

# Study of Per- and Polyfluoroalkyl Substances in Bay Area POTWs

## Final Report

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## **Executive Summary**

Per- and polyfluoroalkyl substances (PFAS) are a broad class of fluorine-rich specialty chemicals with many uses across consumer, commercial, and industrial applications and products. The carbon-fluorine bonds that define this class afford PFAS stability during use and extreme persistence, resulting in widespread occurrence in the environment, wildlife, and humans. The EPA has identified PFAS as an urgent public health and environmental issue. To understand the scope of PFAS contamination in California, the State Water Resources Control Board (SWRCB) developed a statewide assessment requiring testing of drinking water systems and site investigations of locations likely to contain PFAS, including publicly-owned treatment works (POTWs) as a part of the July 2020 State Water Board Investigative Order. POTWs that are a part of the San Francisco Bay Regional Water Quality Control Board (Region 2) were exempted from the investigative order to conduct a two-phase regional study in conjunction with the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), led by the San Francisco Estuary Institute (SFEI), to address the monitoring needs of the SWRCB efficiently as well as to inform the monitoring strategy, management actions, and program decisions of the RMP. Insights gained from the regional approach would be shared with SWRCB, Region 2, and other POTWs across California.

Through Phase 1 and Phase 2 of this study, we demonstrated a collaborative, cost-effective, and innovative approach for investigating PFAS in municipal wastewater in the San Francisco Bay region. During Phase 1, we evaluated levels of PFAS in regional POTW influent, effluent, and biosolids by sampling and analyzing a representative subset of sixteen facilities that included a wide range in POTW size, treatment type, geography, and residential and industrial customers. This approach reduced the number of samples needed and centralized study design, analysis, and interpretation efforts, which reduced overall resources needed to address study questions. POTW samples were analyzed by EPA Method 1633, which includes 40 PFA analytes, using liquid chromatography/mass spectrometry (LC-MS/MS) (target method). Additionally, the presence of PFAS precursors were assessed in sample replicates by converting oxidizable PFAS to terminal PFAS in samples prior to analysis by LC-MS/MS (Total Oxidizable Precursors or TOP method).

Through target analysis, sampled municipal POTWs in Phase 1 exhibited comparable concentrations for the sum of quantified PFAS, with median concentrations of 27 nanograms per liter (ng/L) in influent (See Section 3.2), 58 ng/L in effluent (See Section 3.3), and 178 nanograms per gram dry weight (ng/g dw) in biosolids (See Section 3.5). The sum of quantified PFAS TOP concentrations were significantly higher across matrices studied, with median concentrations of 231 ng/L in influent and 594 ng/g dw in biosolids; the TOP method was not applied to effluent in this phase. These results emphasize the importance of evaluating PFAS precursors to understand the scope of PFAS present in wastewater samples. A second round of sampling during Phase 2 at six of the POTWs revealed results consistent with Phase 1. From Phase 2, the median

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sum of quantified PFAS TOP concentration was 88 ng/L in effluent compared with 256 ng/L in the influent and 441 ng/g dw in biosolids.

Comparing Phase 1 and Phase 2 effluent results with previous RMP wastewater studies implemented in 2009 and 2014, the target and TOP data indicate a declining trend in quantified PFAS in effluent. Considering that our analytical methods are only able to quantify a fraction of potential PFAS in our samples, we do not have enough information to answer whether these are real reductions in levels of total PFAS in effluent or whether there may be market changes in the composition of PFAS used to analytes that we are not able to quantify with target and TOP analyses.

Our objective for Phase 2 investigations was to investigate major sources of PFAS to municipal wastewater in the San Francisco Bay region by conducting a screening level study of residential and select industrial sewershed discharges, which could inform further investigations in the future. Seven BACWA member POTWs volunteered to participate in Phase 2, and worked closely with SFEI to identify priority sampling locations within their sewershed. A major study question was whether residential dischargers are a major source of PFAS. Through Phase 2 sewershed investigations, we found PFAS from residential discharges to be highly variable, with concentrations ranging from non-detect to 80 ng/L via target analysis and 4–850 ng/L via TOP analysis (See Section 4.1). Based on these results, we estimated that for municipal POTWs that receive a greater percentage of flows from residential customers, residential discharges may account for a large majority of the PFAS loadings received by the POTW. Note this conclusion is based on evaluating results from Phase 2 study participants, which do not have heavy PFAS manufacturing industries within the sewershed. The importance of residential discharges of PFAS can inform regional, state, and national strategies to address PFAS in wastewater, which will need to consider the broad use and sources of PFAS in consumer products.

We also were able to relatively quickly screen a number of industrial sewershed discharges by leveraging ongoing compliance monitoring led by participating POTW pretreatment program staff. This screening approach was intended to contribute to our understanding of levels of PFAS from industrial dischargers that are part of POTW pretreatment programs, and inform program decisions. Industries prioritized for sampling had a high likelihood of using products containing PFAS or of using PFAS in industrial processes and had not been monitored prior to this study, although we excluded important sources that were already included as part of State and Regional Water Boards PFAS investigations orders. Five industrial laundry facilities that mostly service restaurants and other industries were screened, and PFAS concentrations ranged from 22–762 ng/L via target analysis and 58–100,369 ng/L via TOP analysis, which are significantly greater than levels measured in POTW influent (See Section 4.2). We estimated that an average industrial laundry facility could contribute 1% of the PFAS loading received at the POTW.

We also screened hospital discharges and discharges from semiconductor-related manufacturing and facilities with chrome plating on-site; most were found to have levels of PFAS lower than levels in POTW influent. Since this was designed as a screening

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study, we do not have enough information to evaluate whether these results are representative. For example, there may be significant temporal variability that we were not able to capture in our study design. Levels of PFAS in car wash sewershed discharges were comparable to levels of PFAS in POTW influent.

This study provided important lessons for PFAS monitoring. Looking forward to future monitoring, we anticipate the importance of utilizing multiple PFAS analytical approaches for quantifying PFAS in samples to provide complementary data on the levels and types of PFAS present in samples. Analytical methods to consider include target and TOP LC-MS methods applied in the present study, in addition to incorporating methods that capture other PFAS sub-classes identified in the science literature, particularly ultra-short chain PFAS. More comprehensive but non-specific methods are currently in development, such as adsorbable organofluorine and extractable organofluorine methods using combustion ion chromatography, fluorine nuclear magnetic resonance (F-NMR) spectroscopy, and high-resolution mass spectrometry (HRMS) suspect screening and non-targeted analysis.

Based on results from Phase 2 investigations, residential and industrial laundry sewershed discharges may warrant further PFAS investigation due to potential PFAS loadings from these sources. Future sampling could incorporate a more comprehensive and representative study design to better understand the levels of PFAS from residential and industrial laundry sewershed discharges. Additionally, further investigation of sewershed sources should be implemented in coordination with an RMP effort to develop conceptual models mapping PFAS transport from products to the Bay via municipal wastewater and urban stormwater runoff, another important pathway for PFAS.

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## **1. Introduction**

Per- and polyfluoroalkyl substances (PFAS), such as perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), are an extensive class of fluorine-rich specialty compounds known for their thermal stability, non-reactivity, and surfactant properties. These unique characteristics make them useful for a variety of applications in consumer, commercial, and industrial applications, including food packaging materials, waterproof textiles, stain-resistant carpets and furniture, fire-suppression foams, and processing aids to produce fluoropolymers like Teflon, mist suppressants in metal-plating, and hydraulic aviation fluids (EPA, 2022). These properties also make them persistent in the environment and potentially toxic to human and ecological health. With nearly 15,000 known chemicals, comprehensive analysis of PFAS remains a significant scientific and regulatory challenge.

To understand the scope of PFAS contamination in California, the State Water Board (SWRCB) developed a statewide assessment requiring testing of drinking water systems and site investigations of locations likely to contain PFAS, including publicly-owned treatment works (POTWs) as a part of the July 2020 State Water Board Investigative Order (SWRCB, 2020). Agencies that are a part of the San Francisco Bay Regional Water Quality Control Board (Region 2) agencies were exempted from the investigative order to conduct a two-phase regional study in conjunction with the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), led by the San Francisco Estuary Institute (SFEI), to address the monitoring needs of the SWRCB efficiently as well as to inform the monitoring strategy, management actions, and program decisions of the RMP.

This report details the findings and analysis of the data collected from Phase 1 and Phase 2 of the Study of PFAS in Bay Area POTWs. The purpose of Phase 1 was to analyze samples from a representative subset of Bay Area POTWs to measure concentrations of PFAS in various matrices, including wastewater influent, effluent, and biosolids. The POTWs included in Phase 1 were carefully selected to provide a representative sample set of Region 2 POTWs to examine the range of PFAS concentrations in wastewater matrices and the diverse characteristics that may influence PFAS concentrations to be investigated in Phase 2.

Phase 2 study objectives were developed through close discussions with BACWA members and Water Boards staff and informed by results from Phase 1. The priority Phase 2 study questions were:

- Are residential flows an important source of PFAS to the participating POTWs?
- Can specific industries (e.g., industrial laundry, semiconductor manufacturing) be identified as discharging higher than average concentrations of PFAS (including oxidizable precursors and end products) to POTWs?

Secondary questions that Phase 2 could help inform to the extent possible with available data and resources were:

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- How do PFAS concentrations (including TOP) compare in influent, effluent, and biosolids from participating POTWs?
- Are there significant amounts of organofluorine in wastewater samples not captured by TOP?
- How do biosolid digestion processes at POTWs affect the transformation and levels of measurable PFAS in biosolids (compare undigested to digested biosolids)?

This final report will primarily focus on the findings from Phase 2 and include the most relevant findings from Phase 1. More details from Phase 1 results are detailed in the Phase 1 technical memo (Appendix A).

## 2. Methods

### 2.2 Study Approach

This study was conducted in two distinct steps. Phase 1 started in August of 2020, with wastewater sample collection implemented between November to December of 2020. Phase 2 was implemented following interpretation and discussion of Phase 1 results, and sampling for Phase 2 was implemented during the summer of 2022. Details for the Phase 1 and Phase 2 sampling strategy, including study design, sample collection, data quality assurance, and reporting, are described in the Phase 1 and Phase 2 Sampling and Analysis Plans (SAP), respectively (Lin and Mendez, 2022; Mendez et al., 2020).

Briefly, the objective of Phase 1 was to understand the levels of PFAS in wastewater matrices using a representative subset of Bay Area POTWs. Participating POTWs were selected to reflect the diverse range of characteristics likely to influence PFAS concentrations, which could be investigated further in Phase 2. The factors considered for POTW selection in Phase 1 included a wide range in discharge volume, service population (i.e., flow inputs from industrial discharges defined by national pretreatment program), treatment type, and geographic location, as well as the inclusion of POTWs previously monitored for PFAS (Mendez et al., 2021). Table 1 and Figure 1 shows the selected Bay Area POTWs chosen to participate in Phase 1, as well as important identifying information used to publicly report target analytical results and monitoring reports for influent, effluent, and biosolids to Geotracker, a California State Water Board database to track and archive environmental data.

**Table 1.** Participating Bay Area POTWs with related acronyms, Geotracker ID, and CIWQS ID.

Region 2 Facilities	Acronyms	Geotracker Global ID	CIWQS ID
Central Contra Costa Sanitary District <sup>1</sup>	CCCSD	NPD100051616	213875
City of San Mateo Wastewater Treatment Plant <sup>1</sup>	CSM	NPD100051601	255420
Dublin San Ramon Services District Wastewater Treatment Plant <sup>1</sup>	DSRSD	NPD100051638	220792

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East Bay Dischargers Authority <sup>2</sup>	EBDA	NPD100053240	222123
East Bay Municipal Utility District Main Wastewater Treatment Plant <sup>1</sup>	EBMUD	NPD100051573	222132
Fairfield-Suisun Sewer District	FSSD	NPD100051485	225526
Novato Sanitary District	NSD	NPD100051924	244705
Oceanside Water Pollution Control Plant (San Francisco Public Utilities Commission or SFPUC) <sup>1</sup>	OSP	NPD100051512	256498
Palo Alto Regional Water Quality Control Plant	PA	NPD100051503	247457
San Francisco International Airport Mel Leong Treatment Plant	SFOS	NPD100051556	256507
San Francisco International Airport Mel Leong Treatment Industrial Plant	SFOI	NPD100051556	256507
San Jose-Santa Clara Regional Wastewater Facility <sup>1</sup>	SJSC	NPD100051475	255333
Southeast Water Pollution Control Plant (SFPUC) <sup>1</sup>	SEP	NPD100051513	256499
Union Sanitary District	USD	NPD100051936	269042
Vallejo Flood & Wastewater District	VFWD	NPD100051544	270006
Valley Water <sup>3</sup>	VW	-	-

<sup>1</sup>These POTWs participated in both Phase 1 and Phase 2 studies.

<sup>2</sup>EBDA was only sampled for effluent in Phase 1 as it exclusively discharges effluent coming from several WWTPs including the City of San Leandro Water Pollution Control Plant, Oro Loma Sanitary District/Castro Valley Sanitary District Water Pollution Control Plant, City of Hayward Water Pollution Control Facility, Union Sanitary District Alvarado Treatment Plant, Dublin-San Ramon Services District Wastewater Treatment Facility, and City of Livermore Water Reclamation Plant.

<sup>3</sup>Reverse osmosis concentrate (ROC) was collected at Valley Water (VW) at its Advanced Water Purification Facility (AWPF) for target analysis during Phase 1. This data set was not uploaded to Geotracker.

During the Phase 1 study, participating POTWs predominantly collected grab samples of all influent, effluent, and biosolids for target and total oxidizable precursors (TOP) analysis (see Section 2.1). Three POTWs also collected 24-hour composites of influent and effluent samples alongside grab samples to inform whether these collection methods provided similar or different results. Field QA/QC samples, including field and equipment rinse blanks, were collected at a subset of facilities to assess potential contamination concerns during sampling. Results from Phase 1 influent and effluent indicated comparable PFAS levels for grab and composite samples. PFAS in field and laboratory blanks were below method detection limits (MDLs) except for one target analyte, indicating minimal contamination concerns. As a result, both grab and

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composite sampling methods were deemed acceptable for Phase 2 based on feasibility with a preference for composite sampling.

During the Phase 2 study, participating POTWs sampled influent, effluent, and biosolids using composites for the aqueous samples and grabs for the solid samples. These samples were analyzed using target and TOP methods (See Section 2.2). Additionally, adsorbable organofluorine (AOF) analysis was applied to influent and effluent samples as an experimental approach to potentially inform the levels of PFAS in wastewater samples that may not be captured by the other methods. AOF was implemented with the understanding that the method is still under development.

Further, Phase 2 included the collection of sewershed samples, collected upstream of the participating POTWs, to evaluate PFAS levels in wastewater discharged from residential or specific industrial or commercial businesses (Lin and Mendez, 2022). Sewershed sampling locations were chosen through discussions with BACWA POTWs who volunteered to participate and provide information to inform the region and state. Six of the POTWs participated in both Phase 1 and Phase 2 of the study (Figure 1). Industrial and commercial operations included at a screening level in this study were: industrial laundry operations, semiconductor/electronics/chemical manufacturers that were suspected to use PFAS, operations with chrome reduction/chrome plating on-site hospitals, car washes and paperboard manufacturing. Sewershed samples were collected as either grabs or 24-hour composites based on feasibility, and leveraged ongoing compliance monitoring conducted by participating POTWs. Similar to Phase 1, field QA/QC samples were collected at a subset of POTWs and sewershed sites to assess potential contamination concerns during sampling.

Three groundwater samples were also collected from one POTW (DSRSD) to assess the potential transport of PFAS to groundwater from biosolids stored at the facility. Although not discussed further in this report, the groundwater results are undergoing review by DSRSD and have been uploaded into Geotracker.



**Figure 1.** Map of Bay Area POTWs selected to participate in Phase 1 and Phase 2. POTWs sampled only during Phase 1 are identified in orange, while those sampled during both phases are identified in green.

## 2.2 SGS AXYS Analytical Methods

Samples from POTWs were analyzed by SGS AXYS for PFAS using a) target analysis (SGS AXYS MLA-110: Analytical Procedures for the Analysis of Per- and Polyfluoroalkyl Substances in Aqueous Samples, Solids, Tissues, AFFF Products, Blood, Serum and Solvent Extracts with LC-MS/MS by EPA Method 1633); b) Total Oxidizable Precursor Analysis (SGS AXYS MLA-111: Analytical Procedures for the Analysis of Total Oxidizable Precursors in Aqueous and Solid Matrices); and for influent and effluent samples only, c) Adsorbable Organofluorine Analysis (MLA-119 Rev.01 Ver.02: Determination of Adsorbable Organic Fluorine on Aqueous Samples by Combustion Ion Chromatography by EPA Draft Method 1621). Detailed sample procedures are

described in the Standard Operating Procedures stored at SFEI and briefly summarized below. Biosolid samples were also analyzed for percent solids. Aqueous samples by Target and TOP analyses are reported in units of ng PFAS/L; aqueous samples for AOF analysis are reported in units of  $\mu\text{g F}^-/\text{L}$ ; biosolid samples are reported in units of ng PFAS/g dry weight (dw), and percent solids content (%).

#### **A. Target Analysis (EPA Draft Method 1633 or MLA-110)**

Samples from all matrices (i.e., influent, effluent, biosolids, food waste, blended feed (biosolids prior to digestion), and sewershed) were analyzed for target PFAS using EPA Draft Method 1633, also referred to as SGS AXYS Method MLA-110. The samples were spiked with isotope-labeled surrogate standards and then extracted and cleaned through Solid Phase Extraction (SPE). Sample extracts were analyzed by liquid chromatography/mass spectrometry (LC-MS/MS), with reported sample concentrations determined by isotope dilution/internal standard quantification. This method is compliant with both EPA draft method 1633 and with DoD QSM 5.4 (U.S. EPA, 2022). The target analyte list includes 40 target analytes, which includes perfluoroalkyl carboxylate, perfluoroalkyl sulfonates, fluorotelomer sulfonates, fluorotelomer carboxylates, perfluorooctane sulfonamides, perfluorooctanesulfonamidoacetic acids, perfluorooctane sulfonamide ethanols, per- and polyfluoroether carboxylates, and ether sulfonates (Table B.1).

#### **B. Total Oxidizable Precursor (TOP) Analysis (MLA-111)**

Samples from all matrices (i.e., influent, effluent, biosolids, food waste, blended feed (biosolids prior to digestion), and sewershed) were analyzed through TOP analysis using SGS AXYS Method MLA-111, with a complete list of analytes and typical RLs shown in Table B.2. The TOP method indirectly quantifies oxidizable PFAS precursors by conversion to terminal perfluorinated carboxylates (PFCAs). Samples are oxidized using persulfate and then, after cooling and pH adjustment, spiked with isotope-labeled quantification standards. Further, the samples are extracted and cleaned using weak anion-exchange SPE. Extracts are analyzed via LC-MS/MS, with the reported concentrations determined by isotope/dilution internal standard quantification. The reported concentrations represent the sum of quantified PFCAs after sample oxidation. Oxidation is monitored using a reaction monitoring standard that is spiked into the sample and control matrix. Overall, this method is used to understand the presence of oxidizable precursors that may not be included in EPA Draft Method 1633 (MLA-110).

#### **C. Adsorbable Organofluorine (AOF) Analysis (MLA-119)**

Samples from influent and effluent were during Phase 2 analyzed via AOF using SGS AXYS Method MLA-119, which is based on EPA Draft Method 1621 (U.S. EPA, 2022). Samples are adsorbed onto activated carbon and rinsed with nitrate to remove inorganic fluoride. The adsorbed sample is combusted under oxidative conditions and analyzed by combustion ion chromatography. This method was developed as a screening method to estimate the concentration of adsorbable organic fluorine (AOF) in

aqueous samples. Results are reported in  $\mu\text{g F/L}$ , and typical reporting limits are in  $1.5 \mu\text{g F/L}$ .

### **3. Results and Discussion**

#### **3.1 General QA/QC Findings for Target and TOP Datasets**

Target data for field and QA/QC samples were reviewed by SFEI's QA Officer (QAO), after initial flagging by the laboratory according to quality control requirements described in the Phase 2 SAP (Lin and Mendez, 2022) based on Draft EPA Method 1633 and/or the lab internal methods. Of note, these QA/QC requirements have been developed for more typical sample matrices, such as wastewater effluent, and were applied for all Phase 2 samples, which include samples that have not been widely analyzed for PFAS, such as industrial and residential sewershed samples. The target measurement quality objectives (MQOs) in the EPA method are derived from a limited set of data obtained in method validation studies, so MQOs typically vary greatly by analyte and matrix. Moderate levels of deviations from quality control requirements could be expected from some of the atypical samples collected in Phase 2. The additional review by SFEI, therefore, focused on identifying large quantitative uncertainty, even when considered acceptable for some compounds in the published EPA method or where there is not yet an established method (e.g., for the TOP analyses).

A review of Phase 2 Target datasets found relatively minor issues, and data are largely considered quantitative. A small percentage of the data (~0.5%) were rejected by SGS AXYS before reporting, ~5% of the reported data were flagged by SGS AXYS or the QAO for large MQO deviations, and an additional ~6% were qualified for more minor MQO deviations. All data deviating from quality control requirements were flagged with a data qualifier. PFAS analytes were most frequently non-detect in samples, with 23 of the 40 analytes not detected in any effluent samples and 18 not detected in any influent samples. PFAS were more consistently detected in biosolids, with 11 of the analytes detected in more than half of the samples. This is expected and consistent with the Phase 1 results. The most frequently applied data qualifier was the J flag for reported values that are estimated because values were between the method detection and reporting limits. Most of the data flagged with data qualifiers did not impact results because most of these values were non-detect (below detection limits) or estimated concentrations where the quantitative uncertainty is high.

One analyte, 6:2 fluorotelomer sulfonate (6:2 FTS), was found in lab and field blanks, and one equipment blank had  $19 \text{ ng/L}$  of this compound, so lab blank contamination might comprise nearly half the quantity found in field blanks and similarly constituted a large portion of the signal found in low concentration samples. Note 6:2 FTS was also detected in a field blank during Phase 1. Recoveries in LCS and MS/MSD samples for most analytes were within targets listed in the EPA Method, or 65%-135% for those analytes not specifically listed. A few analytes with results outside of the target range had their results flagged to warn of poor quantitative certainty.

Phase 2 TOP datasets were also reviewed against similar quality control requirements developed for Target datasets while noting that these data quality objectives were not developed for TOP. Overall the data were evaluated as acceptable by the QAO. During analysis, TOP samples were spiked with isotope-labeled extraction surrogate standards before oxidation, and both PFAS precursor and terminal product surrogate standards were quantified in final oxidized samples along with unlabeled target analytes to monitor for complete oxidation of the samples. As would be expected for TOP analysis, the recoveries of the PFAS precursors were usually near 0% in laboratory control samples (LCS), indicating near complete conversion. While recoveries of the fluorotelomer sulfonates in oxidized matrix spikes in some matrices were ~40%, likely indicating partial conversion, possibly a result of matrix effects, SGS AXYS staff believed the incomplete conversion was limited to the matrix spike samples and not applicable to the field samples because the concentrations of the FTSs were all very low in unspiked samples.

In reviewing precision based on replicate field samples for analytes with average concentrations at least three times the MDL, lab relative percent differences (RPDs) were generally <35%. Exceptions were restricted to biosolids, with perfluorodecanoate (PFDA) at 53%, perfluoroheptanoate (PFHpA) at 53%, and perfluorohexanoate (PFHxA) at 74% RPD, indicating lower precision and thus low quantitative certainty.

## **3.2 Influent**

### **3.2.1 Influent PFAS Target Analysis Results**

Phase 1 influent sampling included CCCSD, CSM, DSRSD, EBMUD, FSSD, NSD, OSP, PA, SFOI, SFOS, SJSC, SEP, USD, and VFWD (Table 1). A major finding from Phase 1 was that two facilities servicing an airport (SFOI and SFOS) showed significantly greater PFAS concentrations when compared to other municipal POTWs, and the distribution of PFAS analytes was quite different from other municipal POTWs. For further characterization of municipal wastewater, data from SFOI and SFOS are excluded from summary tables (Table C.1 and Appendix A).

Another interesting finding is that we did not observe a correlation between the proportion of industrial flows and the sum of quantified PFAS. This finding did not support our original (Phase 1) hypothesis that facilities receiving a higher proportion of industrial flows would contain higher concentrations of PFAS. This led to one of the study questions for Phase 2 to investigate whether residential sewershed discharges are an important source of PFAS to the sewershed.

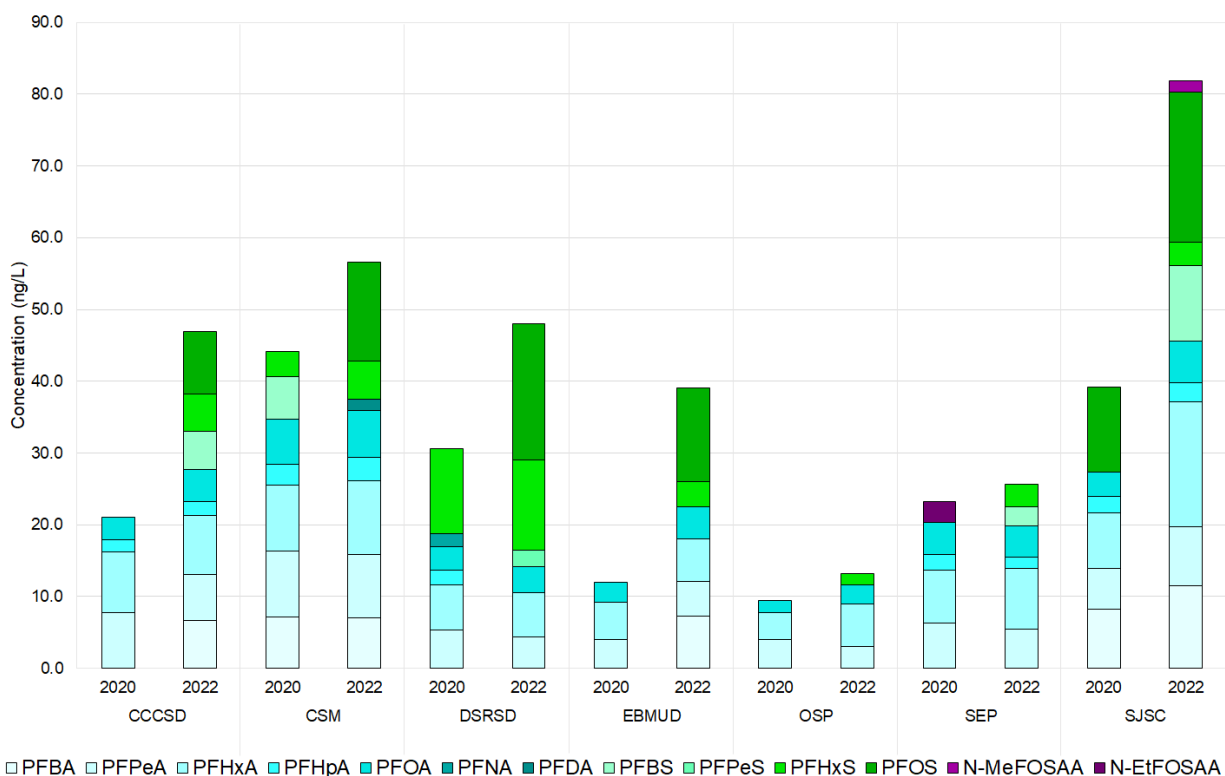
Influent samples showed the detection of a variety of PFAS analytes using target analysis, with results summarized in Table C.1. Three analytes — PFPeA, PFHxA, and PFOA — were detected above MDLs in all samples and had the highest median values among all quantified analytes. PFBA was detected in 42% of the samples, though at higher levels than other analytes, as noted by its higher maximum concentration. The sum of detected PFAS was calculated by summing all target analytes in a sample and treating non-detects as zero. Phase 1 sums of PFAS measured in municipal POTW

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influent via the target method ranged from 10–59 ng/L, with a median of 27 ng/L (Table C.1).

Phase 2 influent sampling included CCCSD, CSM, DSRSD, EBMUD, OSP, SEP, and SJSC (Table 1). During Phase 2, short-chain PFCAs (e.g., PFBA, PFPeA, PFHxA, PFHpA) were among the most commonly detected analytes using target analysis (Table D.1), which was generally consistent with Phase 1 detections. PFOA was detected in 100% of target influent samples, and long-chain perfluorosulfonates (e.g., PFHxS and PFOS) were also frequently detected. Detection frequencies of PFOS and PFHxS were higher in Phase 2 sampling, which could be due to analytical challenges in Phase 1 that led to more frequent elevated detection limits.

The sum of detected PFAS was calculated by summing all target analytes in a sample and treating non-detects as zero. Phase 2 sums of PFAS measured in municipal POTW influent ranged from 13 to 82 ng/L, with a median of 47 ng/L (Table D.1). This median is higher than Phase 1 results, which could be due to more frequent detections of target PFAS analytes, most notably for PFHxS and PFOS. The reported PFAS levels could be considered semi-quantitative because many detections appear to be near detection levels, leading to either J-flagged values or non-detects.



**Figure 2: Target Influent Results.** Concentrations of detected PFAS analytes via the target method in municipal POTW influent grab samples (first single grab) from Phase 1

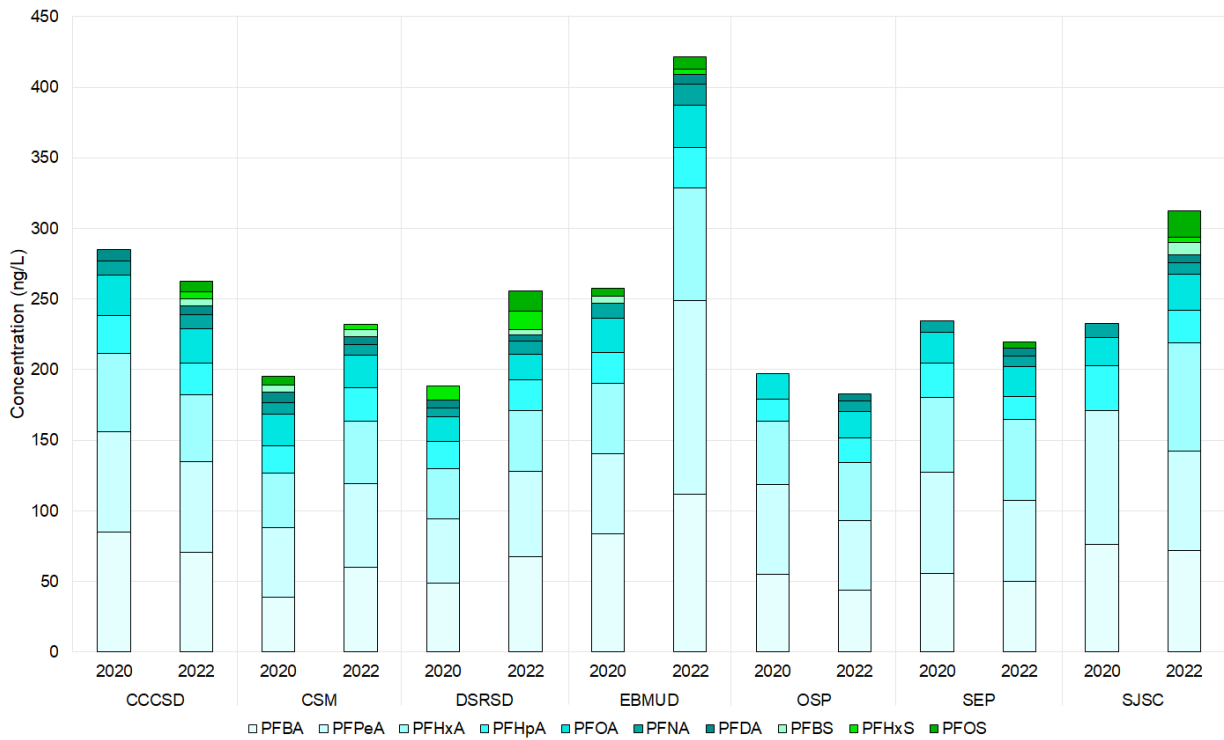
and Phase 2. Analytes that were below detection limits are treated as zeroes and are not shown. Acronyms refer to individual POTWs identified in Table 1.

The sum of PFAS concentrations measured in Phase 1 and 2 are well within the range of PFAS concentrations reported by others, including municipal POTWs across the state responding to SWRCB POTW investigation orders (Aflaki and Voskuhl, 2022). Of the four individual PFAS analytes detected in 100% of BACWA influent samples (PFPeA, PFHxA, PFOA, PFHxS) (Table D.1), the same analytes were also detected in 100% of influent in a study from a regional city catchment in Queensland, Australia (Gallen et al., 2022). Interestingly, 6:2 FTS was frequently detected in the Gallen et al. (2022) Australian study, but was not observed in the BACWA influent samples (Figure 2). Another Australian study also found abundant levels of diPAPs (polyfluoroalkyl phosphoric acid diesters), which are generally used as grease-proofing agents in food contact materials (Szabo et al., 2023); these analytes were not included in the current BACWA study.

### **3.2.2 Influent PFAS TOP Analysis Results**

Both Phase 1 and Phase 2 TOP analysis of influent samples quantified significantly higher levels of PFAS compared to target analysis, indicating a considerable presence of PFAS precursors that are not quantified using the target method. The sums of PFAS quantified using TOP analysis in Phase 1 ranged from 150–299 ng/L, with a median of 231 ng/L (Table C.2). Phase 2 TOP analyses of influent showed consistent results, with sums of PFAS quantified ranging from 183–422 ng/L, with a median of 256 ng/L (Table D.2). Sums of PFAS measured via TOP analyses were between 4 to 13 (median =6) times greater than sums of PFAS measured via target analyses for Phase 2 municipal influent (n = 7).

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**Figure 3: TOP Influent Results.** Concentrations of detected PFAS analytes via the TOP method in municipal POTW influent grab samples (first single grab) from Phase 1 and Phase 2. Analytes that were below detection limits are treated as zeroes and are not shown.

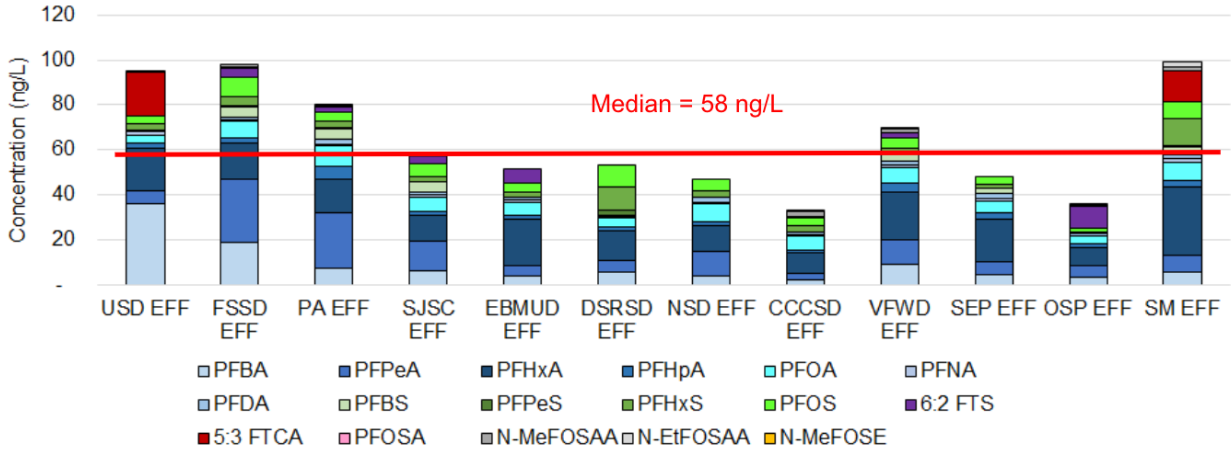
TOP analysis is not widely used for wastewater monitoring, and we did not find comparable wastewater influent data for comparison. We expect BACWA TOP results to be representative of other municipal wastewater in California that are not particularly impacted by PFAS in source waters or industries.

### 3.3 Effluent

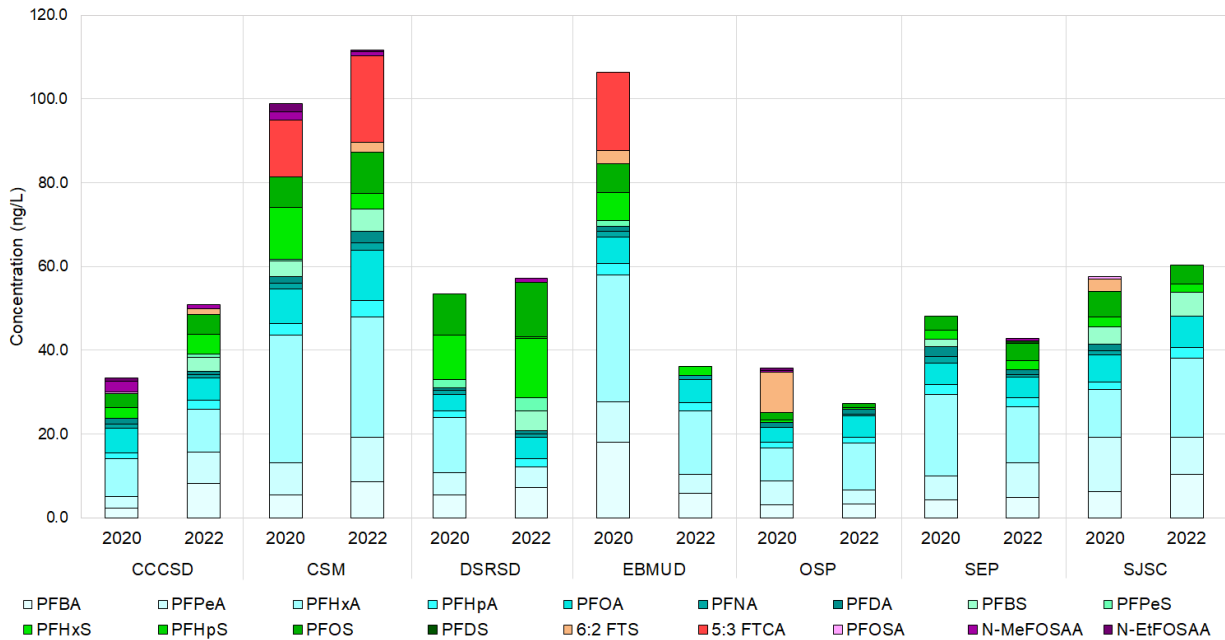
#### 3.3.1 Effluent PFAS Target Analysis Results

Phase 1 and Phase 2 results indicated a broad range of PFAS analytes present in the effluent samples analyzed using target analysis (Table C.3 and D.3). For Phase 1, 17 analytes were detected at municipal facilities with eight, mostly short-chain PFCAs, identified above MDLs in all samples. Phase 1 sums of PFAS measured in municipal POTW effluent ranged from 33–106 ng/L, with a median of 58 ng/L using target analysis. When we compared municipal facilities based on the proportion of flows received from industrial dischargers, we did not find a correlation between the proportion of industrial flows and the sum of quantified target PFAS for effluent data for Phase 1 (Figure 4). Additionally, there was no clear difference between facilities that performed secondary treatment and those with advanced secondary treatment.

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**Figure 4: Target Effluent Results.** Concentrations of detected PFAS analytes via target method in municipal POTW effluent samples from Phase 1. Analytes that were below detection limits are treated as zeroes and are not shown. POTWs are arranged in order from those receiving the greatest proportion of influent flows from industrial discharges (far left - 20% industrial discharges) to those receiving the lowest proportion of influent flows from industrial discharges (far right - 0% industrial discharges). EBDA is not included in this figure as its effluent comes from multiple other POTW sources with differing influent flow compositions.



**Figure 5: Target Effluent Results.** Concentrations of detected PFAS analytes via target method in municipal POTW effluent samples from Phase 1 and Phase 2. Analytes that were below detection limits are treated as zeroes and are not shown.

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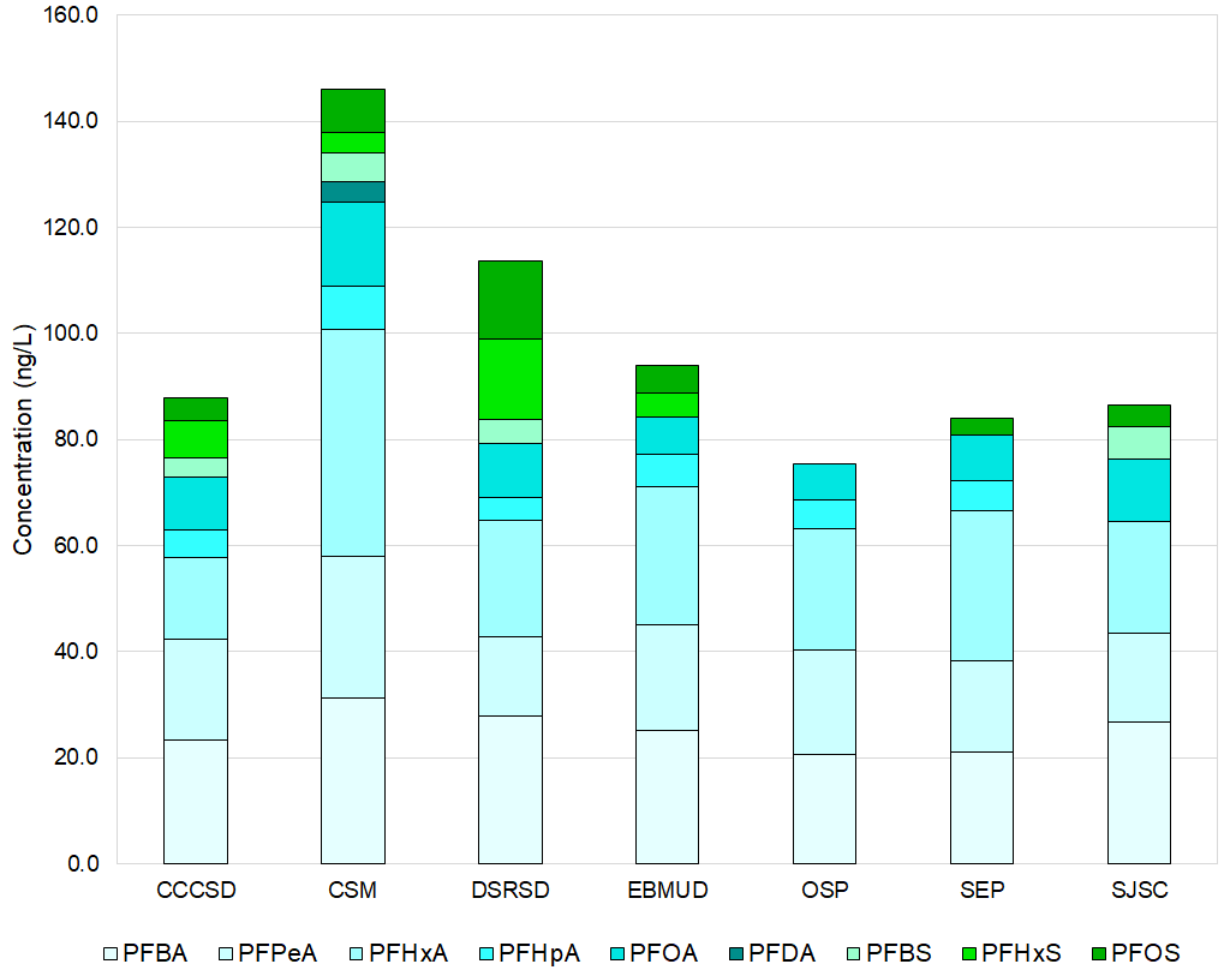
During Phase 2, 17 PFAS analytes were detected in municipal effluent with four perfluoroalkyl carboxylates (PFBA, PFPeA, PFHpA, and PFOA) along with one perfluoroalkyl sulfonate, PFHxS, detected in 100% of samples, with individual concentrations ranging from ND–29 ng/L. The sums of PFAS in municipal effluent via target analysis ranged from 27–112 ng/L, with a median concentration of 51 ng/L for Phase 2. In both phases of the study, the levels of PFAS are generally similar across POTWs (Figure 5).

The PFAS concentrations measured in Phase 1 and 2 are in the lower range of PFAS concentrations reported by others, including municipal POTWs in California (Aflaki and Voskuhl, 2022), and studies of municipal wastewater from Chickasha, OK (Masoner et al., 2023) and Nevada (Thompson et al. 2022). The analyte composition was comparable between the current study and the Oklahoma study, which also observed frequent detections of PFOS. We compared the current study with previous RMP wastewater studies in Section 3.3.3.

### **3.3.2 Effluent TOP Analysis Results**

Analysis of municipal effluent using TOP analysis was only implemented for Phase 2. The sums of PFAS in effluent measured via TOP ranged from 75–146 ng/L, with a median of 88 ng/L (Table D.4; Figure 6). This is approximately double the sum of PFAS measured in effluent measured via the target method (Table D.3).

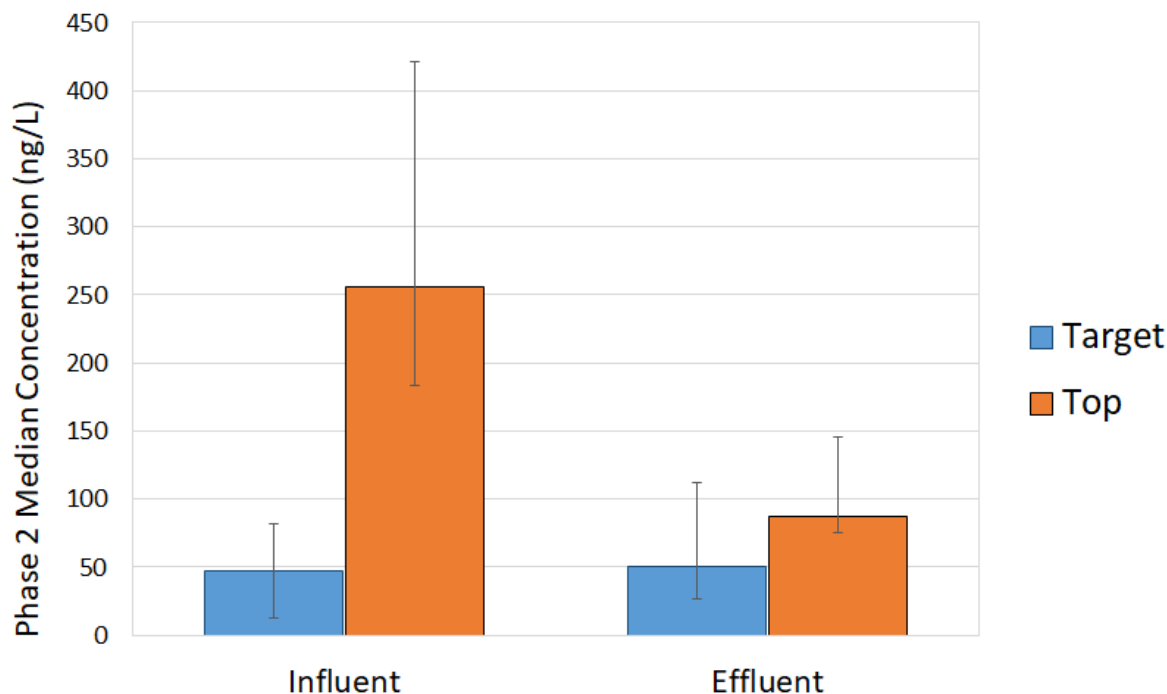
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**Figure 6: TOP Effluent Results.** Concentrations of detected PFAS analytes via TOP method in municipal POTW effluent samples for Phase 2. Analytes that were below detection limits are treated as zeroes and are not shown.

Phase 2 TOP results show a reduction in the median sum of PFAS quantified in effluent (median 88 ng/L) compared to influent (256 ng/L) (Figure 7). This trend was not apparent in the target results, where the Phase 2 median sum of PFAS in effluent (43 ng/L) and influent (47 ng/L) were similar (Figure 7).

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**Figure 7: Target and TOP Influent and Effluent Results.** Phase 2 comparison of median influent and median effluent for PFAS target and TOP analysis. The error bars are the minimum and maximum PFAS levels for both influent and effluent PFAS target and TOP analysis.

Phase 1 target results even showed higher levels of PFAS in effluent compared to influent, which could be explained by the contribution of PFAS precursors in influent that are converted to more detectable terminal products in effluent through the wastewater treatment process. The substantial decline in Phase 2 TOP influent to effluent results indicate the removal of oxidizable precursors during treatment, perhaps due to sorption within the biosolids phase.

Similar to influent, TOP analysis is not widely used for wastewater monitoring, and we did not find comparable wastewater effluent data for comparison. We expect BACWA TOP results to be representative of other municipal wastewater in California that are not particularly impacted by PFAS in source waters or industries. Further comparisons with RMP's previous monitoring efforts are discussed in the next section.

### 3.3.3 Effluent Temporal Trends Discussion

Since 2009, the RMP has performed two studies examining wastewater effluents for PFAS to assess concentrations discharged into the Bay. A blind study of six municipal POTWs in 2009 reported a total of 10 target analytes in sampled effluents with mean

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values and standard deviations (SD) noted in Table 2 (Klosterhaus et al., 2013). In 2014, six municipal POTWs—CCCSD, CSM, EBDA, EBMUD, PA, and SJSC—were sampled for effluent, with means and standard deviations shown for the same ten analytes reported in the 2009 study (Table 2; Houtz et al., 2016) as well as an additional three precursor PFAS. These values can be directly compared to 2020 (Phase 1) data from the same six POTWs and analytes from the 2014 study (Table 2; Mendez et al., 2021). All seven POTWs sampled in 2022 (Phase 2) are included in Table 2.

Across sample years, there is a noticeable decline of over 50% in the average sum of target PFAS from 2009 to 2022, particularly led by decreases of long-chain compounds. Average concentrations of PFOA, PFNA, and PFOS decreased by 81%, 91%, and 78%, respectively, during this time frame. A Kruskal-Wallis test was used to determine any significant differences. The change in concentrations of PFOS over time was not statistically significant ( $p = 0.08$ ). However, differences in PFOA and PFNA over time were statistically significant with  $p = 0.0005$  and  $0.0002$ , respectively. A post-hoc Nemenyi test was used to compare all pairs of sample years for PFOA and PFNA. The change in concentrations of PFOA in 2022 compared to both 2009 and 2014 were statistically significant,  $p = 0.004$  and  $0.005$ , respectively. The same pairs (2009 and 2014 compared to 2022) were also statistically significant for PFNA ( $p = 0.0008$  and  $0.005$ , respectively). In addition, the change in concentrations from 2009 to 2020 was found to be statistically significant ( $p = 0.045$ ) for PFNA. None of the other analyte comparisons were significant ( $p < 0.05$ ).

Further, the 2014 study also analyzed effluents for six PFCAs using the TOP method, with the means and standard deviations noted in Table 3 (Houtz et al., 2016). The same analytes are presented for the 2022 study, including all participating Phase 2 POTWs, which included a slight deviation in participating POTWs (DSRSD, OSP, and SEP instead of EBDA and PA). Similar to the target analysis comparisons, the 2022 average concentrations are roughly half of those in 2014. PFNA was notably non-detect in all samples in 2022, though it had been previously detected on average at 12 ng/L in 2014. An unpaired t-test exhibited that the declines in PFBA, PFPeA, PFHxA, PFHpA, and PFOA were statistically significant at  $p = 0.007$ ,  $p = 0.003$ ,  $p = 0.019$ ,  $p = 0.002$ , and  $p = 0.002$ , respectively. Comparison of target and TOP data across project years appears to indicate a declining temporal trend for quantified PFAS in effluent. A significant reduction in PFOA levels in wastewater between 2012-2021 has also been reported in a meta-analysis of effluent from Nevada (Thompson et al., 2022).

Considering the limitations of our analytical methods to quantify the diversity of PFAS in commerce, of which only a small fraction is elucidated, we do not have enough information to determine whether these are real reductions in levels of total PFAS in effluent, or whether there may be market changes in the composition of PFAS used to analytes that we are not able to quantify with target and TOP analysis.

**Table 2.** Average concentrations of detected PFAS using the targeted method for POTW effluent studies in 2009, 2014, 2020 (Phase 1), and 2022 (Phase 2; present study). PFAS analyzed and detected in at least three of the sample years are shown. All values are in ng/L. SD = standard deviation.

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Detected Analytes	2009 Mean <sup>1</sup>	SD	2014 Mean <sup>2</sup>	SD	2020 Mean <sup>2</sup>	SD	2022 Mean <sup>3</sup>	SD
PFBA	7	5	16	6	7	5	7	2
PFPeA	6	8	12	11	10	7	7	2
PFHxA	17	4	26	5	20	9	14	8
PFHpA	5	1	4	2	3	1	2	1
PFOA	32	30	21	13	7	1	6	2
PFNA	12	6	8	4	1	0	1	0
PFDA	4	2	4	2	2	0	1	1
PFBS	5	7	3	2	2	2	3	3
PFHxS	5	6	5	1	5	4	4	5
PFOS	24	32	13	4	5	2	5	4
6:2 FTS <sup>4</sup>	NA	NA	3	1	2	2	1	1
N-MeFOSAA <sup>4</sup>	NA	NA	2	1	0	1	0	0
N-EtFOSAA <sup>4</sup>	NA	NA	1	0	1	1	0	0
Sum of PFAS	118		119		65		55	

<sup>1</sup>The 2009 project included six unspecified Region 2 POTWs with the average concentration shown (Klosterhaus et al., 2013). Non-detects (NDs) were set to 0.

<sup>2</sup>Each concentration is averaged across six participating facilities (CCCSD, CSM, EBDA, EBMUD, PA, and SJSC) for 2014 (Houtz et al., 2016) and 2020 studies. Non-detects (NDs) were set to 0.

<sup>3</sup>For 2022, each concentration is averaged across all seven participating facilities (CCCSD, CSM, DSRSD, EBMUD, OSP, SEP, and SJSC).

<sup>4</sup>6:2 FTS and N-MeFOSAA were not analyzed in the 2009 study (NA = not applicable).

**Table 3.** Average concentrations of detected PFAS using the TOP method for POTW effluent studies in 2014 and 2022 (Phase 2; present study). Only the PFAS analyzed in the 2014 study are summarized here. All values are in ng/L. SD = standard deviation

Detected Analytes	2014 Mean <sup>1</sup>	SD	2022 Mean <sup>2</sup>	SD
PFBA	43	11	25	3.6
PFPeA	37	10	19	3.5
PFHxA	38	8.8	26	8.0

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PFHpA	<b>15</b>	4.9	<b>5.0</b>	2.3
PFOA	<b>27</b>	8.3	<b>10</b>	2.9
PFNA	<b>12</b>	3.9	<b>ND</b>	ND
Sum of PFAS	<b>172</b>		<b>85</b>	

<sup>1</sup>Each concentration is averaged across six participating facilities (CCCSD, CSM, EBDA, EBMUD, PA, and SJSC) for 2014 (Houtz et al., 2016). Non-detects (NDs) were set to 0.

<sup>2</sup>For 2022, each concentration is averaged across all seven participating facilities (CCCSD, CSM, DSRSD, EBMUD, OSP, SEP, and SJSC).

### 3.4 Adsorbable Organofluorine Analysis (AOF)

During Phase 2, influent and effluent samples were analyzed via AOF analysis (SGS AXYS MLA-119). It is important to note that at present, the method is still under development by the U.S. EPA and that further multi-laboratory validation procedures are still underway, which could result in revisions to the draft method (U.S. EPA, 2022). AOF Draft Method 1621 was developed as a screening method to measure organofluorine compounds from both PFAS and non-PFAS fluorinated compounds, such as many pesticides and pharmaceuticals that contain one or more carbon fluorine bonds (U.S. EPA, 2022). Because this method involves the retention of organofluorine compounds onto granular activated carbon (GAC) prior to analysis, certain organofluorine compounds have been reported to have low recoveries with this method, including very short-chain (less than 4 carbons) and very long-chain (more than 8 carbons) organofluorine compounds (U.S. EPA, 2022), as well as PFAS associated with colloids or micro- and nanoplastics (Ferguson, 2023). The GAC columns are rinsed with sodium nitrate to remove inorganic fluoride, and samples are analyzed by ion chromatography. Results are reported as the concentration of fluoride ( $F^-$ ) in the combusted, GAC-adsorbed sample. The results are described as a “method-defined parameter,” and several analytical challenges have been identified, including the potential for significant background contamination. Considering all the limitations and data gaps with this method, it was applied in Phase 2 as a pilot experimental study; results are interpreted cautiously, acknowledging significant uncertainty.

Influent and effluent AOF results were all above detection limits. AOF influent concentrations ranged from 10.6–82.7  $\mu\text{g/L}$  with a median concentration of 19.8  $\mu\text{g/L}$  (Table 4). The AOF influent concentrations for each POTW are 70–170 times greater than the TOP influent PFAS concentrations after converting TOP results to concentration fluorine ( $F^-$ ) (calculated  $F^-$  concentrations from target and TOP measurements are included in Appendix Tables). The levels of AOF measured did not correlate with levels of PFAS measured with TOP analysis. Other wastewater studies (Camdzic et al., 2023) have reported a significant presence of trifluoroacetic acid (2 carbon length), which could contribute partially to this difference because trifluoroacetic acid can be partially quantified via AOF (due to low recovery) but not via TOP analysis as currently performed.

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AOF effluent concentrations ranged from 3.8–17.8 µg/L with a median concentration of 7.6 µg/L (Table 4). The effluent AOF concentrations were lower than influent concentrations, which is consistent with the trends measured via PFAS TOP analysis. Effluent AOF results were 45-250 times greater than the corresponding TOP analysis results for effluent samples collected from the same POTW on the same date. Similar to the influent results, AOF effluent values did not correlate with levels of PFAS measured with TOP after converting TOP results to concentration of fluorine (Appendix Tables).

**Table 4.** AOF data. Note that results reported here are in units of µg/L, unlike PFAS TOP and Target methods, which reported their concentrations in ng/L.

	Detection Limit	Min	Max	Median	Mean
Influent	5.2 ± 2.0	10.6	82.7	19.8	26.9
Effluent	1.5 ± 0.1	3.8	17.8	7.6	8.3

The significantly higher levels of fluorine measured in influent and effluent samples using AOF are interpreted cautiously, and indicate potential presence of significant amounts of organofluorine not quantified via TOP method. These fluorinated compounds could consist of PFAS and/or non-PFAS compounds. The results could also be influenced by incomplete removal of inorganic fluorine in the sample prior to analysis. This method does not provide additional information about what types of compounds are contributing to the fluorine (F<sup>-</sup>) measurements. At this time, we will continue to investigate this method further by reviewing scientific papers and EPA reporting about this method. We also suggest pairing this method with non-target suspect screening analysis for PFAS to understand what types of PFAS and non-PFAS compounds are present in samples.

### 3.5 Biosolids

#### 3.5.1 Biosolids PFAS Target Analysis Results

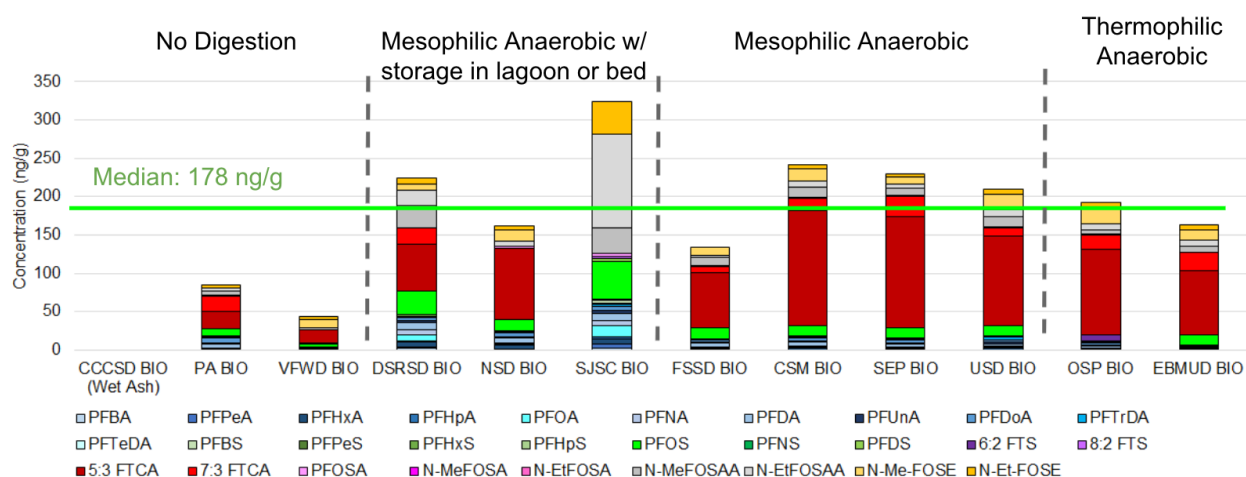
The largest variety of PFAS in all matrices was detected within biosolids, with a total of 25 analytes found out of 40 analyzed (Table C.4 and Table D.5).

Phase 1 municipal biosolids concentrations ranged from non-detect to 320 ng/g dw, with a median of 178 ng/g measured via the target method (Table C.4 and Figure 8). The outlier samples are likely influenced by the particular biosolids processing at the POTW. CCCSD biosolid samples (non-detect in Figure 8) are incinerated and analyzed as wet ash samples and, therefore, are not representative of typical biosolids processes. Two biosolids “cake” samples from CCCSD collected prior to incineration (Appendix A) were analyzed for target PFAS and did show the presence of several PFAS. SJSC exhibited a different composition of dominant PFAS analytes in biosolids compared to others, which is likely due its unique biosolids digestion process. The process involves a four-year storage and processing time in sludge beds, which may allow for further transformation of PFAS precursors.

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Among the biosolid samples from Phase 1 target analysis, 5:3 FTCA was widely detected (83%) at significantly higher concentrations than any other analyte, with a median concentration of 78 ng/g. This is more than five times greater than the next largest median of 14 ng/g for 7:3 FTCA. Generally, 5:3 FTCA is considered an intermediate transformation product, particularly for 6:2 fluorotelomer structures, and is commonly observed in landfill leachates and food contact substances (Lang et al., 2017; Schaidler et al., 2016), which may explain its widespread presence at high concentrations in biosolids. Additionally, all PFCAs within the target method were detected in the full set of samples, with long-chain PFCAs among the most extensively found (83–92%).

When separated by digestion type (Figure 8), POTWs with no digestion showed lower concentrations of PFAS compared to the other processes (Figure 8). One potential explanation for this is the greater concentration of organic matter in undigested samples, which dilutes the concentrations of PFAS (reported per biosolid mass) compared to biosolids that have lost organic matter through digestion processes. This was investigated further during Phase 2 by analyzing and comparing PFAS levels in final biosolids compared to pre-digested biosolid feed samples at three facilities (See Section 3.6). The concentrations of PFAS across all other POTWs performing biosolid digestion processes appear relatively comparable (Figure 9).

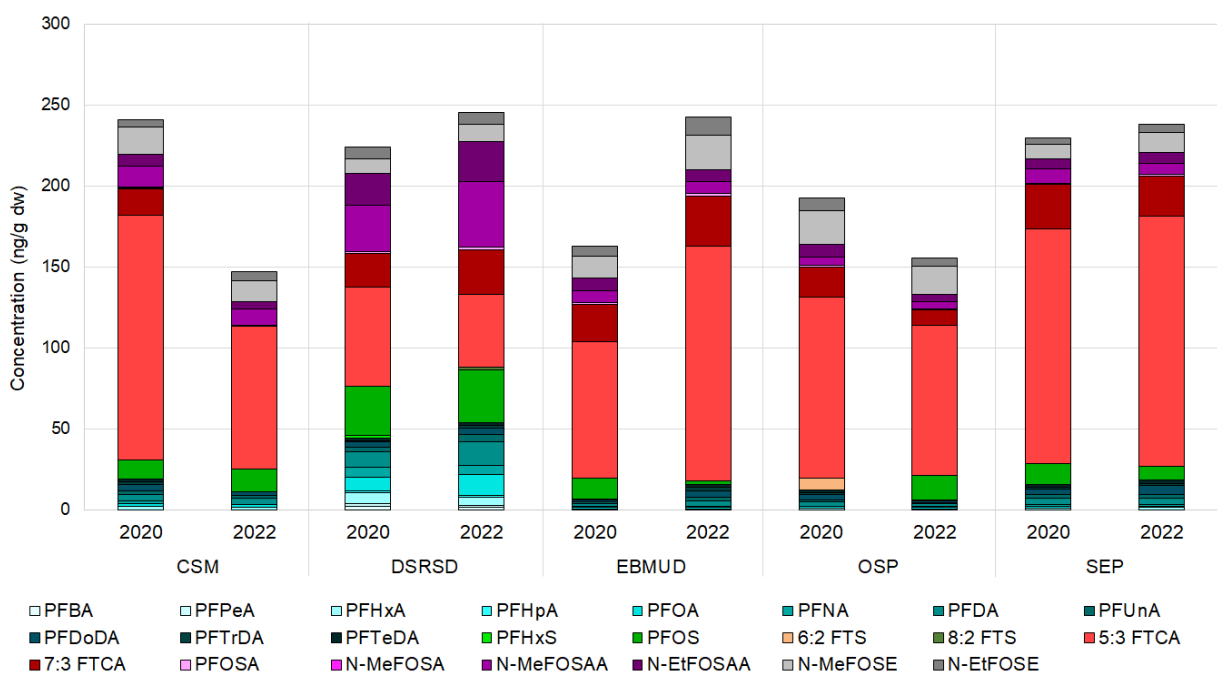


**Figure 8. Target Biosolid Results.** Concentrations of detected PFAS analytes via target method in municipal POTW biosolid samples for Phase 1. Biosolid treatments varied depending on POTW and treatment stage. Analytes that were below detection limits are treated as zeroes and are not shown.

For Phase 2, biosolids were only collected at participating POTWs that utilize anaerobic digestion. Phase 2 target analysis of biosolids detected 20 PFAS analytes, with PFHxA, PFOA, PFDA, PFDoDA, 5:3 FTCA, PFOSA, and N-MeFOSE detected in 100% of target analysis biosolid samples (Figure 9, Table D.5). The relative percent difference between a biosolid sample from EBMUD and its field replicate among detected analytes ranged

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from 22-200%. Consistent with Phase 1 results, 5:3 FTCA had the highest concentrations detected with a range of 45–154 ng/g dw. Although 7:3 FTCA was not detected in every sample, it had the second highest concentration, ranging between ND–31 ng/g. The overall sums of PFAS quantified ranged from 128–246 ng/g with a median concentration of 208 ng/g and a mean concentration of 197 ng/g. These are generally comparable to Phase 1 results, though within a tighter range as expected, based on a smaller set of POTWs with more similar digestion methods.



**Figure 9. Target Biosolid Results.** Phase 1 and 2 comparison of PFAS concentrations detected via Target method in municipal POTW biosolid samples. Concentrations are in ng/g dw. Analytes that were below detection limits are treated as zeroes and are not shown.

PFAS levels in biosolids in Phases 1 and 2 are in the range of PFAS concentrations in biosolids reported by others. Thompson et al. (2023) quantified 92 PFAS analytes in municipal biosolids from 8 POTWs in Florida, and the sum of PFAS ranged from 182–1650 ng/g. Another study in Australia (Coggan et al., 2019, Moodie et al., 2021) reported sum of PFAS concentrations ranging from 3–900 ng/g. In the Florida study, two facilities that used anaerobic digestion processes reported 5:3 FTCA concentrations of 21 and 65 ng/g dw. In the Australian study, 5:3 FTCA was detected in 88% of the biosolids samples (n=17) with a mean concentration of  $16 \pm 21$  ng/g (median = 4.6 ng/g) and a range of ND-61 ng/g (Moodie et al., 2021).

One important difference between the current BACWA study and the Florida and Australia study is that the other studies also quantified three fluorotelomer phosphate diesters (diPAPs), which are PFAS precursors not included in the target analyte list from this study. Thompson et al., (2023) found the sum of the diPAPs ranged from 73 -

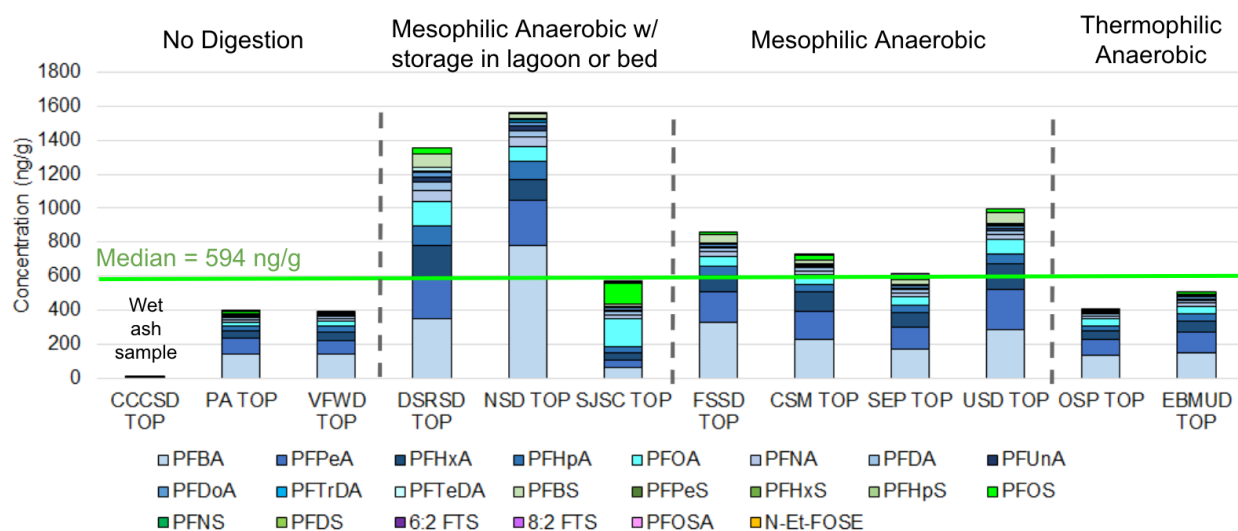
## Study of PFAS in Bay Area POTWs: Phase 2 Final Report

1400 ng/g, composing 54% of the sum of PFAS quantified (92 target analyte list) in biosolids. The PFAS precursors, diPAPs, were also quantified in the Australian biosolids study, in which diPAPs contributed 45% of the total PFAS quantified in samples. The inclusion of additional diPAPs could explain the higher levels of PFAS measured in the Florida and Australia study compared to this study.

Similar to the trends observed in effluent, there may be a temporal trend in reductions of PFOS and PFOA in biosolids. A national survey of PFAS in biosolids conducted by the EPA in 2001 using target analysis of 13 PFAS analytes was dominated by PFOS and PFOA with mean levels at  $403 \pm 127$  ng/g dw and  $34 \pm 22$  ng/g dw, respectively (Venkatesan and Halden, 2013). The mean PFOS and PFOA levels in biosolids for Phases 1 and 2 were  $14 \pm 10$  ng/g and  $3 \pm 4$  ng/g, respectively, meaning there were significantly lower levels in 2020/2022 compared to national trends in 2001 for these two banned PFAS compounds.

### 3.5.2 Biosolids PFAS TOP Analysis Results

Phase 1 TOP analysis of biosolid samples showed significantly higher concentrations compared to target analysis, with a range of 2–1,565 ng/g dw and a median of 594 ng/g dw for the sums of TOP PFAS (Figure 10 and Table C.5). The median for the sum of PFAS in biosolids via TOP is roughly three times greater than the sum of target analytes, which suggests a large presence of PFAS precursors that are not quantified using the target method. While biosolids processed in sludge lagoons appears to have higher levels of PFAS, this is not statistically significant.

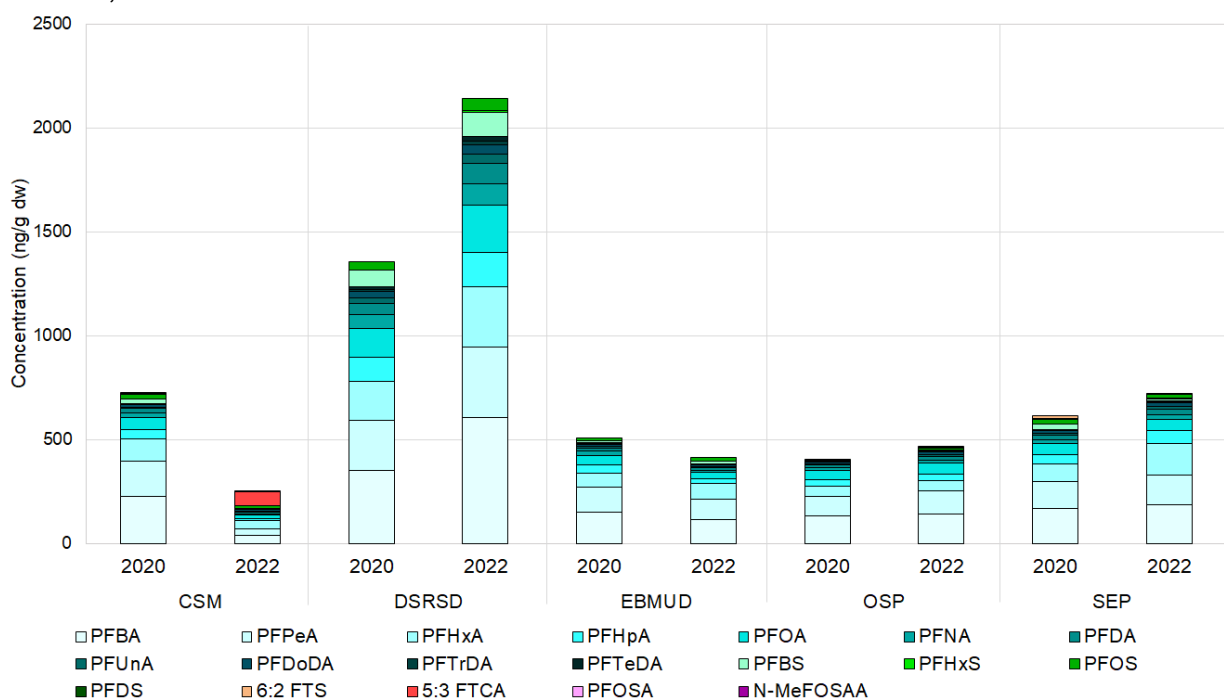


**Figure 10. TOP Biosolid Results.** Phase 1 concentrations of detected PFAS analytes via TOP method in municipal POTW biosolids samples, organized by digestion type. Analytes that were below detection limits are treated as zeroes and are not shown.

Phase 2 TOP analysis concentrations also showed a significantly higher sum of PFAS quantified compared to target analysis. There is consistency between Phase 1 and

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Phase 2 biosolid TOP results based on analytes detected and concentrations (Figure 11, Table D.6). As expected, 5:3 FTCA was not measured in TOP results because this PFAS precursor is converted to terminal PFCAs (although in some limited cases the conversion of precursors to terminal products is not complete, see Figure 11). The terminal perfluorinated PFAS analytes PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnA, PFDoDA, PFTTrDA, PFTeDA, and PFOS were present in all samples. The relative percent difference among three pairs of biosolid sample replicates ranged between 1–200%. PFPeA and PFHxA had the highest concentrations, with ranges between 31–340 ng/g and 39–291 ng/g, respectively. The sum of PFAS TOP analysis concentrations ranged from 250–2,142 ng/g with a median concentration of 441 ng/g and a mean concentration of 659 ng/g (Table D.6). Interestingly, biosolid TOP concentrations at one of the POTWs was notably elevated for Phase 2 relative to Phase 1 results, and relative to other POTWs.



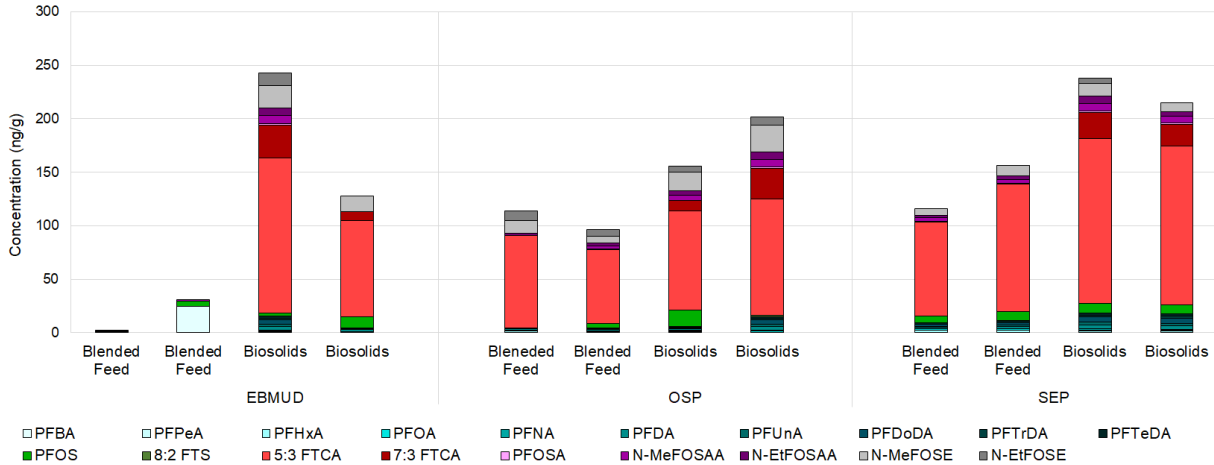
**Figure 11. TOP Biosolid Results.** Phase 1 and 2 comparison of PFAS concentrations detected via TOP method in municipal POTW biosolid samples. Concentrations are in ng/g dw. Analytes that were below detection limits are treated as zeroes and are not shown.

### 3.6 Understanding PFAS in Biosolids: Blended Feed and Food Waste

To preliminarily investigate changes in PFAS in biosolids through the digestion process, blended feed samples from EBMUD, OSP, and SEP were analyzed for PFAS via target and TOP analysis. Compared to final biosolids samples, target results showed the sums of PFAS quantified in blended feed samples were lower for the three POTWs (Figure 12). This is consistent with the trend we expected based on results from Phase 1, with samples with no digestion showing lower levels of target PFAS. Blended feed at OSP and SEP was dominated by the analyte 5:3 FTCA, having the highest concentrations for

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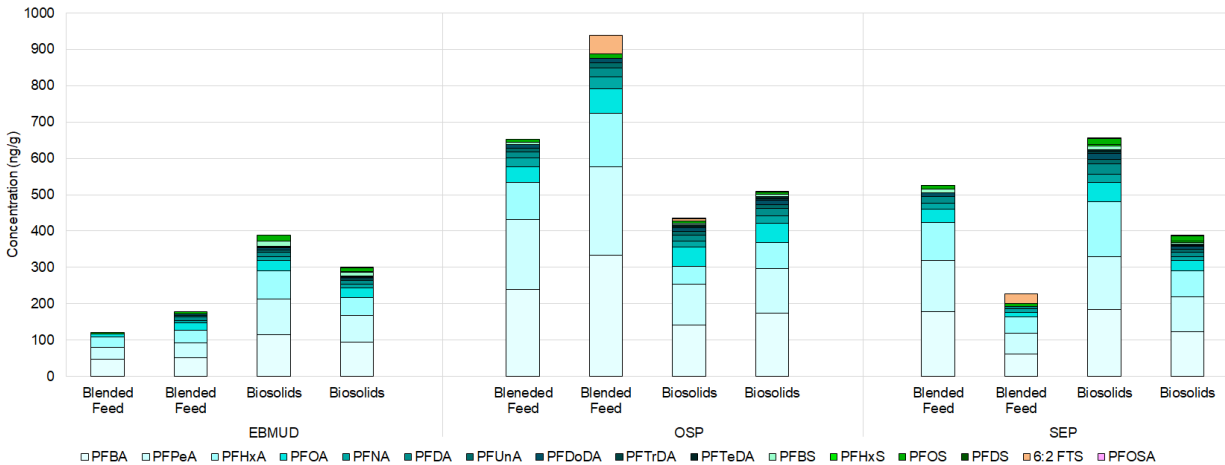
both blended feed and biosolids. The analyte 7:3 FTCA was the second highest concentration analyte in biosolids but was non-detect in blended feed samples. Interestingly, blended feed samples from EBMUD did not have detectable levels of 5:3 FTCA, although this analyte was abundant in final biosolids (Figure 12).



**Figure 12: Target Blended Feed and Biosolid Results.** Phase 2 comparison between pre-digestion blended feed and the final biosolids for POTWs EBMUD, OSP, and SEP via PFAS Target analysis. Analytes that were below detection limits are treated as zeroes and are not shown.

PFAS TOP analysis of blended feed had similarly high concentrations of PFBA, PFPeA, and PFHxA when compared to biosolids samples (Figure 13). EBMUD final biosolid TOP sum of PFAS concentrations was higher in biosolids compared to blended feed as expected based on Phase 2 target and Phase 1 target and TOP. However, OSP and SEP showed different trends. OSP for blended feed had higher levels of TOP PFAS compared to final biosolids (Figure 13). SEP blended feed and biosolid TOP results had more variability between sample replicates. The relative percent difference between SEP blended feed and final biosolid samples was 57% and 42%, respectively. Considering the variability in the samples, the blended feed and biosolid samples had similar levels of PFAS measured via TOP. This emphasizes that the PFAS in biosolids samples are influenced by complex chemical processes, including PFAS transformation, volatilization, and sorption through the digestion process that can result in an increase or decrease in levels of PFAS quantified.

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**Figure 13. TOP Blended Feed and Biosolid Results.** Phase 2 comparison between predigestion blended feed and the final biosolids for POTWs EBMUD, OSP, and SEP via PFAS TOP analysis. Analytes that were below detection limits are treated as zeroes and are not shown.

Food waste samples ( $n = 2$ ) were collected and analyzed for PFAS via target and TOP analysis to assess whether this waste stream could be another potential source of PFAS to biosolids. EBMUD receives approximately 15 tons per day of source-separated food waste (five days per week), which is collected from restaurants, groceries, and cafeterias in Central Contra Costa County. The material is ground and delivered to the EBMUD Main Wastewater Treatment Plant, where it is tipped into an underground tank. It is then slurried with treated wastewater to a total solids concentration of ~8%. It is further processed through a rotocut (grinder-type device) and a paddle finisher (screening contamination). The food waste samples were collected at this step from the paddle finisher prior to further mixing with primary sludge, thickened waste-activated sludge, and high-strength liquid organic wastes before digestion.

While contamination such as plastics and food packaging that contain PFAS is removed at the source, as well as through the processing steps at the transfer station and at EBMUD, the hypothesis we wanted to test was the possibility of de minimis remaining contamination that could contribute PFAS to biosolids. Food waste sample results showed minimal amounts of PFAS measured via target (ND–4 ng/L) and TOP (ND–16 ng/L) analysis, suggesting this is not a significant source of contamination.

## 4. Investigation of Sewershed Sources

### 4.1 Residential Discharges

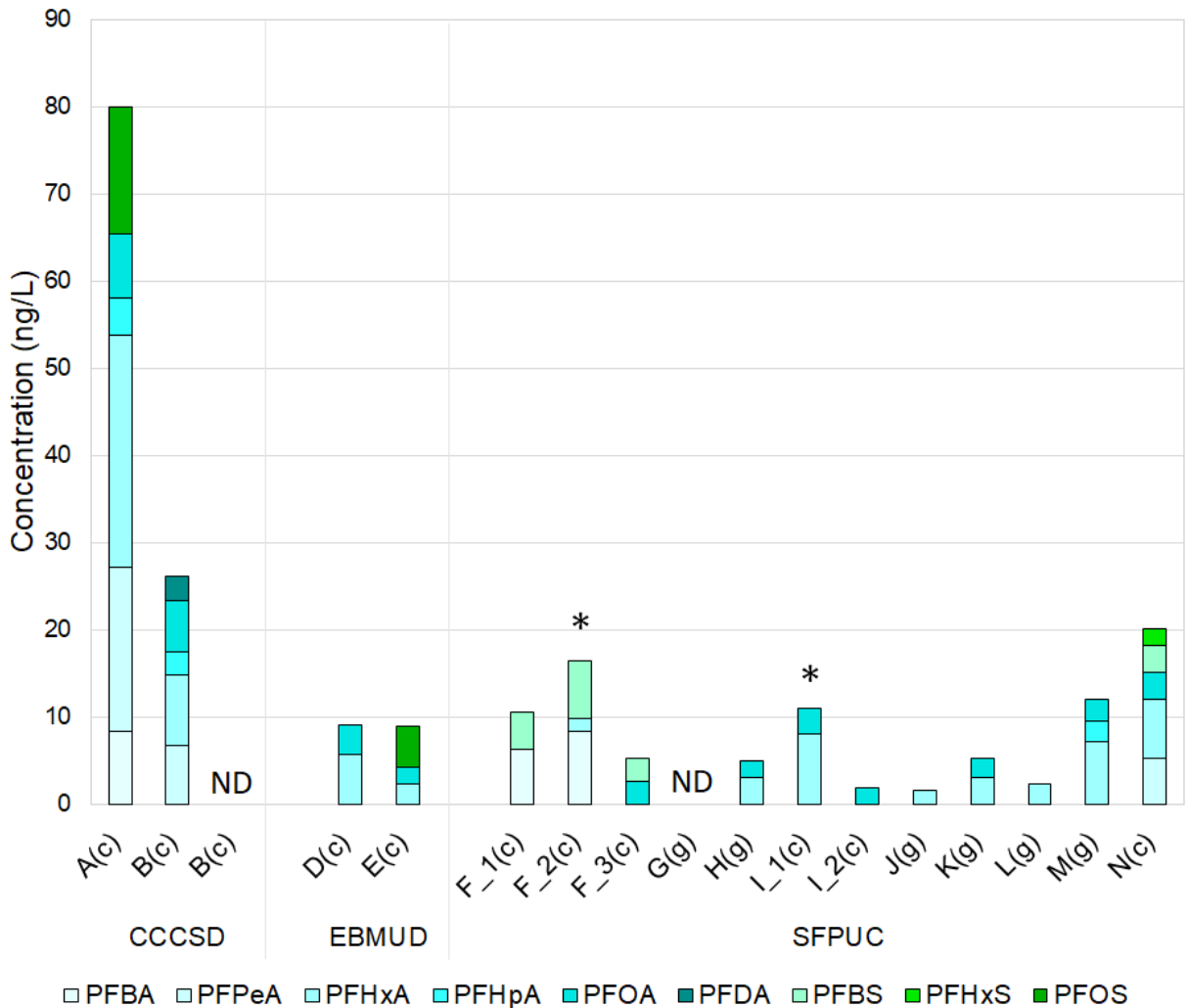
We sampled upstream sewershed discharge locations within the CCCSD, EBMUD, and SFPUC sewersheds that represent wastewater discharges from residential areas to address the Phase 2 study question: Are residential flows an important source of PFAS to the participating POTWs? Sampling locations were identified by POTW staff based on locations that received only residential flows (or included less than 10% of

non-residential flows that are not expected to have significantly different levels of PFAS compared to residential discharges), except for one residential location that included light industries, such as food businesses and warehouses. Sampling locations also represent a diversity in housing types (e.g., multi-unit dwellings, single-family homes), neighborhoods, infrastructure age, and geographic locations, which we hypothesized would also include diversity in socio-economic groups. We anticipated that this diversity in sampling residential locations would provide us with an understanding of the range of concentrations that could be expected from residential discharges in this screening-level study.

Fourteen different residential sampling locations were included. Sample replicates were included at two locations to assess variations due to sampling and analysis. At select sites, samples were collected on different days of the week to screen for any significant changes in PFAS concentrations. There were a total of 17 samples collected from the 14 sampling locations. Most samples were collected as 24-hour composite samples, while some samples were collected as grab samples based on the feasibility of sampling logistics by POTW staff.

#### **4.1.1 Residential Sewershed PFAS Target Analysis Results**

A total of nine analytes were detected via target analysis of residential sewershed samples, with PFHxA and PFOA being present in the most samples at 71% and 65%, respectively, and with PFHxA having the highest concentration range (ND–27 ng/L). Target analysis sums of PFAS for residential sewershed ranged from ND–80 ng/L, with a median concentration of 9 ng/L and a mean concentration of 13 ng/L (Figure 16, Table D.7). The highest sum of PFAS levels was measured in the CCCSD sewershed, with this sample also showing the highest level of PFOS (15 ng/L) among the residential samples. PFOS and PFOA were phased out of manufacturing in the U.S. in 2002 (U.S. EPA, 2002) and 2015 (U.S. EPA, 2015), respectively, so the continued presence of PFOS and PFOA in residential samples is interesting and suggests its continued presence in households or transformation from precursors.



**Figure 16. Target Residential Sewersheds Results.** Phase 2 comparisons of PFAS concentrations in sewershed discharges from different residential neighborhoods (A-N) within CCCSD, EBMUD, and SFPUC sewersheds. Different letters (A-N) represent different neighborhood sampling locations. Sampling occurred on multiple days for Site F and Site I. PFAS analysis was conducted via target analysis. Analytes that were below detection limits are treated as zeroes and are not shown. (c=sample collected as 24-hour composite, g=sample collected as grab sample, \* indicates composite samples collected over a weekend).

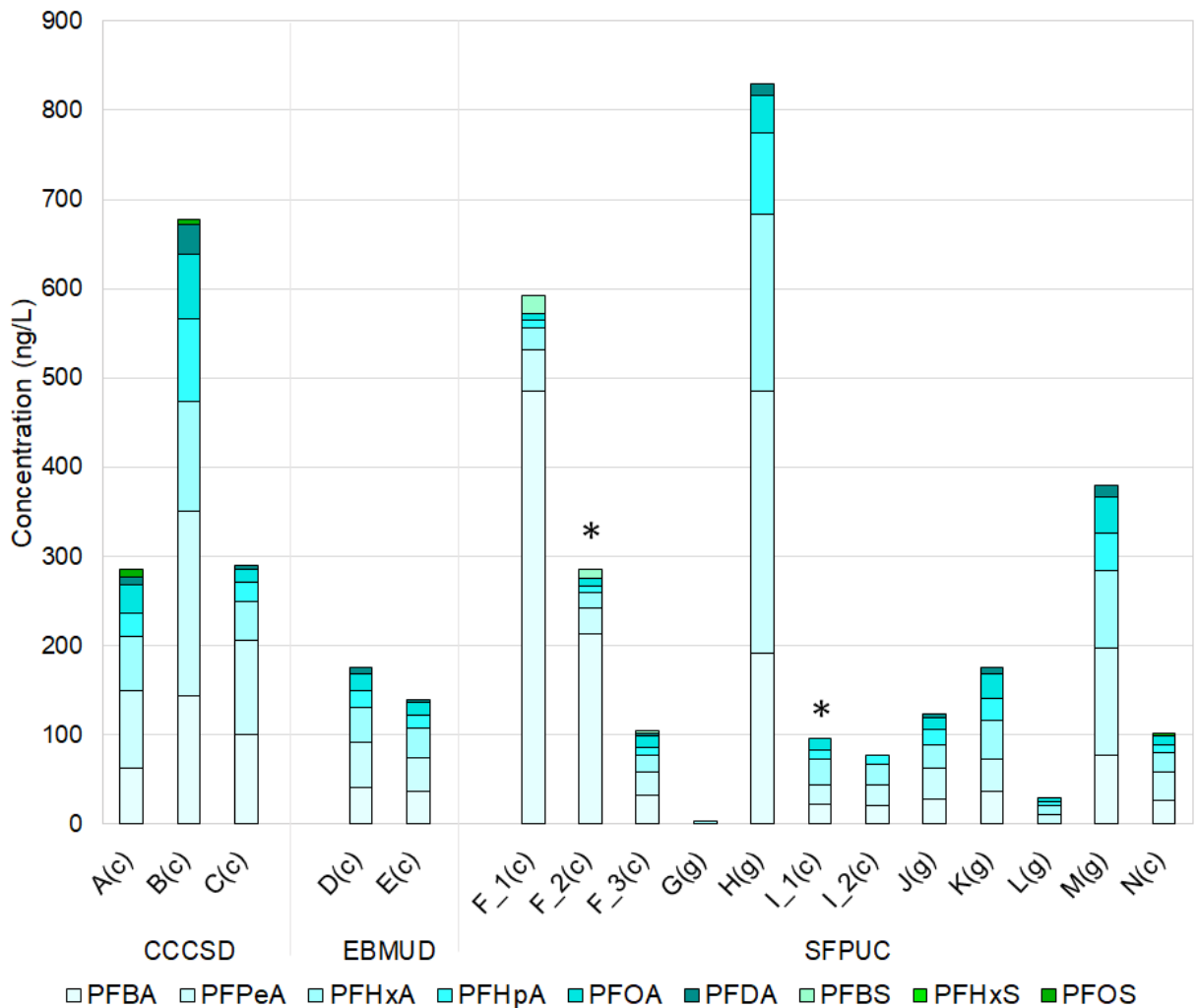
#### 4.1.2 Residential Sewershed PFAS TOP Analysis Results

Residential TOP results showed widely varying PFAS concentrations in comparison to the target results, and there was no correlation between TOP and target results. The sums of PFAS via TOP analysis ranged from 4–850 ng/L, with a median concentration of 187 ng/L and a mean concentration of 271 ng/L (Table D.8, Figure 17). The average

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sum of PFAS measured via TOP was 20 times higher than the mean concentration measured via target analysis. A total of 12 analytes were detected via TOP, with PFBA, PFPeA, PFHxA, PFHpA, PFOA, and PFNA being the most frequently detected. PFBA had the highest concentration range of ND–485 ng/L with a mean concentration of 89 ng/L. The high levels of short-chain PFAS, such as PFBA, PFPeA, and PFHxA, in the TOP results were also observed in the wastewater influent, effluent, and biosolid TOP results, and indicate significant use of unknown PFAS precursors with short-chain components.

It is unclear what the driving factors are for the levels of PFAS measured in residential discharges. Neighborhood H in the SFPUC sewershed had the highest overall PFAS discharge concentration at 850 ng/L (Figure 17). Samples from Site F (Figure 15, F\_1, F\_2, and F\_3) indicate significant variability in day-to-day discharges ranging from 100–596 ng/L of PFAS via TOP method. The average concentrations of PFAS measured via TOP in CCCSD (n = 3), EBMUD (n = 2), and SFPUC (n = 12) were 461, 167, and 241 ng/L.



**Figure 17. TOP Residential Sewersheds Results.** Phase 2 comparisons of PFAS concentrations in sewershed discharges from different residential neighborhoods (A-N) within CCCSD, EBMUD, and SFPUC sewershed. Different letters (A-N) represent different neighborhood sampling locations. Sampling occurred on multiple days for Site F and Site I. PFAS analysis was conducted via TOP analysis. Analytes that were below detection limits are treated as zeroes and are not shown. (c=sample collected as 24-hour composite, g=sample collected as grab sample, \* indicates composite samples collected over a weekend)

To address the major Phase 2 study question of whether residential flows are an important source of PFAS to the participating POTWs, we did a high-level calculation using the equation below to estimate the potential residential contribution to PFAS loadings received as influent at each POTW. Because the levels of PFAS varied significantly, we used a low and high estimate for the PFAS concentrations in residential flows for each POTW sewershed to bound this estimate. The low-high estimate is based

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on the average PFAS concentration measured among all samples ( $n = 17$ ) and the average TOP concentration measured at residential locations within each POTW sewershed only.

$$\text{Residential Contribution (\%)} = \frac{\text{Residential Concentration (ng/L)}}{\text{POTW Influent Concentration (ng/L)}} \times \frac{\text{Residential Flows (MGD)}}{\text{Influent Flows (MGD)}}$$

CCCSD staff estimated that 86% of their influent flows comes from residential customers. The average residential discharge concentration ranged between 271–461 ng/L (low estimate is the mean among all residential samples [ $n = 17$ ]; high estimate is the mean of CCCSD residential samples [ $n = 3$ ]). PFAS TOP concentration measured in CCCSD influent during Phase 2 was 263 ng/L. This results in a calculated potential PFAS contribution of 89–151% of residential discharges. While clearly, it is not possible for residential discharges to contribute more than 100% of the PFAS loadings, these first-order calculations highlight that, indeed, residential sources very likely contribute a majority of the PFAS loadings received at CCCSD.

EBMUD staff estimated that 66% of the influent flows comes from residential sources. Using the same approach as above (residential concentration = 167–271 ng/L; Influent = 422 ng/L, See Section 3.2.2), we estimate that residential sources contribute 26–42% of PFAS loadings received as EBMUD influent.

SFPUC staff were not able to provide a definitive estimate of the contribution of residential flows to influent but did indicate 80% was a reasonable estimate. Using the same approach as above for SFPUC (residential concentration = 241–271 ng/L, influent = 202 ng/L), we estimate that residential sources could contribute 96–108% of PFAS loadings received at SFPUC POTWs.

These are rough estimates since our sampling design was not meant to be representative, and the average PFAS concentration in this subset of residential samples may deviate from the true average. Nevertheless, our findings indicate residential wastewater could be a significant source of PFAS to treatment facilities.

## 4.2 Industrial Sewershed Discharges

Another goal of the Phase 2 study was to screen a limited number of industries discharging to BACWA POTWs to evaluate if these may be important PFAS sources to wastewater. To the extent feasible, we tried to identify and sample from multiple facilities of the same type of industry. At a limited number of sites, samples were collected at different dates in order to avoid missing potential short-term “pulse” PFAS discharges from facility operations. For the same reason, 24-hour composite samples are preferred when available. Grab samples were collected when composite sampling equipment was not feasible to set up at the site, or there was a significant risk of contamination.

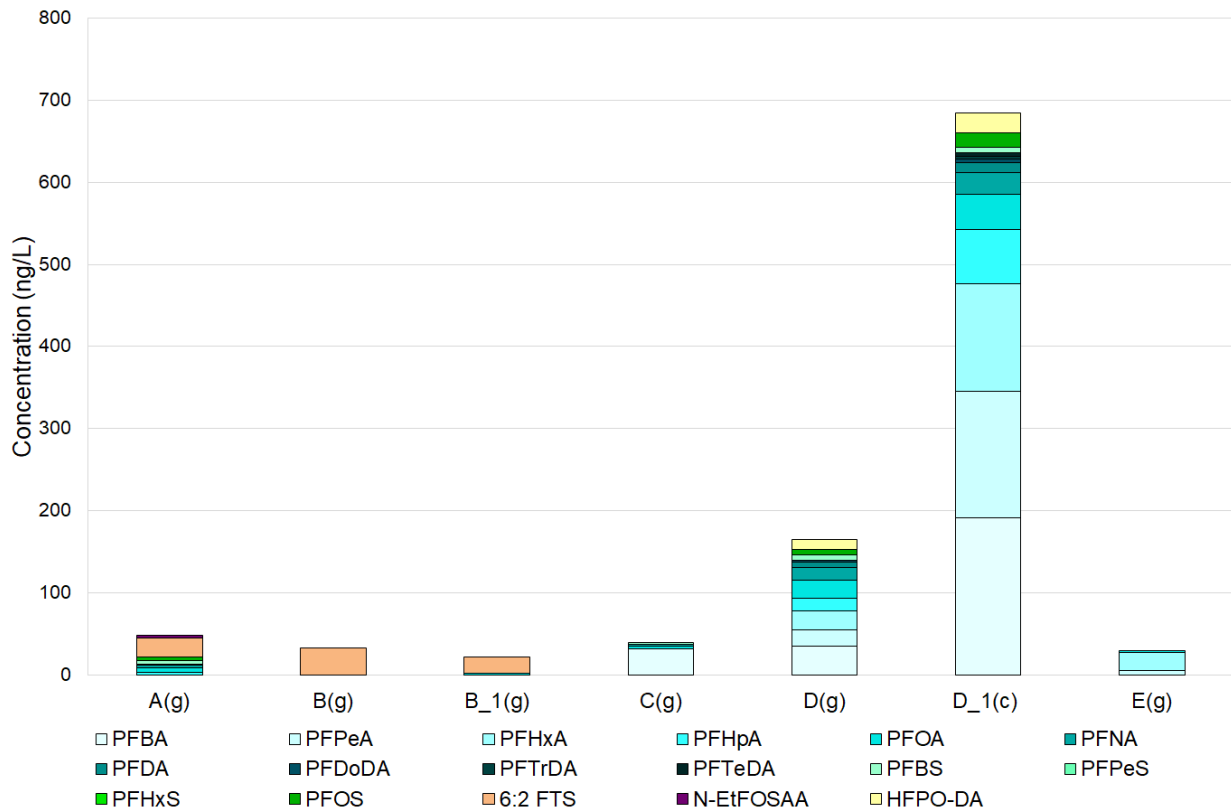
### 4.2.1 Industrial Laundry Sewershed Discharges

Textiles, carpets, and upholstery are known to be treated for PFAS for stain resistance, and recent investigations have measured PFAS in stain-resistant school uniforms (Xia et al., 2022), as well as in dry cleaning solvent and wastewater in Florida (Barnes et al.,

2021). Phase 2 evaluated industrial laundry as a potential source of PFAS derived from textiles from a variety of sites. Five industrial laundry operations were sampled within the sewersheds of three POTWs. A total of seven samples and one replicate were collected because a second sample was collected on the subsequent day at two locations. PFAS sampling efforts leveraged ongoing compliance monitoring of these industries by POTW staff. The selected industrial laundry facilities serve a variety of clients and industries. Restaurant linens, mops, and uniforms composed a majority of laundered items at most of the sampled facilities. Other commonly laundered items include business floor mats, and some facilities reported laundering refinery uniforms and rags, medical uniforms, patient gowns, shop towels, and laboratory coats. All samples have pre-treatment prior to discharging to the sewer, which may include solid/grease separation, ceramic filters, and pH adjustment.

#### **4.2.1.1 Industrial Laundry PFAS Target Analysis Results**

For the industrial laundry PFAS target analysis, a total of 15 analytes were detected across (n = 7) samples and sites. PFOA and 6:2 FTS were the most frequently detected analytes at a detection frequency of 86%. The highest PFAS concentration was measured at Site D (Figure 18); several analytes were detected above 100 ng/L, including PFBA, PFPeA, PFHxA, and 6:2 FTS (Table D.9). Note that this highest concentration target sample was a composite sample, which was almost three times greater than the grab sample collected the prior day. A field replicate grab collected at Site D had a relative percent difference of 41%, indicating moderate levels of variability in the sampling and analysis method. Among all samples (n = 7), the sum of PFAS for industrial laundry target analysis ranged from 22–762 ng/L with a median concentration of 48 ng/L and a mean concentration of 174 ng/L (Table D.9).

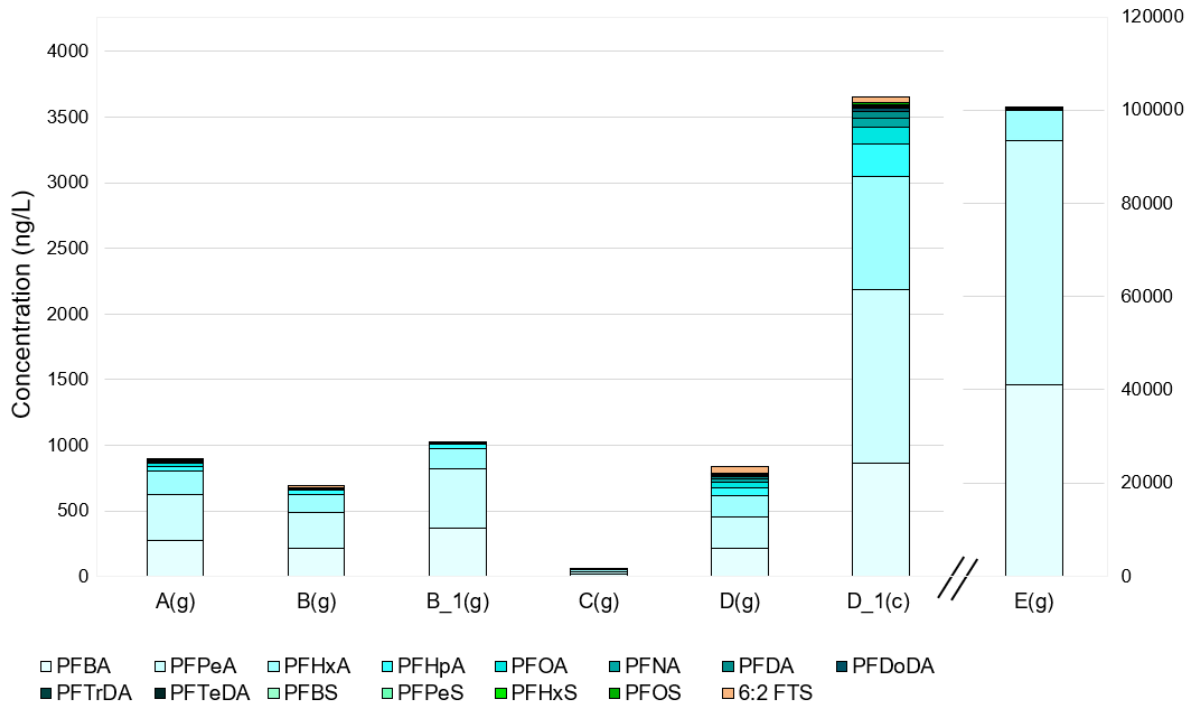


**Figure 18. Target Industrial Sewersheds Results.** Phase 2 comparisons of PFAS concentrations in sewershed discharges from different industrial laundry operations. Letters A - E represent different businesses, and Sites B and D were each sampled on two different days. PFAS analysis was conducted via Target analysis. Analytes that were below detection limits are treated as zeroes and are not shown.

#### 4.2.1.2 Industrial Laundry PFAS TOP Analysis

The industrial laundry PFAS TOP analysis results were significantly greater than levels measured with target analysis, with sums of PFAS measured via TOP ranging between 58 and 100,369 ng/L (Table D.10). The site with the highest total PFAS level was Site E (Figure 19), which had 27 times the PFAS level of the next highest sample. The median sum of PFAS was 892 ng/L, and the mean sum of PFAS was 15,364 ng/L, driven by Site E (Figure 19). The mean TOP concentration was 200 times greater than the mean sum of PFAS measured via target analysis.

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**Figure 19. TOP Industrial Laundry Sewersheds Results.** Phase 2 comparisons of sewershed discharges from different industrial laundry operations. Letters A - E represent different businesses, and Sites B and D were each sampled on two different days. PFAS analysis was conducted via TOP analysis. Analytes that were below detection limits are treated as zeroes and are not shown.

The PFAS concentrations measured in industrial laundry discharges were greater than wastewater influent (Section 3.2). Industrial discharge from Sites A, B, and D had measured TOP levels 3–4 times greater than the POTW influent; Site D had TOP PFAS levels 14 times greater than influent, and Site E had PFAS levels 400 times greater than influent. We also noted target analysis of samples from Site D had detectable levels of analyte HFPO-DA, which is commonly referred to as GenX (Table D.9, Figure 18). GenX was introduced to manufacturing by DuPont as a replacement for PFOA and was subsequently found to have similar persistence and toxicity concerns and greater mobility. Gen-X has been reported in North Carolina’s Cape Fear River and its tributaries, a hub of textile manufacturing and a major water source in North Carolina (EPA, 2021).

To estimate the potential PFAS contribution of a single industrial laundry facility to PFAS sewershed loadings received at the POTW, we used the following equation, which is similar to the equation used to calculate the residential contribution.

$$\text{Industrial Laundry Contribution (\%)} = \frac{\text{Industrial Laundry Conc. (ng/L)}}{\text{POTW Influent Conc. (ng/L)}} \times \frac{\text{Industrial Laundry Flows (MGD)}}{\text{Influent Flows (MGD)}}$$

We used the mean industrial laundry concentration of 15,364 ng/L. Most of these laundry facilities are permitted to discharge at a volume of 2.5 million gallons/year; for an average POTW size receiving 50 million gallons/day and an average 270 ng/L of PFAS (mean influent TOP from Phase 2), each industrial laundry facility is calculated to contribute 1% of the PFAS loading received at the POTW. We applied the same calculation for individual target analytes and found that PFPeA had the highest average percentage contribution of 1.5% from industrial laundry.

#### **4.2.2 Chrome-Platers and Semiconductor-Related Manufacturing Industrial Discharges**

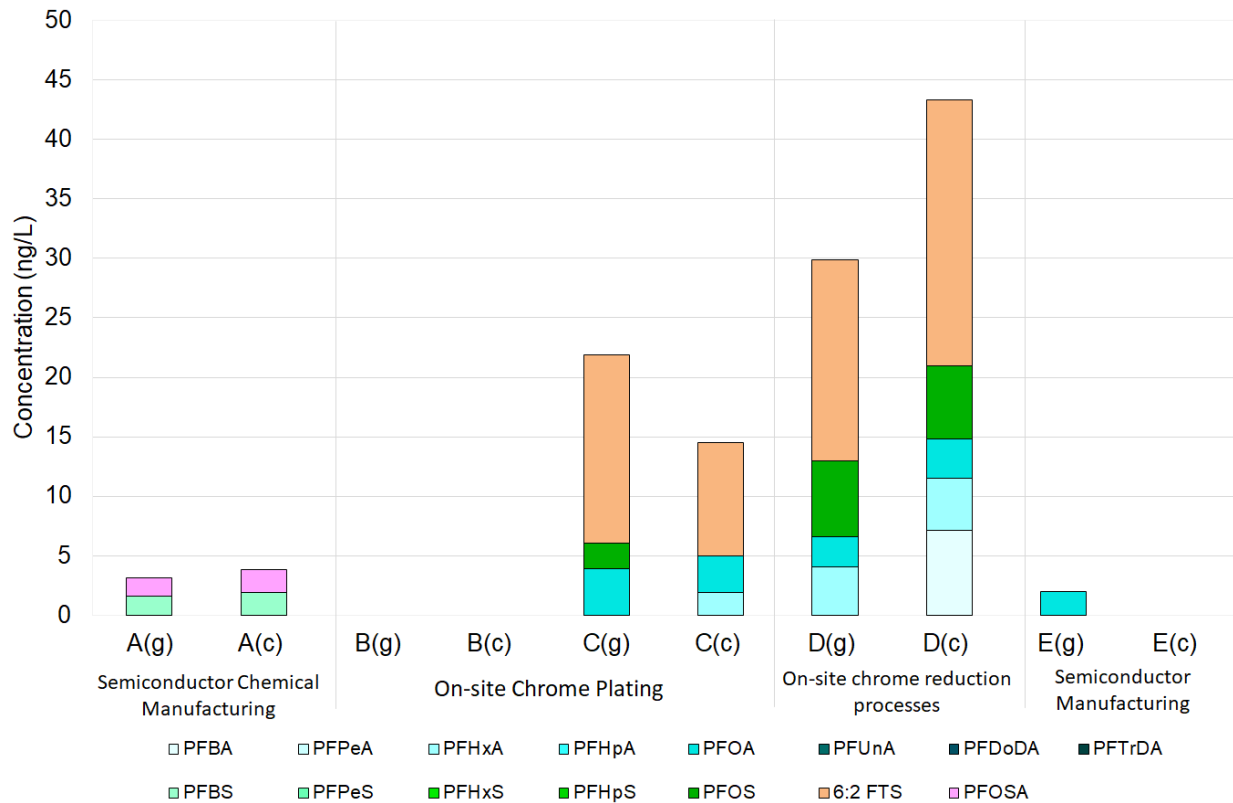
Semiconductor-related manufacturing is another potential source of PFAS. PFAS are used in the photolithography of silicone in semiconductor manufacturing, and PFAS has been reported in semiconductor manufacturing wastewater at concentrations of thousands of ng/L (Lin et al., 2009). Semiconductor manufacturing is transitioning away from banned long-chain PFAS like PFOS (Nienhauser et al., 2022), though PFOS is still widely used in semiconductor manufacturing in China (Xie et al., 2013) and PFAS replacements may still be used. They may also be present in imported products.

Therefore, we sampled industrial discharge from a chemical manufacturing facility relating to semiconductor manufacturing (Site A in Figure 20 and 21) and a semiconductor manufacturing facility (Site E in Figure 20 and 21). PFAS levels measured in the samples had very low detectable levels of PFAS via target (ND–4 ng/L) and TOP (ND–8 ng/L) analytical methods.

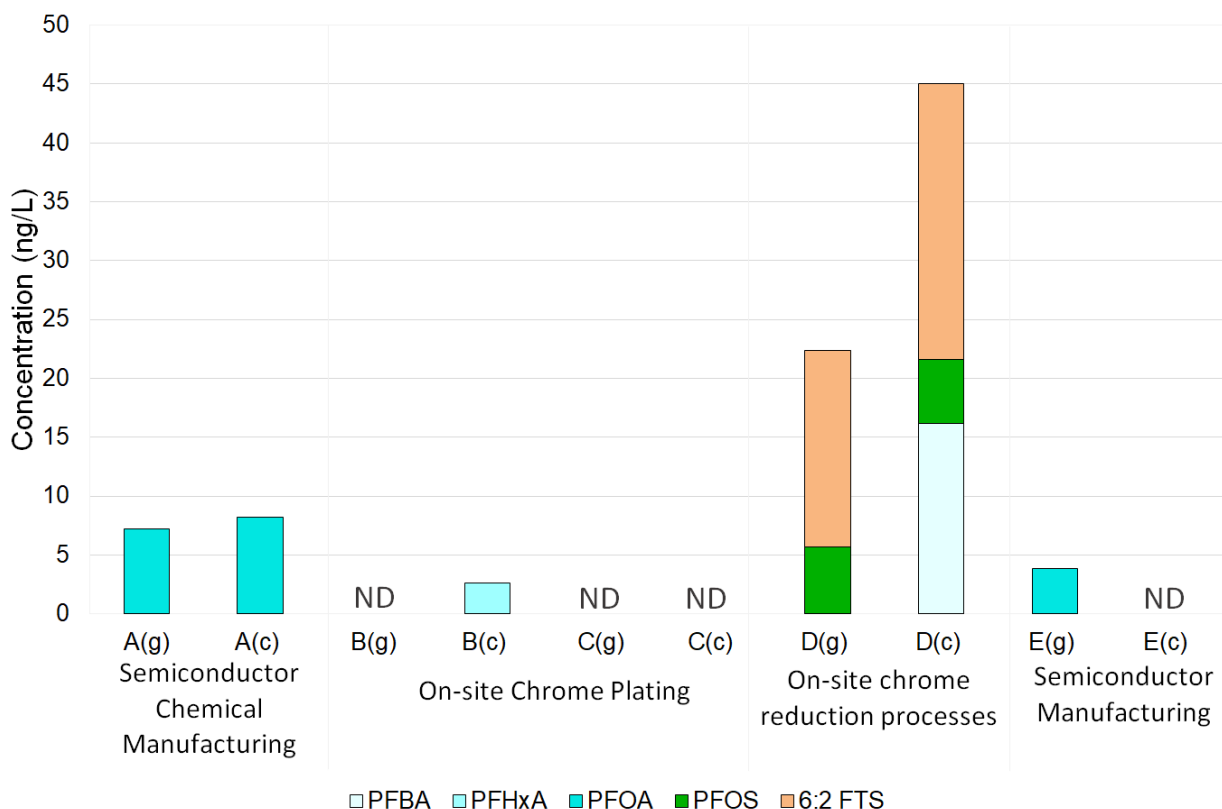
Chrome platers are another suspected PFAS sources due to the use of PFAS as a vapor suppressant in the metal plating bath to reduce chromium-VI air emissions. Site B, C, and D (Figure 20 and 21) were selected for sampling because POTW records indicated that these facilities operate chrome reduction batch processes. Analysis of the industrial sewer discharge from these three selected facilities showed the sums of PFAS measured via target (ND–43 ng/L) and TOP (ND–45 ng/L) analysis to be lower compared to PFAS levels in POTW influent.

In 2019, the SWRCB issued PFAS investigation orders (Order WQ 2019-0045-DWQ) to chrome plating facilities. The chrome platers included in this current BACWA study were not included in these previous SWRCB PFAS investigation orders. For comparison, we also briefly evaluated PFAS Geotracker reported results from three chrome plating facilities that had received official SWRCB PFAS investigation orders in the San Francisco Bay region, described below.

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**Figure 20. Target Industrial Sewersheds Results.** Phase 2 comparison of PFAS concentrations in industrial sewershed discharges from a semiconductor chemical manufacturing facility (Site A), Sites with on-site chrome plating or chrome reduction processes (Site B, C, D), and a semiconductor manufacturing facility (Site E). Different letters represent different locations, and all sites were sampled on two different days. PFAS analysis was conducted via target method. Analytes that were below detection limits are treated as zeroes and are not shown. ND = non-detect. (c = 24-hour composite, g = grab sample).



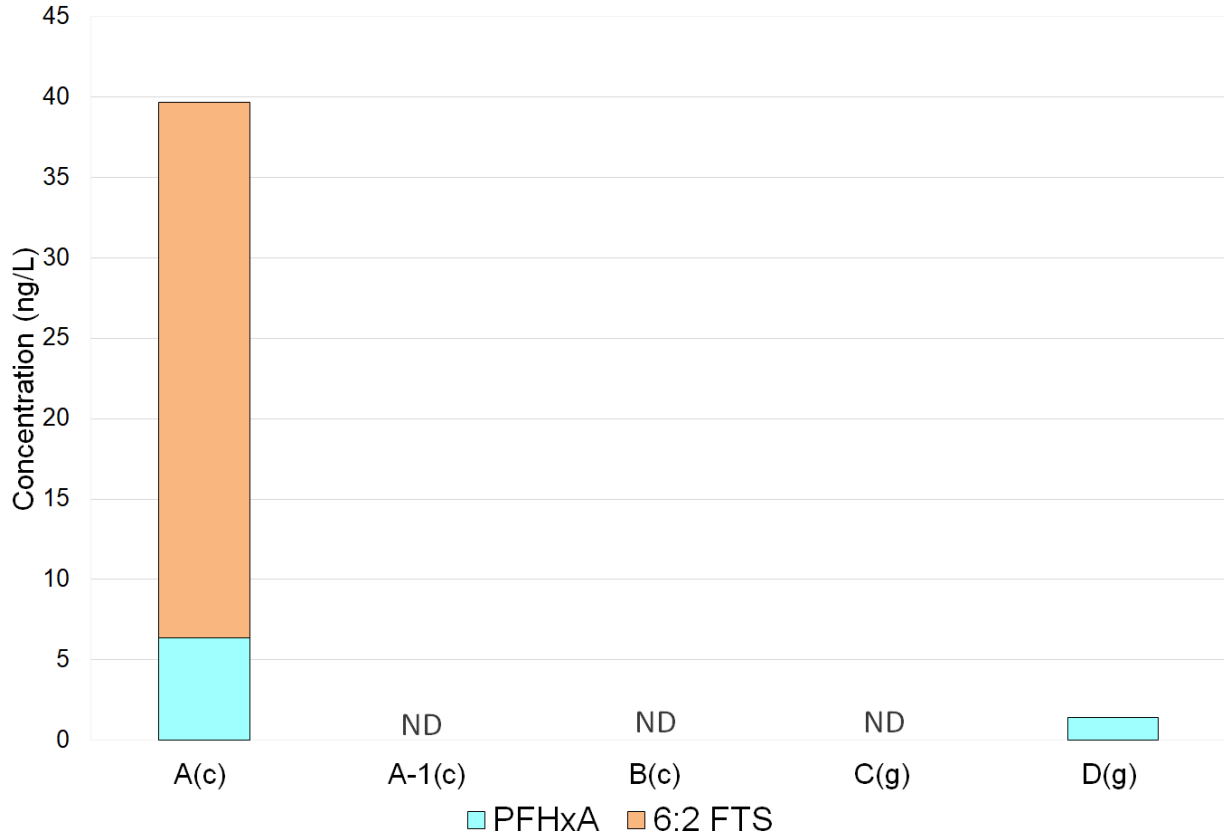
**Figure 21. TOP Industrial Sewersheds Results.** Phase 2 comparison of PFAS concentrations in industrial sewershed discharges from a semiconductor chemical manufacturing facility (Site A), Sites with on-site chrome plating or chrome reduction processes (Site B, C, D), and a semiconductor manufacturing facility (Site E). Different letters represent different locations, and all sites were sampled on two different days. PFAS analysis was conducted via TOP method. Analytes that were below detection limits are treated as zeroes and are not shown. ND = non-detect. (c = 24-hour composite, g = grab sample).

#### 4.5 Hospital Discharges

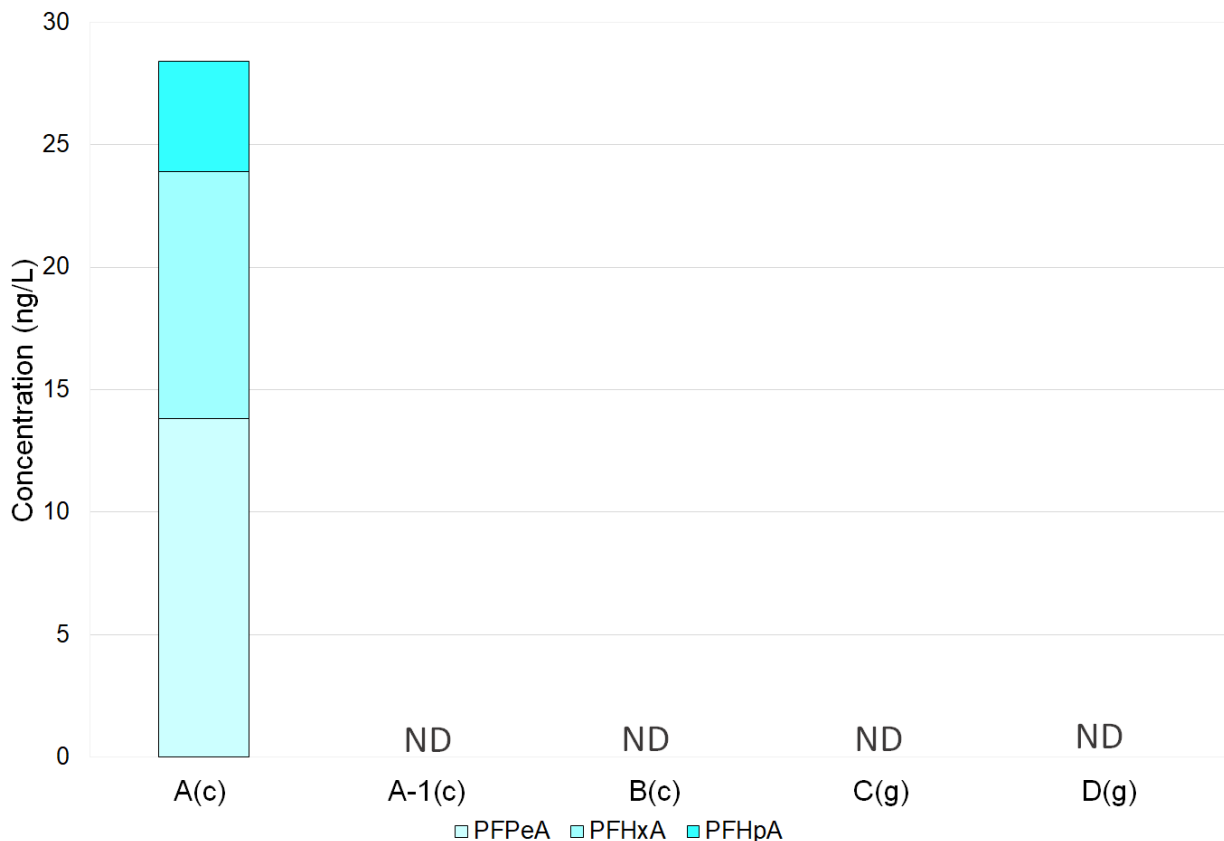
PFAS coatings are used in a variety of medical textiles, materials, and products<sup>1</sup>, and we hypothesized that these products could be a source of PFAS to hospital discharges to the sewershed. To our knowledge, wastewater discharges from hospitals have not been investigated and reported for PFAS. Sampling included collections at four hospitals, with one hospital having two sampling locations (Site A and A-1). Site A, A-1, and B discharges are expected to represent typical hospital processes and domestic waste, Site C represents more biotech, research laboratory, and office waste, while Site D operations include patient care and research operations (Figure 22 and 32).

PFAS target and TOP analysis showed low PFAS levels and little analyte presence or diversity compared to POTW influent.

<sup>1</sup> <https://www.teflon.com/en/industries-and-solutions/industries/medical>



**Figure 22. Target Hospital Sewersheds Results.** Phase 2 comparison of PFAS concentrations in industrial sewershed discharges from four different hospitals (Site A-D). Site A had two sampling locations indicated as Site A and Site A-1. PFAS analysis was conducted via target method. Analytes that were below detection limits are treated as zeroes and are not shown. ND = non-detect. (c=24-hour composite, g = grab sample).



**Figure 23. TOP Hospital Sewersheds Results.** Phase 2 comparison of PFAS concentrations in industrial sewershed discharges from four different hospitals (Site A-D). Site A had two sampling locations indicated as Site A and Site A-1. PFAS analysis was conducted via TOP method. Analytes that were below detection limits are treated as zeroes and are not shown. ND = non-detect. (c = 24-hour composite, g = grab sample).

#### 4.6 Other Industrial Sewersheds PFAS Analysis Results

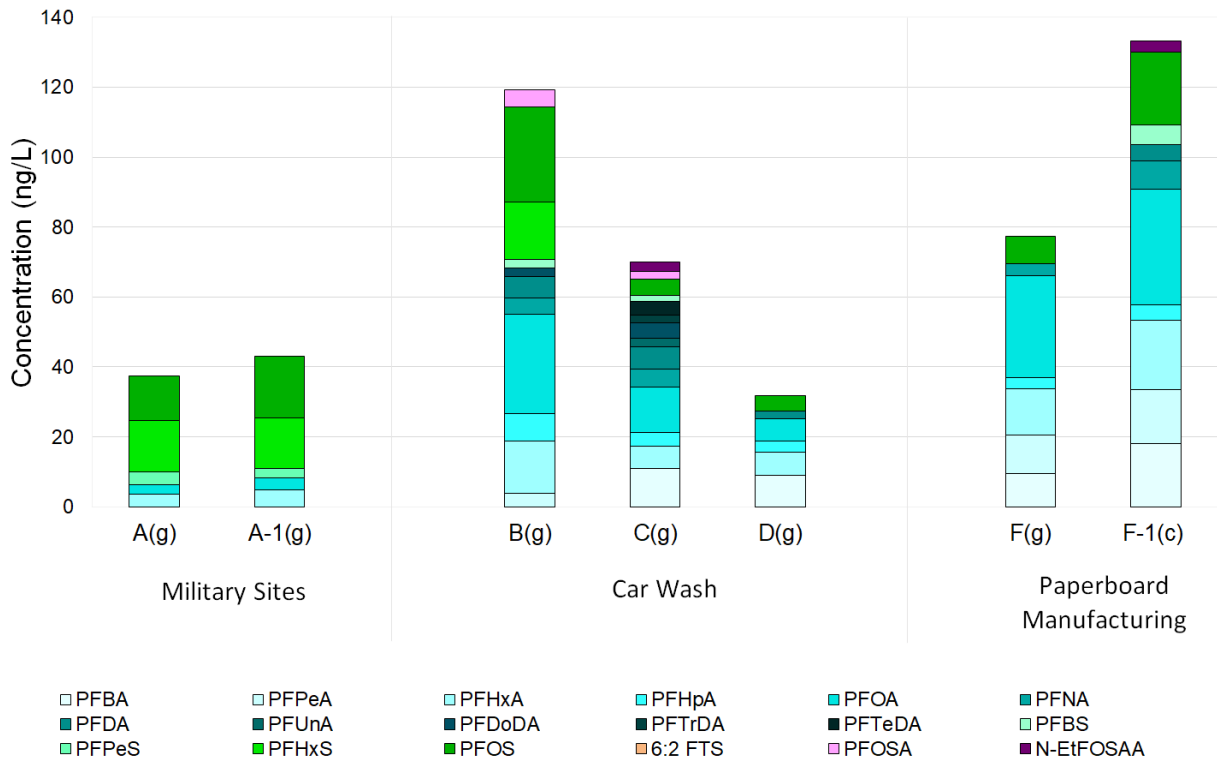
A variety of other sewershed samples were analyzed for this exploratory study. Wastewater discharges from a military site were sampled on two different days (Figure 24 and 25). The military site has AFFF on-site and is permitted to use it in the case of an aircraft crash. Although the risk is low that the base was contributing to PFAS levels seen at the receiving POTW, we believed it could provide informative results for the Phase 2 study. PFAS levels from the military site sewershed samples via target (40 ng/L, n=2) and TOP (138 ng/L) were below average PFAS levels in influent. PFOS (15 ng/L mean, n = 2) and PFHxS (15 ng/L mean, n = 2) were the two analytes detected at the highest concentration in the military site samples via target analysis, which are at or above mean concentrations of these analytes in POTW influent.

We also sampled sewershed discharges from three different car washes (Figure 24 and 25), based on reports of PFAS used in car cleaning and maintenance products. Car

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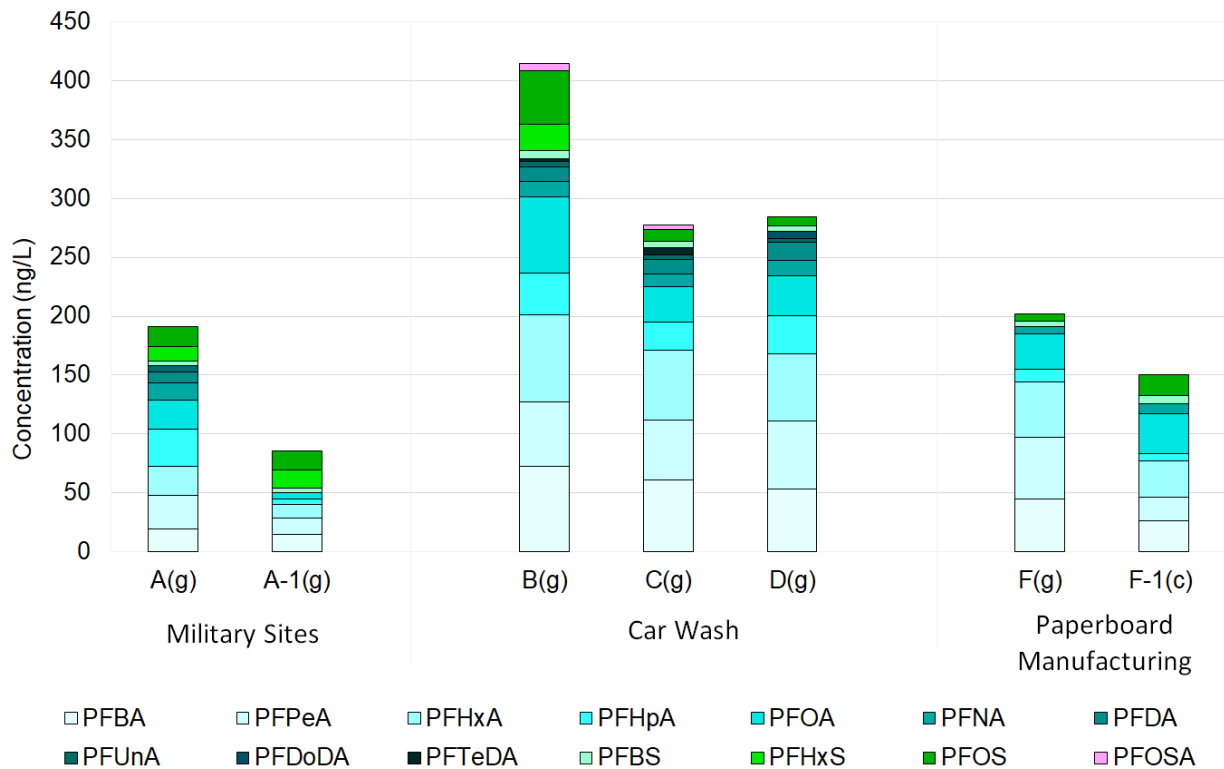
wash sample target concentrations ranged between 32–120 ng/L sum of PFAS, which straddles the median concentration measured in POTW influent (47 ng/L). Car wash TOP concentrations ranged between 285–414 ng/L sum of PFAS, which is slightly larger than the median concentration measured in POTW influent (256 ng/L).

The pulp paperboard manufacturing facility was selected due to the known presence of PFAS in food packaging and previous detections of elevated discharges from related facilities (Clara et al., 2008; Kim Lazcano et al., 2020; Langberg et al., 2021). While paperboard manufacturing is not a major industry in the Bay Area, we believed a screening of wastewater discharges from this industry could be informative for other sewersheds across the state. The mean target concentration in the pulp paperboard manufacturing sewershed samples (n = 2) was 112 ng/L, and the TOP concentration mean was 176 ng/L. The TOP PFAS results are below average influent levels.



**Figure 24. Target Other Industrial Sewersheds Results.** Phase 2 comparison of PFAS concentration in industrial discharges from a military site (Site A), car wash operations (Site B, C, D), and a paperboard manufacturing facility (Site F, sampled on two different days). PFAS analysis conducted via target method. (c = 24-hour composite, g = grab sample)

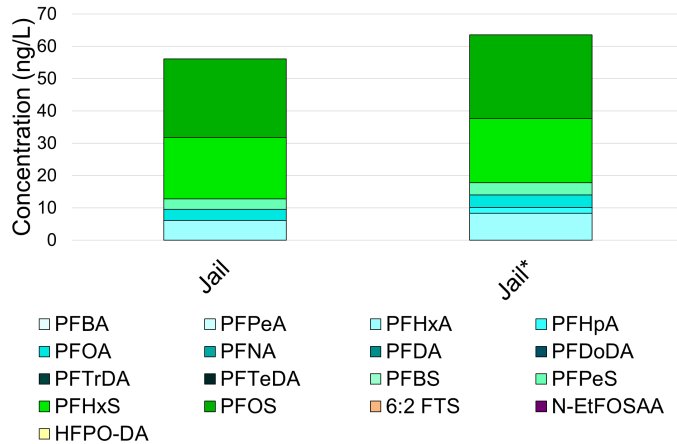
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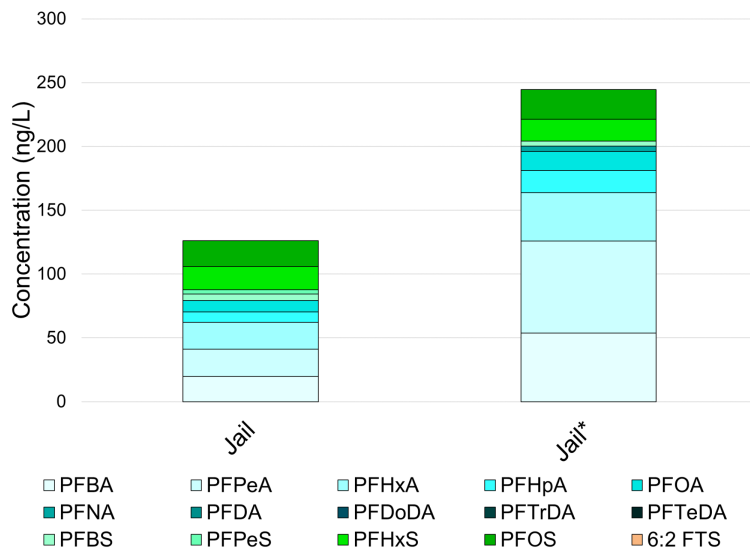
**Figure 25. TOP Other Industrial Sewersheds Results.** Phase 2 comparison of PFAS concentrations in industrial discharges from a military site (Site A), car wash operations (Site B, C, D), and a paperboard manufacturing facility (Site F, sampled on two different days). PFAS analysis conducted via TOP method. (c = 24-hour composite, g = grab sample)

Wastewater from a jail was also sampled because it has a large on-site laundry operation. This facility is not grouped with other industrial laundry facilities because its operations include many other activities. The jail was sampled at the permit compliance point, and samples were collected on two different days. The mean target concentration in the jail sewershed sample (n=2) was 60 ng/L (Figure 26), and the TOP concentration was 185 ng/L (Figure 27). While target concentration was in the range of other industrial laundry sewershed samples, the TOP concentration was significantly lower than all but one of the industrial laundry facilities. The TOP PFAS results are below average influent levels, and therefore the results do not indicate this as a significant source of PFAS.

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**Figure 26: Target Jail Industrial Sewershed Results.** Phase 2 industrial discharges from a jail, sampled on different days. PFAS analysis conducted via target analysis.



**Figure 27: TOP Jail Industrial Sewershed Results.** Phase 2 industrial discharges from a jail, sampled on different days. PFAS analysis conducted via TOP method. (c = 24-hour composite, g = grab sample)

## 5. Strategy for Future Investigations

Based on results from the current study, SFEI recommends two themes to incorporate for future PFAS investigations in Bay wastewater. First, incorporate multiple PFAS methods and apply the state of the science methods to measure PFAS in wastewater. Second, is to continue the sewershed sampling approach piloted in this study to further characterizesewershed sources.

**Complementary application of multiple PFAS methods.** Improving analytical methods for comprehensively quantifying PFAS is a major research focus because

current methods still have significant data gaps. PFAS is an extensive and growing chemical class with a broad range of physical and chemical properties (EPA, 2022). Our study implemented an innovative approach to analyzing all wastewater samples using both targeted LC-MS analytical methods alongside the total oxidizable precursor LC-MS method. Sums of PFAS quantified via TOP methods were often many factors greater than PFAS levels measured via target methods, with large variations in the TOP/target ratio depending on the matrix. Therefore, we found TOP to be a more comprehensive method for evaluating levels of PFAS in wastewater samples compared to conventional targeted methods.

However, even TOP methods have important data gaps and are still subject to the limitations of using LC-MS methods. These limitations include lack of quantification of ultra short-chain PFAS, analyte loss during sample processing, as well as the inability to quantify PFAS that do not oxidize to PFCAs and other analytes with existing analytical standards. Analytical methods to quantify ultra-short chain PFAS, such as trifluoroacetic acid, trifluoropropanoic acid, and trifluoromethanesulfonic acid are a priority for quantifying PFAS in samples because some studies suggest that ultra-short chain PFAS may compose a majority of the PFAS present in wastewater (Camdzic et al., 2023) and drinking water samples (Neuwald et al., 2022). Monitoring of ultra-short chain PFAS is still relatively scarce due to analytical challenges, but commercial laboratories, such as SGS AXYS and Enthality Analytical, have developed in house methods to quantify a short list of ultra-short PFAS. Additionally, applying GC-MS methods along with LC-MS methods would enable broader coverage of PFAS analytes, including several more volatile compounds commonly used in consumer products, though these methods are still limited by available analytical standards for targeted analytes. Innovative methods to more comprehensively detect PFAS are currently in development, and these include the AOF method piloted in this study, as well as extractable organofluorine analysis (EOF), fluorine nuclear magnetic resonance (F-NMR) spectroscopy, and high-resolution mass spectrometry (HRMS) suspect screening and non-targeted analysis.

AOF and EOF methods with combustion ion chromatography are being explored to more comprehensively quantify PFAS and non-PFAS organofluorine. AOF and EOF using combustion ion chromatography both ultimately use combustion ion chromatography to quantify fluorine ions in samples but differ in their sample processing step. AOF samples are adsorbed onto an activated carbon column, while EOF samples are extracted by solvent and/or solid-phase extraction step. A major gap in these methods are low recoveries of ultra-short chain PFAS as well as the inability to differentiate organofluorine from non-PFAS compounds. While we applied AOF methods experimentally during Phase 2 of the study, we did not have significant confidence in the results without further QA/QC measures and confirmation from other analytical methods.

Fluorine nuclear magnetic resonance spectroscopy is a powerful tool in development to quantify PFAS in samples. Current methods are limited to quantifying PFAS with terminal  $-CF_3$  group but may potentially be developed for a broader range of PFAS terminal groups as reference materials are developed (Camdzic et al., 2023). One of the

major limitations to AOF, EOF, and F-NMR methods is that these approaches lose valuable structural information about the PFAS analytes and, therefore, provides complementary information to methods like conventional LC-MS and GC-MS methods.

HRMS suspect screening and nontargeted analysis methods take a different approach to the limitation of analytical standards by either matching unknown sample features to compounds within libraries of spectra (suspect screening) or determining the chemical structures of unknown compounds that are not present in libraries (non-targeted methods) (Newton et al., 2018). A strength of these methods is the ability to observe unanticipated contaminants in samples, which is particularly useful given the breadth of the PFAS class, rapid shifts in production and use of specific compounds, and the importance of transformation products. This approach may not provide quantitative values of analytes, and is often used simply to ascertain occurrence.

Applying combinations of these different analytical approaches to wastewater may be necessary to better understand the presence of PFAS in these samples because each method provides complementary pieces of information to inform overall interpretation. For example, HRMS suspect screening/non-targeted analysis can provide information about the types of PFAS and non-PFAS compounds captured by measurements using AOF and EOF methods. Of course, these additional methods will have additional analytical costs, and therefore, the study design and scope needs to be developed based on the budget and information needs of anticipated management decisions.

**Sewershed monitoring to identify PFAS sources.** Sewershed sampling of residential and industrial dischargers demonstrated the strength of this approach to investigating potential major sources of PFAS to wastewater. Since this was the first time we had applied this approach for investigating PFAS in the sewershed, the study design took the form of a screening approach rather than a representative study design. Residential sewershed sampling ranged by two orders of magnitude (4–850 ng/L measured via TOP). First-order calculations indicated that residential loads could potentially compose a majority of PFAS loadings received at the POTWs. These results emphasize the widespread use of PFAS in consumer products and housing infrastructure, which could be sources to residential wastewater. A more representative study design would be needed to refine estimates of residential contributions. Additionally, a more in-depth investigation of potential household PFAS sources to wastewater might inform differences among neighborhoods.

We also found high levels of PFAS in industrial laundry discharges, which likely reflects the use of PFAS to treat textiles for certain properties, such as stain-resistance, water-resistance, and low flammability. While we sampled five different industrial laundries, additional sampling is needed to refine our understanding of PFAS levels in industrial laundry discharges. We screened several other industrial discharges for PFAS, including hospitals, car washes, a jail, a military site, operations with chrome reduction processes on-site, and manufacturing relating to the semiconductor industry. While our analyses did not reveal significantly higher levels of PFAS in these industries relative to wastewater influent, the limited number of samples restricts the conclusions that can be drawn based on this study.

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Additional efforts are needed to continue to investigate PFAS sources to the sewershed and the Bay. SFEI will be leading an updated synthesis of PFAS monitoring in the Bay and developing an updated RMP monitoring strategy to inform priority monitoring and management questions. Data and insights gathered from this study will be incorporated into the RMP PFAS Synthesis and Strategy Revision. Building upon findings from this study, the proposal would develop conceptual models mapping PFAS transport from products to the Bay via municipal wastewater and urban stormwater runoff and identify and evaluate PFAS-containing product categories most likely to be major contributors to these two PFAS pathways. This systematic review and approach will directly inform what additional sewershed sources to prioritize for additional sewershed monitoring.

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## **7. Appendix A: Phase 1 Technical Memo**

# **Study of Per- and Polyfluoroalkyl Substances in Bay Area POTWs**

## **Phase 1 Memo**

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## **Abstract**

Wastewater influent, effluent, and biosolids were collected from sixteen treatment facilities within the San Francisco Bay Region to assess the presence of per- and polyfluoroalkyl substances (PFAS). Samples were analyzed by LC-MS/MS and 40 PFAS analytes were quantified by isotope dilution/internal standard quantification methods (target method). Additionally, the presence of PFAS precursors for influent and biosolids were assessed by converting oxidizable PFAS to terminal PFAS in samples prior to analysis by LC-MS/MS (Total Oxidizable Precursors or TOP method). Through target analysis, sampled municipal POTWS exhibited comparable concentrations for the sum of quantified PFAS, with median concentrations of 27 ng/L in influent, 58ng/L in effluent, and 178 ng/L in biosolids. The sum of quantified PFAS TOP concentrations were significantly higher across matrices studied, with median concentrations of 231 ng/L in influent and 594 ng/L in biosolids. These results emphasize the importance of evaluating PFAS precursors to understand the scope of PFAS presence in wastewater samples. While we did not observe a correlation between PFAS concentrations in samples from facilities receiving higher proportions of industrial flows, we recommend further investigation of the relative importance of specific industrial and commercial flows compared to residential flows in Phase 2 evaluations to inform major sources of PFAS to wastewater.

## **1. Introduction**

Per- and polyfluoroalkyl substances (PFAS), such as perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), are an extensive class of fluorine-rich specialty compounds known for their thermal stability, non-reactivity, and surfactant properties. These unique characteristics make them useful for a variety of applications. More than 4,700 PFAS are used in consumer, commercial, and industrial applications, including food packaging materials, waterproof textiles, stain-resistant carpets and furniture, fire-suppression foams, and processing aids to produce fluoropolymers like Teflon, mist suppressants in metal-plating, and hydraulic aviation fluids. These same properties also make them persistent in the environment and potentially toxic to human and ecological health.

To understand the scope of PFAS contamination in California, the State Water Board (SWB) developed a statewide assessment requiring testing of drinking water systems and site investigations of locations likely to contain PFAS, including publicly-owned treatment works (POTWs) as a part of the July 2020 State Water Board Investigative Order (SWRCB, 2020). Agencies that are a part of the San Francisco Bay Regional Water Quality Control Board (Region 2) agencies were exempt from the investigative order to conduct a two-phase regional study in conjunction with the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), led by the San Francisco Estuary Institute (SFEI), to address the monitoring needs of the SWB efficiently as well

as inform the monitoring strategy, management actions, and program decisions of the RMP.

This draft report details the findings and analysis of the data collected from Phase 1 of the Study of PFAS in Bay Area POTWs. The purpose of Phase 1 was to analyze samples from a representative subset of Bay Area POTWs to measure concentrations of PFAS in various matrices, including wastewater influent, effluent, and biosolids. The POTWs included in Phase 1 were carefully selected to provide a representative sample set of Region 2 facilities to examine the range of PFAS concentrations in wastewater matrices and the diverse characteristics that may influence PFAS concentrations to be investigated in Phase 2. The study objectives for Phase 2 will be developed based on the results from Phase 1.

## **2. Methods**

Sampling and analysis were completed following the Phase 1 Sampling and Analysis Plan (SAP), which contains the details of the sampling strategy, including study design, coordination of sample collection, data quality assurance, and reporting associated with the Study of PFAS in Bay Area POTWs (Mendez et al., 2020). In addition, the Phase 1 Monitoring Report (Mendez et al., 2021) details the realized collection and reporting of the data. This section will provide a summary of the information presented in these two documents.

### **2.1 Selection of Study Participants**

To inform the selection of representative POTWs, a questionnaire was developed similar to the one required by the SWB Order to obtain relevant facility information, including potential industrial sources of PFAS and biosolids reuse and disposal practices. Questionnaire responses and specific characteristics of each facility can be found in Appendix A. The questionnaires were thoroughly reviewed, with POTW selection based on consideration of the following factors:

- **Discharge volume:** Sampling at the largest facilities was prioritized to capture dominant flows to the Bay. A few small and medium sized facilities are also represented.
- **Service population and industries:** Chosen facilities range from minimal industrial sources to those with a more significant percentage of flows coming from industrial sources, particularly sources related to fabricated metals, electronics manufacturing, airports, and military bases.
- **Participation in previous Bay RMP PFAS study in 2014:** All facilities that participated in the previous RMP PFAS study (Houtz et al., 2016) are included to evaluate changes in specific PFAS concentrations.
- **Treatment type:** Different secondary treatment technologies, including advanced secondary treatment processes, are included to allow the evaluation of treatment processes on PFAS concentrations.

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- **Geographic location:** Selected facilities are geographically diverse and represent all sub embayments.

Table 1 and Figure 1 show the selected Region 2 facilities chosen to participate in this study, as well as important IDs used to report target analysis results and relevant lab QA to Geotracker.

**Table 1.** Participating Region 2 facilities with related acronyms, Geotracker ID, and CIWQS ID.

<b>Region 2 Facilities</b>	<b>Acronyms</b>	<b>Geotracker Global ID</b>	<b>CIWQS ID</b>
Central Contra Costa Sanitary District	CCCSD	NPD100051616	213875
City of San Mateo Wastewater Treatment Plant	CSM	NPD100051601	255420
Dublin San Ramon Sanitary District Wastewater Treatment Plant	DSRSD	NPD100051638	220792
East Bay Dischargers Authority	EBDA	NPD100053240	222123
East Bay Municipal Utility District Main Wastewater Treatment Plant	EBMUD	NPD100051573	222132
Fairfield-Suisun Sewer District	FSSD	NPD100051485	225526
Novato Sanitary District	NSD	NPD100051924	244705
Oceanside Water Pollution Control Plant (SFPUC)	OSP	NPD100051512	256498
Palo Alto Regional Water Quality Control Plant	PA	NPD100051503	247457
San Francisco International Airport Mel Leong Treatment Plant	SFOS	NPD100051556	256507
San Francisco International Airport Mel Leong Treatment Industrial Plant	SFOI	NPD100051556	256507
San Jose-Santa Clara Regional Wastewater Facility	SJSC	NPD100051475	255333
Southeast Water Pollution Control Plant (SFPUC)	SEP	NPD100051513	256499
Union City Sanitary District	USD	NPD100051936	269042
Vallejo Flood & Wastewater District	VFWD	NPD100051544	270006
Valley Water <sup>1</sup>	VW	-	-

<sup>1</sup>Reverse osmosis concentrate (ROC) was collected at Valley Water (VW) at its Advanced Water Purification Facility (AWPF) for target analysis, though this data was not uploaded to Geotracker.



**Figure 1.** Map of Region 2 facilities selected to participate in this study.

## 2.2 Field Sample Collection

### A. Target Analysis

All POTWs collected grab samples of each matrix (i.e., influent, effluent, and biosolids) for target analysis (see section 2.4 A) except EBDA and VW. EBDA receives treated wastewater effluent from several POTWs and discharges these combined flows at one sampling location; thus, only effluent samples can be collected. VW only collected ROC samples. A subgroup of facilities (CCCSD, FSSD, and SFOI) collected 24-hour composite influent and effluent samples concurrently to compare to grab samples to understand if detected concentrations of PFAS in grab samples are representative and inform differences in sampling methods. This subset of POTWs also collected same-day

replicates to assess differences due to sampling methods, as well as field samples on a second date to assess daily or weekly variations in sampled concentrations. The complete list of influent, effluent, and biosolids samples collected for target analysis and their sampling locations is shown in the Phase 1 Monitoring Report (Mendez et al., 2021).

#### B. TOP Analysis

All POTWs, except EBDA and VW, collected grab samples of influent and biosolids for total oxidizable precursors (TOP) analysis (see section 2.4 B). Some facilities collected replicates to assess variations due to the sampling method. The complete list of influent and biosolids samples collected for TOP analysis and their specific sampling locations is shown in the Phase 1 Monitoring Report (Mendez et al., 2021). The results of TOP analysis were not uploaded to Geotracker.

### **2.3 QA/QC Sample Collection**

Field QA/QC samples, specifically field and equipment rinse blanks, were collected at a few facilities for each matrix (i.e., influent, effluent, and biosolids). These samples were collected for both sampling methods (grab and composite). The chosen subset of POTWs represents a diverse group within Region 2 with the intention that QA/QC samples collected are representative of all samples collected as a part of this study. The complete list of samples collected for QA/QC is shown in the Phase 1 Monitoring Report (Mendez et al., 2021).

### **2.4 SGS AXYS Analytical Methods**

All samples were analyzed by SGS AXYS for PFAS using either Target Analysis (MLA-110) or Total Oxidizable Precursor Analysis (MLA-111). Detailed sample procedures are described in Standard Operating Procedures stored at SFEI, and briefly summarized below. Biosolid samples were also analyzed for Percent Solids. Aqueous samples are reported in units of ng/L; biosolid samples are reported in units of ng/g dry weight (dw), and percent solids content (%).

#### A. Target Analysis (MLA-110)

Samples from all matrices (i.e., influent, effluent, and biosolids) were analyzed for target PFAS using SGS AXYS Method MLA-110 (summarized in MSU-110 Rev in the Appendix of Mendez et al., 2021) with a complete list of analytes and typical reporting limits (RLs) shown in Table 2. The samples were spiked with isotope-labeled surrogate standards and then extracted and cleaned through Solid Phase Extraction (SPE). Sample extracts were analyzed by liquid chromatography/mass spectrometry (LC-MS/MS) with reported sample concentrations determined by isotope dilution/internal standard quantification.

## B. TOP Analysis (MLA-111)

Samples from influent and biosolids were analyzed through TOP analysis using SGS AXYS Method MLA-111, with a complete list of analytes and typical RLs shown in Table 3. The TOP method indirectly quantifies oxidizable PFAS precursors by conversion to terminal perfluorinated carboxylates (PFCAs). Samples are oxidized using persulfate and then, after cooling and pH adjustment, spiked with isotope-labeled quantification standards. Further, the samples are extracted and cleaned using weak anion-exchange SPE. Extracts are analyzed via LC-MS/MS, with the reported concentrations determined by isotope/dilution internal standard quantification. The reported concentrations represent the sum of quantified PFCAs after sample oxidation. Oxidation is monitored using a reaction monitoring standard that is spiked into the sample and control matrix. Overall, this method is used to understand the presence of oxidizable precursors that may not be included in target analysis.

## **3. Results and Discussion**

### **3.1 General QA/QC findings**

The results of PFAS target analysis on all QA/QC samples (i.e., field and equipment rinse blanks) collected at POTWs are displayed in Table 4. Out of twenty QA/QC samples, and 40 analytes (800 analyses), there were only 6 detections with 99% (794/800) of analyses showing no detection. A small set of compounds were detected in both equipment and field blanks, with most detections being only slightly above detection limits. One compound, 6:2 FTS, was detected in a field blank at 80 ng/L, which is significantly higher than any other field blank as well as field samples. While this high blank detection indicates a possible source of field contamination, field samples collected with the field blank were below detection limits.

Overall, about half the analytes were not detected in any field samples, and two-thirds were found in fewer than half of the field samples. Recoveries in LCS and MS/MSD samples for most analytes were within targets listed in the DoD QSM, or 65%-135% for those analytes not explicitly listed (relevant DoD QSM pages found in Mendez et al., 2020). A few individual analytes with results outside of the target range had their results flagged in the database. There were no lab replicates of unspiked samples, but MS/MSD pairs were reported, meeting the DoD QSM target for RPDs of 30% for all the MSD pairs in a quantitative range (>RL).

Overall, the data are largely quantitative, and no significant contamination or other QA/QC issues were observed. The full set of data for this study including QA/QC samples is available in Appendix B.

**Table 2. Target PFAS analyte list (MLA-110, SGS AXYS) including expected reporting limits (RLs) for aqueous and biosolids samples.**

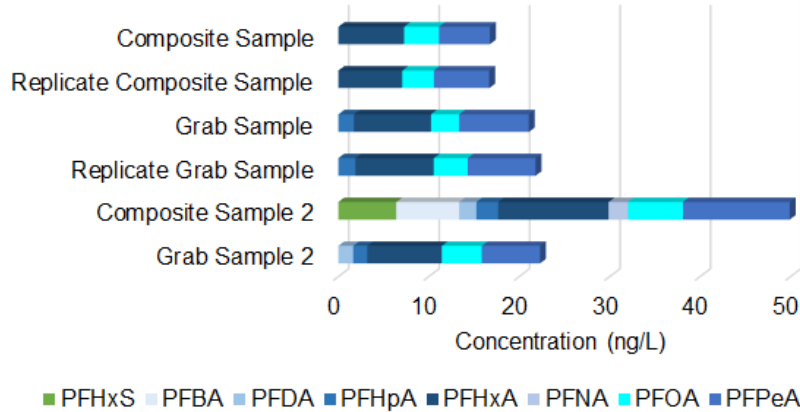
Abbreviation	Geotracker PARLABEL	PFAS Chemical Name (Acid/Conjugate Base)	Aqueous RLs (ng/L)	Biosolids RLs (ng/g dw)
PFBA	PFTBA	Perfluorobutanoic acid (Perfluorobutanoate)	1.6	0.32
PFPeA	PFPA	Perfluoropentanoic acid (Perfluoropentanoate)	0.8	0.16
PFHxA	PFHA	Perfluorohexanoic acid (Perfluorohexanoate)	0.4	0.08
PFHpA	PFHPA	Perfluoroheptanoic acid (Perfluoroheptanoate)	0.4	0.08
PFOA	PFOA	Perfluorooctanoic acid (Perfluorooctanoate)	0.4	0.08
PFNA	PFNA	Perfluorononanoic acid (Perfluorononanoate)	0.4	0.08
PFDA	PFNDCA	Perfluorodecanoic acid (Perfluorodecanoate)	0.4	0.08
PFUnA	PFUNDCA	Perfluoroundecanoic acid (Perfluoroundecanoate)	0.4	0.08
PFDoA	PFDOA	Perfluorododecanoic acid (Perfluorododecanoate)	0.4	0.08
PFTriDA	PFTRIDA	Perfluorotridecanoic acid (Perfluorotridecanoate)	0.4	0.08
PFTeDA	PFTEDA	Perfluorotetradecanoic acid (Perfluorotetradecanoate)	0.4	0.08
PFBS	PFBSA	Perfluorobutanesulfonic acid (Perfluorobutanesulfonate)	0.4	0.08
PFPeS	PFPeS	Perfluoropentanesulfonic acid (Perfluoropentanesulfonate)	0.4	0.08
PFHxS	PFHXSA	Perfluorohexanesulfonic acid (Perfluorohexanesulfonate)	0.4	0.08
PFHpS	PFHPSA	Perfluoroheptanesulfonic acid (Perfluoroheptanesulfonate)	0.4	0.08
PFOS	PFOS	Perfluorooctanesulfonic acid (Perfluorooctanesulfonate)	0.4	0.08
PFNS	PFNS	Perfluorononanesulfonic acid (Perfluorononanesulfonate)	0.4	0.08
PFDS	PFDSA	Perfluorodecanesulfonic acid (Perfluorodecanesulfonate)	0.4	0.08
PFDoS	-	Perfluorododecanesulfonic acid (Perfluorododecanesulfonate)	0.4	0.08
4:2 FTS	4:2FTS	1H, 1H, 2H, 2H-perfluorohexane sulfonic acid (1H, 1H, 2H, 2H-perfluorohexane sulfonate)	1.6	0.32
6:2 FTS	6:2FTS	1H, 1H, 2H, 2H-perfluorooctane sulfonic acid (1H, 1H, 2H, 2H-perfluorooctane sulfonate)	1.6	0.32
8:2 FTS	8:2FTS	1H, 1H, 2H, 2H-perfluorodecane sulfonic acid (1H, 1H, 2H, 2H-perfluorodecane sulfonate)	1.6	0.32
3:3 FTCA	3:3FTCA	2H, 2H, 3H, 3H-perfluorohexanoic acid (2H, 2H, 3H, 3H-perfluorohexanoate)	1.6	0.32
5:3 FTCA	5:3FTCA	2H, 2H, 3H, 3H-perfluorooctanoic acid (2H, 2H, 3H, 3H-perfluorooctanoate)	10	2
7:3 FTCA	7:3FTCA	2H, 2H, 3H, 3H-perfluorodecanoic acid (7:3 FTCA, 2H, 2H, 3H, 3H-perfluorodecanoate)	10	2
PFOSA	PFOSA	Perfluorooctanesulfonamide	0.4	0.08
N-MeFOSA	MEFOSA	N-Methylperfluorooctanesulfonamide	0.4	0.08
N-EtFOSA	ETFOSA	N-Ethylperfluorooctanesulfonamide	0.4	0.08
N-MeFOSAA	NMEFOSAA	N-Methylperfluoro-1-octanesulfonamidoacetic acid (N-Methylperfluoro-1-octanesulfonamidoacetate)	0.4	0.08
N-EtFOSAA	NETFOSAA	N-Ethylperfluoro-1-octanesulfonamidoacetic acid (N-Ethylperfluoro-1-octanesulfonamidoacetate)	0.4	0.08
N-MeFOSE	MEFOSE	N-Methylperfluoro-1-octanesulfonamidoethanol	4	0.8
N-EtFOSE	ETFOSE	N-Ethylperfluoro-1-octanesulfonamidoethanol	4	0.8
HFPO-DA (GenX)	HFPO-DA	2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)propionic acid (2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)propionate)	1.6	0.32
ADONA	ADONA	Decafluoro-3H-4,8-dioxanonoic acid (Decafluoro-3H-4,8-dioxanonoate)	1.6	0.32
NFDHA	NFDHA	Perfluoro-3,6-dioxaheptanoic acid (Perfluoro-3,6-dioxaheptanoate)	0.8	0.16
PFMBA	PFMBA	Perfluoro-3-methoxypropanoic acid (Perfluoro-3-methoxypropanoate)	0.8	0.08
PFMPA	PFMPA	Perfluoro-4-methoxybutanoic acid (Perfluoro-4-methoxybutanoate)	1.6	0.16
9Cl-PF3ONS	9-Cl-PF3ONS	9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-chlorohexadecafluoro-3-oxanonane-1-sulfonate)	1.6	0.32
11Cl-PF3OUdS	11-Cl-PF3OUdS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-chloroeicosafluoro-3-oxaundecane-1-sulfonate)	1.6	0.32
PFEEA	PFEEA	Perfluoro(2-ethoxyethane)sulfonic acid (Perfluoro(2-ethoxyethane)sulfonate)	0.4	0.08

**Table 3: Total Oxidizable Precursors (TOP) PFAS analyte list (MLA-111, SGS-AXYS) including expected reporting limits (RLs) for aqueous samples.**

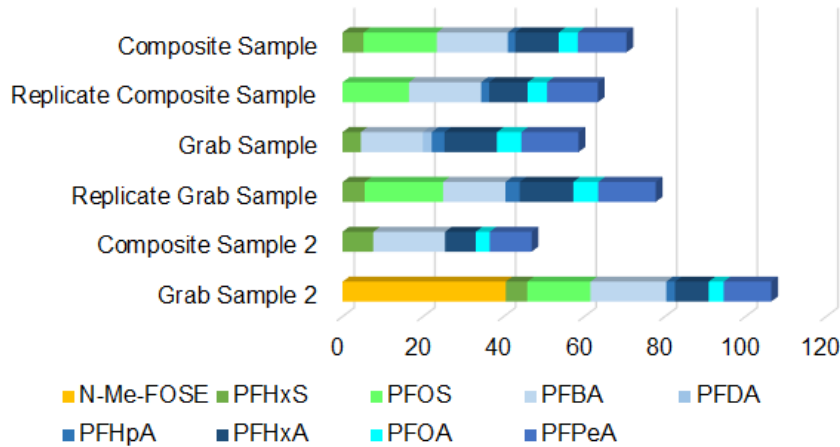
Abbreviation	PFAS Chemical Name (Acid/Conjugate Base)	Aqueous RLs (ng/L)	Solids RLs (ng/g)
PFBA	Perfluorobutanoic acid (Perfluorobutanoate)	6-32  For Perfluorinated Carboxylates C4-C14	0.6-3.2  For Perfluorinated Carboxylates C4-C14
PFPeA	Perfluoropentanoic acid (Perfluoropentanoate)		
PFHxA	Perfluorohexanoic acid (Perfluorohexanoate)		
PFHpA	Perfluoroheptanoic acid (Perfluoroheptanoate)		
PFOA	Perfluorooctanoic acid (Perfluorooctanoate)		
PFNA	Perfluorononanoic acid (Perfluorononanoate)		
PFDA	Perfluorodecanoic acid (Perfluorodecanoate)		
PFUnA	Perfluoroundecanoic acid (Perfluoroundecanoate)		
PFDoA	Perfluorododecanoic acid (Perfluorododecanoate)		
PFTriDA	Perfluorotridecanoic acid (Perfluorotridecanoate)		
PFTeDA	Perfluorotetradecanoic acid (Perfluorotetradecanoate)	8  For perfluorinated sulfonates C4-C10, C12	0.8  For perfluorinated sulfonates C4-C10, C12
PFBS	Perfluorobutanesulfonic acid (Perfluorobutanesulfonate)		
PFPeS	Perfluoropentanesulfonic acid (Perfluoropentanesulfonate)		
PFHxS	Perfluorohexanesulfonic acid (Perfluorohexanesulfonate)		
PFHpS	Perfluoroheptanesulfonic acid (Perfluoroheptanesulfonate)		
PFOS	Perfluorooctanesulfonic acid (Perfluorooctanesulfonate)		
PFNS	Perfluorononanesulfonic acid (Perfluorononanesulfonate)		
PFDS	Perfluorodecanesulfonic acid (Perfluorodecanesulfonate)		
PFDoS	Perfluorododecanesulfonic acid (Perfluorododecanesulfonate)		

### 3.2 Comparison of Grabs and Composites

Grab and composite samples were collected from three POTWs (CCCSD, FSSD, and SFOI) to compare sampling methods and understand the representativeness of grab samples taken at all facilities in this study. As examples, Figures 2 and 3 detail the results of composite and grab influent samples from CCCSD and FSSD, respectively.



**Figure 2.** Comparison of composite and grab influent samples from CCCSD.



**Figure 3.** Comparison of composite and grab influent samples from FSSD.

In Figure 2, CCCSD composite and grab influent samples and replicates collected on the same date were nearly identical within the same method with a replicate percent difference (RPD) of 0% (composite replicate) and 3% (grab replicate) for sum of PFAS. FSSD showed a similar pattern, though RPDs for composite and grab replicates were slightly larger than those for CCCSD (RPDs of 11% and 28%, respectively). For both facilities, there is a more significant variation in some composite and grab samples collected on a different day or week (labeled “Sample 2”), with three of the four samples exceeding an RPD of 40%. Generally, sample replicates for individual analytes had an

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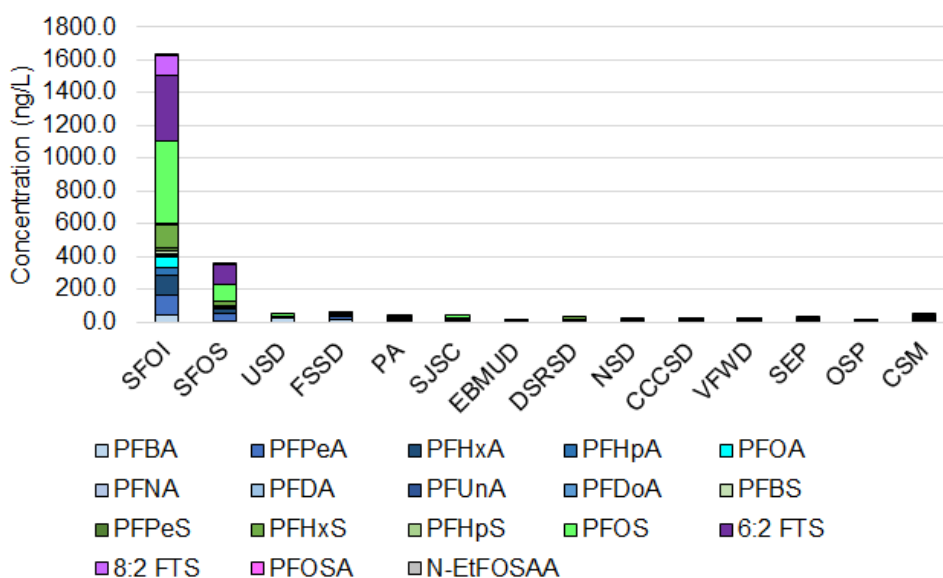
average RPD of 9% with a standard deviation of 11%. In comparison, the average RPD between the composite and grab sample was 19%, with a standard deviation of 15%.

Overall, the concentrations noted for composites and grabs were well within a factor of two, with no clear trend as to which method exhibits higher concentrations and greater variability. For all subsequent analyses, the first grab sample collected from each facility was used to compare concentrations across POTWs.

### 3.3 Influent

There were several PFAS measured at all POTWs and within all matrices. The complete set of data including all POTWs and analytes is available in Appendix B. Influent data are reviewed below.

The two facilities servicing an airport (SFOI and SFOS) showed a different distribution and greater PFAS concentrations when compared to municipal facilities. This trend is shown for influent samples in Figure 4, though it is present across all matrices (i.e., influent, effluent, biosolids) and analyses (target and TOP). The significant difference in concentrations and distributions of PFAS at SFOI and SFOS warranted exclusion from subsequent analyses, which focuses on municipal POTWs to understand the prevalence of PFAS at these facilities.



**Figure 4.** Concentrations of detected PFAS analytes via target method in POTW influent grab samples (first single grab), organized from largest to smallest relative contribution of industrial flows going to the facility.

Influent samples showed detection of a variety of PFAS analytes using target analysis, with results summarized in Table 4. Three analytes — PFPeA, PFHxA, and PFOA — were detected above MDLs in all samples, and had the highest median values among all quantified analytes. PFBA was detected in 42% of the samples, though at higher levels than other analytes, as noted by its higher maximum.

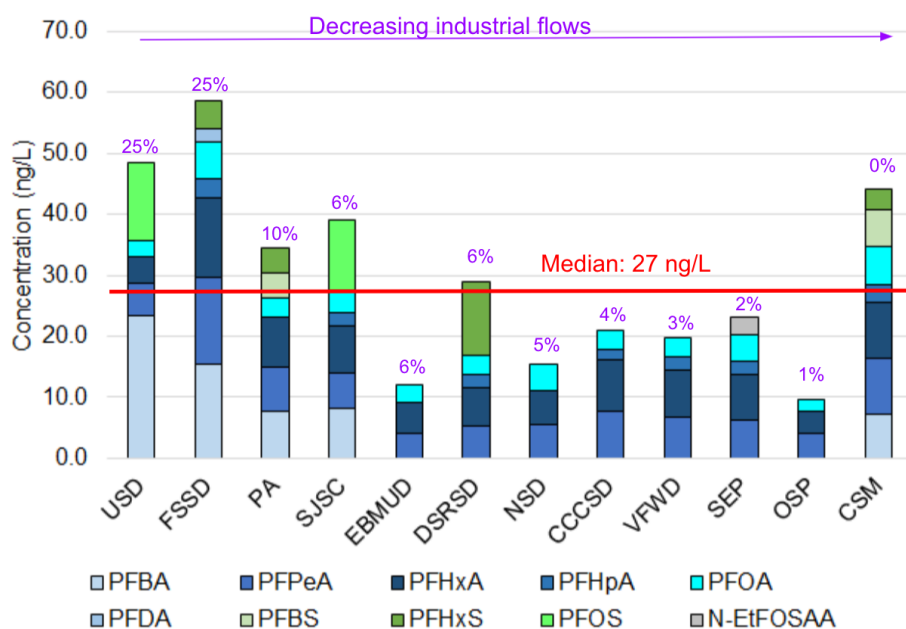
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**Table 4.** Summary statistics for concentrations of detected PFAS via target method in municipal POTW influent grab samples (first single grab). All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (Total: 12)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	5.81	8.25	42%	ND	23	ND	5
PFPeA	2.91	4.12	100%	4	14	6	7
PFHxA	1.45	2.06	100%	4	13	8	7
PFHpA	1.45	2.06	58%	ND	3	1.9	1
PFOA	1.45	2.06	100%	2	6	3	4
PFNA	1.45	2.91 <sup>2</sup>	8%	ND	2	ND	ND
PFDA	1.45	2.06	8%	ND	2	ND	ND
PFBS	1.6	13.9 <sup>2</sup>	17%	ND	6	ND	1
PFHxS	1.65	42.9 <sup>2</sup>	33%	ND	12	ND	2
PFOS	1.81	24.9 <sup>2</sup>	17%	ND	13	ND	2
N-EtFOSAA	1.45	2.95	8%	ND	3	ND	ND
Sum of PFAS	-	-	-	10	59	27	30

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

<sup>2</sup>Values were flagged and considered non quantitative due to peak interference, resulting in higher MDLs.



**Figure 5.** Concentrations of detected PFAS analytes via target method in municipal POTW influent grab samples (first single grab), organized from largest to smallest relative contribution of industrial flows going to the facility.

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Total municipal POTW influent PFAS concentrations ranged from 10 to 59 ng/L with a median of 27 ng/L (Figure 5). Short-chain PFCAs (e.g., PFBA, PFPeA, PFHxA, PFHpA) were the most commonly detected analytes. While we had hypothesized that facilities receiving a higher proportion of industrial flows would contain higher concentrations of PFAS, we did not observe a clear correlation between the proportion of industrial flows and the sum of quantified target PFAS from this dataset.

TOP analysis of influent samples exhibited notably higher concentrations of PFAS compared to target analysis, with a range of 150 - 299 ng/L and a median of 231 ng/L for sum of PFAS (Table 5). The median for sum of PFAS via TOP is over eight times greater than the sum of target analytes, indicating a considerable presence of PFAS precursors that are not quantified using the target method. When organized by industrial flows, as shown in Figure 6, there is no observed correlation between the proportion of industrial flows and the sum of analytes detected through TOP.

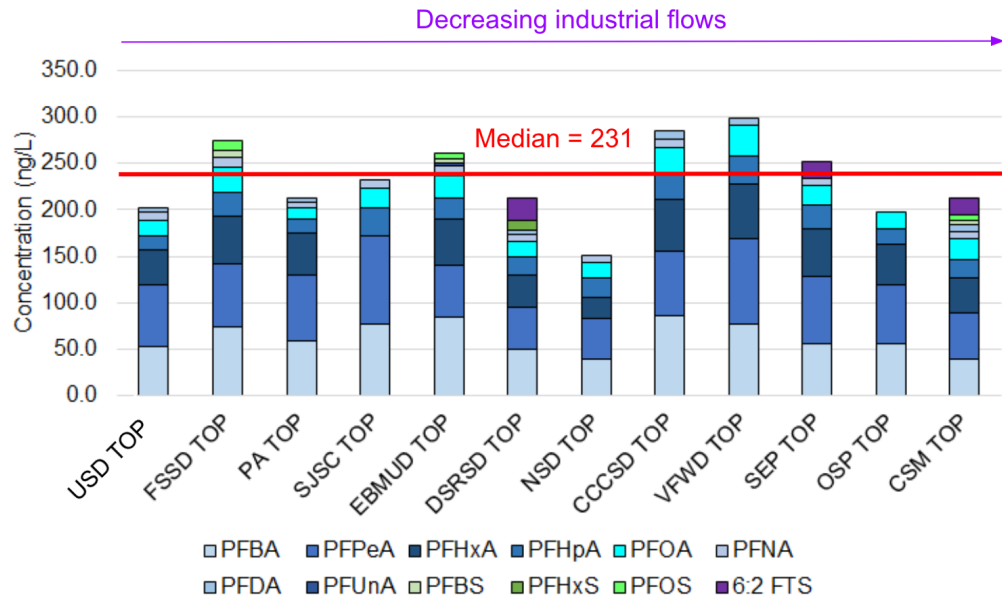
**Table 5.** Summary statistics for concentrations of detected PFAS via TOP method in municipal POTW influent grab samples. All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (Total: 12)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	12.2	26.6	100%	39	85	66	64
PFPeA	6.11	13.3	100%	43	95	70	67
PFHxA	3.05	71.6 <sup>2</sup>	92%	ND	60	45	41
PFHpA	3.05	6.64	100%	16	31	21	22
PFOA	3.05	6.64	100%	13	33	21	22
PFNA	3.09	12.2 <sup>2</sup>	75%	ND	11	8	6
PFDA	3.12	9.69 <sup>2</sup>	50%	ND	8	2	3
PFUnA	3.05	6.64	8%	ND	3	ND	ND
PFBS	3.05	6.64	25%	ND	8	ND	1
PFHxS	3.05	6.64	8%	ND	10	ND	1
PFOS	3.05	10.3 <sup>2</sup>	25%	ND	12	ND	2
6:2 FTS	11	23.9	25%	ND	24	ND	5
Sum of PFAS	-	-	-	150	299	231	235

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

<sup>2</sup>Values were flagged and considered non quantitative due to peak interference, resulting in higher MDLs.

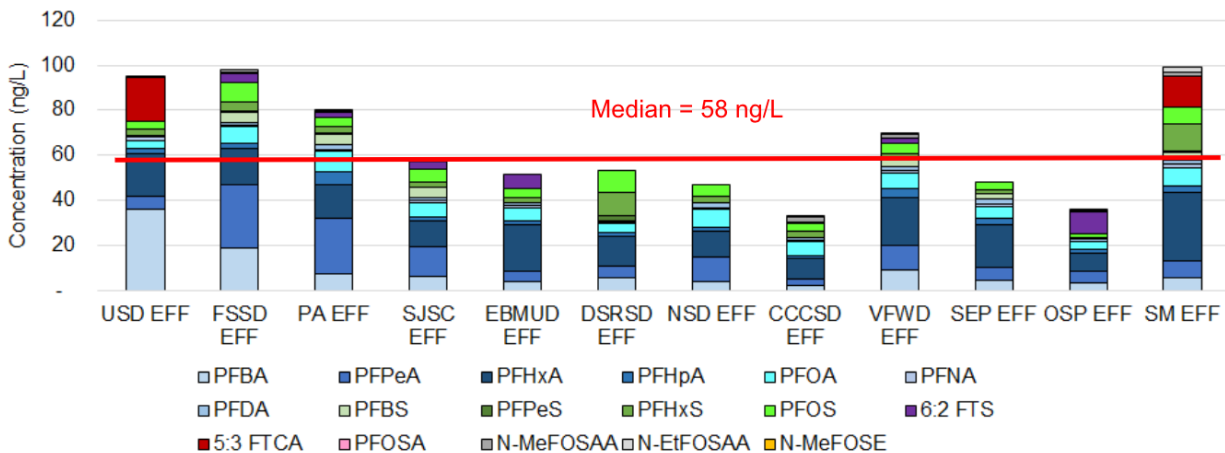
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**Figure 6.** Concentrations of detected PFAS analytes via the TOP method in municipal POTW influent grab samples (first single grab), organized from largest to smallest input of industrial flows.

### 3.4 Effluent

A broad range of PFAS analytes was found in effluent samples when analyzed via target analysis, as shown in Table 6. A total of 17 analytes were detected at municipal facilities with eight, mostly short-chain PFCAs, identified above MDLs in all samples.. Highlighted in Figure 7, total municipal POTW effluent PFAS concentrations ranged from 33 - 106 ng/L with a median of 58 ng/L. We also did not find a clear correlation between the proportion of industrial flows and the sum of quantified target PFAS for effluent data.



**Figure 7.** Concentrations of detected PFAS analytes via target method in municipal POTW effluent samples, organized from largest to smallest input of industrial flows.

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**Table 6.** Summary statistics for concentrations of detected PFAS via target method in municipal POTW effluent grab samples (first single grab). All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (Total: 13)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	1.52	2	100%	2	36	5	9
PFPeA	0.76	1	100%	3	28	8	10
PFHxA	0.38	0.5	100%	8	30	16	17
PFHpA	0.38	0.5	100%	1	6	2	2
PFOA	0.38	0.5	100%	3	9	6	6
PFNA	0.38	1.04	92%	ND	1	1	1
PFDA	0.38	0.5	100%	1	2	1	1
PFBS	0.391	19.9 <sup>2</sup>	46%	ND	5	ND	2
PFPeS	0.382	0.622	38%	ND	2	ND	ND
PFHxS	0.38	0.5	100%	1	12	3	4
PFOS	0.38	0.5	100%	2	10	5	5
6:2 FTS	1.37	1.8	54%	ND	10	2	2
5:3 FTCA	9.5	12.5	23%	ND	20	ND	4
PFOSA	0.38	0.5	31%	ND	1	ND	ND
N-MeFOSAA	0.38	1.88	54%	ND	3	ND	1
N-EtFOSAA	0.38	0.543	31%	ND	2	ND	ND
PFMBA	0.76	1	8%	ND	1	ND	ND
Sum of PFAS	-	-	-	33	106	58	67

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

<sup>2</sup>Values were flagged and considered non quantitative due to peak interference, resulting in higher MDLs.

Compared to the influent data, the effluent data showed a greater variety of PFAS analytes detected at greater concentrations. There were roughly 50% more analytes detected in the effluent, with the target PFAS median more than double the influent target median. This trend has been reported in other wastewater studies and can be explained by the significant presence of precursors in the influent that are converted to terminal products or other precursors that are quantified via target analysis (Guerra et al., 2014; Lenka et al., 2021). There was no clear difference between facilities that performed secondary treatment and those with advanced secondary treatment.

The Regional Monitoring Program for Water Quality in San Francisco Bay (RMP) has previously conducted two studies analyzing PFAS in wastewater effluents to assess concentrations of PFAS in effluents discharged to the Bay. In 2009, a blind study of six

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municipal POTWs reported a total of 10 analytes in sampled effluents with average values and standard deviations noted in Table 7 (Klosterhaus et al., 2013). Additionally, six municipal POTWs — CCCSD, CSM, EBDA, EBMUD, PA, and SJSC — had effluents sampled in 2014 with averages and standard deviations shown for the same ten analytes reported in the 2009 study (Table 7; Houtz et al., 2016).

**Table 7.** Average concentrations of detected PFAS for POTW effluent studies in 2009, 2014, and 2020 (present study). Only the target PFAS analyzed in the 2009 study are summarized here to allow for comparison across studies. All values are in ng/L.

<b>Detected Analytes</b>	<b>2009 Average<sup>1</sup></b>	<b>Standard Deviation</b>	<b>2014 Average<sup>2</sup></b>	<b>Standard Deviation</b>	<b>2020 Average<sup>2</sup></b>	<b>Standard Deviation</b>
PFBA	7.4	4.7	16	5.8	7.2	5.6
PFPeA	6.3	7.5	12	11	10.4	8.0
PFHxA	17	4	26	5.1	19.5	9.3
PFHpA	5.3	1.2	4.4	2.2	2.7	1.5
PFOA	32	30	21	13	7	1.4
PFNA	12	5.6	8.4	3.6	1.1	0.2
PFDA	3.6	1.8	3.5	1.7	1.5	0.3
PFBS	5.3	6.5	2.7	1.5	2	2.3
PFHxS	5.1	5.5	4.8	0.9	4.9	4.0
PFOS	24	32	13	4.4	5.3	1.7

<sup>1</sup>The 2009 project included six unspecified Region 2 facilities with the average concentration shown (Klosterhaus et al., 2013). Non-detects (NDs) were set to 0.

<sup>2</sup>Each concentration is averaged across six participating facilities (CCCSD, CSM, EBDA, EBMUD, PA, and SJSC) for 2014 (Houtz et al., 2016) and 2020 studies. FSSD and SFOI were also sampled in 2014, but were excluded in the analysis of municipal facilities due to signs of AFFF influence. Non-detects (NDs) were set to 0.

Comparing the average concentrations of these two projects to the current study, there are noticeable declines in long-chain PFAS. Average concentrations of PFOA, PFNA, and PFOS from 2009 to 2020 decreased by 80%, 91%, and 78%, respectively. A Kruskal-Wallis test found that the change in concentrations of PFOS over time were not statistically significant ( $p = 0.08$ ). However, differences in PFOA and PFNA over time were statistically significant,  $p = 0.003$  for both analytes. A post-hoc Nemenyi Test was used to compare all pairs of groups for PFOA and PFNA. The change in concentrations of PFOA in 2020 compared to both 2009 and 2014 were significant,  $p = 0.008$  and  $0.012$ , respectively. The same pairs (2009 and 2014 compared to 2020) were also significant for PFNA ( $p = 0.003$  and  $0.03$ , respectively). None of the other comparisons were significant ( $p < 0.05$ ).

Finally, the results of the ROC samples collected at VW are shown in Appendix B. These samples are best compared to those from SJSC, as ROC is the reject water from the purification of secondary effluent from SJSC. The average concentration of the sum

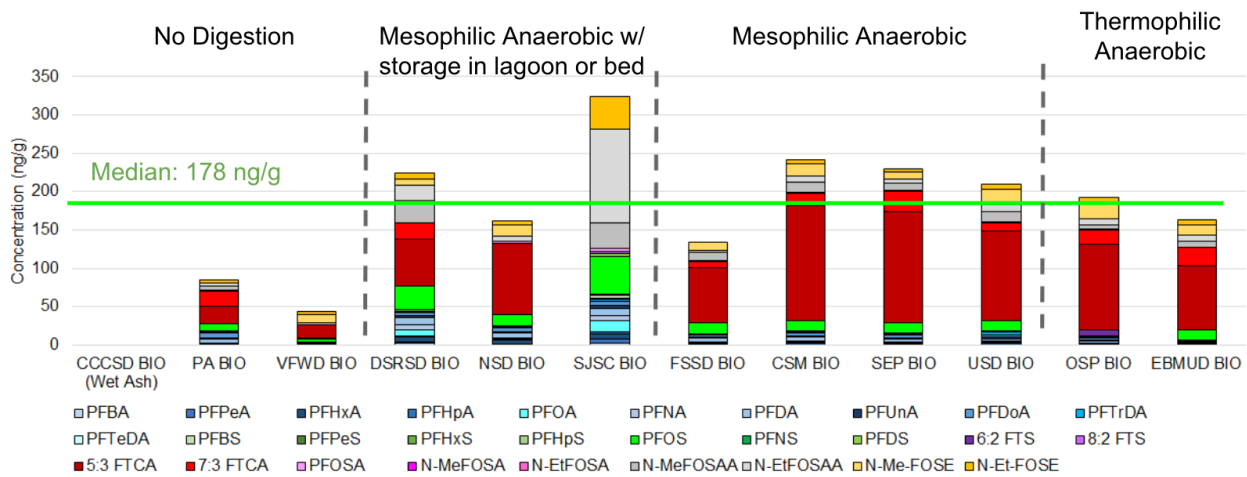
of PFAS analytes in ROC was 6 times greater than at SJSC, which is consistent with general expectation of the treatment process at VW (UC, Berkeley et al., 2020).

### 3.5 Biosolids

The largest variety of PFAS in all matrices was detected within biosolids, with a total of 25 analytes found out of 40 analyzed (Table 8). All PFCAs within the target method were detected in the full set of samples, with long-chain PFCAs among the most extensively found (83 - 92%). 5:3 FTCA was widely detected (83%) at significantly higher concentrations than any other analyte, with a median concentration of 78 ng/g. This is more than five times greater than the next largest median of 14 ng/g for 7:3 FTCA. Generally, 5:3 FTCA is considered an intermediary transformation product, particularly for 6:2 fluorotelomer structures, and is commonly observed in landfill leachates and food contact substances (Lang et al., 2017; Schaider et al., 2017), which may explain its widespread presence at high concentrations in biosolids.

Total municipal biosolids concentrations ranged from ND to 320 ng/g, with a median of 178 ng/g. The samples at both ends of the range are likely influenced by the particular biosolids processing at the POTW. CCCSD biosolid samples are incinerated and analyzed as wet ash samples. Prior to entering the furnace, two biosolids samples were collected and analyzed (detailed in Appendix B), showing the presence of several PFAS in biosolid “cake” prior to incineration.

SJSC exhibited the highest sum of PFAS concentrations in biosolids, though this is probably because of its four-year storage and processing of biosolids in sludge beds. This process gives PFAS precursors present in biosolids the time to transform to detectable analytes, illustrated by the notable difference in the PFAS fingerprint at SJSC compared to the rest of the municipal facilities in Figure 8. Overall, biosolids exhibited a different variety of PFAS, with a focus on 5:3 and 7:3 FTCA compared to the predominance of PFCAs in target analysis of influents and effluents.



**Figure 8.** Concentrations of detected PFAS analytes via target method in municipal POTW biosolids samples, organized by digestion type.

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**Table 8.** Summary statistics for concentrations of detected PFAS via target method in municipal POTW final biosolids samples. All values are in ng/g.

Detected Analytes	MDLs (Range)		% Detected in Samples (Total: 12)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	1.15	2.64	17%	ND	3	ND	ND
PFPeA	0.577	1.32	33%	ND	5	ND	1
PFHxA	0.288	0.674	83%	ND	7	1	2
PFHpA	0.288	0.66	17%	ND	2	ND	ND
PFOA	0.288	0.66	92%	ND	15	1	3
PFNA	0.288	0.752	92%	ND	7	1	2
PFDA	0.288	0.66	92%	ND	10	4	5
PFUnA	0.328	0.66	92%	ND	4	2	2
PFDoA	0.288	0.66	92%	ND	6	3	3
PFTrDA	0.288	0.894 <sup>2</sup>	83%	ND	3	1	1
PFTeDA	0.288	0.66	83%	ND	2	1.5	1
PFBS	0.331	66.8	8%	ND	5	ND	ND
PFHxS	0.328	2.23	17%	ND	2	ND	ND
PFOS	0.288	7.59	83%	ND	49	13	14
PFDS	0.367	4.8 <sup>2</sup>	17%	ND	4	ND	2
6:2 FTS	1.04	2.38	8%	ND	7	ND	7
8:2 FTS	1.15	2.64	8%	ND	2	ND	2
5:3 FTCA	7.21	16.5	83%	ND	151	78	73
7:3 FTCA	7.21	16.5	67%	ND	27	14	12
PFOSA	0.288	0.66	83%	ND	4	1	1
N-MeFOSA	0.377	0.843	8%	ND	0.5	ND	ND
N-EtFOSA	0.721	1.65	8%	ND	1	ND	ND
N-MeFOSAA	0.328	18.6 <sup>2</sup>	75%	ND	33	8	10
N-EtFOSAA	0.288	0.957 <sup>2</sup>	92%	ND	122	7	16
N-MeFOSE	2.88	6.6	75%	ND	21	11	10
N-EtFOSE <sup>3</sup>	2.16	4.94	67%	ND	42	6	8
Sum of PFAS	-	-	-	ND	320	178	166

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

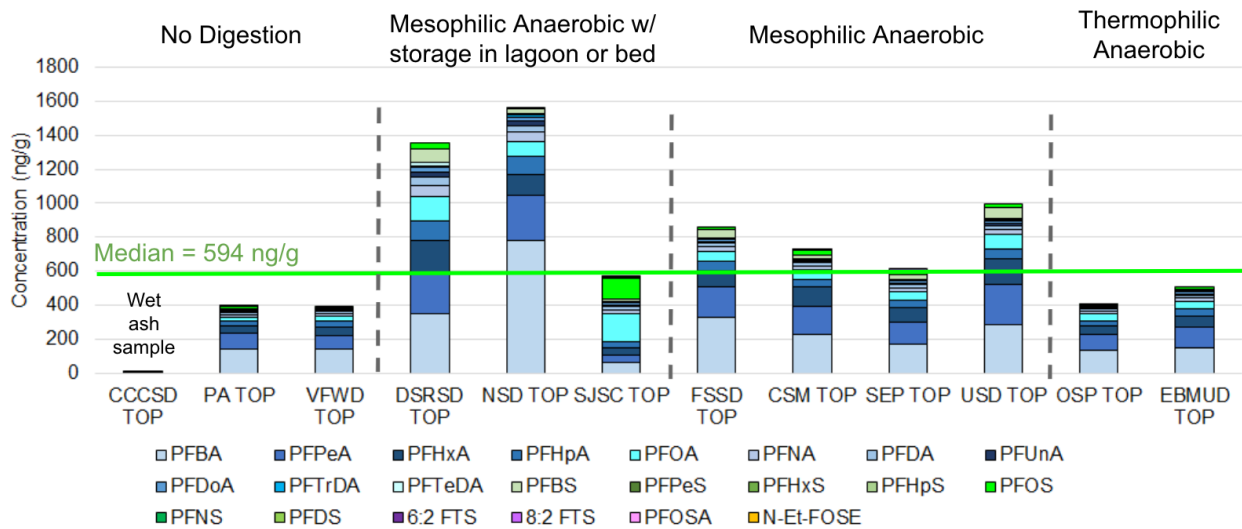
<sup>2</sup>Values were flagged and considered non quantitative due to peak interference, resulting in higher MDLs.

<sup>3</sup>Summary statistics are calculated out of 10 total samples since two samples were flagged as rejected.

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When separated by digestion type, POTWs with no digestion showed lower concentrations of PFAS compared to the other processes (Figure 8). One potential explanation for this is the greater concentration of organic matter in undigested samples, which dilutes the concentrations of PFAS (reported per biosolid mass) compared to biosolids that have lost organic matter through digestion processes. The concentrations of PFAS across facilities performing digestion processes are relatively comparable.

TOP analysis of biosolids samples noted significantly higher concentrations compared to target analysis, with a range of 2 - 1565 ng/g and a median of 594 ng/L for the sum of TOP PFAS (Table 9). The median for sum of PFAS in biosolids via TOP is roughly three times greater than the sum of target analytes, which suggests a large presence of PFAS precursors that are not quantified using the target method. At SJSC, the difference between the sum of PFAS in TOP and target was the lowest (TOP:target ratio = 1.8), which is consistent with their longer treatment process providing for greater conversion of precursors to target products. Similar to the target method, only a small amount of PFAS were detected in the CCCSD wet ash sample. When organized by the digestion method used, there appear to be elevated levels of PFAS in facilities using sludge lagoons (Figure 9), though overall there is no observed correlation between digestion activity and the sum of analytes detected through TOP. Further study is needed to understand the transformation of PFAS through varying digestion methods.



**Figure 9.** Concentrations of detected PFAS analytes via TOP method in municipal POTW biosolids samples, organized by digestion type.

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**Table 9.** Summary statistics for concentrations of detected PFAS via TOP method in municipal POTW biosolids samples. All values are in ng/g.

Detected Analytes	MDLs (Range)		% Detected in Samples (Total: 12)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	1.63	15.4	92%	ND	783	160	231
PFPeA	0.815	7.71	92%	ND	55	19	21
PFHxA	0.408	3.85	92%	ND	30	12	13
PFHpA	0.408	3.85	92%	ND	114	44	50
PFOA	0.454	3.85	100%	1	188	75	84
PFNA	0.408	3.85	92%	ND	65	22	25
PFDA	0.408	3.85	92%	ND	162	54	65
PFUnA	0.408	3.85	100%	1	267	125	138
PFDoA	0.408	3.85	92%	ND	16	4	6
PFTTrDA	0.408	3.85	83%	ND	13	3	4
PFTeDA	0.408	3.85	92%	ND	26	8	10
PFBS	0.408	3.85	83%	ND	80	16	24
PFHxS	0.408	3.85	25%	ND	7	ND	1
PFOS	0.408	3.85	25%	ND	4	ND	1
PFDS	0.408	3.85	92%	ND	120	15	23
6:2 FTS	1.47	13.9	8%	ND	14	ND	1
8:2 FTS	1.63	15.4	8%	ND	6	ND	1
PFOSA	0.408	3.85	25%	ND	1	ND	ND
N-EtFOSAA	0.408	3.85	8%	ND	2	ND	ND
N-Et-FOSE	3.05	28.8	8%	ND	7	ND	1
Sum of PFAS	-	-	-	2	1,565	594	699

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

## **4. Recommendations for Phase 2**

SFEI joined conversations with BACWA, BACWA members, and State and Regional Water Board representatives to discuss priority objectives for Phase 2. The overall consensus was to better understand the major sources of PFAS entering municipal POTWs in order to inform source control measures. While State Water Board investigation orders have been sent to some industrial dischargers (e.g., bulk fuel terminal/refineries, chrome platers, landfills, and airports), many other industrial and commercial dischargers may be potential sources of PFAS to municipal wastewater. Additionally, a presentation of statewide wastewater results presented by Orange County Sanitary District and Ramboll at the Clean Summit Partners (September 1, 2021) meeting showed the contribution of PFAS concentrations from residential/commercial customers were comparable to industrial customers. These results suggest PFAS sources may be widespread and dispersed among residential and commercial wastewater customers as well.

Based on the findings from Phase 1 and priorities from BACWA members and the Water Boards, we recommend the following priority study questions for Phase 2. Specific study questions and scope will be refined through the development of a Sampling and Analysis Plan for Phase 2.

- 1) What are concentrations of TOP and target PFAS from residential flows versus total influent (influent received at the facility)?
- 2) What are concentrations of TOP and target PFAS from specific industrial and commercial dischargers in the sewershed? Potential commercial and industrial operations to investigate for Phase 2 include metalworking (i.e., those not included in previous SWB investigation orders), industrial laundry, dry cleaning, car washes, auto repair shops, hospitals, manufacturing (auto parts, aviation, chemical, pesticide, pharmaceutical, paint, coatings, lens, plastics, semiconductor, electronic components, paperboard), fire stations, composting facilities, jails/prisons, military operations. This list will be narrowed down based on further conversations with BACWA members. How do concentrations from these dischargers compare to concentrations reported to the SWB under previous investigation orders?
- 3) What are TOP concentrations in the effluent, and how do these compare with TOP in influent and biosolids?
- 4) Is there a significant presence of other PFAS in influent, effluent, and biosolids that are not captured by TOP analysis? Total organic fluorine analysis, adsorbable organofluorine analysis (for water samples), and extractable organofluorine analysis (solid samples) may be used to respond to this question.

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## 8. Appendix B: PFAS Analyte List

**Table B.1.** Target PFAS analyte list (USEPA Method 1633 [MLA-110, SGS AXYS]) including reporting limits (RLs) for aqueous and biosolid samples.

Abbreviation	Geotracker PARLABEL	PFAS Chemical Name	Aqueous DLs* (ng/L)	Aqueous RLs* (ng/L)	Biosolids DLs* (ng/g)	Biosolids RLs* (ng/g)
PFBA	PFTBA	Perfluorobutanoic acid	1.6	6.4	1.6	6.4
PFPeA	PFPA	Perfluoropentanoic acid	0.8	3.2	0.8	3.2
PFHxA	PFHA	Perfluorohexanoic acid	0.4	1.6	0.4	1.6
PFHpA	PFHPA	Perfluoroheptanoic acid	0.4	1.6	0.4	1.6
PFOA	PFOA	Perfluorooctanoic acid	0.4	1.6	0.4	1.6
PFNA	PFNA	Perfluorononanoic acid	0.4	1.6	0.4	1.6
PFDA	PFNDCA	Perfluorodecanoic acid	0.4	1.6	0.4	1.6
PFUnA	PFUNDCA	Perfluoroundecanoic acid	0.4	1.6	0.4	1.6
PFDoA	PFDOA	Perfluorododecanoic acid	0.4	1.6	0.4	1.6
PFTrDA	PFTRIDA	Perfluorotridecanoic acid	0.4	1.6	0.4	1.6
PFTeDA	PFTEDA	Perfluorotetradecanoic acid	0.4	1.6	0.4	1.6
PFBS	PFBSA	Perfluorobutanesulfonic acid	0.4	1.6	0.4	1.6
PFPeS	PFPEs	Perfluoropentanesulfonic acid	0.4	1.6	0.4	1.6
PFHxS	PFHXSA	Perfluorohexanesulfonic acid	0.4	1.6	0.4	1.6
PFHpS	PFHPSA	Perfluoroheptanesulfonic acid	0.4	1.6	0.4	1.6
PFOS	PFOS	Perfluorooctanesulfonic acid	0.4	1.6	0.4	1.6
PFNS	PFNS	Perfluorononanesulfonic acid	0.4	1.6	0.4	1.6
PFDS	PFDSA	Perfluorodecanesulfonic acid	0.4	1.6	0.4	1.6
PFDoS	-	Perfluorododecanesulfonic acid	0.4	1.6	0.4	1.6
4:2 FTS	4:2FTS	1H, 1H, 2H, 2H-perfluorohexane sulfonic acid	1.6	6.4	1.6	6.4
6:2 FTS	6:2FTS	1H, 1H, 2H, 2H-perfluorooctane sulfonic acid	1.6	6.4	1.6	6.4
8:2 FTS	8:2FTS	1H, 1H, 2H, 2H-perfluorodecane sulfonic acid	1.6	6.4	1.6	6.4

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<b>Abbreviation</b>	<b>Geotracker PARLABEL</b>	<b>PFAS Chemical Name</b>	<b>Aqueous DLs* (ng/L)</b>	<b>Aqueous RLs* (ng/L)</b>	<b>Biosolids DLs* (ng/g)</b>	<b>Biosolids RLs* (ng/g)</b>
3:3 FTCA	3:3FTCA	2H, 2H, 3H, 3H-perfluorohexanoic acid	1.6	6.4	1.6	6.4
5:3 FTCA	5:3FTCA	2H, 2H, 3H, 3H-perfluorooctanoic acid	10	40	10	40
7:3 FTCA	7:3FTCA	2H, 2H, 3H, 3H-perfluorodecanoic acid	10	40	10	40
PFOSA	PFOSA	Perfluorooctanesulfonamide	0.4	1.6	0.4	1.6
N-MeFOSA	MEFOSA	N-Methylperfluorooctanesulfonamide	0.4	1.6	0.4	1.6
N-EtFOSA	ETFOSA	N-Ethylperfluorooctanesulfonamide	0.4	1.6	0.4	1.6
N-MeFOSAA	NMEFOSAA	N-Methylperfluoro-1-octanesulfonamidoacetic acid	0.4	1.6	0.4	1.6
N-EtFOSAA	NETFOSAA	N-Ethylperfluoro-1-octanesulfonamidoacetic acid	0.4	1.6	0.4	1.6
N-MeFOSE	MEFOSE	N-Methylperfluoro-1-octanesulfonamidoethanol	4	16	4	16
N-EtFOSE	ETFOSE	N-Ethylperfluoro-1-octanesulfonamidoethanol	4	16	4	16
HFPO-DA (GenX)	HFPO-DA	2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-hexafluoroisopropoxy)propionic acid	1.6	6.4	1.6	6.4
ADONA	ADONA	Decafluoro-3H-4,8-dioxanone	1.6	6.4	1.6	6.4
NFDHA	NFDHA	Perfluoro-3,6-dioxahexanoate	0.8	3.2	0.8	3.2
PFMBA	PFMBA	Perfluoro-3-methoxypropanoate	0.4	1.6	0.4	1.6
PFMPA	PFMPA	Perfluoro-4-methoxybutanoate	0.8	3.2	0.8	3.2
9Cl-PF3ONS	9-Cl-PF3ONS	9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	1.6	6.4	1.6	6.4
11Cl-PF3OUdS	11-Cl-PF3OUdS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	1.6	6.4	1.6	6.4
PFEESA	PFEESA	Perfluoro(2-ethoxyethane)sulfonic acid	0.4	1.6	0.4	1.6

\* Detection limits (DL) and Reporting Limits (RL) are prorated to sample size. DLs and RLs shown are based on a standard sample size of 0.5L for aqueous and 0.5g for biosolids.

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**Table B.2.** TOP PFAS analyte list (MLA-111, SGS AXYS) including reporting limits (RLs) for aqueous samples.

<b>Abbreviation</b>	<b>PFAS Chemical Name</b>	<b>Aqueous RLs* (ng/L)</b>
PFBA	Perfluorobutanoate	13.3
PFPeA	Perfluoropentanoate	6.7
PFHxA	Perfluorohexanoate	3.3
PFHpA	Perfluoroheptanoate	3.3
PFOA	Perfluorooctanoate	3.3
PFNA	Perfluorononanoate	3.3
PFDA	Perfluorodecanoate	3.3
PFUnA	Perfluoroundecanoate	3.3
PFDaA	Perfluorododecanoate	3.3
PFTTrDA	Perfluorotridecanoate	3.3
PFTeDA	Perfluorotetradecanoate	3.3
PFBS	Perfluorobutanesulfonate	3.3
PFPeS	Perfluoropentanesulfonate	3.3
PFHxS	Perfluorohexanesulfonate	3.3
PFHpS	Perfluoroheptanesulfonate	3.3
PFOS	Perfluorooctanesulfonate	3.3
PFNS	Perfluorononanesulfonate	3.3
PFDS	Perfluorodecanesulfonate	3.3
PFDoS	Perfluorododecanesulfonate	3.3
4:2 FTS	4:2 fluorotelomersulfonate	13.3
6:2 FTS	6:2 fluorotelomersulfonate	13.3
8:2 FTS	8:2 fluorotelomersulfonate	13.3
N-MeFOSAA	N-Methylperfluorooctanesulfonamidoacetic acid	3.3
N-EtFOSAA	N-Ethylperfluorooctanesulfonamidoacetic acid	3.3
PFOSA	Perfluorooctanesulfonamide	3.3
N-MeFOSA	N-Methylperfluorooctanesulfonamide	3.3
N-EtFOSA	N-Ethylperfluorooctanesulfonamide	3.3

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<b>Abbreviation</b>	<b>PFAS Chemical Name</b>	<b>Aqueous RLs* (ng/L)</b>
N-MeFOSE	N-Methylperfluorooctanesulfonamidoethanol	33.3
N-EtFOSE	N-Ethylperfluorooctanesulfonamidoethanol	33.3

\*Reporting limits (RL) shown are based on standard sample size of 0.060L.

## 9. Appendix C: Phase 1 Summary Statistic Tables

**Table C.1.** Phase 1 summary statistics for concentrations of detected PFAS via target method in municipal POTW influent grab samples (first single grab). All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 12)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	5.81	8.25	42%	ND	23	ND	5
PFPeA	2.91	4.12	100%	4	14	6	7
PFHxA	1.45	2.06	100%	4	13	8	7
PFHpA	1.45	2.06	58%	ND	3	1.9	1
PFOA	1.45	2.06	100%	2	6	3	4
PFNA	1.45	2.91 <sup>2</sup>	8%	ND	2	ND	ND
PFDA	1.45	2.06	8%	ND	2	ND	ND
PFBS	1.6	13.9 <sup>2</sup>	17%	ND	6	ND	1
PFHxS	1.65	42.9 <sup>2</sup>	33%	ND	12	ND	2
PFOS	1.81	24.9 <sup>2</sup>	17%	ND	13	ND	2
N-EtFOSAA	1.45	2.95	8%	ND	3	ND	ND
Sum of PFAS <sup>1</sup>	NA	NA	NA	10	59	27	30

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero. Sample replicates not included in median or mean.

<sup>2</sup>Values were flagged and considered non quantitative due to peak interference, resulting in higher MDLs. NA = not applicable

**Table C.2.** Phase 1 summary statistics for concentrations of detected PFAS via TOP method in municipal POTW influent grab samples. All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 12)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	12.2	26.6	100%	39	85	66	64
PFPeA	6.11	13.3	100%	43	95	70	67
PFHxA	3.05	71.6 <sup>2</sup>	92%	ND	60	45	41
PFHpA	3.05	6.64	100%	16	31	21	22
PFOA	3.05	6.64	100%	13	33	21	22
PFNA	3.09	12.2 <sup>2</sup>	75%	ND	11	8	6
PFDA	3.12	9.69 <sup>2</sup>	50%	ND	8	2	3

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PFUnA	3.05	6.64	8%	ND	3	ND	ND
PFBS	3.05	6.64	25%	ND	8	ND	1
PFHxS	3.05	6.64	8%	ND	10	ND	1
PFOS	3.05	10.3 <sup>2</sup>	25%	ND	12	ND	2
6:2 FTS	11	23.9	25%	ND	24	ND	5
Sum of PFAS	-	-	-	150	299	231	235

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

<sup>2</sup>Values were flagged and considered non quantitative due to peak interference, resulting in higher MDLs

**Table C.3.** Summary statistics for concentrations of detected PFAS via target method in municipal POTW effluent grab samples (first single grab) for Phase 1. All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 13)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	1.52	2	100%	2	36	5	9
PFPeA	0.76	1	100%	3	28	8	10
PFHxA	0.38	0.5	100%	8	30	16	17
PFHpA	0.38	0.5	100%	1	6	2	2
PFOA	0.38	0.5	100%	3	9	6	6
PFNA	0.38	1.04	92%	ND	1	1	1
PFDA	0.38	0.5	100%	1	2	1	1
PFBS	0.391	19.9 <sup>2</sup>	46%	ND	5	ND	2
PFPeS	0.382	0.622	38%	ND	2	ND	ND
PFHxS	0.38	0.5	100%	1	12	3	4
PFOS	0.38	0.5	100%	2	10	5	5
6:2 FTS	1.37	1.8	54%	ND	10	2	2
5:3 FTCA	9.5	12.5	23%	ND	20	ND	4
PFOSA	0.38	0.5	31%	ND	1	ND	ND
N-MeFOSAA	0.38	1.88	54%	ND	3	ND	1
N-EtFOSAA	0.38	0.543	31%	ND	2	ND	ND
PFMBA	0.76	1	8%	ND	1	ND	ND
Sum of PFAS	NA	NA	NA	33	106	58	67

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

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<sup>2</sup>Values were flagged and considered nonquantitative due to peak interference, resulting in higher MDLs.

**Table C.4.** Phase 1 summary statistics for concentrations of detected PFAS via target method in municipal POTW final biosolids samples. All values are in ng/g.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 26)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	1.15	2.64	17%	ND	3	ND	ND
PFPeA	0.577	1.32	33%	ND	5	ND	1
PFHxA	0.288	0.674	83%	ND	7	1	2
PFHpA	0.288	0.66	17%	ND	2	ND	ND
PFOA	0.288	0.66	92%	ND	15	1	3
PFNA	0.288	0.752	92%	ND	7	1	2
PFDA	0.288	0.66	92%	ND	10	4	5
PFUnA	0.328	0.66	92%	ND	4	2	2
PFDoA	0.288	0.66	92%	ND	6	3	3
PFTTrDA	0.288	0.894 <sup>2</sup>	83%	ND	3	1	1
PFTeDA	0.288	0.66	83%	ND	2	1.5	1
PFBS	0.331	66.8	8%	ND	5	ND	ND
PFHxS	0.328	2.23	17%	ND	2	ND	ND
PFOS	0.288	7.59	83%	ND	49	13	14
PFDS	0.367	4.8 <sup>2</sup>	17%	ND	4	ND	2
6:2 FTS	1.04	2.38	8%	ND	7	ND	7
8:2 FTS	1.15	2.64	8%	ND	2	ND	2
5:3 FTCA	7.21	16.5	83%	ND	151	78	73
7:3 FTCA	7.21	16.5	67%	ND	27	14	12
PFOSA	0.288	0.66	83%	ND	4	1	1
N-MeFOSA	0.377	0.843	8%	ND	0.5	ND	ND
N-EtFOSA	0.721	1.65	8%	ND	1	ND	ND
N-MeFOSAA	0.328	18.6 <sup>2</sup>	75%	ND	33	8	10
N-EtFOSAA	0.288	0.957 <sup>2</sup>	92%	ND	122	7	16
N-MeFOSE	2.88	6.6	75%	ND	21	11	10
N-EtFOSE <sup>3</sup>	2.16	4.94	67%	ND	42	6	8
Sum of PFAS	-	-	-	ND	320	178	166

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<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

<sup>2</sup>Values were flagged and considered non quantitative due to peak interference, resulting in higher MDLs.

<sup>3</sup>Summary statistics are calculated out of 10 total samples since two samples were flagged as rejected.

**Table C.5.** Phase 1 summary statistics for concentrations of detected PFAS via TOP method in municipal POTW biosolids samples. All values are in ng/g.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 12)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	1.63	15.4	92%	ND	783	160	231
PFPeA	0.815	7.71	92%	ND	55	19	21
PFHxA	0.408	3.85	92%	ND	30	12	13
PFHpA	0.408	3.85	92%	ND	114	44	50
PFOA	0.454	3.85	100%	1	188	75	84
PFNA	0.408	3.85	92%	ND	65	22	25
PFDA	0.408	3.85	92%	ND	162	54	65
PFUnA	0.408	3.85	100%	1	267	125	138
PFDoA	0.408	3.85	92%	ND	16	4	6
PFTTrDA	0.408	3.85	83%	ND	13	3	4
PFTeDA	0.408	3.85	92%	ND	26	8	10
PFBS	0.408	3.85	83%	ND	80	16	24
PFHxS	0.408	3.85	25%	ND	7	ND	1
PFOS	0.408	3.85	25%	ND	4	ND	1
PFDS	0.408	3.85	92%	ND	120	15	23
6:2 FTS	1.47	13.9	8%	ND	14	ND	1
8:2 FTS	1.63	15.4	8%	ND	6	ND	1
PFOSA	0.408	3.85	25%	ND	1	ND	ND
N-EtFOSAA	0.408	3.85	8%	ND	2	ND	ND
N-Et-FOSE	3.05	28.8	8%	ND	7	ND	1
Sum of PFAS	-	-	-	2	1,565	594	699

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

## 10. Appendix D: Phase 2 Summary Statistic Tables

**Table D.1.** Phase 2 Summary statistics for concentrations of detected PFAS via target method in municipal POTW influent compositesamples. All values are in ng/L.

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Detected Analytes	MDLs (Range)		% Detected in Samples (n = 7)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	5.64	7.18	57%	ND	12	7	5
PFPeA	2.82	3.59	100%	3	9	5	6
PFHxA	1.41	1.8	100%	6	17	8	9
PFHpA	1.41	1.8	57%	ND	3	2	1
PFOA	1.41	1.8	100%	3	7	4	5
PFDA	1.41	1.8	14%	ND	2	ND	ND
PFBS	1.41	3.18	43%	ND	11	ND	3
PFPeS	1.42	1.8	14%	ND	2	ND	ND
PFHxS	1.41	1.8	100%	2	13	4	5
PFOS	1.41	1.8	71%	ND	21	13	11
N-EtFOSAA	1.41	1.8	14%	ND	2	ND	ND
Sum of PFAS <sup>1</sup>	-	-	-	13	82	47	44
Sum of F <sup>-</sup>	-	-	-	8.7	52	30	30

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero. Sample replicates not included in median or mean.

**Table D.2.** Phase 2 summary statistics for concentrations of detected PFAS via TOP method in municipal POTW influent composite samples. All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 7)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	11.6	16.3	100%	44	112	68	68
PFPeA	5.79	8.16	100%	49	137	60	71
PFHxA	2.89	9.47	100%	41	80	47	56
PFHpA	2.89	4.08	100%	17	29	22	22
PFOA	2.89	4.28	100%	18	30	23	23
PFNA	2.89	4.08	100%	7	15	8	9
PFDA	2.89	4.08	100%	5	7	6	6
PFBS	2.89	4.08	57%	ND	9	4	3
PFHxS	2.89	4.08	71%	ND	13	4	4
PFOS	2.89	4.08	71%	ND	13	4	4
Sum of	-	-	-	183	422	256	270

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PFAS <sup>1</sup>							
Sum of F <sup>-</sup>	-	-	-	120	305	169	192

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

**Table D.3.** Summary statistics for concentrations of detected PFAS via target method in municipal POTW effluent composite samples for Phase 2. All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 7)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	1.47	6.02	100%	3	10	7	7
PFPeA	0.73	3.01	100%	3	11	7	7
PFHxA	0.37	1.5	86%	ND	29	13	14
PFPpA	0.37	1.5	100%	1	4	2	2
PFOA	0.37	1.5	100%	5	12	5	6
PFNA	0.37	1.5	86%	ND	1	1	1
PFDA	0.37	1.5	71%	ND	3	1	1
PFBS	0.37	10.8	57%	ND	6	3	3
PFPeS	0.37	1.51	29%	ND	3	ND	1
PFHxS	0.37	1.5	100%	ND	14	2	4
PFPpS	0.37	1.5	14%	ND	0.4	ND	ND
PFOS	0.37	1.5	86%	ND	13	4	5
PFDS	0.37	1.5	14%	ND	1	ND	ND
6:2 FTS	1.32	5.42	29%	ND	2	ND	1
5:3 FTCA	9.16	37.6	14%	ND	21	ND	3
N-MeFOSAA	0.37	1.5	57%	ND	1	ND	ND
N-EtFOSAA	0.37	1.5	14%	ND	0.5	ND	ND
Sum of PFAS	-	-	-	27	112	51	55
Sum of F <sup>-</sup>	-	-	-	18	72	30	34

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

<sup>2</sup>Values were flagged and considered non quantitative due to peak interference, resulting in higher MDLs.

**Table D.4.** Summary statistics for concentrations of detected PFAS via TOP method in municipal POTW effluent composite samples for Phase 2. All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 7)	Minimum	Max	Median	Mean <sup>1</sup>

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PFBA	11.5	16.7	100%	21	31	25	25
PFPeA	5.75	8.37	100%	15	27	19	19
PFHxA	2.87	4.18	100%	15	43	23	26
PFHpA	2.87	4.18	86%	ND	8	6	5
PFOA	3.01	5.89	100%	7	16	10	10
PFDA	2.87	4.18	14%	ND	4	ND	1
PFBS	2.87	4.18	57%	ND	6	4	3
PFHxS	2.87	4.18	57%	ND	15	4	4
PFOS	2.87	4.18	86%	ND	15	4	6
Sum of PFAS	-	-	-	75	146	88	98
Sum of F <sup>-</sup>	-	-	-	49	95	59	63

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

<sup>2</sup>Values were flagged and considered non quantitative due to peak interference, resulting in higher MDLs

**Table D.5.** Phase 2 summary statistics for concentrations of detected PFAS via target method in municipal POTW final biosolids samples. All values are in ng/g.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 8)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	1.07	1.47	13%	ND	1.4	ND	0.2
PFPeA	0.525	0.74	13%	ND	1.4	ND	0.2
PFHxA	0.262	0.368	100%	0.6	5	1	2
PFHpA	0.262	0.368	13%	ND	1	ND	0.1
PFOA	0.262	0.368	100%	0.5	13	1	2
PFNA	0.262	0.368	75%	ND	6	1	1
PFDA	0.262	0.368	100%	2	15	4	5
PFUnA	0.262	0.368	88%	ND	4	2	2
PFDoDA	0.21	0.294	100%	1	5	4	3
PFTTrDA	0.262	0.368	88%	ND	2	2	1
PFTeDA	0.262	0.479	63%	ND	2	1.5	1
PFOS	0.262	0.368	88%	ND	32	10	11
8:2 FTS	0.892	1.25	25%	ND	2	ND	0.3
5:3 FTCA	6.56	9.2	100%	45	154	101	109
7:3 FTCA	6.56	9.2	88%	ND	31	22	19

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PFOSA	0.262	0.368	100%	0.4	2	1	1
N-MeFOSAA	0.262	0.368	88%	ND	41	7	11
N-EtFOSAA	0.262	0.368	88%	ND	24	6	7
N-MeFOSE	2.67	3.68	100%	8	25	14	15
N-EtFOSE	2.62	3.68	75%	ND	12	5	5
Sum of PFAS	-	-	-	128	246	208	197
Sum of F <sup>-</sup>	-	-	-	78	150	121	117

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

<sup>2</sup>Values were flagged and considered non quantitative due to peak interference, resulting in higher MDLs.

<sup>3</sup>Summary statistics are calculated out of 10 total samples since two samples were flagged as rejected.

**Table D.6.** Phase 2 summary statistics for concentrations of detected PFAS via TOP method in municipal POTW biosolids samples. All values are in ng/g.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 8)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	3.33	18.4	100%	41	606	133	185
PFPeA	1.72	9.2	100%	31	340	105	128
PFHxA	0.834	29.2	100%	39	291	71	100
PFHpA	0.834	4.6	100%	11	165	29	47
PFOA	0.834	4.6	100%	15	288	14	25
PFNA	0.834	4.6	100%	6	101	14	25
PFDA	0.834	4.6	100%	11	97	15	26
PFUnA	0.834	4.6	100%	4	45	8	12
PFDODA	0.667	3.68	100%	5	49	10	14
PFTTrDA	0.834	4.6	100%	1	17	4	5
PFTeDA	0.834	4.6	100%	2	23	4	6
PFBS	0.834	4.6	88%	ND	116	8	20
PFHxS	0.834	4.6	75%	ND	6	1	2
PFOS	0.834	4.6	100%	7	60	16	19
PFDS	0.834	4.6	38%	ND	1	ND	0.4
6:2 FTS	3.01	16.6	13%	ND	6	ND	1
5:3 FTCA	20.8	115	13%	ND	65	ND	8
PFOSA	0.834	4.6	25%	ND	1	ND	0.3
N-EtFOSAA	2.33	12.9	13%	ND	3	ND	0.3

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Sum of PFAS	-	-	-	250	2,142	441	659
Sum of F <sup>-</sup>	-	-	-	162	1400	288	407

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

**Table D.7.** Phase 2 summary statistics for concentrations of detected PFAS via target method in residential sewershed samples. All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 17)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	1.71	7.86	18%	ND	8	ND	1.4
PFPeA	0.857	3.93	18%	ND	19	ND	2
PFHxA	0.428	1.97	71%	ND	27	2	5
PFHpA	0.428	1.97	18%	ND	4	2	2
PFOA	0.428	1.97	65%	ND	7	2	2
PFDA	0.428	1.97	6%	ND	3	ND	0.2
PFBS	0.428	1.97	24%	ND	7	ND	1
PFHxS	0.428	1.97	6%	ND	2	ND	0.1
PFOS	0.428	1.97	12%	ND	15	ND	1
Sum of PFAS	-	-	-	ND	80	9	13
Sum of F <sup>-</sup>	-	-	-	ND	52	6	10

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

**Table D.8.** Phase 2 summary statistics for concentrations of detected PFAS via TOP method in residential sewershed samples. All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 17)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	11.3	15.6	88%	ND	485	37	89
PFPeA	5.67	7.79	94%	ND	294	36	68
PFHxA	2.84	3.9	100%	4	198	29	47
PFHpA	2.84	3.9	94%	ND	94	15	24
PFOA	2.89	4.63	88%	ND	72	13	19
PFNA	2.84	3.9	82%	ND	54	6	10
PFDA	2.84	3.9	59%	ND	34	4	6
PFUnA	2.84	3.9	18%	ND	26	ND	2

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PFDODA	2.27	3.12	24%	ND	15	ND	2
PFTTrDA	2.84	3.9	6%	ND	9	ND	1
PFTeDA	2.84	3.9	6%	ND	8	ND	1
PFBS	2.84	3.9	18%	ND	10	ND	1
Sum of PFAS	-	-	-	4	850	187	271
Sum of F <sup>-</sup>	-	-	-	3	555	128	186

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero.

**Table D.9.** Phase 2 summary statistics for concentrations of detected PFAS via target method in industrial laundry sewershed samples. All values are in ng/L.

Detected Analytes	MDLs (Range)		% Detected in Samples (n = 7)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	5.88	8.13	43%	ND	191	ND	37
PFPeA	2.94	4.07	43%	ND	154	ND	26
PFHxA	2.08	2.75	43%	ND	131	ND	25
PFHpA	1.47	2.03	43%	ND	66	ND	12
PFOA	1.47	2.03	86%	ND	43	3	11
PFNA	1.47	2.03	57%	ND	27	2	7
PFDA	1.47	2.03	43%	ND	12	ND	3
PFDODA	1.18	1.63	29%	ND	4	ND	1
PFTTrDA	1.47	2.03	14%	ND	4	ND	1
PFTeDA	1.47	2.03	14%	ND	4	ND	1
PFBS	1.47	2.03	57%	ND	7	3	3
PFOS	1.47	2.03	43%	ND	17	ND	4
6:2 FTS	5.3	7.33	57%	ND	115	32	44
EtFOSAA	1.47	2.03	14%	ND	3	ND	1
HFPO-DA	5.88	8.13	29%	ND	24	ND	5
Sum of PFAS	-	-	-	8	761	48	174
Sum of F <sup>-</sup>	-	-	-	13	476	38	102

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero

**Table D.10.** Phase 2 summary statistics for concentrations of detected PFAS via TOP method in municipal POTW industrial laundry sewershed samples. All values are in ng/g.

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Detected Analytes	MDLs (Range)		% Detected in Samples (n = 7)	Minimum	Max	Median	Mean <sup>1</sup>
PFBA	11.2	23.2	100%	22	41,100	278	6,153
PFPeA	5.62	116	100%	15	52,300	350	7,850
PFHxA	2.81	5.81	100%	13	6,450	159	1,135
PFHpA	2.81	5.81	100%	3	386	37	114
PFOA	2.81	5.81	100%	4	131	25	39
PFNA	2.81	5.81	86%	ND	73	13	22
PFDA	2.81	5.81	71%	ND	52	6	15
PFUnA	2.81	5.81	43%	ND	20	ND	5
PFDODA	2.25	4.65	43%	ND	22	ND	5
PFTTrDA	2.81	5.81	14%	ND	8	ND	1
PFTeDA	2.81	5.81	29%	ND	10	ND	2
PFBS	2.81	5.81	57%	ND	17	5	5
PFOS	2.81	5.81	43%	ND	17	ND	4
6:2 FTS	10.1	20.9	43%	ND	48	ND	16
Sum of PFAS	-	-	-	58	100,369	892	15,364
Sum of F <sup>-</sup>	-	-	-	38	64,051	561	8,651

<sup>1</sup>Calculated with all detected values and setting non-detects (NDs) as zero

## **11. Appendix E: Phase 1 Data Tables**

[Excel File. Available Upon Request.]

## **12. Appendix F: Phase 2 Target Data Tables**

F.1. Influent sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method)										
SampleID	CCCS-INF-0063	CSM-INF-0066	DSRSD-INF-0067	EBMUD-INF-0068	EBMUD-INF-0069	SFPUCOS-INF-0071	SFPUCSE-INF-0070	SJSC-INF-0072	CCCS-DBINF-0064	CCCS-EBINF-0065
StationCode	CCCS	CSM	DSRSD	EBMUD	EBMUD	SFPUCOS	SFPUCSE	SJSC	CCCS	CCCS
SampleDate	2022-04-16	2022-04-25	2022-05-13	2022-05-17	2022-05-17	2022-05-23	2022-05-20	2022-06-22	2022-04-16	2022-04-16
MatrixName	influent	influent	influent	influent	influent	influent	influent	influent	blankwater	blankwater
SampleTypeCode	Composite	Composite	Composite	Composite	Composite	Composite	Composite	Composite	FieldBlank	EquipBlank
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	30.02	36.92	30.83	25.24	41.68	8.72	16.65	52.25	0.00	11.08
Sum of PFAS	46.93	56.59	48.03	39.03	67	13.21	25.61	81.85	0	19.2
Perfluorobutanoate	6.69 (J)	7.08 (J)	<7.05	7.33 (J)	7.59 (J)	<5.64	<6.02	11.5 (J)	<6.08	<6.24
Perfluoropentanoate	6.33 (J)	8.81 (J)	4.33 (J)	4.72 (J)	4.01 (J)	3 (J)	5.45 (J)	8.21 (J)	<3.04	<3.12
Perfluorohexanoate	8.25	10.3	6.26 (J)	5.95 (J)	8.09	6.01	8.44	17.4	<1.52	<1.56
Perfluoroheptanoate	2.01 (J)	3.15 (J)	<1.76	<1.74	<1.8	<1.41	1.56 (J)	2.69 (J)	<1.52	<1.56
Perfluorooctanoate	4.42 (J)	6.62	3.54 (J)	4.45 (J)	4.88 (J)	2.58 (J)	4.35 (J)	5.81 (J)	<1.52	<1.56
Perfluorononanoate	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Perfluorodecanoate	<1.62	1.59 (J)	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Perfluoroundecanoate	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Perfluorododecanoate	<1.3	<1.23	<1.41	<1.39	<1.44	<1.13	<1.2	<1.22	<1.22	<1.25
Perfluorotridecanoate	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Perfluorotetradecanoate	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Perfluorobutanesulfonate	5.31 (J)	<1.54	<1.76	<3.18	<1.8	<1.41	2.74 (J)	10.5	<1.52	<1.56
Perfluoropentanesulfonate	<1.63	<1.54	2.3 (J)	<1.75	<1.8	<1.42	<1.51	<1.53	<1.53	<1.57
Perfluoroheptanesulfonate	5.2 (J)	5.24 (J)	12.6	3.58 (J)	3.53 (J)	1.62 (J)	3.07 (J)	3.28 (J)	<1.52	<1.56
Perfluoroheptanesulfonate	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Perfluorooctanesulfonate	8.72	13.8	19	13	13.6	<1.41	<1.51	20.9	<1.52	<1.56
Perfluorononanesulfonate	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Perfluorodecanesulfonate	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Perfluorododecanesulfonate	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Fluorotelomer Sulfonate, 4:2-	<6.48	<6.15	<7.05	<6.97	<7.18	<5.64	<6.02	<6.1	<6.08	<6.24
Fluorotelomer Sulfonate, 6:2-	<5.84	<5.54	<6.35	<6.28	<6.47	<5.08	<5.43	<5.5	<5.48	19.2 (IP)
Fluorotelomer Sulfonate, 8:2-	<5.51	<5.23	<5.99	<5.92	<6.1	<4.8	<5.12	<5.19	<5.17	<5.31
Fluorotelomer Carboxylic Acid, 3:3-	<6.48	<6.15	<7.05	<6.97	<7.18	<5.64	<6.02	<6.1	<6.08	<6.24
Fluorotelomer Carboxylic Acid, 5:3-	<40.5	<38.4	<44	<43.6	<44.9	<35.3	<37.6	<38.1	<38	<39
Fluorotelomer Carboxylic Acid, 7:3-	<40.5	<38.4	<44	<43.6	<44.9	<35.3	<37.6	<38.1	<38	<39
Perfluorooctanesulfonamide	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Methyl-perfluorooctanesulfonamide, N-	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Ethyl-perfluorooctanesulfonamide, N-	<4.54	<4.3	<4.93	<4.88	<5.03	<3.95	<4.21	<4.27	<4.26	<4.37
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	1.56 (J)	<1.52	<1.56
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Methyl-perfluorooctanesulfonamidoethanol, N-	<16.2	<15.4	<17.6	<17.4	25.3 (J)	<14.1	<15.1	<15.3	<15.2	<15.6
Ethyl-perfluorooctanesulfonamidoethanol, N-	<16.2	<15.4	<17.6	<17.4	<18	<14.1	<15.1	<15.3	<15.2	<15.6
Perfluoro-2-Propoxypropanoic Acid	<6.48	<6.15	<7.05	<6.97	<7.18	<5.64	<6.02	<6.1	<6.08	<6.24
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<6.48	<6.15	<7.05	<6.97	<7.18	<5.64	<6.02	<6.1	<6.08	<6.24
Perfluoro-3,6-dioxaheptanoate	<3.24	<3.07	<3.52	<3.48	<3.59	<2.82	<3.01	<3.05	<3.04	<3.12
Perfluoro-4-methoxybutanoate	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56
Perfluoro-3-methoxypropanoate	<3.24	<3.07	<3.52	<3.48	<3.59	<2.82	<3.01	<3.05	<3.04	<3.12
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<6.5	<6.16	<7.06	<6.99	<7.2	<5.66	<6.04	<6.12	<6.1	<6.26
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<6.49	<6.16	<7.05	<6.98	<7.19	<5.65	<6.03	<6.11	<6.09	<6.25
Perfluoro(2-ethoxyethane)sulfonic acid	<1.62	<1.54	<1.76	<1.74	<1.8	<1.41	<1.51	<1.53	<1.52	<1.56

F.2. Effluent sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method)							
SampleID	CCCS-D-EFF-0106	CSM-EFF-0074	DSRSD-EFF-0075	EBMUD-EFF-0076	SFPUCOS-EFF-0079	SFPUCSE-EFF-0078	SJSC-EFF-0080
StationCode	CCCS-D	CSM	DSRSD	EBMUD	SFPUCOS	SFPUCSE	SJSC
SampleDate	2022-04-16	2022-04-25	2022-05-13	2022-05-17	2022-05-23	2022-05-20	2022-06-22
MatrixName	effluent	effluent	effluent	effluent	effluent	effluent	effluent
SampleTypeCode	Composite	Composite	Composite	Composite	Composite	Composite	Composite
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	32.6	71.9	36.1	23.8	18.1	28.1	39.0
Sum of PFAS	50.88	111.76	57.14	36.17	27.26	42.81	60.28
Perfluorobutanoate	8.21 (LRU)	8.6	7.18	5.78 (J)	3.19 (J)	4.81 (J)	10.3 (J)
Perfluoropentanoate	7.48	10.6	4.96	4.56	3.45	8.41	8.9 (J)
Perfluorohexanoate	10.3	28.7	<0.414 (DF)	15.2	11.2	13.3	19
Perfluoroheptanoate	2.14	3.96	1.92	1.99	1.33 (J)	2.09	2.42 (J)
Perfluorooctanoate	5.16	12.1	5.25	5.51	5.07	4.89	7.47
Perfluorononanoate	0.829 (J)	1.63	0.728 (J)	0.896 (J)	0.49 (J)	0.748 (J)	<1.5
Perfluorodecanoate	0.84 (J)	2.82	0.822 (J)	<0.49 (J,DF)	1.13 (J)	1.03 (J)	<1.5 (J)
Perfluoroundecanoate	<0.386	<0.39	<0.414	<0.49	<0.366	<0.382	<1.5
Perfluorododecanoate	<0.309	<0.312	<0.331	<0.392	<0.293	<0.305	<1.2
Perfluorotridecanoate	<0.406	<0.39	<0.414	<0.49	<0.366	<0.382	<1.5
Perfluorotetradecanoate	<0.386	<0.39	<0.414	<0.49	<0.366	<0.382	<1.5
Perfluorobutanesulfonate	3.42	5.31	4.73	<10.8 (DF)	<0.366 (J)	<0.382	5.66 (J)
Perfluoropentanesulfonate	0.79 (J)	<0.392	2.99	<1.1	<0.368	<0.384	<1.51
Perfluorohexanesulfonate	4.62	3.8	14.3	2.23	0.414 (J)	2.2	2.16 (J)
Perfluoroheptanesulfonate	<0.386	<0.39	0.419 (J)	<0.49	<0.366	<0.382	<1.5
Perfluorooctanesulfonate	4.69	9.82	13	<0.49	0.988 (J)	4.14	4.37 (J)
Perfluorononanesulfonate	<0.386	<0.39	<0.414	<0.49	<0.366	<0.382	<1.5
Perfluorodecanesulfonate	<0.386	<0.39	<0.414	<0.49	<0.366	0.695 (J)	<1.5
Perfluorododecanesulfonate	<0.386	<0.39	<0.414	<0.49	<0.366	<0.382	<1.5
Fluorotelomer Sulfonate, 4:2-	<1.55	<1.56	<1.66	<1.96	<1.47	<1.53	<6.02
Fluorotelomer Sulfonate, 6:2-	1.53 (IP,J)	2.3 (IP,J)	<1.49	<1.77	<1.32	<1.38	<5.42
Fluorotelomer Sulfonate, 8:2-	<1.31	<1.33	<1.41	<1.67	<1.25	<1.3	<5.11
Fluorotelomer Carboxylic Acid, 3:3-	<1.55	<1.56	<1.66	<1.96	<1.47	<1.53	<6.02
Fluorotelomer Carboxylic Acid, 5:3-	<9.66	20.6	<10.4	<12.2	<9.16	<9.54	<37.6
Fluorotelomer Carboxylic Acid, 7:3-	<9.66	<9.75	<10.4	<12.2	<9.16	<9.54	<37.6
Perfluorooctanesulfonamide	<0.386	<0.39	<0.414	<0.49	<0.366	<0.382	<1.5
Methyl-perfluorooctanesulfonamide, N-	<0.386	<0.39	<0.414	<0.49	<0.366	<0.382	<1.5
Ethyl-perfluorooctanesulfonamide, N-	<1.08	<1.09	<1.16	<1.37	<1.03	<1.07	<4.21
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	0.874 (J)	1.05 (J)	0.844 (J)	<0.49	<0.366 (J)	0.497 (J)	<1.5
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<0.386 (J)	0.466 (J)	<0.414	<0.49	<0.366	<0.382	<1.5
Methyl-perfluorooctanesulfonamidoethanol, N-	<3.86	<3.9	<4.14	<4.9	<3.66	<3.82	<15
Ethyl-perfluorooctanesulfonamidoethanol, N-	<3.86	<3.9	<4.14	<4.9	<3.66	<3.82	<15
Perfluoro-2-Propoxypropanoic Acid	<1.55	<1.56	<1.66	<1.96	<1.47	<1.53	<6.02
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<1.55	<1.56	<1.66	<1.96	<1.47	<1.53	<6.02
Perfluoro-3,6-dioxaheptanoate	<0.773	<0.78	<0.829	<0.98	<0.733	<0.764	<3.01
Perfluoro-4-methoxybutanoate	<0.386	<0.39	<0.414	<0.49	<0.366	<0.382	<1.5
Perfluoro-3-methoxypropanoate	<0.773	<0.78	<0.829	<0.98	<0.733	<0.764	<3.01
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<1.55	<1.56	<1.66	<1.96	<1.47	<1.53	<6.03
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<1.55	<1.56	<1.66	<1.96	<1.47	<1.53	<6.02
Perfluoro(2-ethoxyethane)sulfonic acid	<0.386	<0.39	<0.414	<0.49	<0.366	<0.382	<1.5

**F.3. Biosolids sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 1/2**

SampleID	CSM-BIO-0083	DSRSD-BIO-0084	EBMUD-BIO-0089	EBMUD-BIO-0090	EBMUD-BIO-0091	SFPUCOS-BIO-0094	SFPUCOS-BIO-0095
StationCode	CSM	DSRSD	EBMUD	EBMUD	EBMUD	SFPUCOS	SFPUCOS
SampleDate	2022-04-26	2022-03-23	2022-06-03	2022-06-03	2022-07-05	2022-05-23	2022-05-25
MatrixName	biosolids	biosolids	biosolids	biosolids	biosolids	biosolids	biosolids
SampleTypeCode	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Unit	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw
Sum of Fluorine	90.1	150.3	146.3	92.0	77.9	94.2	121.3
Sum of PFAS	147.36	245.7	242.7	139.8	127.6	155.4	201.6
Perfluorobutanoate	<1.19	1.38 (J)	<1.28	<1.09	<1.22	<1.17	<1.07
Perfluoropentanoate	<0.595	1.43 (J)	<0.642	<0.544	<0.612	<0.584	<0.533
Perfluoroheptanoate	1.83	5.19	0.69 (J)	0.991 (J)	0.744 (J)	0.746 (J)	0.559 (J)
Perfluoroheptanoate	<0.297	0.788 (J)	<0.321	<0.272	<0.306	<0.292	<0.267
Perfluorooctanoate	1.66	12.9	0.97 (J)	0.781 (J)	0.524 (J)	0.63 (J)	0.806 (J)
Perfluorononanoate	<0.297 (DF)	5.8	0.649 (J)	<0.272 (J,DF)	<0.306 (J,DF)	0.652 (J)	0.662 (J)
Perfluorodecanoate	4.03	14.7	3.35	1.76	1.61	1.65	3.54
Perfluoroundecanoate	1.34	4.4	2.2	0.741 (J)	<0.306 (J,DF)	0.701 (J)	2.08
Perfluorododecanoate	2.19	4	4.16	0.874 (J)	0.868 (J)	1	4.54
Perfluorotridecanoate	<0.297 (DF)	1.89	1.81	0.595 (J)	0.625 (J)	0.75 (J)	1.57
Perfluorotetradecanoate	<0.479 (DF)	1.53	1.63	0.501 (J)	<0.306 (J)	<0.456	1.38
Perfluorobutanesulfonate	<0.297	<0.328	<0.321	<0.595	<0.324	<0.292	<0.267
Perfluoropentanesulfonate	<0.299 (J,DF)	<0.33	<0.323	<0.273	<0.364	<0.293	<0.268
Perfluoroheptanesulfonate	<0.297	<0.328 (DF)	<0.321 (J,DF)	<0.272	<0.306	<0.292	<0.267
Perfluoroheptanesulfonate	<0.351	<0.328	<0.321	<0.272	<0.306	<0.292	<0.267
Perfluorooctanesulfonate	14.1	32.3	2.66	14.5	10.3	15	<0.267 (DF)
Perfluorononanesulfonate	<0.297	<0.328	<0.321	<0.272	<0.306	<0.292	<0.267
Perfluorodecanesulfonate	<0.297	<0.328	<0.321	<0.272	<0.306	<0.292	<0.267
Perfluorododecanesulfonate	<0.297	<0.328	<0.321	<0.272	<0.306	<0.292	<0.267
Fluorotelomer Sulfonate, 4:2-	<1.19	<1.31	<1.28	<1.09	<1.22	<1.17	<1.07
Fluorotelomer Sulfonate, 6:2-	<1.07	<1.18	<1.16	<0.98	<1.1	<1.05	<0.961
Fluorotelomer Sulfonate, 8:2-	<1.01	1.61 (J)	<1.09	<0.924	<1.04	<0.993	0.972 (J)
Fluorotelomer Carboxylic Acid, 3:3-	<1.19	<1.31	<1.28	<1.09	<1.22	<1.17	<1.07
Fluorotelomer Carboxylic Acid, 5:3-	88	45	145	96.3	90.2	92.6	109
Fluorotelomer Carboxylic Acid, 7:3-	<7.44	27.8 (J)	30.6 (J)	9.19 (J)	8.16 (J)	9.79 (J)	28.7
Perfluorooctanesulfonamide	0.61 (J)	1.39	1.47	0.435 (J)	0.408 (J)	0.414 (J)	1.39
Methyl-perfluorooctanesulfonamide, N-	<0.297 (LRJ)	<0.328	<0.321	<0.272	<0.306	<0.292	<0.267
Ethyl-perfluorooctanesulfonamide, N-	<0.833	<0.919	<0.899	<0.761	<0.857	<0.817 (LRJ)	<0.746
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	10.5	40.8	7.62	4.02	<0.3069 (DF)	4.52	6.91
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	4.29	24.3	7.46	3.66	<0.306 (DF)	4.44	6.89
Methyl-perfluorooctanesulfonamidoethanol, N-	13.2	10.9 (J)	20.9	11.4 (LRJ)	14.2	17.5	25
Ethyl-perfluorooctanesulfonamidoethanol, N-	5.61 (J)	7.59 (J)	11.5 (J)	5.44 (J)	<3.06	4.96 (J)	7.65 (J)
Perfluoro-2-Propoxypropanoic Acid	<1.19	<1.31	<1.28	<1.09	<1.22	<1.17	<1.07
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<1.19	<1.31	<1.28	<1.09	<1.22	<1.17	<1.07
Perfluoro-3,6-dioxaheptanoate	<0.595	<0.656	<0.642	<0.544	<0.647	<0.584	<0.533
Perfluoro-4-methoxybutanoate	<0.297	<0.328	<0.321	<0.272	<0.306	<0.292	<0.267
Perfluoro-3-methoxypropanoate	<0.595	<0.656	<0.642	<0.544	<0.612	<0.584	<0.533
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<1.19	<1.32	<1.29	<1.09	<1.23	<1.17	<1.07
Chloroicosadecafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<1.19	<1.31	<1.29	<1.09	<1.23	<1.17	<1.07
Perfluoro(2-ethoxyethane)sulfonic acid	<0.297	<0.328	<0.321	<0.272	<0.306	<0.292	<0.267
TOTAL SOLIDS	21.7	11.3	22.8	22.8	25.3	20	22.1

F.3. Biosolids sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 2/2				
SampleID	SFPUCSE-BIO-0092	SFPUCSE-BIO-0093	DSRSD-EBBIO-0087	DSRSD-FBBIO-0085
StationCode	SFPUCSE	SFPUCSE	DSRSD	DSRSD
SampleDate	2022-05-23	2022-05-25	2022-03-23	2022-03-23
MatrixName	biosolids	biosolids	blankwater	blankwater
SampleTypeCode	Grab	Grab	EquipBlank	FieldBlank
Unit	ng/g dw	ng/g dw	ng/L	ng/L
Sum of Fluorine	144.8	131.2	0.0	0.0
Sum of PFAS	238.0	214.5	0	0
Perfluorobutanoate	<1.19	<1.47	<4.57	<6.77
Perfluoropentanoate	<0.593	<0.736	<2.29	<3.39
Perfluorohexanoate	1.44	1.33 (J)	<1.14	<1.69
Perfluoroheptanoate	<0.297	<0.368	<1.14	<1.69
Perfluorooctanoate	0.799 (J)	0.823 (J)	<1.14	<1.69
Perfluorononanoate	1.17 (J)	1.08 (J)	<1.14	<1.69
Perfluorodecanoate	3.91	3.6	<1.14	<1.69
Perfluoroundecanoate	2.36	2.05	<1.14	<1.69
Perfluorododecanoate	5.41	4.93	<0.914	<1.35
Perfluorotridecanoate	1.43	1.53	<1.14	<1.69
Perfluorotetradecanoate	2.02	2.21	<1.14	<1.69
Perfluorobutanesulfonate	<0.297	<0.368	<1.14	<1.69
Perfluoropentanesulfonate	<0.298	<0.37	<1.15	<1.7
Perfluorohexanesulfonate	<0.297	<0.368	<1.14	<1.69
Perfluoroheptanesulfonate	<0.372	<0.368	<1.14	<1.69
Perfluorooctanesulfonate	8.6	8.19	<1.14	<1.69
Perfluorononanesulfonate	<0.297	<0.368	<1.14	<1.69
Perfluorodecanesulfonate	<0.297	<0.368	<1.14	<1.69
Perfluorododecanesulfonate	<0.297	<0.368	<1.14	<1.69
Fluorotelomer Sulfonate, 4:2-	<1.19	<1.47	<4.57	<6.77
Fluorotelomer Sulfonate, 6:2-	<1.07	<1.33	<4.12	<6.1
Fluorotelomer Sulfonate, 8:2-	<1.01	<1.25	<3.89	<5.76
Fluorotelomer Carboxylic Acid, 3:3-	<1.19	<1.47	<4.57	<6.77
Fluorotelomer Carboxylic Acid, 5:3-	154	149	<28.6	<42.3
Fluorotelomer Carboxylic Acid, 7:3-	24.8 (J)	19.9 (J)	<28.6	<42.3
Perfluorooctanesulfonamide	1.2	1.18 (J)	<1.14	<1.69
Methyl-perfluorooctanesulfonamide, N-	<0.328	<0.368	<1.14	<1.69
Ethyl-perfluorooctanesulfonamide, N-	<0.83 (LRJ)	<1.03	<3.2	<4.74
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	6.97	6.54	<1.14	<1.69
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	6.72	4.09	<1.14	<1.69
Methyl-perfluorooctanesulfonamidoethanol, N-	12.4	8.09 (J)	<11.4	<16.9
Ethyl-perfluorooctanesulfonamidoethanol, N-	4.73 (J)	<3.68	<11.4	<16.9
Perfluoro-2-Propoxypropanoic Acid	<1.19	<1.47	<4.57	<6.77
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<1.19	<1.47	<4.57	<6.77
Perfluoro-3,6-dioxaheptanoate	<0.593	<0.736	<2.29	<3.39
Perfluoro-4-methoxybutanoate	<0.297	<0.368	<1.14	<1.69
Perfluoro-3-methoxypropanoate	<0.593	<0.736	<2.29	<3.39
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<1.19	<1.48	<4.58	<6.79
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<1.19	<1.47	<4.58	<6.78
Perfluoro(2-ethoxyethane)sulfonic acid	<0.297	<0.368	<1.14	<1.69
TOTAL SOLIDS	22.3	21		

F.4. Residential sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 1/4							
SampleID	CCCCSD-RS-0037	CCCCSD-RS-0038	CCCCSD-RS-0039	CCCCSD-RS-0040	CCCCSD-FBS-0041	EBMUD-RS-0042	EBMUD-RS-0043
StationCode	CCCCSD	CCCCSD	CCCCSD	CCCCSD	CCCCSD	EBMUD	EBMUD
SampleDate	2022-04-21	2022-04-21	2022-04-11	2022-04-20	2022-04-21	2022-06-07	2022-06-08
MatrixName	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed
SampleTypeCode	Composite	Composite	Composite	Composite	FieldBlank	Composite	Composite
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	52.4	49.8	17.5	0.0	0.9	6.2	5.9
Sum of PFAS	80	75.9	29.09	0	1.64	9.16	8.9
Perfluorobutanoate	8.41 (J)	8.89 (J)	<7.74	<7.18	<1.71	<7.41	<7.55
Perfluoropentanoate	18.7	19.3	6.81 (J)	<3.59	<0.857	<3.7	<3.78
Perfluorohexanoate	26.7	19.3	7.95	<1.8	<0.428	5.73 (J)	2.34 (J)
Perfluoroheptanoate	4.32 (J)	4.14 (J)	2.7 (J)	<1.8	<0.428	<1.85	<1.89
Perfluorooctanoate	7.33 (J)	7.52	5.87 (J)	<1.8	<0.428	3.43 (J)	1.97 (J)
Perfluorononanoate	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Perfluorodecanoate	<1.97	1.95 (J)	2.76 (J)	<1.8	<0.428	<1.85	<1.89
Perfluoroundecanoate	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Perfluorododecanoate	<1.57	<1.33	<1.55	<1.44	<0.343	<1.48	<1.51
Perfluorotridecanoate	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Perfluorotetradecanoate	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Perfluorobutanesulfonate	<1.97 (J)	<1.66 (DF)	<1.94 (J,DF)	<1.8 (J,DF)	<0.428	<1.85	<1.89 (J,DF)
Perfluoropentanesulfonate	<1.98	<1.67	<1.95	<1.8	<0.431	<1.86	<1.9
Perfluorohexanesulfonate	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Perfluoroheptanesulfonate	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Perfluorooctanesulfonate	14.5	14.8	<1.94 (J,DF)	<1.8 (J,DF)	<0.428	<1.85 (J,DF)	4.59 (J)
Perfluorononanesulfonate	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Perfluorodecanesulfonate	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Perfluorododecanesulfonate	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Fluorotelomer Sulfonate, 4:2-	<7.86	<6.64	<7.74	<7.18	<1.71	<7.41	<7.55
Fluorotelomer Sulfonate, 6:2-	<7.09	<5.98	<6.98	<6.47	1.64 (IP,J)	<6.67	<6.81
Fluorotelomer Sulfonate, 8:2-	<6.68	<5.64	<6.58	<6.1	<1.46	<6.3	<6.42
Fluorotelomer Carboxylic Acid, 3:3-	<7.86	<6.64	<7.74	<7.18	<1.71	<7.41	<7.55
Fluorotelomer Carboxylic Acid, 5:3-	<49.1	<41.5	<48.4	<44.9	<10.7	<46.3	<47.2
Fluorotelomer Carboxylic Acid, 7:3-	<49.1	<41.5	<48.4	<44.9	<10.7	<46.3	<47.2
Perfluorooctanesulfonamide	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Methyl-perfluorooctanesulfonamide, N-	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Ethyl-perfluorooctanesulfonamide, N-	<5.5	<4.65	<5.42	<5.03	<1.2	<5.18	<5.29
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Methyl-perfluorooctanesulfonamidoethanol, N-	<19.7	<16.6	<19.4	<18	<4.28	<18.5	<18.9
Ethyl-perfluorooctanesulfonamidoethanol, N-	<19.7	<16.6	<19.4	<18	<4.28	<18.5	<18.9
Perfluoro-2-Propoxypropanoic Acid	<7.86	<6.64	<7.74	<7.18	<1.71	<7.41	<7.55
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<7.86	<6.64	<7.74	<7.18	<1.71	<7.41	<7.55
Perfluoro-3,6-dioxaheptanoate	<3.93	<3.32	<3.87	<3.59	<0.857	<3.7	<3.78
Perfluoro-4-methoxybutanoate	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89
Perfluoro-3-methoxypropanoate	<3.93	<3.32	<3.87	<3.59	<0.857	<3.7	<3.78
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<7.88	<6.65	<7.76	<7.2	<1.72	<7.42	<7.57
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<7.87	<6.64	<7.75	<7.19	<1.72	<7.42	<7.56
Perfluoro(2-ethoxyethane)sulfonic acid	<1.97	<1.66	<1.94	<1.8	<0.428	<1.85	<1.89

F.4. Residential sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 2/4							
SampleID	SFPUC-RS-0044	SFPUC-RS-0045	SFPUC-RS-0046	SFPUC-RS-0047	SFPUC-RS-0048	SFPUC-RS-0049	SFPUC-RS-0050
StationCode	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC
SampleDate	2022-06-08	2022-06-08	2022-06-10	2022-06-13	2022-07-08	2022-05-13	2022-05-13
MatrixName	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed
SampleTypeCode	Composite	Composite	Composite	Composite	Grab	Grab	Composite
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	6.3	1.9	9.9	3.3	0.0	3.4	7.3
Sum of PFAS	10.51	3.33	16.39	5.23	0	5.02	10.94
Perfluorobutanoate	6.37 (J)	<5.45	8.42 (J)	<5.99	<5.93	<5.77	<5.89
Perfluoropentanoate	<2.88	<2.73	<2.81	<2.99	<2.97	<2.88	<2.95
Perfluorohexanoate	<1.44	<1.36	1.47 (J)	<1.5	<1.48	3.02 (J)	8.07
Perfluoroheptanoate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Perfluorooctanoate	<1.44	<1.36	<1.41	2.58 (J)	<1.48	2 (J)	2.87 (J)
Perfluorononanoate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Perfluorodecanoate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Perfluoroundecanoate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Perfluorododecanoate	<1.15	<1.09	<1.13	<1.2	<1.19	<1.15	<1.18
Perfluorotridecanoate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Perfluorotetradecanoate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<2.77
Perfluorobutanesulfonate	4.14 (J)	3.33 (J)	6.5	2.65 (J)	<1.48	<1.44	<1.47
Perfluoropentanesulfonate	<1.45	<1.37	<1.41	<1.5	<1.49	<1.45	<1.48
Perfluorohexanesulfonate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Perfluoroheptanesulfonate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Perfluorooctanesulfonate	<1.44 (J,DF)	<1.36 (J,DF)	<1.41 (J,DF)	<1.5	<1.48 (J,DF)	<1.44 (DF)	<1.47 (DF)
Perfluorononanesulfonate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Perfluorodecanesulfonate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Perfluorododecanesulfonate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Fluorotelomer Sulfonate, 4:2-	<5.76	<5.45	<5.63	<5.99	<5.93	<5.77	<5.89
Fluorotelomer Sulfonate, 6:2-	<5.19	<4.92	<5.07	<5.4	<5.35	<5.2	<5.31
Fluorotelomer Sulfonate, 8:2-	<4.9	<4.64	<4.78	<5.09	<5.04	<4.9	<5.01
Fluorotelomer Carboxylic Acid, 3:3-	<5.76	<5.45	<5.63	<5.99	<5.93	<5.77	<5.89
Fluorotelomer Carboxylic Acid, 5:3-	<36	<34.1	<35.2	<37.4	<37.1	<36	<36.8
Fluorotelomer Carboxylic Acid, 7:3-	<36	<34.1	<35.2	<37.4	<37.1	<36	<36.8
Perfluorooctanesulfonamide	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Methyl-perfluorooctanesulfonamide, N-	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Ethyl-perfluorooctanesulfonamide, N-	<4.03	<3.82	<3.94	<4.19	<4.15	<4.04	<4.12
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Methyl-perfluorooctanesulfonamidoethanol, N-	<14.4	<13.6	<14.1	<15	<14.8	<14.4	<14.7
Ethyl-perfluorooctanesulfonamidoethanol, N-	<14.4	<13.6	<14.1	<15	<14.8	<14.4	<14.7
Perfluoro-2-Propoxypropanoic Acid	<5.76	<5.45	<5.63	<5.99	<5.93	<5.77	<5.89
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<5.76	<5.45	<5.63	<5.99	<5.93	<5.77	<5.89
Perfluoro-3,6-dioxaheptanoate	<2.88	<2.73	<2.81	<2.99	<2.97	<2.88	<2.95
Perfluoro-4-methoxybutanoate	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47
Perfluoro-3-methoxypropanoate	<2.88	<2.73	<2.81	<2.99	<2.97	<2.88	<2.95
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<5.77	<5.47	<5.64	<6	<5.95	<5.78	<5.91
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<5.77	<5.46	<5.63	<5.99	<5.94	<5.77	<5.9
Perfluoro(2-ethoxyethane)sulfonic acid	<1.44	<1.36	<1.41	<1.5	<1.48	<1.44	<1.47

F.4. Residential sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 3/4							
SampleID	SFPUC-RS-0051	SFPUC-RS-0052	SFPUC-RS-0053	SFPUC-RS-0054	SFPUC-RS-0055	SFPUC-RS-0056	SFPUC-FBS-0057
StationCode	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC
SampleDate	2022-05-16	2022-05-13	2022-06-17	2022-06-27	2022-06-17	2022-07-14	2022-05-13
MatrixName	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Sewershed Field Blank
SampleTypeCode	Composite	Grab	Grab	Grab	Grab	Composite	FieldBlank
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	1.3	1.1	3.6	1.6	8.1	13.0	0.0
Sum of PFAS	1.85	1.64	5.28	2.33	11.99	20.16	0
Perfluorobutanoate	<5.75	<5.76	<5.97	<5.77	<5.93	<6	<6.38
Perfluoropentanoate	<2.88	<2.88	<2.99	<2.89	<2.96	5.26 (I)	<3.19
Perfluorohexanoate	<1.44 (J,DF)	1.64 (I)	3.07 (I)	2.33 (I)	7.24	6.73	<1.59
Perfluoroheptanoate	<1.44	<1.44	<1.49	<1.44	2.33 (I)	<1.5	<1.59
Perfluorooctanoate	1.85 (I)	<1.44	2.21 (I)	<1.44	2.42 (I)	3.2 (I)	<1.59
Perfluorononanoate	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Perfluorodecanoate	<1.44	<1.44	<1.49 (I,DF)	<1.44	<1.48	<1.5	<1.59
Perfluoroundecanoate	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Perfluorododecanoate	<1.15	<1.15	<1.19 (I,DF)	<1.15	<1.19	<1.2	<1.28
Perfluorotridecanoate	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Perfluorotetradecanoate	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Perfluorobutanesulfonate	<1.44 (I,DF)	<1.44	<1.49	<1.44	<1.48	3.08 (I)	<1.59
Perfluoropentanesulfonate	<1.45	<1.45	<1.5	<1.45	<1.49	<1.51	<1.6
Perfluorohexanesulfonate	<1.44	<1.44	<1.49	<1.44	<1.48	1.89 (I)	<1.59
Perfluoroheptanesulfonate	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Perfluorooctanesulfonate	<1.44 (DF)	<1.44 (DF)	<1.49 (DF)	<1.44 (DF)	<1.48 (I,DF)	<1.5 (DF)	<1.59
Perfluorononanesulfonate	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Perfluorodecanesulfonate	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Perfluorododecanesulfonate	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Fluorotelomer Sulfonate, 4:2-	<5.75	<5.76	<5.97	<5.77	<5.93	<6	<6.38
Fluorotelomer Sulfonate, 6:2-	<5.19	<5.19	<5.38	<5.2	<5.34	<5.41	<5.75
Fluorotelomer Sulfonate, 8:2-	<4.89	<4.89	<5.08	<4.91	<5.04	<5.1	<5.42
Fluorotelomer Carboxylic Acid, 3:3-	<5.75	<5.76	<5.97	<5.77	<5.93	<6	<6.38
Fluorotelomer Carboxylic Acid, 5:3-	<36	<36	<37.3	<36.1	<37	<37.5	<39.8
Fluorotelomer Carboxylic Acid, 7:3-	<36	<36	<37.3	<36.1	<37	<37.5	<39.8
Perfluorooctanesulfonamide	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Methyl-perfluorooctanesulfonamide, N-	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Ethyl-perfluorooctanesulfonamide, N-	<4.03	<4.03	<4.18	<4.04	<4.15	<4.2	<4.46
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Methyl-perfluorooctanesulfonamidoethanol, N-	<14.4	<14.4	<14.9	<14.4	<14.8	<15	<15.9
Ethyl-perfluorooctanesulfonamidoethanol, N-	<14.4	<14.4	<14.9	<14.4	<14.8	<15	<15.9
Perfluoro-2-Propoxypropanoic Acid	<5.75	<5.76	<5.97	<5.77	<5.93	<6	<6.38
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<5.75	<5.76	<5.97	<5.77	<5.93	<6	<6.38
Perfluoro-3,6-dioxaheptanoate	<2.88	<2.88	<2.99	<2.89	<2.96	<3	<3.19
Perfluoro-4-methoxybutanoate	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59
Perfluoro-3-methoxypropanoate	<2.88	<2.88	<2.99	<2.89	<2.96	<3	<3.19
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<5.77	<5.77	<5.99	<5.79	<5.94	<6.02	<6.39
Chloroicosadecafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<5.76	<5.77	<5.98	<5.78	<5.93	<6.01	<6.38
Perfluoro(2-ethoxyethane)sulfonic acid	<1.44	<1.44	<1.49	<1.44	<1.48	<1.5	<1.59

F.4. Residential sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 4/4		
SampleID	SFPUC-FBS-0058	SFPUC-FBS-0060
StationCode	SFPUC	SFPUC
SampleDate	2022-05-13	2022-07-13
MatrixName	Sewershed Field Blank	Sewershed Field Blank
SampleTypeCode	FieldBlank	FieldBlank
Unit	ng/L	ng/L
Sum of Fluorine	0.0	0.0
Sum of PFAS	0	0
Perfluorobutanoate	<6.37	<6.33
Perfluoropentanoate	<3.19	<3.17
Perfluorohexanoate	<1.59	<1.58
Perfluoroheptanoate	<1.59	<1.58
Perfluorooctanoate	<1.59	<1.58
Perfluorononanoate	<1.59	<1.58
Perfluorodecanoate	<1.59	<1.58
Perfluoroundecanoate	<1.59	<1.58
Perfluorododecanoate	<1.27	<1.27
Perfluorotridecanoate	<1.59	<1.58
Perfluorotetradecanoate	<1.59	<1.58
Perfluorobutanesulfonate	<1.59	<1.58
Perfluoropentanesulfonate	<1.6	<1.59
Perfluorohexanesulfonate	<1.59	<1.58
Perfluoroheptanesulfonate	<1.59	<1.58
Perfluorooctanesulfonate	<1.59	<1.58
Perfluorononanesulfonate	<1.59	<1.58
Perfluorodecanesulfonate	<1.59	<1.58
Perfluorododecanesulfonate	<1.59	<1.58
Fluorotelomer Sulfonate, 4:2-	<6.37	<6.33
Fluorotelomer Sulfonate, 6:2-	<5.74	<5.71
Fluorotelomer Sulfonate, 8:2-	<5.42	<5.38
Fluorotelomer Carboxylic Acid, 3:3-	<6.37	<6.33
Fluorotelomer Carboxylic Acid, 5:3-	<39.8	<39.6
Fluorotelomer Carboxylic Acid, 7:3-	<39.8	<39.6
Perfluorooctanesulfonamide	<1.59	<1.58
Methyl-perfluorooctanesulfonamide, N-	<1.59	<1.58
Ethyl-perfluorooctanesulfonamide, N-	<4.46	<4.43
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.59	<1.58
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.59	<1.58
Methyl-perfluorooctanesulfonamidoethanol, N-	<15.9	<15.8
Ethyl-perfluorooctanesulfonamidoethanol, N-	<15.9	<15.8
Perfluoro-2-Propoxypropanoic Acid	<6.37	<6.33
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<6.37	<6.33
Perfluoro-3,6-dioxaheptanoate	<3.19	<3.17
Perfluoro-4-methoxybutanoate	<1.59	<1.58
Perfluoro-3-methoxypropanoate	<3.19	<3.17
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<6.39	<6.35
Chloroeicosafuoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<6.38	<6.34
Perfluoro(2-ethoxyethane)sulfonic acid	<1.59	<1.58

F.5. Industrial sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 1/5							
Industry	Hospital	Hospital	Laundry	Hospital	Jail/Laundry	Jail/Laundry	Military Site
SampleDate	2022-04-20	2022-04-11	2022-04-12	2022-04-20	2022-05-10	2022-05-11	2022-05-10
MatrixName	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed
SampleTypeCode	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	23.4	0.0	29.4	0.0	35.8	40.7	27.5
Sum of PFAS	39.66	0	48.13	0	56.13	63.63	43.03
Perfluorobutanoate	<7.13	<6.74	<25.9 (LRJ)	<8.02	<6.8	<6.76	<6.34
Perfluoropentanoate	<3.56	<3.37	<9.69 (LRJ)	<4.01	<3.4	<3.38	<3.17
Perfluorohexanoate	6.36 (J)	<1.69	<3.75	<2	6.15 (J)	8.38	4.8 (J)
Perfluoroheptanoate	<1.78	<1.69	2.85 (J)	<2	<1.7	1.72 (J)	<1.58
Perfluorooctanoate	<1.78	<1.69	5.37 (J)	<2	3.42 (J)	3.92 (J)	3.41 (J)
Perfluorononanoate	<1.78 (J,DF)	<1.69 (J,DF)	3.24 (J)	<2	<1.7 (J,DF)	<1.69 (J,DF)	<1.58
Perfluorodecanoate	<1.78	<1.69	1.74 (J)	<2	<1.7	<1.69	<1.58
Perfluoroundecanoate	<1.78	<1.69	<1.69	<2	<1.7	<1.69	<1.58
Perfluorododecanoate	<1.43	<1.35	<1.35	<1.6	<1.36	<1.35	<1.27
Perfluorotridecanoate	<1.78	<1.69	<1.69	<2	<1.7	<1.69	<1.58
Perfluorotetradecanoate	<1.78	<1.69	<1.69	<2	<1.7	<1.69	<1.58
Perfluorobutanesulfonate	<1.78	<1.69	4.1 (J)	<2	<1.7 (J,DF)	<1.69 (DF)	<1.58 (J,DF)
Perfluoropentanesulfonate	<1.79	<1.69	<1.7	<2.01	3.26 (J)	3.81 (J)	2.72 (J)
Perfluorohexanesulfonate	<1.78	<1.69	<1.69	<2	19	19.8	14.5
Perfluoroheptanesulfonate	<1.78	<1.69	<1.69	<2	<1.7	<1.69	<1.58
Perfluorooctanesulfonate	<1.78	<1.69	4.24 (J)	<2	24.3	26	17.6
Perfluorononanesulfonate	<1.78	<1.69	<1.69	<2	<1.7	<1.69	<1.58
Perfluorodecanesulfonate	<1.78	<1.69	<1.69	<2	<1.7	<1.69	<1.58
Perfluorododecanesulfonate	<1.78	<1.69	<1.69	<2	<1.7	<1.69	<1.58
Fluorotelomer Sulfonate, 4:2-	<7.13	<6.74	<10.8 (LRJ)	<8.02	<6.8	<6.76	<6.34
Fluorotelomer Sulfonate, 6:2-	33.3	<6.07	23.2 (J)	<7.23	<6.13	<6.09	<5.71
Fluorotelomer Sulfonate, 8:2-	<6.06	<5.73	<5.74	<6.81	<5.78	<5.74	<5.39
Fluorotelomer Carboxylic Acid, 3:3-	<7.13	<6.74	<10.6 (LRJ)	<8.02	<6.8	<6.76	<6.34
Fluorotelomer Carboxylic Acid, 5:3-	<44.5	<42.1	<42.2	<50.1	<42.5	<42.2	<39.6
Fluorotelomer Carboxylic Acid, 7:3-	<44.5	<42.1	<42.2	<50.1	<42.5	<42.2	<39.6
Perfluorooctanesulfonamide	<1.78	<1.69	<1.69	<2	<1.7	<1.69	<1.58
Methyl-perfluorooctanesulfonamide, N-	<1.78	<1.69	<1.69	<2	<1.7	<1.69	<1.58
Ethyl-perfluorooctanesulfonamide, N-	<4.99	<4.72	<4.73	<5.61	<4.76	<4.73	<4.44
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.78	<1.69	<1.69	<2	<1.7	<1.69	<1.58
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.78	<1.69	3.39 (J)	<2	<1.7	<1.69	<1.58
Methyl-perfluorooctanesulfonamidoethanol, N-	<17.8	<16.9	<16.9	<20	<17	<16.9	<15.8
Ethyl-perfluorooctanesulfonamidoethanol, N-	<17.8	<16.9	<16.9 (LRJ)	<20	<17	<16.9	<15.8
Perfluoro-2-Propoxypropanoic Acid	<7.13	<6.74	<6.75	<8.02	<6.8	<6.76	<6.34
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<7.13	<6.74	<6.75	<8.02	<6.8	<6.76	<6.34
Perfluoro-3,6-dioxaheptanoate	<3.56	<3.37	<11.6	<4.01	<3.4	<3.38	<3.17
Perfluoro-4-methoxybutanoate	<1.78	<1.69	<1.69 (LRJ)	<2	<1.7	<1.69	<1.58
Perfluoro-3-methoxypropanoate	<3.56	<3.37	<3.38 (LRJ)	<4.01	<3.4	<3.38	<3.17
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<7.14	<6.76	<6.77	<8.04	<6.81	<6.77	<6.35
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<7.13	<6.75	<6.76	<8.03	<6.81	<6.76	<6.35
Perfluoro(2-ethoxyethane)sulfonic acid	<1.78	<1.69	<1.69	<2	<1.7	<1.69	<1.58

F.5. Industrial sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 2/5							
Industry	Military Site	Laundry	Laundry	Car Wash	Car Wash	Hospital	Laundry
SampleDate	2022-05-11	2022-06-23	2022-06-24	2022-06-03	2022-06-03	2022-05-20	2022-05-20
MatrixName	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed
SampleTypeCode	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	23.8	18.6	12.7	78.8	46.9	0.0	24.8
Sum of PFAS	37.46	32.3	21.6	119.22	69.69	0	7.94
Perfluorobutanoate	<6.99	<18.1	<8.4	<5.44	11 (J)	<5.48	31.6 (LRJ)
Perfluoropentanoate	<3.5	<9.05	<4.2	3.79 (J)	<2.82	<2.74	<10.9 (LRJ)
Perfluorohexanoate	3.61 (J)	<4.88	<2.29	14.9	6.31	<1.37	<15.7
Perfluoroheptanoate	<1.75	<4.53	<2.1	7.84	3.91 (J)	<1.37	<1.36
Perfluorooctanoate	2.73 (J)	<4.53	2.3 (J)	28.5	13.1	<1.37	3.34 (J)
Perfluorononanoate	<1.75	<4.53	<2.1	4.71(J)	5.13 (J)	<1.37	1.94 (J)
Perfluorodecanoate	<1.75	<4.53	<2.1	6.01	6.33	<1.37	<1.36 (J,DF)
Perfluoroundecanoate	<1.75	<4.53	<2.1	<1.36 (J,DF)	2.38 (J)	<1.37	<1.36
Perfluorododecanoate	<1.4	<3.62	<1.68	2.45(J)	4.42 (J)	<1.1	<1.09
Perfluorotridecanoate	<1.75	<4.53	<2.1	<1.36 (J,DF)	2.36 (J)	<1.37	<1.36
Perfluorotetradecanoate	<1.75	<4.53	<2.1	<1.36	3.88 (J)	<1.37	<1.36
Perfluorobutanesulfonate	<1.75 (DF)	<4.53	<2.1	2.59 (J)	1.64 (J)	<1.37	2.66 (J)
Perfluoropentanesulfonate	3.72 (J)	<4.55	<2.11	<1.37	<1.51	<1.38	<1.37
Perfluorohexanesulfonate	14.6	<4.53	<2.1	16.5	<1.41	<1.37	<1.36
Perfluoroheptanesulfonate	<1.75	<4.53	<2.1	<1.64	<1.67	<1.37	<1.36
Perfluorooctanesulfonate	12.8	<4.53	<2.1	27	4.66 (J)	<1.37	<1.36
Perfluorononanesulfonate	<1.75	<4.53	<2.1	<1.36	<2.66	<1.37	<1.36
Perfluorodecanesulfonate	<1.75	<4.53	<2.1	<1.36	<4.63	<1.37	<1.36
Perfluorododecanesulfonate	<1.75	<4.53	<2.1	<1.36	<1.41	<1.37	<1.36
Fluorotelomer Sulfonate, 4:2-	<6.99	<18.1	<8.4	<5.44	<5.65	<5.48	(REJ)
Fluorotelomer Sulfonate, 6:2-	<6.3	32.3 (J)	19.3 (J)	<4.91	<5.09	<4.94	<4.92
Fluorotelomer Sulfonate, 8:2-	<5.94	<15.4	<7.14	<4.63	<4.8	<4.65	<4.64
Fluorotelomer Carboxylic Acid, 3:3-	<6.99	<18.1	<8.4	<5.44	<5.65	<5.48	<7.72 (LRJ)
Fluorotelomer Carboxylic Acid, 5:3-	<43.7	<113	<52.5	<34	<35.3	<34.2	<34.1
Fluorotelomer Carboxylic Acid, 7:3-	<43.7	<113	<52.5	<34	<35.3	<34.2	<34.1
Perfluorooctanesulfonamide	<1.75	<4.53	<2.1	4.93 (J)	2.23 (J)	<1.37	<1.36
Methyl-perfluorooctanesulfonamide, N-	<1.75	<4.53	<2.1	<1.36	<1.41	<1.37	<1.36
Ethyl-perfluorooctanesulfonamide, N-	<4.89	<12.7	<5.88	<3.81	<3.95	<3.83	<3.82
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.75	<4.53	<2.1	<1.36 (DF)	<1.41	<1.37	<1.36
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.75	<4.53	<2.1	<1.36	2.61 (J)	<1.37	<1.36
Methyl-perfluorooctanesulfonamidoethanol, N-	<17.5	<45.3	<21	<13.6	<14.1	<13.7	<13.6
Ethyl-perfluorooctanesulfonamidoethanol, N-	<17.5	<45.3	<21	<13.6	<14.1	<13.7	<13.6 (LRJ)
Perfluoro-2-Propoxypropanoic Acid	<6.99	<18.1	<8.4	<5.44	<5.65	<5.48	<5.46
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<6.99	<18.1	<8.4	<5.44	<5.65	<5.48	<5.46
Perfluoro-3,6-dioxaheptanoate	<3.5	<9.05	<4.2	<2.72	<2.82	<2.74	<4.79
Perfluoro-4-methoxybutanoate	<1.75	<4.53	<2.1	<1.36	<1.41	<1.37	<1.36 (LRJ)
Perfluoro-3-methoxypropanoate	<3.5	<9.05	<4.2	<2.72	<2.82	<2.74	<2.73 (LRJ)
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<7.01	<18.2	<8.42	<5.46	<5.66	<5.49	<5.47
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<7	<18.1	<8.41	<5.45	<5.65	<5.48	<5.46
Perfluoro(2-ethoxyethane)sulfonic acid	<1.75	<4.53	<2.1	<1.36	<1.41	<1.37	<1.36

F.5. Industrial sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 3/5							
Industry	Car Wash	Hospital	Semiconductor	Chrome Plating	Chrome Plating	Chrome Plating	Chrome Plating
SampleDate	2022-06-03	2022-05-20	2022-05-24	2022-05-23	2022-05-24	2022-05-04	2022-05-06
MatrixName	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed
SampleTypeCode	Grab	Grab	Grab	Grab	Composite	Grab	Composite
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	20.9	1.0	1.9	0.0	0.0	13.2	8.9
Sum of PFAS	31.71	1.45	3.14	0	0	21.88	14.49
Perfluorobutanoate	8.91 (J)	<5.47	<5.94	<5.78	<5.82	<5.97	<6.54
Perfluoropentanoate	<2.8	<2.73	<2.97	<2.89	<2.91	<2.98	<3.27
Perfluorohexanoate	6.81	1.45 (J)	<1.48	<1.45	<1.46	<1.49	1.91 (J)
Perfluoroheptanoate	3.12 (J)	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Perfluorooctanoate	6.34	<1.37	<1.48	<1.45	<1.46	3.9 (J)	3.06 (J)
Perfluorononanoate	<1.4 (J,DF)	<1.37	<1.48	<1.45	<1.46	<1.49	<1.92
Perfluorodecanoate	2.19 (J)	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Perfluoroundecanoate	<1.4	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Perfluorododecanoate	<1.12	<1.09	<1.19	<1.16	<1.16	<1.19	<1.31
Perfluorotridecanoate	<1.4	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Perfluorotetradecanoate	<1.4	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Perfluorobutanesulfonate	<1.4 (DF)	<1.37	1.58 (J)	<1.45	<1.46	<1.49	<1.64
Perfluoropentanesulfonate	<2.05	<1.37	<1.49	<1.45	<1.46	<1.5	<1.64
Perfluorohexanesulfonate	<1.4	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Perfluoroheptanesulfonate	<1.97	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Perfluorooctanesulfonate	4.34 (J)	<1.37	<1.48	<1.45	<1.46	2.18 (J)	<1.64
Perfluoronanesulfonate	<3.84	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Perfluorodecanesulfonate	<2.68	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Perfluorododecanesulfonate	<1.4	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Fluorotelomer Sulfonate, 4:2-	<5.61	<5.47	<5.94	<5.78	<5.82	<5.97	<6.54
Fluorotelomer Sulfonate, 6:2-	<5.05	<4.93	<5.35	<5.21	<5.25	15.8 (IP,J)	9.52 (IP,J)
Fluorotelomer Sulfonate, 8:2-	<4.77	<4.65	<5.05	<4.92	<4.95	<5.07	<5.56
Fluorotelomer Carboxylic Acid, 3:3-	<5.61	<5.47	<5.94	<5.78	<5.82	<5.97	<6.54
Fluorotelomer Carboxylic Acid, 5:3-	<35.1	<34.2	<37.1	<36.2	<36.4	<37.3	<40.9
Fluorotelomer Carboxylic Acid, 7:3-	<35.1	<34.2	<37.1	<36.2	<36.4	<37.3	<40.9
Perfluorooctanesulfonamide	<1.4	<1.37	1.56 (J)	<1.45	<1.46	<1.49	<1.64
Methyl-perfluorooctanesulfonamide, N-	<1.4	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Ethyl-perfluorooctanesulfonamide, N-	<3.93	<3.83	<4.16	<4.05	<4.08	<4.18	<4.58
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.4	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.4	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Methyl-perfluorooctanesulfonamidoethanol, N-	<14	<13.7	<14.8	<14.5	<14.6	<14.9	<16.4
Ethyl-perfluorooctanesulfonamidoethanol, N-	<14	<13.7	<14.8	<14.5	<14.6	<14.9	<16.4
Perfluoro-2-Propoxypropanoic Acid	<5.61	<5.47	<5.94	<5.78	<5.82	<5.97	<6.54
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<5.61	<5.47	<5.94	<5.78	<5.82	<5.97	<6.54
Perfluoro-3,6-dioxaheptanoate	<2.8	<2.73	<2.97	<2.89	<2.91	<2.98	<3.27
Perfluoro-4-methoxybutanoate	<1.4	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64
Perfluoro-3-methoxypropanoate	<2.8	<2.73	<2.97	<2.89	<2.91	<2.98	<3.27
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<5.62	<5.48	<5.95	<5.8	<5.84	<5.98	<6.56
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<5.62	<5.48	<5.95	<5.79	<5.83	<5.97	<6.55
Perfluoro(2-ethoxyethane)sulfonic acid	<1.4	<1.37	<1.48	<1.45	<1.46	<1.49	<1.64

F.5. Industrial sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 4/5							
Industry	Semiconductor	Semiconductor	Semiconductor	Semiconductor	Semiconductor	Semiconductor	Laundry
SampleDate	2022-05-16	2022-05-16	2022-05-25	2022-05-09	2022-05-09	2022-05-05	2022-05-18
MatrixName	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed
SampleTypeCode	Grab	Composite	Composite	Grab	Grab	Composite	Grab
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	18.3	26.5	2.3	1.4	1.2	0.0	167.1
Sum of PFAS	29.86	43.29	3.79	2	1.75	0	280.36
Perfluorobutanoate	<6.37	7.15 (J)	<5.91	<6.89	<6.47	<6.72	35.1
Perfluoropentanoate	<3.19	<3.27	<2.95	<3.44	<3.24	<3.36	19.9
Perfluorohexanoate	4.06 (J)	4.33 (J)	<1.48	<1.72	<1.62	<1.68	22.7
Perfluoroheptanoate	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	15.4
Perfluorooctanoate	2.55 (J)	3.35 (J)	<1.48 (J,DF)	2 (J)	1.75 (J)	<1.68	22.8
Perfluorononanoate	<1.59	<1.64	<1.48	<1.72	<1.62 (J,DF)	<1.68	15
Perfluorodecanoate	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	6.81
Perfluoroundecanoate	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5 (J,DF)
Perfluorododecanoate	<1.27	<1.31	<1.18	<1.38	<1.29	<1.34	1.62 (J)
Perfluorotridecanoate	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5
Perfluorotetradecanoate	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5
Perfluorobutanesulfonate	<1.59	<1.64	1.89 (J)	<1.72	<1.62	<1.68	7.07
Perfluoropentanesulfonate	<1.6	<1.65	<1.48	<1.73	<1.63	<1.69	<1.5
Perfluorohexanesulfonate	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5
Perfluoroheptanesulfonate	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5
Perfluorooctanesulfonate	6.35 (J)	6.16 (J)	<1.48	<1.72	<1.62	<1.68	6.86
Perfluorononanesulfonate	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5
Perfluorodecanesulfonate	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5
Perfluorododecanesulfonate	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5
Fluorotelomer Sulfonate, 4:2-	<6.37	<6.55	<5.91	<6.89	<6.47	<6.72	<5.99
Fluorotelomer Sulfonate, 6:2-	16.9 (IP,J)	22.3 (IP,J)	<5.32	<6.21	<5.83	<6.05	115 (IP)
Fluorotelomer Sulfonate, 8:2-	<5.42	<5.57	<5.02	<5.85	<5.5	<5.71	<5.09
Fluorotelomer Carboxylic Acid, 3:3-	<6.37	<6.55	<5.91	<6.89	<6.47	<6.72	<5.99
Fluorotelomer Carboxylic Acid, 5:3-	<39.8	<40.9	<36.9	<43	<40.5	<42	<37.4
Fluorotelomer Carboxylic Acid, 7:3-	<39.8	<40.9	<36.9	<43	<40.5	<42	<37.4
Perfluorooctanesulfonamide	<1.59	<1.64	1.9 (J)	<1.72	<1.62	<1.68	<1.5
Methyl-perfluorooctanesulfonamide, N-	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5
Ethyl-perfluorooctanesulfonamide, N-	<4.46	<4.58	<4.13	<4.82	<4.53	<4.7	<4.19
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5
Methyl-perfluorooctanesulfonamidoethanol, N-	<15.9	<16.4	<14.8	<17.2	<16.2	<16.8	<15
Ethyl-perfluorooctanesulfonamidoethanol, N-	<15.9	<16.4	<14.8	<17.2	<16.2	<16.8	<15
Perfluoro-2-Propoxypropanoic Acid	<6.37	<6.55	<5.91	<6.89	<6.47	<6.72	12.1 (J)
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<6.37	<6.55	<5.91	<6.89	<6.47	<6.72	<5.99
Perfluoro-3,6-dioxaheptanoate	<3.19	<3.27	<2.95	<3.44	<3.24	<3.36	<2.99
Perfluoro-4-methoxybutanoate	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5
Perfluoro-3-methoxypropanoate	<3.19	<3.27	<2.95	<3.44	<3.24	<3.36	<2.99
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<6.39	<6.56	<5.92	<6.9	<6.49	<6.73	<6
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<6.38	<6.56	<5.91	<6.9	<6.48	<6.73	<5.99
Perfluoro(2-ethoxyethane)sulfonic acid	<1.59	<1.64	<1.48	<1.72	<1.62	<1.68	<1.5

F.5. Industrial sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 5/5								
Industry	Laundry	Laundry	Laundry	Paper Pulp	Paper Pulp	Blank	Blank	Blank
SampleDate	2022-05-18	2022-05-19	2022-05-02	2022-05-19	2022-05-24	2022-05-02	2022-05-02	2022-05-19
MatrixName	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Sewershed Field Blank	Sewershed Field Blank	Sewershed Field Blank
SampleTypeCode	Grab	Composite	Grab	Grab	Composite	FieldBlank	FieldBlank	FieldBlank
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	243.6	475.5	41.0	54.8	91.9	0.0	7.3	0.0
Sum of PFAS	395.72	761.47	66.66	83.03	140.75	0	12.7	0
Perfluorobutanoate	77.2	191	<8.13	9.54 (J)	18 (J)	<6.14	<6.77	<5.83
Perfluoropentanoate	59.6	154	5.67 (J)	11 (J)	15.5	<3.07	<3.39	<2.92
Perfluorohexanoate	72	131	21.3	13.1	19.8	<1.53	<1.69	<1.46
Perfluoroheptanoate	22.7	66.4	<2.03 (J,DF)	3.17 (J)	4.46 (J)	<1.53	<1.69	<1.46
Perfluorooctanoate	23.8	42.5	2.49	29.2	33.2	<1.53	<1.69	<1.46
Perfluorononanoate	16	26.7	<2.03	3.4 (J)	8.07 (J)	<1.53	<1.69	<1.46
Perfluorodecanoate	8.61	12	<2.03	<1.44	4.65 (J)	<1.53	<1.69	<1.46
Perfluoroundecanoate	<1.48 (J,DF)	<1.47 (J,DF)	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46
Perfluorododecanoate	1.85 (J)	4.38 (J)	<1.63	<1.15	<1.16	<1.23	<1.35	<1.17
Perfluorotridecanoate	<1.48	3.74 (J)	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46
Perfluorotetradecanoate	1.76 (J)	4.3 (J)	<2.03	<1.48	<1.46	<1.53	<1.69	<1.46
Perfluorobutanesulfonate	<1.48 (J,DF)	7.15	<2.03 (J,DF)	<1.44 (DF)	5.61 (J)	<1.53	<1.69	<1.46
Perfluoropentanesulfonate	<1.49	<1.48	<2.04	<1.45	<1.46	<1.54	<1.7	<1.47
Perfluorohexanesulfonate	<1.48	<1.47	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46
Perfluoroheptanesulfonate	<1.48	<1.47	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46
Perfluorooctanesulfonate	10.8	17.3	<2.03	7.9	20.8	<1.53	<1.69	<1.46
Perfluorononanesulfonate	<1.48	<1.47	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46
Perfluorodecanesulfonate	<1.48	<1.47	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46
Perfluorododecanesulfonate	<1.48	<1.47	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46
Fluorotelomer Sulfonate, 4:2-	<5.94	<5.88	<8.13	<5.77	<5.82	<6.14	<6.77	<5.83
Fluorotelomer Sulfonate, 6:2-	87.8 (IP)	77.2 (IP)	37.2 (IP)	5.72 (IP,J)	7.48 (IP,J)	<5.53	12.7 (IP,J)	<5.26
Fluorotelomer Sulfonate, 8:2-	<5.05	<5	<6.91	<4.9	<4.95	<5.22	<5.76	<4.96
Fluorotelomer Carboxylic Acid, 3:3-	<5.94	<5.88	<8.13	<5.77	<5.82	<6.14	<6.77	<5.83
Fluorotelomer Carboxylic Acid, 5:3-	<37.1	<36.8	<50.8	<36	<36.4	<38.4	<42.3	<36.5
Fluorotelomer Carboxylic Acid, 7:3-	<37.1	<36.8	<50.8	<36	<36.4	<38.4	<42.3	<36.5
Perfluorooctanesulfonamide	<1.48	<1.47	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46
Methyl-perfluorooctanesulfonamide, N-	<1.48	<1.47	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46
Ethyl-perfluorooctanesulfonamide, N-	<4.16	<4.12	<5.69 (LRJ)	<4.04	<4.07	<4.3	<4.74	<4.08
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.48	<1.47	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.48	<1.47	<2.03	<1.44	3.18 (J)	<1.53	<1.69	<1.46
Methyl-perfluorooctanesulfonamidoethanol, N-	<14.8	<14.7	<20.3	<14.4	<14.6	<15.3	<16.9	<14.6
Ethyl-perfluorooctanesulfonamidoethanol, N-	<14.8 (LRJ)	<14.7 (LRJ)	<20.3 (LRJ)	<14.4	<14.6	<15.3	<16.9	<14.6
Perfluoro-2-Propoxypropanoic Acid	13.6 (J)	23.8	<8.13	<5.77	<5.82 (J,DF)	<6.14	<6.77	<5.83
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<5.94	<5.88	<8.13	<5.77	<5.82	<6.14	<6.77	<5.83
Perfluoro-3,6-dioxaheptanoate	<2.97	<2.94	<4.07	<3.18	<5.37	<3.07	<3.39	<2.92
Perfluoro-4-methoxybutanoate	<1.48	<1.47	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46
Perfluoro-3-methoxypropanoate	<2.97	<2.94	<4.07	<2.88	<2.91	<3.07	<3.39	<2.92
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<5.95	<5.9	<8.15	<5.78	<5.84	<6.15	<6.79	<5.85
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<5.95	<5.89	<8.14	<5.78	<5.83	<6.15	<6.78	<5.84
Perfluoro(2-ethoxyethane)sulfonic acid	<1.48	<1.47	<2.03	<1.44	<1.46	<1.53	<1.69	<1.46

F.6. Blended feed sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 1/2							
SampleID	EBMUD-BF-0096	EBMUD-BF-0097	EBMUD-BF-0098	SFPUCOS-BF-0101	SFPUCOS-BF-0102	SFPUCSE-BF-00100	SFPUCSE-BF-0099
StationCode	EBMUD	EBMUD	EBMUD	SFPUCOS	SFPUCOS	SFPUCSE	SFPUCSE
SampleDate	2022-06-03	2022-06-03	2022-07-05	2022-05-23	2022-05-25	2022-05-25	2022-05-23
MatrixName	Biosolids_Blended Feed	Biosolids_Blended Feed	Biosolids_Blended Feed	Biosolids_Blended Feed	Biosolids_Blended Feed	Biosolids_Blended Feed	Biosolids_Blended Feed
SampleTypeCode	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Unit	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw
Sum of Fluorine	1.4	3.3	19.2	69.0	58.6	96.3	71.3
Sum of PFAS	2.2	5.25	6.2	104.9	89.93	156.6	115.9
Perfluorobutanoate	<1.76	<1.52	24.6 (LRJ)	<2.66	<2.07	<1.93	<1.49
Perfluoropentanoate	<0.879	<0.761	<2.15 (LRJ)	<1.33	<1.04	<0.964	<0.743
Perfluorohexanoate	0.994 (J)	0.781 (J)	<2.03	1.77 (J)	1.28 (J)	2.69	2.38
Perfluoroheptanoate	<0.439	<0.38	<1.07	<0.666	<0.518	<0.482	<0.371
Perfluorooctanoate	<0.439	<0.38	<1.07	0.689 (J)	0.538 (J)	1.09 (J)	1.12 (J)
Perfluorononanoate	<0.439 (DF)	<0.38 (DF)	<1.07	<0.666 (J,DF)	<0.518 (J,DF)	<0.482 (J,DF)	<0.371 (J,DF)
Perfluorodecanoate	0.505 (J)	0.46 (J)	<1.07	1.35 (J)	1.1 (J)	2.07	1.47 (J)
Perfluoroundecanoate	<0.439	<0.38	<1.07	<0.666	0.646 (J)	1.05(J)	1.07 (J)
Perfluorododecanoate	<0.352	<0.304	<0.859	0.969 (J)	0.946 (J)	2.57	2.16
Perfluorotridecanoate	<0.439	<0.38	<1.07	<0.666 (J,DF)	<0.518 (J,DF)	0.998 (J)	<0.371 (J,DF)
Perfluorotetradecanoate	<0.439	<0.38	<1.07	<0.666	<0.518	0.861 (J)	0.799 (J)
Perfluorobutanesulfonate	<0.439	<0.38	<1.07 (J,DF)	<0.666	<0.518	<0.482	<0.371
Perfluoropentanesulfonate	<0.442	<0.382	<1.08	<0.669	<0.52	<0.484	<0.373
Perfluorohexanesulfonate	<0.439	<0.38	<1.07	<0.666	<0.518	<0.482	<0.371
Perfluoroheptanesulfonate	<0.439	<0.38	<1.07	<0.666	<0.518	<0.482	<0.371
Perfluorooctanesulfonate	<0.439 (DF)	2.92	4.73	<0.666 (DF)	3.94	8.72	6.62
Perfluorononanesulfonate	<0.439	<0.38	<1.07	<0.666	<0.518	<0.482	<0.371
Perfluorodecanesulfonate	<0.439	<0.38	<1.07	<0.666	<0.518	<0.482	<0.371
Perfluorododecanesulfonate	<0.439	<0.38	<1.07	<0.666	<0.518	<0.482	<0.371
Fluorotelomer Sulfonate, 4:2-	<1.76	<1.52	<4.29 (LRJ)	<2.66	<2.07	<1.93	<1.49
Fluorotelomer Sulfonate, 6:2-	<1.58	<1.37	<3.87	<2.4	<1.87	<1.74	<1.34
Fluorotelomer Sulfonate, 8:2-	<1.49	<1.29	<3.65	<2.26	<1.76	<1.64	<1.26
Fluorotelomer Carboxylic Acid, 3:3-	<1.76	<1.52	<4.29 (LRJ)	<2.66	<2.07	<1.93	<1.49
Fluorotelomer Carboxylic Acid, 5:3-	<11	<9.51	<26.8	86.2	69.3	119	87.9
Fluorotelomer Carboxylic Acid, 7:3-	<11	<9.51	<26.8	<16.7	<12.9	<12	<9.28
Perfluorooctanesulfonamide	<0.439	<0.38	<1.07	<0.666	0.685 (J)	0.725 (J)	0.513 (J)
Methyl-perfluorooctanesulfonamide, N-	<0.439	<0.38	<1.07	<0.666	<0.518	<0.482	<0.371
Ethyl-perfluorooctanesulfonamide, N-	<1.23 (LRJ)	<1.06 (LRJ)	<3.01 (LRJ)	<1.86	<1.45	<1.35	<1.04
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	0.701 (J)	0.626 (J)	1.47 (J)	<0.666 (DF)	2.8	3.54	3.21
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<0.439 (J,DF)	0.463 (J)	<1.07 (J,DF)	2.23 (J)	2.55	3.11	2.53
Methyl-perfluorooctanesulfonamidoethanol, N-	<4.39	<3.8	<10.7	11.7 (J)	6.14 (J)	10.2 (J)	6.11 (J)
Ethyl-perfluorooctanesulfonamidoethanol, N-	<4.39	<3.8 (LRJ)	<10.7 (LRJ)	8.94 (LRJ,J)	6.33 (LRJ,J)	<4.82	<3.71
Perfluoro-2-Propoxypropanoic Acid	<1.76 (LRJ)	<1.52	<4.29	<2.66	<2.07	<1.93	<1.49
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<1.76	<1.52	<4.29	<2.66	<2.07	<1.93	<1.49
Perfluoro-3,6-dioxaheptanoate	<0.879	<0.761	<2.15 (LRJ)	<1.33	<1.04	<0.964	<0.743
Perfluoro-4-methoxybutanoate	<0.439	<0.38	<1.07	<0.666	<0.518	<0.482	<0.371
Perfluoro-3-methoxypropanoate	<0.879	<0.761	<2.15	<1.33	<1.04	<0.964	<0.743
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<1.76	<1.53	<4.3	<2.67	<2.08	<1.93	<1.49
Chloroicosadecafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<1.76	<1.52	<4.3	<2.67	<2.07	<1.93	<1.49
Perfluoro(2-ethoxyethane)sulfonic acid	<0.439	<0.38	<1.07	<0.666	<0.518	<0.482	<0.371
TOTAL SOLIDS	9.03	10	3.53	5.4	7.68	8.22	9.77

F.6. Blended feed sample concentrations in ng/L by SGS AXYS MLA-110 Rev 02 (Target Method) 2/2		
SampleID	EBMUD-FW-0081	EBMUD-FW-0082
StationCode	EBMUD	EBMUD
SampleDate	2022-07-05	2022-07-08
MatrixName	Food Waste	Food Waste
SampleTypeCode	Grab	Grab
Unit	ng/g dw	ng/g dw
Sum of Fluorine	2.0	0.0
Sum of PFAS	3.48	0
Perfluorobutanoate	<1.16	<6.08
Perfluoropentanoate	<0.58	<3.04
Perfluorohexanoate	<0.29	<1.52
Perfluoroheptanoate	<0.29	<1.52
Perfluorooctanoate	<0.29	<1.52
Perfluorononanoate	<0.29 (J,DF)	<1.52 (J,DF)
Perfluorodecanoate	<0.29	<1.52
Perfluoroundecanoate	<0.29	<1.52
Perfluorododecanoate	<0.232	<1.22
Perfluorotridecanoate	<0.29	<1.52
Perfluorotetradecanoate	<0.29	<1.52
Perfluorobutanesulfonate	<0.29	<1.52
Perfluoropentanesulfonate	<0.291	<1.53
Perfluorohexanesulfonate	<0.29	<1.52
Perfluoroheptanesulfonate	<0.29	<1.52
Perfluorooctanesulfonate	<0.29	<1.52
Perfluorononanesulfonate	<0.29	<1.52
Perfluorodecanesulfonate	<0.29	<1.52
Perfluorododecanesulfonate	<0.29	<1.52
Fluorotelomer Sulfonate, 4:2-	<1.16	<6.08
Fluorotelomer Sulfonate, 6:2-	<1.05	<5.48
Fluorotelomer Sulfonate, 8:2-	<0.986	<5.17
Fluorotelomer Carboxylic Acid, 3:3-	<1.16	<6.08
Fluorotelomer Carboxylic Acid, 5:3-	<7.25	<38
Fluorotelomer Carboxylic Acid, 7:3-	<7.25	<38
Perfluorooctanesulfonamide	<0.29	<1.52
Methyl-perfluorooctanesulfonamide, N-	<0.29	<1.52
Ethyl-perfluorooctanesulfonamide, N-	<0.812 (LRJ)	<4.26 (LRJ)
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<0.29	<1.52
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<0.29	<1.52
Methyl-perfluorooctanesulfonamidoethanol, N-	3.48(J)	<15.2
Ethyl-perfluorooctanesulfonamidoethanol, N-	<2.9 (LRJ)	<15.2 (LRJ)
Perfluoro-2-Propoxypropanoic Acid	<1.16	<6.08
Dioxa-3H-Perfluorononanoate Acid, 4,8-	<1.16	<6.08
Perfluoro-3,6-dioxaheptanoate	<0.87	<3.04
Perfluoro-4-methoxybutanoate	<0.29	<1.52
Perfluoro-3-methoxypropanoate	<0.58	<3.04
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	<1.16	<6.1
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	<1.16	<6.09
Perfluoro(2-ethoxyethane)sulfonic acid	<0.29	<1.52
TOTAL SOLIDS	12.5	2.57

## **13. Appendix G: Phase 2 TOP Data Tables**

**Table G.1: Influent concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method)**

SampleID	CCCSO-INT-2063	CCCSO-EBINF-2065	CCCSO-FBINF-2064	CSM-INT-2066	DSRSD-INT-2067	EBMUD-INT-2068	EBMUD-INT-2069	SFPUCOS-INT-2071	SFPUCSE-INT-2070	SJSC-INT-2072
StationCode	CCCSO	CCCSO	CCCSO	CSM	DSRSD	EBMUD	EBMUD	SFPUCOS	SFPUCSE	SJSC
SampleDate	2022-04-16	2022-04-16	2022-04-16	2022-04-25	2022-05-13	2022-05-17	2022-05-17	2022-05-23	2022-05-20	2022-06-22
MatrixName	influent	blankwater	blankwater	influent	influent	influent	influent	influent	influent	influent
SampleTypeCode	Composite	EquipBlank	FieldBlank	Composite	Composite	Composite	Composite	Composite	Composite	Composite
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	171.1	0	0	151.21	165.90	274.67	305.03	120.15	144.01	203.61
Sum of PFAS	262.73	0	0	231.95	255.59	421.78	467.87	183.17	219.7	312.67
Perfluorobutanoate	70.5	<13.2	<13.2	60.1	67.7	112	130	43.9(I)	50	71.8
Perfluoropentanoate	64.6	<6.61	<6.62	59.4	60.1	137	134	49.2	57.5	70.3
Perfluorohexanoate	47.2	<3.31	<3.31	44.1	43.1	79.6	84.9	41.1	57.1	76.7
Perfluoroheptanoate	22.30	<3.31	<3.31	23.7	21.9	28.8	41	17.5	16.6	23.1
Perfluorooctanoate	24.40	<4.28	<3.85	22.7	18.2	29.9	35.6	19	21	26
Perfluorononanoate	9.72 (I)	<3.31	<3.31	7.6 (I)	9 (I)	14.6 (I)	18.8	7.48 (I)	7.5 (I)	7.68 (I)
Perfluorodecanoate	6.68 (I)	<3.31	<3.31	5.47 (I)	4.69 (I)	6.98 (I)	12 (I)	4.99 (I)	5.72 (I)	5.91 (I)
Perfluoroundecanoate	<3.16 (I,DF)	<3.31	<3.31	<3.09	<3.59	<3.86 (I,DF)	<4.08 (I,DF)	<2.89	<3.04	<3.09
Perfluorododecanoate	<2.52	<2.65	<2.65	<2.48	<2.87	<3.09	<3.26	<2.31	<2.43	<2.47
Perfluorotridecanoate	<3.16	<3.31	<3.31	<3.09	<3.59	<3.86	<4.08	<2.89	<3.04	<3.09
Perfluorotetradecanoate	<3.16	<3.31	<3.31	<3.09	<3.59	<3.86	<4.08	<2.89	<3.04	<3.09
Perfluorobutanesulfonate	4.52 (I)	<3.31	<3.31	5.37 (I)	3.8 (I)	<3.86	4.16 (I)	<2.89	<3.04	8.71 (I)
Perfluoropentanesulfonate	<3.17	<3.32	<3.33	<3.11	<3.6	<3.88	<4.1	<2.91	<3.05	<3.1
Perfluorohexanesulfonate	5.18 (I)	<3.31	<3.31	3.51 (I)	13 (I)	4.01 (I)	<4.08	<2.89	<3.04	3.77 (I)
Perfluoroheptanesulfonate	<3.16	<3.31	<3.31	<3.09	<3.59	<3.86	<4.08	<2.89	<3.04	<3.09
Perfluorooctanesulfonate	7.63 (I)	<3.31	<3.31	<3.09 (I,DF)	14.1 (I)	8.89 (I)	7.41 (I)	<2.89	4.28 (I)	18.7
Perfluorononanesulfonate	<3.16	<3.31	<3.31	<3.09	<3.59	<3.86	<4.08	<2.89	<3.04	<3.09
Perfluorodecanesulfonate	<3.16	<3.31	<3.31	<3.09	<3.59	<3.86	<4.08	<2.89	<3.04	<3.09
Perfluorododecanesulfonate	<3.16	<3.31	<3.31	<3.09	<3.59	<3.86	<4.08	<2.89	<3.04	<3.09
Fluorotelomer Sulfonate, 4:2-	<12.6	<13.2	<13.2	<12.4	<14.3	<15.4	<16.3	<11.6	<12.1	<12.4
Fluorotelomer Sulfonate, 6:2-	<11.4	<11.9	<11.9	<11.2	<12.9	<13.9	<14.7	<10.4	<10.9	<11.1
Fluorotelomer Sulfonate, 8:2-	<10.7	<11.2	<11.2	<10.5	<12.2	<13.1	<13.9	<9.84	<10.3	<10.5
Fluorotelomer Carboxylic Acid, 3:3-	<12.6	<13.2	<13.2	<12.4	<14.3	<15.4	<16.3	<11.6	<12.1	<12.4
Fluorotelomer Carboxylic Acid, 5:3-	<237 (D)	<82.7	<82.7	<77.4	<89.7	<96.5	<102	<72.3	<75.9	<77.2
Fluorotelomer Carboxylic Acid, 7:3-	<237 (D)	<82.7	<82.7	<77.4	<89.7	<96.5	<102	<72.3	<75.9	<77.2
Perfluorooctanesulfonamide	<3.16	<3.31	<3.31	<3.09	<3.59	<3.86	<4.08	<2.89	<3.04	<3.09
Methyl-perfluorooctanesulfonamide, N-	<3.16	<3.31	<3.31	<3.09	<3.59	<3.86	<4.08	<2.89	<3.04	<3.09
Ethyl-perfluorooctanesulfonamide, N-	<8.84	<9.26	<9.26	<8.66	<10	<10.8	<11.4	<8.1	<8.5	<8.65
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.16	<3.31	<3.31	<3.09	<3.59	<3.86	<4.08	<2.89	<3.04	<3.09
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.16	<3.31	<3.31	<3.09	<3.59	<3.86	<4.08	<2.89	<3.04	<3.09
Methyl-perfluorooctanesulfonamidoethanol, N-	<31.6	<33.1	<33.1	<30.9	<35.9	<38.6	<40.8	<28.9	<30.4	<30.9
Ethyl-perfluorooctanesulfonamidoethanol, N-	<31.6	<33.1	<33.1	<30.9	<35.9	<38.6	<40.8	<28.9	<30.4	<30.9

Table G.2: Effluent concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method)									
SampleID	CCCSO-EFF-2106	CSM-EFF-2074	DSRSD-EFF-2075	EBMUD-EFF-2076	EBMUD-EFF-2077	EBMUD-EFF-2077	SFPUCOS-EFF-2079	SFPUCSE-EFF-2078	SJSC-EFF-2080
StationCode	CCCSO	CSM	DSRSD	EBMUD	EBMUD	EBMUD	SFPUCOS	SFPUCSE	SJSC
SampleDate	2022-04-16	2022-04-25	2022-05-13	2022-05-17	2022-05-17	2022-05-17	2022-05-23	2022-05-20	2022-06-22
MatrixName	effluent	effluent	effluent	effluent	effluent	effluent	effluent	effluent	effluent
SampleTypeCode	Composite	Composite	Composite	Composite	Composite	Composite	Composite	Composite	Composite
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	56.6	95.1	72.9	61.0	61.3	58.9	49.1	54.9	55.8
Sum of PFAS	87.8	146.07	113.62	93.93	94.12	90.42	75.33	84.02	86.61
Perfluorobutanoate	23.3 (J)	31.3 (J)	27.9 (J)	25.1 (J)	24.6 (J)	26.2 (J)	20.5 (J)	21.1 (J)	26.8 (J)
Perfluoropentanoate	19.1 (J)	26.6	14.8 (J)	19.9 (J)	20.5 (J)	19.7 (J)	19.8 (J)	17.2 (J)	16.6 (J)
Perfluorohexanoate	15.4	42.9	22	26.1	31.5	30.6	22.8	28.3	21.1
Perfluoroheptanoate	5.18 (J)	8.22 (J)	4.45 (J)	6.01 (J)	5.33 (J)	4.26 (J)	5.62 (J)	5.62 (J)	<3.13
Perfluorooctanoate	9.88 (J)	15.8	10 (J)	7.09 (J)	7.06 (J)	9.66 (J)	6.61 (J)	8.53 (J)	11.8 (J)
Perfluorononanoate	<3.41	<3.14	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.13
Perfluorodecanoate	<3.41	3.88 (J)	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.13
Perfluoroundecanoate	<3.41	<3.14	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.13
Perfluorododecanoate	<2.73	<2.51	<2.61	<3.35	<3.17	<3.29	<2.3	<2.6	<2.5
Perfluorotridecanoate	<3.41	<3.14	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.57
Perfluorotetradecanoate	<3.41	<3.14	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.42
Perfluorobutanesulfonate	3.77 (J)	5.27 (J)	4.67 (J)	<4.18	<3.97	<4.11	<2.87	<3.26	6.12 (J)
Perfluoropentanesulfonate	<3.42	<3.15	<3.28	<4.2	<3.99	<4.13	<2.89	<3.27	<3.15
Perfluorohexanesulfonate	6.86 (J)	4 (J)	15.1	4.49 (J)	<3.97	<4.11	<2.87	<3.26	<3.13
Perfluoroheptanesulfonate	<3.41	<3.14	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.13
Perfluorooctanesulfonate	4.31 (J)	8.1 (J)	14.7	5.24 (J)	5.13 (J)	<4.11	<2.87	3.27 (J)	4.19 (J)
Perfluorononanesulfonate	<3.41	<3.14	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.13
Perfluorodecanesulfonate	<3.41	<3.14	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.13
Perfluorododecanesulfonate	<3.41 (VEUM)	<3.14 (VEUM)	<3.26 (VEUM)	<4.18 (VEUM)	<3.97 (VEUM)	<4.11 (VEUM)	<2.87 (VEUM)	<3.26 (VEUM)	<3.13 (VEUM)
Fluorotelomer Sulfonate, 4:2-	<13.6	<12.6	<13	<16.7	<15.9	<16.4	<11.5	<13	<12.5
Fluorotelomer Sulfonate, 6:2-	<12.3	<11.3	<11.7	<15.1	<14.3	<14.8	<10.4	<11.7	<11.3
Fluorotelomer Sulfonate, 8:2-	<11.6	<10.7	<11.1	<14.2	<13.5	<14	<9.77	<11.1	<10.6
Fluorotelomer Carboxylic Acid, 3:3-	<13.6	<12.6	<13	<16.7	<15.9	<16.4	<11.5	<13	<12.5
Fluorotelomer Carboxylic Acid, 5:3-	<85.2	<78.5	<81.5	<105	<99.1	<103	<71.9	<81.4	<78.2
Fluorotelomer Carboxylic Acid, 7:3-	<85.2	<78.5	<81.5	<105	<99.1	<103	<71.9	<81.4	<78.2
Perfluorooctanesulfonamide	<3.41	<3.14	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.13
Methyl-perfluorooctanesulfonamide, N-	<3.41	<3.14	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.13
Ethyl-perfluorooctanesulfonamide, N-	<9.54	<8.79	<9.12	<11.7	<11.1	<11.5	<8.05	<9.12	<8.76
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.41	<3.14	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.13
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.41	<3.14	<3.26	<4.18	<3.97	<4.11	<2.87	<3.26	<3.13
Methyl-perfluorooctanesulfonamidoethanol, N-	<34.1	<31.4	<32.6	<41.8	<39.7	<41.1	<28.7	<32.6	<31.3
Ethyl-perfluorooctanesulfonamidoethanol, N-	<34.1	<31.4	<32.6	<41.8	<39.7	<41.1	<28.7	<32.6	<31.3

**Table G.3: Biosolid concentrations in ng/g dw by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 1/3**

SampleID	CSM-BIO-0083	DSRSD-BIO-0084	EBMUD-BIO-0089	EBMUD-BIO-0090	EBMUD-BIO-0091	EBMUD-BF-0096	EBMUD-BF-0097
StationCode	CSM	DSRSD	EBMUD	EBMUD	EBMUD	EBMUD	EBMUD
SampleDate	2022-04-26	2022-03-23	2022-06-03	2022-06-03	2022-07-05	2022-06-03	2022-06-03
MatrixName	biosolids	biosolids	biosolids	biosolids	biosolids	biosolids	biosolids
SampleTypeCode	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Unit	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw
Sum of Fluorine	161.6	1400.4	269.3	266.5	207.2	83.0	913.9
Sum of PFAS	250.13	2142.33	413.429	409.24	318.399	128.55	1389.23
Perfluorobutanoate	41.2 (IP)	606 (IP)	114 (IP)	117 (IP)	94.6 (IP)	48.2 (IP, J)	185 (IP)
Perfluoropentanoate	30.5 (IP)	340 (IP)	98.2 (IP)	99.8 (IP)	73.8 (IP)	32.1 (IP)	297 (IP)
Perfluorohexanoate	38.8 (IP)	291 (IP)	77.4 (IP)	66.6 (IP)	49.3 (IP)	29.1 (IP)	719 (IP)
Perfluoroheptanoate	10.9	165	23.9	24.7	18.3	7.17 (J)	150 (VFDP)
Perfluorooctanoate	14.6	228	29.2	28.7	26	7.91 (J)	18.9 (VFDP)
Perfluorononanoate	5.58	101	11.1	11.1	9.56	<3.96 (J,DF)	<3.68 (J,DF)
Perfluorodecanoate	11.4	96.5	12.7	13.7	10.6	<3.96	8.33 (J)
Perfluoroundecanoate	4.2 (J)	44.5	4.78	5.39	4.5	<3.96	<3.68
Perfluorododecanoate	5.29	48.5	6.5	6.04	4.52	<3.17	6.87 (J)
Perfluorotridecanoate	1.63 (J)	16.5 (J)	2.3 (J)	2.85 (J)	1.26 (J)	<3.96	<3.68
Perfluorotetradecanoate	1.53 (J)	22.7	2.73 (J)	3.26 (J)	2.35 (J)	<3.96	<3.68
Perfluorobutanesulfonate	<1.08	116	12.7	12.2	10.2	<3.96	<3.68
Perfluoropentanesulfonate	<1.09	<4.62	<0.839	<0.897	<0.838	<3.98	<3.7
Perfluorohexanesulfonate	1.19 (J)	6.33 (J)	0.919 (J)	<0.892	0.844 (J)	<3.96	<3.68
Perfluoroheptanesulfonate	<1.08	<4.6	<0.835	<0.892	<0.834	<3.96	<3.68
Perfluorooctanesulfonate	16.2	60.3	17	17.9	11.7	4.07 (J)	4.13 (J)
Perfluorononanesulfonate	<1.08	<4.6	<0.835	<0.892	<0.834	<3.96	<3.68
Perfluorodecanesulfonate	<1.08	<4.6	<0.835	<0.892	0.865 (J)	<3.96	<3.68
Perfluorododecanesulfonate	<1.08	<4.6	<0.835	<0.892	<0.834	<3.96	<3.68
Fluorotelomer Sulfonate, 4:2-	<4.33	<18.4	<3.34	<3.57	<3.33	<15.8	<14.7
Fluorotelomer Sulfonate, 6:2-	<3.9	<16.6	<3.01	<3.22	<3.01	<14.3	<13.3
Fluorotelomer Sulfonate, 8:2-	<3.68	<15.6	<2.84	<3.03	<2.83	<13.5	<12.5
Fluorotelomer Carboxylic Acid, 3:3-	<4.33	<18.4	<3.34	<3.57	<3.33	<15.8	<14.7
Fluorotelomer Carboxylic Acid, 5:3-	64.6 (J)	<115	<20.9	<22.3	<20.8	<99	<92.1
Fluorotelomer Carboxylic Acid, 7:3-	<27	<115	<20.9	<22.3	<20.8	<99	<92.1
Perfluorooctanesulfonamide	<1.08	<4.6	<0.835	<0.892	<0.834	<3.96	<3.68
Methyl-perfluorooctanesulfonamide, N-	<1.08	<4.6	<0.835	<0.892	<0.834	<3.96	<3.68
Ethyl-perfluorooctanesulfonamide, N-	<3.03	<12.9	<2.34	<2.5	<2.33	<11.1	<10.3
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	2.51 (J)	<4.6	<0.835	<0.892	<0.834	<3.96	<3.68
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<1.08 (J,DF)	<4.6	<0.835	<0.892	<0.834	<3.96	<3.68
Methyl-perfluorooctanesulfonamidoethanol, N-	<10.8	<46	<8.35	<8.92	<8.34	<39.6	<36.8
Ethyl-perfluorooctanesulfonamidoethanol, N-	<10.8	<46	<8.35	<8.92	<8.34	<39.6	<36.8
TOTAL SOLIDS	18.2	4	21.9	20.8	23.6	4.76	5.06

**Table G.3: Biosolid concentrations in ng/g dw by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 2/3**

SampleID	EBMUD-BF-0098	SFPUCOS-BIO-0094	SFPUCOS-BIO-0095	SFPUCOS-BF-0101	SFPUCOS-BF-0102	SFPUCSE-BIO-0092	SFPUCSE-BIO-0092
StationCode	EBMUD	SFPUCOS	SFPUCOS	SFPUCOS	SFPUCOS	SFPUCSE	SFPUCSE
SampleDate	2022-07-05	2022-05-23	2022-05-25	2022-05-23	2022-05-25	2022-05-23	2022-05-23
MatrixName	biosolids	biosolids	biosolids	biosolids	biosolids	biosolids	biosolids
SampleTypeCode	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Unit	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw
Sum of Fluorine	127.5	304.2	359.1	456.1	645.9	470.9	360.1
Sum of PFAS	193.81	464.94	548.68	701.76	1011.4	717.53	552.48
Perfluorobutanoate	51.6 (IP)	142 (IP)	173 (IP)	239 (IP)	333 (IP)	185 (IP)	178 (IP)
Perfluoropentanoate	40.6 (IP)	112 (IP)	124 (IP)	192 (IP)	243 (IP)	145 (IP)	131 (IP)
Perfluorohexanoate	35.6 (IP)	49.2 (IP)	70.7 (IP)	102 (IP)	147 (IP)	150 (IP)	69.2 (IP)
Perfluoroheptanoate	16.1	30.1	40.1	49	73.8	62.6	36.5 (IL)
Perfluorooctanoate	18.8	52.3	53.2	44.3	67.8	53.9	38.8
Perfluorononanoate	7.74 (J)	16.6	21.6	23.9	33.8	23.1	17.4
Perfluorodecanoate	9.27 (J)	17.1	18.8	16.4 (J)	24.6	28.3	16.5 (IL)
Perfluoroundecanoate	4.85 (J)	8.8	10.7	10.8 (J)	13.5 (J)	12.1	9.48
Perfluorododecanoate	4.06 (J)	11.3	12.1	8.82 (J)	11.8 (J)	16.8	12.7
Perfluorotridecanoate	<3.87	4.54	5.31	<5.51 (J,DF)	<5.75	4.79	3.86
Perfluorotetradecanoate	<3.87	4.21	5.02	<5.51	<5.75	5.25	5.5
Perfluorobutanesulfonate	<3.87	2.61 (J)	6.37	6.3 (J)	<5.75	9.76	8.65
Perfluoropentanesulfonate	<3.89	<1.06	<1.03	<5.54	<5.78	<0.979	<0.936
Perfluorohexanesulfonate	<3.87	<1.05	<1.02	<5.51	<5.75	3.56 (J)	3.59 (J)
Perfluoroheptanesulfonate	<3.87	<1.05	<1.02	<5.51	<5.75	<0.974	<0.931
Perfluorooctanesulfonate	5.19 (J)	6.55	6.46	9.24 (J)	13.9 (J)	16.2	18.8
Perfluorononanesulfonate	<3.87	<1.05	<1.02	<5.51	<5.75	<0.974	<0.931
Perfluorodecanesulfonate	<3.87	<1.05	<1.02	<5.51	<5.75	1.17 (J)	1.24 (J)
Perfluorododecanesulfonate	<3.87	<1.05	<1.02	<5.51	<5.75	<0.974	<0.931
Fluorotelomer Sulfonate, 4:2-	<15.5	<4.21	<4.09	<22	<23	<3.89	<3.72
Fluorotelomer Sulfonate, 6:2-	<13.9	6.22 (J)	<3.69	<19.9	49.2 (J)	<3.51	<3.36
Fluorotelomer Sulfonate, 8:2-	<13.2	<3.58	<3.48	<18.7	<19.5	<3.31	<3.17
Fluorotelomer Carboxylic Acid, 3:3-	<15.5	<4.21	<4.09	<22	<23	<3.89	<3.72
Fluorotelomer Carboxylic Acid, 5:3-	<96.7	<26.3	<25.6	<138	<144	<24.3	<23.3
Fluorotelomer Carboxylic Acid, 7:3-	<96.7	<26.3	<25.6	<138	<144	<24.3	<23.3
Perfluorooctanesulfonamide	<3.87	1.39 (J)	1.32 (J)	<5.51	<5.75	<0.974	1.26 (J)
Methyl-perfluorooctanesulfonamide, N-	<3.87	<1.05	<1.02	<5.51	<5.75	<0.974	<0.931
Ethyl-perfluorooctanesulfonamide, N-	<10.8	<2.95	<2.86	<15.4	<16.1	<2.73	<2.61
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.87	<1.05	<1.02	<5.51	<5.75	<0.974	<0.931
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.87	<1.05	<1.02	<5.51	<5.75	<0.974	<0.931
Methyl-perfluorooctanesulfonamidoethanol, N-	<38.7	<10.5	<10.2	<55.1	<57.5	<9.74	<9.31
Ethyl-perfluorooctanesulfonamidoethanol, N-	<38.7	<10.5	<10.2	<55.1	<57.5	<9.74	<9.31
TOTAL SOLIDS	4.96	18.2	19.1	3.57	3.38	20.6	

Table G.3: Biosolid concentrations in ng/g dw by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 3/3					
SampleID	SFPUCSE-BIO-0093	SFPUCSE-BF-00100	SFPUCSE-BF-0099	EBMUD-FW-0081	EBMUD-FW-0082
StationCode	SFPUCSE	SFPUCSE	SFPUCSE	EBMUD	EBMUD
SampleDate	2022-05-25	2022-05-25	2022-05-23	2022-07-05	2022-07-08
MatrixName	biosolids	biosolids	biosolids	biosolids	biosolids
SampleTypeCode	Grab	Grab	Grab	Grab	Grab
Unit	ng/g dw	ng/g dw	ng/g dw	ng/g dw	ng/g dw
Sum of Fluorine	271.5	365.5	154.9	9.8	0.0
Sum of PFAS	415.98	562.13	240.83	15.52	0
Perfluorobutanoate	123 (IP)	179 (IP)	61.5 (IP, J)	<12.5	<40.4
Perfluoropentanoate	96.7 (IP)	140 (IP)	56.5(IP, J)	10.1 (IP, J)	<20.2
Perfluorohexanoate	70.2 (IP)	104 (IP)	46.5(IP, J)	5.42 (IP, J)	<10.1
Perfluoroheptanoate	27.9	37.5	13.7 (J)	<3.13	<10.1
Perfluorooctanoate	28.2	36.3	12.4 (J)	<3.13	<10.1
Perfluorononanoate	12.2	17.4 (J)	8.56 (J)	<3.13	<10.1
Perfluorodecanoate	12.1	18.6 (J)	6.04 (J)	<3.13	<10.1
Perfluoroundecanoate	6.7	<5.13 (J,DF)	<4.18	<3.13	<10.1
Perfluorododecanoate	8.67	9.52 (J)	<3.34	<2.51	<8.08
Perfluorotridecanoate	2.7 (J)	<5.13	<4.53	<3.13	<10.1
Perfluorotetradecanoate	3.25 (J)	<5.13	<4.18	<3.13	<10.1
Perfluorobutanesulfonate	5.33	10.5 (J)	<4.18	<3.13	<10.1
Perfluoropentanesulfonate	<0.862	<5.15	<4.2	<3.15	<10.2
Perfluorohexanesulfonate	3.27 (J)	<5.13	<4.18	<3.13	<10.1
Perfluoroheptanesulfonate	<0.858	<5.13	<4.18	<3.13	<10.1
Perfluorooctanesulfonate	14.7	9.31 (J)	8.23 (J)	<3.13	<10.1
Perfluorononanesulfonate	<0.858	<5.13	<4.18	<3.13	<10.1
Perfluorodecanesulfonate	1.06 (J)	<5.13	<4.18	<3.13	<10.1
Perfluorododecanesulfonate	<0.858	<5.13	<4.18	<3.13	<10.1
Fluorotelomer Sulfonate, 4:2-	<3.43	<20.5	<16.7	<12.5	<40.4
Fluorotelomer Sulfonate, 6:2-	<3.09	<18.5	27.4 (J)	<11.3	<36.4
Fluorotelomer Sulfonate, 8:2-	<2.92	<17.4	<14.2	<10.7	<34.3
Fluorotelomer Carboxylic Acid, 3:3-	<3.43	<20.5	<16.7	<12.5	<40.4
Fluorotelomer Carboxylic Acid, 5:3-	<21.5	<128	<104	<78.4	<253
Fluorotelomer Carboxylic Acid, 7:3-	<21.5	<128	<104	<78.4	<253
Perfluorooctanesulfonamide	<0.858	<5.13	<4.18	<3.13	<10.1
Methyl-perfluorooctanesulfonamide, N-	<0.858	<5.13	<4.18	<3.13	<10.1
Ethyl-perfluorooctanesulfonamide, N-	<2.4	<14.4	<11.7	<8.78	<28.3
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<0.858	<5.13	<4.18	<3.13	<10.1
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<0.858	<5.13	<4.18	<3.13	<10.1
Methyl-perfluorooctanesulfonamidoethanol, N-	<8.58	<51.3	<41.8	<31.3	<101
Ethyl-perfluorooctanesulfonamidoethanol, N-	<8.58	<51.3	<41.8	<31.3	<101
TOTAL SOLIDS	21.5	3.74	4.67	5.93	1.98

Table G.4: Residential sewershed sample concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 1/4							
SampleID	CCCSD-RS-2037	CCCSD-RS-2038	CCCSD-RS-2039	CCCSD-RS-2040	CCCSD-FBS-2041	EBMUD-RS-2042	EBMUD-RS-2043
StationCode	CCCSD	CCCSD	CCCSD	CCCSD	CCCSD	EBMUD	EBMUD
SampleDate	2022-04-21	2022-04-21	2022-04-11	2022-04-20	2022-04-21	2022-06-07	2022-06-08
MatrixName	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed
SampleTypeCode	Composite	Composite	Composite	Composite	FieldBlank	Composite	Composite
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	196.2	154.8	524.0	191.9	0.0	123.1	96.3
Sum of PFAS	299.08	237.42	789.96	296.34	0	187.02	146.88
Perfluorobutanoate	63.5	60.7	144	100	<13.3	41.7 (J)	37.3 (J)
Perfluoropentanoate	85.5	80.4	207	106	<6.64	50.2	37.2
Perfluorohexanoate	61.3	34	122	43	<3.32	39.4	33.2
Perfluoroheptanoate	26.8	18	93.6	21.6	<3.32	18.1	14.8 (J)
Perfluorooctanoate	31.4	23.9	71.9	15.3	<3.35	18.6	13.5 (J)
Perfluorononanoate	12.8 (J)	7.36 (J)	54.3	6.35 (J)	<3.32	8.03 (J)	6.71 (J)
Perfluorodecanoate	7.91 (J)	3.99 (J)	33.6	4.09 (J)	<3.32	7.84 (J)	4.17 (J)
Perfluoroundecanoate	<3.62	<3.46	26.1	<3.76	<3.32	<3.9	<3.73
Perfluorododecanoate	<2.9	<2.77	15.4	<3.01	<2.66	3.15 (J)	<2.98
Perfluorotridecanoate	<3.62	<3.46	9.35 (J)	<3.76	<3.32	<3.9	<3.73
Perfluorotetradecanoate	<3.62	<3.46	7.89 (J)	<3.76	<3.32	<3.9	<3.73
Perfluorobutanesulfonate	<3.62	<3.46	<3.6	<3.76	<3.32	<3.9	<3.73
Perfluoropentanesulfonate	<3.64	<3.48	<3.62	<3.78	<3.34	<3.92	<3.75
Perfluorohexanesulfonate	<3.62	<3.46	<3.6	<3.76	<3.32	<3.9	<3.73
Perfluoroheptanesulfonate	<3.62	<3.46	<3.6	<3.76	<3.32	<3.9	<3.73
Perfluorooctanesulfonate	9.87 (J)	9.07 (J)	4.82 (J)	<3.76	<3.32	<3.9	<3.73
Perfluorononanesulfonate	<3.62	<3.46	<3.6	<3.76	<3.32	<3.9	<3.73
Perfluorodecanesulfonate	<3.62	<3.46	<3.6	<3.76	<3.32	<3.9	<3.73
Perfluorododecanesulfonate	<3.62 (VEUM)	<3.46 (VEUM)	<3.6 (VEUM)	<3.76 (VEUM)	<3.32	<3.9 (VEUM)	<3.73 (VEUM)
Fluorotelomer Sulfonate, 4:2-	<14.5	<13.9	<14.4	<15	<13.3	<15.6	<14.9
Fluorotelomer Sulfonate, 6:2-	<13.1	<12.5	<13	<13.5	<12	<14	<13.4
Fluorotelomer Sulfonate, 8:2-	<12.3	<11.8	<12.2	<12.8	<11.3	<13.3	<12.7
Fluorotelomer Carboxylic Acid, 3:3-	<14.5	<13.9	<14.4	<15	<13.3	<15.6	<14.9
Fluorotelomer Carboxylic Acid, 5:3-	<90.6	<86.6	<90	<93.9	<83	<97.4	<93.2
Fluorotelomer Carboxylic Acid, 7:3-	<90.6	<86.6	<90	<93.9	<83	<97.4	<93.2
Perfluorooctanesulfonamide	<3.62	<3.46	<3.6	<3.76	<3.32	<3.9	<3.73
Methyl-perfluorooctanesulfonamide, N-	<3.62	<3.46	<3.6	<3.76	<3.32	<3.9	<3.73
Ethyl-perfluorooctanesulfonamide, N-	<10.1	<9.7	<10.1	<10.5	<9.29	<10.9	<10.4
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.62	<3.46	<3.6	<3.76	<3.32	<3.9	<3.73
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.62	<3.46	<3.6	<3.76	<3.32	<3.9	<3.73
Methyl-perfluorooctanesulfonamidoethanol, N-	<36.2	<34.6	<35.1	<37.6	<33.2	<39	<37.3
Ethyl-perfluorooctanesulfonamidoethanol, N-	<36.2	<34.6	<36	<37.6	<33.2	<39	<37.3

**Table G.4: Residential sewershed sample concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 2/4**

SampleID	SFPUC-RS-2044	SFPUC-RS-2045	SFPUC-RS-2046	SFPUC-RS-2047	SFPUC-RS-2048	SFPUC-RS-2049	SFPUC-RS-2050
StationCode	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC
SampleDate	2022-06-08	2022-06-08	2022-06-10	2022-06-13	2022-07-08	2022-05-13	2022-05-13
MatrixName	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed
SampleTypeCode	Composite	Composite	Composite	Composite	Grab	Grab	Composite
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	372.5	376.6	179.3	71.0	2.6	555.1	66.2
Sum of PFAS	595.57	603.3	285.26	109.07	3.93	849.9	100.68
Perfluorobutanoate	485	496	213	32.1 (J)	<11.9	191	21.9 (J)
Perfluoropentanoate	46.8	50.9	28.9	27	<5.94	294	22.1 (J)
Perfluorohexanoate	23.9	17.3	17.8	18.4	3.93 (J)	198	29
Perfluoroheptanoate	8.6 (J)	10.6 (J)	7.48 (J)	8.98 (J)	<2.97	91.7	10 (J)
Perfluorooctanoate	7.14 (J)	<2.97 (J,DF)	8.73 (J)	12.2	<2.97	42.1	13.4
Perfluorononanoate	3.23 (J)	3.1 (J)	<2.89	3.89 (J)	<2.97	20.8	4.28 (J)
Perfluorodecanoate	<2.9	<2.97	<2.89	3.46 (J)	<2.97	12.3 (J)	<3.04
Perfluoroundecanoate	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13 (J,DF)	<3.04
Perfluorododecanoate	<2.32	<2.38	<2.31	<2.35 (J,DF)	<2.38	<2.5	<2.43 (J,DF)
Perfluorotridecanoate	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13	<3.04
Perfluorotetradecanoate	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13	<3.04
Perfluorobutanesulfonate	20.9	25.4	9.35 (J)	3.04 (J)	<2.97	<3.13	<3.04
Perfluoropentanesulfonate	<2.92	<2.99	<2.91	<2.95	<2.99	<3.15	<3.06
Perfluorohexanesulfonate	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13	<3.04
Perfluoroheptanesulfonate	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13	<3.04
Perfluorooctanesulfonate	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13	<3.04
Perfluorononanesulfonate	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13	<3.04
Perfluorodecanesulfonate	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13	<3.04
Perfluorododecanesulfonate	<2.9 (VEUM)	<2.97 (VEUM)	<2.89 (VEUM)	<2.94 (VEUM)	<2.97 (VEUM)	<3.13 (VEUM)	<3.04 (VEUM)
Fluorotelomer Sulfonate, 4:2-	<11.6	<11.9	<11.6	<11.7	<11.9	<12.5	<12.2
Fluorotelomer Sulfonate, 6:2-	<10.5	<10.7	<10.4	<10.6	<10.7	<11.3	<11
Fluorotelomer Sulfonate, 8:2-	<9.87	<10.1	<9.83	<9.98	<10.1	<10.6	<10.3
Fluorotelomer Carboxylic Acid, 3:3-	<11.6	<11.9	<11.6	<11.7	<11.9	<12.5	<12.2
Fluorotelomer Carboxylic Acid, 5:3-	<72.6	<74.4	<72.3	<73.4	<74.3	<78.3	<76
Fluorotelomer Carboxylic Acid, 7:3-	<72.6	<74.4	<72.3	<73.4	<74.3	<78.3	<76
Perfluorooctanesulfonamide	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13	<3.04
Methyl-perfluorooctanesulfonamide, N-	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13	<3.04
Ethyl-perfluorooctanesulfonamide, N-	<8.13	<8.33	<8.1	<8.22	<8.32	<8.77	<8.52
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13	<3.04
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<2.9	<2.97	<2.89	<2.94	<2.97	<3.13	<3.04
Methyl-perfluorooctanesulfonamidoethanol, N-	<29	<29.7	<28.9	<29.4	<29.7	<31.3	<30.4
Ethyl-perfluorooctanesulfonamidoethanol, N-	<29	<29.7	<28.9	<29.4	<29.7	<31.3	<30.4

**Table G.4: Residential sewershed sample concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 3/4**

SampleID	SFPUC-RS-2051	SFPUC-RS-2052	SFPUC-RS-2053	SFPUC-RS-2054	SFPUC-RS-2055	SFPUC-RS-2056	SFPUC-FBS-2057
StationCode	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC	SFPUC
SampleDate	2022-05-16	2022-05-13	2022-06-17	2022-06-27	2022-06-17	2022-07-14	2022-05-13
MatrixName	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed	Residential Sewershed
SampleTypeCode	Composite	Grab	Grab	Grab	Grab	Composite	FieldBlank
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	53.7	86.8	128.0	19.2	268.8	69.2	0.0
Sum of PFAS	82.28	131.82	192.94	29	407.87	106.06	0
Perfluorobutanoate	21.1 (J)	27.5 (J)	37.2 (J)	<11.7	76.7	26.7 (J)	<11.3
Perfluoropentanoate	23.1 (J)	35.7	35.9	11 (J)	120	31.4	<5.67
Perfluorohexanoate	23.7	25.5	43	10 (J)	87	22.6	<2.84
Perfluoroheptanoate	10.1 (J)	17.2	25.1	4.59 (J)	42.5	8.1 (J)	<2.84
Perfluorooctanoate	<3.19 (DF)	13.3	27.6	3.41 (J)	40	10.2 (J)	<3.71
Perfluorononanoate	4.28 (J)	8.43 (J)	8.75 (J)	<2.94	18.2	3.79 (J)	<2.84
Perfluorodecanoate	<2.95	4.19 (J)	7.44 (J)	<2.94	13.8	<2.99	<2.84
Perfluoroundecanoate	<2.95	<2.94	3.55 (J)	<2.94	4.96 (J)	<2.99	<2.84
Perfluorododecanoate	<2.36	<2.35	4.4 (J)	<2.35	4.71 (J)	<2.39	<2.27
Perfluorotridecanoate	<2.95	<2.94	<2.94	<2.94	<3.11	<2.99	<2.84
Perfluorotetradecanoate	<2.95	<2.94	<2.94	<2.94	<3.11	<2.99	<2.84
Perfluorobutanesulfonate	<2.95	<2.94	<2.94	<2.94	<3.11	<2.99	<2.84
Perfluoropentanesulfonate	<2.96	<2.95	<2.96	<2.95	<3.12	<3.01	<2.85
Perfluorohexanesulfonate	<2.95	<2.94	<2.94	<2.94	<3.11	<2.99	<2.84
Perfluoroheptanesulfonate	<2.95	<2.94	<2.94	<2.94	<3.11	<2.99	<2.84
Perfluorooctanesulfonate	<2.95	<2.94	<2.94	<2.94	<3.11	3.27 (J)	<2.84
Perfluorononanesulfonate	<2.95	<2.94	<2.94	<2.94	<3.11	<2.99	<2.84
Perfluorodecanesulfonate	<2.95	<2.94	<2.94	<2.94	<3.11	<2.99	<2.84
Perfluorododecanesulfonate	<2.95 (VEUM)	<2.94 (VEUM)	<2.94 (VEUM)	<2.94 (VEUM)	<3.11 (VEUM)	<2.99 (VEUM)	<2.84
Fluorotelomer Sulfonate, 4:2-	<11.8	<11.7	<11.8	<11.7	<12.4	<12	<11.3
Fluorotelomer Sulfonate, 6:2-	<10.6	<10.6	<10.6	<10.6	<11.2	<10.8	<10.2
Fluorotelomer Sulfonate, 8:2-	<10	<9.98	<10	<9.99	<10.6	<10.2	<9.64
Fluorotelomer Carboxylic Acid, 3:3-	<11.8	<11.7	<11.8	<11.7	<12.4	<12	<11.3
Fluorotelomer Carboxylic Acid, 5:3-	<73.7	<73.4	<73.6	<73.4	<77.6	<74.8	<70.9
Fluorotelomer Carboxylic Acid, 7:3-	<73.7	<73.4	<73.6	<73.4	<77.6	<74.8	<70.9
Perfluorooctanesulfonamide	<2.95	<2.94	<2.94	<2.94	<3.11	<2.99	<2.84
Methyl-perfluorooctanesulfonamide, N-	<2.95	<2.94	<2.94	<2.94	<3.11	<2.99	<2.84
Ethyl-perfluorooctanesulfonamide, N-	<8.25	<8.22	<8.24	<8.22	<8.69	<8.37	<7.94
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<2.95	<2.94	<2.94	<2.94	<3.11	<2.99	<2.84
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<2.95	<2.94	<2.94	<2.94	<3.11	<2.99	<2.84
Methyl-perfluorooctanesulfonamidoethanol, N-	<29.5	<29.4	<29.4	<29.4	<31.1	<29.9	<28.4
Ethyl-perfluorooctanesulfonamidoethanol, N-	<29.5	<29.4	<29.4	<29.4	<31.1	<29.9	<28.4

Table G.4: Residential sewershed sample concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 4/4		
SampleID	SFPUC-FBS-2058	SFPUC-FBS-2060
StationCode	SFPUC	SFPUC
SampleDate	2022-05-13	2022-07-13
MatrixName	Residential Sewershed	Residential Sewershed
SampleTypeCode	FieldBlank	FieldBlank
Unit	ng/L	ng/L
Sum of Fluorine	0.0	0.0
Sum of PFAS	0	0
Perfluorobutanoate	<12.1	<11.5
Perfluoropentanoate	<6.07	<5.73
Perfluorohexanoate	<3.03	<2.86
Perfluoroheptanoate	<3.03	<2.86
Perfluorooctanoate	<3.03	<3.01
Perfluorononanoate	<3.03	<2.86
Perfluorodecanoate	<3.03	<2.86
Perfluoroundecanoate	<3.03	<2.86
Perfluorododecanoate	<2.43	<2.29
Perfluorotridecanoate	<3.03	<2.86
Perfluorotetradecanoate	<3.03	<2.86
Perfluorobutanesulfonate	<3.03	<2.86
Perfluoropentanesulfonate	<3.05	<2.88
Perfluorohexanesulfonate	<3.03	<2.86
Perfluoroheptanesulfonate	<3.03	<2.86
Perfluorooctanesulfonate	<3.03	<2.86
Perfluorononanesulfonate	<3.03	<2.86
Perfluorodecanesulfonate	<3.03	<2.86
Perfluorododecanesulfonate	<3.03	<2.86
Fluorotelomer Sulfonate, 4:2-	<12.1	<11.5
Fluorotelomer Sulfonate, 6:2-	<10.9	<10.3
Fluorotelomer Sulfonate, 8:2-	<10.3	<9.74
Fluorotelomer Carboxylic Acid, 3:3-	<12.1	<11.5
Fluorotelomer Carboxylic Acid, 5:3-	<75.8	<71.6
Fluorotelomer Carboxylic Acid, 7:3-	<75.8	<71.6
Perfluorooctanesulfonamide	<3.03	<2.86
Methyl-perfluorooctanesulfonamide, N-	<3.03	<2.86
Ethyl-perfluorooctanesulfonamide, N-	<8.49	<8.02
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.03	<2.86
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.03	<2.86
Methyl-perfluorooctanesulfonamidoethanol, N-	<30.3	<28.6
Ethyl-perfluorooctanesulfonamidoethanol, N-	<30.3	<28.6

**Table G.5: Industrial sewershed sample concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 1/6**

Industry	Hospital	Hospital	Laundry	Hospital	Jail/Laundry	Jail/Laundry	Military Site
SampleDate	2022-04-20	2022-04-11	2022-04-12	2022-04-20	2022-05-10	2022-05-11	2022-05-11
MatrixName	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed
SampleTypeCode	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	18.7	0.0	576.4	0.0	81.0	158.1	54.7
Sum of PFAS	28.4	0	892.35	0	126.11	244.56	85.32
Perfluorobutanoate	<14.6	<13	278	<16.6	19.9 (J)	53.8 (I)	15.1 (J)
Perfluoropentanoate	13.8 (J)	<6.51	350	<8.3	21.2 (J)	72	13.5 (J)
Perfluorohexanoate	10.1 (J)	<3.25 (J,DF)	174	<4.15	21	37.9	12 (J)
Perfluoroheptanoate	4.5 (J)	<3.25	37.2	<4.15	8.36 (J)	17.6	3.97 (J)
Perfluorooctanoate	<3.66	<3.25	24.6	<4.15	8.82 (J)	14.7	5.93 (J)
Perfluorononanoate	<3.66	<3.25	12.5 (J)	<4.15	<3.31	4.29 (J)	<3.24
Perfluorodecanoate	<3.66	<3.25	5.75 (J)	<4.15	<3.31	<3.45	<3.24
Perfluoroundecanoate	<3.66	<3.25	<3.51	<4.15	<3.31	<3.45	<3.24
Perfluorododecanoate	<2.93	<2.6	<2.81 (J,DF)	<3.32	<2.64	<2.76	<2.59
Perfluorotridecanoate	<3.66	<3.25	<3.51	<4.15	<3.31	<3.45	<3.24
Perfluorotetradecanoate	<3.66	<3.25	<3.51	<4.15	<3.31	<3.45	<3.24
Perfluorobutanesulfonate	<3.66	<3.25	4.83 (J)	<4.15	5.01 (J)	3.97 (J)	3.52 (J)
Perfluoropentanesulfonate	<3.68	<3.27	<3.52	<4.17	3.42 (J)	<3.47	<3.25
Perfluorohexanesulfonate	<3.66	<3.25	<3.51	<4.15	18.4	17.1	15.2
Perfluoroheptanesulfonate	<3.66	<3.25	<3.51	<4.15	<3.31	<3.45	<3.24
Perfluorooctanesulfonate	<3.66	<3.25	5.47 (J)	<4.15	20	23.2	16.1
Perfluorononanesulfonate	<3.66	<3.25	<3.51	<4.15	<3.31	<3.45	<3.24
Perfluorodecanesulfonate	<3.66	<3.25	<3.51	<4.15	<3.31	<3.45	<3.24
Perfluorododecanesulfonate	<3.66	<3.25	<3.51	<4.15	<3.31	<3.45	<3.24
Fluorotelomer Sulfonate, 4:2-	<14.6	<13	<14	<16.6	<13.2	<13.8	<12.9
Fluorotelomer Sulfonate, 6:2-	<13.2	<11.7	<12.6	<15	<11.9	<12.4	<11.7
Fluorotelomer Sulfonate, 8:2-	<12.4	<11.1	<11.9	<14.1	<11.2	<11.7	<11
Fluorotelomer Carboxylic Acid, 3:3-	<14.6	<13	<14	<16.6	<13.2	<13.8	<12.9
Fluorotelomer Carboxylic Acid, 5:3-	<91.5	<81.4	<87.7	<104	<82.6	<86.3	<80.9
Fluorotelomer Carboxylic Acid, 7:3-	<91.5	<81.4	<87.7	<104	<82.6	<86.3	<80.9
Perfluorooctanesulfonamide	<3.66	<3.25	<3.51	<4.15	<3.31	<3.45	<3.24
Methyl-perfluorooctanesulfonamide, N-	<3.66	<3.25	<3.51	<4.15	<3.31	<3.45	<3.24
Ethyl-perfluorooctanesulfonamide, N-	<10.3	<9.11	<9.82	<11.6	<9.26	<9.66	<9.06
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.66	<3.25	<3.51	<4.15	<3.31	<3.45	<3.24
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.66	<3.25	<3.51	<4.15	<3.31	<3.45	<3.24
Methyl-perfluorooctanesulfonamidoethanol, N-	<36.6	<32.5	<35.1	<41.5	<33.1	<34.5	<32.4
Ethyl-perfluorooctanesulfonamidoethanol, N-	<36.6	<32.5	<35.1	<41.5	<33.1	<34.5	<32.4

**Table G.5: Industrial sewershed sample concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 2/6**

Industry	Military Site	Laundry	Laundry	Laundry	Laundry	Car Wash	Car Wash
SampleDate	2022-05-10	2022-06-23	2022-06-23	2022-06-23	2022-06-24	2022-06-03	2022-06-03
MatrixName	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed
SampleTypeCode	Grab	Grab	Grab	MS1	Grab	Grab	Grab
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	126.4	447.5	502.9	4640.1	657.0	271.8	182.3
Sum of PFAS	190.97	694.82	780.52	7386.16	1022.65	414.85	277.68
Perfluorobutanoate	19.6 (I)	216	238	975	372	72.9	61
Perfluoropentanoate	28.3	273	306	706	447	54.4	50.9
Perfluoroheptanoate	24.6	133	171	629	153	74	59
Perfluoroheptanoate	31.4	34.3 (VGB)	34.3	337 (VGB)	34.5	35.2	24.5
Perfluorooctanoate	24.6	10.2 (I,VGB)	10.4 (I)	756 (VGB)	10.7 (I)	65.1	29.7
Perfluorononanoate	15	6.6 (I,VGB)	5.22 (I)	173 (VGB)	5.45 (I)	12.8	10.4 (I)
Perfluorodecanoate	9.15 (I)	4.32 (I)	<4.07	115	<4.44	12.4	12.3
Perfluoroundecanoate	5.3 (I)	<3.97	<4.07	103	<4.44	4.21	4.19 (I)
Perfluorododecanoate	<2.65	<3.18	<3.26	109	<3.56	<2.3 (I,DF)	<2.33 (I,DF)
Perfluorotridecanoate	<3.31	<3.97	<4.07	109	<4.44	<2.88	<2.91
Perfluorotetradecanoate	<3.31	<3.97	<4.07	93.6	<4.44	2.99 (I)	6.13 (I)
Perfluorobutanesulfonate	4.12 (I)	<3.97	<4.07	89.6	<4.44	6.77 (I)	5.55 (I)
Perfluoropentanesulfonate	<3.32	<3.99	<4.1	98.1	<4.47	<2.89	<2.93
Perfluorohexanesulfonate	12.3 (I)	<3.97	<4.07	89.3	<4.44	22.2	<2.91
Perfluoroheptanesulfonate	<3.31	<3.97	<4.07	103	<4.44	<2.88	<2.91
Perfluorooctanesulfonate	16.6	<3.97 (VGB)	<4.07	110 (VGB)	<4.44	45.5	10.3 (I)
Perfluorononanesulfonate	<3.31	<3.97	<4.07	96.8	<4.44	<2.88	<2.91
Perfluorodecanesulfonate	<3.31	<3.97	<4.07	103	<4.44	<2.88	<2.91
Perfluorododecanesulfonate	<3.31	<3.97	<4.07	85.6	<4.44	<2.88	<2.91
Fluorotelomer Sulfonate, 4:2-	<13.2	<15.9 (VGB)	<16.3	933 (VGB)	<17.8	<11.5	<11.6
Fluorotelomer Sulfonate, 6:2-	<11.9	17.4 (I,VGB)	15.6 (I)	760 (VGB)	<16	<10.4	<10.5
Fluorotelomer Sulfonate, 8:2-	<11.2	<13.5 (VGB)	<13.9	781 (VGB)	<15.1	<9.79	<9.9
Fluorotelomer Carboxylic Acid, 3:3-	<13.2	<15.9	<16.3		<17.8	<11.5	<11.6
Fluorotelomer Carboxylic Acid, 5:3-	<82.7	<99.3	<102		<111	<72	<72.8 (I,DF)
Fluorotelomer Carboxylic Acid, 7:3-	<82.7	<99.3	<102		<111	<72	<72.8
Perfluorooctanesulfonamide	<3.31	<3.97 (VGB)	<4.07	22.9 (VGB)	<4.44	6.38 (I)	3.71 (I)
Methyl-perfluorooctanesulfonamide, N-	<3.31	<3.97	<4.07	<4.08	<4.44	<2.88	<2.91
Ethyl-perfluorooctanesulfonamide, N-	<9.26	<11.1	<11.4	<11.4	<12.4	<8.06	<8.15
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.31	<3.97	<4.07	8.26 (I)	<4.44	<2.88	<2.91
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.31	<3.97	<4.07	<4.08 (I,DF)	<4.44	<2.88	<2.91
Methyl-perfluorooctanesulfonamidoethanol, N-	<33.1	<39.7	<40.7	<40.8	<44.4	<28.8	<29.1
Ethyl-perfluorooctanesulfonamidoethanol, N-	<33.1	<39.7	<40.7	<40.8	<44.4	<28.8	<29.1

**Table G.5: Industrial sewershed sample concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 3/6**

Industry	Hospital	Laundry	Laundry	Hospital	Chemical	Chrome Plating	Chrome Plating
SampleDate	2022-05-20	2022-05-20	2022-06-03	2022-05-20	2022-05-24	2022-05-23	2022-05-24
MatrixName	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed
SampleTypeCode	Grab	Grab	Grab	Grab	Grab	Grab	Composite
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	0.0	37.6	187.9	0.0	5.0	0.0	1.7
Sum of PFAS	0	58.16	284.61	0	7.2	0	2.61
Perfluorobutanoate	<11.1	22.4 (J)	53	<11.1	<12.2	<11.9	<9.69
Perfluoropentanoate	<5.56	15.2 (J)	57.8	<5.57	<6.08	<5.97	<4.84
Perfluorohexanoate	<2.78	13.4	57	<2.78 (J,DF)	<3.04	<2.99	2.61 (J)
Perfluoroheptanoate	<2.78	3.31 (J)	32.9	<2.78	<3.04	<2.99	<2.42
Perfluorooctanoate	<2.78	3.85 (J)	34	<2.78 (J,DF)	7.2 (J)	<2.99	<2.42
Perfluorononanoate	<2.78	<2.81	12.9	<2.78	<3.04	<2.99	<2.42
Perfluorodecanoate	<2.78	<2.81	14.9	<2.78	<3.04	<2.99	<2.42
Perfluoroundecanoate	<2.78	<2.81	3.43 (J)	<2.78	<3.04	<2.99	<2.42
Perfluorododecanoate	<2.22	<2.25	5.8 (J)	<2.23	<2.43	<2.39	<1.94
Perfluorotridecanoate	<2.78	<2.81	<2.83 (J,DF)	<2.78	<3.04	<2.99	<2.42
Perfluorotetradecanoate	<2.78	<2.81	<2.83	<2.78	<3.04	<2.99	<2.42
Perfluorobutanesulfonate	<2.78	<2.81	5 (J)	<2.78	<3.04	<2.99	<2.42
Perfluoropentanesulfonate	<2.79	<2.82	<2.84	<2.8	<3.06	<3	<2.43
Perfluorohexanesulfonate	<2.78	<2.81	<2.83	<2.78	<3.04	<2.99	<2.42
Perfluoroheptanesulfonate	<2.78	<2.81	<2.83	<2.78	<3.04	<2.99	<2.42
Perfluorooctanesulfonate	<2.78	<2.81	7.88 (J)	<2.78	<3.04	<2.99	<2.42
Perfluorononanesulfonate	<2.78	<2.81	<2.83	<2.78	<3.04	<2.99	<2.42
Perfluorodecanesulfonate	<2.78	<2.81	<2.83	<2.78	<3.04	<2.99	<2.42
Perfluorododecanesulfonate	<2.78	<2.81	<2.83	<2.78	<3.04	<2.99	<2.42
Fluorotelomer Sulfonate, 4:2-	<11.1	<11.2	<11.3	<11.1	<12.2	<11.9	<9.69
Fluorotelomer Sulfonate, 6:2-	<10	<10.1	<10.2	<10	<11	<10.8	<8.73
Fluorotelomer Sulfonate, 8:2-	<9.45	<9.55	<9.61	<9.47	<10.3	<10.2	<8.23
Fluorotelomer Carboxylic Acid, 3:3-	<11.1	<11.2	<11.3	<11.1	<12.2	<11.9	<9.69
Fluorotelomer Carboxylic Acid, 5:3-	<69.5	<70.2	<70.7	<69.6	<76	<74.7	<60.5
Fluorotelomer Carboxylic Acid, 7:3-	<69.5	<70.2	<70.7	<69.6	<76	<74.7	<60.5
Perfluorooctanesulfonamide	<2.78	<2.81	<2.83	<2.78	<3.04	<2.99	<2.42
Methyl-perfluorooctanesulfonamide, N-	<2.78	<2.81	<2.83	<2.78	<3.04	<2.99	<2.42
Ethyl-perfluorooctanesulfonamide, N-	<7.78	<7.86	<7.91	<7.8	<8.52	<8.36	<6.78
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<2.78	<2.81	<2.83	<2.78	<3.04	<2.99	<2.42
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<2.78	<2.81	<2.83	<2.78	<3.04	<2.99	<2.42
Methyl-perfluorooctanesulfonamidoethanol, N-	<27.8	<28.1	<28.3	<27.8	<30.4	<29.9	<24.2
Ethyl-perfluorooctanesulfonamidoethanol, N-	<27.8	<28.1	<28.3	<27.8	<30.4	<29.9	<24.2

**Table G.5: Industrial sewershed sample concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 4/6**

Industry	Chrome Plating	Chrome Plating	Chrome Reduction	Chrome Reduction	Chemical	Semiconductor	Semiconductor
SampleDate	2022-05-04	2022-05-06	2022-05-16	2022-05-16	2022-05-25	2022-05-09	2022-05-09
MatrixName	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed
SampleTypeCode	Grab	Composite	Grab	Composite	Composite	Grab	Grab
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	0.0	0.0	13.3	27.1	5.7	2.6	0.0
Sum of PFAS	0	0	22.36	45.07	8.22	3.82	0
Perfluorobutanoate	<13.9	<13.2	<13.7	16.2 (I)	<12.2	<12.9	<14.4
Perfluoropentanoate	<6.94	<6.61	<6.84	<6.72	<6.1	<6.43	<7.18
Perfluorohexanoate	<3.47	<3.31	<3.42 (I,DF)	<3.36 (I,DF)	<3.05	<3.21	<3.59
Perfluoroheptanoate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Perfluorooctanoate	<3.47	<3.31	<3.42 (I,DF)	<3.36 (I,DF)	8.22 (I)	3.82 (I)	<3.59
Perfluorononanoate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Perfluorodecanoate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Perfluoroundecanoate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Perfluorododecanoate	<2.77	<2.64	<2.74	<2.69	<2.44	<2.57	<2.87
Perfluorotridecanoate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Perfluorotetradecanoate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Perfluorobutanesulfonate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Perfluoropentanesulfonate	<3.49	<3.32	<3.44	<3.38	<3.06	<3.23	<3.61
Perfluorohexanesulfonate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Perfluoroheptanesulfonate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Perfluorooctanesulfonate	<3.47	<3.31	5.66 (I)	5.37 (I)	<3.05	<3.21	<3.59
Perfluorononanesulfonate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Perfluorodecanesulfonate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Perfluorododecanesulfonate	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Fluorotelomer Sulfonate, 4:2-	<13.9	<13.2	<13.7	<13.4	<12.2	<12.9	<14.4
Fluorotelomer Sulfonate, 6:2-	<12.5	<11.9	16.7 (I)	23.5 (I)	<11	<11.6	<12.9
Fluorotelomer Sulfonate, 8:2-	<11.8	<11.2	<11.6	<11.4	<10.4	<10.9	<12.2
Fluorotelomer Carboxylic Acid, 3:3-	<13.9	<13.2	<13.7	<13.4	<12.2	<12.9	<14.4
Fluorotelomer Carboxylic Acid, 5:3-	<86.7	<82.6	<85.5	<84.1	<76.2	<80.4	<89.7
Fluorotelomer Carboxylic Acid, 7:3-	<86.7	<82.6	<85.5	<84.1	<76.2	<80.4	<89.7
Perfluorooctanesulfonamide	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Methyl-perfluorooctanesulfonamide, N-	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Ethyl-perfluorooctanesulfonamide, N-	<9.71	<9.26	<9.58	<9.41	<8.53	<9	<10
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.47	<3.31	<3.42	<3.36	<3.05	<3.21	<3.59
Methyl-perfluorooctanesulfonamidoethanol, N-	<34.7	<33.1	<34.2	<33.6	<30.5	<32.1	<35.9
Ethyl-perfluorooctanesulfonamidoethanol, N-	<34.7	<33.1	<34.2	<33.6	<30.5	<32.1	<35.9

**Table G.5: Industrial sewershed sample concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 5/6**

Industry	Semiconductor	Laundry	Laundry	Laundry	Laundry	Paper Pulp	Paper Pulp
SampleDate	2022-05-05	2022-05-18	2022-05-18	2022-05-19	2022-05-02	2022-05-19	2022-05-24
MatrixName	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed	Industrial Sewershed
SampleTypeCode	Composite	Grab	Grab	Composite	Grab	Grab	Composite
Unit	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Sum of Fluorine	0.0	545.1	1208.9	2392.0	64051.1	131.9	98.9
Sum of PFAS	0	841.03	1862.4	3673	100396.41	201.99	150.73
Perfluorobutanoate	<12.6	212	470	868	41100	44.8 (J)	26.5 (J)
Perfluoropentanoate	<6.31	245	668	1320	52300 (D)	52.3	20.2 (J)
Perfluorohexanoate	<3.16	159	357	859	6450	47.2	30.6
Perfluoroheptanoate	<3.16	56.8	108	245	386	10.4 (J)	6.06 (J)
Perfluorooctanoate	<3.16	47.2	78.8	131	45.2	30.2	33.7
Perfluorononanoate	<3.16	24.5	41.7	72.7	30.9	6.2 (J)	8.76 (J)
Perfluorodecanoate	<3.16	20.2	35.6	51.9	22.1 (J)	<3.07	<3.03 (J,DF)
Perfluoroundecanoate	<3.16	6.29 (J)	12.7	19.5	8.98 (J)	<3.07	<3.03
Perfluorododecanoate	<2.53	6.76 (J)	13	21.5	8.93 (J)	<2.45	<2.42
Perfluorotridecanoate	<3.16	<3.11	3.77 (J)	7.86 (J)	<5.81	<3.07	<3.03
Perfluorotetradecanoate	<3.16	3.6 (J)	6.86 (J)	10.2 (J)	<5.81	<3.07	<3.03
Perfluorobutanesulfonate	<3.16	5.04 (J)	9.47 (J)	6.14 (J)	17.3 (J)	4.79 (J)	6.91 (J)
Perfluoropentanesulfonate	<3.17	<3.13	<2.94	<3.05	<5.84	<3.08	<3.04
Perfluorohexanesulfonate	<3.16	<3.11	<2.93	<3.03	<5.81	<3.07	<3.03
Perfluoroheptanesulfonate	<3.16	<3.11	<2.93	<3.03	<5.81	<3.07	<3.03
Perfluorooctanesulfonate	<3.16	6.64 (J)	10.8 (J)	16.6	<5.81	6.1 (J)	18
Perfluorononanesulfonate	<3.16	<3.11	<2.93	<3.03	<5.81	<3.07	<3.03
Perfluorodecanesulfonate	<3.16	<3.11	<2.93	<3.03	<5.81	<3.07	<3.03
Perfluorododecanesulfonate	<3.16	<3.11	<2.93	<3.03	<5.81	<3.07	<3.03
Fluorotelomer Sulfonate, 4:2-	<12.6	<12.5	<11.7	<12.1	<23.2	<12.3	<12.1
Fluorotelomer Sulfonate, 6:2-	<11.4	48	46.7	43.6 (J)	<20.9	<11.1	<10.9
Fluorotelomer Sulfonate, 8:2-	<10.7	<10.6	<9.95	<10.3	<19.8	<10.4	<10.3
Fluorotelomer Carboxylic Acid, 3:3-	<12.6	<12.5	<11.7	<12.1	<23.2	<12.3	<12.1
Fluorotelomer Carboxylic Acid, 5:3-	<78.9	<77.9	<73.2	<75.9	<145	<76.7	<75.7
Fluorotelomer Carboxylic Acid, 7:3-	<78.9	<77.9	<73.2	<75.9	<145	<76.7	<75.7
Perfluorooctanesulfonamide	<3.16	<3.11	<2.93	<3.03	<5.81	<3.07	<3.03
Methyl-perfluorooctanesulfonamide, N-	<3.16	<3.11	<2.93	<3.03	<5.81	<3.07	<3.03
Ethyl-perfluorooctanesulfonamide, N-	<8.84	<8.72	<8.2	<8.5	<16.3	<8.59	<8.48
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.16	<3.11	<2.93	<3.03	<5.81	<3.07	<3.03
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.16	<3.11	<2.93	<3.03	<5.81	<3.07	<3.03
Methyl-perfluorooctanesulfonamidoethanol, N-	<31.6	<31.1	<29.3	<30.3	<58.1	<30.7	<30.3
Ethyl-perfluorooctanesulfonamidoethanol, N-	<31.6	<31.1	<29.3	<30.3	<58.1	<30.7	<30.3

Table G.5: Industrial sewershed sample concentrations in ng/L by SGS AXYS MLA-111 (Total Oxidizable Precursor Method) 6/6			
Industry			
SampleDate	2022-05-02	2022-05-02	2022-05-19
MatrixName	Sewershed Field Blank	Sewershed Field Blank	Sewershed Field Blank
SampleTypeCode	FieldBlank	FieldBlank	FieldBlank
Unit	ng/L	ng/L	ng/L
Sum of Fluorine	0.0	0.0	0.0
Sum of PFAS	0	0	0
Perfluorobutanoate	<12.3	<13	<12
Perfluoropentanoate	<6.17	<6.48	<6
Perfluorohexanoate	<3.08	<3.24	<3
Perfluoroheptanoate	<3.08	<3.24	<3
Perfluorooctanoate	<3.18	<3.58	<3.64
Perfluorononanoate	<3.08	<3.24	<3
Perfluorodecanoate	<3.08	<3.24	<3
Perfluoroundecanoate	<3.08	<3.24	<3
Perfluorododecanoate	<2.47	<2.59	<2.4
Perfluorotridecanoate	<3.08	<3.24	<3
Perfluorotetradecanoate	<3.08	<3.24	<3
Perfluorobutanesulfonate	<3.08	<3.24	<3
Perfluoropentanesulfonate	<3.1	<3.26	<3.02
Perfluorohexanesulfonate	<3.08	<3.24	<3
Perfluoroheptanesulfonate	<3.08	<3.24	<3
Perfluorooctanesulfonate	<3.08	<3.24	<3
Perfluoronanesulfonate	<3.08	<3.24	<3
Perfluorodecanesulfonate	<3.08	<3.24	<3
Perfluorododecanesulfonate	<3.08	<3.24	<3
Fluorotelomer Sulfonate, 4:2-	<12.3	<13	<12
Fluorotelomer Sulfonate, 6:2-	<11.1	<11.7	<10.8
Fluorotelomer Sulfonate, 8:2-	<10.5	<11	<10.2
Fluorotelomer Carboxylic Acid, 3:3-	<12.3	<13	<12
Fluorotelomer Carboxylic Acid, 5:3-	<77.1	<81.1	<75
Fluorotelomer Carboxylic Acid, 7:3-	<77.1	<81.1	<75
Perfluorooctanesulfonamide	<3.08	<3.24	<3
Methyl-perfluorooctanesulfonamide, N-	<3.08	<3.24	<3
Ethyl-perfluorooctanesulfonamide, N-	<8.63	<9.08	<8.4
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.08	<3.24	<3
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	<3.08	<3.24	<3
Methyl-perfluorooctanesulfonamidoethanol, N-	<30.8	<32.4	<30
Ethyl-perfluorooctanesulfonamidoethanol, N-	<30.8	<32.4	<30