyl diphenyl phosphate	56803-37-3	New	Not specified	Yes	2006-2007	3020	ng/g, dw	max	Wang et al. 2019
Terephthalic acid	100-21-0	New	Not specified	Yes	2006-2007	3.8	ug/g, dw	mean	Zhang et al. 2019
Terephthalic acid	100-21-0	New	Not specified	Yes	2006-2007	1.1	ug/g, dw	median	Zhang et al. 2019
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	38051-10-4	New	Not specified	Yes	2006-2007	0.71	ng/g, dw	mean	Wang et al. 2019
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	38051-10-4	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	median	Wang et al. 2019
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	38051-10-4	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	38051-10-4	New	Not specified	Yes	2006-2007	6.36	ng/g, dw	max	Wang et al. 2019
Triethyl phosphate (TEP)	78-40-0	New	Not specified	Yes	2006-2007	8.50	ng/g, dw	mean	Wang et al. 2019
Triethyl phosphate (TEP)	78-40-0	New	Not specified	Yes	2006-2007	0.52	ng/g, dw	median	Wang et al. 2019
Triethyl phosphate (TEP)	78-40-0	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Triethyl phosphate (TEP)	78-40-0	New	Not specified	Yes	2006-2007	381	ng/g, dw	max	Wang et al. 2019
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)	36443-68-2	New	Various	No	2016	5.2	ng/g, dw	median	Lu et al. 2019
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)	36443-68-2	New	Various	No	2016	3.5	ng/g, dw	min	Lu et al. 2019
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)	36443-68-2	New	Various	No	2016	11	ng/g, dw	max	Lu et al. 2019
Triisobutyl phosphate	126-71-6	New	Not specified	Yes	2006-2007	3.38	ng/g, dw	mean	Wang et al. 2019

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Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
Triisobutyl phosphate	126-71-6	New	Not specified	Yes	2006-2007	0.15	ng/g, dw	median	Wang et al. 2019
Triisobutyl phosphate	126-71-6	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Triisobutyl phosphate	126-71-6	New	Not specified	Yes	2006-2007	30.7	ng/g, dw	max	Wang et al. 2019
Trimethyl phosphate (TMP)	512-56-1	New	Not specified	Yes	2006-2007	<MDL	ng/g, dw	mean	Wang et al. 2019
Trimethyl phosphate (TMP)	512-56-1	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	median	Wang et al. 2019
Trimethyl phosphate (TMP)	512-56-1	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Trimethyl phosphate (TMP)	512-56-1	New	Not specified	Yes	2006-2007	5.80	ng/g, dw	max	Wang et al. 2019
Tris(methylphenyl) phosphate	1330-78-5	New	Not specified	Yes	2006-2007	115	ng/g, dw	mean	Wang et al. 2019
Tris(methylphenyl) phosphate	1330-78-5	New	Not specified	Yes	2006-2007	21.3	ng/g, dw	median	Wang et al. 2019
Tris(methylphenyl) phosphate	1330-78-5	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Tris(methylphenyl) phosphate	1330-78-5	New	Not specified	Yes	2006-2007	2320	ng/g, dw	max	Wang et al. 2019
Trimethylsilanol (TMS)	1066-40-6	New	Not specified	No	Not specified	63.6	ng/g, ww	individual	Xu 2020
Tributyl phosphate	126-73-8	New	Not specified	Yes	2006-2007	127	ng/g, dw	mean	Wang et al. 2019
Tributyl phosphate	126-73-8	New	Not specified	Yes	2006-2007	17.7	ng/g, dw	median	Wang et al. 2019
Tributyl phosphate	126-73-8	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Tributyl phosphate	126-73-8	New	Not specified	Yes	2006-2007	6080	ng/g, dw	max	Wang et al. 2019
Tripropyl phosphate	513-08-6	New	Not specified	Yes	2006-2007	<MDL	ng/g, dw	mean	Wang et al. 2019
Tripropyl phosphate	513-08-6	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	median	Wang et al. 2019
Tripropyl phosphate	513-08-6	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Tripropyl phosphate	513-08-6	New	Not specified	Yes	2006-2007	<MDL	ng/g, dw	max	Wang et al. 2019
Tris(2-chloroisopropyl) phosphate	13674-84-5	New	Not specified	Yes	2006-2007	61.7	ng/g, dw	mean	Wang et al. 2019
Tris(2-chloroisopropyl) phosphate	13674-84-5	New	Not specified	Yes	2006-2007	23.5	ng/g, dw	median	Wang et al. 2019
Tris(2-chloroisopropyl) phosphate	13674-84-5	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Tris(2-chloroisopropyl) phosphate	13674-84-5	New	Not specified	Yes	2006-2007	359	ng/g, dw	max	Wang et al. 2019
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	New	Not specified	Yes	2006-2007	101	ng/g, dw	mean	Wang et al. 2019
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	New	Not specified	Yes	2006-2007	86.7	ng/g, dw	median	Wang et al. 2019
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	New	Not specified	Yes	2006-2007	5.18	ng/g, dw	min	Wang et al. 2019
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	New	Not specified	Yes	2006-2007	328	ng/g, dw	max	Wang et al. 2019
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	New	Not specified	Yes	2006-2007	199	ng/g, dw	mean	Wang et al. 2019
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	New	Not specified	Yes	2006-2007	170	ng/g, dw	median	Wang et al. 2019
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	New	Not specified	Yes	2006-2007	26.5	ng/g, dw	min	Wang et al. 2019
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	New	Not specified	Yes	2006-2007	857	ng/g, dw	max	Wang et al. 2019
Tris(4-tert-butylphenyl) phosphate	78-33-1	New	Not specified	Yes	2006-2007	18.9	ng/g, dw	mean	Wang et al. 2019
Tris(4-tert-butylphenyl) phosphate	78-33-1	New	Not specified	Yes	2006-2007	8.82	ng/g, dw	median	Wang et al. 2019
Tris(4-tert-butylphenyl) phosphate	78-33-1	New	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Tris(4-tert-butylphenyl) phosphate	78-33-1	New	Not specified	Yes	2006-2007	168	ng/g, dw	max	Wang et al. 2019
4-(1,1,3,3-Tetramethylbutyl)phenol	140-66-9	Previous	Various	No	2016	1131	ng/g, dw	median	Lu et al. 2019
4-(1,1,3,3-Tetramethylbutyl)phenol	140-66-9	Previous	Various	No	2016	170	ng/g, dw	min	Lu et al. 2019
4-(1,1,3,3-Tetramethylbutyl)phenol	140-66-9	Previous	Various	No	2016	3714	ng/g, dw	max	Lu et al. 2019
Aluminum	7429-90-5	Previous	Not specified	No	June 2016-Sep 2017	12,538	mg/kg, dw	mean	Onchoke et al. 2018
Aluminum	7429-90-5	Previous	Not specified	No	June 2016-Sep 2017	12,857	mg/kg, dw	mean	Onchoke et al. 2018

Table C-1. Concentrations of Newly and Previously Identified Chemicals in Biosolids for the 2018-2019 Biennial Review

Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
Aluminum	7429-90-5	Previous	Class A	No	Not specified	600	mg/kg	individual	Sidhu et al. 2019b
Ammonium	14798-03-9	Previous	Class B	No	Not specified	17	g/kg	individual	Silveira et al. 2019
Ammonium	14798-03-9	Previous	Class B	No	Not specified	24	g/kg	individual	Silveira et al. 2019
Ammonium	14798-03-9	Previous	Class B	No	Not specified	14	g/kg	individual	Silveira et al. 2019
Ammonium	14798-03-9	Previous	Class B	No	Not specified	11	g/kg	individual	Silveira et al. 2019
Ammonium	14798-03-9	Previous	Class AA	No	Not specified	6	g/kg	individual	Silveira et al. 2019
Ammonium	14798-03-9	Previous	Class B	No	Not specified	11	g/kg	individual	Silveira et al. 2019
Ammonium	14798-03-9	Previous	Class B	No	Not specified	3	g/kg	individual	Silveira et al. 2019
Ammonium	14798-03-9	Previous	Class A	No	Not specified	3700	mg/kg	individual	Sidhu et al. 2019b
Ammonium	14798-03-9	Previous	Not specified	No	June 2016-Sep 2017	170	mg/kg, dw	mean	Onchoke et al. 2018
Ammonium	14798-03-9	Previous	Not specified	No	June 2016-Sep 2017	205	mg/kg, dw	mean	Onchoke et al. 2018
Azithromycin	83905-01-5	Previous	Class A	No	Not specified	0.06	mg/kg, dw	individual	Sidhu et al. 2019a
Azithromycin	83905-01-5	Previous	Class A	No	Not specified	0.06	mg/kg, dw	individual	Sidhu et al. 2019b
Azithromycin	83905-01-5	Previous	Class A	No	Not specified	0.06	mg/kg, dw	individual	Sidhu et al. 2019c
Barium	7440-39-3	Previous	Not specified	No	June 2016-Sep 2017	319	mg/kg, dw	mean	Onchoke et al. 2018
Barium	7440-39-3	Previous	Not specified	No	June 2016-Sep 2017	316	mg/kg, dw	mean	Onchoke et al. 2018
Barium	7440-39-3	Previous	Class A	No	Not specified	358	mg/kg	mean	Vaughn et al. 2018
Beryllium	7440-41-7	Previous	Not specified	No	June 2016-Sep 2017	2.53	mg/kg, dw	mean	Onchoke et al. 2018
Beryllium	7440-41-7	Previous	Not specified	No	June 2016-Sep 2017	4.90	mg/kg, dw	mean	Onchoke et al. 2018
Bisphenol A	80-05-7	Previous	Not specified	Yes	2006-2007	0.43	ug/g, dw	mean	Zhang et al. 2019
Bisphenol A	80-05-7	Previous	Not specified	Yes	2006-2007	0.20	ug/g, dw	median	Zhang et al. 2019
Bisphenol A	80-05-7	Previous	Not specified	Yes	2006-2007	0.0083	ug/g, dw	min	Zhang et al. 2019
Bisphenol A	80-05-7	Previous	Not specified	Yes	2006-2007	2.5	ug/g, dw	max	Zhang et al. 2019
Boron	7440-42-8	Previous	Not specified	No	June 2016-Sep 2017	107	mg/kg, dw	mean	Onchoke et al. 2018
Boron	7440-42-8	Previous	Not specified	No	June 2016-Sep 2017	91	mg/kg, dw	mean	Onchoke et al. 2018
Butylated hydroxytoluene	128-37-0	Previous	Various	No	2016	477	ng/g, dw	median	Lu et al. 2019
Butylated hydroxytoluene	128-37-0	Previous	Various	No	2016	<MQL	ng/g, dw	min	Lu et al. 2019
Butylated hydroxytoluene	128-37-0	Previous	Various	No	2016	1074	ng/g, dw	max	Lu et al. 2019
Calcium	7440-70-2	Previous	Class A	No	Not specified	51,760	mg/kg	individual	Vaughn et al. 2018
Calcium	7440-70-2	Previous	Not specified	No	June 2016-Sep 2017	9372	mg/kg, dw	mean	Onchoke et al. 2018
Calcium	7440-70-2	Previous	Not specified	No	June 2016-Sep 2017	16,398	mg/kg, dw	mean	Onchoke et al. 2018
Ciprofloxacin	85721-33-1	Previous	Class A	No	Not specified	1	mg/kg, dw	individual	Sidhu et al. 2019a
Ciprofloxacin	85721-33-1	Previous	Class A	No	Not specified	1	mg/kg, dw	individual	Sidhu et al. 2019b
Ciprofloxacin	85721-33-1	Previous	Class A	No	Not specified	1	mg/kg, dw	individual	Sidhu et al. 2019c
Chromium	7440-47-3	Previous	Class A	No	Not specified	185	mg/kg	individual	Vaughn et al. 2018
Chromium	7440-47-3	Previous	Not specified	No	June 2016-Sep 2017	19.8	mg/kg, dw	mean	Onchoke et al. 2018
Chromium	7440-47-3	Previous	Not specified	No	June 2016-Sep 2017	19.4	mg/kg, dw	mean	Onchoke et al. 2018
Cobalt	7440-48-4	Previous	Not specified	No	June 2016-Sep 2017	7.61	mg/kg, dw	mean	Onchoke et al. 2018
Cobalt	7440-48-4	Previous	Not specified	No	June 2016-Sep 2017	13.46	mg/kg, dw	mean	Onchoke et al. 2018
Erythromycin	114-07-8	Previous	Not specified	Yes	2006-2007	0.6	ng/g, dw	mean	Magee et al. 2018
Erythromycin	114-07-8	Previous	Not specified	Yes	2006-2007	0.4	ng/g, dw	min	Magee et al. 2018
Erythromycin	114-07-8	Previous	Not specified	Yes	2006-2007	1	ng/g, dw	max	Magee et al. 2018

Table C-1. Concentrations of Newly and Previously Identified Chemicals in Biosolids for the 2018-2019 Biennial Review

Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
Fipronil	120068-37-3	Previous	Not specified	Yes	2001	9.2	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil	120068-37-3	Previous	Not specified	Yes	2001	6.6	ug/kg, dw	median	Sadaria et al. 2019
Fipronil	120068-37-3	Previous	Not specified	Yes	2001	0.04	ug/kg, dw	min	Sadaria et al. 2019
Fipronil	120068-37-3	Previous	Not specified	Yes	2001	44.3	ug/kg, dw	max	Sadaria et al. 2019
Fipronil	120068-37-3	Previous	Not specified	Yes	2006-2007	31.4	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil	120068-37-3	Previous	Not specified	Yes	2006-2007	12.7	ug/kg, dw	median	Sadaria et al. 2019
Fipronil	120068-37-3	Previous	Not specified	Yes	2006-2007	0.1	ug/kg, dw	min	Sadaria et al. 2019
Fipronil	120068-37-3	Previous	Not specified	Yes	2006-2007	191.8	ug/kg, dw	max	Sadaria et al. 2019
Fipronil	120068-37-3	Previous	Not specified	Yes	2015-2016	17.0	ug/kg, dw	mean	Sadaria et al. 2019
Fipronil	120068-37-3	Previous	Not specified	Yes	2015-2016	10.2	ug/kg, dw	median	Sadaria et al. 2019
Fipronil	120068-37-3	Previous	Not specified	Yes	2015-2016	0.3	ug/kg, dw	min	Sadaria et al. 2019
Fipronil	120068-37-3	Previous	Not specified	Yes	2015-2016	62.7	ug/kg, dw	max	Sadaria et al. 2019
Fluoride	16984-48-8	Previous	Not specified	No	June 2016-Sep 2017	1.51	mg/L	mean	Onchoke et al. 2018
Fluoride	16984-48-8	Previous	Not specified	No	June 2016-Sep 2017	1.53	mg/L	mean	Onchoke et al. 2018
Iron	7439-89-6	Previous	Naturally air-dried	No	Not specified	12,779.3	mg/kg, dw	individual	Li et al. 2019
Iron	7439-89-6	Previous	Treated by thickening, anaerobic digestion, dewatering, and thermal heat-drying	No	Not specified	1,586.2	mg/kg, dw	individual	Li et al. 2019
Iron	7439-89-6	Previous	Class A	No	Not specified	360	mg/kg	individual	Sidhu et al. 2019b
Iron	7439-89-6	Previous	Class A	No	Not specified	19,440	mg/kg	individual	Vaughn et al. 2018
Iron	7439-89-6	Previous	Not specified	No	June 2016-Sep 2017	22,688	mg/kg, dw	mean	Onchoke et al. 2018
Iron	7439-89-6	Previous	Not specified	No	June 2016-Sep 2017	17,304	mg/kg, dw	mean	Onchoke et al. 2018
Magnesium	7439-95-4	Previous	Not specified	No	June 2016-Sep 2017	3370	mg/kg, dw	mean	Onchoke et al. 2018
Magnesium	7439-95-4	Previous	Not specified	No	June 2016-Sep 2017	3136	mg/kg, dw	mean	Onchoke et al. 2018
Magnesium	7439-95-4	Previous	Class A	No	Not specified	22,600	mg/kg	individual	Vaughn et al. 2018
Manganese	7439-96-5	Previous	Not specified	No	June 2016-Sep 2017	700.34	mg/kg, dw	mean	Onchoke et al. 2018
Manganese	7439-96-5	Previous	Not specified	No	June 2016-Sep 2017	1103.78	mg/kg, dw	mean	Onchoke et al. 2018
Manganese	7439-96-5	Previous	Class A	No	Not specified	553	mg/kg	mean	Vaughn et al. 2018
Nitrate	14797-55-8	Previous	Class B	No	Not specified	3	g/kg	individual	Silveira et al. 2019
Nitrate	14797-55-8	Previous	Class B	No	Not specified	3	g/kg	individual	Silveira et al. 2019
Nitrate	14797-55-8	Previous	Class B	No	Not specified	3	g/kg	individual	Silveira et al. 2019
Nitrate	14797-55-8	Previous	Class B	No	Not specified	3	g/kg	individual	Silveira et al. 2019
Nitrate	14797-55-8	Previous	Class AA	No	Not specified	2	g/kg	individual	Silveira et al. 2019
Nitrate	14797-55-8	Previous	Class B	No	Not specified	7	g/kg	individual	Silveira et al. 2019
Nitrate	14797-55-8	Previous	Class B	No	Not specified	9	g/kg	individual	Silveira et al. 2019
Nitrate	14797-55-8	Previous	Class A	No	Not specified	1540	mg/kg	individual	Vaughn et al. 2018
Nitrate	14797-55-8	Previous	Not specified	No	June 2016-Sep 2017	1.31	mg/L	mean	Onchoke et al. 2018
Nitrate	14797-55-8	Previous	Not specified	No	June 2016-Sep 2017	1.26	mg/L	mean	Onchoke et al. 2018
Nitrite	14797-65-0	Previous	Not specified	No	June 2016-Sep 2017	0.32	mg/L	mean	Onchoke et al. 2018
Nitrite	14797-65-0	Previous	Not specified	No	June 2016-Sep 2017	0.244	mg/L	mean	Onchoke et al. 2018
Nitrogen	7727-37-9	Previous	Class B	No	Not specified	72	g/kg	individual	Silveira et al. 2019

Table C-1. Concentrations of Newly and Previously Identified Chemicals in Biosolids for the 2018-2019 Biennial Review

Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
Nitrogen	7727-37-9	Previous	Class B	No	Not specified	84	g/kg	individual	Silveira et al. 2019
Nitrogen	7727-37-9	Previous	Class B	No	Not specified	61	g/kg	individual	Silveira et al. 2019
Nitrogen	7727-37-9	Previous	Class B	No	Not specified	76	g/kg	individual	Silveira et al. 2019
Nitrogen	7727-37-9	Previous	Class AA	No	Not specified	66	g/kg	individual	Silveira et al. 2019
Nitrogen	7727-37-9	Previous	Class B	No	Not specified	48	g/kg	individual	Silveira et al. 2019
Nitrogen	7727-37-9	Previous	Class B	No	Not specified	76	g/kg	individual	Silveira et al. 2019
Oxolinic acid	14698-29-4	Previous	Not specified	Yes	2006-2007	2.7	ng/g, dw	mean	Magee et al. 2018
Oxolinic acid	14698-29-4	Previous	Not specified	Yes	2006-2007	0.1	ng/g, dw	min	Magee et al. 2018
Oxolinic acid	14698-29-4	Previous	Not specified	Yes	2006-2007	5.2	ng/g, dw	max	Magee et al. 2018
Oxytetracycline	79-57-2	Previous	Not specified	Yes	2006-2007	4.5	ng/g, dw	mean	Magee et al. 2018
Oxytetracycline	79-57-2	Previous	Not specified	Yes	2006-2007	1	ng/g, dw	min	Magee et al. 2018
Oxytetracycline	79-57-2	Previous	Not specified	Yes	2006-2007	9.7	ng/g, dw	max	Magee et al. 2018
Phosphate	14265-44-2	Previous	Not specified	No	June 2016-Sep 2017	22.60	mg/L	mean	Onchoke et al. 2018
Phosphate	14265-44-2	Previous	Not specified	No	June 2016-Sep 2017	25.43	mg/L	mean	Onchoke et al. 2018
Phosphorus	7723-14-0	Previous	Not specified	No	June 2016-Sep 2017	17,804	mg/kg, dw	mean	Onchoke et al. 2018
Phosphorus	7723-14-0	Previous	Not specified	No	June 2016-Sep 2017	19,648	mg/kg, dw	mean	Onchoke et al. 2018
Phosphorus	7723-14-0	Previous	Class B	No	Not specified	23	g/kg	individual	Silveira et al. 2019
Phosphorus	7723-14-0	Previous	Class B	No	Not specified	28	g/kg	individual	Silveira et al. 2019
Phosphorus	7723-14-0	Previous	Class B	No	Not specified	18	g/kg	individual	Silveira et al. 2019
Phosphorus	7723-14-0	Previous	Class B	No	Not specified	34	g/kg	individual	Silveira et al. 2019
Phosphorus	7723-14-0	Previous	Class AA	No	Not specified	19	g/kg	individual	Silveira et al. 2019
Phosphorus	7723-14-0	Previous	Class B	No	Not specified	33	g/kg	individual	Silveira et al. 2019
Phosphorus	7723-14-0	Previous	Class B	No	Not specified	34	g/kg	individual	Silveira et al. 2019
Phosphorus	7723-14-0	Previous	Class A	No	Not specified	24,380	mg/kg	individual	Vaughn et al. 2018
Potassium	7440-09-7	Previous	Not specified	No	June 2016-Sep 2017	3514	mg/kg, dw	mean	Onchoke et al. 2018
Potassium	7440-09-7	Previous	Not specified	No	June 2016-Sep 2017	1385	mg/kg, dw	mean	Onchoke et al. 2018
Potassium	7440-09-7	Previous	Class A	No	Not specified	4200	mg/kg	individual	Sidhu et al. 2019b
Potassium	7440-09-7	Previous	Class A	No	Not specified	3886	mg/kg	individual	Vaughn et al. 2018
Silver	7440-22-4	Previous	Not specified	No	June 2016-Sep 2017	17.13	mg/kg, dw	mean	Onchoke et al. 2018
Silver	7440-22-4	Previous	Not specified	No	June 2016-Sep 2017	56.92	mg/kg, dw	mean	Onchoke et al. 2018
Silver	7440-22-4	Previous	Class A	No	Not specified	7.1	mg/kg	individual	Vaughn et al. 2018
Sodium	7440-23-5	Previous	Not specified	No	June 2016-Sep 2017	1510.8	mg/kg, dw	mean	Onchoke et al. 2018
Sodium	7440-23-5	Previous	Not specified	No	June 2016-Sep 2017	2303.7	mg/kg, dw	mean	Onchoke et al. 2018
Sodium	7440-23-5	Previous	Class A	No	Not specified	2452	mg/kg	individual	Vaughn et al. 2018
Triclocarban	101-20-2	Previous	Class B	No	2005-2007	18,800	ng/g, dw	mean	Lozano et al. 2018
Triclocarban	101-20-2	Previous	Class B	No	2005-2007	14,000	ng/g, dw	min	Lozano et al. 2018
Triclocarban	101-20-2	Previous	Class B	No	2005-2007	22,900	ng/g, dw	max	Lozano et al. 2018
Triphenyl phosphate	115-86-6	Previous	Not specified	Yes	2006-2007	30.4	ng/g, dw	mean	Wang et al. 2019
Triphenyl phosphate	115-86-6	Previous	Not specified	Yes	2006-2007	3.84	ng/g, dw	median	Wang et al. 2019
Triphenyl phosphate	115-86-6	Previous	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Triphenyl phosphate	115-86-6	Previous	Not specified	Yes	2006-2007	1170	ng/g, dw	max	Wang et al. 2019
Tris(2-butoxyethyl) phosphate	78-51-3	Previous	Not specified	Yes	2006-2007	1760	ng/g, dw	mean	Wang et al. 2019

Table C-1. Concentrations of Newly and Previously Identified Chemicals in Biosolids for the 2018-2019 Biennial Review

Chemical	CAS number	New or previous	Biosolid type	Did study use archived samples from TNSSS?	Date(s) of sample collection	Biosolids concentration	Biosolids units	Data type (individual, mean, median, min, max)	Source
Tris(2-butoxyethyl) phosphate	78-51-3	Previous	Not specified	Yes	2006-2007	580	ng/g, dw	median	Wang et al. 2019
Tris(2-butoxyethyl) phosphate	78-51-3	Previous	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Tris(2-butoxyethyl) phosphate	78-51-3	Previous	Not specified	Yes	2006-2007	28,300	ng/g, dw	max	Wang et al. 2019
Tris(2-chloroethyl) phosphate	115-96-8	Previous	Not specified	Yes	2006-2007	10.6	ng/g, dw	mean	Wang et al. 2019
Tris(2-chloroethyl) phosphate	115-96-8	Previous	Not specified	Yes	2006-2007	2.46	ng/g, dw	median	Wang et al. 2019
Tris(2-chloroethyl) phosphate	115-96-8	Previous	Not specified	Yes	2006-2007	n.d.	ng/g, dw	min	Wang et al. 2019
Tris(2-chloroethyl) phosphate	115-96-8	Previous	Not specified	Yes	2006-2007	317	ng/g, dw	max	Wang et al. 2019
Vanadium	7440-62-2	Previous	Not specified	No	June 2016-Sep 2017	24.06	mg/kg, dw	mean	Onchoke et al. 2018
Vanadium	7440-62-2	Previous	Not specified	No	June 2016-Sep 2017	13.05	mg/kg, dw	mean	Onchoke et al. 2018

Notes:

CAS = Chemical Abstracts Service

n.d. = No date

TNSSS = Targeted National Sewage Sludge Survey

[a] = Total PCBs were analyzed using U.S. EPA method 8082A and is the sum of 129 PCB congeners.

Appendix D. Human Health Toxicity Values for Chemicals Found in Biosolids

Table D-1. Human Health Toxicity Values from EPA's Integrated Risk Information System (IRIS) for Chemicals Newly and Previously Identified in Biosolids

Chemical	CAS number	New or previous	RfD mg/kg/day	Date of last update	RfC mg/m^3	Date of last update	CSF mg/kg/day	Date of last update	IUR $\mu g/m^3$	Date of last update
Polychlorinated biphenyl (PCB) [a]	1336-36-3	New	—	—	—	—	2.0	10/1/1996	0.0001	10/1/1996
Polychlorinated biphenyl (PCB) [b]	1336-36-3	New	—	—	—	—	1.0	10/1/1996	—	—
Polychlorinated biphenyl (PCB) [c]	1336-36-3	New	—	—	—	—	0.4	10/1/1996	—	—
Polychlorinated biphenyl (PCB) [d]	1336-36-3	New	—	—	—	—	0.3	10/1/1996	—	—
Polychlorinated biphenyl (PCB) [e]	1336-36-3	New	—	—	—	—	0.07	10/1/1996	—	—
Polychlorinated biphenyl (PCB) [f]	1336-36-3	New	—	—	—	—	0.04	10/1/1996	—	—
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin[g]	57653-85-7	Previous	—	—	—	—	6.20E+03	3/31/1987	1.3	3/31/1987
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin[g]	19408-74-3	Previous	—	—	—	—	6.20E+03	3/31/1987	1.3	3/31/1987
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin[g]	19408-74-3	Previous	—	—	—	—	6.2E+03	3/31/1987	1.3	3/31/1987
1,4-Dichlorobenzene	106-46-7	Previous	—	—	8.00E-01	1/1/1994	—	—	—	—
2,2',3,3',4,4',5,5',6,6'-decabromodiphenyl ether	1163-19-5	Previous	0.007	6/30/2008	—	—	0.0007	6/30/2008	—	—
2,2',4,4',5,5'-Hexabromodiphenyl ether	68631-49-2	Previous	0.0002	6/30/2008	—	—	—	—	—	—
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	Previous	7.00E-10	2/17/2012	—	—	—	—	—	—
2,4,5-Trichlorophenol	95-95-4	Previous	1.00E-01	1/31/1987	—	—	—	—	—	—
2,4-Dichlorophenol	120-83-2	Previous	3.00E-03	1/31/1987	—	—	—	—	—	—
2,4-Dichlorophenoxyacetic acid	94-75-7	Previous	1.00E-02	3/31/1987	—	—	—	—	—	—
2-Chloronaphthalene	91-58-7	Previous	8.00E-02	11/1/1990	—	—	—	—	—	—
2-Methylnaphthalene	91-57-6	Previous	4.00E-03	12/22/2003	—	—	—	—	—	—
4-Chloroaniline	106-47-8	Previous	4.00E-03	8/22/1988	—	—	—	—	—	—
Acetone	67-64-1	Previous	0.9	7/31/2003	—	—	—	—	—	—
Acetophenone	98-86-2	Previous	1.00E-01	8/22/1988	—	—	—	—	—	—
Anthracene	120-12-7	Previous	3.00E-01	9/1/1990	—	—	—	—	—	—
Antimony	7440-36-0	Previous	4.00E-04	1/31/1987	—	—	—	—	—	—
Arsenic	7440-38-2	Previous	3.00E-04	9/1/1991	—	—	1.5	6/1/1995	4.30E-03	6/1/1995
Barium	7440-39-3	Previous	0.2	7/11/2005	—	—	—	—	—	—
Benzo(a)pyrene	50-32-8	Previous	3.00E-04	1/19/2017	2.00E-06	1/19/2017	1	1/19/2017	—	—
Benzoic acid	65-85-0	Previous	4	9/7/1988	—	—	—	—	—	—
Bisphenol A	80-05-7	Previous	5.00E-02	9/26/1988	—	—	—	—	—	—
Boron	7440-42-8	Previous	2.00E-01	8/5/2004	—	—	—	—	—	—
Cadmium[h]	7440-43-9	Previous	5.00E-04	10/1/1989	—	—	—	—	1.80E-03	3/31/1987
Cadmium[i]	7440-43-9	Previous	1.00E-03	10/1/1989	—	—	—	—	—	—
Carbon tetrachloride	56-23-5	Previous	0.004	3/31/2010	0.1	3/31/2010	7.00E-02	3/31/2010	6E10-6	3/31/2010
Chloroform	67-66-3	Previous	0.01	10/19/2001	—	—	—	—	2.30E-05	10/19/2001
Cyanide	57-12-5	Previous	6.30E-04	9/28/2010	0.00083	9/28/2010	—	9/28/2010	—	—
Di(2-ethylhexyl) phthalate	117-81-7	Previous	2.00E-02	1/31/1987	—	—	1.40E-02	9/7/1988	—	—
Dibutyl phthalate	84-74-2	Previous	1.00E-01	1/31/1987	—	—	—	—	—	—
Dichloromethane	75-09-2	Previous	6.00E-03	11/18/2011	0.6	11/18/2011	2.00E-03	11/18/2011	1 × 10-8	11/18/2011
Ethylbenzene	100-41-4	Previous	1.00E-01	1/31/1987	1.00E+00	3/1/1991	—	—	—	—
Fluoranthene	206-44-0	Previous	4.00E-02	9/1/1990	—	—	—	—	—	—
Heptachlor epoxide B	1024-57-3	Previous	1.30E-05	9/30/1987	—	—	9.10E+00	9/30/1987	2.60E-03	9/30/1987

Table D-1. Human Health Toxicity Values from EPA's Integrated Risk Information System (IRIS) for Chemicals Newly and Previously Identified in Biosolids

Chemical	CAS number	New or previous	RfD mg/kg/day	Date of last update	RfC mg/m^3	Date of last update	CSF mg/kg/day	Date of last update	IUR $\mu g/m^3$	Date of last update
Hexabromobenzene	87-82-1	Previous	2.00E-03	3/31/1987	—	—	—	—	—	—
Manganese	7439-96-5	Previous	1.40E-01	11/1/1995	5.00E-05	12/1/1993	—	—	—	—
Mercury	7439-97-6	Previous	—	—	3.00E-04	6/1/1995	—	—	—	—
Molybdenum	7439-98-7	Previous	5.00E-03	11/1/1992	—	—	—	—	—	—
Naphthalene	91-20-3	Previous	2.00E-02	9/17/1998	3.00E-03	9/17/1998	—	—	—	—
Nickel	7440-02-0	Previous	2.00E-02	12/1/1991	—	—	—	—	—	—
Nitrate	14797-55-8	Previous	1.6	5/1/1991	—	—	—	—	—	—
Nitrite	14797-65-0	Previous	0.1	1/31/1987	—	—	—	—	—	—
N-Nitrosodibutylamine	924-16-3	Previous	—	—	—	—	5.40E+00	1/31/1987	1.60E-03	1/31/1987
N-Nitrosodiethylamine	55-18-5	Previous	—	—	—	—	1.50E+02	1/31/1987	4.30E-02	1/31/1987
N-Nitrosodimethylamine	62-75-9	Previous	—	—	—	—	5.10E+01	1/31/1987	1.40E-02	—
N-Nitrosodiphenylamine	86-30-6	Previous	—	—	—	—	4.90E-03	—	—	—
N-Nitrosopyrrolidine	930-55-2	Previous	—	—	—	—	2.10E+00	1/31/1987	6.10E-04	—
Pentabromodiphenyl ether	32534-81-9	Previous	2.00E-03	3/31/1987	—	—	—	—	—	—
Pentachloronitrobenzene	82-68-8	Previous	3.00E-03	9/30/1987	—	—	—	—	—	—
Phenol	108-95-2	Previous	3.00E-01	9/30/2002	—	—	—	—	—	—
Phosphorus	7723-14-0	Previous	2.00E-05	8/1/1990	—	—	—	—	—	—
Pyrene	129-00-0	Previous	3.00E-02	9/1/1990	—	—	—	—	—	—
Selenium	7782-49-2	Previous	5.00E-03	6/1/1991	—	—	—	—	—	—
Silver	7440-22-4	Previous	5.00E-03	12/1/1991	—	—	—	—	—	—
Styrene	100-42-5	Previous	2.00E-01	1/31/1987	1	11/1/1992	—	—	—	—
Tetrachloroethylene	127-18-4	Previous	0.006	2/10/2012	0.04	2/10/2012	2.10E-03	2/10/2012	3.00E-07	2/10/2012
Toluene	108-88-3	Previous	0.08	9/23/2005	5	9/23/2005	—	—	—	—
Warfarin	81-81-2	Previous	3.00E-04	3/31/1987	—	—	—	—	—	—
Zinc	7440-66-6	Previous	0.3	8/3/2005	—	—	—	—	—	—

Notes:

CAS = Chemical Abstracts Service

[a] = High risk and persistence, upper bound

[b] = High risk and persistence, central estimate

[c] = Low risk and persistence, upper bound

[d] = Low risk and persistence, central estimate

[e] = Lowest risk and persistence, upper bound

[f] = Lowest risk and persistence, central estimate

[g] = Values are for a mixture of 1,2,3,6,7,8-HxCDD and 1,2,3,7,8,9-HxCDD (CASRN 57653-85-7 and 19408-74-3)

[h] = RfD is for significant proteinuria

[i] = RfD is for human studies involving chronic exposures

Table D-2. Human Health Toxicity Values from EPA's Human Health Benchmarks for Pesticides (HHBP) for Chemicals Newly and Previously Identified in Biosolids

Chemical	CAS number	New or previous	PAD or RfD	Units	Date	Notes
Oxytetracycline	79-57-2	Previous	0.0005	mg/kg/day	6/1/2006	
Thiabendazole	148-79-8	Previous	0.025	mg/kg/day	8/22/2007	Acute or one day PAD
Thiabendazole	148-79-8	Previous	0.0002	mg/kg/day	8/22/2007	Chronic or lifetime HHBP (general population)
Thiabendazole	148-79-8	Previous	170	ppb	8/22/2007	Acute or one day HHBP (children)
Thiabendazole	148-79-8	Previous	1	ppb	8/22/2007	Chronic or lifetime HHBP (general population)
Thiabendazole	148-79-8	Previous	0.05	mg/kg/day	2015	Acute (children)
Thiabendazole	148-79-8	Previous	0.033	mg/kg/day	2015	Chronic (general population)
Thiabendazole	148-79-8	Previous	300	ppb	2015	Accute HHBP (children)
Thiabendazole	148-79-8	Previous	210	ppb	2015	Chronic HHBP (general population)
Triclosan	3380-34-5	Previous	0.3	mg/kg/day	1998	Acute, children (drinking water HHBP is 2000 ppb)
Triclosan	3380-34-5	Previous	0.3	mg/kg/day	1998	Chronic, general population (drinking water HHBP is 2000 ppb)

Notes:

CAS = Chemical Abstracts Service

PAD = Population adjusted does

Table D-3. EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) for Chemicals Newly and Previously Identified in Biosolids

Chemical	CAS number	New or previous	RfD mg/kg/day	RfC mg/m^3	CSF mg/kg/day	Date of last revision	Notes
Trimethyl phosphate (TMP)	512-56-1	New	0.01	—	0.017	9/30/2010	Subchronic and chronic provisional RfD and provisional oral slope factor
Tributyl phosphate	126-73-8	New	0.0325	—	0.009	11/8/2010	Subchronic provisional RfD and provisional oral slope factor
Tributyl phosphate	126-73-8	New	0.011	—	—	11/8/2010	Chronic provisional RfD
Tris(2-chloroisopropyl) phosphate	13674-84-5	New	1.00E-02	—	—	11/29/2012	Screening Chronic RfD
Tris(2-chloroisopropyl) phosphate	13674-84-5	New	1.00E-01	—	—	11/29/2012	Screening Subchronic RfD
2,4,5-Trichlorophenol	95-95-4	Previous	3.00E-01	—	—	7/27/2007	Subchronic provisional RfD
2,4-Dichlorophenol	120-83-2	Previous	2.00E-02	—	—	7/30/2007	Subchronic provisional RfD
2-Chloronaphthalene	91-58-7	Previous	0.2	—	—	9/3/2009	Subchronic provisional RfD
2-Methylnaphthalene	91-57-6	Previous	4.00E-03	—	—	9/18/2007	Subchronic provisional RfD
4-Chloroaniline	106-47-8	Previous	5.00E-04	—	0.2	9/30/2008	Subchronic provisional RfD
Acetophenone	98-86-2	Previous	8.00E-01	—	—	6/15/2011	Screening level subchronic RfD
Aluminum	7429-90-5	Previous	1	5.00E-03	—	8/25/2008	Chronic
Anthracene	120-12-7	Previous	1	—	—	6/15/2009	Subchronic provisional RfD
Antimony	7440-36-0	Previous	4.00E-04	—	—	7/30/2008	Subschronic RfD
Benz(a)anthracene	56-55-3	Previous	—	—	0.7	6/19/2007	Screening value
Benzoic acid	65-85-0	Previous	4	0.002	—	3/29/2005	Provisional subchronic RfD was derived by adopting chronic provisional RfD from IRIS; provisional subchronic RfC
Butylated hydroxytoluene	128-37-0	Previous	3.00E-01	—	3.60E-03	6/5/2013	Chronic
Butylated hydroxytoluene	128-37-0	Previous	1	—	3.60E-03	6/5/2013	Subchronic
Butylated hydroxytoluene	128-37-0	Previous	1.00E+00	—	—	6/5/2013	Subchronic provisional RfD
Butylated hydroxytoluene	128-37-0	Previous	3.00E-01	—	3.60E-03	6/5/2013	Chronic provisional RfD and provisional oral slope factor
Butylated hydroxytoluene	128-37-0	Previous	3.00E-01	—	3.60E-03	6/5/2013	Chronic provisional RfD
Butylated hydroxytoluene	128-37-0	Previous	1	—	—	6/5/2013	Subchronic provisional RfD
Cobalt	7440-48-4	Previous	3.00E-04	6.00E-06	—	8/25/2008	Chronic
Di-n-octyl phthalate	117-84-0	Previous	1.00E-01	—	—	12/20/2012	Subchronic provisional RfD
Di-n-octyl phthalate	117-84-0	Previous	1.00E-02	—	—	12/20/2012	Chronic provisional RfD
Fluoranthene	206-44-0	Previous	1.00E-01	—	—	12/27/2012	Subchronic provisional RfD
Iron	7439-89-6	Previous	0.7	—	—	9/11/2006	Subchronic and chronic provisional RfD
Nitrofen	1836-75-5	Previous	3.00E-03	—	3.80E-02	11/5/2012	Provisional subchronic RfD and oral slope factor
Nitrofen	1836-75-5	Previous	3.00E-03	—	—	11/5/2012	Provisional chronic RfD
N-Nitrosodimethylamine	62-75-9	Previous	0.000008	—	0.12	6/19/2007	Subchronic and chronic provisional RfD and screening value
p-Cresol	106-44-5	Previous	0.02	—	—	9/29/2010	Subchronic provisional RfD

Table D-3. EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) for Chemicals Newly and Previously Identified in Biosolids

Chemical	CAS number	New or previous	RfD mg/kg/day	RfC mg/m^3	CSF mg/kg/day	Date of last revision	Notes
Perfluorobutanesulfonic acid (PFBS)	375-73-5	Previous	2.00E-01	—	—	7/17/2014	Chronic provisional RfD
Perfluorobutanesulfonic acid (PFBS)	375-73-5	Previous	2.00E-02	—	—	7/17/2014	Subchronic provisional RfD
Rubidium	7440-17-7	Previous	4.00E-03	—	—	9/2/2016	Screening value provisional RfD
Thallium	7440-28-0	Previous	4.00E-05	—	—	11/1/2012	Screening value for soluble thallium subchronic provisional RfD
Thallium	7440-28-0	Previous	1.00E-05	—	—	11/1/2012	Screening value for soluble thallium chronic provisional RfD
Tris(2-chloroethyl) phosphate	115-96-8	Previous	2.00E-01	—	0.02	9/30/2009	Subchronic provisional RfD and provisional oral slope factor
Tris(2-chloroethyl) phosphate	115-96-8	Previous	0.007	—	—	9/30/2009	Chronic provisional RfD
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	Previous	1.00E-01	—	3.20E-03	9/10/2002	Provisional values with low confidence in the RfD
Vanadium	7440-62-2	Previous	0.0007	—	—	9/30/2009	Subchronic provisional RfD
Vanadium	7440-62-2	Previous	0.00007	—	—	9/30/2009	Chronic provisional RfD

Notes:

CAS = Chemical Abstracts Service

Table D-4. Human Health Toxicity Values from EPA's Health Effects Support Documents (HESDs) for Chemicals Newly and Previously Identified in Biosolids

Chemical	CAS number	New or previous	RfD mg/kg/day	RfC mg/m^3	CSF mg/kg/day	Date of last revision
Boron	7440-42-8	Previous	0.2	—	—	1/1/2008
Manganese	7439-96-5	Previous	0.14	5.00E-05	—	2/1/2003
Naphthalene	91-20-3	Previous	0.02	3.00E-03	—	2/1/2003
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	Previous	0.00002	—	—	5/1/2016
Perfluorooctanoic acid (PFOA)	335-67-1	Previous	0.00002	—	0.07	5/1/2016

Notes:

CAS = Chemical Abstracts Service

Table D-5. Human Health Toxicity Values from the Agency for Toxic Substances and Disease Registry (ATSDR) for Chemicals Newly and Previously Identified in Biosolids

Chemical	CAS number	New or previous	Oral MRL (acute)	Units	Oral MRL (intermediate)	Units	Oral MRL (chronic)	Units	Inhalation MRL (acute)	Units	Inhalation MRL (intermediate)	Units	Inhalation MRL (chronic)	Units	Date of last revision
Polychlorinated biphenyl (PCB)	1336-36-3	New	—	—	0.03	µg/kg-d	0.02	µg/kg/day	—	—	—	—	—	—	11/1/2000
1,3-Dichlorobenzene	541-73-1	Previous	0.4	mg/kg/day	0.02	mg/kg/day	—	—	—	—	—	—	—	—	8/1/2006
1,4-Dichlorobenzene	106-46-7	Previous	0.07	mg/kg/day	0.07	mg/kg/day	—	—	2	ppm	0.2	ppm	0.001	ppm	8/1/2006
2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether	1163-19-5	Previous	0.01	mg/kg/day	0.0002	mg/kg/day	—	—	—	—	—	—	—	—	3/1/2017
2,2',4,4',5-Pentabromodiphenyl ether	60348-60-9	Previous	0.00006	mg/kg/day	0.000003	mg/kg/day	—	—	—	—	0.006	mg/m^3	—	—	3/1/2017
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	Previous	0.001	µg/kg-d	0.00003	µg/kg-d	—	—	—	—	—	—	—	—	5/1/1994
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	Previous	0.0002	µg/kg-d	0.00002	µg/kg-d	0.000001	µg/kg-d	—	—	—	—	—	—	12/1/1998
2,4-Dichlorophenol	120-83-2	Previous	—	—	0.003	mg/kg/day	—	—	—	—	—	—	—	—	7/1/1999
Acetone	67-64-1	Previous	—	—	2	mg/kg/day	—	—	26	ppm	13	ppm	13	ppm	5/1/1994
Aluminum	7429-90-5	Previous	—	—	1	mg/kg/day	1	mg/kg/day	—	—	—	—	—	—	9/1/2008
Anthracene	120-12-7	Previous	—	—	10	mg/kg/day	—	—	—	—	—	—	—	—	8/1/1995
Antimony	7440-36-0	Previous	1	mg/kg/day	0.0006	mg/kg/day	—	—	0.001	mg/m^3	0.001	mg/m^3	0.0003	mg/m^3	10/1/2019
Arsenic	7440-38-2	Previous	0.005	mg/kg/day	—	—	0.0003	mg/kg/day	—	—	—	—	—	—	8/1/2007
Barium	7440-39-3	Previous	—	—	0.2	mg/kg/day	0.2	mg/kg/day	—	—	—	—	—	—	8/1/2007
Beryllium	7440-41-7	Previous	—	—	—	—	0.002	mg/kg/day	—	—	—	—	—	—	9/1/2002
Boron	7440-42-8	Previous	0.2	mg/kg/day	0.2	mg/kg/day	—	—	0.3	mg/m^3	—	—	—	—	11/1/2010
Cadmium	7440-43-9	Previous	—	—	0.0005	mg/kg/day	0.0001	mg/kg/day	0.00003	mg/m^3	—	—	0.00001	mg/m^3	9/1/2012
Carbon tetrachloride	56-23-5	Previous	0.02	mg/kg/day	0.007	mg/kg/day	—	—	—	—	0.03	ppm	0.03	ppm	8/1/2005
Chloroform	67-66-3	Previous	0.3	mg/kg/day	0.1	mg/kg/day	0.01	mg/kg/day	0.1	ppm	0.05	ppm	0.02	ppm	9/1/1997
Cobalt	7440-48-4	Previous	—	—	0.01	mg/kg/day	—	—	—	—	—	—	0.0001	mg/m^3	4/1/2004
Copper	7440-50-8	Previous	0.01	mg/kg/day	0.01	mg/kg/day	—	—	—	—	—	—	—	—	9/1/2004
DEET	134-62-3	Previous	—	—	1	mg/kg/day	—	—	—	—	—	—	—	—	8/1/2017
Di(2-ethylhexyl) phthalate	117-81-7	Previous	3	µg/kg-d	0.1	µg/kg-d	—	—	—	—	0.2	ppb	—	—	12/1/2019
Di-n-octyl phthalate	117-84-0	Previous	3	mg/kg/day	0.4	mg/kg/day	—	—	—	—	—	—	—	—	9/1/1997
Ethylbenzene	100-41-4	Previous	—	—	0.4	mg/kg/day	—	—	5	ppm	2	ppm	0.06	ppm	11/1/2010
Manganese	7439-96-5	Previous	—	—	—	—	—	—	—	—	—	—	0.3	$µg/m^3$	—
Mercury	7439-97-6	Previous	—	—	—	—	—	—	—	—	—	—	0.0002	mg/m^3	—
Molybdenum	7439-98-7	Previous	0.05	mg/kg/day	0.008	mg/kg/day	—	—	—	—	—	—	0.0004	mg/m^3	4/1/2017
Naphthalene	91-20-3	Previous	0.6	mg/kg/day	0.6	mg/kg/day	—	—	—	—	—	—	0.0007	ppm	8/1/2005
Nickel	7440-02-0	Previous	—	—	—	—	—	—	—	—	0.0002	mg/m^3	0.00009	mg/m^3	—
Nitrate	14797-55-8	Previous	4	mg/kg/day	4	mg/kg/day	4	mg/kg/day	—	—	—	—	—	—	7/1/2017
Nitrite	14797-65-0	Previous	0.1	mg/kg/day	0.1	mg/kg/day	0.1	mg/kg/day	—	—	—	—	—	—	7/1/2017
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	Previous	—	—	0.00002	mg/kg/day	—	—	—	—	—	—	—	—	6/1/2018
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	Previous	—	—	0.000002	mg/kg/day	—	—	—	—	—	—	—	—	6/1/2018
Perfluorooctanoic acid (PFOA)	335-67-1	Previous	—	—	0.000003	mg/kg/day	—	—	—	—	—	—	—	—	6/1/2018
Phenol	108-95-2	Previous	1	mg/kg/day	—	—	—	—	—	—	—	—	—	—	9/1/2008
Phosphorus	7723-14-0	Previous	—	—	0.0002	mg/kg/day	—	—	0.02	mg/m^3	—	—	—	—	9/1/1997
Selenium	7782-49-2	Previous	—	—	—	—	0.005	mg/kg/day	—	—	—	—	—	—	9/1/2003
Styrene	100-42-5	Previous	0.1	mg/kg/day	—	—	—	—	5	ppm	—	—	0.2	ppm	11/1/2010
Tin	7440-31-5	Previous	—	—	0.3	mg/kg/day	—	—	—	—	—	—	—	—	8/1/2005
Toluene	108-88-3	Previous	0.8	mg/kg/day	0.2	mg/kg/day	—	—	2	ppm	—	—	1	ppm	6/1/2017
Tris(2-butoxyethyl) phosphate	78-51-3	Previous	4.8	mg/kg/day	0.09	mg/kg/day	—	—	—	—	—	—	—	—	9/1/2012
Tris(2-chloroethyl) phosphate	115-96-8	Previous	—	—	0.6	mg/kg/day	0.2	mg/kg/day	—	—	—	—	—	—	9/1/2012
Vanadium	7440-62-2	Previous	—	—	0.01	mg/kg/day	—	—	0.0008	mg/m^3	—	—	0.0001	mg/m^3	9/1/2012
Zinc	7440-66-6	Previous	—	—	0.3	mg/kg/day	0.3	mg/kg/day	—	—	—	—	—	—	8/1/2005

Notes:

CAS = Chemical Abstracts Service

Table D-6. Human Health Toxicity Values from the California Environmental Protection Agency (CalEPA) for Chemicals Newly and Previously Identified in Biosolids

Chemical	PCB congener #	CAS number	New or previous	Inhalation REL (acute) µg/m^3	Date reviewed	Inhalation REL (8-hour) µg/m^3	Inhalation REL (chronic) µg/m^3	Date reviewed	Oral REL (chronic)	Units	Date reviewed	Unit risk (µg/m^3)$^{-1}$	Inhalation slope factor mg/kg/day	Date reviewed [added]	Oral slope factor mg/kg/day	Date reviewed [added]
Polychlorinated biphenyl (PCB)[a]	NA	1336-36-3	New	—	—	—	—	—	—	—	—	0.00057	2.00E+00	Apr-99	2.00E+00	Oct-00
Polychlorinated biphenyl (PCB)[b]	NA	1336-36-3	New	—	—	—	—	—	—	—	—	0.00011	4.00E-01	Apr-99	4.00E-01	Oct-00
Polychlorinated biphenyl (PCB)[b]	NA	1336-36-3	New	—	—	—	—	—	—	—	—	0.00002	7.00E-02	Apr-99	7.00E-02	Oct-00
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	NA	35822-46-9	Previous	—	—	—	0.004	Feb-00	1.00E-06	mg/kg/day	Oct-00	3.80E-01	1.30E+03	Apr-99	1.30E+03	Oct-00
1,2,3,4,7,8,9-Heptachlorodibenzofuran	NA	55673-89-7	Previous	—	—	—	0.004	Feb-00	1.00E-06	mg/kg/day	Oct-00	3.80E-01	1.30E+03	Apr-99	1.30E+03	Oct-00
1,2,3,4,7,8-Hexachlorodibenzodioxin	NA	39227-28-6	Previous	—	—	—	0.0004	Feb-00	1.00E-07	mg/kg/day	Oct-00	3.80E+00	1.30E+04	Apr-99	1.30E+04	Oct-00
1,2,3,6,7,8-Hexachlorodibenzofuran	NA	57117-44-9	Previous	—	—	—	0.0004	Feb-00	1.00E-07	mg/kg/day	Oct-00	3.80E+00	1.30E+04	Apr-99	1.30E+04	Oct-00
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	NA	57653-85-7	Previous	—	—	—	0.0004	Feb-00	1.00E-07	mg/kg/day	Oct-00	3.80E+00	1.30E+04	Apr-99	1.30E+04	Oct-00
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	NA	19408-74-3	Previous	—	—	—	0.0004	Feb-00	1.00E-07	mg/kg/day	Oct-00	3.80E+00	1.30E+04	Apr-99	1.30E+04	Oct-00
1,2,3,7,8-Pentachlorodibenzofuran	NA	57117-41-6	Previous	—	—	—	0.0013	Jan-11	3.30E-07	mg/kg/day	Jan-11	1.10E+00	3.90E+03	Jan-11	3.90E+03	Jan-11
1,4-Dichlorobenzene	NA	106-46-7	Previous	—	—	—	8.00E+02	Jan-01	—	—	—	1.10E-05	4.00E-02	4/1999 [1/1991]	—	—
1,4-Dichlorobenzene	NA	106-46-7	Previous	—	—	—	8.00E+02	Jan-01	—	—	—	1.10E-05	4.00E-02	Apr-99	—	—
2,3,3',4,4',5,5'-Heptachlorobiphenyl	189	39635-31-9	Previous	—	—	—	1.3	Jan-11	0.00033	mg/kg/day	Jan-11	1.10E+03	3.90E+00	Jan-11	3.90E+00	Jan-11
2,3,3',4,4',5'-Hexachlorobiphenyl	157	69782-90-7	Previous	—	—	—	1.3	Jan-11	0.00033	mg/kg/day	Jan-11	1.30E-03	3.90E+00	Jan-11	3.90E+00	Jan-11
2,3,3',4,4',5-Hexachlorobiphenyl	156	38380-08-4	Previous	—	—	—	1.3	Jan-11	0.00033	mg/kg/day	Jan-11	1.10E-03	3.90E+00	Jan-11	3.90E+00	Jan-11
2,3,3',4,4'-Pentachlorobiphenyl	105	32598-14-4	Previous	—	—	—	1.3	Jan-11	0.00033	mg/kg/day	Jan-11	1.10E-03	3.90E+00	Jan-11	3.90E+00	Jan-11
2,3',4,4',5,5'-Hexachlorobiphenyl	167	52663-72-6	Previous	—	—	—	1.3	Jan-11	0.00033	mg/kg/day	Jan-11	1.10E-03	3.90E+00	Jan-11	3.90E+00	Jan-11
2,3,4,4',5-Pentachlorobiphenyl	114	74472-37-0	Previous	—	—	—	1.3	Jan-11	0.00033	mg/kg/day	Jan-11	1.10E-03	3.90E+00	Jan-11	3.90E+00	Jan-11
2,3',4,4',5-Pentachlorobiphenyl	118	31508-00-6	Previous	—	—	—	1.3	Jan-11	0.00033	mg/kg/day	Jan-11	1.10E-03	3.90E+00	Jan-11	3.90E+00	Jan-11
2',3,4,4',5-Pentachlorobiphenyl	123	65510-44-3	Previous	—	—	—	1.3	Jan-11	0.00033	mg/kg/day	Jan-11	1.10E-03	3.90E+00	Jan-11	3.90E+00	Jan-11
2,3,4,6,7,8-Hexachlorodibenzo[b,d]furan	NA	60851-34-5	Previous	—	—	—	0.0004	Feb-00	1.00E-07	mg/kg/day	Oct-00	3.8	1.30E+04	Oct-00	1.30E+04	Oct-00
2,3,4,7,8-Pentachlorodibenzofuran	NA	57117-31-4	Previous	—	—	—	0.00013	Jan-11	3.30E-08	mg/kg/day	Jan-11	1.10E+01	3.90E+04	Jan-11	3.90E+04	Jan-11
2,3,7,8-Tetrachlorodibenzofuran	NA	51207-31-9	Previous	—	—	—	0.0004	Feb-00	1.00E-07	mg/kg/day	Oct-00	3.80E+00	1.30E+04	Apr-99	1.30E+04	Oct-00
2,3,7,8-Tetrachlorodibenzo-p-dioxin	NA	1746-01-6	Previous	—	—	—	0.00004	Feb-00	1.00E-05	µg/kg-d	Oct-00	3.80E+01	1.30E+05	Aug-86	1.30E+05	Aug-86
2,3,7,8-Tetrachlorodibenzo-p-dioxin	NA	1746-01-6	Previous	—	—	—	0.00004	Feb-00	1.00E-08	mg/kg/day	Oct-00	3.80E+01	1.30E+05	Apr-99	1.30E+05	Oct-00
3,3',4,4',5,5'-Hexachlorobiphenyl	169	32774-16-6	Previous	—	—	—	0.013	Jan-11	0.00000033	mg/kg/day	Jan-11	1.10E+00	3.90E+03	Jan-11	3.90E+03	Jan-11
3,3',4,4',5-Pentachlorobiphenyl	126	57465-28-8	Previous	—	—	—	0.0004	Aug-03	0.0000001	mg/kg/day	Aug-03	3.80E+00	1.30E+04	Aug-03	1.30E+04	Aug-03
3,3',4,4'-Tetrachlorobiphenyl	77	32598-13-3	Previous	—	—	—	0.4	Aug-03	0.0001	mg/kg/day	Aug-03	3.80E-03	1.30E+01	Aug-03	1.30E+01	Aug-03
3,4,4',5-Tetrachlorobiphenyl	81	70362-50-4	Previous	—	—	—	0.13	Jan-11	0.000033	mg/kg/day	Jan-11	1.10E-02	3.90E+01	Jan-11	3.90E+01	Jan-11
Arsenic	NA	7440-38-2	Previous	2.00E-01	Dec-08	0.015	0.015	Dec-08	0.0035	ug/kg-d	Dec-08	3.30E-03	1.20E+01	Jul-90	1.5	Oct-00
Benz(a)anthracene	NA	56-55-3	Previous	—	—	—	—	—	—	—	—	1.10E-04	3.90E-01	4/1999 [4/1994]	1.20E+00	2011
Benzo(a)pyrene	NA	50-32-8	Previous	—	—	—	—	—	—	—	—	1.10E-03	3.90E+00	4/1999 [4/1994]	1.20E+01	10/2000 [4/1994]
Benzo(b)fluoranthene	NA	205-99-2	Previous	—	—	—	—	—	—	—	—	1.10E-04	3.90E-01	4/1999 [4/1994]	1.20E+00	10/2000 [4/1994]
Benzo(k)fluoranthene	NA	207-08-9	Previous	—	—	—	—	—	—	—	—	1.10E-04	3.90E-01	4/1999 [4/1994]	1.20E+00	10/2000 [4/1994]
Cadmium	NA	7440-43-9	Previous	—	—	—	0.02	Jan-01	0.5	µg/kg-d	Oct-00	4.20E-03	1.5 E1	Jan-87	—	—
Carbon tetrachloride	NA	56-23-5	Previous	1.90E+03	Apr-99	—	40	Jan-01	—	—	—	4.20E-05	1.5 E-1	Sep-87	—	2011
Chloroform	NA	67-66-3	Previous	1.50E+02	Apr-99	—	300	Apr-00	—	—	—	5.30E-06	1.9 E-2	Dec-90	—	—
Chrysene	NA	218-01-9	Previous	—	—	—	—	—	—	—	—	1.10E-05	3.90E-02	—	1.20E-01	NS
Copper	NA	7440-50-8	Previous	1.00E-02	Apr-99	—	—	—	—	—	—	—	—	—	—	—
Cyanide	NA	57-12-5	Previous	3.40E+02	Apr-99	—	9	Apr-00	—	—	—	—	—	—	—	—
Di(2-ethylhexyl) phthalate	NA	117-81-7	Previous	—	—	—	—	—	—	—	—	2.40E-06	8.40E-03	4/1999 [1/1992]	8.40E-03	Oct-00
Dichloromethane	NA	75-09-2	Previous	1.40E+04	Apr-99	—	4.00E+02	Feb-00	—	—	—	1.00E-06	3.50E-03	Jul-89	—	—
Ethylbenzene	NA	100-41-4	Previous	—	—	—	2.00E+03	Feb-00	—	—	—	2.50E-06	8.70E-03	Nov-07	—	—

Table D-6. Human Health Toxicity Values from the California Environmental Protection Agency (CalEPA) for Chemicals Newly and Previously Identified in Biosolids

Chemical	PCB congener #	CAS number	New or previous	Inhalation REL (acute) µg/m^3	Date reviewed	Inhalation REL (8-hour) µg/m^3	Inhalation REL (chronic) µg/m^3	Date reviewed	Oral REL (chronic)	Units	Date reviewed	Unit risk (µg/m^3)$^{-1}$	Inhalation slope factor mg/kg/day	Date reviewed [added]	Oral slope factor mg/kg/day	Date reviewed [added]
Lead	NA	7439-92-1	Previous	—	—	—	—	—	—	—	—	1.20E-05	4.20E-02	—	8.50E-03	NS
Manganese	NA	7439-96-5	Previous	—	—	0.17	0.09	Dec-08	—	—	—	—	—	—	—	—
Mercury	NA	7439-97-6	Previous	6.00E-01	Dec-08	0.06	0.03	Dec-08	0.16	µg/kg-d	Dec-08	—	—	—	—	—
m-Xylene	NA	108-38-3	Previous	2.20E-04	Apr-99		700	Apr-00	—	—	—	—	—	—	—	—
Naphthalene	NA	91-20-3	Previous	—	—	—	9	Apr-00	—	—	—	3.40E-05	1.20E-01	Aug-04	—	—
Nickel	NA	7440-02-0	Previous	2.00E-01	Mar-12	0.06	0.014	Mar-12	11	µg/kg-d	Mar-12	2.60E-04	9.10E-01	Aug-91	—	—
N-Nitrosodibutylamine	NA	924-16-3	Previous	—	—	—	—	—	—	—	—	3.10E-03	1.10E+01	4/1999 [1/1992]	—	—
N-Nitrosodiethylamine	NA	55-18-5	Previous	—	—	—	—	—	—	—	—	1.00E-02	3.60E+01	4/1999 [1/1991]	—	—
N-Nitrosodimethylamine	NA	62-75-9	Previous	—	—	—	—	—	—	—	—	4.60E-03	1.60E+01	Apr-99	—	—
N-Nitrosodiphenylamine	NA	86-30-6	Previous	—	—	—	—	—	—	—	—	2.60E-06	9.00E-03	Apr-99	—	—
N-Nitrosopyrrolidine	NA	930-55-2	Previous	—	—	—	—	—	—	—	—	6.00E-04	2.10E+00	4/1999 [7/90]	—	—
o-Xylene	NA	95-47-6	Previous	2.20E+04	Apr-99	—	700	Apr-00	—	—	—	—	—	—	—	—
p-Cresol	NA	106-44-5	Previous	—	—	—	6.00E+02	Jan-20	—	—	—	—	—	—	—	—
Phenol	NA	108-95-2	Previous	5.80E+03	Apr-99	—	200	Apr-00	—	—	—	—	—	—	—	—
p-Xylene	NA	106-42-3	Previous	22000	Apr-99	—	700	Apr-00	—	—	—	—	—	—	—	—
Selenium	NA	7782-49-2	Previous	—	—	—	20	Dec-01	5	µg/kg-d	Dec-01	—	—	—	—	—
Styrene	NA	100-42-5	Previous	2.10E+04	Apr-99	—	900	Apr-00	—	—	—	—	—	—	—	—
Tetrachloroethylene	NA	127-18-4	Previous	2.00E+04	Apr-99	—	—	—	—	—	—	5.90E-06	2.10E-02	Oct-91	—	—
Toluene	NA	108-88-3	Previous	3.70E+04	Apr-99	—	300	Apr-00	—	—	—	—	—	—	—	—

Notes:

CAS = Chemical Abstracts Service

[a] = High risk

[b] = Low risk

[c] = Lowest risk

Table D-7. Human Health Toxicity Values from Health Canada's List of Priority Substances for Chemicals Newly and Previously Identified in Biosolids

Chemical	CAS number	New or previous	TDI	Units	Date
2,4-Dichlorophenol	120-83-2	Previous	0.1*	mg/kg/day	2/1/1987
Antimony	7440-36-0	Previous	0.0002	mg/kg/day	5/1/1997
Barium	7440-39-3	Previous	0.19	mg/kg/day	1/1/2020
Benzo(a)pyrene	50-32-8	Previous	0.0667	µg/kg/day	1/1/2016
Boron	7440-42-8	Previous	0.035*	mg/kg/day	5/1/1991
Carbon tetrachloride	56-23-5	Previous	0.71	µg/kg/day	11/1/2010
Copper	7440-50-8	Previous	426	µg/kg/day	6/1/2019
Dichloromethane	75-09-2	Previous	0.014	mg/kg/day	3/1/2011
Dimethoate	60-51-5	Previous	0.002*	mg/kg/day	2/1/1991
Ethylbenzene	100-41-4	Previous	0.022	mg/kg/day	8/1/2014
Fluoride	16984-48-8	Previous	0.105	mg/kg/day	12/1/2010
Manganese	7439-96-5	Previous	0.025	mg/kg/day	5/1/2019
Mercury	7439-97-6	Previous	0.03	mg/kg/day	9/1/1986
m-Xylene	108-38-3	Previous	0.013	mg/kg/day	8/1/2014
o-Xylene	95-47-6	Previous	0.013	mg/kg/day	8/1/2014
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	Previous	0.0011	mg/kg/day	12/1/2018
Perfluorooctanoic acid (PFOA)	335-67-1	Previous	0.003	mg/kg/day	12/1/2018
p-Xylene	106-42-3	Previous	0.013	mg/kg/day	8/1/2014
Tetrachloroethylene	127-18-4	Previous	0.0068	mg/kg/day	1/1/2015
Toluene	108-88-3	Previous	0.0097	mg/kg/day	8/1/2014

Notes:

CAS = Chemical Abstracts Service

* Value is acceptable daily intake (ADI), not tolerable daily intake (TDI).

Appendix E. Ecological Toxicity Data

Table E-1. Summary of Papers Found in ECOTOX for Chemicals Newly Identified in Biosolids in the 2018-2019 Reporting Period

Chemical	CAS number	# of terrestrial species	# of papers terrestrial	# of aquatic species	# of papers aquatic
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	0	0	3	2
2,2',3,3',4,4'-Hexachlorobiphenyl	38380-07-3	0	0	5	6
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	1	1	1	1
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	1	1	2	2
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	1	1	7	7
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	0	0	1	1
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	3	3	43	50
2,2',4,4'-Tetrachlorobiphenyl	2437-79-8	1	1	20	14
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	0	0	19	16
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	0	0	4	4
2,2',4,5-Tetrachlorobiphenyl	70362-47-9	0	0	2	3
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4	4	23	33
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	38051-10-4	0	0	1	1
2,2'-Dichlorobiphenyl	13029-08-8	1	2	12	14
2,3,3',4,4',5,6-Heptachlorobiphenyl	41411-64-7	0	0	1	2
2,3,4'-Trichlorobiphenyl	38444-85-8	0	0	2	2
2,3-Dichlorobiphenyl	16605-91-7	1	1	2	2
2,4',5-Trichlorobiphenyl	16606-02-3	1	1	20	16
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	1	1	1	1
2,4'-Dichlorobiphenyl	34883-43-7	0	0	4	3
2-Chlorobiphenyl	2051-60-7	0	0	9	6
2-Ethylhexyl diphenyl phosphate	1241-94-7	3	3	6	7
2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	0	0	1	3
3,4,4'-Trichlorobiphenyl	38444-90-5	0	0	1	1
4-Chlorobiphenyl	2051-62-9	0	0	15	10
6:2 Fluorotelomer phosphate diester	57677-95-9	0	0	1	2
6:2 Fluorotelomer sulfonic acid	27619-97-2	1	1	4	2
8:2 Fluorotelomer phosphate diester	678-41-1	2	1	1	2
Ammeline	645-92-1	1	1	1	1
Amoxicillin	26787-78-0	3	1	17	10
Ampicillin	69-53-4	5	5	10	6
Bis(2-ethylhexyl) phosphate	298-07-7	0	0	4	4
Cesium	7440-46-2	1	1	4	5
Cresyl diphenyl phosphate (CDPP)	26444-49-5	1	1	4	2
Cyanuric acid	108-80-5	4	13	2	11
Decachlorobiphenyl	2051-24-3	0	0	7	7
Dibutyl ester phosphoric acid	107-66-4	0	0	1	1
Diethyl hydrogen phosphate	598-02-7	0	0	2	2
Fipronil amide	205650-69-7	1	1	1	1
Fipronil sulfide	120067-83-6	1	1	11	5
Fipronil sulfone	120068-36-2	2	3	15	4
Fipronil desulfinyl	205650-65-3	0	0	3	3
Hexachlorobiphenyl	26601-64-9	1	1	3	3
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	1	1	4	3
Melamine	108-78-1	7	19	8	8
Monochlorobiphenyl	27323-18-8	0	0	2	1
Nalidixic acid	389-08-2	1	1	3	3
Octachlorobiphenyl	55722-26-4	0	0	1	1

Table E-1. Summary of Papers Found in ECOTOX for Chemicals Newly Identified in Biosolids in the 2018-2019 Reporting Period

Chemical	CAS number	# of terrestrial species	# of papers terrestrial	# of aquatic species	# of papers aquatic
Pentachlorobiphenyl	25429-29-2	1	1	5	5
Polychlorinated biphenyl (PCB)	1336-36-3	5	7	38	39
Resorcinol bis(diphenyl phosphate) (RDP)	57583-54-7	0	0	1	1
Sulfur	7704-34-9	121	102	12	9
Tert-butylphenyl diphenyl phosphate	56803-37-3	1	1	5	3
Tetrachlorobiphenyl	26914-33-0	0	0	3	3
Tributyl phosphate	126-73-8	1	1	32	28
Triethyl phosphate (TEP)	78-40-0	3	1	13	7
Triisobutyl phosphate	126-71-6	1	1	3	1
Trimethyl phosphate (TMP)	512-56-1	2	2	4	4
Tripropyl phosphate	513-08-6	0	0	1	2
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	3	3	6	28
Tris(2-chloroisopropyl) phosphate	13674-84-5	2	2	2	4
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	1	1	1	1
Tris(methylphenyl) phosphate	1330-78-5	3	4	4	20

Notes:

CAS = Chemical Abstracts Service

Table E-2. Summary of Papers Found in ECOTOX for Chemicals Previously Identified in Biosolids in the 2018-2019 Reporting Period

Chemical	CAS number	# of terrestrial species	# of papers terrestrial	# of aquatic species	# of papers aquatic
(+/-)-Verapamil	52-53-9	0	0	1	1
1-(p-Chlorobenzoyl)-5-methoxy-2-methyl-Indole-3-acetic acid	53-86-1	0	0	1	1
17alpha-Ethinylestradiol	57-63-6	0	0	2	2
17beta-Estradiol	50-28-2	0	0	4	7
2,2',3,3',4,4',5,5',6,6'-decabromodiphenyl ether	1163-19-5	1	1	0	0
2,2',4,4'-Tetrabromodiphenyl ether	5436-43-1	0	0	1	1
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	0	0	1	1
2,4-Dichlorophenoxyacetic acid	94-75-7	1	1	1	1
3,3',5,5'-Tetrabromobisphenol A	79-94-7	6	5	5	8
4-(1,1,3,3-Tetramethylbutyl)phenol	140-66-9	2	2	0	0
Acetaminophen	103-90-2	0	0	1	1
Acetic acid	64-19-7	0	0	1	1
Acetone	67-64-1	0	0	6	6
Acetophenone	98-86-2	0	0	1	1
Aspirin	50-78-2	0	0	1	1
Benz(a)anthracene	56-55-3	0	0	1	1
Benzo(a)pyrene	50-32-8	0	0	2	3
Benzo(b)fluoranthene	205-99-2	0	0	1	1
Bisphenol A	80-05-7	0	0	7	16
Butylated hydroxytoluene	128-37-0	2	5	8	8
Butylparaben	94-26-8	0	0	1	1
Caffeine	58-08-2	0	0	1	1
Carbamazepine	298-46-4	0	0	1	1
Chloroform	67-66-3	0	0	1	1
Clorophene	120-32-1	0	0	1	1
Clotrimazole	23593-75-1	1	1	3	2
Cloxacillin	61-72-3	0	0	1	1
Cyclophosphamide	50-18-0	0	0	1	1
Di(2-ethylhexyl) phthalate	117-81-7	1	1	4	6
Dibutyl phthalate	84-74-2	4	4	9	12
Dichloromethane	75-09-2	0	0	1	1
Diclofenac	15307-86-5	0	0	1	1
Dimethoate	60-51-5	1	1	0	0
Dimethyl phthalate	131-11-3	0	0	2	2
Di-n-octyl phthalate	117-84-0	0	0	1	1
Ethylparaben	120-47-8	0	0	1	1
Fipronil	120068-37-3	0	0	1	1
Furosemide	54-31-9	0	0	1	1
Galaxolide	1222-05-5	3	3	14	4
Ibuprofen	15687-27-1	0	0	2	2
Methylparaben	99-76-3	0	0	1	1

Table E-2. Summary of Papers Found in ECOTOX for Chemicals Previously Identified in Biosolids in the 2018-2019 Reporting Period

Chemical	CAS number	# of terrestrial species	# of papers terrestrial	# of aquatic species	# of papers aquatic
Naphthalene	91-20-3	0	0	1	1
N-Nitrosodiphenylamine	86-30-6	0	0	1	1
o-Xylene	95-47-6	0	0	1	1
Perfluorobutanesulfonate	45187-15-3	2	2	2	4
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1	1	0	0
Perfluorobutanoic acid (PFBA)	375-22-4	1	1	2	2
Perfluorodecanoic acid (PFDA)	335-76-2	0	0	2	2
Perfluorododecanoic acid (PFDoDA)	307-55-1	0	0	2	3
Perfluoroheptanoic acid (PFHpA)	375-85-9	2	2	1	1
Perfluorohexanesulfonate	108427-53-8	1	1	3	3
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	1	1	0	0
Perfluorohexanoic acid (PFHxA)	307-24-4	1	1	3	4
Perfluorononanoic acid (PFNA)	375-95-1	1	1	2	2
Perfluoroundecanoic acid (PFUdA)	2058-94-8	7	5	8	7
Perfluorooctanesulfonamide (PFOSA)	754-91-6	4	2	0	0
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	0	0	5	7
Perfluorooctanoic acid (PFOA)	335-67-1	3	5	12	14
Perfluoropentanoic acid (PFPeA)	2706-90-3	1	1	0	0
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	5	2	1	1
Phenol	108-95-2	1	1	0	0
Potassium perfluorooctanesulfonate	2795-39-3	6	5	8	12
Propylparaben	94-13-3	0	0	2	2
Pyrene	129-00-0	0	0	1	1
Tetrachloroethylene	127-18-4	0	0	1	1
Tonalide	21145-77-7	0	0	1	1
Triclosan	3380-34-5	0	0	2	3
Trimethoprim	738-70-5	0	0	1	1
Triphenyl phosphate	115-86-6	1	1	5	11
Tris(2-butoxyethyl) phosphate	78-51-3	0	0	4	4
Tris(2-chloroethyl) phosphate	115-96-8	1	1	4	4

Notes:

CAS = Chemical Abstracts Service

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
2,2',3,3',4,4',5,6'-Octachlorobiphenyl[b]	196	42740-50-1	Neutral Organics	Fish	96-hr	LC50	0.000218
2,2',3,3',4,4',5,6'-Octachlorobiphenyl[b]	196	42740-50-1	Neutral Organics	Daphnid	48-hr	LC50	0.000235
2,2',3,3',4,4',5,6'-Octachlorobiphenyl[b]	196	42740-50-1	Neutral Organics	Green Algae	96-hr	EC50	0.002
2,2',3,3',4,4',5,6'-Octachlorobiphenyl[b]	196	42740-50-1	Neutral Organics	Fish		ChV	4.53E-05
2,2',3,3',4,4',5,6'-Octachlorobiphenyl[b]	196	42740-50-1	Neutral Organics	Daphnid		ChV	0.000135
2,2',3,3',4,4',5,6'-Octachlorobiphenyl[b]	196	42740-50-1	Neutral Organics	Green Algae		ChV	0.003
2,2',3,3',4,4',5,6'-Octachlorobiphenyl[b]	196	42740-50-1	Neutral Organics	Fish(SW)	96-hr	LC50	0.000287
2,2',3,3',4,4',5,6'-Octachlorobiphenyl[b]	196	42740-50-1	Neutral Organics	Mysid	96-hr	LC50	1.97E-06
2,2',3,3',4,4',5,6'-Octachlorobiphenyl[b]	196	42740-50-1	Neutral Organics	Fish(SW)		ChV	0.002
2,2',3,3',4,4',5,6'-Octachlorobiphenyl[b]	196	42740-50-1	Neutral Organics	Mysid(SW)		ChV	2.20E-08
2,2',3,3',4,4',5,6'-Octachlorobiphenyl[b]	196	42740-50-1	Neutral Organics	Earthworm	14-day	LC50	143.404
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	Neutral Organics	Fish	96-hr	LC50	0.000762
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	Neutral Organics	Daphnid	48-hr	LC50	0.000772
2,2',3,3',4,4',5-Heptachlorobiphenyl[b]	170	35065-30-6	Neutral Organics	Green Algae	96-hr	EC50	0.006
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	Neutral Organics	Fish		ChV	0.000147
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	Neutral Organics	Daphnid		ChV	0.000377
2,2',3,3',4,4',5-Heptachlorobiphenyl[b]	170	35065-30-6	Neutral Organics	Green Algae		ChV	0.006
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	Neutral Organics	Fish (SW)	96-hr	LC50	0.000996
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	Neutral Organics	Mysid	96-hr	LC50	1.06E-05
2,2',3,3',4,4',5-Heptachlorobiphenyl[b]	170	35065-30-6	Neutral Organics	Fish (SW)		ChV	0.005
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	Neutral Organics	Mysid (SW)		ChV	1.43E-07
2,2',3,3',4,4',5-Heptachlorobiphenyl[b]	170	35065-30-6	Neutral Organics	Earthworm	14-day	LC50	153.856
2,2',3,3',4,4'-Hexachlorobiphenyl[b]	128	38380-07-3	Neutral Organics	Fish	96-hr	LC50	0.003
2,2',3,3',4,4'-Hexachlorobiphenyl[b]	128	38380-07-3	Neutral Organics	Daphnid	48-hr	LC50	0.003
2,2',3,3',4,4'-Hexachlorobiphenyl[b]	128	38380-07-3	Neutral Organics	Green Algae	96-hr	EC50	0.016
2,2',3,3',4,4'-Hexachlorobiphenyl[b]	128	38380-07-3	Neutral Organics	Fish		ChV	0.000476
2,2',3,3',4,4'-Hexachlorobiphenyl[b]	128	38380-07-3	Neutral Organics	Daphnid		ChV	0.00104
2,2',3,3',4,4'-Hexachlorobiphenyl[b]	128	38380-07-3	Neutral Organics	Green Algae		ChV	0.013
2,2',3,3',4,4'-Hexachlorobiphenyl[b]	128	38380-07-3	Neutral Organics	Fish (SW)	96-hr	LC50	0.003
2,2',3,3',4,4'-Hexachlorobiphenyl	128	38380-07-3	Neutral Organics	Mysid	96-hr	LC50	5.65E-05
2,2',3,3',4,4'-Hexachlorobiphenyl[b]	128	38380-07-3	Neutral Organics	Fish (SW)		ChV	0.012
2,2',3,3',4,4'-Hexachlorobiphenyl	128	38380-07-3	Neutral Organics	Mysid (SW)		ChV	9.23E-07
2,2',3,3',4,4'-Hexachlorobiphenyl[b]	128	38380-07-3	Neutral Organics	Earthworm	14-day	LC50	163.817
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	201	40186-71-8	Neutral Organics	Fish	96-hr	LC50	0.000218
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	201	40186-71-8	Neutral Organics	Daphnid	48-hr	LC50	0.000235
2,2',3,3',4,5',6,6'-Octachlorobiphenyl[b]	201	40186-71-8	Neutral Organics	Green Algae	96-hr	EC50	0.002
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	201	40186-71-8	Neutral Organics	Fish		ChV	4.53E-05
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	201	40186-71-8	Neutral Organics	Daphnid		ChV	0.000135
2,2',3,3',4,5',6,6'-Octachlorobiphenyl[b]	201	40186-71-8	Neutral Organics	Green Algae		ChV	0.003
2,2',3,3',4,5',6,6'-Octachlorobiphenyl[b]	201	40186-71-8	Neutral Organics	Fish (SW)	96-hr	LC50	0.000287
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	201	40186-71-8	Neutral Organics	Mysid	96-hr	LC50	1.97E-06
2,2',3,3',4,5',6,6'-Octachlorobiphenyl[b]	201	40186-71-8	Neutral Organics	Fish (SW)		ChV	0.002
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	201	40186-71-8	Neutral Organics	Mysid (SW)		ChV	2.20E-08
2,2',3,3',4,5',6,6'-Octachlorobiphenyl[b]	201	40186-71-8	Neutral Organics	Earthworm	14-day	LC50	143.404
2,2',3,3',4,5-Hexachlorobiphenyl[b]	129	55215-18-4	Neutral Organics	Fish	96-hr	LC50	0.003
2,2',3,3',4,5-Hexachlorobiphenyl[b]	129	55215-18-4	Neutral Organics	Daphnid	48-hr	LC50	0.003
2,2',3,3',4,5-Hexachlorobiphenyl[b]	129	55215-18-4	Neutral Organics	Green Algae	96-hr	EC50	0.016
2,2',3,3',4,5-Hexachlorobiphenyl	129	55215-18-4	Neutral Organics	Fish		ChV	0.000476
2,2',3,3',4,5-Hexachlorobiphenyl	129	55215-18-4	Neutral Organics	Daphnid		ChV	0.00104
2,2',3,3',4,5-Hexachlorobiphenyl[b]	129	55215-18-4	Neutral Organics	Green Algae		ChV	0.013
2,2',3,3',4,5-Hexachlorobiphenyl[b]	129	55215-18-4	Neutral Organics	Fish (SW)	96-hr	LC50	0.003
2,2',3,3',4,5-Hexachlorobiphenyl	129	55215-18-4	Neutral Organics	Mysid	96-hr	LC50	5.65E-05
2,2',3,3',4,5-Hexachlorobiphenyl[b]	129	55215-18-4	Neutral Organics	Fish (SW)		ChV	0.012
2,2',3,3',4,5-Hexachlorobiphenyl	129	55215-18-4	Neutral Organics	Mysid (SW)		ChV	9.23E-07
2,2',3,3',4,5-Hexachlorobiphenyl[b]	129	55215-18-4	Neutral Organics	Earthworm	14-day	LC50	163.817
2,2',3,3',4,6-Hexachlorobiphenyl[b]	131	61798-70-7	Neutral Organics	Fish	96-hr	LC50	0.003
2,2',3,3',4,6-Hexachlorobiphenyl[b]	131	61798-70-7	Neutral Organics	Daphnid	48-hr	LC50	0.003

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
2,2',3,3',4,6-Hexachlorobiphenyl[b]	131	61798-70-7	Neutral Organics	Green Algae	96-hr	EC50	0.016
2,2',3,3',4,6-Hexachlorobiphenyl	131	61798-70-7	Neutral Organics	Fish		ChV	0.000476
2,2',3,3',4,6-Hexachlorobiphenyl	131	61798-70-7	Neutral Organics	Daphnid		ChV	0.00104
2,2',3,3',4,6-Hexachlorobiphenyl[b]	131	61798-70-7	Neutral Organics	Green Algae		ChV	0.013
2,2',3,3',4,6-Hexachlorobiphenyl[b]	131	61798-70-7	Neutral Organics	Fish (SW)	96-hr	LC50	0.003
2,2',3,3',4,6-Hexachlorobiphenyl	131	61798-70-7	Neutral Organics	Mysid	96-hr	LC50	5.65E-05
2,2',3,3',4,6-Hexachlorobiphenyl[b]	131	61798-70-7	Neutral Organics	Fish (SW)		ChV	0.012
2,2',3,3',4,6-Hexachlorobiphenyl	131	61798-70-7	Neutral Organics	Mysid (SW)		ChV	9.23E-07
2,2',3,3',4,6-Hexachlorobiphenyl[b]	131	61798-70-7	Neutral Organics	Earthworm	14-day	LC50	163.817
2,2',3,3',5,5',6-Heptachlorobiphenyl	178	52663-67-9	Neutral Organics	Fish	96-hr	LC50	0.000762
2,2',3,3',5,5',6-Heptachlorobiphenyl	178	52663-67-9	Neutral Organics	Daphnid	48-hr	LC50	0.000772
2,2',3,3',5,5',6-Heptachlorobiphenyl[b]	178	52663-67-9	Neutral Organics	Green Algae	96-hr	EC50	0.006
2,2',3,3',5,5',6-Heptachlorobiphenyl	178	52663-67-9	Neutral Organics	Fish		ChV	0.000147
2,2',3,3',5,5',6-Heptachlorobiphenyl	178	52663-67-9	Neutral Organics	Daphnid		ChV	0.000377
2,2',3,3',5,5',6-Heptachlorobiphenyl[b]	178	52663-67-9	Neutral Organics	Green Algae		ChV	0.006
2,2',3,3',5,5',6-Heptachlorobiphenyl	178	52663-67-9	Neutral Organics	Fish (SW)	96-hr	LC50	0.000996
2,2',3,3',5,5',6-Heptachlorobiphenyl	178	52663-67-9	Neutral Organics	Mysid	96-hr	LC50	1.06E-05
2,2',3,3',5,5',6-Heptachlorobiphenyl[b]	178	52663-67-9	Neutral Organics	Fish (SW)		ChV	0.005
2,2',3,3',5,5',6-Heptachlorobiphenyl	178	52663-67-9	Neutral Organics	Mysid (SW)		ChV	1.43E-07
2,2',3,3',5,5',6-Heptachlorobiphenyl[b]	178	52663-67-9	Neutral Organics	Earthworm	14-day	LC50	153.856
2,2',3,3',6,6'-Hexachlorobiphenyl	136	38411-22-2	Neutral Organics	Fish	96-hr	LC50	0.003
2,2',3,3',6,6'-Hexachlorobiphenyl	136	38411-22-2	Neutral Organics	Daphnid	48-hr	LC50	0.003
2,2',3,3',6,6'-Hexachlorobiphenyl[b]	136	38411-22-2	Neutral Organics	Green Algae	96-hr	EC50	0.016
2,2',3,3',6,6'-Hexachlorobiphenyl	136	38411-22-2	Neutral Organics	Fish		ChV	0.000476
2,2',3,3',6,6'-Hexachlorobiphenyl	136	38411-22-2	Neutral Organics	Daphnid		ChV	0.00104
2,2',3,3',6,6'-Hexachlorobiphenyl[b]	136	38411-22-2	Neutral Organics	Green Algae		ChV	0.013
2,2',3,3',6,6'-Hexachlorobiphenyl	136	38411-22-2	Neutral Organics	Fish (SW)	96-hr	LC50	0.003
2,2',3,3',6,6'-Hexachlorobiphenyl	136	38411-22-2	Neutral Organics	Mysid	96-hr	LC50	5.65E-05
2,2',3,3',6,6'-Hexachlorobiphenyl[b]	136	38411-22-2	Neutral Organics	Fish (SW)		ChV	0.012
2,2',3,3',6,6'-Hexachlorobiphenyl	136	38411-22-2	Neutral Organics	Mysid (SW)		ChV	9.23E-07
2,2',3,3',6,6'-Hexachlorobiphenyl[b]	136	38411-22-2	Neutral Organics	Earthworm	14-day	LC50	163.817
2,2',3,4,4',5,5',6-Octachlorobiphenyl[b]	203	52663-76-0	Neutral Organics	Fish	96-hr	LC50	0.000218
2,2',3,4,4',5,5',6-Octachlorobiphenyl[b]	203	52663-76-0	Neutral Organics	Daphnid	48-hr	LC50	0.000235
2,2',3,4,4',5,5',6-Octachlorobiphenyl[b]	203	52663-76-0	Neutral Organics	Green Algae	96-hr	EC50	0.002
2,2',3,4,4',5,5',6-Octachlorobiphenyl	203	52663-76-0	Neutral Organics	Fish		ChV	4.53E-05
2,2',3,4,4',5,5',6-Octachlorobiphenyl	203	52663-76-0	Neutral Organics	Daphnid		ChV	0.000135
2,2',3,4,4',5,5',6-Octachlorobiphenyl[b]	203	52663-76-0	Neutral Organics	Green Algae		ChV	0.003
2,2',3,4,4',5,5',6-Octachlorobiphenyl[b]	203	52663-76-0	Neutral Organics	Fish (SW)	96-hr	LC50	0.000287
2,2',3,4,4',5,5',6-Octachlorobiphenyl	203	52663-76-0	Neutral Organics	Mysid	96-hr	LC50	1.97E-06
2,2',3,4,4',5,5',6-Octachlorobiphenyl[b]	203	52663-76-0	Neutral Organics	Fish (SW)		ChV	0.002
2,2',3,4,4',5,5',6-Octachlorobiphenyl	203	52663-76-0	Neutral Organics	Mysid (SW)		ChV	2.20E-08
2,2',3,4,4',5,5',6-Octachlorobiphenyl[b]	203	52663-76-0	Neutral Organics	Earthworm	14-day	LC50	143.404
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	Neutral Organics	Fish	96-hr	LC50	0.000762
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	Neutral Organics	Daphnid	48-hr	LC50	0.000772
2,2',3,4,4',5,5'-Heptachlorobiphenyl[b]	180	35065-29-3	Neutral Organics	Green Algae	96-hr	EC50	0.006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	Neutral Organics	Fish		ChV	0.000147
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	Neutral Organics	Daphnid		ChV	0.000377
2,2',3,4,4',5,5'-Heptachlorobiphenyl[b]	180	35065-29-3	Neutral Organics	Green Algae		ChV	0.006
2,2',3,4,4',5,5'-Heptachlorobiphenyl[b]	180	35065-29-3	Neutral Organics	Fish (SW)	96-hr	LC50	0.000996
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	Neutral Organics	Mysid	96-hr	LC50	1.06E-05
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	Neutral Organics	Fish (SW)		ChV	0.005
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	Neutral Organics	Mysid (SW)		ChV	1.43E-07
2,2',3,4,4',5,5'-Heptachlorobiphenyl[b]	180	35065-29-3	Neutral Organics	Earthworm	14-day	LC50	153.856
2,2',3,4,4',5'-Hexachlorobiphenyl[b]	138	35065-28-2	Neutral Organics	Fish	96-hr	LC50	0.003
2,2',3,4,4',5'-Hexachlorobiphenyl[b]	138	35065-28-2	Neutral Organics	Daphnid	48-hr	LC50	0.003
2,2',3,4,4',5'-Hexachlorobiphenyl[b]	138	35065-28-2	Neutral Organics	Green Algae	96-hr	EC50	0.016
2,2',3,4,4',5'-Hexachlorobiphenyl	138	35065-28-2	Neutral Organics	Fish		ChV	0.000476
2,2',3,4,4',5'-Hexachlorobiphenyl	138	35065-28-2	Neutral Organics	Daphnid		ChV	0.00104

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
2,2',3,4,4',5'-Hexachlorobiphenyl[b]	138	35065-28-2	Neutral Organics	Green Algae		ChV	0.013
2,2',3,4,4',5'-Hexachlorobiphenyl[b]	138	35065-28-2	Neutral Organics	Fish (SW)	96-hr	LC50	0.003
2,2',3,4,4',5'-Hexachlorobiphenyl	138	35065-28-2	Neutral Organics	Mysid	96-hr	LC50	5.65E-05
2,2',3,4,4',5'-Hexachlorobiphenyl[b]	138	35065-28-2	Neutral Organics	Fish (SW)		ChV	0.012
2,2',3,4,4',5'-Hexachlorobiphenyl	138	35065-28-2	Neutral Organics	Mysid (SW)		ChV	9.23E-07
2,2',3,4,4',5'-Hexachlorobiphenyl[b]	138	35065-28-2	Neutral Organics	Earthworm	14-day	LC50	163.817
2,2',3,4,4'-Pentachlorobiphenyl[b]	85	65510-45-4	Neutral Organics	Fish	96-hr	LC50	0.009
2,2',3,4,4'-Pentachlorobiphenyl[b]	85	65510-45-4	Neutral Organics	Daphnid	48-hr	LC50	0.008
2,2',3,4,4'-Pentachlorobiphenyl[b]	85	65510-45-4	Neutral Organics	Green Algae	96-hr	EC50	0.041
2,2',3,4,4'-Pentachlorobiphenyl	85	65510-45-4	Neutral Organics	Fish		ChV	0.00152
2,2',3,4,4'-Pentachlorobiphenyl	85	65510-45-4	Neutral Organics	Daphnid		ChV	0.003
2,2',3,4,4'-Pentachlorobiphenyl[b]	85	65510-45-4	Neutral Organics	Green Algae		ChV	0.03
2,2',3,4,4'-Pentachlorobiphenyl[b]	85	65510-45-4	Neutral Organics	Fish (SW)	96-hr	LC50	0.012
2,2',3,4,4'-Pentachlorobiphenyl	85	65510-45-4	Neutral Organics	Mysid	96-hr	LC50	0.000299
2,2',3,4,4'-Pentachlorobiphenyl[b]	85	65510-45-4	Neutral Organics	Fish (SW)		ChV	0.027
2,2',3,4,4'-Pentachlorobiphenyl	85	65510-45-4	Neutral Organics	Mysid (SW)		ChV	5.91E-06
2,2',3,4,4'-Pentachlorobiphenyl[b]	85	65510-45-4	Neutral Organics	Earthworm	14-day	LC50	172.833
2,2',3,4,5'-Pentachlorobiphenyl	87	38380-02-8	Neutral Organics	Fish	96-hr	LC50	0.009
2,2',3,4,5'-Pentachlorobiphenyl	87	38380-02-8	Neutral Organics	Daphnid	48-hr	LC50	0.008
2,2',3,4,5'-Pentachlorobiphenyl[b]	87	38380-02-8	Neutral Organics	Green Algae	96-hr	EC50	0.041
2,2',3,4,5'-Pentachlorobiphenyl	87	38380-02-8	Neutral Organics	Fish		ChV	0.00152
2,2',3,4,5'-Pentachlorobiphenyl	87	38380-02-8	Neutral Organics	Daphnid		ChV	0.003
2,2',3,4,5'-Pentachlorobiphenyl[b]	87	38380-02-8	Neutral Organics	Green Algae		ChV	0.03
2,2',3,4,5'-Pentachlorobiphenyl[b]	87	38380-02-8	Neutral Organics	Fish (SW)	96-hr	LC50	0.012
2,2',3,4,5'-Pentachlorobiphenyl	87	38380-02-8	Neutral Organics	Mysid	96-hr	LC50	0.000299
2,2',3,4,5'-Pentachlorobiphenyl	87	38380-02-8	Neutral Organics	Fish (SW)		ChV	0.027
2,2',3,4,5'-Pentachlorobiphenyl	87	38380-02-8	Neutral Organics	Mysid (SW)		ChV	5.91E-06
2,2',3,4,5'-Pentachlorobiphenyl[b]	87	38380-02-8	Neutral Organics	Earthworm	14-day	LC50	172.833
2,2',3,5',6-Pentachlorobiphenyl	95	38379-99-6	Neutral Organics	Fish	96-hr	LC50	0.009
2,2',3,5',6-Pentachlorobiphenyl	95	38379-99-6	Neutral Organics	Daphnid	48-hr	LC50	0.008
2,2',3,5',6-Pentachlorobiphenyl[b]	95	38379-99-6	Neutral Organics	Green Algae	96-hr	EC50	0.041
2,2',3,5',6-Pentachlorobiphenyl	95	38379-99-6	Neutral Organics	Fish		ChV	0.00152
2,2',3,5',6-Pentachlorobiphenyl	95	38379-99-6	Neutral Organics	Daphnid		ChV	0.003
2,2',3,5',6-Pentachlorobiphenyl[b]	95	38379-99-6	Neutral Organics	Green Algae		ChV	0.03
2,2',3,5',6-Pentachlorobiphenyl[b]	95	38379-99-6	Neutral Organics	Fish (SW)	96-hr	LC50	0.012
2,2',3,5',6-Pentachlorobiphenyl	95	38379-99-6	Neutral Organics	Mysid	96-hr	LC50	0.000299
2,2',3,5',6-Pentachlorobiphenyl	95	38379-99-6	Neutral Organics	Fish (SW)		ChV	0.027
2,2',3,5',6-Pentachlorobiphenyl	95	38379-99-6	Neutral Organics	Mysid (SW)		ChV	5.91E-06
2,2',3,5',6-Pentachlorobiphenyl[b]	95	38379-99-6	Neutral Organics	Earthworm	14-day	LC50	172.833
2,2',3,5-Tetrachlorobiphenyl[b]	43	70362-46-8	Neutral Organics	Fish	96-hr	LC50	0.031
2,2',3,5-Tetrachlorobiphenyl[b]	43	70362-46-8	Neutral Organics	Daphnid	48-hr	LC50	0.026
2,2',3,5-Tetrachlorobiphenyl[b]	43	70362-46-8	Neutral Organics	Green Algae	96-hr	EC50	0.101
2,2',3,5-Tetrachlorobiphenyl	43	70362-46-8	Neutral Organics	Fish		ChV	0.005
2,2',3,5-Tetrachlorobiphenyl	43	70362-46-8	Neutral Organics	Daphnid		ChV	0.008
2,2',3,5-Tetrachlorobiphenyl[b]	43	70362-46-8	Neutral Organics	Green Algae		ChV	0.065
2,2',3,5-Tetrachlorobiphenyl[b]	43	70362-46-8	Neutral Organics	Fish (SW)	96-hr	LC50	0.04
2,2',3,5-Tetrachlorobiphenyl	43	70362-46-8	Neutral Organics	Mysid	96-hr	LC50	0.00156
2,2',3,5-Tetrachlorobiphenyl[b]	43	70362-46-8	Neutral Organics	Fish (SW)		ChV	0.061
2,2',3,5-Tetrachlorobiphenyl	43	70362-46-8	Neutral Organics	Mysid (SW)		ChV	3.74E-05
2,2',3,5-Tetrachlorobiphenyl[b]	43	70362-46-8	Neutral Organics	Earthworm	14-day	LC50	180.316
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	Neutral Organics	Fish	96-hr	LC50	0.031
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	Neutral Organics	Daphnid	48-hr	LC50	0.026
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	Neutral Organics	Green Algae	96-hr	EC50	0.101
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	Neutral Organics	Fish		ChV	0.005
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	Neutral Organics	Daphnid		ChV	0.008
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	Neutral Organics	Green Algae		ChV	0.065
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	Neutral Organics	Fish (SW)	96-hr	LC50	0.04
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	Neutral Organics	Mysid	96-hr	LC50	0.00156

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	Neutral Organics	Fish (SW)		ChV	0.061
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	Neutral Organics	Mysid (SW)		ChV	3.74E-05
2,2',3,6-Tetrachlorobiphenyl[b]	45	70362-45-7	Neutral Organics	Earthworm	14-day	LC50	180.316
2,2',4,4',5,5'-Hexachlorobiphenyl[b]	153	35065-27-1	Neutral Organics	Fish	96-hr	LC50	0.003
2,2',4,4',5,5'-Hexachlorobiphenyl[b]	153	35065-27-1	Neutral Organics	Daphnid	48-hr	LC50	0.003
2,2',4,4',5,5'-Hexachlorobiphenyl[b]	153	35065-27-1	Neutral Organics	Green Algae	96-hr	EC50	0.016
2,2',4,4',5,5'-Hexachlorobiphenyl	153	35065-27-1	Neutral Organics	Fish		ChV	0.000476
2,2',4,4',5,5'-Hexachlorobiphenyl[b]	153	35065-27-1	Neutral Organics	Daphnid		ChV	0.00104
2,2',4,4',5,5'-Hexachlorobiphenyl[b]	153	35065-27-1	Neutral Organics	Green Algae		ChV	0.013
2,2',4,4',5,5'-Hexachlorobiphenyl[b]	153	35065-27-1	Neutral Organics	Fish (SW)	96-hr	LC50	0.003
2,2',4,4',5,5'-Hexachlorobiphenyl	153	35065-27-1	Neutral Organics	Mysid	96-hr	LC50	5.65E-05
2,2',4,4',5,5'-Hexachlorobiphenyl[b]	153	35065-27-1	Neutral Organics	Fish (SW)		ChV	0.012
2,2',4,4',5,5'-Hexachlorobiphenyl	153	35065-27-1	Neutral Organics	Mysid (SW)		ChV	9.23E-07
2,2',4,4',5,5'-Hexachlorobiphenyl[b]	153	35065-27-1	Neutral Organics	Earthworm	14-day	LC50	163.817
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	Neutral Organics	Fish	96-hr	LC50	0.031
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	Neutral Organics	Daphnid	48-hr	LC50	0.026
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	Neutral Organics	Green Algae	96-hr	EC50	0.101
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	Neutral Organics	Fish		ChV	0.005
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	Neutral Organics	Daphnid		ChV	0.008
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	Neutral Organics	Green Algae		ChV	0.065
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	Neutral Organics	Fish (SW)	96-hr	LC50	0.04
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	Neutral Organics	Mysid	96-hr	LC50	0.00156
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	Neutral Organics	Fish (SW)		ChV	0.061
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	Neutral Organics	Mysid (SW)		ChV	3.74E-05
2,2',4,4'-Tetrachlorobiphenyl[b]	47	2437-79-8	Neutral Organics	Earthworm	14-day	LC50	180.316
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	Neutral Organics	Fish	96-hr	LC50	0.009
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	Neutral Organics	Daphnid	48-hr	LC50	0.008
2,2',4,5,5'-Pentachlorobiphenyl[b]	101	37680-73-2	Neutral Organics	Green Algae	96-hr	EC50	0.041
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	Neutral Organics	Fish		ChV	0.00152
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	Neutral Organics	Daphnid		ChV	0.003
2,2',4,5,5'-Pentachlorobiphenyl[b]	101	37680-73-2	Neutral Organics	Green Algae		ChV	0.03
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	Neutral Organics	Fish (SW)	96-hr	LC50	0.012
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	Neutral Organics	Mysid	96-hr	LC50	0.000299
2,2',4,5,5'-Pentachlorobiphenyl[b]	101	37680-73-2	Neutral Organics	Fish (SW)		ChV	0.027
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	Neutral Organics	Mysid (SW)		ChV	5.91E-06
2,2',4,5,5'-Pentachlorobiphenyl[b]	101	37680-73-2	Neutral Organics	Earthworm	14-day	LC50	172.833
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	Neutral Organics	Fish	96-hr	LC50	0.031
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	Neutral Organics	Daphnid	48-hr	LC50	0.026
2,2',4,5'-Tetrachlorobiphenyl[b]	49	41464-40-8	Neutral Organics	Green Algae	96-hr	EC50	0.101
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	Neutral Organics	Fish		ChV	0.005
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	Neutral Organics	Daphnid		ChV	0.008
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	Neutral Organics	Green Algae		ChV	0.065
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	Neutral Organics	Fish (SW)	96-hr	LC50	0.04
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	Neutral Organics	Mysid	96-hr	LC50	0.00156
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	Neutral Organics	Fish (SW)		ChV	0.061
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	Neutral Organics	Mysid (SW)		ChV	3.74E-05
2,2',4,5'-Tetrachlorobiphenyl[b]	49	41464-40-8	Neutral Organics	Earthworm	14-day	LC50	180.316
2,2',4,5-Tetrachlorobiphenyl[b]	48	70362-47-9	Neutral Organics	Fish	96-hr	LC50	0.031
2,2',4,5-Tetrachlorobiphenyl[b]	48	70362-47-9	Neutral Organics	Daphnid	48-hr	LC50	0.026
2,2',4,5-Tetrachlorobiphenyl[b]	48	70362-47-9	Neutral Organics	Green Algae	96-hr	EC50	0.101
2,2',4,5-Tetrachlorobiphenyl	48	70362-47-9	Neutral Organics	Fish		ChV	0.005
2,2',4,5-Tetrachlorobiphenyl	48	70362-47-9	Neutral Organics	Daphnid		ChV	0.008
2,2',4,5-Tetrachlorobiphenyl[b]	48	70362-47-9	Neutral Organics	Green Algae		ChV	0.065
2,2',4,5-Tetrachlorobiphenyl[b]	48	70362-47-9	Neutral Organics	Fish (SW)	96-hr	LC50	0.04
2,2',4,5-Tetrachlorobiphenyl	48	70362-47-9	Neutral Organics	Mysid	96-hr	LC50	0.00156
2,2',4,5-Tetrachlorobiphenyl[b]	48	70362-47-9	Neutral Organics	Fish (SW)		ChV	0.061
2,2',4,5-Tetrachlorobiphenyl	48	70362-47-9	Neutral Organics	Mysid (SW)		ChV	3.74E-05
2,2',4,5-Tetrachlorobiphenyl[b]	48	70362-47-9	Neutral Organics	Earthworm	14-day	LC50	180.316

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	Neutral Organics	Fish	96-hr	LC50	0.031
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	Neutral Organics	Daphnid	48-hr	LC50	0.026
2,2',4,6'-Tetrachlorobiphenyl[b]	51	68194-04-7	Neutral Organics	Green Algae	96-hr	EC50	0.101
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	Neutral Organics	Fish		ChV	0.005
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	Neutral Organics	Daphnid		ChV	0.008
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	Neutral Organics	Green Algae		ChV	0.065
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	Neutral Organics	Fish (SW)	96-hr	LC50	0.04
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	Neutral Organics	Mysid	96-hr	LC50	0.00156
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	Neutral Organics	Fish (SW)		ChV	0.061
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	Neutral Organics	Mysid (SW)		ChV	3.74E-05
2,2',4,6'-Tetrachlorobiphenyl[b]	51	68194-04-7	Neutral Organics	Earthworm	14-day	LC50	180.316
2,2',5,5'-Tetrachlorobiphenyl[b]	52	35693-99-3	Neutral Organics	Fish	96-hr	LC50	0.031
2,2',5,5'-Tetrachlorobiphenyl[b]	52	35693-99-3	Neutral Organics	Daphnid	48-hr	LC50	0.026
2,2',5,5'-Tetrachlorobiphenyl[b]	52	35693-99-3	Neutral Organics	Green Algae	96-hr	EC50	0.101
2,2',5,5'-Tetrachlorobiphenyl	52	35693-99-3	Neutral Organics	Fish		ChV	0.005
2,2',5,5'-Tetrachlorobiphenyl	52	35693-99-3	Neutral Organics	Daphnid		ChV	0.008
2,2',5,5'-Tetrachlorobiphenyl[b]	52	35693-99-3	Neutral Organics	Green Algae		ChV	0.065
2,2',5,5'-Tetrachlorobiphenyl[b]	52	35693-99-3	Neutral Organics	Fish (SW)	96-hr	LC50	0.04
2,2',5,5'-Tetrachlorobiphenyl	52	35693-99-3	Neutral Organics	Mysid	96-hr	LC50	0.00156
2,2',5,5'-Tetrachlorobiphenyl	52	35693-99-3	Neutral Organics	Fish (SW)		ChV	0.061
2,2',5,5'-Tetrachlorobiphenyl[b]	52	35693-99-3	Neutral Organics	Mysid (SW)		ChV	3.74E-05
2,2',5,5'-Tetrachlorobiphenyl[b]	52	35693-99-3	Neutral Organics	Earthworm	14-day	LC50	180.316
2,2',6-Trichlorobiphenyl[b]	19	38444-73-4	Neutral Organics	Fish	96-hr	LC50	0.103
2,2',6-Trichlorobiphenyl	19	38444-73-4	Neutral Organics	Daphnid	48-hr	LC50	0.082
2,2',6-Trichlorobiphenyl[b]	19	38444-73-4	Neutral Organics	Green Algae	96-hr	EC50	0.25
2,2',6-Trichlorobiphenyl	19	38444-73-4	Neutral Organics	Fish		ChV	0.015
2,2',6-Trichlorobiphenyl	19	38444-73-4	Neutral Organics	Daphnid		ChV	0.021
2,2',6-Trichlorobiphenyl[b]	19	38444-73-4	Neutral Organics	Green Algae		ChV	0.14
2,2',6-Trichlorobiphenyl	19	38444-73-4	Neutral Organics	Fish (SW)	96-hr	LC50	0.132
2,2',6-Trichlorobiphenyl	19	38444-73-4	Neutral Organics	Mysid	96-hr	LC50	0.008
2,2',6-Trichlorobiphenyl[b]	19	38444-73-4	Neutral Organics	Fish (SW)		ChV	0.136
2,2',6-Trichlorobiphenyl	19	38444-73-4	Neutral Organics	Mysid (SW)		ChV	0.000233
2,2',6-Trichlorobiphenyl[b]	19	38444-73-4	Neutral Organics	Earthworm	14-day	LC50	185.504
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters	Fish	96-hr	LC50	13.461
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters	Daphnid	48-hr	LC50	24.33
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters	Green Algae	96-hr	EC50	8.419
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters	Fish		ChV	0.77
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters	Daphnid		ChV	11.427
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters	Green Algae		ChV	3.298
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters	Fish (SW)	96-hr	LC50	18.903
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters	Mysid	96-hr	LC50	9.769
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters	Fish (SW)		ChV	3.428
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters	Mysid (SW)		ChV	50.199
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters	Earthworm	14-day	LC50	2882.783
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters (phosphate)	Fish	96-hr	LC50	4.413
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters (phosphate)	Daphnid	48-hr	LC50	0.007

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters (phosphate)	Green Algae	96-hr	EC50	311.506
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters (phosphate)	Fish		ChV	0.019
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters (phosphate)	Green Algae		ChV	42.414
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters (phosphate)	Fish (SW)	96-hr	LC50	2.225
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.016
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters (phosphate)	Fish (SW)		ChV	0.094
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid[b]	NA	38051-10-4	Esters (phosphate)	Mysid (SW)		ChV	0.000171
2,2'-Dichlorobiphenyl	4	13029-08-8	Neutral Organics	Fish	96-hr	LC50	0.337
2,2'-Dichlorobiphenyl	4	13029-08-8	Neutral Organics	Daphnid	48-hr	LC50	0.253
2,2'-Dichlorobiphenyl	4	13029-08-8	Neutral Organics	Green Algae	96-hr	EC50	0.604
2,2'-Dichlorobiphenyl	4	13029-08-8	Neutral Organics	Fish		ChV	0.046
2,2'-Dichlorobiphenyl	4	13029-08-8	Neutral Organics	Daphnid		ChV	0.054
2,2'-Dichlorobiphenyl	4	13029-08-8	Neutral Organics	Green Algae		ChV	0.296
2,2'-Dichlorobiphenyl	4	13029-08-8	Neutral Organics	Fish (SW)	96-hr	LC50	0.432
2,2'-Dichlorobiphenyl	4	13029-08-8	Neutral Organics	Mysid	96-hr	LC50	0.041
2,2'-Dichlorobiphenyl	4	13029-08-8	Neutral Organics	Fish (SW)		ChV	0.301
2,2'-Dichlorobiphenyl	4	13029-08-8	Neutral Organics	Mysid (SW)		ChV	0.00143
2,2'-Dichlorobiphenyl[b]	4	13029-08-8	Neutral Organics	Earthworm	14-day	LC50	187.428
2,3,3',4,4',5,6-Heptachlorobiphenyl[b]	190	41411-64-7	Neutral Organics	Fish	96-hr	LC50	0.000762
2,3,3',4,4',5,6-Heptachlorobiphenyl[b]	190	41411-64-7	Neutral Organics	Daphnid	48-hr	LC50	0.000772
2,3,3',4,4',5,6-Heptachlorobiphenyl[b]	190	41411-64-7	Neutral Organics	Green Algae	96-hr	EC50	0.006
2,3,3',4,4',5,6-Heptachlorobiphenyl	190	41411-64-7	Neutral Organics	Fish		ChV	0.000147
2,3,3',4,4',5,6-Heptachlorobiphenyl[b]	190	41411-64-7	Neutral Organics	Daphnid		ChV	0.000377
2,3,3',4,4',5,6-Heptachlorobiphenyl[b]	190	41411-64-7	Neutral Organics	Green Algae		ChV	0.006
2,3,3',4,4',5,6-Heptachlorobiphenyl[b]	190	41411-64-7	Neutral Organics	Fish (SW)	96-hr	LC50	0.000996
2,3,3',4,4',5,6-Heptachlorobiphenyl	190	41411-64-7	Neutral Organics	Mysid	96-hr	LC50	1.06E-05
2,3,3',4,4',5,6-Heptachlorobiphenyl[b]	190	41411-64-7	Neutral Organics	Fish (SW)		ChV	0.005
2,3,3',4,4',5,6-Heptachlorobiphenyl	190	41411-64-7	Neutral Organics	Mysid (SW)		ChV	1.43E-07
2,3,3',4,4',5,6-Heptachlorobiphenyl[b]	190	41411-64-7	Neutral Organics	Earthworm	14-day	LC50	153.856
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	Neutral Organics	Fish	96-hr	LC50	0.003
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	Neutral Organics	Daphnid	48-hr	LC50	0.003
2,3,3',4,4',6-Hexachlorobiphenyl[b]	158	74472-42-7	Neutral Organics	Green Algae	96-hr	EC50	0.016
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	Neutral Organics	Fish		ChV	0.000476
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	Neutral Organics	Daphnid		ChV	0.00104
2,3,3',4,4',6-Hexachlorobiphenyl[b]	158	74472-42-7	Neutral Organics	Green Algae		ChV	0.013
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	Neutral Organics	Fish (SW)	96-hr	LC50	0.003
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	Neutral Organics	Mysid	96-hr	LC50	5.65E-05
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	Neutral Organics	Fish (SW)		ChV	0.012
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	Neutral Organics	Mysid (SW)		ChV	9.23E-07
2,3,3',4,4',6-Hexachlorobiphenyl[b]	158	74472-42-7	Neutral Organics	Earthworm	14-day	LC50	163.817
2,3,3',4',5,6-Hexachlorobiphenyl[b]	163	74472-44-9	Neutral Organics	Fish	96-hr	LC50	0.003
2,3,3',4',5,6-Hexachlorobiphenyl[b]	163	74472-44-9	Neutral Organics	Daphnid	48-hr	LC50	0.003
2,3,3',4',5,6-Hexachlorobiphenyl[b]	163	74472-44-9	Neutral Organics	Green Algae	96-hr	EC50	0.016
2,3,3',4',5,6-Hexachlorobiphenyl	163	74472-44-9	Neutral Organics	Fish		ChV	0.000476
2,3,3',4',5,6-Hexachlorobiphenyl	163	74472-44-9	Neutral Organics	Daphnid		ChV	0.00104
2,3,3',4',5,6-Hexachlorobiphenyl[b]	163	74472-44-9	Neutral Organics	Green Algae		ChV	0.013
2,3,3',4',5,6-Hexachlorobiphenyl[b]	163	74472-44-9	Neutral Organics	Fish (SW)	96-hr	LC50	0.003
2,3,3',4',5,6-Hexachlorobiphenyl	163	74472-44-9	Neutral Organics	Mysid	96-hr	LC50	5.65E-05
2,3,3',4',5,6-Hexachlorobiphenyl[b]	163	74472-44-9	Neutral Organics	Fish (SW)		ChV	0.012
2,3,3',4',5,6-Hexachlorobiphenyl	163	74472-44-9	Neutral Organics	Mysid (SW)		ChV	9.23E-07
2,3,3',4',5,6-Hexachlorobiphenyl[b]	163	74472-44-9	Neutral Organics	Earthworm	14-day	LC50	163.817
2,3',4,4'-Tetrachlorobiphenyl	66	32598-10-0	Neutral Organics	Fish	96-hr	LC50	0.031

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
2,3',4,4'-Tetrachlorobiphenyl	66	32598-10-0	Neutral Organics	Daphnid	48-hr	LC50	0.026
2,3',4,4'-Tetrachlorobiphenyl[b]	66	32598-10-0	Neutral Organics	Green Algae	96-hr	EC50	0.101
2,3',4,4'-Tetrachlorobiphenyl	66	32598-10-0	Neutral Organics	Fish		ChV	0.005
2,3',4,4'-Tetrachlorobiphenyl	66	32598-10-0	Neutral Organics	Daphnid		ChV	0.008
2,3',4,4'-Tetrachlorobiphenyl[b]	66	32598-10-0	Neutral Organics	Green Algae		ChV	0.065
2,3',4,4'-Tetrachlorobiphenyl[b]	66	32598-10-0	Neutral Organics	Fish (SW)	96-hr	LC50	0.04
2,3',4,4'-Tetrachlorobiphenyl	66	32598-10-0	Neutral Organics	Mysid	96-hr	LC50	0.00156
2,3',4,4'-Tetrachlorobiphenyl[b]	66	32598-10-0	Neutral Organics	Fish (SW)		ChV	0.061
2,3',4,4'-Tetrachlorobiphenyl	66	32598-10-0	Neutral Organics	Mysid (SW)		ChV	3.74E-05
2,3',4,4'-Tetrachlorobiphenyl[b]	66	32598-10-0	Neutral Organics	Earthworm	14-day	LC50	180.316
2,3,4'-Trichlorobiphenyl	22	38444-85-8	Neutral Organics	Fish	96-hr	LC50	0.103
2,3,4'-Trichlorobiphenyl	22	38444-85-8	Neutral Organics	Daphnid	48-hr	LC50	0.082
2,3,4'-Trichlorobiphenyl[b]	22	38444-85-8	Neutral Organics	Green Algae	96-hr	EC50	0.25
2,3,4'-Trichlorobiphenyl	22	38444-85-8	Neutral Organics	Fish		ChV	0.015
2,3,4'-Trichlorobiphenyl	22	38444-85-8	Neutral Organics	Daphnid		ChV	0.021
2,3,4'-Trichlorobiphenyl[b]	22	38444-85-8	Neutral Organics	Green Algae		ChV	0.14
2,3,4'-Trichlorobiphenyl[b]	22	38444-85-8	Neutral Organics	Fish (SW)	96-hr	LC50	0.132
2,3,4'-Trichlorobiphenyl	22	38444-85-8	Neutral Organics	Mysid	96-hr	LC50	0.008
2,3,4'-Trichlorobiphenyl[b]	22	38444-85-8	Neutral Organics	Fish (SW)		ChV	0.136
2,3,4'-Trichlorobiphenyl	22	38444-85-8	Neutral Organics	Mysid (SW)		ChV	0.000233
2,3,4'-Trichlorobiphenyl[b]	22	38444-85-8	Neutral Organics	Earthworm	14-day	LC50	185.504
2,3,6-Trichlorobiphenyl[b]	24	55702-45-9	Neutral Organics	Fish	96-hr	LC50	0.103
2,3,6-Trichlorobiphenyl	24	55702-45-9	Neutral Organics	Daphnid	48-hr	LC50	0.082
2,3,6-Trichlorobiphenyl[b]	24	55702-45-9	Neutral Organics	Green Algae	96-hr	EC50	0.25
2,3,6-Trichlorobiphenyl	24	55702-45-9	Neutral Organics	Fish		ChV	0.015
2,3,6-Trichlorobiphenyl	24	55702-45-9	Neutral Organics	Daphnid		ChV	0.021
2,3,6-Trichlorobiphenyl	24	55702-45-9	Neutral Organics	Green Algae		ChV	0.14
2,3,6-Trichlorobiphenyl	24	55702-45-9	Neutral Organics	Fish (SW)	96-hr	LC50	0.132
2,3,6-Trichlorobiphenyl	24	55702-45-9	Neutral Organics	Mysid	96-hr	LC50	0.008
2,3,6-Trichlorobiphenyl[b]	24	55702-45-9	Neutral Organics	Fish (SW)		ChV	0.136
2,3,6-Trichlorobiphenyl	24	55702-45-9	Neutral Organics	Mysid (SW)		ChV	0.000233
2,3,6-Trichlorobiphenyl[b]	24	55702-45-9	Neutral Organics	Earthworm	14-day	LC50	185.504
2,3',6-Trichlorobiphenyl[b]	27	38444-76-7	Neutral Organics	Fish	96-hr	LC50	0.103
2,3',6-Trichlorobiphenyl[b]	27	38444-76-7	Neutral Organics	Daphnid	48-hr	LC50	0.082
2,3',6-Trichlorobiphenyl[b]	27	38444-76-7	Neutral Organics	Green Algae	96-hr	EC50	0.25
2,3',6-Trichlorobiphenyl	27	38444-76-7	Neutral Organics	Fish		ChV	0.015
2,3',6-Trichlorobiphenyl	27	38444-76-7	Neutral Organics	Daphnid		ChV	0.021
2,3',6-Trichlorobiphenyl[b]	27	38444-76-7	Neutral Organics	Green Algae		ChV	0.14
2,3',6-Trichlorobiphenyl[b]	27	38444-76-7	Neutral Organics	Fish (SW)	96-hr	LC50	0.132
2,3',6-Trichlorobiphenyl	27	38444-76-7	Neutral Organics	Mysid	96-hr	LC50	0.008
2,3',6-Trichlorobiphenyl[b]	27	38444-76-7	Neutral Organics	Fish (SW)		ChV	0.136
2,3',6-Trichlorobiphenyl	27	38444-76-7	Neutral Organics	Mysid (SW)		ChV	0.000233
2,3',6-Trichlorobiphenyl[b]	27	38444-76-7	Neutral Organics	Earthworm	14-day	LC50	185.504
2,3-Dichlorobiphenyl	5	16605-91-7	Neutral Organics	Fish	96-hr	LC50	0.337
2,3-Dichlorobiphenyl	5	16605-91-7	Neutral Organics	Daphnid	48-hr	LC50	0.253
2,3-Dichlorobiphenyl	5	16605-91-7	Neutral Organics	Green Algae	96-hr	EC50	0.604
2,3-Dichlorobiphenyl	5	16605-91-7	Neutral Organics	Fish		ChV	0.046
2,3-Dichlorobiphenyl	5	16605-91-7	Neutral Organics	Daphnid		ChV	0.054
2,3-Dichlorobiphenyl	5	16605-91-7	Neutral Organics	Green Algae		ChV	0.296
2,3-Dichlorobiphenyl	5	16605-91-7	Neutral Organics	Fish (SW)	96-hr	LC50	0.432
2,3-Dichlorobiphenyl	5	16605-91-7	Neutral Organics	Mysid	96-hr	LC50	0.041
2,3-Dichlorobiphenyl	5	16605-91-7	Neutral Organics	Fish (SW)		ChV	0.301
2,3-Dichlorobiphenyl	5	16605-91-7	Neutral Organics	Mysid (SW)		ChV	0.00143
2,3-Dichlorobiphenyl	5	16605-91-7	Neutral Organics	Earthworm	14-day	LC50	187.428
2,4',5-Trichlorobiphenyl[b]	31	16606-02-3	Neutral Organics	Fish	96-hr	LC50	0.103
2,4',5-Trichlorobiphenyl	31	16606-02-3	Neutral Organics	Daphnid	48-hr	LC50	0.082
2,4',5-Trichlorobiphenyl[b]	31	16606-02-3	Neutral Organics	Green Algae	96-hr	EC50	0.25
2,4',5-Trichlorobiphenyl	31	16606-02-3	Neutral Organics	Fish		ChV	0.015

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
2,4',5-Trichlorobiphenyl	31	16606-02-3	Neutral Organics	Daphnid		ChV	0.021
2,4',5-Trichlorobiphenyl	31	16606-02-3	Neutral Organics	Green Algae		ChV	0.14
2,4',5-Trichlorobiphenyl	31	16606-02-3	Neutral Organics	Fish (SW)	96-hr	LC50	0.132
2,4',5-Trichlorobiphenyl	31	16606-02-3	Neutral Organics	Mysid	96-hr	LC50	0.008
2,4',5-Trichlorobiphenyl	31	16606-02-3	Neutral Organics	Fish (SW)		ChV	0.136
2,4',5-Trichlorobiphenyl	31	16606-02-3	Neutral Organics	Mysid (SW)		ChV	0.000233
2,4',5-Trichlorobiphenyl[b]	31	16606-02-3	Neutral Organics	Earthworm	14-day	LC50	185.504
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	Phenols	Fish	96-hr	LC50	0.021
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	Phenols	Daphnid	48-hr	LC50	0.045
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	Phenols	Green Algae	96-hr	EC50	0.134
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	Phenols	Fish		ChV	0.004
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	Phenols	Daphnid		ChV	0.008
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	Phenols	Green Algae		ChV	0.059
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	Phenols	Fish (SW)	96-hr	LC50	0.004
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	Phenols	Earthworm	14-day	LC50	3.903
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	Phenols	Lemna gibba	7-day	EC50	0.005
2,4'-Dichlorobiphenyl	8	34883-43-7	Neutral Organics	Fish	96-hr	LC50	0.337
2,4'-Dichlorobiphenyl	8	34883-43-7	Neutral Organics	Daphnid	48-hr	LC50	0.253
2,4'-Dichlorobiphenyl	8	34883-43-7	Neutral Organics	Green Algae	96-hr	EC50	0.604
2,4'-Dichlorobiphenyl	8	34883-43-7	Neutral Organics	Fish		ChV	0.046
2,4'-Dichlorobiphenyl	8	34883-43-7	Neutral Organics	Daphnid		ChV	0.054
2,4'-Dichlorobiphenyl	8	34883-43-7	Neutral Organics	Green Algae		ChV	0.296
2,4'-Dichlorobiphenyl	8	34883-43-7	Neutral Organics	Fish (SW)	96-hr	LC50	0.432
2,4'-Dichlorobiphenyl	8	34883-43-7	Neutral Organics	Mysid	96-hr	LC50	0.041
2,4'-Dichlorobiphenyl	8	34883-43-7	Neutral Organics	Fish (SW)		ChV	0.301
2,4'-Dichlorobiphenyl	8	34883-43-7	Neutral Organics	Mysid (SW)		ChV	0.00143
2,4'-Dichlorobiphenyl	8	34883-43-7	Neutral Organics	Earthworm	14-day	LC50	187.428
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	Phenols	Fish	96-hr	LC50	0.105
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	Phenols	Daphnid	48-hr	LC50	0.14
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	Phenols	Green Algae	96-hr	EC50	0.465
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	Phenols	Fish		ChV	0.017
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	Phenols	Daphnid		ChV	0.026
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	Phenols	Green Algae		ChV	0.209
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	Phenols	Fish (SW)	96-hr	LC50	0.026
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	Phenols	Earthworm	14-day	LC50	8.321
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	Phenols	Lemna gibba	7-day	EC50	0.033
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	Phenols	Fish	96-hr	LC50	0.021
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	Phenols	Daphnid	48-hr	LC50	0.044
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	Phenols	Green Algae	96-hr	EC50	0.133
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	Phenols	Fish		ChV	0.004
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	Phenols	Daphnid		ChV	0.008
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	Phenols	Green Algae		ChV	0.059
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	Phenols	Fish (SW)	96-hr	LC50	0.004
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	Phenols	Earthworm	14-day	LC50	3.749
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	Phenols	Lemna gibba	7-day	EC50	0.005
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	Phenols	Fish	96-hr	LC50	0.105
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	Phenols	Daphnid	48-hr	LC50	0.14
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	Phenols	Green Algae	96-hr	EC50	0.465
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	Phenols	Fish		ChV	0.017
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	Phenols	Daphnid		ChV	0.026
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	Phenols	Green Algae		ChV	0.209
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	Phenols	Fish (SW)	96-hr	LC50	0.026
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	Phenols	Earthworm	14-day	LC50	8.321
2,5-Di-tert-butylphenol (2,5-DTBP)[b]	NA	5875-45-6	Phenols	Lemna gibba	7-day	EC50	0.033
2,6-Dichlorobiphenyl	10	33146-45-1	Neutral Organics	Fish	96-hr	LC50	0.337
2,6-Dichlorobiphenyl	10	33146-45-1	Neutral Organics	Daphnid	48-hr	LC50	0.253
2,6-Dichlorobiphenyl	10	33146-45-1	Neutral Organics	Green Algae	96-hr	EC50	0.604
2,6-Dichlorobiphenyl	10	33146-45-1	Neutral Organics	Fish		ChV	0.046
2,6-Dichlorobiphenyl	10	33146-45-1	Neutral Organics	Daphnid		ChV	0.054
2,6-Dichlorobiphenyl	10	33146-45-1	Neutral Organics	Green Algae		ChV	0.296

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Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
2,6-Dichlorobiphenyl	10	33146-45-1	Neutral Organics	Fish (SW)	96-hr	LC50	0.432
2,6-Dichlorobiphenyl	10	33146-45-1	Neutral Organics	Mysid	96-hr	LC50	0.041
2,6-Dichlorobiphenyl	10	33146-45-1	Neutral Organics	Fish (SW)		ChV	0.301
2,6-Dichlorobiphenyl	10	33146-45-1	Neutral Organics	Mysid (SW)		ChV	0.00143
2,6-Dichlorobiphenyl	10	33146-45-1	Neutral Organics	Earthworm	14-day	LC50	187.428
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters	Fish	96-hr	LC50	6.277
2-Butoxy-, hydrogen phosphate ethanol[b]	NA	14260-97-0	Esters	Daphnid	48-hr	LC50	10.937
2-Butoxy-, hydrogen phosphate ethanol[b]	NA	14260-97-0	Esters	Green Algae	96-hr	EC50	3.585
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters	Fish		ChV	0.334
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters	Daphnid		ChV	4.655
2-Butoxy-, hydrogen phosphate ethanol[b]	NA	14260-97-0	Esters	Green Algae		ChV	1.569
2-Butoxy-, hydrogen phosphate ethanol[b]	NA	14260-97-0	Esters	Fish (SW)	96-hr	LC50	8.632
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters	Mysid	96-hr	LC50	3.768
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters	Fish (SW)		ChV	1.665
2-Butoxy-, hydrogen phosphate ethanol[b]	NA	14260-97-0	Esters	Mysid (SW)		ChV	9.635
2-Butoxy-, hydrogen phosphate ethanol[b]	NA	14260-97-0	Esters	Earthworm	14-day	LC50	1652.378
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters (phosphate)	Fish	96-hr	LC50	2.474
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters (phosphate)	Daphnid	48-hr	LC50	0.004
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters (phosphate)	Green Algae	96-hr	EC50	89.715
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters (phosphate)	Fish		ChV	0.012
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters (phosphate)	Green Algae		ChV	19.413
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters (phosphate)	Fish (SW)	96-hr	LC50	1.387
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.01
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters (phosphate)	Fish (SW)		ChV	0.055
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	Esters (phosphate)	Mysid (SW)		ChV	9.60E-05
2-Chlorobiphenyl	1	2051-60-7	Neutral Organics	Fish	96-hr	LC50	1.08
2-Chlorobiphenyl	1	2051-60-7	Neutral Organics	Daphnid	48-hr	LC50	0.766
2-Chlorobiphenyl	1	2051-60-7	Neutral Organics	Green Algae	96-hr	EC50	1.426
2-Chlorobiphenyl	1	2051-60-7	Neutral Organics	Fish		ChV	0.137
2-Chlorobiphenyl	1	2051-60-7	Neutral Organics	Daphnid		ChV	0.138
2-Chlorobiphenyl	1	2051-60-7	Neutral Organics	Green Algae		ChV	0.612
2-Chlorobiphenyl	1	2051-60-7	Neutral Organics	Fish (SW)	96-hr	LC50	1.38
2-Chlorobiphenyl	1	2051-60-7	Neutral Organics	Mysid	96-hr	LC50	0.202
2-Chlorobiphenyl	1	2051-60-7	Neutral Organics	Fish (SW)		ChV	0.649
2-Chlorobiphenyl	1	2051-60-7	Neutral Organics	Mysid (SW)		ChV	0.009
2-Chlorobiphenyl[b]	1	2051-60-7	Neutral Organics	Earthworm	14-day	LC50	184.859
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters	Fish	96-hr	LC50	0.15
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters	Daphnid	48-hr	LC50	0.197
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters	Green Algae	96-hr	EC50	0.042
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters	Fish		ChV	0.005
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters	Daphnid		ChV	0.039
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters	Green Algae		ChV	0.044
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters	Fish (SW)	96-hr	LC50	0.175
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters	Mysid	96-hr	LC50	0.021
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters	Fish (SW)		ChV	0.054
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters	Mysid (SW)		ChV	0.00024
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters	Earthworm	14-day	LC50	194.499
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters (phosphate)	Fish	96-hr	LC50	0.246
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters (phosphate)	Daphnid	48-hr	LC50	0.000335
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters (phosphate)	Green Algae	96-hr	EC50	0.052
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters (phosphate)	Fish		ChV	0.005
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters (phosphate)	Green Algae		ChV	0.401
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters (phosphate)	Fish (SW)	96-hr	LC50	0.312
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.00176
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	Esters (phosphate)	Fish (SW)		ChV	0.008
2-Ethylhexyl diphenyl phosphate[b]	NA	1241-94-7	Esters (phosphate)	Mysid (SW)		ChV	9.86E-06
3,4,4'-Trichlorobiphenyl[b]	37	38444-90-5	Neutral Organics	Fish	96-hr	LC50	0.103
3,4,4'-Trichlorobiphenyl	37	38444-90-5	Neutral Organics	Daphnid	48-hr	LC50	0.082
3,4,4'-Trichlorobiphenyl[b]	37	38444-90-5	Neutral Organics	Green Algae	96-hr	EC50	0.25

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
3,4,4'-Trichlorobiphenyl	37	38444-90-5	Neutral Organics	Fish		ChV	0.015
3,4,4'-Trichlorobiphenyl	37	38444-90-5	Neutral Organics	Daphnid		ChV	0.021
3,4,4'-Trichlorobiphenyl[b]	37	38444-90-5	Neutral Organics	Green Algae		ChV	0.14
3,4,4'-Trichlorobiphenyl	37	38444-90-5	Neutral Organics	Fish (SW)	96-hr	LC50	0.132
3,4,4'-Trichlorobiphenyl	37	38444-90-5	Neutral Organics	Mysid	96-hr	LC50	0.008
3,4,4'-Trichlorobiphenyl[b]	37	38444-90-5	Neutral Organics	Fish (SW)		ChV	0.136
3,4,4'-Trichlorobiphenyl	37	38444-90-5	Neutral Organics	Mysid (SW)		ChV	0.000233
3,4,4'-Trichlorobiphenyl[b]	37	38444-90-5	Neutral Organics	Earthworm	14-day	LC50	185.504
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Esters	Fish	96-hr	LC50	0.00125
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Esters	Daphnid	48-hr	LC50	0.0011
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Esters	Green Algae	96-hr	EC50	0.000132
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	NA	4221-80-1	Esters	Fish		ChV	1.75E-05
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	NA	4221-80-1	Esters	Daphnid		ChV	7.53E-05
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Esters	Green Algae		ChV	0.000454
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Esters	Fish (SW)	96-hr	LC50	0.00116
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Esters	Mysid	96-hr	LC50	2.21E-05
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	NA	4221-80-1	Esters	Fish (SW)		ChV	0.000703
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	NA	4221-80-1	Esters	Mysid (SW)		ChV	1.35E-10
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Esters	Earthworm	14-day	LC50	15.055
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Phenols	Fish	96-hr	LC50	6.31E-05
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Phenols	Daphnid	48-hr	LC50	0.00067
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Phenols	Green Algae	96-hr	EC50	0.00142
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Phenols	Fish		ChV	2.06E-05
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Phenols	Daphnid		ChV	0.000126
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Phenols	Green Algae		ChV	0.000601
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	NA	4221-80-1	Phenols	Fish (SW)	96-hr	LC50	6.51E-06
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid[b]	NA	4221-80-1	Phenols	Earthworm	14-day	LC50	0.218
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	NA	4221-80-1	Phenols	Lemna gibba	7-day	EC50	6.17E-06
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	Phenols	Fish	96-hr	LC50	0.02
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	Phenols	Daphnid	48-hr	LC50	0.042
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	Phenols	Green Algae	96-hr	EC50	0.127
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	Phenols	Fish		ChV	0.004
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	Phenols	Daphnid		ChV	0.008
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	Phenols	Green Algae		ChV	0.056
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	Phenols	Fish (SW)	96-hr	LC50	0.004
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	Phenols	Earthworm	14-day	LC50	3.767
4-(Butan-2-yl)-2,6-di-tert-butylphenol[b]	NA	17540-75-9	Phenols	Lemna gibba	7-day	EC50	0.005
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol[b]	NA	1843-03-4	Phenols, Poly	Fish	96-hr	LC50	1.24E-05

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol[b]	NA	1843-03-4	Phenols, Poly	Daphnid	48-hr	LC50	1.38E-06
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol[b]	NA	1843-03-4	Phenols, Poly	Green Algae	96-hr	EC50	0.003
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol[b]	NA	1843-03-4	Phenols, Poly	Fish		ChV	1.34E-06
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol[b]	NA	1843-03-4	Phenols, Poly	Daphnid		ChV	2.71E-07
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol[b]	NA	1843-03-4	Phenols, Poly	Green Algae		ChV	0.00179
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)[b]	NA	118-82-1	Phenols, Poly	Fish	96-hr	LC50	0.00155
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)[b]	NA	118-82-1	Phenols, Poly	Daphnid	48-hr	LC50	0.000755
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)[b]	NA	118-82-1	Phenols, Poly	Green Algae	96-hr	EC50	0.038
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)[b]	NA	118-82-1	Phenols, Poly	Fish		ChV	0.000295
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)[b]	NA	118-82-1	Phenols, Poly	Daphnid		ChV	0.000185
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)[b]	NA	118-82-1	Phenols, Poly	Green Algae		ChV	0.014
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)[b]	NA	118-82-1	Phenols, Poly	Fish	96-hr	LC50	0.000183
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)[b]	NA	118-82-1	Phenols, Poly	Daphnid	48-hr	LC50	0.000198
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)[b]	NA	118-82-1	Phenols, Poly	Green Algae	96-hr	EC50	0.002
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)	NA	118-82-1	Phenols, Poly	Fish		ChV	3.83E-05
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)	NA	118-82-1	Phenols, Poly	Daphnid		ChV	0.000116
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)[b]	NA	118-82-1	Phenols, Poly	Green Algae		ChV	0.002
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)[b]	NA	96-69-5	Phenols, Poly	Fish	96-hr	LC50	0.004
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)[b]	NA	96-69-5	Phenols, Poly	Daphnid	48-hr	LC50	0.002
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)[b]	NA	96-69-5	Phenols, Poly	Green Algae	96-hr	EC50	0.058
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)	NA	96-69-5	Phenols, Poly	Fish		ChV	0.00078
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)	NA	96-69-5	Phenols, Poly	Daphnid		ChV	0.000615
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)[b]	NA	96-69-5	Phenols, Poly	Green Algae		ChV	0.02
4-Chlorobiphenyl	3	2051-62-9	Neutral Organics	Fish	96-hr	LC50	1.08
4-Chlorobiphenyl	3	2051-62-9	Neutral Organics	Daphnid	48-hr	LC50	0.766
4-Chlorobiphenyl	3	2051-62-9	Neutral Organics	Green Algae	96-hr	EC50	1.426
4-Chlorobiphenyl	3	2051-62-9	Neutral Organics	Fish		ChV	0.137
4-Chlorobiphenyl	3	2051-62-9	Neutral Organics	Daphnid		ChV	0.138
4-Chlorobiphenyl	3	2051-62-9	Neutral Organics	Green Algae		ChV	0.612
4-Chlorobiphenyl	3	2051-62-9	Neutral Organics	Fish (SW)	96-hr	LC50	1.38
4-Chlorobiphenyl	3	2051-62-9	Neutral Organics	Mysid	96-hr	LC50	0.202
4-Chlorobiphenyl	3	2051-62-9	Neutral Organics	Fish (SW)		ChV	0.649
4-Chlorobiphenyl	3	2051-62-9	Neutral Organics	Mysid (SW)		ChV	0.009
4-Chlorobiphenyl[b]	3	2051-62-9	Neutral Organics	Earthworm	14-day	LC50	184.859
6:2 Fluorotelomer sulfonic acid[b]	NA	27619-97-2	Neutral Organics-acid	Fish	96-hr	LC50	900.811
6:2 Fluorotelomer sulfonic acid[b]	NA	27619-97-2	Neutral Organics-acid	Daphnid	48-hr	LC50	543.56
6:2 Fluorotelomer sulfonic acid[b]	NA	27619-97-2	Neutral Organics-acid	Green Algae	96-hr	EC50	520.667
6:2 Fluorotelomer sulfonic acid[b]	NA	27619-97-2	Neutral Organics-acid	Fish		ChV	94.6
6:2 Fluorotelomer sulfonic acid[b]	NA	27619-97-2	Neutral Organics-acid	Daphnid		ChV	62.785
6:2 Fluorotelomer sulfonic acid[b]	NA	27619-97-2	Neutral Organics-acid	Green Algae		ChV	156.128
6:2 Fluorotelomer sulfonic acid[b]	NA	27619-97-2	Neutral Organics-acid	Fish (SW)	96-hr	LC50	1138.535
6:2 Fluorotelomer sulfonic acid[b]	NA	27619-97-2	Neutral Organics-acid	Mysid	96-hr	LC50	541.573
6:2 Fluorotelomer sulfonic acid[b]	NA	27619-97-2	Neutral Organics-acid	Fish (SW)		ChV	184.771
6:2 Fluorotelomer sulfonic acid[b]	NA	27619-97-2	Neutral Organics-acid	Mysid (SW)		ChV	38.511
6:2 Fluorotelomer sulfonic acid[b]	NA	27619-97-2	Neutral Organics-acid	Earthworm	14-day	LC50	6360.704
8:2 Fluorotelomer sulfonic acid	NA	39108-34-4	Neutral Organics-acid	Fish	96-hr	LC50	69.818
8:2 Fluorotelomer sulfonic acid[b]	NA	39108-34-4	Neutral Organics-acid	Daphnid	48-hr	LC50	47.67
8:2 Fluorotelomer sulfonic acid[b]	NA	39108-34-4	Neutral Organics-acid	Green Algae	96-hr	EC50	76.108
8:2 Fluorotelomer sulfonic acid[b]	NA	39108-34-4	Neutral Organics-acid	Fish		ChV	8.482
8:2 Fluorotelomer sulfonic acid[b]	NA	39108-34-4	Neutral Organics-acid	Daphnid		ChV	7.766
8:2 Fluorotelomer sulfonic acid[b]	NA	39108-34-4	Neutral Organics-acid	Green Algae		ChV	30.051
8:2 Fluorotelomer sulfonic acid[b]	NA	39108-34-4	Neutral Organics-acid	Fish (SW)	96-hr	LC50	88.953
8:2 Fluorotelomer sulfonic acid[b]	NA	39108-34-4	Neutral Organics-acid	Mysid	96-hr	LC50	17.091

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
8:2 Fluorotelomer sulfonic acid[b]	NA	39108-34-4	Neutral Organics-acid	Fish (SW)		ChV	32.684
8:2 Fluorotelomer sulfonic acid[b]	NA	39108-34-4	Neutral Organics-acid	Mysid (SW)		ChV	0.817
Ammelide	NA	645-93-2	Aliphatic Amines	Fish	96-hr	LC50	3192.474
Ammelide	NA	645-93-2	Aliphatic Amines	Daphnid	48-hr	LC50	261.821
Ammelide	NA	645-93-2	Aliphatic Amines	Green Algae	96-hr	EC50	452.702
Ammelide	NA	645-93-2	Aliphatic Amines	Fish		ChV	581.053
Ammelide	NA	645-93-2	Aliphatic Amines	Daphnid		ChV	14.951
Ammelide	NA	645-93-2	Aliphatic Amines	Green Algae		ChV	114.773
Ammelide	NA	645-93-2	Triazines, Aromatic	Fish	96-hr	LC50	37829.289
Ammelide	NA	645-93-2	Triazines, Aromatic	Daphnid	48-hr	LC50	2680.09
Ammelide	NA	645-93-2	Triazines, Aromatic	Green Algae	96-hr	EC50	2.91
Ammelide	NA	645-93-2	Triazines, Aromatic	Fish		ChV	831.762
Ammelide	NA	645-93-2	Triazines, Aromatic	Daphnid		ChV	140.511
Ammelide	NA	645-93-2	Triazines, Aromatic	Green Algae		ChV	0.568
Ammelide	NA	645-93-2	Triazines, Aromatic	Fish (SW)	96-hr	LC50	7546.853
Ammelide	NA	645-93-2	Triazines, Aromatic	Mysid (SW)	96-hr	LC50	1222.794
Ammelide	NA	645-93-2	Triazines, Aromatic	Fish (SW)		ChV	91.971
Ammelide	NA	645-93-2	Triazines, Aromatic	Mysid (SW)		ChV	39508.148
Ammeline	NA	645-92-1	Aliphatic Amines	Fish	96-hr	LC50	1.25E+05
Ammeline	NA	645-92-1	Aliphatic Amines	Daphnid	48-hr	LC50	7.75E+03
Ammeline	NA	645-92-1	Aliphatic Amines	Green Algae	96-hr	EC50	2.34E+04
Ammeline	NA	645-92-1	Aliphatic Amines	Fish		ChV	5.40E+04
Ammeline	NA	645-92-1	Aliphatic Amines	Daphnid		ChV	3.36E+02
Ammeline	NA	645-92-1	Aliphatic Amines	Green Algae		ChV	4.85E+03
Ammeline	NA	645-92-1	Triazines, Aromatic	Fish	96-hr	LC50	4.62E+06
Ammeline	NA	645-92-1	Triazines, Aromatic	Daphnid	48-hr	LC50	7.52E+04
Ammeline	NA	645-92-1	Triazines, Aromatic	Green Algae	96-hr	EC50	3.48E+01
Ammeline	NA	645-92-1	Triazines, Aromatic	Fish		ChV	9.00E+04
Ammeline	NA	645-92-1	Triazines, Aromatic	Daphnid		ChV	4.59E+03
Ammeline	NA	645-92-1	Triazines, Aromatic	Green Algae		ChV	3.31E+00
Ammeline	NA	645-92-1	Triazines, Aromatic	Fish (SW)	96-hr	LC50	3.72E+05
Ammeline	NA	645-92-1	Triazines, Aromatic	Mysid (SW)	96-hr	LC50	6.42E+04
Ammeline	NA	645-92-1	Triazines, Aromatic	Fish (SW)		ChV	1.48E+03
Ammeline	NA	645-92-1	Triazines, Aromatic	Mysid (SW)		ChV	3.97E+07
Amoxicillin	NA	26787-78-0	Aliphatic Amines-acid	Fish	96-hr	LC50	3316.052
Amoxicillin	NA	26787-78-0	Aliphatic Amines-acid	Daphnid	48-hr	LC50	350.823
Amoxicillin	NA	26787-78-0	Aliphatic Amines-acid	Green Algae	96-hr	EC50	366.544
Amoxicillin	NA	26787-78-0	Aliphatic Amines-acid	Fish		ChV	277.769
Amoxicillin	NA	26787-78-0	Aliphatic Amines-acid	Daphnid		ChV	25.662
Amoxicillin	NA	26787-78-0	Aliphatic Amines-acid	Green Algae		ChV	111.651
Amoxicillin	NA	26787-78-0	Phenols-acid	Fish	96-hr	LC50	3825.984
Amoxicillin	NA	26787-78-0	Phenols-acid	Daphnid	48-hr	LC50	729.352
Amoxicillin	NA	26787-78-0	Phenols-acid	Green Algae	96-hr	EC50	3706.393
Amoxicillin	NA	26787-78-0	Phenols-acid	Fish		ChV	332.326
Amoxicillin	NA	26787-78-0	Phenols-acid	Daphnid		ChV	138.981
Amoxicillin	NA	26787-78-0	Phenols-acid	Green Algae		ChV	1763.992
Amoxicillin	NA	26787-78-0	Phenols-acid	Fish (SW)	96-hr	LC50	2081.878
Amoxicillin[b]	NA	26787-78-0	Phenols-acid	Earthworm	14-day	LC50	8922.189
Amoxicillin	NA	26787-78-0	Phenols-acid	Lemna gibba	7-day	EC50	3530.973
Amoxicillin[b]	NA	26787-78-0	Amides -acid	Fish	96-hr	LC50	5916.368
Amoxicillin[b]	NA	26787-78-0	Amides -acid	Daphnid	48-hr	LC50	10452.924
Amoxicillin	NA	26787-78-0	Amides -acid	Green Algae	96-hr	EC50	149.101
Amoxicillin	NA	26787-78-0	Amides -acid	Fish		ChV	5.51
Amoxicillin	NA	26787-78-0	Amides -acid	Daphnid		ChV	297.762
Amoxicillin	NA	26787-78-0	Amides -acid	Green Algae		ChV	90.833
Amoxicillin[b]	NA	26787-78-0	Amides -acid	Fish (SW)	96-hr	LC50	5171.768
Amoxicillin	NA	26787-78-0	Amides -acid	Mysid (SW)	96-hr	LC50	236.604
Amoxicillin	NA	26787-78-0	Phenol Amines -acid	Fish	96-hr	LC50	370.208
Amoxicillin	NA	26787-78-0	Phenol Amines -acid	Daphnid	48-hr	LC50	28.89
Amoxicillin	NA	26787-78-0	Phenol Amines -acid	Green Algae	96-hr	EC50	157.124

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
Amoxicillin	NA	26787-78-0	Phenol Amines -acid	Fish		ChV	26.014
Amoxicillin	NA	26787-78-0	Phenol Amines -acid	Daphnid		ChV	13.678
Amoxicillin	NA	26787-78-0	Phenol Amines -acid	Green Algae		ChV	24.702
Ampicillin	NA	69-53-4	Aliphatic Amines-acid	Fish	96-hr	LC50	1533.506
Ampicillin	NA	69-53-4	Aliphatic Amines-acid	Daphnid	48-hr	LC50	171.555
Ampicillin	NA	69-53-4	Aliphatic Amines-acid	Green Algae	96-hr	EC50	160.497
Ampicillin	NA	69-53-4	Aliphatic Amines-acid	Fish		ChV	108.354
Ampicillin	NA	69-53-4	Aliphatic Amines-acid	Daphnid		ChV	13.249
Ampicillin	NA	69-53-4	Aliphatic Amines-acid	Green Algae		ChV	50.896
Ampicillin	NA	69-53-4	Amides -acid	Fish	96-hr	LC50	2565.781
Ampicillin	NA	69-53-4	Amides -acid	Daphnid	48-hr	LC50	3633.408
Ampicillin	NA	69-53-4	Amides -acid	Green Algae	96-hr	EC50	71.72
Ampicillin	NA	69-53-4	Amides -acid	Fish		ChV	3.179
Ampicillin	NA	69-53-4	Amides -acid	Daphnid		ChV	142.108
Ampicillin	NA	69-53-4	Amides -acid	Green Algae		ChV	53.503
Ampicillin	NA	69-53-4	Amides -acid	Fish (SW)	96-hr	LC50	2253.805
Ampicillin	NA	69-53-4	Amides -acid	Mysid (SW)	96-hr	LC50	119.974
Bis(2-chloroethyl) phosphate	NA	3040-56-0	Neutral Organics	Fish	96-hr	LC50	2048.446
Bis(2-chloroethyl) phosphate	NA	3040-56-0	Neutral Organics	Daphnid	48-hr	LC50	1044.258
Bis(2-chloroethyl) phosphate	NA	3040-56-0	Neutral Organics	Green Algae	96-hr	EC50	498.123
Bis(2-chloroethyl) phosphate	NA	3040-56-0	Neutral Organics	Fish		ChV	176.32
Bis(2-chloroethyl) phosphate	NA	3040-56-0	Neutral Organics	Daphnid		ChV	75.442
Bis(2-chloroethyl) phosphate	NA	3040-56-0	Neutral Organics	Green Algae		ChV	102.607
Bis(2-chloroethyl) phosphate	NA	3040-56-0	Neutral Organics	Fish (SW)	96-hr	LC50	2560.879
Bis(2-chloroethyl) phosphate	NA	3040-56-0	Neutral Organics	Mysid	96-hr	LC50	4197.276
Bis(2-chloroethyl) phosphate	NA	3040-56-0	Neutral Organics	Fish (SW)		ChV	136.26
Bis(2-chloroethyl) phosphate	NA	3040-56-0	Neutral Organics	Mysid (SW)		ChV	512.773
Bis(2-chloroethyl) phosphate	NA	3040-56-0	Neutral Organics	Earthworm	14-day	LC50	512.345
Bis(2-ethylhexyl) phosphate	NA	298-07-7	Neutral Organics	Fish	96-hr	LC50	0.058
Bis(2-ethylhexyl) phosphate	NA	298-07-7	Neutral Organics	Daphnid	48-hr	LC50	0.048
Bis(2-ethylhexyl) phosphate	NA	298-07-7	Neutral Organics	Green Algae	96-hr	EC50	0.17
Bis(2-ethylhexyl) phosphate	NA	298-07-7	Neutral Organics	Fish		ChV	0.009
Bis(2-ethylhexyl) phosphate	NA	298-07-7	Neutral Organics	Daphnid		ChV	0.013
Bis(2-ethylhexyl) phosphate	NA	298-07-7	Neutral Organics	Green Algae		ChV	0.103
Bis(2-ethylhexyl) phosphate	NA	298-07-7	Neutral Organics	Fish (SW)	96-hr	LC50	0.075
Bis(2-ethylhexyl) phosphate	NA	298-07-7	Neutral Organics	Mysid	96-hr	LC50	0.004
Bis(2-ethylhexyl) phosphate	NA	298-07-7	Neutral Organics	Fish (SW)		ChV	0.098
Bis(2-ethylhexyl) phosphate	NA	298-07-7	Neutral Organics	Mysid (SW)		ChV	9.20E-05
Bis(2-ethylhexyl) phosphate[b]	NA	298-07-7	Neutral Organics	Earthworm		ChV	2.12E+02
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	Neutral Organics	Fish	96-hr	LC50	3.875
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	Neutral Organics	Daphnid	48-hr	LC50	2.639
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	Neutral Organics	Green Algae	96-hr	EC50	4.174
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	Neutral Organics	Fish		ChV	0.469
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	Neutral Organics	Daphnid		ChV	0.427
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	Neutral Organics	Green Algae		ChV	1.639
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	Neutral Organics	Fish (SW)	96-hr	LC50	4.936
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	Neutral Organics	Mysid	96-hr	LC50	0.965
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	Neutral Organics	Fish (SW)		ChV	1.786
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	Neutral Organics	Mysid (SW)		ChV	0.046
Bis(2-methylphenyl) hydrogen phosphate[b]	NA	35787-74-7	Neutral Organics	Earthworm	14-day	LC50	302.11
Cresyl diphenyl phosphate (CDPP)[b]	NA	26444-49-5	Esters	Fish	96-hr	LC50	0.577
Cresyl diphenyl phosphate (CDPP)[b]	NA	26444-49-5	Esters	Daphnid	48-hr	LC50	0.847
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters	Green Algae	96-hr	EC50	0.216
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters	Fish		ChV	0.022
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters	Daphnid		ChV	0.228
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters	Green Algae		ChV	0.159
Cresyl diphenyl phosphate (CDPP)[b]	NA	26444-49-5	Esters	Fish (SW)	96-hr	LC50	0.719
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters	Mysid	96-hr	LC50	0.143
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters	Fish (SW)		ChV	0.185
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters	Mysid (SW)		ChV	0.014

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
Cresyl diphenyl phosphate (CDPP)[b]	NA	26444-49-5	Esters	Earthworm	14-day	LC50	398.073
Cresyl diphenyl phosphate (CDPP)[b]	NA	26444-49-5	Esters (phosphate)	Fish	96-hr	LC50	0.538
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters (phosphate)	Daphnid	48-hr	LC50	0.00079
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters (phosphate)	Green Algae	96-hr	EC50	0.869
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters (phosphate)	Fish		ChV	0.006
Cresyl diphenyl phosphate (CDPP)[b]	NA	26444-49-5	Esters (phosphate)	Green Algae		ChV	1.635
Cresyl diphenyl phosphate (CDPP)[b]	NA	26444-49-5	Esters (phosphate)	Fish (SW)	96-hr	LC50	0.494
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.003
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters (phosphate)	Fish (SW)		ChV	0.015
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	Esters (phosphate)	Mysid (SW)		ChV	2.13E-05
Cyanuric acid	NA	108-80-5	Neutral Organics	Fish	96-hr	LC50	0.000218
Cyanuric acid	NA	108-80-5	Neutral Organics	Daphnid	48-hr	LC50	0.000235
Cyanuric acid[b]	NA	108-80-5	Neutral Organics	Green Algae	96-hr	EC50	0.002
Cyanuric acid	NA	108-80-5	Neutral Organics	Fish		ChV	4.53E-05
Cyanuric acid	NA	108-80-5	Neutral Organics	Daphnid		ChV	0.000135
Cyanuric acid[b]	NA	108-80-5	Neutral Organics	Green Algae		ChV	0.003
Cyanuric acid[b]	NA	108-80-5	Neutral Organics	Fish (SW)	96-hr	LC50	0.000287
Cyanuric acid	NA	108-80-5	Neutral Organics	Mysid	96-hr	LC50	1.97E-06
Cyanuric acid[b]	NA	108-80-5	Neutral Organics	Fish (SW)		ChV	0.002
Cyanuric acid	NA	108-80-5	Neutral Organics	Mysid (SW)		ChV	2.20E-08
Cyanuric acid[b]	NA	108-80-5	Neutral Organics	Earthworm	14-day	LC50	143.404
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Fish	96-hr	LC50	1.76E-05
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Daphnid	48-hr	LC50	2.13E-05
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Green Algae	96-hr	EC50	0.000364
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Fish		ChV	4.21E-06
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Daphnid		ChV	1.71E-05
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Green Algae		ChV	0.000515
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Fish (SW)	96-hr	LC50	2.33E-05
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Mysid	96-hr	LC50	6.69E-08
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Fish (SW)		ChV	0.000379
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Mysid (SW)		ChV	5.09E-10
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Earthworm	14-day	LC50	122.309
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Fish	96-hr	LC50	1.76E-05
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Daphnid	48-hr	LC50	2.13E-05
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Green Algae	96-hr	EC50	0.000364
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Fish		ChV	4.21E-06
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Daphnid		ChV	1.71E-05
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Green Algae		ChV	0.000515
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Fish (SW)	96-hr	LC50	2.33E-05
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Mysid	96-hr	LC50	6.69E-08
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Fish (SW)		ChV	0.000379
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Mysid (SW)		ChV	5.09E-10
Decachlorobiphenyl[b]	NA	2051-24-3	Neutral Organics	Earthworm	14-day	LC50	122.309
Dibutyl ester phosphoric acid	NA	107-66-4	Neutral Organics	Fish	96-hr	LC50	95.016
Dibutyl ester phosphoric acid	NA	107-66-4	Neutral Organics	Daphnid	48-hr	LC50	55.409
Dibutyl ester phosphoric acid	NA	107-66-4	Neutral Organics	Green Algae	96-hr	EC50	46.087
Dibutyl ester phosphoric acid	NA	107-66-4	Neutral Organics	Fish		ChV	9.584
Dibutyl ester phosphoric acid	NA	107-66-4	Neutral Organics	Daphnid		ChV	5.82
Dibutyl ester phosphoric acid	NA	107-66-4	Neutral Organics	Green Algae		ChV	12.808
Dibutyl ester phosphoric acid	NA	107-66-4	Neutral Organics	Fish (SW)	96-hr	LC50	119.825
Dibutyl ester phosphoric acid	NA	107-66-4	Neutral Organics	Mysid	96-hr	LC50	73.224
Dibutyl ester phosphoric acid	NA	107-66-4	Neutral Organics	Fish (SW)		ChV	15.515
Dibutyl ester phosphoric acid	NA	107-66-4	Neutral Organics	Mysid (SW)		ChV	5.81
Dibutyl ester phosphoric acid	NA	107-66-4	Neutral Organics	Earthworm	14-day	LC50	341.114
Dichlorobiphenyl	NA	25512-42-9	Neutral Organics	Fish	96-hr	LC50	0.337
Dichlorobiphenyl	NA	25512-42-9	Neutral Organics	Daphnid	48-hr	LC50	0.253
Dichlorobiphenyl	NA	25512-42-9	Neutral Organics	Green Algae	96-hr	EC50	0.604
Dichlorobiphenyl	NA	25512-42-9	Neutral Organics	Fish		ChV	0.046

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
Dichlorobiphenyl	NA	25512-42-9	Neutral Organics	Daphnid		ChV	0.054
Dichlorobiphenyl	NA	25512-42-9	Neutral Organics	Green Algae		ChV	0.296
Dichlorobiphenyl	NA	25512-42-9	Neutral Organics	Fish (SW)	96-hr	LC50	0.432
Dichlorobiphenyl	NA	25512-42-9	Neutral Organics	Mysid	96-hr	LC50	0.041
Dichlorobiphenyl	NA	25512-42-9	Neutral Organics	Fish (SW)		ChV	0.301
Dichlorobiphenyl	NA	25512-42-9	Neutral Organics	Mysid (SW)		ChV	0.00143
Dichlorobiphenyl[b]	NA	25512-42-9	Neutral Organics	Earthworm	14-day	LC50	187.428
Diethyl hydrogen phosphate	NA	598-02-7	Neutral Organics	Fish	96-hr	LC50	4047.436
Diethyl hydrogen phosphate	NA	598-02-7	Neutral Organics	Daphnid	48-hr	LC50	1968.758
Diethyl hydrogen phosphate	NA	598-02-7	Neutral Organics	Green Algae	96-hr	EC50	773.561
Diethyl hydrogen phosphate	NA	598-02-7	Neutral Organics	Fish		ChV	329.632
Diethyl hydrogen phosphate	NA	598-02-7	Neutral Organics	Daphnid		ChV	124.826
Diethyl hydrogen phosphate	NA	598-02-7	Neutral Organics	Green Algae		ChV	143.54
Diethyl hydrogen phosphate	NA	598-02-7	Neutral Organics	Fish (SW)	96-hr	LC50	5044.564
Diethyl hydrogen phosphate	NA	598-02-7	Neutral Organics	Mysid	96-hr	LC50	11664.221
Diethyl hydrogen phosphate	NA	598-02-7	Neutral Organics	Fish (SW)		ChV	196.825
Diethyl hydrogen phosphate	NA	598-02-7	Neutral Organics	Mysid (SW)		ChV	1656.504
Diethyl hydrogen phosphate[b]	NA	598-02-7	Neutral Organics	Earthworm	14-day	LC50	399.726
Diisobutyl hydrogen phosphate	NA	6303-30-6	Neutral Organics	Fish	96-hr	LC50	128.771
Diisobutyl hydrogen phosphate	NA	6303-30-6	Neutral Organics	Daphnid	48-hr	LC50	74.081
Diisobutyl hydrogen phosphate	NA	6303-30-6	Neutral Organics	Green Algae	96-hr	EC50	58.255
Diisobutyl hydrogen phosphate	NA	6303-30-6	Neutral Organics	Fish		ChV	12.783
Diisobutyl hydrogen phosphate	NA	6303-30-6	Neutral Organics	Daphnid		ChV	7.493
Diisobutyl hydrogen phosphate	NA	6303-30-6	Neutral Organics	Green Algae		ChV	15.707
Diisobutyl hydrogen phosphate	NA	6303-30-6	Neutral Organics	Fish (SW)	96-hr	LC50	162.251
Diisobutyl hydrogen phosphate	NA	6303-30-6	Neutral Organics	Mysid	96-hr	LC50	109.532
Diisobutyl hydrogen phosphate	NA	6303-30-6	Neutral Organics	Fish (SW)		ChV	19.205
Diisobutyl hydrogen phosphate	NA	6303-30-6	Neutral Organics	Mysid (SW)		ChV	9.078
Diisobutyl hydrogen phosphate	NA	6303-30-6	Neutral Organics	Earthworm	14-day	LC50	353.299
Diphenyl phosphate (DPHP)	NA	838-85-7	Neutral Organics	Fish	96-hr	LC50	33.508
Diphenyl phosphate (DPHP)	NA	838-85-7	Neutral Organics	Daphnid	48-hr	LC50	20.631
Diphenyl phosphate (DPHP)	NA	838-85-7	Neutral Organics	Green Algae	96-hr	EC50	21.481
Diphenyl phosphate (DPHP)	NA	838-85-7	Neutral Organics	Fish		ChV	3.604
Diphenyl phosphate (DPHP)	NA	838-85-7	Neutral Organics	Daphnid		ChV	2.521
Diphenyl phosphate (DPHP)	NA	838-85-7	Neutral Organics	Green Algae		ChV	6.737
Diphenyl phosphate (DPHP)	NA	838-85-7	Neutral Organics	Fish (SW)	96-hr	LC50	42.406
Diphenyl phosphate (DPHP)	NA	838-85-7	Neutral Organics	Mysid	96-hr	LC50	17.398
Diphenyl phosphate (DPHP)	NA	838-85-7	Neutral Organics	Fish (SW)		ChV	7.864
Diphenyl phosphate (DPHP)	NA	838-85-7	Neutral Organics	Mysid (SW)		ChV	1.16
Diphenyl phosphate (DPHP)	NA	838-85-7	Neutral Organics	Earthworm	14-day	LC50	352.792
Dipropyl ester phosphoric acid	NA	1804-93-9	Neutral Organics	Fish	96-hr	LC50	627.626
Dipropyl ester phosphoric acid	NA	1804-93-9	Neutral Organics	Daphnid	48-hr	LC50	334.272
Dipropyl ester phosphoric acid	NA	1804-93-9	Neutral Organics	Green Algae	96-hr	EC50	191.096
Dipropyl ester phosphoric acid	NA	1804-93-9	Neutral Organics	Fish		ChV	56.886
Dipropyl ester phosphoric acid	NA	1804-93-9	Neutral Organics	Daphnid		ChV	56.886
Dipropyl ester phosphoric acid	NA	1804-93-9	Neutral Organics	Green Algae		ChV	43.395
Dipropyl ester phosphoric acid	NA	1804-93-9	Neutral Organics	Fish (SW)	96-hr	LC50	786.862
Dipropyl ester phosphoric acid	NA	1804-93-9	Neutral Organics	Mysid	96-hr	LC50	935.335
Dipropyl ester phosphoric acid	NA	1804-93-9	Neutral Organics	Fish (SW)		ChV	55.929
Dipropyl ester phosphoric acid	NA	1804-93-9	Neutral Organics	Mysid (SW)		ChV	99.288
Dipropyl ester phosphoric acid		1804-93-9	Neutral Organics	Earthworm	14-day	LC50	373.718
Heptachlorobiphenyl	NA	28655-71-2	Neutral Organics	Fish	96-hr	LC50	0.000762
Heptachlorobiphenyl	NA	28655-71-2	Neutral Organics	Daphnid	48-hr	LC50	0.000772
Heptachlorobiphenyl	NA	28655-71-2	Neutral Organics	Green Algae	96-hr	EC50	0.006
Heptachlorobiphenyl	NA	28655-71-2	Neutral Organics	Fish		ChV	0.000147
Heptachlorobiphenyl	NA	28655-71-2	Neutral Organics	Daphnid		ChV	0.000377
Heptachlorobiphenyl	NA	28655-71-2	Neutral Organics	Green Algae		ChV	0.006
Heptachlorobiphenyl	NA	28655-71-2	Neutral Organics	Fish (SW)	96-hr	LC50	0.000996
Heptachlorobiphenyl	NA	28655-71-2	Neutral Organics	Mysid	96-hr	LC50	1.06E-05
Heptachlorobiphenyl	NA	28655-71-2	Neutral Organics	Fish (SW)		ChV	0.005

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
Heptachlorobiphenyl	NA	28655-71-2	Neutral Organics	Mysid (SW)		ChV	1.43E-07
Heptachlorobiphenyl	NA	28655-71-2	Neutral Organics	Earthworm	14-day	LC50	153.856
Hexachlorobiphenyl[b]	NA	26601-64-9	Neutral Organics	Fish	96-hr	LC50	0.003
Hexachlorobiphenyl[b]	NA	26601-64-9	Neutral Organics	Daphnid	48-hr	LC50	0.003
Hexachlorobiphenyl[b]	NA	26601-64-9	Neutral Organics	Green Algae	96-hr	EC50	0.016
Hexachlorobiphenyl	NA	26601-64-9	Neutral Organics	Fish		ChV	0.000476
Hexachlorobiphenyl[b]	NA	26601-64-9	Neutral Organics	Daphnid		ChV	0.00104
Hexachlorobiphenyl[b]	NA	26601-64-9	Neutral Organics	Green Algae		ChV	0.013
Hexachlorobiphenyl[b]	NA	26601-64-9	Neutral Organics	Fish (SW)	96-hr	LC50	0.003
Hexachlorobiphenyl	NA	26601-64-9	Neutral Organics	Mysid	96-hr	LC50	5.65E-05
Hexachlorobiphenyl[b]	NA	26601-64-9	Neutral Organics	Fish (SW)		ChV	0.012
Hexachlorobiphenyl	NA	26601-64-9	Neutral Organics	Mysid (SW)		ChV	9.23E-07
Hexachlorobiphenyl[b]	NA	26601-64-9	Neutral Organics	Earthworm	14-day	LC50	163.817
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters	Fish	96-hr	LC50	0.043
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters	Daphnid	48-hr	LC50	0.051
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters	Green Algae	96-hr	EC50	0.009
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters	Fish		ChV	0.00107
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters	Daphnid		ChV	0.008
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters	Green Algae		ChV	0.013
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters	Fish (SW)	96-hr	LC50	0.047
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters	Mysid	96-hr	LC50	0.003
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters	Fish (SW)		ChV	0.018
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters	Mysid (SW)		ChV	5.41E-06
Isodecyl diphenyl phosphate (IDDP)[b]	NA	29761-21-5	Esters	Earthworm	14-day	LC50	101.074
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters (phosphate)	Fish	96-hr	LC50	0.12
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters (phosphate)	Daphnid	48-hr	LC50	0.000152
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters (phosphate)	Green Algae	96-hr	EC50	0.004
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters (phosphate)	Fish		ChV	0.004
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters (phosphate)	Green Algae		ChV	0.109
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters (phosphate)	Fish (SW)	96-hr	LC50	0.207
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.00108
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters (phosphate)	Fish (SW)		ChV	0.005
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	Esters (phosphate)	Mysid (SW)		ChV	4.86E-06
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Fish	96-hr	LC50	2680.134
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Daphnid	48-hr	LC50	6.226
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Green Algae	96-hr	EC50	2.785
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Fish		ChV	263.18
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Daphnid		ChV	0.078
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Green Algae		ChV	0.697
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Fish	96-hr	LC50	390.883
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Daphnid	48-hr	LC50	144.341
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Green Algae	96-hr	EC50	325.036
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Fish		ChV	1102.257
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Daphnid		ChV	14.845
Melamine	NA	108-78-1	ilines (amino-meta); melamin	Green Algae		ChV	81.258
Monochlorobiphenyl	NA	27323-18-8	Neutral Organics	Fish	96-hr	LC50	1.08
Monochlorobiphenyl	NA	27323-18-8	Neutral Organics	Daphnid	48-hr	LC50	0.766
Monochlorobiphenyl	NA	27323-18-8	Neutral Organics	Green Algae	96-hr	EC50	1.426
Monochlorobiphenyl	NA	27323-18-8	Neutral Organics	Fish		ChV	0.137
Monochlorobiphenyl	NA	27323-18-8	Neutral Organics	Daphnid		ChV	0.138
Monochlorobiphenyl	NA	27323-18-8	Neutral Organics	Green Algae		ChV	0.612
Monochlorobiphenyl	NA	27323-18-8	Neutral Organics	Fish (SW)	96-hr	LC50	1.38
Monochlorobiphenyl	NA	27323-18-8	Neutral Organics	Mysid	96-hr	LC50	0.202
Monochlorobiphenyl	NA	27323-18-8	Neutral Organics	Fish (SW)		ChV	0.649
Monochlorobiphenyl	NA	27323-18-8	Neutral Organics	Mysid (SW)		ChV	0.009
Monochlorobiphenyl[b]	NA	27323-18-8	Neutral Organics	Earthworm	14-day	LC50	184.859
Nalidixic acid	NA	389-08-2	Vinyl/Allyl Ketones-acid	Fish	96-hr	LC50	4420.071
Nalidixic acid	NA	389-08-2	Vinyl/Allyl Ketones-acid	Daphnid	48-hr	LC50	3285.149
Nalidixic acid	NA	389-08-2	Vinyl/Allyl Ketones-acid	Green Algae	96-hr	EC50	1804.829

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
Nalidixic acid	NA	389-08-2	Vinyl/Allyl Ketones-acid	Fish		ChV	1538.409
Nalidixic acid	NA	389-08-2	Vinyl/Allyl Ketones-acid	Daphnid		ChV	465.658
Nalidixic acid	NA	389-08-2	Vinyl/Allyl Ketones-acid	Green Algae		ChV	499.939
Nalidixic acid	NA	389-08-2	Vinyl/Allyl Ketones-acid	Fish (SW)	96-hr	LC50	78675.867
Nalidixic acid	NA	389-08-2	Vinyl/Allyl Ketones-acid	Mysid (SW)	96-hr	LC50	2745.547
Nalidixic acid	NA	389-08-2	Vinyl/Allyl Ketones-acid	Fish (SW)		ChV	12245.601
Nalidixic acid	NA	389-08-2	Vinyl/Allyl Ketones-acid	Mysid (SW)		ChV	422.439
Nonachlorobiphenyl[b]	NA	53742-07-7	Neutral Organics	Fish	96-hr	LC50	6.22E-05
Nonachlorobiphenyl[b]	NA	53742-07-7	Neutral Organics	Daphnid	48-hr	LC50	7.10E-05
Nonachlorobiphenyl[b]	NA	53742-07-7	Neutral Organics	Green Algae	96-hr	EC50	0.000947
Nonachlorobiphenyl	NA	53742-07-7	Neutral Organics	Fish		ChV	1.39E-05
Nonachlorobiphenyl[b]	NA	53742-07-7	Neutral Organics	Daphnid		ChV	4.83E-05
Nonachlorobiphenyl[b]	NA	53742-07-7	Neutral Organics	Green Algae		ChV	0.00117
Nonachlorobiphenyl[b]	NA	53742-07-7	Neutral Organics	Fish (SW)	96-hr	LC50	8.20E-05
Nonachlorobiphenyl	NA	53742-07-7	Neutral Organics	Mysid	96-hr	LC50	3.64E-07
Nonachlorobiphenyl[b]	NA	53742-07-7	Neutral Organics	Fish (SW)		ChV	0.000898
Nonachlorobiphenyl	NA	53742-07-7	Neutral Organics	Mysid (SW)		ChV	3.35E-09
Nonachlorobiphenyl[b]	NA	53742-07-7	Neutral Organics	Earthworm	14-day	LC50	132.803
Octachlorobiphenyl	NA	55722-26-4	Neutral Organics	Fish	96-hr	LC50	0.000218
Octachlorobiphenyl	NA	55722-26-4	Neutral Organics	Daphnid	48-hr	LC50	0.000235
Octachlorobiphenyl[b]	NA	55722-26-4	Neutral Organics	Green Algae	96-hr	EC50	0.002
Octachlorobiphenyl	NA	55722-26-4	Neutral Organics	Fish		ChV	4.53E-05
Octachlorobiphenyl	NA	55722-26-4	Neutral Organics	Daphnid		ChV	0.000135
Octachlorobiphenyl[b]	NA	55722-26-4	Neutral Organics	Green Algae		ChV	0.003
Octachlorobiphenyl[b]	NA	55722-26-4	Neutral Organics	Fish (SW)	96-hr	LC50	0.000287
Octachlorobiphenyl	NA	55722-26-4	Neutral Organics	Mysid	96-hr	LC50	1.97E-06
Octachlorobiphenyl[b]	NA	55722-26-4	Neutral Organics	Fish (SW)		ChV	0.002
Octachlorobiphenyl	NA	55722-26-4	Neutral Organics	Mysid (SW)		ChV	2.20E-08
Octachlorobiphenyl[b]	NA	55722-26-4	Neutral Organics	Earthworm	14-day	LC50	143.404
Pentachlorobiphenyl	NA	25429-29-2	Neutral Organics	Fish	96-hr	LC50	0.009
Pentachlorobiphenyl	NA	25429-29-2	Neutral Organics	Daphnid	48-hr	LC50	0.008
Pentachlorobiphenyl[b]	NA	25429-29-2	Neutral Organics	Green Algae	96-hr	EC50	0.041
Pentachlorobiphenyl	NA	25429-29-2	Neutral Organics	Fish		ChV	0.00152
Pentachlorobiphenyl	NA	25429-29-2	Neutral Organics	Daphnid		ChV	0.003
Pentachlorobiphenyl[b]	NA	25429-29-2	Neutral Organics	Green Algae		ChV	0.03
Pentachlorobiphenyl	NA	25429-29-2	Neutral Organics	Fish (SW)	96-hr	LC50	0.012
Pentachlorobiphenyl	NA	25429-29-2	Neutral Organics	Mysid	96-hr	LC50	0.000299
Pentachlorobiphenyl[b]	NA	25429-29-2	Neutral Organics	Fish (SW)		ChV	0.027
Pentachlorobiphenyl	NA	25429-29-2	Neutral Organics	Mysid (SW)		ChV	5.91E-06
Pentachlorobiphenyl[b]	NA	25429-29-2	Neutral Organics	Earthworm	14-day	LC50	172.833
Perfluorobutanesulfonic acid (PFBS)[b]	NA	375-73-5	Neutral Organics-acid	Fish	96-hr	LC50	3597.024
Perfluorobutanesulfonic acid (PFBS)[b]	NA	375-73-5	Neutral Organics-acid	Daphnid	48-hr	LC50	2008.247
Perfluorobutanesulfonic acid (PFBS)[b]	NA	375-73-5	Neutral Organics-acid	Green Algae	96-hr	EC50	1395.165
Perfluorobutanesulfonic acid (PFBS)[b]	NA	375-73-5	Neutral Organics-acid	Fish		ChV	344.669
Perfluorobutanesulfonic acid (PFBS)	NA	375-73-5	Neutral Organics-acid	Daphnid		ChV	186.865
Perfluorobutanesulfonic acid (PFBS)[b]	NA	375-73-5	Neutral Organics-acid	Green Algae		ChV	351.893
Perfluorobutanesulfonic acid (PFBS)[b]	NA	375-73-5	Neutral Organics-acid	Fish (SW)	96-hr	LC50	4523.436
Perfluorobutanesulfonic acid (PFBS)[b]	NA	375-73-5	Neutral Organics-acid	Mysid	96-hr	LC50	3804.685
Perfluorobutanesulfonic acid (PFBS)[b]	NA	375-73-5	Neutral Organics-acid	Fish (SW)		ChV	439.153
Perfluorobutanesulfonic acid (PFBS)[b]	NA	375-73-5	Neutral Organics-acid	Mysid (SW)		ChV	347.162
Perfluorobutanesulfonic acid (PFBS)[b]	NA	375-73-5	Neutral Organics-acid	Earthworm	14-day	LC50	5450.125
Perfluorotridecanoic acid (PFTrDA)	NA	72629-94-8	Neutral Organics-acid	Fish	96-hr	LC50	0.016
Perfluorotridecanoic acid (PFTrDA)[b]	NA	72629-94-8	Neutral Organics-acid	Daphnid	48-hr	LC50	0.016
Perfluorotridecanoic acid (PFTrDA)[b]	NA	72629-94-8	Neutral Organics-acid	Green Algae	96-hr	EC50	0.126
Perfluorotridecanoic acid (PFTrDA)[b]	NA	72629-94-8	Neutral Organics-acid	Fish		ChV	0.003
Perfluorotridecanoic acid (PFTrDA)[b]	NA	72629-94-8	Neutral Organics-acid	Daphnid		ChV	0.008
Perfluorotridecanoic acid (PFTrDA)[b]	NA	72629-94-8	Neutral Organics-acid	Green Algae		ChV	0.117
Perfluorotridecanoic acid (PFTrDA)[b]	NA	72629-94-8	Neutral Organics-acid	Fish (SW)	96-hr	LC50	0.021

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
Perfluorotridecanoic acid (PFTrDA)[b]	NA	72629-94-8	Neutral Organics-acid	Mysid	96-hr	LC50	0.00024
Perfluorotridecanoic acid (PFTrDA)[b]	NA	72629-94-8	Neutral Organics-acid	Fish (SW)		ChV	0.098
Perfluorotridecanoic acid (PFTrDA)	NA	72629-94-8	Neutral Organics-acid	Mysid (SW)		ChV	3.34E-06
Perfluorotridecanoic acid (PFTrDA)[b]	NA	72629-94-8	Neutral Organics-acid	Earthworm	14-day	LC50	2652.713
Polychlorinated biphenyl (PCB)	NA	1336-36-3	Neutral Organics	Fish	96-hr	LC50	0.031
Polychlorinated biphenyl (PCB)	NA	1336-36-3	Neutral Organics	Daphnid	48-hr	LC50	0.026
Polychlorinated biphenyl (PCB)	NA	1336-36-3	Neutral Organics	Green Algae	96-hr	EC50	0.101
Polychlorinated biphenyl (PCB)	NA	1336-36-3	Neutral Organics	Fish		ChV	0.005
Polychlorinated biphenyl (PCB)	NA	1336-36-3	Neutral Organics	Daphnid		ChV	0.008
Polychlorinated biphenyl (PCB)	NA	1336-36-3	Neutral Organics	Green Algae		ChV	0.065
Polychlorinated biphenyl (PCB)	NA	1336-36-3	Neutral Organics	Fish (SW)	96-hr	LC50	0.04
Polychlorinated biphenyl (PCB)	NA	1336-36-3	Neutral Organics	Mysid	96-hr	LC50	0.00156
Polychlorinated biphenyl (PCB)	NA	1336-36-3	Neutral Organics	Fish (SW)		ChV	0.061
Polychlorinated biphenyl (PCB)	NA	1336-36-3	Neutral Organics	Mysid (SW)		ChV	3.74E-05
Polychlorinated biphenyl (PCB)[b]	NA	1336-36-3	Neutral Organics	Earthworm	14-day	LC50	180.316
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters	Fish	96-hr	LC50	0.053
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters	Daphnid	48-hr	LC50	0.062
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters	Green Algae	96-hr	EC50	0.011
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters	Fish		ChV	0.00129
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters	Daphnid		ChV	0.009
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters	Green Algae		ChV	0.017
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters	Fish (SW)	96-hr	LC50	0.058
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters	Mysid	96-hr	LC50	0.004
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters	Fish (SW)		ChV	0.022
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters	Mysid (SW)		ChV	4.79E-06
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters	Earthworm	14-day	LC50	135.164
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters (phosphate)	Fish	96-hr	LC50	0.159
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters (phosphate)	Daphnid	48-hr	LC50	0.0002
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters (phosphate)	Green Algae	96-hr	EC50	0.004
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters (phosphate)	Fish		ChV	0.005
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters (phosphate)	Green Algae		ChV	0.134
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters (phosphate)	Fish (SW)	96-hr	LC50	0.285
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.00148
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	Esters (phosphate)	Fish (SW)		ChV	0.006
Sulfate	NA	14808-79-8	Inorganic Compound	Fish	96-hr	LC50	4.77E+05
Sulfate	NA	14808-79-8	Inorganic Compound	Daphnid	48-hr	LC50	1.84E+05
Sulfate	NA	14808-79-8	Inorganic Compound	Green Algae	96-hr	EC50	27531.549
Sulfate	NA	14808-79-8	Inorganic Compound	Fish		ChV	29497.303
Sulfate	NA	14808-79-8	Inorganic Compound	Daphnid		ChV	6088.096
Sulfate	NA	14808-79-8	Inorganic Compound	Green Algae		ChV	3039.855
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters	Fish	96-hr	LC50	0.104
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters	Daphnid	48-hr	LC50	0.132
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters	Green Algae	96-hr	EC50	0.027
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters	Fish		ChV	0.003
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters	Daphnid		ChV	0.024
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters	Green Algae		ChV	0.031
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters	Fish (SW)	96-hr	LC50	0.119
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters	Mysid	96-hr	LC50	0.012
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters	Fish (SW)		ChV	0.039
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters	Mysid (SW)		ChV	7.39E-05
Tert-butylphenyl diphenyl phosphate[b]	NA	56803-37-3	Esters	Earthworm	14-day	LC50	162.713
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters (phosphate)	Fish	96-hr	LC50	0.201
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters (phosphate)	Daphnid	48-hr	LC50	0.000269
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters (phosphate)	Green Algae	96-hr	EC50	0.023
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters (phosphate)	Fish		ChV	0.005
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters (phosphate)	Green Algae		ChV	0.273
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters (phosphate)	Fish (SW)	96-hr	LC50	0.282
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.00156
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters (phosphate)	Fish (SW)		ChV	0.007
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	Esters (phosphate)	Mysid (SW)		ChV	8.10E-06

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Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
Tetrabutyl ethylidenebisphenol (AO22E46)[b]	NA	35958-30-6	Phenols, Poly	Fish	96-hr	LC50	0.00133
Tetrabutyl ethylidenebisphenol (AO22E46)[b]	NA	35958-30-6	Phenols, Poly	Daphnid	48-hr	LC50	0.000615
Tetrabutyl ethylidenebisphenol (AO22E46)[b]	NA	35958-30-6	Phenols, Poly	Green Algae	96-hr	EC50	0.036
Tetrabutyl ethylidenebisphenol (AO22E46)[b]	NA	35958-30-6	Phenols, Poly	Fish		ChV	0.000248
Tetrabutyl ethylidenebisphenol (AO22E46)[b]	NA	35958-30-6	Phenols, Poly	Daphnid		ChV	0.000149
Tetrabutyl ethylidenebisphenol (AO22E46)[b]	NA	35958-30-6	Phenols, Poly	Green Algae		ChV	0.014
Tetrachlorobiphenyl[b]	NA	26914-33-0	Neutral Organics	Fish	96-hr	LC50	0.031
Tetrachlorobiphenyl[b]	NA	26914-33-0	Neutral Organics	Daphnid	48-hr	LC50	0.026
Tetrachlorobiphenyl[b]	NA	26914-33-0	Neutral Organics	Green Algae	96-hr	EC50	0.101
Tetrachlorobiphenyl	NA	26914-33-0	Neutral Organics	Fish		ChV	0.005
Tetrachlorobiphenyl	NA	26914-33-0	Neutral Organics	Daphnid		ChV	0.008
Tetrachlorobiphenyl[b]	NA	26914-33-0	Neutral Organics	Green Algae		ChV	0.065
Tetrachlorobiphenyl[b]	NA	26914-33-0	Neutral Organics	Fish (SW)	96-hr	LC50	0.04
Tetrachlorobiphenyl	NA	26914-33-0	Neutral Organics	Mysid	96-hr	LC50	0.00156
Tetrachlorobiphenyl[b]	NA	26914-33-0	Neutral Organics	Fish (SW)		ChV	0.061
Tetrachlorobiphenyl	NA	26914-33-0	Neutral Organics	Mysid (SW)		ChV	3.74E-05
Tetrachlorobiphenyl[b]	NA	26914-33-0	Neutral Organics	Earthworm	14-day	LC50	180.316
Tributyl phosphate	NA	126-73-8	Esters	Fish	96-hr	LC50	3.088
Tributyl phosphate	NA	126-73-8	Esters	Daphnid	48-hr	LC50	5.283
Tributyl phosphate	NA	126-73-8	Esters	Green Algae	96-hr	EC50	1.686
Tributyl phosphate	NA	126-73-8	Esters	Fish		ChV	0.159
Tributyl phosphate	NA	126-73-8	Esters	Daphnid		ChV	2.141
Tributyl phosphate	NA	126-73-8	Esters	Green Algae		ChV	0.78
Tributyl phosphate	NA	126-73-8	Esters	Fish (SW)	96-hr	LC50	4.202
Tributyl phosphate	NA	126-73-8	Esters	Mysid	96-hr	LC50	1.687
Tributyl phosphate	NA	126-73-8	Esters	Fish (SW)		ChV	0.836
Tributyl phosphate	NA	126-73-8	Esters	Mysid (SW)		ChV	3.052
Tributyl phosphate[b]	NA	126-73-8	Esters	Earthworm	14-day	LC50	900.295
Tributyl phosphate	NA	126-73-8	Esters (phosphate)	Fish	96-hr	LC50	1.333
Tributyl phosphate	NA	126-73-8	Esters (phosphate)	Daphnid	48-hr	LC50	0.002
Tributyl phosphate	NA	126-73-8	Esters (phosphate)	Green Algae	96-hr	EC50	34.75
Tributyl phosphate	NA	126-73-8	Esters (phosphate)	Fish		ChV	0.007
Tributyl phosphate	NA	126-73-8	Esters (phosphate)	Green Algae		ChV	9.461
Tributyl phosphate	NA	126-73-8	Esters (phosphate)	Fish (SW)	96-hr	LC50	0.788
Tributyl phosphate	NA	126-73-8	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.005
Tributyl phosphate	NA	126-73-8	Esters (phosphate)	Fish (SW)		ChV	0.031
Tributyl phosphate	NA	126-73-8	Esters (phosphate)	Mysid (SW)		ChV	5.19E-05
Trichlorobiphenyl	NA	25323-68-6	Neutral Organics	Fish	96-hr	LC50	0.103
Trichlorobiphenyl	NA	25323-68-6	Neutral Organics	Daphnid	48-hr	LC50	0.082
Trichlorobiphenyl	NA	25323-68-6	Neutral Organics	Green Algae	96-hr	EC50	0.25
Trichlorobiphenyl	NA	25323-68-6	Neutral Organics	Fish		ChV	0.015
Trichlorobiphenyl	NA	25323-68-6	Neutral Organics	Daphnid		ChV	0.021
Trichlorobiphenyl	NA	25323-68-6	Neutral Organics	Green Algae		ChV	0.14
Trichlorobiphenyl	NA	25323-68-6	Neutral Organics	Fish (SW)	96-hr	LC50	0.132
Trichlorobiphenyl	NA	25323-68-6	Neutral Organics	Mysid	96-hr	LC50	0.008
Trichlorobiphenyl	NA	25323-68-6	Neutral Organics	Fish (SW)		ChV	0.136
Trichlorobiphenyl	NA	25323-68-6	Neutral Organics	Mysid (SW)		ChV	2.33E-04
Trichlorobiphenyl[b]	NA	25323-68-6	Neutral Organics	Earthworm	14-day	LC50	185.504
Triethyl phosphate (TEP)	NA	78-40-0	Esters	Fish	96-hr	LC50	111.039
Triethyl phosphate (TEP)	NA	78-40-0	Esters	Daphnid	48-hr	LC50	260.46
Triethyl phosphate (TEP)	NA	78-40-0	Esters	Green Algae	96-hr	EC50	132.547
Triethyl phosphate (TEP)	NA	78-40-0	Esters	Fish		ChV	10.585
Triethyl phosphate (TEP)	NA	78-40-0	Esters	Daphnid		ChV	246.358
Triethyl phosphate (TEP)	NA	78-40-0	Esters	Green Algae		ChV	23.555
Triethyl phosphate (TEP)	NA	78-40-0	Esters	Fish (SW)	96-hr	LC50	181.004
Triethyl phosphate (TEP)	NA	78-40-0	Esters	Mysid	96-hr	LC50	310.416
Triethyl phosphate (TEP)	NA	78-40-0	Esters	Fish (SW)		ChV	21.177
Triethyl phosphate (TEP)	NA	78-40-0	Esters	Mysid (SW)		ChV	2.28E+05
Triethyl phosphate (TEP)	NA	78-40-0	Esters	Earthworm	14-day	LC50	5487.976

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
Triethyl phosphate (TEP)	NA	78-40-0	Esters (phosphate)	Fish	96-hr	LC50	9.829
Triethyl phosphate (TEP)	NA	78-40-0	Esters (phosphate)	Daphnid	48-hr	LC50	0.02
Triethyl phosphate (TEP)	NA	78-40-0	Esters (phosphate)	Green Algae	96-hr	EC50	78973.203
Triethyl phosphate (TEP)	NA	78-40-0	Esters (phosphate)	Fish		ChV	0.012
Triethyl phosphate (TEP)	NA	78-40-0	Esters (phosphate)	Green Algae		ChV	399.591
Triethyl phosphate (TEP)	NA	78-40-0	Esters (phosphate)	Fish (SW)	96-hr	LC50	2.333
Triethyl phosphate (TEP)	NA	78-40-0	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.02
Triethyl phosphate (TEP)	NA	78-40-0	Esters (phosphate)	Fish (SW)		ChV	0.148
Triethyl phosphate (TEP)	NA	78-40-0	Esters (phosphate)	Mysid (SW)		ChV	0.000368
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Esters	Fish	96-hr	LC50	0.019
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Esters	Daphnid	48-hr	LC50	0.02
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Esters	Green Algae	96-hr	EC50	0.003
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Esters	Fish		ChV	0.00038
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Esters	Daphnid		ChV	0.002
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Esters	Green Algae		ChV	0.006
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Esters	Fish (SW)	96-hr	LC50	0.019
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Esters	Mysid	96-hr	LC50	0.000894
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Esters	Fish (SW)		ChV	0.008
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)	NA	36443-68-2	Esters	Mysid (SW)		ChV	2.11E-07
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Esters	Earthworm	14-day	LC50	76.301
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Phenols, Poly	Fish	96-hr	LC50	0.006
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Phenols, Poly	Daphnid	48-hr	LC50	0.004
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Phenols, Poly	Green Algae	96-hr	EC50	0.098
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Phenols, Poly	Fish		ChV	0.00135
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Phenols, Poly	Daphnid		ChV	0.00108
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[b]	NA	36443-68-2	Phenols, Poly	Green Algae		ChV	0.033
Triisobutyl phosphate	NA	126-71-6	Esters	Fish	96-hr	LC50	0.15
Triisobutyl phosphate	NA	126-71-6	Esters	Daphnid	48-hr	LC50	0.197
Triisobutyl phosphate	NA	126-71-6	Esters	Green Algae	96-hr	EC50	0.042
Triisobutyl phosphate	NA	126-71-6	Esters	Fish		ChV	0.005
Triisobutyl phosphate	NA	126-71-6	Esters	Daphnid		ChV	0.039
Triisobutyl phosphate	NA	126-71-6	Esters	Green Algae		ChV	0.044
Triisobutyl phosphate	NA	126-71-6	Esters	Fish (SW)	96-hr	LC50	0.175
Triisobutyl phosphate	NA	126-71-6	Esters	Mysid	96-hr	LC50	0.021
Triisobutyl phosphate	NA	126-71-6	Esters	Fish (SW)		ChV	0.054
Triisobutyl phosphate	NA	126-71-6	Esters	Mysid (SW)		ChV	0.00024
Triisobutyl phosphate[b]	NA	126-71-6	Esters	Earthworm	14-day	LC50	194.499
Triisobutyl phosphate	NA	126-71-6	Esters (phosphate)	Fish	96-hr	LC50	0.246
Triisobutyl phosphate	NA	126-71-6	Esters (phosphate)	Daphnid	48-hr	LC50	0.000335
Triisobutyl phosphate	NA	126-71-6	Esters (phosphate)	Green Algae	96-hr	EC50	0.052
Triisobutyl phosphate	NA	126-71-6	Esters (phosphate)	Fish		ChV	0.005
Triisobutyl phosphate	NA	126-71-6	Esters (phosphate)	Green Algae		ChV	0.401
Triisobutyl phosphate	NA	126-71-6	Esters (phosphate)	Fish (SW)	96-hr	LC50	0.312

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
Triisobutyl phosphate	NA	126-71-6	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.00176
Triisobutyl phosphate	NA	126-71-6	Esters (phosphate)	Fish (SW)		ChV	0.008
Triisobutyl phosphate	NA	126-71-6	Esters (phosphate)	Mysid (SW)		ChV	9.86E-06
Trimethyl phosphate (TMP)	NA	512-56-1	Esters	Fish	96-hr	LC50	619.156
Trimethyl phosphate (TMP)	NA	512-56-1	Esters	Daphnid	48-hr	LC50	1700.493
Trimethyl phosphate (TMP)	NA	512-56-1	Esters	Green Algae	96-hr	EC50	1092.861
Trimethyl phosphate (TMP)	NA	512-56-1	Esters	Fish		ChV	80.42
Trimethyl phosphate (TMP)	NA	512-56-1	Esters	Daphnid		ChV	2457.053
Trimethyl phosphate (TMP)	NA	512-56-1	Esters	Green Algae		ChV	120.376
Trimethyl phosphate (TMP)	NA	512-56-1	Esters	Fish (SW)	96-hr	LC50	1104.594
Trimethyl phosphate (TMP)	NA	512-56-1	Esters	Mysid	96-hr	LC50	3915.122
Trimethyl phosphate (TMP)	NA	512-56-1	Esters	Fish (SW)		ChV	99.119
Trimethyl phosphate (TMP)	NA	512-56-1	Esters	Mysid (SW)		ChV	5.78E+07
Trimethyl phosphate (TMP)	NA	512-56-1	Esters	Earthworm	14-day	LC50	12598.584
Trimethyl phosphate (TMP)	NA	512-56-1	Esters (phosphate)	Fish	96-hr	LC50	24.812
Trimethyl phosphate (TMP)	NA	512-56-1	Esters (phosphate)	Daphnid	48-hr	LC50	0.055
Trimethyl phosphate (TMP)	NA	512-56-1	Esters (phosphate)	Green Algae	96-hr	EC50	3.50E+06
Trimethyl phosphate (TMP)	NA	512-56-1	Esters (phosphate)	Fish		ChV	0.014
Trimethyl phosphate (TMP)	NA	512-56-1	Esters (phosphate)	Green Algae		ChV	2414.672
Trimethyl phosphate (TMP)	NA	512-56-1	Esters (phosphate)	Fish (SW)	96-hr	LC50	3.733
Trimethyl phosphate (TMP)	NA	512-56-1	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.035
Trimethyl phosphate (TMP)	NA	512-56-1	Esters (phosphate)	Fish (SW)		ChV	0.302
Trimethyl phosphate (TMP)	NA	512-56-1	Esters (phosphate)	Mysid (SW)		ChV	0.000913
Trimethylsilanol (TMS)	NA	1066-40-6	Neutral Organics	Fish	96-hr	LC50	436.615
Trimethylsilanol (TMS)	NA	1066-40-6	Neutral Organics	Daphnid	48-hr	LC50	229.036
Trimethylsilanol (TMS)	NA	1066-40-6	Neutral Organics	Green Algae	96-hr	EC50	122.97
Trimethylsilanol (TMS)	NA	1066-40-6	Neutral Organics	Fish		ChV	38.871
Trimethylsilanol (TMS)	NA	1066-40-6	Neutral Organics	Daphnid		ChV	17.918
Trimethylsilanol (TMS)	NA	1066-40-6	Neutral Organics	Green Algae		ChV	26.996
Trimethylsilanol (TMS)	NA	1066-40-6	Neutral Organics	Fish (SW)	96-hr	LC50	546.85
Trimethylsilanol (TMS)	NA	1066-40-6	Neutral Organics	Mysid	96-hr	LC50	726.614
Trimethylsilanol (TMS)	NA	1066-40-6	Neutral Organics	Fish (SW)		ChV	35.157
Trimethylsilanol (TMS)	NA	1066-40-6	Neutral Organics	Mysid (SW)		ChV	80.982
Trimethylsilanol (TMS)	NA	1066-40-6	Neutral Organics	Earthworm	14-day	LC50	192.46
Tripropyl phosphate	NA	513-08-6	Esters	Fish	96-hr	LC50	18.851
Tripropyl phosphate	NA	513-08-6	Esters	Daphnid	48-hr	LC50	37.765
Tripropyl phosphate	NA	513-08-6	Esters	Green Algae	96-hr	EC50	15.218
Tripropyl phosphate	NA	513-08-6	Esters	Fish		ChV	1.319
Tripropyl phosphate	NA	513-08-6	Esters	Daphnid		ChV	23.383
Tripropyl phosphate	NA	513-08-6	Esters	Green Algae		ChV	4.363
Tripropyl phosphate	NA	513-08-6	Esters	Fish (SW)	96-hr	LC50	28.077
Tripropyl phosphate	NA	513-08-6	Esters	Mysid	96-hr	LC50	23.298
Tripropyl phosphate	NA	513-08-6	Esters	Fish (SW)		ChV	4.283
Tripropyl phosphate	NA	513-08-6	Esters	Mysid (SW)		ChV	848.721
Tripropyl phosphate	NA	513-08-6	Esters	Earthworm	14-day	LC50	2262.996
Tripropyl phosphate	NA	513-08-6	Esters (phosphate)	Fish	96-hr	LC50	3.686
Tripropyl phosphate	NA	513-08-6	Esters (phosphate)	Daphnid	48-hr	LC50	0.007
Tripropyl phosphate	NA	513-08-6	Esters (phosphate)	Green Algae	96-hr	EC50	1686.563
Tripropyl phosphate	NA	513-08-6	Esters (phosphate)	Fish		ChV	0.01
Tripropyl phosphate	NA	513-08-6	Esters (phosphate)	Green Algae		ChV	62.597
Tripropyl phosphate	NA	513-08-6	Esters (phosphate)	Fish (SW)	96-hr	LC50	1.38
Tripropyl phosphate	NA	513-08-6	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.01
Tripropyl phosphate	NA	513-08-6	Esters (phosphate)	Fish (SW)		ChV	0.068
Tripropyl phosphate	NA	513-08-6	Esters (phosphate)	Mysid (SW)		ChV	0.000141
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters	Fish	96-hr	LC50	6.277
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)[b]	NA	13674-87-8	Esters	Daphnid	48-hr	LC50	10.937
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters	Green Algae	96-hr	EC50	3.585
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters	Fish		ChV	0.334
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters	Daphnid		ChV	4.655
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters	Green Algae		ChV	1.569

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)[b]	NA	13674-87-8	Esters	Fish (SW)	96-hr	LC50	8.632
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters	Mysid	96-hr	LC50	3.768
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters	Fish (SW)		ChV	1.665
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)[b]	NA	13674-87-8	Esters	Mysid (SW)		ChV	9.635
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)[b]	NA	13674-87-8	Esters	Earthworm	14-day	LC50	1652.378
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters (phosphate)	Fish	96-hr	LC50	2.474
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters (phosphate)	Daphnid	48-hr	LC50	0.004
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)[b]	NA	13674-87-8	Esters (phosphate)	Green Algae	96-hr	EC50	89.715
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters (phosphate)	Fish		ChV	0.012
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)[b]	NA	13674-87-8	Esters (phosphate)	Green Algae		ChV	19.413
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters (phosphate)	Fish (SW)	96-hr	LC50	1.387
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.01
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters (phosphate)	Fish (SW)		ChV	0.055
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	Esters (phosphate)	Mysid (SW)		ChV	9.60E-05
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters	Fish	96-hr	LC50	13.295
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters	Daphnid	48-hr	LC50	25.135
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters	Green Algae	96-hr	EC50	9.296
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters	Fish		ChV	0.83
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters	Daphnid		ChV	13.318
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters	Green Algae		ChV	3.177
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters	Fish (SW)	96-hr	LC50	19.156
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters	Mysid	96-hr	LC50	12.173
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters	Fish (SW)		ChV	3.221
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters	Mysid (SW)		ChV	147.082
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters	Earthworm	14-day	LC50	2211.578
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters (phosphate)	Fish	96-hr	LC50	3.478
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters (phosphate)	Daphnid	48-hr	LC50	0.006
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters (phosphate)	Green Algae	96-hr	EC50	555.206
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters (phosphate)	Fish		ChV	0.012
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters (phosphate)	Green Algae		ChV	42.863
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters (phosphate)	Fish (SW)	96-hr	LC50	1.54
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.011
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters (phosphate)	Fish (SW)		ChV	0.07
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	Esters (phosphate)	Mysid (SW)		ChV	0.000134
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters	Fish	96-hr	LC50	0.002
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters	Daphnid	48-hr	LC50	0.002
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters	Green Algae	96-hr	EC50	0.000297
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters	Fish		ChV	3.82E-05
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters	Daphnid		ChV	0.000181
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters	Green Algae		ChV	0.000866
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters	Fish (SW)	96-hr	LC50	0.002
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters	Mysid	96-hr	LC50	5.78E-05
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters	Fish (SW)		ChV	0.0013
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters	Mysid (SW)		ChV	9.97E-10
Tris(2-ethylhexyl) phosphate (TEHP)[b]	NA	78-42-2	Esters	Earthworm	14-day	LC50	21.789
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters (phosphate)	Fish	96-hr	LC50	0.022
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters (phosphate)	Daphnid	48-hr	LC50	2.44E-05
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters (phosphate)	Green Algae	96-hr	EC50	9.42E-06
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters (phosphate)	Fish		ChV	0.002
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters (phosphate)	Green Algae		ChV	0.006
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters (phosphate)	Fish (SW)	96-hr	LC50	0.077
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.000341
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters (phosphate)	Fish (SW)		ChV	0.00116
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	Esters (phosphate)	Mysid (SW)		ChV	9.34E-07
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters	Fish	96-hr	LC50	0.00079
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters	Daphnid	48-hr	LC50	0.000666
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters	Green Algae	96-hr	EC50	7.46E-05
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters	Fish		ChV	1.01E-05
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters	Daphnid		ChV	4.03E-05

Table E-3. ECOSAR Values from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Chemical class - ECOSAR	Organism - ECOSAR	Duration - ECOSAR	Endpoint - ECOSAR	Predicted value - ECOSAR
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters	Green Algae		ChV	0.000295
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters	Fish (SW)	96-hr	LC50	0.000717
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters	Mysid	96-hr	LC50	1.11E-05
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters	Fish (SW)		ChV	0.000469
Tris(4-tert-butylphenyl) phosphate	NA	78-33-1	Esters	Mysid (SW)		ChV	2.82E-11
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters	Earthworm	14-day	LC50	12.357
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters (phosphate)	Fish	96-hr	LC50	0.012
Tris(4-tert-butylphenyl) phosphate	NA	78-33-1	Esters (phosphate)	Daphnid	48-hr	LC50	1.22E-05
Tris(4-tert-butylphenyl) phosphate	NA	78-33-1	Esters (phosphate)	Green Algae	96-hr	EC50	8.11E-07
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters (phosphate)	Fish		ChV	0.0019
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters (phosphate)	Green Algae		ChV	0.00169
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters (phosphate)	Fish (SW)	96-hr	LC50	0.055
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.000227
Tris(4-tert-butylphenyl) phosphate[b]	NA	78-33-1	Esters (phosphate)	Fish (SW)		ChV	0.000706
Tris(4-tert-butylphenyl) phosphate	NA	78-33-1	Esters (phosphate)	Mysid (SW)		ChV	5.05E-07
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters	Fish	96-hr	LC50	0.143
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters	Daphnid	48-hr	LC50	0.187
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters	Green Algae	96-hr	EC50	0.04
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters	Fish		ChV	0.004
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters	Daphnid		ChV	0.037
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters	Green Algae		ChV	0.042
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters	Fish (SW)	96-hr	LC50	0.167
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters	Mysid	96-hr	LC50	0.019
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters	Fish (SW)		ChV	0.052
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters	Mysid (SW)		ChV	0.000204
Tris(methylphenyl) phosphate[b]	NA	1330-78-5	Esters	Earthworm	14-day	LC50	191.19
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters (phosphate)	Fish	96-hr	LC50	0.241
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters (phosphate)	Daphnid	48-hr	LC50	0.000327
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters (phosphate)	Green Algae	96-hr	EC50	0.046
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters (phosphate)	Fish		ChV	0.005
Tris(methylphenyl) phosphate[b]	NA	1330-78-5	Esters (phosphate)	Green Algae		ChV	0.383
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters (phosphate)	Fish (SW)	96-hr	LC50	0.311
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters (phosphate)	Mysid (SW)	96-hr	LC50	0.00175
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters (phosphate)	Fish (SW)		ChV	0.008
Tris(methylphenyl) phosphate	NA	1330-78-5	Esters (phosphate)	Mysid (SW)		ChV	9.66E-06

Notes

CAS = Chemical Abstracts Service

NA = Not applicable

SW = Salt water

[a] = Inorganic compound, outside of EPISuite estimation domain.

[b] = Chemical may not be soluble enough to measure ECOSAR predicted effect.

Appendix F. Environmental Fate and Transport Data: Bioaccumulation and Bioconcentration Data

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	5.57	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	6.45	BAF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	6.22	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	6.35	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	6.40	BAF	*Osmerus mordax*	Rainbow smelt	Arnot & Gobas 2006
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	6.71	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	6.87	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	6.93	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	7.30	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	7.49	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',3,3',4,4'-Hexachlorobiphenyl	38380-07-3	5.77	BCF	*Danio rerio*	Zebra danio	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	5.82	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	5.85	BAF	*Gammarus fasciatus*	Amphipod	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	5.99	BAF	*Hexagenia limbata*	Mayfly	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	5.95	BAF	*Hydropychidae alterans*	Caddisfly larvae	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	6.18	BAF	*Orconectes propinquus*	Crayfish	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	5.25	BAF	*Stizostedion vitreum*	Walleye	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	5.59	BAF	*Pomoxis nigromaculatus*	Black crappie	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	6.21	BAF	*Micropterus dolomieu*	Smallmouth bass	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	6.10	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	5.90	BAF	*Aplodinotus grunniens*	Freshwater drum	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	6.60	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	5.98	BAF	*Perca flavescens*	Yellow perch	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	6.43	BAF	*Percopsis omiscomaycus*	Troutperch	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	6.90	BAF	*Micropterus salmoides*	Largemouth bass	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	6.37	BAF	*Morone americana*	White perch	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	6.51	BAF	*Dorosoma cepedianum*	Gizzard shad	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	5.84	BAF	Mixed (mostly yellow perch and smelt)	Young of the year	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	6.37	BAF	*Notropis atherinoides*	Emerald shiner	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	5.49	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	4.70	BAF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	5.56	BAF	*Pontoporeia hoyi*	Amphipod	Arnot & Gobas 2006
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	4.91	BAF	*Mysis relicta*	Shrimp	Arnot & Gobas 2006
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	4.27	BAF	*Tubifex tubifex*	Oligocheate	Arnot & Gobas 2006
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	5.97	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	5.91	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	6.29	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	4.80	BAF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	5.43	BAF	*Danio rerio*	Zebra danio	Arnot & Gobas 2006
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	6.40	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	6.73	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	6.66	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	7.05	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	7.30	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.21	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.29	BAF	*Gammarus fasciatus*	Amphipod	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.58	BAF	*Hexagenia limbata*	Mayfly	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.44	BAF	*Hydropychidae alterans*	Caddisfly larvae	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.63	BAF	*Orconectes propinquus*	Crayfish	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.25	BAF	*Pontoporeia hoyi*	Amphipod	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	5.61	BAF	*Mysis relicta*	Shrimp	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	5.17	BAF	*Tubifex tubifex*	Oligocheate	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	5.51	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.45	BAF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.15	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.28	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.40	BAF	*Osmerus mordax*	Rainbow smelt	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.01	BAF	*Pomoxis nigromaculatus*	Black crappie	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.58	BAF	*Micropterus dolomieu*	Smallmouth bass	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.45	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.26	BAF	*Aplodinotus grunniens*	Freshwater drum	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.73	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.35	BAF	*Perca flavescens*	Yellow perch	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.77	BAF	*Percopsis omiscomaycus*	Troutperch	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	7.33	BAF	*Micropterus salmoides*	Largemouth bass	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.81	BAF	*Morone americana*	White perch	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.65	BAF	*Dorosoma cepedianum*	Gizzard shad	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.44	BAF	Mixed (mostly yellow perch and smelt)	Young of the year	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.81	BAF	*Notropis atherinoides*	Emerald shiner	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.79	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.03	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.31	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.25	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.61	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	6.87	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	5.57	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	4.47	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	4.48	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	4.58	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	5.92	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.00	BAF	*Gammarus fasciatus*	Amphipod	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.31	BAF	*Hexagenia limbata*	Mayfly	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.12	BAF	*Hydropychidae alterans*	Caddisfly larvae	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.31	BAF	*Orconectes propinquus*	Crayfish	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	5.97	BAF	*Pontoporeia hoyi*	Amphipod	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	5.76	BAF	*Mysis relicta*	Shrimp	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	5.04	BAF	*Tubifex tubifex*	Oligocheate	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	5.45	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.45	BAF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.13	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.32	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.42	BAF	*Osmerus mordax*	Rainbow smelt	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	5.43	BAF	*Stizostedion vitreum*	Walleye	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	5.77	BAF	*Pomoxis nigromaculatus*	Black crappie	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.36	BAF	*Micropterus dolomieu*	Smallmouth bass	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.13	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	5.87	BAF	*Aplodinotus grunniens*	Freshwater drum	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.61	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.06	BAF	*Perca flavescens*	Yellow perch	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.38	BAF	*Percopsis omiscomaycus*	Troutperch	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	7.00	BAF	*Micropterus salmoides*	Largemouth bass	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.60	BAF	*Morone americana*	White perch	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.55	BAF	*Dorosoma cepedianum*	Gizzard shad	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.23	BAF	Mixed (mostly yellow perch and smelt)	Young of the year	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.60	BAF	*Notropis atherinoides*	Emerald shiner	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.48	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.10	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.45	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.37	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.59	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	6.97	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	5.34	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	4.63	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	5.94	BAF	*Pontoporeia hoyi*	Amphipod	Arnot & Gobas 2006
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	5.67	BAF	*Mysis relicta*	Shrimp	Arnot & Gobas 2006
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	5.23	BAF	*Tubifex tubifex*	Oligocheate	Arnot & Gobas 2006
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	5.87	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	6.31	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	6.37	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	6.26	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	6.79	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	4.93	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.03	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.06	BAF	*Gammarus fasciatus*	Amphipod	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.71	BAF	*Hexagenia limbata*	Mayfly	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.18	BAF	*Hydropychidae alterans*	Caddisfly larvae	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.27	BAF	*Orconectes propinquus*	Crayfish	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	4.99	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	6.12	BAF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.74	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.82	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	6.11	BAF	*Osmerus mordax*	Rainbow smelt	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	4.76	BAF	*Stizostedion vitreum*	Walleye	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	4.96	BAF	*Pomoxis nigromaculatus*	Black crappie	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.64	BAF	*Micropterus dolomieu*	Smallmouth bass	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.33	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	4.98	BAF	*Aplodinotus grunniens*	Freshwater drum	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.74	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.30	BAF	*Perca flavescens*	Yellow perch	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.48	BAF	*Percopsis omiscomaycus*	Troutperch	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	6.23	BAF	*Micropterus salmoides*	Largemouth bass	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.98	BAF	*Morone americana*	White perch	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.80	BAF	*Dorosoma cepedianum*	Gizzard shad	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.48	BAF	Mixed (mostly yellow perch and smelt)	Young of the year	Arnot & Gobas 2006

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.98	BAF	*Notropis atherinoides*	Emerald shiner	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.82	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	6.25	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	6.52	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	6.59	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	6.30	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	6.98	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	5.38	BCF	*Danio rerio*	Zebra danio	Arnot & Gobas 2006
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	4.67	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	5.63	BAF	*Pontoporeia hoyi*	Amphipod	Arnot & Gobas 2006
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	4.73	BAF	*Mysis relicta*	Shrimp	Arnot & Gobas 2006
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	4.97	BAF	*Tubifex tubifex*	Oligocheate	Arnot & Gobas 2006
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	5.33	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	5.66	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	5.89	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	5.78	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	6.19	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	4.78	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.05	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.12	BAF	*Gammarus fasciatus*	Amphipod	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.37	BAF	*Hexagenia limbata*	Mayfly	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.24	BAF	*Hydropychidae alterans*	Caddisfly larvae	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.46	BAF	*Orconectes propinquus*	Crayfish	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.95	BAF	*Pontoporeia hoyi*	Amphipod	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.78	BAF	*Mysis relicta*	Shrimp	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.18	BAF	*Tubifex tubifex*	Oligocheate	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.14	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.30	BAF	*Gammarus fasciatus*	Amphipod	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.47	BAF	*Hydropychidae alterans*	Caddisfly larvae	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.12	BAF	*Lampsilis lampsilis*	Mussel	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.54	BAF	*Orconectes propinquus*	Crayfish	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.44	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.41	BAF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.12	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.31	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.43	BAF	*Osmerus mordax*	Rainbow smelt	Arnot & Gobas 2006

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.51	BAF	*Stizostedion vitreum*	Walleye	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.88	BAF	*Pomoxis nigromaculatus*	Black crappie	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.45	BAF	*Micropterus dolomieu*	Smallmouth bass	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.09	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.05	BAF	*Aplodinotus grunniens*	Freshwater drum	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.70	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.05	BAF	*Perca flavescens*	Yellow perch	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.45	BAF	*Percopsis omiscomaycus*	Troutperch	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	7.10	BAF	*Micropterus salmoides*	Largemouth bass	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.52	BAF	*Morone americana*	White perch	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.60	BAF	*Dorosoma cepedianum*	Gizzard shad	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.30	BAF	Mixed (mostly yellow perch and smelt)	Young of the year	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.52	BAF	*Notropis atherinoides*	Emerald shiner	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.70	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.11	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.41	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.24	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.53	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.93	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.80	BAF	*Ambloplites rupestris*	Rock bass	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.59	BAF	*Noturus flavus*	Stonecat	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.98	BAF	*Aplodinotus grunniens*	Freshwater drum	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.85	BAF	*Perca flavescens*	Yellow perch	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.18	BAF	*Moxostoma macrolepidotum*	Shorthead redhorse	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.76	BAF	*Morone americana*	White perch	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	7.11	BAF	*Morone chrysops*	White bass	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.31	BAF	*Cottus bairdi*	Mottled sculpin	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.56	BAF	*Dorosoma cepedianum*	Gizzard shad	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.88	BAF	*Ambloplites rupestris*	Rock bass	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.14	BAF	*Notropis hudsonius*	Spottail shiner	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.81	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.91	BAF	*Ambloplites rupestris*	Rock bass	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.39	BAF	*Notropis atherinoides*	Emerald shiner	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	6.27	BAF	*Labidesthes sicculus*	Brook silversides	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.49	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	4.64	BCF	Various	Phytoplankton	Arnot & Gobas 2006

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.69	BCF	*Poecilia reticulata*	Guppy	Arnot & Gobas 2006
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	5.65	BCF	*Danio rerio*	Zebra danio	Arnot & Gobas 2006
2,2',4,4'-Tetrachlorobiphenyl	2437-79-8	5.28	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',4,4'-Tetrachlorobiphenyl	2437-79-8	5.77	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006
2,2',4,4'-Tetrachlorobiphenyl	2437-79-8	5.64	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,4'-Tetrachlorobiphenyl	2437-79-8	5.00	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',4,4'-Tetrachlorobiphenyl	2437-79-8	6.17	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',4,4'-Tetrachlorobiphenyl	2437-79-8	4.40	BCF	*Oncorhynchus mykiss*	Rainbow trout	Arnot & Gobas 2006
2,2',4,4'-Tetrachlorobiphenyl	2437-79-8	4.39	BCF	*Oncorhynchus mykiss*	Rainbow trout	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.19	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.19	BAF	*Gammarus fasciatus*	Amphipod	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.77	BAF	*Hexagenia limbata*	Mayfly	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.34	BAF	*Hydropychidae alterans*	Caddisfly larvae	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.43	BAF	*Orconectes propinquus*	Crayfish	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.45	BAF	*Pontoporeia hoyi*	Amphipod	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.14	BAF	*Mysis relicta*	Shrimp	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	4.77	BAF	*Tubifex tubifex*	Oligocheate	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	4.83	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.25	BAF	*Gammarus fasciatus*	Amphipod	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	4.88	BAF	*Hexagenia limbata*	Mayfly	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.17	BAF	*Hydropychidae alterans*	Caddisfly larvae	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	4.82	BAF	*Lampsilis lampsilis*	Mussel	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.01	BAF	*Orconectes propinquus*	Crayfish	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.06	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	6.13	BAF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.84	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.92	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	6.14	BAF	*Osmerus mordax*	Rainbow smelt	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	4.88	BAF	*Stizostedion vitreum*	Walleye	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.13	BAF	*Pomoxis nigromaculatus*	Black crappie	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.73	BAF	*Micropterus dolomieu*	Smallmouth bass	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.29	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.12	BAF	*Aplodinotus grunniens*	Freshwater drum	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.85	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.46	BAF	*Perca flavescens*	Yellow perch	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.63	BAF	*Percopsis omiscomaycus*	Troutperch	Arnot & Gobas 2006

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	6.33	BAF	*Micropterus salmoides*	Largemouth bass	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.65	BAF	*Morone americana*	White perch	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.82	BAF	*Dorosoma cepedianum*	Gizzard shad	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.66	BAF	Mixed (mostly yellow perch and smelt)	Young of the year	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	6.04	BAF	*Notropis atherinoides*	Emerald shiner	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	6.05	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.48	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.78	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.93	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	6.03	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	6.32	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.40	BAF	*Ambloplites rupestris*	Rock bass	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.99	BAF	*Noturus flavus*	Stonecat	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.55	BAF	*Aplodinotus grunniens*	Freshwater drum	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.34	BAF	*Perca flavescens*	Yellow perch	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.65	BAF	*Moxostoma macrolepidotum*	Shorthead redhorse	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	6.28	BAF	*Morone americana*	White perch	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	6.57	BAF	*Morone chrysops*	White bass	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.35	BAF	*Cottus bairdi*	Mottled sculpin	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.29	BAF	*Dorosoma cepedianum*	Gizzard shad	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.61	BAF	*Ambloplites rupestris*	Rock bass	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.80	BAF	*Notropis hudsonius*	Spottail shiner	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.78	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.68	BAF	*Ambloplites rupestris*	Rock bass	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	6.07	BAF	*Notropis atherinoides*	Emerald shiner	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.96	BAF	*Labidesthes sicculus*	Brook silversides	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	4.94	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	4.47	BCF	Various	—	Arnot & Gobas 2006
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	5.47	BCF	*Danio rerio*	Zebra danio	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.69	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.84	BAF	*Gammarus fasciatus*	Amphipod	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.44	BAF	*Hexagenia limbata*	Mayfly	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.83	BAF	*Hydropychidae alterans*	Caddisfly larvae	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.70	BAF	*Orconectes propinquus*	Crayfish	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.82	BAF	*Pontoporeia hoyi*	Amphipod	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.98	BAF	*Mysis relicta*	Shrimp	Arnot & Gobas 2006

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.16	BAF	*Tubifex tubifex*	Oligocheate	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.04	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.62	BAF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.24	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.51	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.49	BAF	*Osmerus mordax*	Rainbow smelt	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.23	BAF	*Stizostedion vitreum*	Walleye	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.49	BAF	*Pomoxis nigromaculatus*	Black crappie	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.25	BAF	*Micropterus dolomieu*	Smallmouth bass	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.73	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.47	BAF	*Aplodinotus grunniens*	Freshwater drum	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.13	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.75	BAF	*Perca flavescens*	Yellow perch	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.06	BAF	*Percopsis omiscomaycus*	Troutperch	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.81	BAF	*Micropterus salmoides*	Largemouth bass	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.82	BAF	*Morone americana*	White perch	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.60	BAF	*Dorosoma cepedianum*	Gizzard shad	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.06	BAF	Mixed (mostly yellow perch and smelt)	Young of the year	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.79	BAF	*Notropis atherinoides*	Emerald shiner	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.46	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.00	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.57	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.77	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	5.62	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	6.11	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.47	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.57	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	4.84	BCF	*Danio rerio*	Zebra danio	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.69	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.82	BCF and BAF	*Gammarus fasciatus*	Amphipod	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.29	BCF and BAF	*Hexagenia limbata*	Mayfly	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.78	BAF	*Hydropychidae alterans*	Caddisfly larvae	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.85	BAF	*Orconectes propinquus*	Crayfish	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.54	BAF	*Pontoporeia hoyi*	Amphipod	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.74	BAF	*Mysis relicta*	Shrimp	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.00	BAF	*Tubifex tubifex*	Oligocheate	Arnot & Gobas 2006

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.00	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.54	BAF	*Gammarus fasciatus*	Amphipod	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.85	BAF	*Hydropychidae alterans*	Caddisfly larvae	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.70	BAF	*Lampsilis lampsilis*	Mussel	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.57	BAF	*Orconectes propinquus*	Crayfish	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.41	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.78	BAF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.35	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.63	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.73	BAF	*Osmerus mordax*	Rainbow smelt	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.31	BAF	*Stizostedion vitreum*	Walleye	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.51	BAF	*Pomoxis nigromaculatus*	Black crappie	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.17	BAF	*Micropterus dolomieu*	Smallmouth bass	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.21	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.49	BAF	*Aplodinotus grunniens*	Freshwater drum	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.08	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.88	BAF	*Perca flavescens*	Yellow perch	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.02	BAF	*Percopsis omiscomaycus*	Troutperch	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.75	BAF	*Micropterus salmoides*	Largemouth bass	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.26	BAF	*Morone americana*	White perch	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.53	BAF	*Dorosoma cepedianum*	Gizzard shad	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.11	BAF	Mixed (mostly yellow perch and smelt)	Young of the year	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.66	BAF	*Notropis atherinoides*	Emerald shiner	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.30	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.08	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.46	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.63	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.65	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.99	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.87	BAF	*Ambloplites rupestris*	Rock bass	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.24	BAF	*Noturus flavus*	Stonecat	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.16	BAF	*Aplodinotus grunniens*	Freshwater drum	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.04	BAF	*Perca flavescens*	Yellow perch	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.98	BAF	*Morone chrysops*	White bass	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.25	BAF	*Moxostoma macrolepidotum*	Shorthead redhorse	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	6.11	BAF	*Morone americana*	White perch	Arnot & Gobas 2006

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Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.87	BAF	*Cottus bairdi*	Mottled sculpin	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.11	BAF	*Dorosoma cepedianum*	Gizzard shad	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.36	BAF	*Ambloplites rupestris*	Rock bass	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.74	BAF	*Notropis hudsonius*	Spottail shiner	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.44	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.48	BAF	*Ambloplites rupestris*	Rock bass	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.79	BAF	*Notropis atherinoides*	Emerald shiner	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.69	BAF	*Labidesthes sicculus*	Brook silversides	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.83	BCF	*Poecilia reticulata*	Guppy	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	4.64	BCF	*Poecilia reticulata*	Guppy	Arnot & Gobas 2006
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	5.65	BCF	*Danio rerio*	Zebra danio	Arnot & Gobas 2006
2,2'-Dichlorobiphenyl	13029-08-8	3.43	BCF	*Chlorella fusca*	Green algae	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	5.99	BAF	*Pontoporeia hoyi*	Amphipod	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	5.68	BAF	*Mysis relicta*	Shrimp	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	5.43	BAF	*Tubifex tubifex*	Oligocheate	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	5.40	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	6.53	BAF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	6.13	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	6.30	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	6.57	BAF	*Osmerus mordax*	Rainbow smelt	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	4.94	BAF	*Osmerus mordax*	Smelt (small)	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	5.37	BAF	*Osmerus mordax*	Smelt (large)	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	5.29	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	5.23	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	5.71	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,3,4'-Trichlorobiphenyl	38444-85-8	5.71	BAF	*Pontoporeia hoyi*	Amphipod	Arnot & Gobas 2006
2,3,4'-Trichlorobiphenyl	38444-85-8	4.87	BAF	*Mysis relicta*	Shrimp	Arnot & Gobas 2006
2,3,4'-Trichlorobiphenyl	38444-85-8	5.32	BAF	*Tubifex tubifex*	Oligocheate	Arnot & Gobas 2006
2,3,4'-Trichlorobiphenyl	38444-85-8	5.40	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
2,3,4'-Trichlorobiphenyl	38444-85-8	4.47	BCF	Various	Phytoplankton	Arnot & Gobas 2006
2,3-Dichlorobiphenyl	16605-91-7	4.11	BCF	*Oncorhynchus mykiss*	Rainbow trout	Arnot & Gobas 2006
2,3-Dichlorobiphenyl	16605-91-7	4.04	BCF	*Oncorhynchus mykiss*	Rainbow trout	Arnot & Gobas 2006
2,3-Dichlorobiphenyl	16605-91-7	4.08	BCF	*Oncorhynchus mykiss*	Rainbow trout	Arnot & Gobas 2006
2,4',5-Trichlorobiphenyl	16606-02-3	4.01	BCF	*Chlorella fusca*	Green algae	Arnot & Gobas 2006
2,4',5-Trichlorobiphenyl	16606-02-3	4.15	BCF	*Poecilia reticulata*	Guppy	Arnot & Gobas 2006
2,4',5-Trichlorobiphenyl	16606-02-3	4.66	BCF	*Danio rerio*	Zebra danio	Arnot & Gobas 2006

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Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
2,4',5-Trichlorobiphenyl	16606-02-3	5.38	BCF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
2,4',5-Trichlorobiphenyl	16606-02-3	4.91	BCF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,4',5-Trichlorobiphenyl	16606-02-3	4.69	BCF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,4',5-Trichlorobiphenyl	16606-02-3	5.32	BCF	*Osmerus mordax*	Rainbow smelt	Arnot & Gobas 2006
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	4.14	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	5.38	BAF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	4.91	BAF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	4.69	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	5.32	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	4.01	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	732-26-3	4.14	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
2,4'-Dichlorobiphenyl	34883-43-7	3.83	BCF	*Chlorella fusca*	Green algae	Arnot & Gobas 2006
2,4-Di-tert-butylphenol (2,4-DTBP)	96-76-4	2.45	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
2,4-Di-tert-butylphenol (2,4-DTBP)	96-76-4	2.40	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
2-Ethylhexyl diphenyl phosphate	1241-94-7	2.49	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
2-Ethylhexyl diphenyl phosphate	1241-94-7	2.77	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
2-Ethylhexyl diphenyl phosphate	1241-94-7	2.49	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
2-Ethylhexyl diphenyl phosphate	1241-94-7	2.77	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Bis(2-ethylhexyl) phosphate	298-07-7	0.64	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Bis(2-ethylhexyl) phosphate	298-07-7	0.64	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Cresyl diphenyl phosphate (CDPP)	26444-49-5	2.51	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Cresyl diphenyl phosphate (CDPP)	26444-49-5	2.52	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Cresyl diphenyl phosphate (CDPP)	26444-49-5	2.51	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Cresyl diphenyl phosphate (CDPP)	26444-49-5	2.52	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Decachlorobiphenyl	2051-24-3	5.11	BAF	*Catostomus commersonii*	White sucker	Arnot & Gobas 2006
Decachlorobiphenyl	2051-24-3	6.56	BAF	*Salvelinus namaycush*	Lake trout	Arnot & Gobas 2006
Decachlorobiphenyl	2051-24-3	6.35	BAF	*Alosa pseudoharengus*	Alewife	Arnot & Gobas 2006
Decachlorobiphenyl	2051-24-3	6.85	BAF	*Cottus cognatus*	Sculpin	Arnot & Gobas 2006
Decachlorobiphenyl	2051-24-3	6.49	BAF	*Osmerus mordax*	Rainbow smelt	Arnot & Gobas 2006
Decachlorobiphenyl	2051-24-3	5.74	BAF	Mixed - see refererence	Salmonid	Arnot & Gobas 2006
Decachlorobiphenyl	2051-24-3	3.92	BCF	*Poecilia reticulata*	Guppy	Arnot & Gobas 2006
Decachlorobiphenyl	2051-24-3	5.44	BCF	*Danio rerio*	Zebra danio	Arnot & Gobas 2006
Dichlorobiphenyl	25512-42-9	4.10	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Dichlorobiphenyl	25512-42-9	3.75	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Hexachlorobiphenyl	26601-64-9	4.34	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	2.43	BCF	*Cyprinus carpio*	Common carp	ECCC 2020

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	2.83	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	2.43	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	2.83	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Melamine	108-78-1	-0.42	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Melamine	108-78-1	0.58	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Melamine	108-78-1	-0.42	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Melamine	108-78-1	0.58	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Polychlorinated biphenyl (PCB)	1336-36-3	4.30	BAF	*Dreissena polymorpha*	Zebra mussel	Arnot & Gobas 2006
Polychlorinated biphenyl (PCB)[a]	1336-36-3	2.10	BAF	*E. fetida*	Earthworm	Needham and Ghosh 2019
Tetrachlorobiphenyl	26914-33-0	4.18	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Tetrachlorobiphenyl	26914-33-0	4.10	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Tributyl phosphate	126-73-8	1.48	BCF	*Oryzias latipes*	Medaka, high-eyes	ECCC 2020
Tributyl phosphate	126-73-8	0.78	BCF	*Carassius auratus*	Goldfish	ECCC 2020
Tributyl phosphate	126-73-8	0.89	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Tributyl phosphate	126-73-8	0.85	BCF	*Carassius auratus*	Goldfish	ECCC 2020
Tributyl phosphate	126-73-8	1.13	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Tributyl phosphate	126-73-8	1.43	BCF	*Oryzias latipes*	Medaka, high-eyes	ECCC 2020
Tributyl phosphate	126-73-8	1.49	BCF	*Oryzias latipes*	Medaka, high-eyes	ECCC 2020
Tributyl phosphate	126-73-8	1.54	BCF	*Oryzias latipes*	Medaka, high-eyes	ECCC 2020
Tributyl phosphate	126-73-8	1.48	BCF	*Oryzias latipes*	Medaka, high-eyes	Arnot & Gobas 2006
Tributyl phosphate	126-73-8	1.13	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Tributyl phosphate	126-73-8	0.89	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Tributyl phosphate	126-73-8	1.54	BCF	*Oryzias latipes*	Medaka, high-eyes	Arnot & Gobas 2006
Tributyl phosphate	126-73-8	1.49	BCF	*Oryzias latipes*	Medaka, high-eyes	Arnot & Gobas 2006
Tributyl phosphate	126-73-8	0.85	BCF	*Carassius auratus*	Goldfish	Arnot & Gobas 2006
Tributyl phosphate	126-73-8	0.78	BCF	*Carassius auratus*	Goldfish	Arnot & Gobas 2006
Tributyl phosphate	126-73-8	1.43	BCF	*Oryzias latipes*	Medaka, high-eyes	Arnot & Gobas 2006
Trichlorobiphenyl	25323-68-6	4.12	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Trichlorobiphenyl	25323-68-6	4.03	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Triethyl phosphate (TEP)	78-40-0	-0.19	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Triethyl phosphate (TEP)	78-40-0	0.11	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Triethyl phosphate (TEP)	78-40-0	-0.19	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Triethyl phosphate (TEP)	78-40-0	0.11	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Trimethyl phosphate (TMP)	512-56-1	-0.52	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Trimethyl phosphate (TMP)	512-56-1	0.15	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Trimethyl phosphate (TMP)	512-56-1	-0.52	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006

Table F-1. Bioaccumulation and Bioconcentration Factors as Reported in the Literature, Arnot & Gobas 2006, and Environment and Climate Change Canada for Newly Identified Chemicals in Biosolids

Chemical	CAS number	Log BAF or Log BCF (L/kg, ww)	BAF or BCF	Organism scientific name	Organism common name	Source
Trimethyl phosphate (TMP)	512-56-1	0.15	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	1.69	BCF	*Oryzias latipes*	Medaka, high-eyes	ECCC 2020
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	0.52	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	0.26	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	1.08	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	0.48	BCF	*Carassius auratus*	Goldfish	ECCC 2020
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	0.70	BCF	*Carassius auratus*	Goldfish	ECCC 2020
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	1.89	BCF	*Oryzias latipes*	Medaka, high-eyes	ECCC 2020
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	2.04	BCF	*Oryzias latipes*	Medaka, high-eyes	ECCC 2020
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	2.05	BCF	*Oryzias latipes*	Medaka, high-eyes	ECCC 2020
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	1.77	BCF	*Oryzias latipes*	Medaka, high-eyes	ECCC 2020
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	1.69	BCF	*Oryzias latipes*	Medaka, high-eyes	Arnot & Gobas 2006
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	1.08	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	0.26	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	2.04	BCF	*Oryzias latipes*	Medaka, high-eyes	Arnot & Gobas 2006
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	1.89	BCF	*Oryzias latipes*	Medaka, high-eyes	Arnot & Gobas 2006
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	2.05	BCF	*Oryzias latipes*	Medaka, high-eyes	Arnot & Gobas 2006
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	0.70	BCF	*Carassius auratus*	Goldfish	Arnot & Gobas 2006
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	0.48	BCF	*Carassius auratus*	Goldfish	Arnot & Gobas 2006
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	1.77	BCF	*Oryzias latipes*	Medaka, high-eyes	Arnot & Gobas 2006
Tris(2-chloroisopropyl) phosphate	13674-84-5	0.26	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Tris(2-chloroisopropyl) phosphate	13674-84-5	0.26	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Tris(2-chloroisopropyl) phosphate	13674-84-5	0.52	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	0.65	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	1.08	BCF	*Cyprinus carpio*	Common carp	ECCC 2020
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	0.65	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	1.08	BCF	*Cyprinus carpio*	Common carp	Arnot & Gobas 2006

Notes:

CAS = Chemical Abstracts Service

ECCC 2020 = Environment and Climate Change Canada

[a] = Total PCBs were analyzed using U.S. EPA method 8082A and is the sum of 129 PCB congeners.

Table F-2. Bioaccumlation and Bioconcentration Factors from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	EPISuite Log BCF (regression based estimate) (L/kg, ww) - BCFBAF	EPISuite Log BCF (Arnot-Gobas upper trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BCF (Arnot-Gobas mid trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BCF (Arnot-Gobas lower trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BAF (Arnot-Gobas upper trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BAF (Arnot-Gobas mid trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BAF (Arnot-Gobas lower trophic incl biotrans) (L/kg, ww) - BCFBAF
2,2',3,3',4,4',5,6'-Octachlorobiphenyl	196	42740-50-1	3.77	2.828	3.007	3.061	6.482	6.126	5.851
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	4.09	3.277	3.463	3.519	6.848	6.508	6.241
2,2',3,3',4,4'-Hexachlorobiphenyl	128	38380-07-3	4.56	3.821	4.012	4.068	6.966	6.65	6.399
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	201	40186-71-8	3.77	2.586	2.747	2.796	6.139	5.811	5.569
2,2',3,3',4,5-Hexachlorobiphenyl	129	55215-18-4	4.55	3.804	3.994	4.049	6.945	6.632	6.385
2,2',3,3',4,6-Hexachlorobiphenyl	131	61798-70-7	4.59	3.842	4.03	4.085	6.93	6.619	6.373
2,2',3,3',5,5',6-Heptachlorobiphenyl	178	52663-67-9	4.09	3.277	3.463	3.519	6.848	6.508	6.241
2,2',3,3',6,6'-Hexachlorobiphenyl	136	38411-22-2	4.65	3.86	4.041	4.093	6.788	6.499	6.276
2,2',3,4,4',5,5',6-Octachlorobiphenyl	203	52663-76-0	3.77	2.828	3.007	3.061	6.482	6.126	5.851
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	4.09	3.277	3.463	3.519	6.848	6.508	6.241
2,2',3,4,4',5'-Hexachlorobiphenyl	138	35065-28-2	4.49	3.731	3.921	3.977	6.947	6.635	6.388
2,2',3,4,4'-Pentachlorobiphenyl	85	65510-45-4	4.61	4.111	4.274	4.317	6.615	6.309	6.077
2,2',3,4,5'-Pentachlorobiphenyl	87	38380-02-8	4.77	3.998	4.172	4.221	6.699	6.409	6.187
2,2',3,5',6-Pentachlorobiphenyl	95	38379-99-6	4.575	4.127	4.286	4.327	6.57	6.263	6.032
2,2',3,5-Tetrachlorobiphenyl	43	70362-46-8	4.43	4.259	4.399	4.43	6.613	6.238	5.957
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	4.43	4.196	4.336	4.368	6.458	6.125	5.88
2,2',4,4',5,5'-Hexachlorobiphenyl	153	35065-27-1	4.34	3.525	3.711	3.766	6.888	6.575	6.331
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	4.4	4.164	4.299	4.33	6.323	6.013	5.791
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	4.74	4.06	4.235	4.283	6.768	6.457	6.216
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	4.36	4.168	4.295	4.323	6.251	5.939	5.718
2,2',4,5-Tetrachlorobiphenyl	48	70362-47-9	4.43	4.159	4.299	4.332	6.367	6.059	5.835
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	4.433	4.214	4.354	4.385	6.502	6.157	5.902
2,2',5,5'-Tetrachlorobiphenyl	52	35693-99-3	4.27	4.168	4.279	4.3	6.108	5.791	5.572
2,2',6-Trichlorobiphenyl	19	38444-73-4	3.87	4.134	4.114	4.092	5.607	5.124	4.846
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	NA	38051-10-4	1.023	1.492	1.564	1.577	1.492	1.564	1.578
2,2'-Dichlorobiphenyl	4	13029-08-8	3.53	3.76	3.683	3.647	4.426	4.126	3.996
2,3,3',4,4',5,6-Heptachlorobiphenyl	190	41411-64-7	4.09	3.277	3.463	3.519	6.848	6.508	6.241
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	4.4	3.613	3.801	3.857	6.925	6.612	6.366
2,3,3',4',5,6-Hexachlorobiphenyl	163	74472-44-9	4.61	3.88	4.069	4.124	6.943	6.628	6.379
2,3',4,4'-Tetrachlorobiphenyl	66	32598-10-0	4.42	4.111	4.248	4.281	6.213	5.941	5.747
2,3,4'-Trichlorobiphenyl	22	38444-85-8	3.83	4.061	4.043	4.022	5.357	4.94	4.71
2,3,6-Trichlorobiphenyl	24	55702-45-9	3.99	3.807	3.894	3.91	4.719	4.702	4.695
2,3',6-Trichlorobiphenyl	27	38444-76-7	4.01	4.099	4.147	4.146	5.576	5.246	5.047
2,3-Dichlorobiphenyl	5	16605-91-7	3.57	3.855	3.76	3.72	4.781	4.333	4.126
2,4',5-Trichlorobiphenyl	31	16606-02-3	4.01	4.063	4.118	4.119	5.469	5.181	5.008
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	3.443	4.033	4.148	4.173	5.714	5.511	5.377
2,4'-Dichlorobiphenyl	8	34883-43-7	3.61	3.834	3.775	3.744	4.623	4.31	4.167
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	2.87	2.243	2.376	2.415	2.244	2.394	2.527

Table F-2. Bioaccumlation and Bioconcentration Factors from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	EPISuite Log BCF (regression based estimate) (L/kg, ww) - BCFBAF	EPISuite Log BCF (Arnot-Gobas upper trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BCF (Arnot-Gobas mid trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BCF (Arnot-Gobas lower trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BAF (Arnot-Gobas upper trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BAF (Arnot-Gobas mid trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BAF (Arnot-Gobas lower trophic incl biotrans) (L/kg, ww) - BCFBAF
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	3.61	3.07	3.208	3.249	3.49	4	4.331
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	2.96	2.928	3.049	3.083	2.95	3.166	3.362
2,6-Dichlorobiphenyl	10	33146-45-1	3.54	3.535	3.535	3.522	3.762	3.78	3.798
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	1.25	2.003	2.048	2.05	2.003	2.048	2.05
2-Chlorobiphenyl	1	2051-60-7	2.66	3.269	3.208	3.178	3.324	3.287	3.284
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	2.62	2.43	2.566	2.607	2.436	2.664	2.968
3,4,4'-Trichlorobiphenyl	37	38444-90-5	4.15	4.143	4.227	4.238	5.858	5.538	5.33
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	NA	4221-80-1	2.431	0.75	0.873	0.911	3.459	3.483	3.5
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	3.687	2.917	3.055	3.097	3.267	3.843	4.229
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol	NA	1843-03-4	1.111	-0.047	-0.027	-0.023	0.368	0.507	0.6
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)	NA	118-82-1	2.925	1.304	1.438	1.48	3.44	3.761	3.956
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)	NA	96-69-5	3.293	1.45	1.586	1.627	2.488	3.307	3.784
4-Chlorobiphenyl	3	2051-62-9	2.66	3.269	3.208	3.178	3.324	3.287	3.284
6:2 Fluorotelomer sulfonic acid	NA	27619-97-2	0.5	1.654	1.487	1.434	1.654	1.488	1.435
8:2 Fluorotelomer sulfonic acid	NA	39108-34-4	0.5	2.87	2.754	2.71	2.877	2.77	2.738
Ammelide	NA	645-93-2	0.5	-0.049	-0.03	-0.026	-0.049	-0.03	-0.026
Ammeline	NA	645-92-1	0.5	-0.049	-0.031	-0.027	-0.049	-0.031	-0.027
Amoxicillin	NA	26787-78-0	0.5	0.04	0.06	0.063	0.04	0.06	0.063
Ampicillin	NA	69-53-4	0.5	0.262	0.26	0.253	0.262	0.26	0.253
Bis(2-chloroethyl) phosphate	NA	3040-56-0	0.5	0.164	0.128	0.116	0.164	0.128	0.116
Bis(2-ethylhexyl) phosphate	NA	298-07-7	1.47	2.926	3.062	3.103	3.066	3.526	3.894
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	1.46	2.719	2.654	2.623	2.72	2.661	2.641
Cesium[a]	NA	7440-46-2	0.5	-0.017	-0.001	0.001	-0.017	-0.001	0.001
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	1.82	2.329	2.438	2.466	2.329	2.443	2.495
Cyanuric acid	NA	108-80-5	3.773	2.586	2.747	2.796	6.139	5.811	5.569
Decachlorobiphenyl	NA	2051-24-3	4.088	3.267	3.451	3.507	6.833	6.494	6.229
Dibutyl ester phosphoric acid	NA	107-66-4	0.35	1.214	1.094	1.052	1.214	1.094	1.052
Dichlorobiphenyl	NA	25512-42-9	3.552	3.779	3.706	3.672	4.476	4.171	4.039
Diethyl hydrogen phosphate	NA	598-02-7	0.5	0.018	0.021	0.02	0.018	0.021	0.02
Diisobutyl hydrogen phosphate	NA	6303-30-6	0.255	1.074	0.958	0.918	1.074	0.958	0.918
Diphenyl phosphate (DPHP)	NA	838-85-7	0.74	1.604	1.551	1.524	1.604	1.551	1.524
Dipropyl ester phosphoric acid	NA	1804-93-9	-0.3	0.406	0.331	0.307	0.406	0.331	0.307
Heptachlorobiphenyl	NA	28655-71-2	4.09	3.277	3.463	3.519	6.848	6.508	6.241
Hexachlorobiphenyl	NA	26601-64-9	4.343	3.525	3.711	3.766	6.888	6.575	6.331
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	1.06	2.46	2.593	2.633	2.463	2.648	2.858
Melamine	NA	108-78-1	0.5	-0.049	-0.03	-0.026	-0.049	-0.03	-0.026
Monochlorobiphenyl	NA	27323-18-8	2.689	3.3	3.246	3.218	3.365	3.336	3.337

Table F-2. Bioaccumlation and Bioconcentration Factors from EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	EPISuite Log BCF (regression based estimate) (L/kg, ww) - BCFBAF	EPISuite Log BCF (Arnot-Gobas upper trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BCF (Arnot-Gobas mid trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BCF (Arnot-Gobas lower trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BAF (Arnot-Gobas upper trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BAF (Arnot-Gobas mid trophic incl biotrans) (L/kg, ww) - BCFBAF	EPISuite Log BAF (Arnot-Gobas lower trophic incl biotrans) (L/kg, ww) - BCFBAF
Nalidixic acid	NA	389-08-2	0.5	0.235	0.268	0.272	0.235	0.268	0.272
Nonachlorobiphenyl	NA	53742-07-7	3.661	2.482	2.647	2.697	6.091	5.745	5.486
Octachlorobiphenyl	NA	55722-26-4	3.773	2.828	3.007	3.061	6.482	6.126	5.851
Pentachlorobiphenyl	NA	25429-29-2	4.74	4.06	4.235	4.283	6.768	6.457	6.216
Polychlorinated biphenyl (PCB)	NA	1336-36-3	4.403	4.164	4.299	4.33	6.323	6.013	5.791
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	3.1	1.725	1.861	1.903	1.909	2.828	3.516
Sulfate	NA	14808-79-8	0.5	-0.049	-0.031	-0.027	-0.049	-0.031	-0.027
Sulfur[a]	NA	7704-34-9	2.08	2.016	2.058	2.06	2.016	2.058	2.063
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	2.22	2.724	2.845	2.878	2.73	2.893	3.036
Tetrabutyl ethylidenebisphenol (AO22E46)	NA	35958-30-6	2.86	1.291	1.426	1.467	3.63	3.855	3.994
Tetrachlorobiphenyl	NA	26914-33-0	4.271	4.168	4.279	4.3	6.108	5.791	5.572
Tributyl phosphate	NA	126-73-8	1.48	1.843	1.949	1.977	1.843	1.95	1.982
Trichlorobiphenyl	NA	25323-68-6	3.915	4.02	4.051	4.045	5.261	4.973	4.81
Triethyl phosphate (TEP)	NA	78-40-0	0.5	0.146	0.146	0.116	0.116	0.106	0.106
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)	NA	36443-68-2	2.71	0.089	0.143	0.16	0.089	0.222	0.971
Triisobutyl phosphate	NA	126-71-6	2.62	2.43	2.566	2.607	2.436	2.664	2.968
Trimethyl phosphate (TMP)	NA	512-56-1	0.5	-0.046	-0.027	-0.023	-0.046	-0.027	-0.023
Trimethylsilanol (TMS)	NA	1066-40-6	0.42	0.342	0.261	0.238	0.342	0.261	0.238
Tripropyl phosphate	NA	513-08-6	0.08	0.726	0.666	0.64	0.726	0.666	0.641
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	1.25	2.003	2.048	2.05	2.003	2.048	2.054
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	0.55	1.108	1.123	1.116	1.108	1.123	1.116
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	1.48	0.086	0.14	0.156	0.146	0.872	1.623
Tris(4-tert-butylphenyl) phosphate	NA	78-33-1	1.619	1.367	1.533	1.583	5.017	4.656	4.381
Tris(methylphenyl) phosphate	NA	1330-78-5	2.214	3.107	3.203	3.225	3.14	3.314	3.449

Notes

CAS = Chemical Abstracts Service

NA = Not applicable

[a] = Inorganic compound, outside of EPISuite estimation domain

Table F-3. Bioconcentration Factors (BCF) as Reported by ORNL for Newly Identified Chemicals in Biosolids

Chemical	CAS number	BCF (L/g)	Source
Polychlorinated biphenyl (PCB)	1336-36-3	25300	ORNL 2020
Tributyl phosphate	126-73-8	29.60056495	ORNL 2020
Tris(2-chloroisopropyl) phosphate	13674-84-5	3.56	ORNL 2020
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	12.0005182	ORNL 2020
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	672.9766563	ORNL 2020
Trimethyl phosphate (TMP)	512-56-1	1.399909627	ORNL 2020
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	50.11872336	ORNL 2020

Notes

CAS = Chemical Abstracts Service

Appendix G. Environmental Fate and Transport Data: Physical/ Chemical Properties

Table G-1. Physical/Chemical Properties as Reported in the Literature for Newly and Previously Identified Chemicals in Biosolids

Chemical	CAS number	New or previous	Molecular weight	Solubility (mg/L @ 25 C)	Vapor pressure (mmHg @ 25 C)	Log K_{ow}	Log K_{oc}	Log K_{oa}	PNECsoil (ng/g)	Sludge adsorption (%)	Soil half-life time (h)	MDL (ng/g dw)	Source
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	38051-10-4	New	582.9	2.1	0.0±1.7	1.92	3.08	–	–	–	–	0.70	Wang et al. 2019
2-Butoxy-, hydrogen phosphate ethanol	14260-97-0	New	298.3	410.1	3.16E-07	1.74	3.775	12.116	552	1.97	–	0.68	Wang et al. 2019
2-Ethylhexyl diphenyl phosphate	1241-94-7	New	362.40	1.90	3.34E-05	6.30	4.20	8.92	30.2	89.79	720	0.90	Wang et al. 2019
Ammelide[c]	645-93-2	New	–	50,000,000		-1.22	1.68	–	–	1.75	3240	–	Zhu et al. 2019
Ammeline[c]	645-92-1	New	–	1,000,000,000	–	-4.08	2.35	–	–	1.75	3240	–	Zhu et al. 2019
Bis(1,3-dichloropropan-2-yl) hydrogen phosphate	72236-72-7	New	319.9	130	1.03E-07	2.18	2.640	10.998	–	2.35	–	0.03	Wang et al. 2019
Bis(2-chloroethyl) phosphate	3040-56-0	New	222.9	6456	1.22E-05	0.83	1.649	8.988	512	1.78	–	1.11	Wang et al. 2019
Bis(2-ethylhexyl) phosphate	298-07-7	New	322.4	0.05926	1.8E-07	6.07	4.235	11.845	–	91.66	–	1.38	Wang et al. 2019
Bis(2-methylphenyl) hydrogen phosphate	35787-74-7	New	278.2	6.652	4.69E-08	3.97	2.519	12.245	–	28.4	–	0.02	Wang et al. 2019
Bisphenol A bis(diphenyl phosphate) (BDP)	5945-33-5	New	692.6	0.42	0.0±2.0	8.66	5.72		–		–	0.42	Wang et al. 2019
Cresyl diphenyl phosphate (CDPP)	26444-49-5	New	340.3	0.233	1.04E-07	5.25	3.92	10.9	–	83.47	1.8E+03	1.59E+00	Wang et al. 2019
Cyanuric acid[d]	108-80-5	New	–	1,990,000	–	1.95	1.00		–	2.11	3240	–	Zhu et al. 2019
Dibutyl ester phosphoric acid	107-66-4	New	210.2	430.1	3.79E-05	2.29	2.180	9.049	341	2.52	–	1.17	Wang et al. 2019
Diethyl hydrogen phosphate	598-02-7	New	154.1	3.844E+04	1.83E-03	0.32	1.117	7.572	–	1.76	–	0.40	Wang et al. 2019
Diisobutyl hydrogen phosphate	6303-30-6	New	210.2	574.3	1.12E-04	2.14	2.027	8.899	–	2.3	–	0.47	Wang et al. 2019
Diphenyl phosphate (DPHP)	838-85-7	New	250.1	82.38	2.26E-07	2.88	2.082	11.243	353	4.67	–	0.39	Wang et al. 2019
Dipropyl ester phosphoric acid	1804-93-9	New	182.1	4115	2.39E-04	1.31	1.649	8.315	–	1.84	–	0.13	Wang et al. 2019
Isodecyl diphenyl phosphate (IDDP)	29761-21-5	New	390.4	0.75	4.72E-08	7.28	4.69	12.0	–	93.16	1.8E+03	6.3E-01	Wang et al. 2019
Melamine[c]	108-78-1	New	–	3,240,000	–	-1.37	1.32	–	500	1.75	1800	–	Zhu et al. 2019
Resorcinol bis(diphenyl phosphate) (RDP)	57583-54-7	New	574.5	1.10E+04	0.0±1.6	5.97	4.54	–	–	–	–	0.60	Wang et al. 2019
Tert-butylphenyl diphenyl phosphate	56803-37-3	New	382.3	8.90E-03	2.61E-08	6.61	4.57	11.9	–	92.79	1.8E+03	9.6E-01	Wang et al. 2019
Tributyl phosphate	126-73-8	New	266.31	7.35	3.49E-03	3.82	3.27	9.21	900	29.74	416	1.70	Wang et al. 2019
Triethyl phosphate (TEP)	78-40-0	New	182.15	5.00E+05	0.165	0.87	1.68	6.63	–	1.78	720	0.98	Wang et al. 2019
Triisobutyl phosphate	126-71-6	New	266.32	16.2	1.28E-02	3.6	3.04	7.48	1060	15.3	720	0.15	Wang et al. 2019
Trimethyl phosphate (TMP)	512-56-1	New	140.8	5.00E+05	0.85	-0.65	0.88	5.88		1.76	720	0.26	Wang et al. 2019
Tripropyl phosphate	513-08-6	New	224.23	6.45E+03	2.31E-02	2.35	2.47	6.42	226	2.05	720	1.68	Wang et al. 2019
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	13674-87-8	New	430.90	7.00	2.86E-07	3.65	3.96	10.6	320	16.7	8.64E+03	7.2E-01	Wang et al. 2019
Tris(2-chloroisopropyl) phosphate	13674-84-5	New	327.57	1.20E+03	5.64E-05	2.89	3.10	8.20	1700	3.27	2.88E+03	5.6E-01	Wang et al. 2019
Tris(2-ethylhexyl) phosphate (TEHP)	78-42-2	New	434.63	0.6	6.07E-07	9.49	6.35	14.9	21.8	93.26	416	1.62	Wang et al. 2019
Tris(4-tert-butylphenyl) phosphate	78-33-1	New	494	9.62E-07	2.06E-08	10.43	6.28	14.9		93.26	8.64E+03	1.26E+00	Wang et al. 2019
Tris(methylphenyl) phosphate	1330-78-5	New	368.36	0.30	3.49E-08	6.34	4.34	12.0	2.70	92.39	1.8E+03	2.8E-01	Wang et al. 2019
Azithromycin[a]	83905-01-5	Previous	–	–	–	–	1990 L/kg (not log)	–	–	–	–	–	Sidhu et al. 2019c
Ciprofloxacin[b]	85721-33-1	Previous	–	–	–	–	1660 L/kg (not log)	–	–	–	–	–	Sidhu et al. 2019c
Triphenyl phosphate	115-86-6	Previous	326.28	1.90	4.72E-07	4.70	3.71	8.45	130	60.09	1.8E+03	7.30E-01	Wang et al. 2019
Tris(2-butoxyethyl) phosphate	78-51-3	Previous	398.47	1.10E+03	1.23E-06	3.00	5.66	13.0	2480	19.84	416	0.40	Wang et al. 2019
Tris(2-chloroethyl) phosphate	115-96-8	Previous	285.49	7.00E+03	3.91E-04	1.63	2.47	7.42	386	1.86	2.88E+03	6.40E-01	Wang et al. 2019

Notes

CAS = Chemical Abstracts Service

[a] = Kd is 428 L/kg

[b] = Kd is 357 L/kg

[c] = Degradation rate is 0.09%

[d] = Degradation rate is 0.1%

Table G-2. Physical/Chemical Properties Related to Water and Soil from EPISUITE and ORNL for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Solubility based on log K_{ow} (mg/L) - WSKOWWIN	Solubility based on fragment constant (mg/L) WATERNT	Solubility (PHYSPROP)	Solubility units (PHYSPROP)	Log K_{ow} (atom fragment contrib method) - KOWWIN	Log K_{ow} (PHYSPROP)	Log K_{oc} (MCI method corrected) - KOCWIN	Log K_{oc} (log Kow method corrected) - KOCWIN	F_{oc} - Organic carbon partition coefficient (L/kg) - ORNL	Water degradation half-life (hr) - AOPWIN & BIOWIN	Soil degradation half-life (hr) - AOPWIN & BIOWIN
2,2',3,3',4,4',5,6'-Octachlorobiphenyl	196	42740-50-1	4.88E-05	8.10E-05	0.000163	mg/L at 25 C	8.98	—	5.7665	5.9979	—	4320	8640
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	0.0002842	0.00036674	0.00347	mg/L at 20 C	8.27	—	5.5525	5.6439	356800	4320	8640
2,2',3,3',4,4'-Hexachlorobiphenyl	128	38380-07-3	0.003044	0.0016469	0.00035	mg/L at 25 C	7.31	7.31	5.3384	5.1129	—	4320	8640
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	201	40186-71-8	4.88E-05	8.10E-05	0.000271	mg/L at 25 C	8.91	—	5.7665	5.9979	—	4320	8640
2,2',3,3',4,5-Hexachlorobiphenyl	129	55215-18-4	0.002984	0.0016469	0.00137	mg/L at 25 C	7.32	7.32	5.3384	5.1184	—	4320	8640
2,2',3,3',4,6-Hexachlorobiphenyl	131	61798-70-7	0.003425	0.0016469	0.0012	mg/L at 25 C	7.25	7.25	5.3384	5.0797	—	4320	8640
2,2',3,3',5,5',6-Heptachlorobiphenyl	178	52663-67-9	0.0002842	0.00036674	0.00102	mg/L at 25 C	8.2685	—	5.5437	5.6439	—	4320	8640
2,2',3,3',6,6'-Hexachlorobiphenyl	136	38411-22-2	0.004422	0.0016469	0.00451	mg/L at 25 C	7.12	7.12	5.3384	5.0078	—	4320	8640
2,2',3,4,4',5,5',6-Octachlorobiphenyl	203	52663-76-0	4.88E-05	8.10E-05	0.000136	mg/L at 25 C	8.913	—	5.7665	5.9979	—	4320	8640
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	0.0002842	0.00036674	0.00385	mg/L at 20 C	8.27	—	5.5437	5.6439	349700	4320	8640
2,2',3,4,4',5'-Hexachlorobiphenyl	138	35065-28-2	0.002357	0.0016469	0.0015	mg/L at 20 C	7.44	7.44	5.3296	5.1848	—	4320	8640
2,2',3,4,4'-Pentachlorobiphenyl	85	65510-45-4	0.01943	0.0073282	0.00783	mg/L at 25 C	6.61	6.61	5.1155	4.7257	—	4320	8640
2,2',3,4,5'-Pentachlorobiphenyl	87	38380-02-8	0.01212	0.0073282	0.0294	mg/L at 20 C	6.85	6.85	5.1155	4.8584	—	4320	8640
2,2',3,5',6-Pentachlorobiphenyl	95	38379-99-6	0.02186	0.0073282	0.0211	mg/L at 20 C	6.55	6.55	5.1155	4.6925	—	4320	8640
2,2',3,5-Tetrachlorobiphenyl	43	70362-46-8	0.05316	0.032245	0.172	mg/L at 25 C	6.34	—	4.9014	4.5763	—	4320	8640
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	0.05316	0.032245	0.146	mg/L at 25 C	6.34	—	4.91	4.5763	—	4320	8640
2,2',4,4',5,5'-Hexachlorobiphenyl	153	35065-27-1	0.001281	0.0016469	0.00095	mg/L at 24 C	7.75	7.75	5.3208	5.3563	—	4320	8640
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	0.05808	0.032245	0.0541	mg/L at 22 C	6.29	6.29	4.8926	4.5487	—	4320	8640
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	0.01337	0.0073282	0.0154	mg/L at 25 C	6.8	6.8	5.1067	4.8308	—	4320	8640
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	0.06665	0.032245	0.0781	mg/L at 25 C	—	6.22	4.8926	4.51	—	4320	8640
2,2',4,5-Tetrachlorobiphenyl	48	70362-47-9	0.05316	0.032245	0.0164	mg/L at 25 C	6.335	—	4.9014	4.5763	—	4320	8640
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	0.05316	0.032245	0.0654	mg/L at 25 C	6.34	—	4.9014	4.5763	—	4320	8640
2,2',5,5'-Tetrachlorobiphenyl	52	35693-99-3	0.08606	0.032245	0.0153	mg/L at 25 C	—	—	4.8926	4.4381	—	4320	8640
2,2',6-Trichlorobiphenyl	19	38444-73-4	0.448	0.13991	0.324	mg/L at 25 C	5.48	5.48	4.696	4.1006	—	1440	2880
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	NA	38051-10-4	0.312	33.402	—	—	3.31	—	6.288	2.859	—	4.32E+03	8.64E+03
2,2'-Dichlorobiphenyl	4	13029-08-8	1.714	0.59619	1.85	mg/L at 25 C		4.97	4.1382	4.3131	—	900	1800
2,3,3',4,4',5,6-Heptachlorobiphenyl	190	41411-64-7	0.0002842	0.00036674	—	—	8.27	—	5.5525	5.6439	—	4320	8640
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	0.001641	0.0016469	0.00807	mg/L at 20 C	7.62	—	5.3296	5.2843	—	4320	8640
2,3,3',4',5,6-Hexachlorobiphenyl	163	74472-44-9	0.003779	0.0016469	0.0012	mg/L at 25 C	7.2	7.2	5.3296	5.052	—	4320	8640
2,3',4,4'-Tetrachlorobiphenyl	66	32598-10-0	0.05584	0.032245	0.0368	mg/L at 20 C	6.31	6.31	4.8926	4.5597	—	4320	8640
2,3,4'-Trichlorobiphenyl	22	38444-85-8	0.5049	0.13991	0.142	mg/L at 20 C	5.42	5.42	4.6873	4.0675	—	1440	2880
2,3,6-Trichlorobiphenyl	24	55702-45-9	0.3088	0.13991	0.0833	mg/L at 25 C	5.67	5.67	4.6961	4.2057	—	1440	2880
2,3',6-Trichlorobiphenyl	27	38444-76-7	0.2966	0.13991	0.0386	mg/L at 20 C	5.69		4.6873	4.2168	—	1440	2880
2,3-Dichlorobiphenyl	5	16605-91-7	1.711	0.59619	0.997	mg/L at 25 C	5.02	5.02	4.1382	4.3565	—	900	1.80E+03
2,4',5-Trichlorobiphenyl	31	16606-02-3	0.2969	0.13991	0.143	mg/L at 25 C	5.69	5.69	4.6785	4.2168	—	1400	2880
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	0.512	0.74303	35	mg/L at 25 C	6.39	6.06	4.8	4.444	—	1440	2880
2,4'-Dichlorobiphenyl	8	34883-43-7	1.491	0.59619	1.17	mg/L at 25 C	5.09	5.09	4.1294	4.4172	—	900	1800
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	5.704	32.493	35	mg/L at 25 C	5.3318	5.19	3.9547	3.9627	—	900	1800
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	0.4441	3.1126	—	—	6.314	—	4.5393	4.5822	—	900	1800
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	4.316	32.493	—	—	5.33	—	3.955	4.04	—	900	1800
2,6-Dichlorobiphenyl	10	33146-45-1	1.851	0.59619	2.41	mg/L at 25 C	4.98	4.98	4.1382	4.3217	—	900	1800
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	1.501	30.169	—	—	3.65	—	4.0465	3.0474	—	4320	8640
2-Chlorobiphenyl	1	2051-60-7	8.804	2.48	4.83	mg/L at 25 C	4.402	4.53	3.9241	3.9312	—	900	1800
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	0.06659	0.1844	1.9	mg/L at 25 C	5.73	5.73	4.5074	3.8683	—	360	720
3,4,4'-Trichlorobiphenyl	37	38444-90-5	0.1965	0.13991	0.0719	mg/L at 20 C	5.9	5.9	4.6785	4.333	—	1440	2880

Table G-2. Physical/Chemical Properties Related to Water and Soil from EPISUITE and ORNL for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Solubility based on log K_{ow} (mg/L) - WSKOWWIN	Solubility based on fragment constant (mg/L) WATERNT	Solubility (PHYSPROP)	Solubility units (PHYSPROP)	Log K_{ow} (atom fragment contrib method) - KOWWIN	Log K_{ow} (PHYSPROP)	Log K_{oc} (MCI method corrected) - KOCWIN	Log K_{oc} (log Kow method corrected) - KOCWIN	F_{oc} - Organic carbon partition coefficient (L/kg) - ORNL	Water degradation half-life (hr) - AOPWIN & BIOWIN	Soil degradation half-life (hr) - AOPWIN & BIOWIN
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	NA	4221-80-1	1.92E-05	1.62E-05	—	—	10	—	6.62E+00	6.558	—	4.32E+03	8.64E+03
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	0.2479	0.50593	—	—	6.43	—	4.924	4.649	—	1.44E+03	2.88E+03
4,4',4''-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol	NA	1843-03-4	2.01E-08	5.45E-07	—	—	12.7	—	9.7575	8.4504	—	4.32E+03	8.64E+03
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)	NA	118-82-1	0.0001707	0.00013684	—	—	8.99	—	7.562	6.231	—	4.32E+03	8.64E+03
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)	NA	96-69-5	0.001906	0.0568	—	—	8.24	—	6.299	5.817	—	3.27	55.6
4-Chlorobiphenyl	3	2051-62-9	8.804	2.48	1.34	mg/L at 25 C	4.4015	4.61			8229	900	1800
6:2 Fluorotelomer sulfonic acid	NA	27619-97-2	10.97	1.9609	—	—	2.66	—	4.0511	2.3964	—	4320	8640
8:2 Fluorotelomer sulfonic acid	NA	39108-34-4	0.1821	0.00445	—	—	4	—	5.354	3.138	—	4320	8640
Ammelide	NA	645-93-2	5.01E+04	9.32E+05	76.9	mg/L at 2 C	-1.2163	—	1.3504	0.1965	—	360	720
Ammeline	NA	645-92-1	1.00E+06	1.00E+06	75	mg/L at 23 C	-3.6476	—	2.1414	-1.1592	—	360	720
Amoxicillin	NA	26787-78-0	3433	1.00E+06	—	—	0.9736	0.87	2.035	0.7091	—	900	1800
Ampicillin	NA	69-53-4	439.3	1.00E+06	1.00E+04	mg/L at 21 C	1.4538	1.35	1.9263	0.8077	—	900	1800
Bis(2-chloroethyl) phosphate	NA	3040-56-0	6456	56368	—	—	0.83	—	1.7756	1.4875	—	900	1800
Bis(2-ethylhexyl) phosphate	NA	298-07-7	0.05926	0.83431	182	mg/L at 25 C	6.07	—	4.311	4.3859	—	360	720
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	6.652	50.767	—	—	3.97	—	2.8368	2.8948	—	900	1800
Cesium[a]	NA	7440-46-2	5.71E+04	2.36E+05	—	—	0.23	—	1.121	0.199	—	360	720
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	0.9973	1.454	0.24	mg/L at 25 C	4.51	4.51	4.245	3.1934	—	900	1800
Cyanuric acid	NA	108-80-5	4.88E-05	8.10E-05	—	—	8.91	—	5.7665	5.9979	—	4320	8640
Decachlorobiphenyl	NA	2051-24-3	6.32E-05	3.89E-06	7.43E-06	mg/L at 25 C	10.2	8.27	—	—	—		
Dibutyl ester phosphoric acid	NA	107-66-4	430.1	3830.2	1.72E+04	mg/L at 25 C	2.29	—	2.2969	2.2951	—	208.1	416.2
Dichlorobiphenyl	NA	25512-42-9	1.78	0.59619	0.055	mg/L	5.05	5	4.1382	4.3391	—		
Diethyl hydrogen phosphate	NA	598-02-7	3.84E+04	3.95E+05	—	—	0.32	—	1.254	1.205	—	360	720
Diisobutyl hydrogen phosphate	NA	6303-30-6	574.3	10757	—	—	2.14	—	2.147	2.212	—	900	1800
Diphenyl phosphate (DPHP)	NA	838-85-7	82.38	513.03	—	—	2.88	—	2.426	2.292	—	900	1.80E+03
Dipropyl ester phosphoric acid	NA	1804-93-9	4115	39359	—	—	1.31	—	1.7756	1.753	—	360	720
Heptachlorobiphenyl	NA	28655-71-2	0.0002842	0.00036674	0.000314	mg/L at 25 C	8.27	—	5.544	5.644	—	4.32E+03	8.64E+03
Hexachlorobiphenyl	NA	26601-64-9	0.001281	0.0016469	0.0035	mg/L at 25 C	6.34	6.34	5.321	5.365	—	4.32E+03	8.64E+03
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	0.07929	0.016753	0.75	mg/L at 25 C	5.44	5.44	4.9891	3.7079	97530	900	1800
Melamine	NA	108-78-1	1.00E+06	1040.5	3230	mg/L at 20 C	—	-1.37	1.509	0.0002	—	900	1800
Monochlorobiphenyl	NA	27323-18-8	6.122	2.48	—	—	4.58	—	3.915	3.975	—	900	1800
Nalidixic acid	NA	389-08-2	3224	1.50E+05	100	mg/L at 23 C	—	1.59	0.7816	1.342	—	900	1800
Nonachlorobiphenyl	NA	53742-07-7	1.90E-05	1.78E-05	0.00011	mg/L at 182 C	9.14	—	5.989	6.125	—	4.32E+03	8.64E+03
Octachlorobiphenyl	NA	55722-26-4	4.88E-05	8.10E-05	0.000271	mg/L at 25 C	8.91	—	5.767	5.998	—	4320	8640
Pentachlorobiphenyl	NA	25429-29-2	0.01337	0.007282	—	—	6.98	5.68	5.107	4.831	—	4.32E+03	8.64E+03
Polychlorinated biphenyl (PCB)	NA	1336-36-3	0.05808	0.032245	0.7	mg/L at 25 C	6.29	7.1	4.893	4.549	78100	4.32E+03	8.64E+04
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	0.0001113	0.0068756	—	—	7.41	—	8.3237	4.7975	—	900	1800
Sulfate	NA	14808-79-8	1.00E+06	1.00E+06	—	—	-2.2	—	0.3444	-0.1303	—	360	720
Sulfur[a, e]	NA	7704-34-9	1.00E+06	60488	—	—	-1.38	—	1.121	3.1674	—	360	720
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	0.1668	0.098469	32	mg/L at 25 C	5.12	5.12	4.8676	3.5309	—	900	1800
Tetrabutyl ethylidenebisphenol (AO22E46)	NA	35958-30-6	0.000107	6.88E-05	—	—	9.13	—	7.7844	6.3089	—	4320	8640
Tetrachlorobiphenyl	NA	26914-33-0	0.08606	0.032245	0.046	mg/L	6.09	—	4.893	4.438	—	4.32E+03	3.89E+04
Tributyl phosphate	NA	126-73-8	7.355	101.04	280	mg/L at 25 C	—	4	3.3711	3.241	2350	208.1	416.2
Trichlorobiphenyl	NA	25323-68-6	0.391	0.13991	—	—	5.55	5.48	4.687	4.139	—	1.44E+03	2.88E+03
Triethyl phosphate (TEP)	NA	78-40-0	1.12E+04	1.15E+05	5.00E+05	mg/L at 25 C	—	0.8	1.8072	1.471	—	360	720

Table G-2. Physical/Chemical Properties Related to Water and Soil from EPISUITE and ORNL for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Solubility based on log K_{ow} (mg/L) - WSKOWWIN	Solubility based on fragment constant (mg/L) WATERNT	Solubility (PHYSPROP)	Solubility units (PHYSPROP)	Log K_{ow} (atom fragment contrib method) - KOWWIN	Log K_{ow} (PHYSPROP)	Log K_{oc} (MCI method corrected) - KOCWIN	Log K_{oc} (log Kow method corrected) - KOCWIN	F_{oc} - Organic carbon partition coefficient (L/kg) - ORNL	Water degradation half-life (hr) - AOPWIN & BIOWIN	Soil degradation half-life (hr) - AOPWIN & BIOWIN
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)[d]	NA	36443-68-2	7.31E-05	0.0038365	—	—	8.207	—	6.2819	5.4876	—	4320	8640
Triisobutyl phosphate	NA	126-71-6	0.06659	0.1844	—	—	5.73	—	4.5074	3.8683	—	360	720
Trimethyl phosphate (TMP)	NA	512-56-1	3.00E+05	1.00E+06	5.00E+05	mg/L at 25 C	-0.65	-0.65	1.0253	0.6689	10.6	360	720
Trimethylsilanol (TMS)	NA	1066-40-6	4.26E+04	1.00E+06	—	—	1.14	—	1.6424	0.989	—	360	720
Tripropyl phosphate	NA	513-08-6	826.6	3474.1	6450	mg/L at 25 C	—	1.87	2.5892	2.0628	—	360	720
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	1.501	30.169	7	mg/L at 24 C	3.65	3.65	4.0465	3.0474	11130	4320	8640
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	51.85	740.16	1200	mg/L at 25 C	2.59	2.59	3.2051	2.4611	1604	1440	2880
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	1.46E-05	0.00027907	0.6	mg/L at 24 C	9.49	—	6.3923	6.2777	2468000	208.1	416.2
Tris(4-tert-butylphenyl) phosphate	NA	78-33-1	9.62E-07	4.12E-05	—	—	10.43	—	6.541	6.468	—	4.32E+03	8.64E+03
Tris(methylphenyl) phosphate	NA	1330-78-5	0.2073	0.14004	—	—	5.11	—	4.6731	3.5253	—	900	1800

Notes

CAS = Chemical Abstracts Service

[a] = Inorganic compound, outside of EPISuite estimation domain

[b] = K_d is 7.5 cm^3/g

[c] = Water degradation - hydrolysis rate constant (estimated using HYDROWIN) is $2.48E^{-8}$

[d] = Water degradation - hydrolysis rate constant (estimated using HYDROWIN) is $3.5E^{-1}$

[e] = K_{oc} is not corrected

Table G-3. Physical/Chemical Properties Related to Air in EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Molecular weight	Vapor pressure (mmHg) - MPBPWIN	Vapor pressure (PHYSPROP)	Vapor pressure units (PHYSPROP)	Henry's law constant - bond est (atm-m^3/mole) - HENRYWIN	Henry's law constant - group est (atm-m^3/mole) - HENRYWIN	Henry's law constant (PHYSPROP)	Henry's law constant units (PHYSPROP)	Air degradation half-life (hr) - AOPWIN & BIOWIN	Air overall OH degradation rate constant (cm^3/molecule-sec) - AOP	Air fraction sorbed to airborne particulates (Junge-Pankow, Mackay avg) - AOP	Air fraction sorbed to airborne particulates (K_{oa}) - AOP
2,2',3,3',4,4',5,6'-Octachlorobiphenyl	196	42740-50-1	429.77	2.87E-08	—	—	3.76E-05	1.17E-04	1.00E-05	atm-m3/mole at 25 C	3650	7.03E-14	0.502	0.975
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	395.33	1.30E-07	6.28E-07	mm Hg at 25 C	5.07E-05	1.38E-04	9.00E-06	atm-m3/mole at 25 C	2453	1.05E-13	0.0807	0.909
2,2',3,3',4,4'-Hexachlorobiphenyl	128	38380-07-3	360.88	5.81E-07	2.56E-06	mm Hg at 25 C	6.85E-05	1.62E-04	1.30E-05	atm-m3/mole at 25 C	1565	1.64E-13	0.031	0.43
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	201	40186-71-8	429.77	2.87E-08	—	—	3.76E-05	1.17E-04	1.70E-05	atm-m3/mole at 25 C	3650	7.03E-14	0.502	0.958
2,2',3,3',4,5-Hexachlorobiphenyl	129	55215-18-4	360.88	5.81E-07	—	—	6.85E-05	1.62E-04	2.90E-05	atm-m3/mole at 25 C	1217	2.11E-13	0.115	0.257
2,2',3,3',4,6-Hexachlorobiphenyl	131	61798-70-7	360.88	5.81E-07	—	—	6.85E-05	1.62E-04	3.90E-05	atm-m3/mole at 25 C	1169	2.20E-13	0.115	0.18
2,2',3,3',5,5',6-Heptachlorobiphenyl	178	52663-67-9	395.33	1.30E-07	—	—	5.07E-05	1.38E-04	2.30E-05	atm-m3/mole at 25 C	1833	1.40E-13	0.266	0.796
2,2',3,3',6,6'-Hexachlorobiphenyl	136	38411-22-2	360.88	5.81E-07	—	—	6.85E-05	1.62E-04	8.80E-05	atm-m3/mole at 25 C	1565	1.64E-13	0.115	0.0671
2,2',3,4,4',5,5',6-Octachlorobiphenyl	203	52663-76-0	429.77	2.87E-08	—	—	3.76E-05	1.17E-04	—	—	4202	6.11E-14	0.502	0.912
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	395.33	1.30E-07	9.77E-07	mm Hg at 25 C	5.07E-05	1.38E-04	1.00E-05	atm-m3/mole at 25 C	2453	1.05E-13	0.0536	0.13
2,2',3,4,4',5'-Hexachlorobiphenyl	138	35065-28-2	360.88	5.81E-07	3.80E-06	mm Hg at 25 C	6.85E-05	1.62E-04	2.10E-05	atm-m3/mole at 25 C	1565	1.64E-13	0.0212	0.0597
2,2',3,4,4'-Pentachlorobiphenyl	85	65510-45-4	326.44	2.22E-06	—	—	9.24E-05	1.90E-04	6.60E-05	atm-m3/mole at 25 C	642.5	4.00E-13	0.0443	0.0288
2,2',3,4,5'-Pentachlorobiphenyl	87	38380-02-8	326.44	2.22E-06	1.70E-05	mm Hg at 25 C	9.24E-05	1.90E-04	7.40E-05	atm-m3/mole at 25 C	766.8	3.35E-13	0.0063	0.0439
2,2',3,5',6-Pentachlorobiphenyl	95	38379-99-6	326.44	2.22E-06	—	—	9.24E-05	1.90E-04	1.20E-04	atm-m3/mole at 25 C	641.8	3.35E-13	0.0443	0.012
2,2',3,5-Tetrachlorobiphenyl	43	70362-46-8	291.99	8.45E-06	—	—	1.25E-04	2.23E-04	—	—	337.9	7.60E-13	0.0164	0.00835
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	291.99	8.45E-06	—	—	1.25E-04	2.23E-04	—	—	445.2	5.77E-13	0.0164	0.00835
2,2',4,4',5,5'-Hexachlorobiphenyl	153	35065-27-1	360.88	5.81E-07	3.43E-06	mm Hg at 25 C	6.85E-05	1.62E-04	2.30E-05	atm-m3/mole at 25 C	1565	1.64E-13	0.0234	0.0954
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	291.99	8.45E-06	8.63E-05	mm Hg at 25 C	1.25E-04	2.23E-04	1.90E-04	atm-m3/mole at 25 C	256.8	8.13E-13	0.00165	0.00491
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	326.44	2.22E-06	2.50E-05	mm Hg at 25 C	9.24E-05	1.90E-04	9.00E-05	atm-m3/mole at 25 C	766.8	3.35E-13	0.00425	0.022
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	291.99	8.45E-06	8.48E-06	mm Hg at 25 C	1.25E-04	2.23E-04	2.10E-04	atm-m3/mole at 25 C	332.6	7.72E-13	0.0165	0.0048
2,2',4,5-Tetrachlorobiphenyl	48	70362-47-9	291.99	8.45E-06	—	—	1.25E-04	2.23E-04	—	—	445.2	5.77E-13	0.0164	0.00835
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	291.99	8.45E-06	—	—	1.25E-04	2.23E-04	1.40E-04	atm-m3/mole at 25 C	315.6	8.13E-13	0.0164	0.00744
2,2',5,5'-Tetrachlorobiphenyl	52	35693-99-3	291.99	8.45E-06	—	—	1.25E-04	2.23E-04	2.00E-04	atm-m3/mole at 25 C	351.6	7.30E-13	0.0164	0.00576
2,2',6-Trichlorobiphenyl	19	38444-73-4	257.55	4.00E-05	—	—	1.68E-04	2.62E-04	2.30E-04	atm-m3/mole at 25 C	216.5	1.19E-12	0.00592	0.000631
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	NA	38051-10-4	583	2.06E-08	—	—	1.55E-14	—	—	—	3.322	7.73E-11	0.928	1
2,2'-Dichlorobiphenyl	4	13029-08-8	223.1	0.00275	0.00275	mm Hg at 25	2.27E-04	3.08E-04	2.30E-04	atm-m3/mole at 25 C	128.4	1.73E-12	0.000207	0.000297
2,3,3',4,4',5,6-Heptachlorobiphenyl	190	41411-64-7	395.33	1.30E-07	—	—	5.07E-05	1.38E-04	—	—	2065	1.24E-13	0.266	0.638
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	360.88	1.55E-06	—	—	6.85E-05	1.62E-04	—	—	1169	2.20E-13	0.115	0.226
2,3,3',4',5,6-Hexachlorobiphenyl	163	74472-44-9	360.88	5.81E-07	—	—	6.85E-05	1.62E-04	1.50E-05	atm-m3/mole at 25 C	1.22E+03	2.11E-13	0.115	0.336
2,3',4,4'-Tetrachlorobiphenyl	66	32598-10-0	291.99	8.45E-06	4.60E-05	mm Hg at 25	1.25E-04	2.23E-04	1.20E-04	atm-m3/mole at 25 C	332.6	7.72E-13	0.00307	0.0201
2,3,4'-Trichlorobiphenyl	22	38444-85-8	257.55	4.00E-05	—	—	1.68E-04	2.62E-04	1.40E-04	atm-m3/mole at 25 C	235.3	1.09E-12	0.00592	0.000901
2,3,6-Trichlorobiphenyl	24	55702-45-9	257.55	4.00E-05	—	—	1.68E-04	2.62E-04	2.20E-04	atm-m3/mole at 25 C	204.5	1.26E-12	0.00592	0.00102
2,3',6-Trichlorobiphenyl	27	38444-76-7	257.55	4.00E-05	—	—	1.68E-04	2.62E-04	—	—	138.2	1.86E-12	0.00592	0.0014
2,3-Dichlorobiphenyl	5	16605-91-7	223.1	0.00019	—	—	2.27E-04	3.08E-04	2.30E-04	atm-m3/mole at 25 C	104	2.47E-12	0.00198	0.000219
2,4',5-Trichlorobiphenyl	31	16606-02-3	257.55	4.00E-05	0.0004	mm Hg at 25 C	1.68E-04	2.62E-04	—	—	213.9		0.00058	0.00163
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	262.44	0.0002	0.000661	mm Hg extrap at 25 C	9.65E-06	6.89E-06	—	—	16.04	1.60E-11	0.000177	0.0541
2,4'-Dichlorobiphenyl	8	34883-43-7	223.1	0.000191	0.00209	mm Hg at 25 C	2.27E-04	3.08E-04	2.30E-04	atm-m3/mole at 25 C	148.7	1.73E-12	0.000173	0.000493
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	206.33	0.00267	0.0047	mm Hg extrap at 25 C	0.00000374	0.00000315	—	—	5.227	4.91E-11	0.000134	0.0195
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	234.38	0.000347	—	—	6.59E-06	6.29E-06	—	—	4.994	5.14E-11	0.00375	0.13
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	206.33	0.000618	—	—	3.74E-06	3.15E-06	—	—	2.878	8.92E-11	0.000676	0.0267
2,6-Dichlorobiphenyl	10	33146-45-1	223.1	0.000191	—	—	2.27E-04	3.08E-04	2.30E-04	atm-m3/mole at 25 C	104.1	2.47E-12	0.00198	0.0002
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	430.91	2.86E-07	—	—	2.61E-09				14.2	1.81E-11	0.795	0.451
2-Chlorobiphenyl	1	2051-60-7	188.66	0.00637	0.00138	mm Hg at 25 C	3.07E-04	3.62E-04	7.36E-04	atm-m3/mole at 25 C	91.03	3.48E-12	0.000772	2.21E-05
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	362.41	3.34E-05	5.00E-05	mm Hg at 25 C	2.48E-07		5.42E-05	atm-m3/mole at 25 C	6.442	3.98E-11	0.0254	0.00473
3,4,4'-Trichlorobiphenyl	37	38444-90-5	257.55	4.00E-05	—	—	1.68E-04	2.62E-04	1.00E-04	atm-m3/mole at 25 C	235.3	1.09E-12	0.00592	0.0038

Table G-3. Physical/Chemical Properties Related to Air in EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Molecular weight	Vapor pressure (mmHg) - MPBPWIN	Vapor pressure (PHYSPROP)	Vapor pressure units (PHYSPROP)	Henry's law constant - bond est (atm-m^3/mole) - HENRYWIN	Henry's law constant - group est (atm-m^3/mole) - HENRYWIN	Henry's law constant (PHYSPROP)	Henry's law constant units (PHYSPROP)	Air degradation half-life (hr) - AOPWIN & BIOWIN	Air overall OH degradation rate constant (cm^3/molecule-sec) - AOP	Air fraction sorbed to airborne particulates (Junge-Pankow, Mackay avg) - AOP	Air fraction sorbed to airborne particulates (K_{oa}) - AOP
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	NA	4221-80-1	438.66	1.35E-10	—	—	5.93E-08	—	—	—	21.67	1.18E-11	0.991	1
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	262.44	2.07E-05	—	—	9.65E-06	1.02E-05	—	—	12.54	2.05E-11	0.011	0.118
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol	NA	1843-03-4	544.82	1.55E-15	—	—	2.36E-15	—	—	—	1.23	2.09E-10	1	1
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)	NA	118-82-1	424.67	1.19E-11	—	—	2.31E-10	3.30E-11	—	—	7.21	3.56E-11	0.999	1
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)	NA	96-69-5	358.54	2.17E-10	—	—	2.76E-12	—	—	—	0.000653	1.30E-10	0.995	1
4-Chlorobiphenyl	3	2051-62-9	188.66	0.00138	0.0105	mm Hg at 25 C	3.07E-04	3.62E-04	5.73E-04	atm-m3/mole at 25 C	66.5	3.48E-12	0.000772	0.000124
6:2 Fluorotelomer sulfonic acid	NA	27619-97-2	428.17	0.000862	—	—	7.00E-04	—	—	—	196	1.31E-12	0.000637	3.13E-07
8:2 Fluorotelomer sulfonic acid	NA	39108-34-4	528.18	0.00045	—	—	1.93E-02	—	—	—	196	1.31E-12	0.00102	2.49E-07
Ammelide	NA	645-93-2	128.09	8.40E-09	—	—	9.73E-15	—	—	—	11.16	2.30E-11	0.722	0.748
Ammeline	NA	645-92-1	127.11	3.44E-07	—	—	1.19E-16	—	—	—	5.969	4.30E-11	0.12	0.475
Amoxicillin	NA	26787-78-0	365.41	4.69E-17	—	—	2.49E-21	—	—	—	1.848	1.39E-10	1	1
Ampicillin	NA	69-53-4	349.41	2.84E-13	—	—	2.39E-17	—	—	—	2.484	1.03E-10	1	1
Bis(2-chloroethyl) phosphate	NA	3040-56-0	222.99	4.42E-06	—	—	1.70E-10	—	—	—	17.35	1.48E-11	0.0955	0.0187
Bis(2-ethylhexyl) phosphate	NA	298-07-7	322.43	1.80E-07	—	—	4.11E-08	—	—	—	3.926	6.54E-11	0.864	0.932
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	278.25	1.26E-08	—	—	1.30E-10	—	—	—	27.67	9.27E-12	0.96	0.972
Cesium[a]	NA	7440-46-2	132.91	4.24E-09	—	—	2.45E-02	—	—	—	1.00E+05	0.00E+00	0.84	3.33E-11
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	340.32	1.04E-07	4.70E-06	mm Hg at 25 C	4.39E+00	—	—	—	21.77	1.18E-11	0.062	0.27
Cyanuric acid	NA	108-80-5	429.77	2.87E-08	—	—	3.76E-05	1.17E-04	—	—	3650	7.03E-14	0.502	0.958
Decachlorobiphenyl	NA	2051-24-3	498.66	1.02E-10	1.06E-07	mm Hg at 25 C	2.06E-05	8.48E-05	—	—		1.82E-14	0.0201	0.00942
Dibutyl ester phosphoric acid	NA	107-66-4	210.21	3.79E-05	—	—	4.26E-09	—	—	—	4.872	5.27E-11	0.0332	0.0215
Dichlorobiphenyl	NA	25512-42-9	223.1	0.000301	—	—	2.27E-04	3.08E-04	—	—		1.73E-12	0.000207	0.000297
Diethyl hydrogen phosphate	NA	598-02-7	154.1	0.00183	—	—	1.37E-09	—	—	—	6.622	3.88E-11	0.000713	0.000732
Diisobutyl hydrogen phosphate	NA	6303-30-6	210.21	0.000107	—	—	4.26E-09	—	—	—	4.87	5.27E-11	0.0115	0.0153
Diphenyl phosphate (DPHP)	NA	838-85-7	250.19	9.12E-08	—	—	1.06E-10	—	—	—	34.8	7.37E-12	0.835	0.775
Dipropyl ester phosphoric acid	NA	1804-93-9	182.16	0.00021	—	—	2.42E-09	—	—	—	5.148	4.99E-11	0.00543	0.00404
Heptachlorobiphenyl	NA	28655-71-2	395.33	1.30E-07	—	—	5.07E-05	1.38E-04	—	—	1.83E+03	1.40E-13	0.266	0.638
Hexachlorobiphenyl	NA	26601-64-9	360.88	5.81E-07	3.75E-06	mm Hg at 25 C	6.85E-05	1.62E-04	—	—	1.57E+03	1.64E-13	0.0234	0.0954
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	390.46	4.72E-08	8.93E-08		4.36E-07	—	—	—	6.115	4.20E-11	0.854	0.233
Melamine	NA	108-78-1	126.12	8.93E-08	3.59E-10	mm Hg extrap at 20 C	1.89E-13	—	—	—	389.3	6.60E-13	0.691	0.527
Monochlorobiphenyl	NA	27323-18-8	188.66	0.00443	0.0084	mm Hg	3.07E-04	3.62E-04	—	—	48.62	4.88E-12	0.000295	0.00013
Nalidixic acid	NA	389-08-2	232.24	6.17E-08	—	—	5.12E-16		—	—	11.09	2.15E-11	0.117	1
Nonachlorobiphenyl	NA	53742-07-7	464.22	7.60E-09	—	—	2.79E-05	9.96E-05	—	—	7.80E+03	3.29E-14	0.738	0.96
Octachlorobiphenyl	NA	55722-26-4	429.77	2.87E-08	—	—	3.76E-05	1.17E-04	1.70E-05	atm-m3/mole at 25 C	3650	7.03E-14	0.502	0.958
Pentachlorobiphenyl	NA	25429-29-2	326.44	2.22E-06	—	—	9.24E-05	1.90E-04	—	—	766.8	3.35E-13	0.00425	0.022
Polychlorinated biphenyl (PCB)	NA	1336-36-3	291.99	8.45E-06	—	—	1.25E-04	2.23E-04	4.15E-04	atm-m3/mole at 25 C	257	8.13E-13	0.00165	0.00491
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	574.47	2.06E-08	—	—	2.94E-13	—	—	—	12.13	2.12E-11	0.928	1
Sulfate	NA	14808-79-8	98.07	—	0.000143		2.54E-11	—	—	—	916.8	2.80E-13	0.0215	0.000119
Sulfur[a]	NA	7704-34-9	34.08	—	—	—	8.69E-03	—	—	—	1.00E+05	0.00E+00	0.897	2.30E-12
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	382.4	2.61E-08	1.40E-06	mm Hg at 25 C	1.03E-07	—	8.80E-07	atm-m3/mole at 25 C	16.36	1.57E-11	0.172	0.0666
Tetrabutyl ethylidenebisphenol (AO22E46)	NA	35958-30-6	438.7	8.23E-12	—	—	3.07E-10	—	—	—	7.27	3.53E-11	0.999	1
Tetrachlorobiphenyl	NA	26914-33-0	291.99	8.45E-06	—	—	1.25E-04	2.23E-04	—	—	3.52E+02	7.30E-13	0.0164	0.00576
Tributyl phosphate	NA	126-73-8	266.32	3.49E-03	0.00113	mm Hg at 25 C	3.19E-06	—	—	—	3.257	7.88E-11	0.00115	0.00339
Trichlorobiphenyl	NA	25323-68-6	257.55	4.00E-05	—	—	1.68E-04	2.62E-04	—	—	235	1.09E-12	0.000221	0.000781
Triethyl phosphate (TEP)	NA	78-40-0	182.16	0.153	0.393	mm Hg at 25 C	5.83E-07	—	3.60E-08	atm-m3/mole at 20 C	4.642	5.79E-11	3.32E-06	8.41E-05
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)	NA	36443-68-2	586.77	1.14E-16	—	—	1.35E-19	1.94E-23	—	—	3.439	7.46E-11	1	1

Table G-3. Physical/Chemical Properties Related to Air in EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Molecular weight	Vapor pressure (mmHg) - MPBPWIN	Vapor pressure (PHYSPROP)	Vapor pressure units (PHYSPROP)	Henry's law constant - bond est (atm-m^3/mole) - HENRYWIN	Henry's law constant - group est (atm-m^3/mole) - HENRYWIN	Henry's law constant (PHYSPROP)	Henry's law constant units (PHYSPROP)	Air degradation half-life (hr) - AOPWIN & BIOWIN	Air overall OH degradation rate constant (cm^3/molecule-sec) - AOP	Air fraction sorbed to airborne particulates (Junge-Pankow, Mackay avg) - AOP	Air fraction sorbed to airborne particulates (K_{oa}) - AOP
Triisobutyl phosphate	NA	126-71-6	362.41	3.34E-05	—	—	2.48E-07	—	—	—	6.442	3.98E-11	0.0254	0.00473
Trimethyl phosphate (TMP)	NA	512-56-1	140.08	0.379	0.85	mm Hg extrap at 25 C		—	7.20E-09	atm-m3/mole at 20 C	34.82	8.36E-12	1.54E-06	1.49E-05
Trimethylsilanol (TMS)	NA	1066-40-6	90.2	12.9	—	—	5.06E-05	—	—	—	64.99	3.90E-12	1.01E-07	1.31E-07
Tripropyl phosphate	NA	513-08-6	224.24	0.0231	—	—	1.36E-06	—	6.80E-07	atm-m3/mole at 20 C	3.442	7.46E-11	5.44E-05	5.24E-05
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	430.91	2.86E-07	—	—	2.61E-09	—	—	—	14.2	1.81E-11	0.795	0.451
Tris(2-butoxyethyl) phosphate	NA	78-51-3	398.48	1.23E-06	3.75	—	1.20E-11	—	—	—	1.994	1.29E-10	0.496	0.996
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	327.57	5.64E-05	—	—	5.96E-08	—	—	—	5.734	4.48E-11	0.0226	0.00312
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	434.65	6.07E-07	8.25E-08	mm Hg at 25 C	9.56E-05	—	—	—	2.623	9.79E-11	0.932	1
Tris(4-tert-butylphenyl) phosphate	NA	78-33-1	494.62	2.06E-08	—	—	6.85E-07	—	—	—	17.7	1.45E-11	0.928	1
Tris(methylphenyl) phosphate	NA	1330-78-5	368.37	0.0123	—	—	5.35E-08	—	—	—	18.74	1.37E-11	0.663	0.0711

Notes

CAS = Chemical Abstracts Service

[a] = Inorganic compound, outside of EPISuite estimation domain

Table G-4. Physical/Chemical Properties Related to Fugacity and Advection in EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Fugacity in air (atm) - Level III Fugacity Model	Fugacity in water (atm) - Level III Fugacity Model	Fugacity in soil (atm) - Level III Fugacity Model	Advection in air (kg/hr) - Level III Fugacity Model	Advection in water (kg/hr) - Level III Fugacity Model
2,2',3,3',4,4',5,6'-Octachlorobiphenyl	196	42740-50-1	1.21E-11	2.38E-12	1.75E-12	404	870
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	2.71E-11	8.39E-12	2.50E-12	5.68E+02	8.00E+02
2,2',3,3',4,4'-Hexachlorobiphenyl	128	38380-07-3	4.64E-11	4.86E-11	5.69E-12	752	633
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	201	40186-71-8	1.21E-11	4.04E-12	2.97E-12	405	869
2,2',3,3',4,5-Hexachlorobiphenyl	129	55215-18-4	4.80E-11	1.04E-10	1.27E-11	778	613
2,2',3,3',4,6-Hexachlorobiphenyl	131	61798-70-7	4.90E-11	1.43E-10	1.71E-11	795	588
2,2',3,3',5,5',6-Heptachlorobiphenyl	178	52663-67-9	2.74E-11	2.13E-11	6.51E-12	575	794
2,2',3,3',6,6'-Hexachlorobiphenyl	136	38411-22-2	5.37E-11	3.19E-10	3.90E-01	8.70E+02	520
2,2',3,4,4',5,5',6-Octachlorobiphenyl	203	52663-76-0	1.24E-11	2.74E-11	2.05E-11	413	857
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	2.71E-11	9.35E-12	2.84E-12	569	801
2,2',3,4,4',5'-Hexachlorobiphenyl	138	35065-28-2	4.73E-11	7.03E-11	9.36E-12	767	652
2,2',3,4,4'-Pentachlorobiphenyl	85	65510-45-4	6.97E-11	3.80E-10	4.85E-11	962	526
2,2',3,4,5'-Pentachlorobiphenyl	87	38380-02-8	7.09E-11	3.94E-10	5.45E-11	979	539
2,2',3,5',6-Pentachlorobiphenyl	95	38379-99-6	7.50E-11	6.30E-10	8.86E-11	1.03E+03	471
2,2',3,5-Tetrachlorobiphenyl	43	70362-46-8	9.25E-11	1.32E-09	2.84E-10	1.12E+03	424
2,2',3,6-Tetrachlorobiphenyl	45	70362-45-7	9.61E-11	1.31E-09	2.79E-10	1.16E+03	423
2,2',4,4',5,5'-Hexachlorobiphenyl	153	35065-27-1	4.69E-11	5.58E-11	1.04E-11	760	722
2,2',4,4'-Tetrachlorobiphenyl	47	2437-79-8	8.67E-11	1.17E-09	2.47E-10	1.05E+03	437
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	7.28E-11	4.75E-10	6.77E-11	1.01E+03	519
2,2',4,5'-Tetrachlorobiphenyl	49	41464-40-8	9.20E-11	1.27E-09	2.73E-10	1.11E+03	425
2,2',4,5-Tetrachlorobiphenyl	48	70362-47-9	9.62E-11	1.32E-09	2.85E-10	1.16E+03	424
2,2',4,6'-Tetrachlorobiphenyl	51	68194-04-7	8.67E-11	9.16E-10	1.79E-10	1.05E+03	469
2,2',5,5'-Tetrachlorobiphenyl	52	35693-99-3	9.26E-11	1.24E-09	2.60E-10	1.12E+03	426
2,2',6-Trichlorobiphenyl	19	38444-73-4	9.75E-11	1.47E-09	1.75E-10	1.03E+03	360
2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester phosphoric acid	NA	38051-10-4	2.66E-18	1.04E-20	7.49E-22	0.00069	307
2,2'-Dichlorobiphenyl	4	13029-08-8	9.82E-11	1.70E-09	4.47E-10	897	338
2,3,3',4,4',5,6-Heptachlorobiphenyl	190	41411-64-7	2.91E-11	1.21E-10	3.88E-11	610	754
2,3,3',4,4',6-Hexachlorobiphenyl	158	74472-42-7	6.41E-11	3.90E-10	6.63E-11	981	592

Table G-4. Physical/Chemical Properties Related to Fugacity and Advection in EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Fugacity in air (atm) - Level III Fugacity Model	Fugacity in water (atm) - Level III Fugacity Model	Fugacity in soil (atm) - Level III Fugacity Model	Advection in air (kg/hr) - Level III Fugacity Model	Advection in water (kg/hr) - Level III Fugacity Model
2,3,3',4',5,6-Hexachlorobiphenyl	163	74472-44-9	4.64E-11	6.03E-11	6.69E-12	753	613
2,3',4,4'-Tetrachlorobiphenyl	66	32598-10-0	8.60E-11	8.18E-10	1.56E-10	1.04E+03	485
2,3,4'-Trichlorobiphenyl	22	38444-85-8	9.42E-11	1.00E-09	1.09E-10	997	401
2,3,6-Trichlorobiphenyl	24	55702-45-9	9.56E-11	1.42E-09	1.67E-10	1.01E+03	364
2,3',6-Trichlorobiphenyl	27	38444-76-7	8.70E-11	1.63E-09	2.02E-10	920	351
2,3-Dichlorobiphenyl	5	16605-91-7	9.05E-11	1.69E-09	4.48E-10	827	337
2,4',5-Trichlorobiphenyl	31	16606-02-3	9.53E-11	1.27E-09	1.50E-10	1.01E+03	377
2,4,6-Tris(tert-butyl)phenol (2,4,6-TTBP)	NA	732-26-3	1.78E-11	6.19E-11	4.02E-12	191	543
2,4'-Dichlorobiphenyl	8	34883-43-7	1.03E-10	1.70E-09	4.58E-10	939	339
2,4-Di-tert-butylphenol (2,4-DTBP)	NA	96-76-4	8.37E-12	4.06E-11	1.02E-11	70.7	543
2,4-Di-tert-pentylphenol (2,4-DTPP)	NA	120-95-6	7.15E-12	5.80E-11	4.67E-12	68.6	499
2,5-Di-tert-butylphenol (2,5-DTBP)	NA	5875-45-6	4.78E-12	4.04E-11	1.02E-11	40.3	542
2,6-Dichlorobiphenyl	10	33146-45-1	9.06E-11	1.70E-09	4.48E-10	828	337
2-Butoxy-, hydrogen phosphate ethanol	NA	14260-97-0	5.32E-13	2.74E-14	2.81E-14	16.4	921
2-Chlorobiphenyl	1	2051-60-7	1.13E-10	5.31E-09	2.68E-09	871	276
2-Ethylhexyl diphenyl phosphate	NA	1241-94-7	6.34E-12	1.97E-10	1.12E-11	94.7	283
3,4,4'-Trichlorobiphenyl	37	38444-90-5	9.02E-11	7.59E-10	7.92E-11	955	435
3,5-Bis(1,1-dimethylethyl)-4-hydroxy-, 2,4-bis(1,1-dimethylethyl)phenyl ester benzoic acid	NA	4221-80-1	6.84E-14	1.16E-15	1.28E-15	139	869
4-(Butan-2-yl)-2,6-di-tert-butylphenol	NA	17540-75-9	1.45E-11	7.97E-11	4.48E-12	157	517
4,4',4"-(1-Methyl-1-propanyl-3-ylidene)tris 2-(1,1-dimethylethyl)-5-methyl-phenol	NA	1843-03-4	1.99E-19	6.92E-26	3.14E-26	8.94	828
4,4'-Methylenebis(2,6-di-t-butylphenol) (AO-702)	NA	118-82-1	2.48E-15	1.36E-18	8.74E-20	50	365
4,4'-Thiobis(6-tert-butyl-m-cresol) (AO44S25)	NA	96-69-5	7.42E-16	1.39E-18	6.96E-20	0.912	0.912
4-Chlorobiphenyl	3	2051-62-9	9.74E-11	5.31E-09	2.73E-09	753	276
6:2 Fluorotelomer sulfonic acid	NA	27619-97-2	7.22E-11	2.72E-09	3.67E-09	1.27E+03	339
8:2 Fluorotelomer sulfonic acid	NA	39108-34-4	5.57E-11	3.57E-08	3.96E-09	1.20E+03	262
Ammelide	NA	645-93-2	7.60E-18	2.01E-19	7.59E-18	0.000139	530
Ammeline	NA	645-92-1	9.36E-20	1.96E-21	2.64E-20	5.40E-07	419

Table G-4. Physical/Chemical Properties Related to Fugacity and Advection in EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Fugacity in air (atm) - Level III Fugacity Model	Fugacity in water (atm) - Level III Fugacity Model	Fugacity in soil (atm) - Level III Fugacity Model	Advection in air (kg/hr) - Level III Fugacity Model	Advection in water (kg/hr) - Level III Fugacity Model
Amoxicillin	NA	26787-78-0	6.81E-25	2.79E-26	5.26E-25	0.000189	818
Ampicillin	NA	69-53-4	6.84E-21	2.93E-22	6.30E-21	0.000336	856
Bis(2-chloroethyl) phosphate	NA	3040-56-0	7.59E-14	3.48E-15	8.76E-14	0.742	913
Bis(2-ethylhexyl) phosphate	NA	298-07-7	1.47E-12	1.95E-13	1.75E-14	43.3	334
Bis(2-methylphenyl) hydrogen phosphate	NA	35787-74-7	4.38E-14	1.53E-15	7.23E-15	9.71	658
Cesium[a]	NA	7440-46-2	6.36E-11	2.64E-07	5.86E-07	2.12E+03	286
Cresyl diphenyl phosphate (CDPP)	NA	26444-49-5	2.85E-12	3.37E-13	6.07E-14	122	561
Cyanuric acid	NA	108-80-5	1.21E-11	4.04E-12	2.97E-12	405	869
Decachlorobiphenyl	NA	2051-24-3	8.27E-14	4.06E-09	5.79E-10	282	549
Dibutyl ester phosphoric acid	NA	107-66-4	1.59E-12	2.64E-14	2.22E-13	13.8	260
Dichlorobiphenyl	NA	25512-42-9	9.80E-11	1.70E-09	4.48E-10	896	338
Diethyl hydrogen phosphate	NA	598-02-7	8.35E-13	2.40E-14	9.56E-13	5.27	539
Diisobutyl hydrogen phosphate	NA	6303-30-6	1.59E-12	7.65E-14	1.16E-12	13.8	755
Diphenyl phosphate (DPHP)	NA	838-85-7	4.20E-14	1.51E-15	1.58E-14	1.49	715
Dipropyl ester phosphoric acid	NA	1804-93-9	1.16E-12	3.00E-14	6.88E-13	8.67	451
Heptachlorobiphenyl	NA	28655-71-2	2.90E-11	1.22E-10	3.95E-11	6.08E+02	756
Hexachlorobiphenyl	NA	26601-64-9	4.69E-11	5.58E-01	1.04E-11	760	722
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	7.72E-13	2.13E-12	7.94E-14	67.2	442
Melamine	NA	108-78-1	1.46E-17	7.48E-19	2.32E-17	0.00014	1.03E+03
Monochlorobiphenyl	NA	27323-18-8	8.11E-11	4.53E-09	2.29E-09	627	283
Nalidixic acid	NA	389-08-2	2.20E-19	1.33E-20	5.08E-19	3.37E-06	1.21E+03
Nonachlorobiphenyl	NA	53742-07-7	4.44E-12	1.30E-11	1.03E-11	314	868
Octachlorobiphenyl	NA	55722-26-4	1.21E-11	1.21E-11	1.75E-12	404	870
Pentachlorobiphenyl	NA	25429-29-2	7.28E-11	4.75E-10	6.77E-11	1.01E+03	519
Polychlorinated biphenyl (PCB)	NA	1336-36-3	8.67E-11	1.17E-09	2.47E-10	1.05E+03	437
Resorcinol bis(diphenyl phosphate) (RDP)	NA	57583-54-7	5.12E-17	1.49E-21	2.77E-23	0.0131	185
Sulfate	NA	14808-79-8	2.59E-14	8.43E-16	4.63E-14	0.104	651
Sulfur[a]	NA	7704-34-9	1.85E-10	3.74E-07	2.26E-06	2.03E+03	294
Tert-butylphenyl diphenyl phosphate	NA	56803-37-3	9.11E-13	4.91E-12	2.47E-13	126	472

Table G-4. Physical/Chemical Properties Related to Fugacity and Advection in EPISuite for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Fugacity in air (atm) - Level III Fugacity Model	Fugacity in water (atm) - Level III Fugacity Model	Fugacity in soil (atm) - Level III Fugacity Model	Advection in air (kg/hr) - Level III Fugacity Model	Advection in water (kg/hr) - Level III Fugacity Model
Tetrabutyl ethylidenebisphenol (AO22E46)	NA	35958-30-6	2.49E-15	7.42E-18	4.06E-19	71.3	339
Tetrachlorobiphenyl	NA	26914-33-0	9.26E-11	1.24E-09	2.60E-10	1.12E+03	426
Tributyl phosphate	NA	126-73-8	4.09E-12	6.08E-12	3.13E-12	44.6	230
Trichlorobiphenyl	NA	25323-68-6	1.00E-10	1.58E-09	1.94E-10	1.06E+03	3.55E+02
Triethyl phosphate (TEP)	NA	78-40-0	5.90E-12	4.01E-13	6.88E-12	44	406
Triethylene glycol bis(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate (AO-245)	NA	36443-68-2	3.31E-27	7.83E-30	9.46E-31	2.15E-06	567
Triisobutyl phosphate	NA	126-71-6	6.34E-12	1.97E-10	1.12E-11	94.7	283
Trimethyl phosphate (TMP)	NA	512-56-1	4.74E-12	1.47E-13	6.65E-12	27.2	573
Trimethylsilanol (TMS)	NA	1066-40-6	1.65E-10	9.73E-10	1.73E-08	610	347
Tripropyl phosphate	NA	513-08-6	5.09E-12	5.32E-12	1.79E-11	46.7	351
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	5.32E-13	2.74E-14	2.81E-14	16.4	921
Tris(2-butoxyethyl) phosphate	NA	78-51-3	3.01E-15	3.84E-17	6.19E-17	0.058	255
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	4.27E-12	6.45E-13	1.29E-12	57.6	711
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	1.35E-12	1.29E-15	1.11E-16	32.6	228
Tris(4-tert-butylphenyl) phosphate	NA	78-33-1	5.91E-13	4.53E-15	1.52E-14	130	885
Tris(methylphenyl) phosphate	NA	1330-78-5	1.31E-11	5.04E-12	2.96E-13	198	495

Notes

CAS = Chemical Abstracts Service

[a] = Inorganic compound, outside of EPISuite estimation domain

Table G-5. Physical/Chemical Properties Related to Diffusivity and Transfer Factors as Reported by ORNL for Newly Identified Chemicals in Biosolids

Chemical	PCB congener #	CAS number	Diffusivity in air (cm^2/s) - ORNL	Diffusivity in water (cm^2/s) - ORNL	Beef transfer coefficient (day/kg) - ORNL	Milk transfer coefficient (day/kg) - ORNL	Soil-to-dry plant uptake - ORNL	Soil-to-wet Plant uptake - ORNL
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6	0.042441369	4.12142E-06	4.655217842	1.471048838	0.00061498	0.000122996
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	35065-29-3	0.042441369	4.12142E-06	4.655217842	1.471048838	0.00061498	0.000122996
4-Chlorobiphenyl	3	2051-62-9	0.031830682	7.04598E-06	0.001018451	0.00032183	0.081594471	0.016318894
Isodecyl diphenyl phosphate (IDDP)	NA	29761-21-5	0.035566072	4.15561E-06	0.006885572	0.002175841	0.026931512	0.005386302
Polychlorinated biphenyl (PCB)	NA	1336-36-3	0.024339655	6.26713E-06	0.314731353	0.099455108	0.002934004	0.000586801
Sulfur[a]	NA	7704-34-9	—	—	4.24561E-08	1.34161E-08	28.31787951	5.663575902
Tributyl phosphate	NA	126-73-8	0.021184112	5.2338E-06	0.00025	0.000079	0.184272586	0.036854517
Trimethyl phosphate (TMP)	NA	512-56-1	0.058254687	8.7915E-06	5.5968E-09	1.76859E-09	91.71929957	18.34385991
Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP)	NA	13674-87-8	0.033303961	3.8913E-06	0.000111671	3.5288E-05	0.294076777	0.058815355
Tris(2-chloroisopropyl) phosphate	NA	13674-84-5	0.039983811	4.67179E-06	9.72613E-06	3.07346E-06	1.211325137	0.242265027
Tris(2-ethylhexyl) phosphate (TEHP)	NA	78-42-2	0.016451124	3.94248E-06	77.25738581	24.41333392	0.000120576	2.41152E-05