Standard Operating Procedure for:

Analysis of Pesticides, Herbicides, and other Chemicals in Water and Sediment/Waste by High Performance Liquid Chromatography Mass Spectrometry

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

CHEMISTRY PROGRAM

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Table of contents

1. Scope and Application 3

2. Acronyms and Abbreviations 5

3. Method Summary 6

4. Apparatus and Equipment 7

5. Reagents and Chemicals 7

6. Sample Preparation Procedure 8

7. Data Acquisition and Analysis 8

8. Data Reporting and Archival 12

9. Quality Control 12

10. Safety / Hazardous Waste Management 12

11. References 13

Appendix-A 14

Appendix-B 31

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1. Scope and Application

1.1 This SOP is based on our TNI accredited method, "DEP SOP LC-001-3.4 (2023)" and is applicable to the analysis of pesticides, herbicides and other chemicals in waters, soils, sediments and wastes. This SOP describes the use of high-performance liquid chromatography (HPLC) coupled with electrospray ionization mass spectrometry (MS/MS) in Multiple Reaction Monitoring (MRM) mode to enhance selectivity for the analysis of selected pesticides, herbicides, and other chemicals in water and sediment/waste samples; analytes are listed in Appendix B. The preparation of these samples is described in DEP SOP LC-011 (Extraction of Pesticides, Herbicides, and Other Chemicals from Water or Sediment/Waste).

1.2 The laboratory Test ID's and equivalent method associations are provided in Table 1. These methods comply with the requirements of EPA Method 8321B, USGS Method O-2060-01 and EPA Method 1633 for the parameters in Table 5.1 of the laboratory's quality manual. Method 1633 is for use in the Clean Water Act (CWA) for the determination of the per- and polyfluoroalkyl substances (PFAS) in aqueous and soil samples by liquid chromatography/mass spectrometry (LC-MS/MS). The USGS Method O-2060-01 is an approved test procedure of the National Pollutant Discharge Elimination System under the Clean Water Act. Method 8321B is listed in the SW-846 publication under Subtitle C of the Resource Conservation and Recovery Act.

Table 1. FDEP Laboratory Test ID's and Equivalent Methods.

Lab Test ID	Test Description
W-CAB-AA-R	EPA Method 8321B carbamate analysis/EPA Method 3535A preparation, water matrix
W-CARB-AA	USGS Method O-2060-01 carbamate analysis/EPA Method 3535A preparation, water matrix
W-E8321-21	EPA Method 8321B analysis, water matrix analysis by direct injection, 21 days holding time
W-E8321-DI	EPA Method 8321B analysis, water matrix analysis by direct injection, 7 days holding time
W-E8321-MS	EPA Method 8321B analysis/EPA Method 3535A preparation, water matrix
W-U2060-MS	USGS Method O-2060-01 analysis/EPA Method 3535A preparation, water matrix
SPLP-AH-AA	EPA Method 8321B analysis/EPA Method 3010/3535A preparation, SPLP water matrix
TPLP-AH-AA	EPA Method 8321B analysis/EPA Method 3011/3535A preparation, TCLP water matrix
W-MCYST-AA	EPA Method 8321B analysis of microcystins, water matrix
W-SAXTN-MS	EPA Method 8321B analysis of saxitoxin, water matrix
W-PDQUAT	EPA Method 8321B analysis of diquat/paraquat by Direct Injection, water matrix
W-PFAS-MS	EPA Method 1633 analysis of PFAS compounds, water matrix
S-AHERB-AA	EPA Method 8321B analysis of acid herbicides, soil matrix
S-E8321-MS	EPA Method 8321B analysis/EPA Method 3570 preparation, soil matrix
S-PFAS-MS2	EPA Method 1633 analysis of PFAS compounds, soil matrix
WS-PFAS-MS	EPA Method 1633 analysis/EPA Method 3580A preparation, waste sample
SA-LCMSMS	EPA Method 8321B analysis, surface area wipe matrix
O-LCMSMS	EPA Method 8321B analysis, unknown screening sample

1.3 The acceptance limits, as provided in EPA Methods 1633/8321B and USGS Method O-2060-01, are programmed into the LIMS and applied automatically as part of the data processing, review, and reporting procedures. Table 5.1 of the FL DEP Quality Manual

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provides information regarding method limits of detection, accuracy, and precision (FL DEP Quality Manual).

1.4 Limits of detection (LOD) and Demonstration of Capability (DOC)

LOD and DOC shall be determined for each main quality system matrix group identified by NELAP (air, drinking water, non-potable water, biological materials, and solids/chemical materials). These groups represent the minimum matrix distinctions where there is evidence that the method performance is not affected by sub-matrix distinctions within these groups. Specifically, LOD and DOC shall be determined separately for the system matrix sub-groups listed in section 1.4.1. If a suitable matrix cannot be found another similar matrix type may be used, or samples may need to be prepared in the absence of a matrix blank. Reasons for matrix substitution may include, but are not limited to, inappropriate background analyte levels in the matrix for the intended study, no analyte-free matrix is available for method blanks, or no reference materials are available for a matrix. Refer to SOP LB-007 and SOP LB-031 for specific procedural details (FL DEP SOP LB-007. Procedure and Policy for Demonstration of Capability for Methods, Instruments, and Laboratory Staff.) (FL DEP SOP LB-031: Limit of Detection Verification.). LOD verifications are performed quarterly for all the analytes for each matrix type at 1 to 4 times to method detection limit but not higher than the PQL.

1.4.1 System Matrix Sub-Groups

- Aqueous – all aqueous samples excluding drinking water and salt/estuarine waters.
- Drinking Water – water from a designated potable source
- Saline/Estuarine – an aqueous sample from an ocean or estuarine. The effects of this matrix type may vary from analysis to analysis and with salt content. Therefore, the decision of the extent of effect this matrix has on the LOD, and DOC is left to the discretion of the HPLC lab supervisor.

1.5 Method Detection Limit (MDL) and Practical Quantitation Limit (PQL)

MDLs are established using procedures given in EPA Chapter 40 Part 136, Appendix B of the Federal Register. Also, refer to DEP SOP LC-011 (FL DEP SOP LC-011. Extraction of Pesticides, Herbicides, and Other Chemicals from Water or Sediment/Waste). In summary, seven replicate samples are analyzed near the target MDL. The results of the seven replicates are tabulated and statistical calculations are performed to determine the concentration of analyte where there is analyte present with 99% confidence. The PQL is four times the MDL. MDLs and PQLs are updated on an annual basis for each analyte and matrix. A list of MDLs and PQLs can be found in Table 5.1 of the laboratory's quality manual (FL DEP Quality Manual). The actual detection limits reported may vary depending on the amount of water, sediment or waste sample extracted and the final extract volumes.

1.6 The methods detailed in this SOP are comparable to EPA methods 1633/8321B and USGS method O-2060-01 with the main difference in the mass spectrometry technique used. Our MS systems utilize polypropylene glycols (PPGs) for calibration of the mass spectrometer and an electrospray ionization source for sample introduction. All the MS

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techniques utilized are well established by the manufacturer and widely used for similar compounds.

1.7 Per- and polyfluoroalkyl substances (PFAS) analysis is performed by using recommended 20 labelled Extracted Internal Standard Surrogates (Table 9) following EPA method 1633. This 20 Extracted Internal Standard Surrogates mix is added to all the ICAL standards and samples prior to preparation at 0.5 µg/L. Some PFAS are commercially available as ammonium, sodium, and potassium salts. This method measures all forms of the analytes as anions while the identity of the counterion is inconsequential. Analytes may be purchased as acids or as any of the corresponding salts.

2. Acronyms and Abbreviations

Table 2. Acronyms

Acronym	Meaning
NELAP	Nation Environmental Laboratory Accreditation Program
DOC	Demonstration of capability
HPLC	High performance liquid chromatography
PQL	Practical quantitation limit
LC-MS/MS	Liquid chromatography with mass spectral fragmentation
MCA	Multi-channel acquisition (signal averaging)
ICAL	Initial calibration
CCV	Continuing calibration verification
ICV	Initial calibration verification
RSE	Relative Standard Error
PFAS	Per- and polyfluoroalkyl substances
LOD	Limit of detection
LIMS	Laboratory information management system
MS	Mass spectrometry
MDL	Method detection limit
EICP	Extracted ion current profile
NIPI	Negative ion/ positive ion
MRM	Multiple reaction monitoring

Table 3. Compound Abbreviations

Abbreviation	Compound
3:3 FTCA	3-Perfluoropropyl propanoic acid
5:3 FTCA	2H, 2H, 3H, 3H-Perfluorooctanoic acid
7:3 FTCA	3-Perfluoroheptyl propanoic acid
4:2 FTS	1H,1H,2H,2H-Perfluorohexane sulfonic acid
6:2 FTS	1H,1H,2H,2H-Perfluorooctane sulfonic acid
8:2 FTS	1H,1H,2H,2H-Perfluorodecane sulfonic acid
HFPO-DA	Hexafluoropropylene oxide dimer acid
NEtFOSAA	N-ethyl perfluorooctanesulfonamidoacetic acid
NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid
NFDHA	Nonafluoro-3,6-dioxahepatanoic acid
PFBA	Perfluorobutanoic acid

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PFBS	Perfluorobutanesulfonic acid
PFDA	Perfluorodecanoic acid
PFDoA	Perfluorododecanoic acid
PFDS	Perfluorodecane sulfonic acid
PFECHS	Perfluoro-4-ethylcyclohexanesulfonic acid
PFEESA	Perfluoro-(2-ethoxyethane) sulfonic acid
PFHpA	Perfluoroheptanoic acid
PFHpS	Perfluoroheptane sulfonic acid
PFHxA	Perfluorohexanoic acid
PFHxS	Perfluorohexane sulfonic acid
PFMBA	Perfluoro-4-methoxybutanoic acid
PFMPA	Perfluoro-3-methoxypropanoic acid
PFNA	Perfluorononanoic acid
PFNS	Perfluorononane sulfonic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PFPeA	Perfluoropentanoic acid
PFPeS	Perfluoropentane sulfonic acid
PFPrS	Perfluoropropanesulfonic acid
PFTeDA	Perfluorotetradecanoic acid
PFTrDA	Perfluorotridecanoic acid
PFUnA	Perfluoroundecanoic acid
FOSA	Perfluoro-1-octane sulfonamide
ADONA	4,8-Dioxa-3H-perfluorononanoic acid
9Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid
11Cl-PF3OUdS	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid
FBSA	Perfluoro-1-butane sulfonamide
FHxSA	Perfluoro-1-hexane sulfonamide

3. Method Summary

3.1 An aliquot of the sample or sample extract is analyzed by LC-MS/MS (FL DEP SOP LC-011. Extraction of Pesticides, Herbicides, and Other Chemicals from Water or Sediment/Waste). Each analyte is identified and quantified based on known precursor ions (both in standard and unknown samples) that are fragmented into at least two daughter ions, each with a particular retention time. The LC column and gradient program, and MS method are optimized for each analyte. Analytes with similar parameters can be grouped into the same program.

3.2 Environmental samples are prepared and extracted using method-specific procedures. Sample extracts are subjected to cleanup procedures designed to remove interferences. Analyses of the sample extracts are conducted by LC-MS/MS in the multiple reaction monitoring (MRM) mode. For PFAS analysis, sample concentrations are determined by isotope dilution or extracted internal standard quantification using isotopically labeled compounds added to the samples before extraction. Note: Not all target PFAS currently have an isotopically labeled compound. In these cases, an alternate isotopically labeled compound is used as recommended in Table 9. For the analysis of PFHxS and PFOS peak area of all the isomers are integrated together, quantified, and reported as one isomer.

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4. Apparatus and Equipment

4.1 2-mL crimp top glass and polypropylene auto sampler vials with crimp caps.

4.2 Syringe filters:
- Millipore (SLCR013NK) PTFE membrane, hydrophilic, 0.45 µm, 13 mm diameter, or equivalent.
- PTFE membrane, hydrophilic, 0.45 µm, 15 mm diameter
- OMICRON, NYLON, 13mm, 0.2 µm
- OMICRON, NYLON, 25mm, 0.2 µm

4.3 Disposable luer-tip syringes, 3 mL.

4.4 Guard cartridge reversed phase (Whatman), or equivalent.

4.5 AB Sciex 7500 and 6500+ LC-MSMS Mass spectrometer with heated electrospray ionization source and coupled Shimadzu Nexera HPLC system that contains an autosampler, column oven with dual column valve, degassing unit, and communications bus module. The column used for each analysis can be found in Table 6 in Appendix A. The electrospray ionization source can ionize a mass range sufficient for the calibration range of the target analytes at the required concentration. The source can generate both positive and negative ions.

4.6 AB Sciex Analyst Software - A computer system interface for continuous data acquisition and storage of machine-readable mass spectra are obtained throughout the duration of the chromatographic program. Software for operation of the LC and MS includes an ion search function and EICP graph function. The software is capable of integration of an individual ion abundance in an EICP given a pre-designated retention time.

5. Reagents and Chemicals

5.1 Solvents
- Acetonitrile (Fisher Scientific, HPLC grade)
- Methanol (Fisher Scientific, HPLC grade)
- Deionized water (in-house, HPLC grade, tested to ensure free of analytes)

5.2 Chemicals
- Formic acid (Acros, reagent grade)
- Ammonium acetate (Fisher, HPLC grade)
- Ammonium fluoride (Fisher, ACS Grade)
- Ammonium formate (Acros, reagent grade)
- Heptafluorobutyric acid

5.3 In-house liquid nitrogen gas is used and split with two additional regulators prior to the instruments. Each gas pressure is set to deliver the required volumes.

5.4 Mobile phases are dependent on the compounds being analyzed (prepared in-house). See table 6 in Appendix A for details.

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5.5 See DEP SOP LC-039 for required standards, reagents and solvents used and document to trace the source. (FL DEP SOP LC-039: HPLC Standard Preparation.).

6. Sample Preparation Procedure

6.1 Refer to DEP SOP LC-011 for details on sample preparation for water and sediment/waste matrices (FL DEP SOP LC-011. Extraction of Pesticides, Herbisides, and Other Chemicals from Water or Sediment/Waste).

6.2 Typically, sample extracts must be analyzed within 40 days of extraction. The exceptions are carbamates, which must be analyzed within 21 days of extraction; direct injection analyses, which must be done within 7 days of collection; and PFAS which must be analyzed within 28 days of extraction. Refer to the reference methods and analytical tests for applicable holding times.

7. Data Acquisition and Analysis

7.1 Calibration and Optimization

Table 4. Target Mass, Intensity, and Width of PPGs from 10 MCA scan Positive (POS PPG E-07 M) and Negative (NEG PPG E-05 M) using standard solution.

	Target Mass (Da)	Intensity (cps)	Width (Da)
Low mass + Q1	175.133	8.0 E+06	0.6 - 0.8
	500.38	3.7 E+07	0.6 - 0.8
	616.464	2.4 E+07	0.6 - 0.8
	906.673	1.0 E+08	0.6 - 0.8
Low mass + Q3	175.133	8.0 8E+06	0.6 - 0.8
	500.38	3.7 E+07	0.6 - 0.8
	616.464	2.4 E+07	0.6 - 0.8
	906.673	1.0 E+08	0.6 - 0.8
Low mass - Q1	933.636	1.8 E+0 7	0.6 - 0.8
Low Mass - Q3	933.636	1.8 E+0 7	0.6 - 0.8

7.1.1 Tuning parameters are instrument dependent and vary with the type of experiment. Each Target Mass response is optimized for the specific analysis (Table 4) by manual, semiautomatic, and/or automatic tuning procedures. 6500 plus and 7500 uses different Tuning solutions to tune. Adjust the resolution parameter numbers to achieve the required width of 0.6 to 0.8 Da. If the intensity (cps) is lower than suggested, then try to increase the detector CEM by 100. If the intensity doesn't increase by more than 30% then stop. Clean Q0 or make the service call. Perform PPG tune and calibration and initial mass checkup when it has problems and/or at the time of preventive maintenance done by service engineer.

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7.1.2 Automatic optimization for MS/MS analysis optimizes certain compound-dependent parameters for MRM transitions. In an automatic infusion experiment, parameters can be optimized for more than two transitions from the specified precursor ion for each compound. The software determines the optimal conditions for the single or multifold compound's precursor ion (Q1) and selected fragment ions (Q3). The compound dependent parameters (DP, EP, CE, and CXP) for the known MRMs are standardized and results are stored under the acquisition method.

7.1.3 For MRM transitions add LC running method and do mass optimization (Curtain Gas, Collision Gas, Ion Spray Voltage, Source Temperature, Gas 1, and Gas 2).

7.2 Acquisition Method and Batch

7.2.1 Setup all the HPLC conditions in the method file which includes divert valve settings, gradient program, flow rate, injection volume, and equilibration time. Use the suggested gradient program and column for each method.

7.2.2 Filter samples prior to analysis with 0.45 µm filters (0.2 µm for PFOS) using disposable syringes. Cap and store at 5 °C or proceed directly to HPLC/MS/MS analysis.

7.2.3 Each extraction batch must contain method blank, LFB, and duplicate matrix spikes and up to 20 samples. If there is insufficient sample for matrix spikes, prepare duplicate LFBs.

7.2.4 First evaluate the instrument blank by injecting mobile phase followed by an initial calibration curve. Quantitative analysis is accomplished by an external calibration method. For building an initial calibration curve a minimum of 5 calibration levels must be used. The following calibration curve fit options are used to get 20% RSD limit and meet the minimum correlation criteria ≥0.995 or Relative Standard Error (RSE) ≤20%. The first calibration curve fit option used is Regression Parameter Type - Area, Regression Type – Linear and Weighting Type – 1/x. The second option used is Regression Parameter Type - Area, Regression Type – Quadratic and Weighting Type – 1/x. After these two options Linear through zero, Linear and Quadratic curve fits may be used. Verify the validity of the standards by running 2nd source with a different lot number for each target analytes and the accuracy must be within ≤ 20%. Analyze a mid-level ICAL standard as a CCV and proceed with analysis if CCV is within ± 30% accuracy based on the current curve. After identification, all positives are quantified. If the quantity found is not within the calibration range the samples are diluted or re-run with a multilevel calibration curve. Check that the target and surrogate compound recovery is within ≤ 20% by analyzing mid-level ICAL standard. If the curve is not satisfactory, a new curve must be generated until the requirements are met.

7.2.5 Each run has the following run sequence: mobile phase, CCV, and calibration standards (minimum 5 calibration levels are required) with second source check standard (if the CCV is not within ± 30% accuracy based on the current curve). If the check standard passes, then proceed with the rest of the run sequence by injecting five to eight samples followed by a CCV standard. This standard must

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be analyzed to ensure that the system has remained in linear calibration. End the analysis sequence with a CCV and a low-level standard, which is close to the MDL. CCV standard recoveries must be within ± 30% of the expected concentration. If at any time the continuing calibration check standard fails to fall within this criterion, any samples analyzed after it must be re-analyzed after ensuring a CCV passes. Otherwise, run a new five-point calibration curve.

7.2.6 Review the current injection or run to see if the data is collecting properly. Check all the MRM transitions by opening their EICP. Review all the injections for proper collection of data before proceeding to quantitation.

7.2.7 Per- and polyfluoroalkyl substances (PFAS) analysis: A solution of the method analytes, Extracted Internal Standard (EIS) – (a.k.a. isotopically labeled compounds), and Non-Extracted Internal Standard (NIS) prepared from the Primary Dilution Standards and stock standards. The calibration standards are used to calibrate the instrument response with respect to analyte concentration. Also prepared, Continuing Calibration Check (CCC) standard that is analyzed periodically to verify the accuracy of the existing calibration. Isotope Dilution Technique is used for measuring analyte concentration using the ratio of peak area of the native analyte to that of an isotopically labeled compound, added to the original sample in a known amount and carried through the entire analytical procedure.

7.2.8 Extracted Internal Standards: Quality control compounds that are added to all standard solutions and extracts in a known amount and used to measure the relative response of the isotopically labeled compounds that are components of the same solution. For this method, the Non-Extracted Internal Standard are three isotopically labeled compounds of the method analytes. The Non-Extracted Internal Standards are indicators of instrument performance. In this method, the Non-Extracted Internal Standard are not used in the calculation of the recovery of the native analytes.

7.2.9 Isotopically labeled compound analytical technique for measuring analyte concentration using the ratio of the peak area of the native analyte to that of an isotopically labeled compound, added to the original sample in a known amount and carried through the entire analytical procedure. Check Peak Area Intensity counts for the 20 labelled Extracted Internal Standard Surrogates (Table 9) are within the range of 50 to 150 %. If any Extracted Internal Standard Surrogate falls outside this range, the sample needs additional dilution with the 20 labelled Extracted Internal Standard Surrogates mix until it passes the criteria.

7.2.10 Note that the concentrations of sulfonates in the isotope dilution compound are based on the weight of salt. It is not necessary to account for the difference in the formula weight of salt compared to the free acid for sample quantitation.

7.3 Parameters for acquisition can be found in Table 5 and 6 in Appendix A

7.4 When processing data, verify the retention time half window for each peak is set to 30 seconds. Also, the Gaussian smooth width should be set at 1.0 points, the noise percentage is set at 90%, and the peak splitting is set to 6 points.

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7.5 Reporting

7.5.1 In MS/MS analysis, identification and quantitation of each compound is based on the known precursor ion, fragmenting into known daughter ions. MRM transitions from the known precursor ion can be used for quantitation, confirmation, and reporting. For analyte concentrations above the MDL, ion ratios are used for further confirmation.

7.5.2 The surrogate, lab fortified blank, and matrix spike recoveries in each batch are used to validate the data and must be calculated.

7.5.3 If the surrogate recovery is outside of established limits of the analysis, then the results must be flagged, and an explanation offered. For surrogate failures, re-extraction of the sample must be performed, even after expiration. Follow DEP SOP LB-027 for reporting (FL DEP SOP LB-027: Standard Operating Procedure for Reporting Qualified Data and Correcting Quality Control Problems.).

7.5.4 The lab fortified blank and matrix spike recoveries must be within the acceptance range with an RSD of <30%. This range is evaluated once a year after initial method development. Acceptance ranges for lab fortified blanks and matrix spikes are statutory limits, which are tighter than the statistical limits. In real samples both surrogate and matrix spike recoveries can be observed to recover low due to matrix interferences.

7.5.5 A comment must be added to qualified data in the final report explaining any deviation from the routine limits (FL DEP SOP LB-027: Standard Operating Procedure for Reporting Qualified Data and Correcting Quality Control Problems.).

7.5.6 Check the method blank for any interfering contaminants. The MDLs may have to be elevated if the blank(s) indicate contamination.

7.6 Calculations

Spike recoveries

$$\%Rec = \frac{\left(amount\ detected, \frac{\mu g}{L}\right)(final\ extract\ volume, mL)}{(spike\ volume, mL)(spike\ concentration, \frac{\mu g}{L})} * 100$$

Concentration in water samples

$$Conc(\frac{\mu g}{L}) = \frac{(detected\ conc, \frac{\mu g}{L})(final\ extract\ volume, mL)}{(volume\ of\ sample\ extracted, mL)}$$

Concentration in sediment samples

$$Conc\left(\frac{\mu g}{kg}\right) = \frac{(detected\ conc, \frac{\mu g}{L})(final\ extract\ volume, mL)}{(dry\ weight\ of\ sample, g)}$$

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Example: If 25 µg/L was detected in a sample extracted from 30 g of sediment with a final volume of 10 mL then,

$$Conc\left(\frac{\mu g}{kg}\right) = \frac{(25\frac{\mu g}{L})(10\ mL)}{(30\ g)} = 8.3\ \mu g/kg$$

Dilution factor for soil samples

$$Dilution\ factor = \frac{1}{dry\ weight(as\ a\ fraction\ of\ 1)}$$

Example: if the dry weight is 8.15%, then

$$Dilution\ factor = \frac{1}{0.0815} = 12.27$$

If performing dilutions, show all calculations and include copies of the dilution/sample prep logbook entry in results folder. When entering the dilution factor for soil samples in QC Manager, make sure that the dilution factor is correct.

8. Data Reporting and Archival

8.1 When analysis is complete, transfer the results as a text file into the LIMS QC Manager. If a sample has been diluted or has a dry weight of less than 100 %, ensure that the information is entered properly into the QC Manager.

8.2 Add the appropriate qualifiers and comments after performing a complete review of the sample data.

8.3 Ensure that the results are consistent with each sample type. For example, equipment blanks should not contain hits while an effluent sample could. If anything looks suspicious, further analysis is necessary before posting results.

8.4 Include cover page, photocopy of preparation logbook page, run sequence, the results table, printout of QC results, dilutions page if any, and printout of analytes above MDL in the results folder. Submit folder to the section supervisor for review, authorization, and archival.

8.5 Original data files are archived in X:\Labs\Lab3\Chem_Data\Organic\LC.

9. Quality Control

See DEP SOP LB-027 for guidelines for qualifying data when quality control results are outside established control limits and re-analysis is not a viable or desired option. Definitions of the available qualifying codes are listed (FL DEP SOP LB-027. Standard Operating Procedure for Reporting Qualified Data and Correcting Quality Control Problems.).

10. Safety / Hazardous Waste Management

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See SOP OG-001 for specific details on safety and hazardous waste management (FL DEP SOP OG-001. Safety and Waste Management Practices in the Organic Analysis Groups (Volatiles, Semi-Volatile, and Pesticide Laboratories).).

11. References

11.1 Batchu, S. R., Quinete, N., Panditi, V. R., & Gardinali, P. R. (2013). Online solid phase extraction liquid chromatography tandem mass spectrometry (SPE-LC-MS/MS) method for the determination of sucralose in reclaimed and drinking waters and its photo degradation in natural waters from South Florida. *Chemistry Central Journal*, 1-16.

11.2 EPA Method 8321B. Solvent-Extractable Nonvolatile Compounds by High-Performance Liquid Chromatography/Thermospray/Mass Spectrometry (HPLC/TS/MS) or Ultraviolet (UV) Detection, Revision 2. (2007, February).

11.3 EPA Method 1633. Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, 4th Draft Method. (2023, July).

11.4 FL DEP Quality Manual. (n.d.). Tallahassee, FL: FL Department of Environmental Protection.

11.5 FL DEP SOP LB-007. Procedure and Policy for Demonstration of Capability for Methods, Instruments, and Laboratory Staff. (n.d.). Tallahassee, FL: FL Department of Environmental Protection.

11.6 FL DEP SOP LB-027. Standard Operating Procedure for Reporting Qualified Data and Correcting Quality Control Problems. (n.d.). Tallahassee, FL: FL Department of Environmental Protection.

11.7 FL DEP SOP LB-031. Limit of Detection Verification. (n.d.). Tallahassee, FL: FL Department of Environmental Protection.

11.8 FL DEP SOP LC-011. Extraction of Pesticides, Herbisides, and Other Chemicals from Water or Sediment/Waste. (n.d.). Tallahassee, FL: FL Department of Environmental Protection.

11.9 FL DEP SOP LC-039. HPLC Standard Preparation. (n.d.). Tallahassee , FL: FL Department of Environmental Protection.

11.10 FL DEP SOP OG-001. Safety and Waste Management Practices in the Organic Analysis Groups (Volatiles, Semi-Volatile, and Pesticide Laboratories). (n.d.). Tallahassee, FL: FL Department of Environmental Protection.

11.11 USGS O-2060-01. Determination of Pesticides in Water by Graphited Carbon-Based Solid-Phase Extraction and High-Performance Liquid Chromatography/Mass Spectrometry. (2001). Denver, CO: U.S. Geological Survey.

11.12 Wu, Z., Gao, W., Wu, D., Miller, D. D., & Dalton, J. T. (2004). Favorable Effects of Weak Acids on Negative-Ion Electrospray Ionization Mass Spectrometry. *Analytical Chemistry*, 839-847.

11.13 DoD Quality Systems Manual Version 5.3 2019. (Department of Defense (DoD), Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories)

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Appendix-A

Table 5. MS Acquisition Parameters

Analysis	Acquisition (mins)	Polarity	Dwell time (ms)	Curtain Gas	CAD Gas	Spray Voltage	Temperature (°C)	Ion Source Gas 1	Ion Source Gas 2	Interface Heater	Valve Time (min)
API 6500 +											
NIPI	17	-/+	10			-/+ 3250	375	35	40	on	1.3-11.5
Acesulfame K & Sucralose	13	-	150 /225	40	10	- 3500	600	60	65	on	4-9
Glyphosates & Endothall	14	-	50	40	10	-3500	600	60	65	on	1-9.5
Microcystins	16	+	20	30	10	4500	400	45	50	on	2-12
Anatoxin a & Saxitoxins	11.01	+	25/20/ 20 0	30	10	5000	450	55	60	on	2-6.5
Diquat/ Paraquat	13	+		20	2	5500	700	70	60	on	6.3-7.5
PFAS	12	-	25	40	10	-4000	400	35	50	on	1.5-10.5
API 7500											
NIPI	17	-/+	10			-/+ 3250	375	35	40	on	1.3-11.5
Acesulfame K & Sucralose	13	-	100	40	9	- 3500	600	60	60	on	4-9
Glyphosates & Endothall	14	-	50	40	9	-3500	600	60	60	on	0.5-6.5
Microcystins	16	+	20	40	11	3000	500	35	60	on	2-12
Anatoxin a & Saxitoxins	11.01	+	25/20/ 20 0	30	10	5000	450	55	60	on	2-6.5
PFAS	12	-	25	45	11	-2000	400	40	55	on	1.5-10.5

Table 6. LC Acquisition Parameters

Analysis	Column	Mobile Phase A	Mobile Phase B	Gradient Program
NIPI	RESTEK Luna 1.8 µm biphenyl,	5 mmol ammonium acetate and 0.1%	0.1% formic acid in acetonitrile	Flow Rate: 0.48 mL/min Injection Volume: 3µL

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Analysis	Column	Mobile Phase A	Mobile Phase B	Gradient Program
	3.0 x 100 mm	formic acid in HLPC water		start 95:5 A: B 0-6 mins shift to 70:30 A: B 6-9 mins shift to 20:80 A: B 9-11 mins shift to 5:95 A: B 11-11.5 mons shift to 2:98 A:B 11.5-13.5 min hold 13.5-14 mins shift to 95:5 A:B 14-17 min hold 17 mins stop
Acesulfame K & Sucralose	RESTEK Raptor biphenyl 2.7 µm,4.6 x 150 mm, Waters XSelect CSH Phenyl-Hexyl 3.5 µm, 4.5 x 150 mm	0.25 mmol ammonium fluoride in HPLC water	acetonitrile	Flow Rate: 0.80 mL/min Injection Volume: 50µL Time Flow A conc B conc 0.01 0.8 100 0 0.10 0.8 100 0 8.00 0.8 20 80 8.10 0.8 1 99 8.11 0.8 1 99 8.20 1.5 1 99 10.10 1.5 1 99 10.20 1.5 100 0 13.01 1.5 100 0 13.10 0.8 100 0 13.11 0.8 100 0
Endothall, Glyphosates & other DI Analytes	Waters Symmetry Shield RP8 5 µm, 3.9 x 150 mm	5 mmol ammonium acetate and 0.1% formic acid in HLPC water	0.1% formic acid in acetonitrile	Flow Rate: 0.80 mL/min Injection Volume: 10uL(7500), 50µL(6500+) Time Flow A conc B conc 0.6 100 0 2 0.6 100 0 8 1.5 10 90 8.01 1.5 1 99 10 1.5 1 99 10.1 1.5 100 0 12.9 1.5 100 0 12.99 0.6 100 0

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Analysis	Column	Mobile Phase A	Mobile Phase B	Gradient Program
Microcystins	RESTEK Raptor biphenyl 2.7 µm,4.6 x 150 mm	5 mmol ammonium acetate and 0.1% formic acid in HLPC water	0.1% formic acid in acetonitrile	Flow Rate: 0.80 mL/min Injection Volume: 20µL(7500), 50 uL(6500+) Time Flow A conc B conc 0.8 95 5 1.50 0.8 95 5 3.00 0.8 75 25 8.00 0.8 45 55 8.90 0.8 20 80 9.00 0.8 2 98 13.50 0.8 2 98 14.00 0.8 95 5 16.00 0.8 95 5
Anatoxin-a, Saxitoxin & Neosaxitoxin	TOSOH TSKgel Amide-80 3 µm 4.6 x 150 mm	5 mmol ammonium acetate and 0.1% formic acid in HLPC water	0.1% formic acid in acetonitrile	Flow Rate: 0.50 mL/min Injection Volume: 2µL Time Flow A conc B conc 0.5 70 30 1.00 0.5 70 30 6.00 0.5 40 60 7.00 0.5 1 99 8.00 0.5 1 99 8.10 0.5 70 30 11.00 0.5 70 30
Diquat/ Paraquat	HAMILTON, PRP-1, 5 µm COLUMN, 150 x 4.1mm	5 mmol heptafluorobutyric acid in HPLC water	0.1% formic acid in acetonitrile	start 95:5 A: B 0-8 mins shift to 70:30 A: B 8-9 mins shift to 10:90 A: B 9-13 mins shift to 95:5 A: B
PFAS	Phenomenex, Gemini 3.0 µm, C18, 100 m x 2.0 mm ID Delay column: Phenomenex, Gemini 5.0 µm, C18, 50 m x 3.0 mm ID	10 mmol ammonium acetate in HPLC water (0.77 grams in 1 Liter Water)	10 mmol ammonium acetate in Methanol (0.77 grams in 1 Liter Methanol)	Flow Rate: 0.30 mL/min Injection Volume: 1µL Time Flow A conc B conc 0.3 75 25 0.20 0.4 70 30 4.00 0.4 35 65 7.00 0.4 10 90

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Analysis	Column	Mobile Phase A	Mobile Phase B	Gradient Program
				9.00 0.4 1 99 10.00 0.4 1 99 10.10 0.5 70 30 11.80 0.5 70 30 12.00 0.3 75 25

Table 7. QC Solutions

Analysis	Target to Surrogate Ratio	Calibration Levels (µg/L)	CCV/LFB/MSPK Level (µg/L)	SUR Level (µg/L)
NIPI	1:2	100, 50, 25, 10, 5, 2.5, 1, 0.5, 0.25	2.5/5/5	10
Acesulfame K, Endothall, Glyphosates & Sucralose	1:2/1:1	10, 5, 2.5, 1, 0.5, 0.25, 0.1, 0.01	2.5/6.25	5/2.5
Microcystins	4:1	50, 25, 10, 2.5, 1, 0.5, 0.25, 0.1	10	2.5
Anatoxin a & Saxitoxins	2:1	10, 5, 2.5, 1, 0.5, 0.25	2.5	2.5
Diquat/ Paraquat	1:2	50, 25, 10, 5, 2, 1	10	10
PFAS	1:1	10, 5, 2.5, 1, 0.5, 0.25, 0.05, 0.025, 0.01	0.5	0.5

Table 8. Acquisition Parameters for Target Analytes. Surrogates and Internal Standards

Note: DP: Declustering Potential; EP: Exit Potential; CE: Collision Energy; CXP: Collision cell Exit Potential

Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
NIPI 6500									
Carbaryl-d7		P	209.0	152.1	10	45	10	17	16
Aldicarb Sulfoxide	1646-87-3	P	207.1	132/ 89.2	10	45	10	9/ 19	10
Oxamyl	23135-22-0	P	237.1	72.1/ 90.1	10	40	10	27/ 12	10
Aldicarb Sulfone	1646-88-4	P	240.1	86.1/ 76.1	10	40	10	25.5/16.5	10
Methomyl	16752-77-5	P	163.1	106/ 88	10	40	10	15	10
3-Hydroxycarbofuran	16655-82-6	P	238.2	163/ 107.1	10	45	10	20/40	10
Aldicarb	116-06-3	P	208.2/ 208.1	116.1/ 89.1	10	31	10	10.5/23	10

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
Propoxur	114-26-1	P	210.1	111/ 93.1	10	40	10	20.5/ 35	10
Carbofuran	1563-66-2	P	222.1	165.1/ 123	10	45	10	17/ 30	10
Carbaryl	63-65-2	P	202.1	144.9/ 127.1	10	45	10	15/ 38	10
Methiocarb	2032-65-7	P	226.1	169/ 121.1	10	40	10	13/ 25	10
Acetaminophen-d4		P	156.1	114	10	50	10	20	9
Primidone-d5		P	224.1	167	10	40	10	17	10
Carbamazepine-d10		P	248.1	205.2	10	45	10	29	16
Diuron-d6		P	240.2	78.2	10	40	10	20	9
2,4-D-d3		N	222.0	163.9	10	-25	-10	-20.2	-17
Ibuprofen-d3		P	208	164.1	10	-80	-10	-10	-17
Acetaminophen	103-90-2	P	152.1	110.1/ 65	10	50	10	22/ 39	10
Dinotefuran	165252-70-0	P	203.08	114.1/129	10	1/11	10	25/17	14/16
Hydrocodone	125-29-1	N	300	199/ 171	10	4/ 1	10	41/ 51	12/ 20
Primidone	125-33-7	P	219.1/ 219.0	162/ 91	10	40	10	17/ 31	10/ 11
Thiamethoxam	153719-23-4	P	291.9	211/181	10	51	10	17/31	12
Fenuron	101-42-8	P	165.1	72.1/ 46.2	10	40	10	21/ 19	10
Clothianidin	210880-92-5	P	250	132/169	10	66/26	10	21/27	18/8
Imidacloprid	138261-41-3	P	256.1	209/ 175	10	35	10	23/ 26	10
Acetamiprid	135410-20-7	P	223.027	126.1/99.1	10	51	10	29/51	14/12
Carbamazepine	298-46-4	P	237.1	194.1/ 193.1	10	45	10	28/ 46	10
Diuron	330-54-1	P	233	72.2/ 46.2	10	40	10	36/ 31	10
Afidopyropen	915972-17-7	P	594.2	202.2/148	10	31	10	45/59	10/4
Linuron	330-55-2	P	249.1	160.1/ 182	10	35	10	24/ 21	10
Fluridone	59756-60-4	P	330.037	310.1/259	10	150	10	47	10
Mandestrobin	173662-97-0	P	314.1	192.1/160.1	10	101	10	15/27	14/12
Benzovindiflupyr	1072957-71-1	P	398	342/378	10	71	10	25/21	22/12
Pyraclostrobin	175013-18-0	P	388.1	194/ 163.1	10	35	10	17/ 31	10
Tolfenpyrad	129558-76-5	P	384.1	154.1/197.1	10	81	10	55/35	10/12
Picloram	1918-02-1	N	240.8/ 238.9	196.81/ 194.91	10	-30	-10	-14	-11/ -9

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
Imazapyr	81334-34-1	N	259.978	216/ 173	10	-25/ -40	-10	-18/ -28	-13/ -19
Dicamba	1918-00-9	N	218.85/ 220.9	174.911/ 176.9	10	-20	-10	-10/-11	-11/ -10
Bentazon	25057-89-0	N	239	132/ 175	10	-70	-10	-35/-26	-10
2,4-D	94-75-7	N	218.9/ 220.9	160.9/ 162.9	10	-25	-10	-18	-10
MCPA	94-74-6	N	198.9/ 200.9	140.9/ 143	10	-35	-10	-20	-10
Triclopyr	55335-06-3	N	253.1/ 254.9	194.9/ 196.902	10	-25	-10	-18/ -16	-11
Dichlorprop	120-36-5	N	232.9/ 232.8	160.9/ 124.902	10	-20	-10	-18/-40	-10/ -15
MCPP	93-65-2	N	213/ 215	141/ 143	10	-20	-10	-20	-10
2,4,5-T	93-76-5	N	252.9/ 254.9	194.9/ 196.9	10	-35	-10	-20	-10
Naproxen	22204-53-1	N	228.9	169/ 170	10	-80	-10	-38/ -20	-21/ -9
Acifluorfen	50594-66-6	N	360	316/ 195	10	-25	-10	-13/ 35	-10
2,4-DB	94-82-6	N	246.9/ 248.9	160.9/ 162.9	10	-20	-10	-16	-10
Silvex	93-72-1	N	266.9/ 268.9	194.9/ 196.9	10	-20	-10	-18	-10
Ibuprofen	15687-27-1	P	205	161	10	-80	-10	-10	-10
Dinoseb	88-85-7	N	239	193/ 134	10	-50	-10	-34/-58	-10
Direct Injection 6500									
Glyphosate 13C 15N		N	169.906	63.052	50	-5	-10	-28	-9
Glyphosate	1071-83-6	N	167.887	62.9/ 78.8	50	-5	-10	-26/ -52	-9/ -11
AMPA	1066-51-9	N	109.882	63/ 79	50	-50/ -30	-10	-24/-36	-7/ -11
Glufosinate	77182-82-2	N	179.915	85/ 95	50	-35	-10	-24/ -26	-11
Endothall-d6		N	190.955	147	150	-25	-3	-22	-17
Endothall	145-73-3	N	184.916	141.001/ 43.201	150	-20/-30	-3/-3	-20/-48	-17/ -19
Sucralose-d6		N	401.1	35.1	225	-45	-10	-66	-15

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
Sucralose	56038-13-2	N	395.100/ 395.001	35/359.001	225	-40/-30	-10	-60/ -16	-15/ -11
Acesulfame K	55589-62-3	N	161.881	78/ 82	150	-30	-10	-48/-20	-9
Microcystins 6500									
Microcystin LR ethyl-d5		P	1028.5	103.1/246.1	20	1	10	177/79	14/16
Cylindrospermopsin	143545-90-8	P	416.1/ 416.2	194.1/ 176.1	20	100	10	47/ 49	12
Microcystin RR	111755-37-4	P	519.9/51 9.901	135.1/103.101	20	90	10	36/ 91	12
Nodularin-R	118399-22-7	P	825.4	227/ 135.1	20	160	10	65/ 99	12
Microcystin YR	101064-48-6	P	1045.4/ 1045.5	103.1/135.4	20	70	10	160/139	6/10
Microcystin HtyR	FL-ORG-009	P	1059.559	103/107	20	6	10	179/165	12
Microcystin LR	101043-37-2	P	995.5	105/ 213.2	20	120	10	150/ 75	12
Desmethyl microcystin LR	120011-66-7	P	981.6	103/599.3	20	111	10	127/63	14/6
Microcystin HilR	FL-ORG-010	P	1009.590	103/105.2	20	16	10	179/171	14/12
Microcystin WR	138234-58-9	P	1068.6	103/134.9	20	70	10	165/150	9/ 11
Microcystin LA	96180-79-9	P	910.5	402.3/ 135	20	90/70	10	35/ 91	12/ 8
Microcystin LY	123304-10-9	P	1002.5	868.4/ 135.3	20	90/ 70	10	30/ 119	12
Microcystin LW	157622-02-1	P	1025.5/ 1025.3	135.2/517.2	20	70/176	10	106/37	14/20
Microcystin LF	154037-70-4	P	986.5	852.5/ 478.2	20	70/ 95	10	30/ 37	17/ 12
Saxitoxins 6500									
Anatoxin-a 13C4	DEP SUR	P	170.12	153.293	25	61	10	19	12
Anatoxin-a	64285-06-09	P	166.1	131.1/ 91	20	50	10	23/ 30	12
Saxitoxin	35523-89-8	P	300.0	282.1/179.1	200	116	10	25/33	18/12
Neosaxitoxin	64296-20-4	P	315.9	298/220	200	131	10	25/31	18/22
Diquat/ Paraquat 6500									

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
Diquatd4	6385-62-2	P	186/187	158.1/ 157	25	1/136	10	31/ 33	10/ 11
Diquat	6385-62-2	P	183	157/ 168	25	136	10	33/ 35	11/ 18
Paraquat	1910-42-5	P	185	170/ 169	25	156	10	29/ 43	22/ 8
PFAS 6500									
13C2PFOA (IS)		N	415.0	370.0	25	-25	-10	-14	-15
13C4PFOS (IS)		N	503.0	80.0	25	-65	-10	-108	-12
Perfluorohexanoic acid-13C5 (IS, SUR)		N	318.0	273.0	25	-25	-10	-12	-15
Perfluorodecanoic acid-13C6 (IS, SUR)		N	519.0	474.0	25	-25	-10	-16	-15
Perfluorobutanesulfonate - 13C3 (IS, SUR)		N	302.0	80/99	25	-55/ -65	-10	-58/-38	-12/-11
Perfluorohexanesulfonate - 13C3 (IS, SUR)		N	402.0	80/99	25	-60/-9	-10	-50/-76	-12/-13
Perfluorobutanoic acid-13C4 (IS, SUR)		N	217.0	172.0	25	-25	-10	-12	-15
Perfluoropentanoic acid-13C5 (IS, SUR)		N	268.0	223.0	25	-20	-10	-12	-15
Perfluoroheptanoic acid-13C4 (IS, SUR)		N	367.0	322.0	25	-25	-10	-12	-15
Perfluorooctanoic acid-13C8 (IS, SUR)		N	421.0	376.0	25	-25	-10	-14	-15
Perfluorononanoic acid-13C9 (IS, SUR)		N	472.0	427.0	25	-25	-10	-14	-15
Perfluoroundecanoic acid-13C7 (IS, SUR)		N	570.0	525.0	25	-25	-10	-18	-15
Perfluorododecanoic acid-13C2 (IS, SUR)		N	615.0	570.0	25	-25	-10	-18	-15
Perfluorotetradecanoic acid-13C2 (IS, SUR)		N	715.0	670.0	25	-25	-10	-22	-15
Perfluorooctanesulfonate - 13C8 (IS, SUR)		N	507.0	80.0	25	-65	-10	-108	-12

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
Perfluorooctanesulfonamide -13C8 (IS, SUR)		N	506.0	78.0	25	-60	-10	-85	-12
d3-N-MeFOSAA (IS, SUR)		N	573.0	419.0	25	-75	-10	-28	-12
d5-N-EtFOSAA (IS, SUR)		N	589.0	419.0	25	-90	-10	-28	-12
4:2 FTS-13C2 (IS, SUR)		N	329.0	81.0	25	-55	-10	-54	-13
6:2 FTS-13C2 (IS, SUR)		N	429.0	81.0	25	-75	-10	-70	-13
8:2 FTS-13C2 (IS, SUR)		N	529.0	81.0	25	-105	-10	-84	-37
HFPO-DA 13C3 (IS, SUR)		N	287	169/185	25	-70/-50	-10	-10/-24	-15/-13
ADONA	919005-14-4	N	377.0	85.0/251	25	-70	-10	-35/-15	-15
9Cl-PF3ONS	756426-58-1	N	530.9	351/353	25	-120	-10	-38	-12
11Cl-PF3OUdS	763051-92-9	N	630.9	451/453	25	-160	-10	-41	-12
FBSA	30334-69-1	N	298.0	78.0	25	-55	-10	-58	-15
FHxSA	41997-13-1	N	398.0	78.0	25	-60	-10	-74	-15
FOSA	754-91-6	N	498.0	78.0	25	-60	-10	-85	-15
3:3 FTCA	356-02-05	N	240.9	177/117	25	-35	-10	-12/-48	-11/-53
5:3 FTCA	914637-49-3	N	340.9	237/217	25	-30	-10	-18/-36	-13/-11
7:3 FTCA	812-70-4	N	440.9	337/317	25	-40	-10	-18/-32	-19/-17
4:2 FTS	757124-72-4	N	327	307/81	25	-60	-10	-28/-50	-12
6:2 FTS	27619-97-2	N	427	407/81	25	-80	-10	-32/-72	-12
8:2 FTS	39108-34-4	N	527	507/81	25	-60	-10	-40/-82	-12/-9
HFPO-DA	13252-13-6	N	285	169/185	25	-75	-10	-10/-18	-15
NEtFOSAA	2991-50-6	P	583.8	418.9/ 526	25	-90	-10	-28	-12
NMeFOSAA	2355-31-9	P	569.8	419/ 482.9	25	-75	-10	-28/ -22	-12
PFBA	375-22-4	N	212.9	169	25	-25	-10	-12	-15
PFBS	29420-49-3	N	298.8	79.9/ 98.9	25	-55	-10	-58/ -40	-12
PFDA	335-76-2	N	512.8	468.9/ 168.9	25	-25	-10	-16/ -26	-15
PFDoA	307-55-1	N	612.8	568.9/ 168.9	25	-25	-10	-18/ -30	-15
PFDS	2806-15-7	N	599	80/99	25	-85	-10	-118/-84	-12
PFECHS	67584-42-3	N	461	381/99	25	-40	-10	-34/-56	-9/-11
PFEESA	113507-82-7	N	314.9	134.9/68.9/82.9	25	-45	-10	-32/-72/-26	-9
PFHpA	375-85-9.	N	362.9	318.9/ 168.9	25	-25	-10	-12/ -20	-15
PFHpS	375-92-8	N	449	80/99	25	-65	-10	-88/-50	-12
PFHxA	307-24-4	N	312.9	268.9/ 118.9	25	-25	-10	-12/ -28	-15

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
PFHxS	355-46-4	N	398.8	79.9/ 98.9	25	-60	-10	-74/ -50	-12
PFMBA	863090-89-5	N	279	85	25	-22	-10	-10	-16
PFMPA	377-73-1	N	229	85	25	-23	-10	-10	-16
PFNA	375-95-1	N	462.8	418.9/ 169	25	-25	-10	-14/ -24	-15
PFNS	98789-57-2	N	549	80/99	25	-70	-10	-110/-70	-12
PFOA	335-67-1	N	412.8	368.9/ 168.9	25	-25	-10	-14/ -22	-15
PFOS	1763-23-1	N	498.8	79.9/ 98.9	25	-65	-10	-108/ -58	-12
PFPeA	2706-90-3	N	262.9	219	25	-20	-10	-12	-15
PFPeS	630402-22-1	N	349	80/99	25	-60	-10	-66/-45	-12
PFPrS	423-41-6	N	249.8	79.9/98.8	25	-50	-10	-50/-36	-39/-7
PFTeA	376-06-7	N	712.7	668.9/ 168.9	25	-25	-10	-22/ -38	-15
PFTriA	72629-94-8	N	662.7	618.9/ 168.9	25	-25	-10	-20/ -36	-15
PFUnA	2058-94-8	N	562.8	518.9/ 168.9	25	-25	-10	-18/ -28	-15
NFDHA	151772-58-6	N	294.9	200.9/84.9	25	-40	-10	-14/-34	-11/-9
NIPI 7500									
Carbaryl-d7		P	209.0	152.1	10		10	17	16
Aldicarb Sulfoxide	1646-87-3	P	207.1	132/ 89.2	10		10	9/ 19	10
Oxamyl	23135-22-0	P	237.1	72.1/ 90.1	10		10	27/ 12	10
Aldicarb Sulfone	1646-88-4	P	240.1	86.1/ 76.1	10		10	25.5/16.5	10
Methomyl	16752-77-5	P	163.1	106/ 88	10		10	15	10
3-Hydroxycarbofuran	16655-82-6	P	238.2	163/ 107.1	10		10	20/40	10
Aldicarb	116-06-3	P	208.2/ 208.1	116.1/ 89.1	10		10	10.5/23	10
Propoxur	114-26-1	P	210.1	111/ 93.1	10		10	20.5/ 35	10
Carbofuran	1563-66-2	P	222.1	165.1/ 123	10		10	17/ 30	10
Carbaryl	63-65-2	P	202.1	144.9/ 127.1	10		10	15/ 38	10
Methiocarb	2032-65-7	P	226.1	169/ 121.1	10		10	13/ 25	10
Acetaminophen-d4		P	156.1	114	10		10	20	9
Primidone-d5		P	224.1	167	10		10	17	10
Carbamazepine-d10		P	248.1	205.2	10		10	29	16
Diuron-d6		P	240.2	78.2	10		10	20	9

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
2,4-D-d3		N	222.0	163.9	10		-10	-20.2	-17
Ibuprofen-d3		P	208	164.1	10		-10	-10	-17
Acetaminophen	103-90-2	P	152.1	110.1/ 65	10		10	22/ 39	10
Dinotefuran	165252-70-0	P	203.08	114.1/129	10		10	25/17	14/16
Hydrocodone	125-29-1	N	300	199/ 171	10		10	41/ 51	12/ 20
Primidone	125-33-7	P	219.1/ 219.0	162/ 91	10		10	17/ 31	10/ 11
Thiamethoxam	153719-23-4	P	291.9	211/181	10		10	17/31	12
Fenuron	101-42-8	P	165.1	72.1/ 46.2	10		10	21/ 19	10
Clothianidin	210880-92-5	P	250	132/169	10		10	21/27	18/8
Imidacloprid	138261-41-3	P	256.1	209/ 175	10		10	23/ 26	10
Acetamiprid	135410-20-7	P	223.027	126.1/99.1	10		10	29/51	14/12
Carbamazepine	298-46-4	P	237.1	194.1/ 193.1	10		10	28/ 46	10
Diuron	330-54-1	P	233	72.2/ 46.2	10		10	36/ 31	10
Afidopyropen	915972-17-7	P	594.2	202.2/148	10		10	45/59	10/4
Linuron	330-55-2	P	249.1	160.1/ 182	10		10	24/ 21	10
Fluridone	59756-60-4	P	330.037	310.1/259	10		10	47	10
Mandestrobin	173662-97-0	P	314.1	192.1/160.1	10		10	15/27	14/12
Benzovindiflupyr	1072957-71-1	P	398	342/378	10		10	25/21	22/12
Pyraclostrobin	175013-18-0	P	388.1	194/ 163.1	10		10	17/ 31	10
Tolfenpyrad	129558-76-5	P	384.1	154.1/197.1	10		10	55/35	10/12
Picloram	1918-02-1	N	240.8/ 238.9	196.81/ 194.91	10		-10	-14	-11/ -9
Imazapyr	81334-34-1	N	259.978	216/ 173	10		-10	-18/ -28	-13/ -19
Dicamba	1918-00-9	N	218.85/ 220.9	174.911/ 176.9	10		-10	-10/-11	-11/ -10
Bentazon	25057-89-0	N	239	132/ 175	10		-10	-35/-26	-10
2,4-D	94-75-7	N	218.9/ 220.9	160.9/ 162.9	10		-10	-18	-10

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
MCPA	94-74-6	N	198.9/ 200.9	140.9/ 143	10		-10	-20	-10
Triclopyr	55335-06-3	N	253.1/ 254.9	194.9/ 196.902	10		-10	-18/ -16	-11
Dichlorprop	120-36-5	N	232.9/ 232.8	160.9/ 124.902	10		-10	-18/-40	-10/ -15
MCPP	93-65-2	N	213/ 215	141/ 143	10		-10	-20	-10
2,4,5-T	93-76-5	N	252.9/ 254.9	194.9/ 196.9	10		-10	-20	-10
Naproxen	22204-53-1	N	228.9	169/ 170	10		-10	-38/ -20	-21/ -9
Acifluorfen	50594-66-6	N	360	316/ 195	10		-10	-13/ 35	-10
2,4-DB	94-82-6	N	246.9/ 248.9	160.9/ 162.9	10		-10	-16	-10
Silvex	93-72-1	N	266.9/ 268.9	194.9/ 196.9	10		-10	-18	-10
Ibuprofen	15687-27-1	P	205	161	10		-10	-10	-10
Dinoseb	88-85-7	N	239	193/ 134	10		-10	-34/-58	-10
Direct Injection 7500									
Glyphosate 13C 15N		N	169.906	63.052	50		-10	-32	-7
Glyphosate	1071-83-6	N	167.887	62.9/ 78.8	50		-10	-44/ -67	-7/ -22
AMPA	1066-51-9	N	109.882	63/ 79	50		-10	-25/-38	-14/ -23
Glufosinate	77182-82-2	N	179.915	85/ 95	50		-10	-29/-25	-22/-24
Endothall-d6		N	190.955	147	150		-10	-21	-23
Endothall	145-73-3	N	184.916	141.001/ 43.201	150		-10	-20/--52	-24/-22
Sucralose-d6		N	401.1	35.1	225		-10	-66	-15
Sucralose	56038-13-2	N	395.100/ 395.001	35/359.001	225		-10	-60/ -16	-15/ -11
Acesulfame K	55589-62-3	N	161.881	78/ 82	150		-10	-48/-20	-9
Microcystins 7500									

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
Microcystin LR ethyl-d5		P	1028.5	103.1/246.1	20		10	177/79	14/16
Cylindrospermopsin	143545-90-8	P	416.1/ 416.2	194.1/ 176.1	20		10	47/ 49	12
Microcystin RR	111755-37-4	P	519.9/519.901	135.1/103.101	20		10	36/ 91	12
Nodularin-R	118399-22-7	P	825.4	227/ 135.1	20		10	65/ 99	12
Microcystin YR	101064-48-6	P	1045.4/ 1045.5	103.1/135.4	20		10	160/139	6/10
Microcystin HtyR	FL-ORG-009	P	1059.559	103/107	20		10	179/165	12
Microcystin LR	101043-37-2	P	995.5	105/ 213.2	20		10	150/ 75	12
Desmethyl microcystin LR	120011-66-7	P	981.6	103/599.3	20		10	127/63	14/6
Microcystin HilR	FL-ORG-010	P	1009.590	103/105.2	20		10	179/171	14/12
Microcystin WR	138234-58-9	P	1068.6	103/134.9	20		10	165/150	9/ 11
Microcystin LA	96180-79-9	P	910.5	402.3/ 135	20		10	35/ 91	12/ 8
Microcystin LY	123304-10-9	P	1002.5	868.4/ 135.3	20		10	30/ 119	12
Microcystin LW	157622-02-1	P	1025.5/ 1025.3	135.2/517.2	20		10	106/37	14/20
Microcystin LF	154037-70-4	P	986.5	852.5/ 478.2	20		10	30/ 37	17/ 12
Saxitoxins 7500									
Anatoxin-a 13C4	DEP SUR	P	170.12	153.293	25	61	10	19	12
Anatoxin-a	64285-06-09	P	166.1	131.1/ 91	20	50	10	23/ 30	12
Saxitoxin	35523-89-8	P	300.0	282.1/179.1	25	116	10	25/33	18/12
Neosaxitoxin	64296-20-4	P	315.9	298/220	25	131	10	25/31	18/22
PFAS 7500									
13C2PFOA (IS)		N	415.0	370.0	25		-10	-14	-15
13C4PFOS (IS)		N	503.0	80.0	25		-10	-108	-12
Perfluorohexanoic acid-13C5 (IS, SUR)		N	318.0	273.0	25		-10	-12	-15

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
Perfluorodecanoic acid-13C6 (IS, SUR)		N	519.0	474.0	25		-10	-16	-15
Perfluorobutanesulfonate -13C3 (IS, SUR)		N	302.0	80/99	25		-10	-58/-38	-12/-11
Perfluorohexanesulfonate -13C3 (IS, SUR)		N	402.0	80/99	25		-10	-50/-76	-12/-13
Perfluorobutanoic acid-13C4 (IS, SUR)		N	217.0	172.0	25		-10	-12	-15
Perfluoropentanoic acid-13C5 (IS, SUR)		N	268.0	223.0	25		-10	-12	-15
Perfluoroheptanoic acid-13C4 (IS, SUR)		N	367.0	322.0	25		-10	-12	-15
Perfluorooctanoic acid-13C8 (IS, SUR)		N	421.0	376.0	25		-10	-14	-15
Perfluorononanoic acid-13C9 (IS, SUR)		N	472.0	427.0	25		-10	-14	-15
Perfluoroundecanoic acid-13C7 (IS, SUR)		N	570.0	525.0	25		-10	-18	-15
Perfluorododecanoic acid-13C2 (IS, SUR)		N	615.0	570.0	25		-10	-18	-15
Perfluorotetradecanoic acid-13C2 (IS, SUR)		N	715.0	670.0	25		-10	-22	-15
Perfluorooctanesulfonate -13C8 (IS, SUR)		N	507.0	80.0	25		-10	-108	-12
Perfluorooctanesulfonamide -13C8 (IS, SUR)		N	506.0	78.0	25		-10	-85	-12
d3-N-MeFOSAA (IS, SUR)		N	573.0	419.0	25		-10	-28	-12
d5-N-EtFOSAA (IS, SUR)		N	589.0	419.0	25		-10	-28	-12
4:2 FTS-13C2 (IS, SUR)		N	329.0	81.0	25		-10	-54	-13
6:2 FTS-13C2 (IS, SUR)		N	429.0	81.0	25		-10	-70	-13
8:2 FTS-13C2 (IS, SUR)		N	529.0	81.0	25		-10	-84	-37
HFPO-DA 13C3 (IS, SUR)		N	287	169/185	25		-10	-10/-24	-15/-13
ADONA	919005-14-4	N	377.0	85.0/251	25		-10	-35/-15	-15
9Cl-PF3ONS	756426-58-1	N	530.9	351/353	25		-10	-38	-12

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
11Cl-PF3OUdS	763051-92-9	N	630.9	451/453	25		-10	-41	-12
FBSA	30334-69-1	N	298.0	78.0	25		-10	-58	-15
FHxSA	41997-13-1	N	398.0	78.0	25		-10	-74	-15
FOSA	754-91-6	N	498.0	78.0	25		-10	-85	-15
3:3 FTCA	356-02-05	N	240.9	177/117	25		-10	-12/-48	-11/-53
5:3 FTCA	914637-49-3	N	340.9	237/217	25		-10	-18/-36	-13/-11
7:3 FTCA	812-70-4	N	440.9	337/317	25		-10	-18/-32	-19/-17
4:2 FTS	757124-72-4	N	327	307/81	25		-10	-28/-50	-12
6:2 FTS	27619-97-2	N	427	407/81	25		-10	-32/-72	-12
8:2 FTS	39108-34-4	N	527	507/81	25		-10	-40/-82	-12/-9
HFPO-DA	13252-13-6	N	285	169/185	25		-10	-10/-18	-15
NEtFOSAA	2991-50-6	P	583.8	418.9/ 526	25		-10	-28	-12
NMeFOSAA	2355-31-9	P	569.8	419/ 482.9	25		-10	-28/ -22	-12
PFBA	375-22-4	N	212.9	169	25		-10	-12	-15
PFBS	29420-49-3	N	298.8	79.9/ 98.9	25		-10	-58/ -40	-12
PFDA	335-76-2	N	512.8	468.9/ 168.9	25		-10	-16/ -26	-15
PFDoA	307-55-1	N	612.8	568.9/ 168.9	25		-10	-18/ -30	-15
PFDS	2806-15-7	N	599	80/99	25		-10	-118/-84	-12
PFECHS	67584-42-3	N	461	381/99	25		-10	-34/-56	-9/-11
PFEESA	113507-82-7	N	314.9	134.9/68.9/82.9	25		-10	-32/-72/-26	-9
PFHpA	375-85-9.	N	362.9	318.9/ 168.9	25		-10	-12/ -20	-15
PFHpS	375-92-8	N	449	80/99	25		-10	-88/-50	-12
PFHxA	307-24-4	N	312.9	268.9/ 118.9	25		-10	-12/ -28	-15
PFHxS	355-46-4	N	398.8	79.9/ 98.9	25		-10	-74/ -50	-12
PFMBA	863090-89-5	N	279	85	25		-10	-10	-16
PFMPA	377-73-1	N	229	85	25		-10	-10	-16
PFNA	375-95-1	N	462.8	418.9/ 169	25		-10	-14/ -24	-15
PFNS	98789-57-2	N	549	80/99	25		-10	-110/-70	-12
PFOA	335-67-1	N	412.8	368.9/ 168.9	25		-10	-14/ -22	-15
PFOS	1763-23-1	N	498.8	79.9/ 98.9	25		-10	-108/ -58	-12
PFPeA	2706-90-3	N	262.9	219	25		-10	-12	-15
PFPeS	630402-22-1	N	349	80/99	25		-10	-66/-45	-12
PFPrS	423-41-6	N	249.8	79.9/98.8	25		-10	-50/-36	-39/-7

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Analyte	CAS #	Ion-Mode	Q1 Mass	Q3 Mass	Duration	DP (V)	EP (V)	CE (eV)	CXP (V)
PFTeA	376-06-7	N	712.7	668.9/ 168.9	25		-10	-22/ -38	-15
PFTriA	72629-94-8	N	662.7	618.9/ 168.9	25		-10	-20/ -36	-15
PFUnA	2058-94-8	N	562.8	518.9/ 168.9	25		-10	-18/ -28	-15
NFDHA	151772-58-6	N	294.9	200.9/84.9	25		-10	-14/-34	-11/-9

Table 9: PFAS Target analytes associated with Extracted Internal Standard Surrogates (Acceptance Range for Extracted Internal Standard 50 to 150%)

Extracted Internal Standard	Target Analytes	Extracted Internal Standard	Target Analytes
Perfluorobutanoic acid-13C4	PFBA	Perfluorooctanesulfonamide -13C8	FBSA
	PFMBA		FHxSA
	PFMPA	HFPO-DA 13C3	HFPO-DA
	PFEESA	d3-N-MeFOSAA	N-MeFOSAA
Perfluoropentanoic acid-13C5	3:3 FTCA	d5-N-EtFOSAA	N-EtFOSAA
	PFPeA	Perfluorobutanesulfonate -13C3	PFBS
Perfluorohexanoic acid-13C5	5:3 FTCA		PFPeS
	7:3 FTCA		PFPrS
	PFHxA	Perfluorohexanesulfonate -13C3	PFHxS
Perfluoroheptanoic acid-13C4	PFHpA		PFHpS
	NFDHA		PFECHS
Perfluorooctanoic acid-13C8	PFOA	Perfluorooctanesulfonate -13C8	PFOS
Perfluorononanoic acid-13C9	PFNA		PFNS
	ADONA		PFDS
Perfluorodecanoic acid-13C6	PFDA		9Cl-PF3ONS
Perfluoroundecanoic acid-13C7	PFUnA		11Cl-PF3OUdS
Perfluorododecanoic acid-13C2	PFDoA	4:2 FTS-13C2	4:2 FTS

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Extracted Internal Standard	Target Analytes	Extracted Internal Standard	Target Analytes
Perfluorotetradecanoic acid-13C2	PFTriA	6:2 FTS-13C2	6:2 FTS
	PFTeA	8:2 FTS-13C2	8:2 FTS
Perfluorooctanesulfonamide -13C8	FOSA		

Table 10. PFA surrogates associated with Internal Standard

Isotope Dilution Compounds (IS)	Surrogate
13C2PFOAIS 13C4PFOSIS	Check Internal Standards
Perfluoroheptanoic acid-13C4	Perfluorohexanoic acid-13C5 HFPO-DA-13C3
Perfluorooctanesulfonate-13C8	Perfluorobutanesulfonate-13C3 Perfluorohexanesulfonate-13C3
Perfluoroundecanoic acid-13C7	Perfluorodecanoic acid-13C6

Table 11. Surrogate Association in Water and Sediment for PFA analytes

Surrogate	Target	Surrogate	Target
Perfluorohexanoic acid-13C5	PFBA	**Perfluorohexanesulfonate-13C3**	PFHxS
	PFPeA		8:2 FTS
	PFHxA		PFHpS
	PFHpA		N-MeFOSAA
	PFOA		N-EtFOSAA
	PFNA		PFOS
	ADONA		PFNS

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Surrogate	Target	Surrogate	Target
	PFMPA		PFDS
	PFMBA		FOSA
	NFDHA		9Cl-PF3ONS
	3:3 FTCA		11Cl-PF3OUdS
	5:3 FTCA		FBSA
	7:3 FTCA		FHxSA
			FOSA
Perfluorobutanesulfonate-13C3	4:2 FTS		PFECHS
	PFBS		
	PFPeS	**Perfluorodecanoic acid-13C7**	PFDA
	6:2 FTS		PFUnA
	PFPrS		PFDoA
	PFEESA		PFTriA
			PFTeA
Hexafluoropropylene oxide dimer acid-13C	HFPO-DA		

Appendix-B

08/05/2010 Added new analyte Cyanuric acid in water analysis by direct injection. Elaborated MDL determination section 1.4 to include different matrices and supporting references in section 10.

08/22/2011 Added new analyte Dioctyl sulfosuccinate and Sucralose in water analysis. Changed criteria for initial calibration curve.

08/15/2012 Added new HPLC instrument and edited method files to reflect current analysis.

03/06/2013 Edited to include low level Negative Ion Mode Analysis

09/24/2013 Added Diquat and Paraquat in water analysis.

01/13/2014 Added Glyphosate and AMPA in water analysis; Merged SOPs LC-001-2.7, LC-006-2.13 and LC-008-2.15 into LC-001

01/14/2015 Merged SOPs LC-038-1 and LC-001-2 into LC-001-2

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01/26/2016	Added new analyte Benzoic acid
01/16/2017	Added new analyte Malathion
03/07/2018	Edited to include two AB Sciex API 6500+ instruments
10/02/2018	Added per- and polyfluoroalkyl substances
02/06/2016	General edits regarding grammar, spelling, and document organization. Removed unnecessary information.
02/12/2020	Added new analytes
12/14/2020	Added new analytes
04/21/2021	Added new analytes
06/30/2021	Added new analytes
12/06/2023	Added new analytes and updated PFAS method to EPA Method 1633
12/11/2024	Added AB Sciex API 7500 methods for analysis

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