Quality Assurance Project Plan

for

Per- and Polyfluoroalkyl Substances in New Jersey Soils: A Statewide Investigation

Prepared by:

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Prepared for:

New Jersey Department of Environmental Protection (NJDEP) Contaminated Site

August 2023

State of New Jersey
Phil Murphy, Governor

Department of Environmental Protection
Shawn M. LaTourette, Commissioner

My signature below indicates my approval of the plan and my commitment to follow the procedures noted herein. I understand that changes to this plan shall not be made without approval/signature by all below signatories.

NJDEP Project Manager:	Zahid Aziz Zahid Aziz, Research Scientist, DSR
NJDEP Principal Investigator:	Jennifer Willemsen Jennifer Willemsen, Research Scientist, BEERA
Project Quality Assurance (QA) Officer:	Greg Toffoli Greg Toffoli, Section Chief, BEERA

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A1 Distribution List

Table 1: Distribution List			
Name	Organization	Title	E-mail Address
Jennifer Willemsen	NJDEP – Bureau of Environmental Evaluation and Risk Assessment (BEERA)	Principal Investigator	Jennifer.Willemsen@dep.nj.gov
Zahid Aziz	NJDEP – Division of Science and Research (DSR)	Project Manager	Zahid.Aziz@dep.nj.gov
Greg Toffoli	NJDEP – BEERA	Project QA Officer, Financial and Analysis Coordinator	Greg.Toffoli@dep.nj.gov

A2 Project / Task Organization

Table 2: Roles and Responsibilities of Key Project Personnel			
Name	Organization	Project Role	Project Duties
Jennifer Willemsen	NJDEP – BEERA	Principal Investigator	Experimental design, data interpretation, and final report preparation
Zahid Aziz	NJDEP – DSR	Project Manager	Project coordination, document preparation, technical support
Greg Toffoli	NJDEP – BEERA	Project QA Officer, Financial and Analysis Coordinator	Laboratory contracting, analytical and data validation support, QAPP preparation, financial coordination (CSRR), document preparation
Nicholas Procopio	NJDEP – DSR	Financial Coordinator, Technical Support	Financial coordination (DSR), document review, technical support
Alex Iannone	NJDEP – BEERA	GIS Coordinator	Sample location selection, data compilation, figure creation, document preparation
Joe Stefanoni	NJDEP – Bureau of Information Systems (BIS)	GIS Support	GIS technical support
Allan Motter	NJDEP – BEERA	Technical Support	Document review, technical support
Erica Snyder	NJDEP – BEERA	Technical Support	Document review, technical support

Sandra Goodrow	NJDEP – CSRR	Technical Support	Document review, technical support
Lori Lester	NJDEP – DSR	Technical Support	Statistical analysis, document review, technical support
John Evenson	NJDEP – Bureau of Environmental Measurement and Site Assessment (BEMSA)	Field Coordinator	Field operations management and sample collection
David Froehlich	NJDEP – BIS	Technical Support	Data formatting

A3 Problem Definition / Background

Per- and Polyfluoroalkyl Substance (PFAS) soil contamination at sites across New Jersey is a preeminent issue being addressed by the Contaminated Site Remediation & Redevelopment (CSRR) program at this time. With the release of the New Jersey Department of Environmental Protection's interim soil remediation standards for perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorooctane sulfonate (PFOS), and Hexafluoropropylene oxide dimer acid and its ammonium salt (GenX chemicals), CSRR would like to investigate PFAS soil impacts from atmospheric deposition throughout New Jersey. Recent PFAS studies from other states in the Northeast United States (Maine, Vermont) have reported widely disbursed PFAS impacts (Sanborn, Head & Associates, Inc., 2022; Zhu et al., 2019). To date, no such study has been conducted in New Jersey. This project will be co-led by CSRR and the Division of Science & Research (DSR).

A4 Project / Task Description

The main goal of the proposed research is to evaluate and quantify PFAS soil impacts in New Jersey. A second research motivation is to improve the understanding of PFAS-soil interactions. One of the key properties related to the fate and transport of PFAS in soils is the soil-water partitioning coefficient (K_d value). Reported PFAS K_d values in the scientific literature can span several orders of magnitude (Rovero, 2021) and uncertainty remains about the extent to which different soil properties influence PFAS adsorption. As a part of this proposed research, samples will be analyzed using the synthetic precipitation leaching procedure (SPLP) to determine site-specific K_d values. The same samples will also be analyzed for soil properties known to influence contaminant adsorption including total organic carbon (TOC) content, particle size, pH, metals, and cation exchange capacity to better understand the relationships between these properties and K_d values.

Within CSRR, overall direction of the project and sampling location selection will be the responsibility of the Bureau of Environmental Evaluation and Risk Assessment (BEERA). Soil sample collection will

be accomplished by personnel from the Bureau of Environmental Monitoring and Sampling Assistance (BEMSA) with assistance from BEERA. The Department's Field Sampling and Procedures Manual (FSPM) and the Interstate Technology and Regulatory Council's PFAS guidance document (ITRC 2022) will be used to form the basis of the sampling procedures. All sampling procedures will adhere to methods that limit any cross contamination. Analysis of the collected samples will be done by Alpha Analytical laboratory using New Jersey certified methods where certified methods are available. The parameters and methods are listed in Appendix 1. Statistical analysis of results will be the responsibility of DSR scientists, and a final report will be prepared by BEERA and reviewed by DSR.

Sample results will be analyzed to quantify PFAS concentrations in New Jersey soils and to examine the distribution of different PFAS compounds. Concentration differences between counties and between urban and rural locations will also be examined. SPLP analysis will be conducted to evaluate PFAS leachability and each sample will be analyzed for various soil properties including Total Organic Carbon (TOC), particle size, Superfund Analytical Methods-SFAM01.1 Target Analyte List (TAL) metals, pH, and cation exchange capacity. Soil property information will be compared to measured PFAS concentrations to better understand the geochemical processes influencing PFAS adsorption by soils.

Table 3: Task Schedule

Task	Start Date	Anticipated End Date
QAPP submittal	August 2023	August 2023
Sample collection and laboratory analysis	August 2023	November 2023
Data analysis and report generation	November 2023	March 2024

A5 Quality Objectives and Criteria

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision for PFAS is evaluated for analytical results using matrix spikes and duplicate matrix spike samples (10 percent of samples). It is expressed in terms of the relative percent difference (RPD) as shown below:

$$RPD = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100$$

where:

C1 = concentration of matrix spike (MS)
C2 = concentration of matrix spike duplicate (MSD)

The acceptable limits of precision for this effort are 30%.

Accuracy is the degree of agreement of a measurement (or an average of the same measurement type), with an accepted reference or true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components due to sampling and analytical operations. Accuracy is evaluated using laboratory control samples (LCSs) (5 percent of samples) and MS and MSD samples (10 percent of samples). Accuracy is typically expressed as percent recovery (%R), as shown below:

$$\%R = \frac{S - U}{C_{sa}} \times 100$$

where:
S = measured concentration of spiked aliquot
U = measured concentration of unspiked aliquot
Csa = concentration of spike added

The acceptable limits of accuracy for this effort are 70 to 130%.

Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variation at a sampling point, or an environmental condition. Representativeness is influenced by the number and location of the sampling points, sampling timing and frequency of monitoring efforts, as well as the field and laboratory procedures. The representativeness of data will be maintained by the use and consistent application of established field and laboratory procedures and the spatial distribution of samples throughout all New Jersey (NJ) counties.

Comparability expresses the confidence with which one data set is similar to another, based on using standardized techniques and procedures, standard reference materials, quality control (QC) samples and surrogates, as well as by reporting each data type in consistent units. Analytical methods employed will be the same or equivalent for all rounds of sampling. All proposed analytical methods (except for Grain Size with Hydrometer) are available for certification by the Department's Office of Quality Assurance and the laboratory is required to hold all such certifications for analytes, matrices and methods.

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. The data quality assessment process will be used to evaluate the validity of the data, and whether the number of samples and analyses proposed were actually obtained during the field study. Percent completeness is defined as:

$$Percent\ Completeness = \frac{V}{T} \times 100$$

where:
V = number of valid (not rejected) measurements over a given time; and
T = total number of measurements over a given time.

The overall completeness goal for this project will be a minimum of 90 percent for all project data. In the event that the completeness goal is not met, additional samples may be collected and analyzed.

Sensitivity is the capability of an analytical method or instrument to discriminate between measurement responses representing different concentrations of an analyte of interest.

TABLE 4: PFAS Project Reporting Limits

Analyte	Project Reporting Limits Aqueous (ng/L)	Project Reporting Limits Soil (ng/g)
PFBA	6.4	0.8
PFPeA	3.2	0.4
PFHxA	1.6	0.2
PFHpA	1.6	0.2
PFOA	1.6	0.2
PFNA	1.6	0.2
PFDA	1.6	0.2
PFUnA	1.6	0.2
PFDoA	1.6	0.2
PFTrDA	1.6	0.2
PFTA	1.6	0.2
PFBS	1.6	0.2
PFPeS	1.6	0.2
PFHxS	1.6	0.2
PFHpS	1.6	0.2
PFOS	1.6	0.2
PFNS	1.6	0.2
PFDS	1.6	0.2
PFDoS	1.6	0.2
4:2FTS	6.4	0.8
6:2FTS	6.4	0.8
8:2FTS	6.4	0.8
FOSA	1.6	0.2
NMeFOSA	1.6	0.2
NEtFOSA	1.6	0.2
NMeFOSAA	1.6	0.2
NEtFOSAA	1.6	0.2
NMeFOSE	16	2
NEtFOSE	16	2
Analyte	Project Reporting Limits Aqueous (ng/L)	Project Reporting Limits Soil (ng/g)

HFPO-DA	6.4	0.8
ADONA	6.4	0.8
9Cl-PFONS	6.4	0.8
11Cl-PFOUdS	6.4	0.8
3:3FTCA	8	1
5:3FTCA	40	5
7:3FTCA	40	5
PFEESA	3.2	0.4
PFMPA	3.2	0.4
PFMBA	3.2	0.4
NFDHA	3.2	0.4

A6 Special Training / Certifications

A6.1 Field Sampling and Measurement Personnel

All sampling will be conducted by BEMSA with assistance from BEERA.

A6.2 Laboratory Personnel

All Alpha Analytical laboratory personnel shall have the necessary education and experience for all methods as required and defined in The Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18.

A7 Documentation and Records

A7.1 QA Project Plan Distribution

The QAPP will be distributed to all members of the project team.

A7.2 Field Documentation and Records

Field logbooks and sampling sheets contain the documentary evidence for procedures as performed by field personnel. Hard cover, bound field logbooks and BEMSA/BEERA-supplied sampling sheets will be used for this field study. The pages of the notebook will be numbered consecutively and will not be removed.

Entries will be made in indelible blue or black ink. No erasures will be allowed. If an incorrect entry is made, the information will be crossed out with a single strike mark, and the correction initialed and dated by the team member making the correction.

Each entry will be dated. Entries will be legible and contain accurate and complete documentation of the individual or sampling team's activities or observations made. The level of detail will be sufficient to explain and reconstruct the activity conducted for an individual independent of the field activities. Each entry will be signed by the person(s) making the entry.

The following types of information will be provided for each sampling task, as appropriate:

- Project name and number
- Date and time of activity
- Unique sample identification code
- Geographical location of the sampling point (state plane coordinates or latitude/longitude determined by GPS)
- Sample depth
- Description of the sampling location (forested or open cover)
- Description of the sampling method including procedures followed, equipment used, and any departure from the specified procedures.
- Description of the sample physical characteristics (color, texture, odor, etc.)
- Description of removed vegetation (if any) and root depth and density
- Weather conditions at the time of sampling and previous meteorological events that may affect the representative nature of a sample
- Photographic information, including a brief description of what was photographed, the date and time, the compass direction of the picture, and the number of the photograph. Each picture should be downloaded from the camera as soon as possible and electronically incorporated into a photo log with captions that include pertinent information.
- Reference numbers from all serialized forms on which the sample is listed or labels which are attached to the sample (i.e., chain of custody forms, air bill numbers, etc.)
- Other pertinent observations, such as the presence of other persons on the site (those associated with the job or members of the press, special interest groups, or passersby), actions by others that may affect performance of site tasks, or any unusual activities, etc.
- Names of sampling personnel and signature of persons making entries.

A7.3 Laboratory Documentation and Records

The laboratory will be responsible for maintaining supporting documentation as per the Direct Purchasing Authority contract (PFAS Research Study – SRP 2023) in the form of sample preparation logs, instrument run logs, maintenance logs, standards receipt and preparation logs, instrument printouts, and chromatograms. Calculations should be clearly identified in the sample analysis records or in laboratory standard operating procedures (SOPs).

The laboratory will maintain records documenting each phase of sample handling, from receipt to final report of analyses. Accountable documents used by laboratories include sample receipt forms, laboratory operation logbooks, chain of custody (COC) records, bench work sheets, and other documents relating to sample preparation or analysis. The laboratory will utilize a document numbering and identification system for all documents/logs.

The analytical laboratory will record all observations, pre-screening data, and results on either pre-printed laboratory forms or permanently-bound laboratory logbooks, or enter into secure computer systems. Pages, in both the bound and unbound logbooks, will be sequentially-numbered. Pre-printed laboratory forms will contain the project laboratory's name, date (month/day/year) and time of activity, and signature of the person(s) performing associated laboratory activities. Permanently-bound laboratory logbooks will include the date (month/day/year) and time of activity, and signature of the person(s) performing associated laboratory activities. All logbook entries will be in chronological order and recorded in indelible ink. Corrections will consist of line-out deletions that will be initialed and dated by the person making the correction. Each entry will be signed and dated, and the remaining space on each page will be crossed out. Computer forms will contain the project laboratory's name, date, and signature of the person performing the activity when the form is printed.

Computer systems will be configured for restricted access and provide for appropriate backups and audit trails. Instrument run logs will be maintained to allow for a complete reconstruction of the run sequence for each instrument and will include calibration, QC samples, and project sample data. Computer logs can be used if all of the preceding information is captured. Computer/instrument printouts, or other independent information, can be incorporated into logbooks if permanently affixed to the instrument-specific logbook.

Analytical data generated by the laboratory for this project will undergo a QC review prior to release of the reported data. Each step of this review process involves evaluation of data quality based on both the results of the QC data and the professional judgment of those performing the review. This application of technical knowledge and experience to the data evaluation is essential so that data of high quality are generated consistently.

A8 Deliverables and Reporting Requirements

All data generated from the laboratory shall be submitted to the Department electronically according to the requirements specified in the *Professional Laboratory Services Contract for the Analysis of Per- and Polyfluorinated Alkyl Substances (PFAS) in Water – NJDEP Regulatory Data Report Format April 2019* Section 3.0 ELECTRONIC DATA FILES DELIVERABLE REQUIREMENTS.

PFAS data shall be submitted in a full laboratory deliverables format according to all appropriate sections of the attached document, *Professional Laboratory Services Contract for the Analysis of Per- and Polyfluorinated Alkyl Substances (PFAS) in Water – NJDEP Regulatory Data Report Format April 2019,* and the requirements in Technical Requirements for Site Remediation, N.J.A.C.7:26E Appendix A Section I.(h).

All other data are to be submitted in a reduced laboratory deliverables format pursuant to the requirements in N.J.A.C.7:26E Appendix A Section II.

Laboratory results are to be provided to the Department (with BEERA being the ultimate destination) as the data become available.

B1 Sampling Process Design (Experimental Design)

Sites will be carefully selected from all counties with the intent of sampling locations not impacted by discrete, direct discharges. Prior to the selection of sampling locations, all available internal and external data relevant to known and presumptive sources of PFAS contamination were reviewed and compiled into ArcGIS Pro. A total of 19 known contamination layers and 9 presumptive contamination layers were included (*Tables A-B)*. A half mile buffer was placed around 3,028 known contamination data points and a quarter mile buffer was placed around 7,578 presumptive contamination data points, covering 22.73% of the state (*Figure A, Table C*). It should be noted that PFAS atmospheric impacts from a point source can extend far beyond a 0.5-mile radius (Washington et al., 2020). A major limitation was the inability to find data on historic biosolid applications to agricultural fields, a well-documented potential source of PFAS contamination. Thus, a 2015 GIS agriculture data layer was used as an initial screening tool to prevent sample selection in agricultural fields (*Figure A, Table C*).

The 2020 U.S. Census definition was used to define urban and rural areas throughout the state (*Figure A, Table D*). To be considered urban, an area must have at least 5,000 people or 2,000 housing units. Each area must also have at least one high-density nucleus of at least 1,275 housing units per square mile. A full definition can be found in the Federal Register (Urban Area Criteria, 2022). Any area that does not qualify as urban is considered rural. A total of 160 urban and 142 rural potential sampling locations were identified for this study. Each potential sample location was screened against aerial imagery from the 1940s to present. Samples were removed or moved accordingly if they fell within an imagery layer showing agricultural use, historical buildings, or any major land disturbance. From the set of potential sample locations, eight samples (four urban and four rural) were randomly

selected for each county with the exceptions of Essex (six samples), Hudson (four samples), Salem (seven samples), and Union (four samples) (*Table E*). This resulted in a total of 157 sampling locations statewide (*Figure B*). All locations were on publicly accessible land, were at least 50 feet off roadways (AVG. 0.11 miles) and were at least two miles away from another sampling location (AVG. 4.4 miles).

Sample collection is scheduled to begin in August, 2023. BEMSA will sample the locations utilizing available opportunities in their schedule with the goal of sampling 1-2 counties per day, per sampling team. Sites will be identified using GPS coordinates and supplied sampling maps. If a sampling site is inaccessible, a backup location meeting the screening criteria described above will be provided. BEMSA will also be responsible for transport of the collected material to the chosen laboratory or shipping location. This will continue throughout summer and fall 2023 until all the designated locations have been sampled. As per the Direct Purchasing Authority contract noted in *A9.3* above, laboratory results will be transmitted to the Department (with BEERA being the ultimate destination) as the data become available.

One surface (0-6 inch) sample will be collected from each location. This depth is consistent with the PFAS studies conducted by other Northeast states (Maine, Vermont) and this interval is expected to be impacted by atmospheric deposition (Sanborn, Head & Associates, Inc., 2022; Zhu, W. *et al.,* 2019). If vegetation is present at a sampling location, the vegetation will be removed prior to sample collection, and the soil sample will be collected from the six-inch interval below where the vegetation existed. A sufficient volume of soil will be collected to perform the analyses described in Section B4.2. All samples will be placed into laboratory provided containers. See sampling methods in section B2 for more detail.

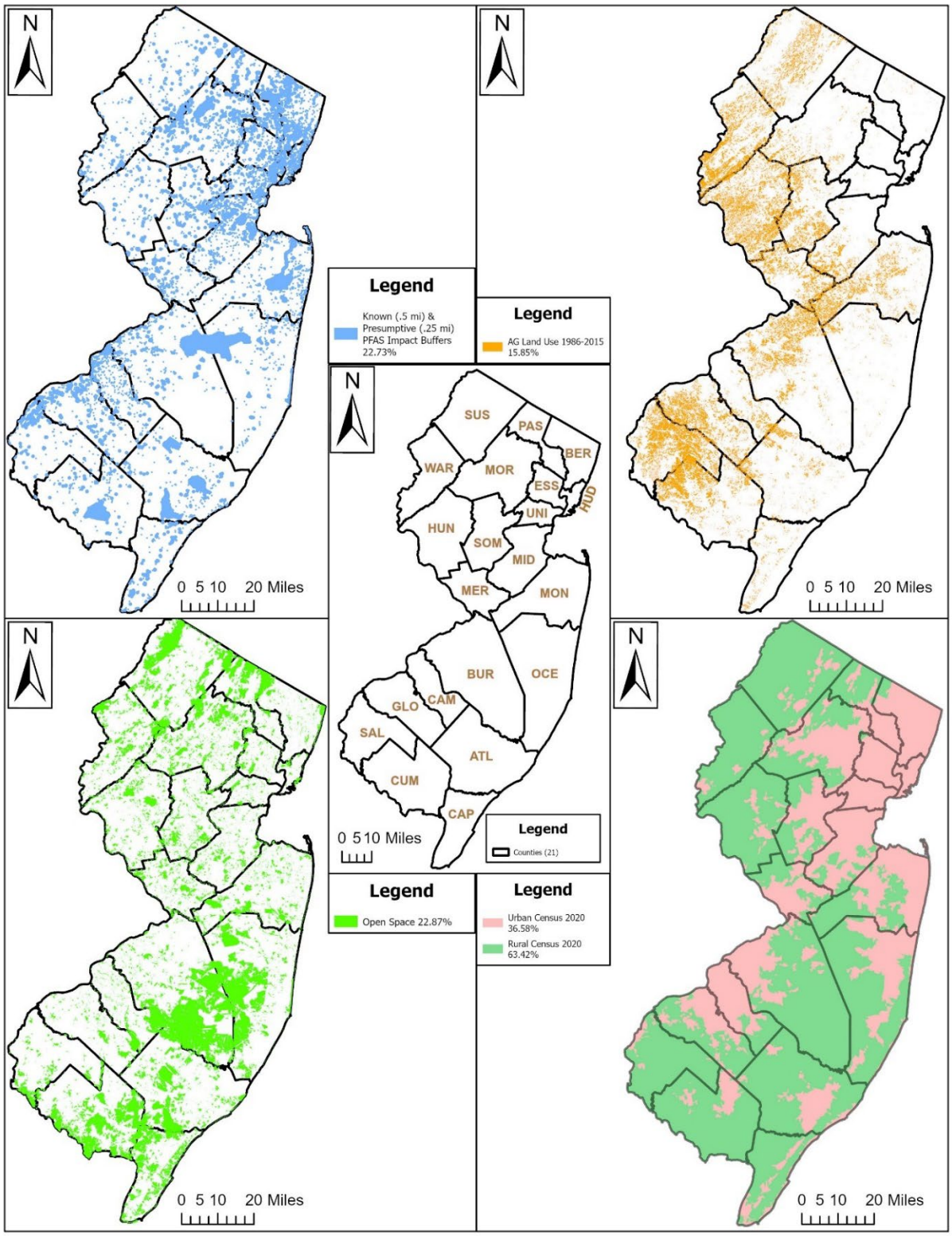

Figure A: Sample selection considerations. Top left: Buffered area (blue) based on known and presumptive PFAS contamination. Top right: GIS agricultural land use layer (yellow) from 1986-2015. Bottom left: Open space land in NJ (bright green). Bottom right: Urban (pink) and rural (green) areas of NJ based on the 2020 US Census definition (U.S. Census Bureau, 2022). The percentages listed in the legends represent the area of the state. Middle: NJ counties.

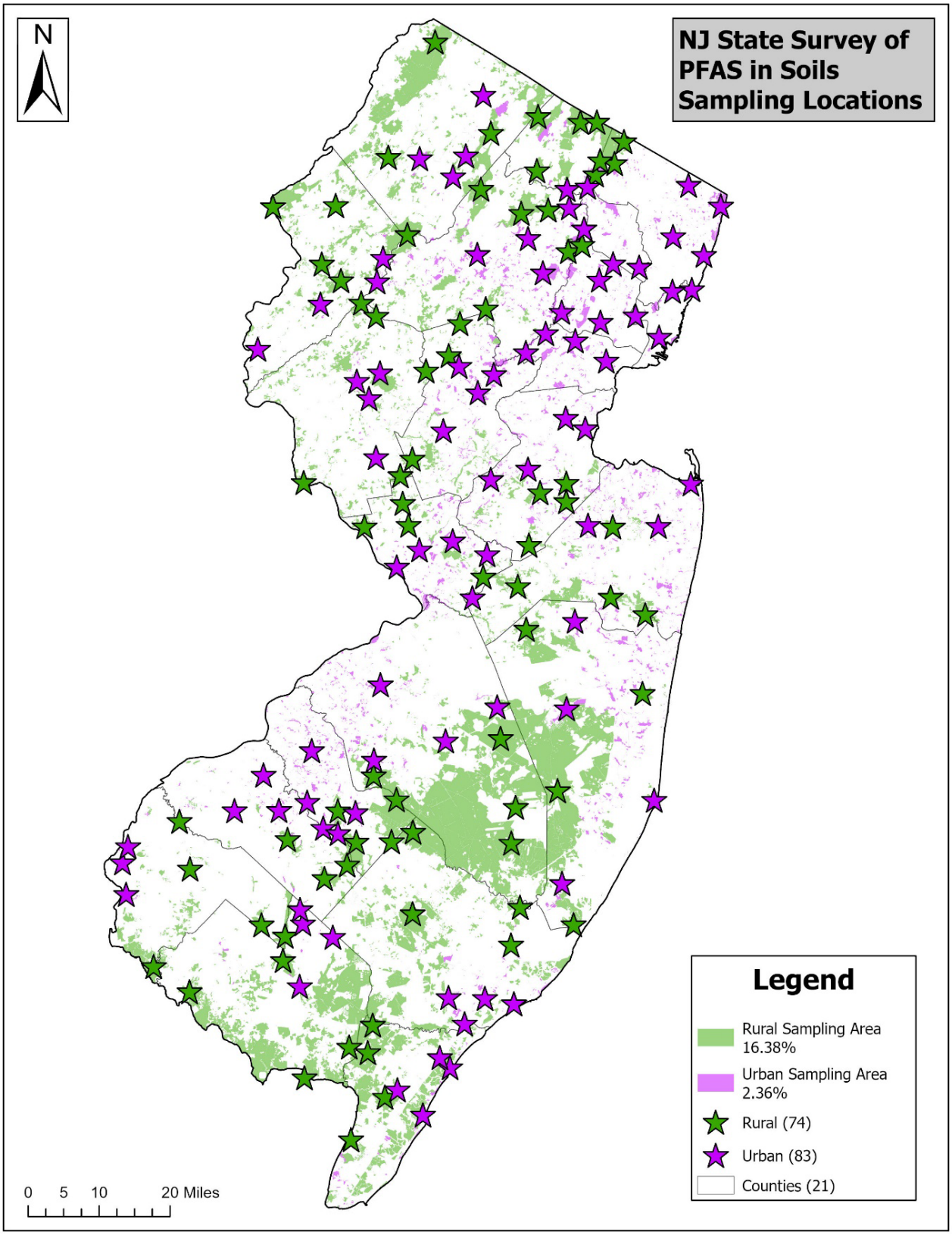

Figure B: Selected rural (green star) and urban (purple star) sampling locations. Shaded green and purple areas represent the available urban and rural sampling areas meeting the criteria of this study.

Table A: Known Contamination Layers

Known Contamination	Layer Type	Data Source	Total Data Points
DEP PFNA Sites	Point	Internal	70
DEP PFOA Sites	Point	Internal	132
DEP PFOS Sites	Point	Internal	112
SDWIS PFNA	Point	Internal	28
SDWIS PFOS	Point	Internal	177
SDWIS PFOA	Point	Internal	271
NJ Ambient Ground Water Quality Monitoring Network	Point	Internal	43
DEP Case Manager Sites	Point	Internal	19
Emerging Contaminant Survey	Point	Internal	159
PWTA Potable Wells 2022	Point	Internal	1,114
DEP Public Funded Potable Wells	Point	Internal	306
Dupont Domestic Potable Wells	Point	Internal	225
Solvay Domestic Potable Wells	Point	Internal	109
DEP Publicly Funded Soil Sampling	Point	Internal	162
Discharge to Ground Water Permits	Point	Internal	21
Superfund Sites	Polygon	External	18
BGWRPA Sludge Incinerators	Point	Internal	5
County Fire Training Facilities	Polygon	Internal	21
AFFF Incidents	Point	Internal	36
Total: 18 Layers			**3,028**

Table B: Presumptive Sources of Potential Contamination Layers

Presumptive Contamination	Layer Type	Data Source	Total Data Points
Fire stations	Point	Internal	1,296
FUDS Properties	Polygon	External	42
Landfills	Point	Internal	674
Landfills > 35 Acres	Polygon	Internal	211
Major Airports AFFF Cert	Polygon	External	4
Airports	Point	Internal	121
Military Bases	Polygon	External	8
SICCODES	Point	Internal	5,210
BGWRPA Sludge Applications	Point	Internal	12
Total: 9 Layers			**7,578**

Table C: Total Restricted Area

Type	Total Sq/Mi	% of NJ
PFAS Known and Presumptive	1772.79	22.73%
AG Land Use 2015	849.15	10.94%
Non-Open Space	5993.78	77.19%
Combined Restricted Areas	**6310.28**	**81.26%**

Table D: 2020 Census Data

Type	Total Sq/Mi	%NJ
Urban	2840.36	36.58%
Rural	4924.84	63.42%

Table E: Sampling Locations by County

County	Urban	Rural	Total
Atlantic	4	4	8
Bergen	4	4	8
Burlington	4	4	8
Camden	4	4	8
Cape May	4	4	8
Cumberland	4	4	8
Essex	4	2	6
Gloucester	4	4	8
Hudson	4	0	4
Hunterdon	4	4	8
Mercer	4	4	8
Middlesex	4	4	8
Monmouth	4	4	8
Morris	4	4	8
Ocean	4	4	8
Passaic	4	4	8
Salem	3	4	7
Somerset	4	4	8
Sussex	4	4	8
Union	4	0	4
Warren	4	4	8
Total	**83**	**74**	**(157)**

B2 Sampling Methods

Sampling Program

Samples will be collected consistent with the NJDEP FSPM and USEPA analytical method requirements. Clean, wrapped, sampling spoons/trowels will be used to collect soil samples for chemical analysis. The equipment will be decontaminated prior to the sampling event. Care will be taken to prevent PFAS cross contamination.

- For soil samples, fill laboratory supplied sample container, seal with the supplied lid or cap with a custody seal, and place sample on sufficient ice to preserve to less than or equal to 6°C until receipt by the laboratory. Loose debris (sticks, large stones) should be removed.

Sample Labeling

Each sample collected will be placed in an appropriate sample container in accordance with the analytical method and assigned a unique identification number. Each sample container will have a sample label affixed to the outside of the container with the following information provided using a PFAS-free Sharpie (fine point):

- Project name
- Sample identification number
- Date and time of sample collection
- Analysis required
- Preservatives (if any)
- Sampler's initials.

If the laboratory is required to conduct matrix spike/matrix spike duplicate (MS/MSD) analyses for a sample, the field sampler will collect three times the sample volume and note on the COC that MS/MSD are to be run.

Sample Containers

The sample containers will be supplied by the analytical laboratory and will be the proper container as required by the analytical methods to be performed. The laboratory-supplied containers will be PFAS-free.

Sample containers with caps (e.g., glass jars, amber bottles, or polyethylene bottles) will be shipped in protective cardboard cartons or other wrapping to the user with sample coolers. All polyethylene containers will be provided with polypropylene closures.

The sampler must use the appropriate sample container as specified by the analytical method for each sample type.

Decontamination of Sampling and Field Measurement Equipment

Decontamination will be performed as needed to minimize the potential for cross-contamination between sampling locations and contamination to off-site areas. Non-disposable sampling equipment that will need to be reused will be decontaminated in the field consistent with the following procedures:

1. Laboratory grade glassware non-phosphate detergent (e.g., Liquinox™) and tap water scrub to remove visual contamination
2. PFAS-free water rinse
3. Methanol rinse
4. Final PFAS-free water rinse

B3 Sample Handling and Custody

Examples of chain of custodies can be found in Appendix 2. Although not a requirement to use the exact forms, the laboratory should include all items on the form.

Handling

Samples collected in the field for laboratory analysis will be placed directly into the laboratory-supplied sample containers as required by the analytical methods to be performed. All containers will be labeled with the unique sample ID. Possession of samples collected in the field will be traceable from the time of collection through analysis and disposal by an analytical laboratory using COC documentation procedures.

Sample containers, including the field QC samples, will be placed into metal or plastic coolers. The coolers will be filled with ice in re-sealable plastic bags to maintain a temperature of less than or equal to 6 degrees Celsius (°C), not frozen. Coolers containing the sample containers and associated field (equipment rinsate) blanks will be sent to the laboratory within 24 hours of their shipment from the field. The temperature in the coolers containing samples, including field QC samples, will be maintained at a temperature of less than or equal to 6°C (not frozen) while on-site and upon arrival at the analytical laboratory.

Packaging

The samples are expected to contain low concentrations of chemical contaminants and will be packaged and shipped as environmental samples consistent with applicable federal and state

regulations. Field personnel will use the following procedures when packing and transporting samples to the laboratory:

- Use metal or equivalent strength plastic ice chests.
- Attach the label to the top of container that identifies the name of the project and NJDEP field personnel who was responsible for the samples.
- Package wet ice in plastic bags or Blue ice in HDPE bags and place a "layer" of bags at the bottom of the ice chest.
- Place two sheets of cushion material, such as "bubble wrap" on the top of the layer of ice packages.
- Package samples in individual plastic bags prior to placement in the ice chest.
- Package wet ice in plastic bags and place bags around, among and on top of samples.
- Place "bubble wrap", bagged Styrofoam "peanuts" or other cushion material on top of the bags of ice.
- Put paperwork (chain-of-custody record, etc.) in a waterproof plastic bag and tape it to the inside lid of the sample shipment container.
- Tape the container shut with fiber-reinforced tape.
- Signed custody seals will be placed on the front and both sides of the cooler, before the cooler is placed in the custody of the overnight carrier.

Sample packaging and shipping procedures are based on USEPA specifications, as well as U.S. Department of Transportation regulations (49 *Code of Federal Regulations*). Wet ice will be included in coolers containing samples that require temperature control. The samples will be transported by a laboratory courier within 24 hours of sample collection whenever possible.

The laboratory will be notified of a shipment of samples either by phone or sending copies of the COC records by email or fax. If the number, type, or date of shipment changes due to site constraints or program changes, the laboratory will be informed. Upon receipt by the laboratory, samples will be stored consistent with procedures established in the analytical methods used.

Chain-of-Custody (COC) Procedures

The COC record documents the transfer of sample custody from the time of sampling to laboratory disposal. The COC records will be completed by the sampler and will accompany the samples from the field to the analytical laboratory. Each individual that takes custody of the samples will sign the COC record at the time of transfer. Samples are considered to be in custody if they are within sight of the individual responsible for their security or locked in a secure location. Each person or service who takes possession of the samples is responsible for sample integrity and safe keeping. The use of a courier service for sample shipping will be recorded on the COC and shipping documentation (i.e., air bill, etc.) will be tracked accordingly.

All entries will be made in waterproof, indelible blue or black ink. Erasures are not permitted. All applicable information on the COC record, including signatures, will be filled out completely and

legibly. Unused space (rows) for sample/analysis information will be crossed out, initialed, and dated. Samples requiring different turnaround times will not be included together on the same COC record.

The COC procedures are discussed below:

- At the time of sample collection, the COC record will be completed for each sample collected by the sample collector, as well as the field QC samples, including the trip blanks. The sample identification number, date and time of sample collection, sample collector's name, analyses requested and other pertinent information (e.g., preservatives) will be recorded on the COC record. Additional sample volume collected for MS/MSD analysis by the laboratory will also be noted on the COC record.
- Field samplers will be responsible for the care and custody of the samples collected until the samples are transferred to another party, dispatched to the laboratory, or disposed, with the relinquishment of the samples recorded on the COC record. The sampling team leader will be responsible for enforcing COC procedures during field work.
- The sampling team leader will check the COC record(s) against the samples in the associated cooler to verify both the sample labels and the COC records are complete and correct. If the COC records are deemed correct and complete, the sampling team leader will sign each COC record. Necessary corrections will be made to the record with a single line strike-out, dated, and initialed by the person making the correction.
- Each cooler will be accompanied by the associated COC records that will be stored in a resealable plastic bag and placed on top of the samples or taped to the inside of the cooler lid.
- Each chain of custody form in their associated coolers will be acknowledged and completed by the sample custodian upon sample receipt by the laboratory.

Samples will be packaged for shipment and transported to the analytical laboratory under the appropriate COC record. A copy of the COC record will be sent to the laboratory and will also be retained by the sampling team for the project file and the original will be sent with the samples. Bills of lading will also be retained as part of the documentation for the COC records.

Laboratory Custody and Documentation

The analytical laboratory used during this study will be required to establish custody procedures that conform to those required by the Contract Laboratory Program (CLP), as outlined in the USEPA's *User's Guide to the Contract Laboratory Program* (USEPA, 1991). These procedures include:

- designation of a laboratory sample custodian;
- completion by the custodian of the COC record, any sample tags, and laboratory request sheets, including documentation of sample condition upon receipt;
- laboratory sample tracking and documentation procedures;
- secure sample storage with the appropriate environment (e.g., refrigerated, dry); and

- proper data logging and documentation procedures, including custody of all original laboratory records.

A designated sample custodian will take custody of all samples upon their arrival at the laboratory. The custodian will inspect all sample labels and COC records to verify correspondence between information on the labels and COC records. The custodian will also inspect all samples and document any signs of damage or tampering and temperature discrepancies and report these discrepancies or any missing samples to the BEMSA staff person listed on the Chain of Custody associated with the sample(s) in question who will then coordinate with the BEERA project leader within 24 hours. The custodian will then assign a unique laboratory number to each sample and will distribute the samples to the appropriate analysts or to secured storage areas. All sample transfers in the laboratory will be recorded.

Holding and Turnaround Times

Laboratory analysis turnaround time is as per the Sampling Assistance Contract in effect at the time of sampling. Preservation will be at 6^{o} C in an appropriate sized HDPE container. Maximum holding times will be consistent with the methods in Appendix 1.

B4 Analytical Methods

B4.1 Field Measurement Methods (On-site)

Not applicable. No field measurements will be taken.

B4.2 Laboratory Analysis Methods (Off-site)

See Appendix 1 for analytical methods.

B5 Quality Control

Both field and laboratory QC checks will be employed to evaluate the performance of field and laboratory analytical procedures. The QC checks will take the form of samples introduced into the sampling and analytical stream to enable evaluation of analytical accuracy and precision, as well as representativeness.

B5.1 Field Quality Control

Duplicates

Field duplicate samples are two samples taken at the same time and place under identical circumstances. Field duplicate samples may be collected and submitted to the laboratory. Field

duplicate samples, if needed, will be collected at a frequency not to exceed 1 duplicate per 20 samples (or 5 percent).

Blanks

Equipment rinse blanks involve a final rinse of sampling equipment with PFAS-free water. These blanks will be collected at a frequency of one sample per sampling team per day.

B5.2 Laboratory Quality Control

The laboratory QC samples are used to assess data quality in terms of precision and accuracy, and verify that laboratory handling, extraction, and analytical procedures are not introducing variables into the sampling chain that could compromise the validity of sample data. Such QC samples are regularly prepared in the laboratory so that all phases of the sample handling process are monitored. The types of QC samples to be collected during the project are discussed below.

Duplicates

A laboratory duplicate consists of two aliquots of the same sample taken in the laboratory and analyzed separately with identical preparation and analytical procedures. Analyses of both samples indicate precision associated with laboratory procedure, but not with sample collection, preservation, or storage. Laboratory duplicates are not a substitute for field duplicates, but the Relative Percent Differences (RPDs) are reviewed to evaluate the laboratory's performance. The laboratory will utilize this QC sample type consistent with USEPA- and NJDEP-certified method-specific requirements.

Blanks

A variety of QC blank samples will be used to assess the potential for sample contamination during the sampling and analysis processes. Laboratory QC samples, used for assessing the impact of contamination on sample results, include method blanks, calibration blanks, instrument blanks, and refrigerator storage blanks. The laboratory will utilize these QC sample types consistent with USEPA and NJDEP-certified method-specific requirements.

Spikes

The types of QC spike samples to be employed by the project laboratory include LCS and LCS duplicate (or blank spike/blank spike duplicate) and surrogates. A blank spike is a clean matrix (i.e., same used for a method blank) spiked with known concentration(s) of target analyte(s). The blank spike is carried through the entire analytical procedure to assess the overall accuracy of the method. The LCS is an independent sample from the continuing calibration verification standard and is not to be used for calibration verification purposes. A surrogate is a non-target analyte spiked at a known concentration prior to sample preparation. Surrogate analytes are used to monitor method performance on a matrix-specific/sample-specific basis.

For this project, the acceptance limits for precision and accuracy are presented in Section A7. One blank spike/blank spike duplicate set must be included with each analytical preparation batch of a maximum of 20 samples, or each sample delivery group (SDG).

A Matrix spike (MS) and matrix spike duplicate (MSD) pair will be prepared at a frequency of 1 in 20 for PFAS soil samples. In addition, 16 MS/MSD samples will be prepared for SPLP soil samples. The sample location selected for MS/MSD sample collection will require that triple the sample volume (soil) be obtained so that there is sufficient sample to prepare and analyze the MS/MSD samples at the above frequency. The sample designated for MS/MSD analysis will be noted on the record.

Laboratory Quality Control Checks

Laboratory checks will include the procedures detailed below.

- The reagents, gases, and standards required by a method will use the highest quality standards available. Materials and procedures will be recorded in a logbook to document complete traceability a certified reference standard and source such as the National Institute of Standards and Technology.
- Instruments will be calibrated according to the manufacturer's instructions and as required by the USEPA or NJDEP-certified analytical method. Where there are no specifications for each parameter, a five-point calibration curve will be implemented.
- Calibration of instruments will be documented in a bound logbook dedicated to each instrument, and records will be maintained.
- Continuing calibration standards will be analyzed and documented in a logbook for each analytical method during sample analysis as required by the method.
- The percent recovery and percent difference criteria for inorganics and organics continuing calibration shall be within the QC criteria of the requested analytical method.
- Laboratory method blanks will be included in every preparation batch or analytical batch
- An analysis of one blank spike sample will be made for every 20 samples and will be fortified with representative compounds for each analytical method performed.

Control Charts

Control charts will be used by the project laboratory to assess variability in QC parameters over time. At a minimum, the project laboratory shall control chart LCS or blank spike results for each method of analysis. In addition, all surrogate spike recoveries (from LCS/LCSD results) shall be monitored by use of control charts. In cases for which surrogate spikes are not applicable, LCS or blank spikes shall be monitored for accuracy. The project laboratories will include in their QA plan a description of the methodology used in control charting.

Internal Quality Control and Corrective Action

A method blank will be analyzed with every batch of 20 or fewer samples to measure laboratory contamination. The method blank will consist of ultrapure air or "clean" matrix and will be carried through the entire preparation and analytical procedure. Acceptance criteria for method blanks must conform to reference method requirements when specified. Generally, corrective action is required if target compound concentrations in the method blank are greater than the MDL. Corrective action, including data flagging, is required when method blank concentrations are greater than the reporting detection limit, and the samples must be reprocessed if sample target compound/analyte concentrations are not greater than 10 times the method blank concentrations.

An LCS or blank spike set will be analyzed with every batch containing 20 samples or less to measure accuracy. The LCS or blank spike will consist of a method blank spiked with a known amount of analyte, and it will be carried through the entire preparation and analysis procedure. The standards source will be separate from that used to prepare calibration standards. The recoveries will be plotted on control charts, and control limits will be calculated based upon historical data. If control limits are exceeded, the analysis will be stopped and the problem corrected. Samples associated with the out-of-control LCS will be reanalyzed in another batch, unless documented evidence is presented to show that associated samples were not affected.

A laboratory duplicate may be analyzed for one out of every 20 samples to measure precision. If the RPD does not meet the required acceptance limits, the problem will be investigated and corrected. Any affected samples will be re-analyzed in a separate batch. Acceptance limits for precision in Section A7 will be used.

The laboratory will make every attempt to analyze the project samples submitted to laboratory for the same parameter utilizing the same instrument, not multiple instruments. If the laboratory is not able to utilize the same instrument, the laboratory will notify the BEERA project lead and the Project QA Officer.

Data Calculation and Reporting Units

Calculations of results will be documented in the laboratory SOPs and must be consistent with the reference method. Reporting units will be consistent with applicable regulatory and decision thresholds.

Documentation and Deliverables

The project laboratory is responsible for maintaining supporting documentation in the form of sample preparation logs; instrument run logs; maintenance logs; standards, receipt, and preparation logs; instrument printouts; and chromatograms. Calculations should be clearly identified in the sample analysis records or in laboratory SOPs.

B6 Instrument / Equipment Testing, Inspection, and Maintenance

The project laboratory will perform and maintain records of preventive maintenance on instruments used for analysis of project samples. Preventive maintenance documentation is incorporated into the National Environmental Laboratory Accreditation Program (NELAP) or state laboratory accreditation requirements and is an element of the laboratory QA plan.

B7 Instrument / Equipment Calibration and Frequency

The project laboratory is required to document calibration procedures and will be consistent with specified analytical method requirements. Multi-level initial calibrations are to be performed as required by the analytical method and include an acceptable initial calibration verification standard (ICV), analyzed immediately after the initial calibration curve. If the relative standard deviations of the initial calibration or the ICV do not meet the analytical method requirements, a new calibration curve with an acceptable ICV is to be performed prior to sample analysis. Additionally, an acceptable continuing calibration verification standard (CCV) will be analyzed prior to the analysis of the samples. If two consecutive CCVs fail, then an acceptable initial calibration curve is to be performed prior to sample analysis. All samples analyzed after a failed CCV will be reanalyzed with acceptable calibration standards – initial calibration curve, ICV, and CCV.

No field equipment requiring calibration will be used in this study.

B8 Inspection / Acceptance of Supplies and Consumables

BEMSA will verify the correct number of sample containers have been supplied. All containers will be checked for integrity.

B9 Non-direct Measurements

Not applicable.

B10 Data Quality Management

Data quality management includes data management, data quality assessment (i.e., data review, verification, validation, and usability assessment), preventive maintenance, and corrective actions as described below.

Data Management

Data collected during this investigation will consist of various types of information, ranging from field measurements to laboratory analyses. Data requirements for this investigation will be governed by the specific type of data and the project-specific objectives. Chemical data management for this project will be directed and supervised by BEERA. Field data management will be directed and supervised by BEMSA.

Data Receipt and Tracking

Data generated by the analytical laboratory will be submitted to ODQ in electronic format. Data submitted to ODQ will duplicate original data, which will be secured at the laboratory. Any laboratory sample ID system applied to the samples by the laboratory will be clearly cross-referenced to the original sample ID number designated on the COC record.

Electronic Data Deliverable

See Section A10.

Data Archive

The laboratory will securely maintain all data associated with the project for a minimum of 5 years following submittal of the EDDs.

Field data documentation, including completed daily field reports, measurement logs, and photographs, will also be archived in the project files. Field data that are archived will be the responsibility of BEMSA initially.

Data Quality Assessment

Data quality assessment is the process in which data are examined and evaluated throughout the project and will include data review, verification, validation, and usability assessment in terms of the Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity (PARCCS) criteria. However, all project personnel, including field personnel and the project chemist, will be responsible for performing some level of data review and verification, and should have a clear understanding of field documentation protocols and procedures, as well as the types of data being generated under these procedures.

Data verification and validation will be performed under the guidance of the USEPA's *Guidance on Environmental Data Verification and Data Validation,* EPA QA/G-8 (November 2002, reissued 2008). If deficiencies are identified, personnel involved in the review and verification process are responsible for documenting deficiencies and whether corrective action should be taken, if any. Field and laboratory documentation will be evaluated to verify that the data are complete, correct, and conform to the criteria defined in this QAPP.

Data Verification

The objective of data verification is to assess whether the data required for the project are correct, complete, and compliant with contractual, method, or procedural requirements. Verification is a completeness check that is performed before the data quality assessment process continues in order to evaluate whether the required information (the complete data package) is available for further review. It is an evaluation of performance compared to the specified or pre-established parameters presented in the analytical methods, field and laboratory SOPs, and this QAPP. Field and laboratory data will be managed using manual and electronic systems. Discrepancies will be corrected either internally or via a resubmittal by the laboratory within 72 hours of the resubmittal request and documented.

The requirements for performance of analytical laboratory analysis are specified in the analytical services contract under which the work is performed. The contract specifies deliverables, turnaround time, and performance standards. Outstanding items will be resolved before the project is closed.

Data Validation

The data validation process consists of a systematic assessment and verification of data quality through independent review. Validation will be performed at the discretion of BEERA. Data validation procedures will be consistent with this QAPP and USEPA CLP National Functional Guidelines, modified as necessary to accommodate non-CLP methods. Data validation requirements and criteria are described below:

- Full data validation follows the USEPA protocols and CLP criteria set forth in the USEPA National Functional Guidelines for evaluating organic and inorganic analyses (USEPA 2008 and 2010, respectively). These guidelines apply to full (CLP-like) analytical data reports that include the raw data (e.g., spectra and chromatograms) and backup documentation for calibration standards, analysis run logs, instrument tuning, internal standards, LCS, dilution factors, and other types of information. This additional information is utilized in the full data validation process for checking calculations of quantified analytical data. Calculations are checked for QC samples (e.g., MS/MSD and LCS data) and routine field samples (including field duplicates, field and equipment rinsate blanks, and trip blanks). To verify that the detection limit and data values are appropriate, an evaluation is made of instrument performance, method of calibration, and the original data for calibration standards.

- For reduced laboratory data validation, the data values for routine and QC samples are generally assumed to be correctly reported by the laboratory. Data quality is assessed by comparing the QC parameters listed above to the appropriate criteria (or limits), as specified in this QAPP, by CLP requirements, or by method-specific requirements (e.g., USEPA CLP, SW-846). If calculations for quantitation are verified, it is done on a limited basis and may require raw data, in addition to, the standard data forms normally present in a laboratory analytical report.

Data validation for PFAS will be performed on the analytical laboratory data consistent with this QAPP, the Department of Defense Data Validation Guidelines Module 6: Data Validation Procedure for Per and Polyfluoroalkyl Substances Analysis by QSM Table B-24 Environmental Data Quality Workgroup October 18, 2022, and NJDEP SOPs for Analytical Data Validation. The following parameters, at a minimum, will be reviewed:

- COC records and sample condition (i.e., preservation, damage, etc.)
- Technical Holding Time
- Laboratory and field blanks
- Laboratory duplicate or field duplicate samples
- Initial and Continuing Calibration
- MS/MSD recoveries
- LCS recoveries
- Surrogate recoveries, if applicable
- Compound identification
- Compound quantitation and sample reporting limits, including dilutions

Following the completion of the full data validation process, a signed Data Validation Report will be prepared by the Office of Data Quality, NJDEP. The Data Validation Report will summarize the data validation process and its findings and qualifications consistent with the aforementioned guidance documents.

Usability Assessment

The usability assessment process is used to assess and document the usability of the data by considering quality objectives (e.g., PARCCS) and whether the data are suitable as a basis for the decision. All data types (e.g., sampling and laboratory analytical data) are relevant to the usability assessment.

The assessment should consider each type of data, the relationship to the entire data set, and the adequacy of the data to fulfill the data quality goals of the project. Data sets are assessed for completeness and compliance to method-specific or project-specific QA/QC requirements, including the results of the independent data validation process.

Data Reporting

Data reporting will be reviewed by qualified individuals independent of those performing the initial analysis. Preliminary or informal analysis of calculations may be performed by one or more reviewers and need not be completely checked but may be reviewed by ODQ. Final calculations and summary data tables will be made on calculation sheets or spreadsheets, respectively that have signoff blocks for peer review documentation.

Conclusions and/or recommendations will be reviewed by one or more peers, independent of the preparation of the conclusion/recommendation, to evaluate for accuracy of the information based on the data. Technical and/or quality peer reviews will be performed by independent qualified senior professionals who have the necessary technical knowledge and skill to perform the review. Technical or quality peer reviews will be documented and retained in the file.

C1 Reports to Management

A final report will be prepared by BEERA and reviewed by DSR. This report will contain processed data and statistical analysis which will inform the results and discussion. Anticipated completion is mid-2024. The report will be published on the Department's website in electronic form and will be publically available.

D1, D2, & D3: Laboratory Data Review, Verification, and Validation; Verification and Validation Methods; and Reconciliation with User Requirements

Level 1: Analyst Review

Each analyst will review the quality of his/her work based on an established set of guidelines. The review criteria as established in each method, in this document, or within the laboratory will be used. The analyst review will be documented by using a check list, dated and signed by the reviewer.

Level 2: Peer Review

The Level 2 (or peer) review will be performed by a supervisor or data review specialist whose function is to provide an independent, peer review of the data package. This review will also be performed according to an established set of laboratory guidelines.

The peer review will be structured to include all calibration, QC samples, and project sample data at a minimum frequency of 25 percent and will be checked against the raw data and/or bench sheets. If no discrepancies are found with the data package, the review will be complete. If discrepancies are identified, then all sample results will be checked. All errors and corrections will be documented on a check list, with the signature of the reviewer, and date.

Level 3: Administrative Review

The Level 3 (or administrative) review will be performed by the Laboratory Program Administrator. This review will provide a total overview of the data package to ensure its consistency and compliance with project-specific requirements. All errors will be corrected and documented. If significant errors

are identified, samples may need to be re-extracted and reanalyzed. The administrative review will also be documented on a checklist, dated, and signed by the reviewer.

Quality Assurance Review

The QA review will be performed by the Laboratory QA Office and is similar to the Level 3 review. This review is independent of the data reduction and production operations. The QA Officer will randomly select the data packages to be reviewed, at a minimum of 10 percent of the data generated. As a result of the QA review, additional analytical data or quality control parameters may be reviewed. Noncompliant reports will be required for any discrepancies noted.

Treatment of Outliers

During the QC review process, laboratory data qualifiers (or flags) will be applied to any outlying data. These qualifiers will be applied when acceptance criteria have exceeded method defined acceptance criteria. Some of the laboratory flags that may be applied during this project are as follows:

- U - The analyte was analyzed for but was not detected above the adjusted sample reporting limit.
- J - The analyte was detected, but the result is an estimated concentration of the analyte. This qualifier may also be applied for reported values between the method reporting limit (MRL) and the MDL.
- E - The reported value exceeds the instrument calibration range.
- D - The reported value is the result of a dilution.
- B - The analyte was detected in the associated method blank.

Each flag used by the laboratory will be defined in the case narrative of the SDG. These flags will also identify any suspected bias in the data, either low or high.

E1 References

ITRC (Interstate Technology & Regulatory Council). 2022. *PFAS Technical and Regulatory Guidance Document and Fact Sheets* PFAS-1. Washington, D.C.: Interstate Technology & Regulatory Council, PFAS Team. https://pfas-1.itrcweb.org/

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Sanborn, Head & Associates, Inc. (2022). *Background levels of PFAS and PAHs in Maine shallow soils study report*. Retrieved from https://www.maine.gov/dep/spills/topics/pfas/Maine_Background_PFAS_Study_Report.pdf.

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Zhu, W., Roakes, H., Zemba, S. G., & Badireddy, A. R. (2019). *PFAS background in Vermont shallow soils*. Retrieved from https://anrweb.vt.gov/PubDocs/DEC/PFOA/Soil-Background/PFAS-Background-Vermont-Shallow-Soils-03-24-19.pdf.

E2 Appendices

E2.1 Appendix 1: Parameters and Methods

Target Analyte Name	Abbreviation	CAS Number	Method
PFAS			1633 Draft-User Defined
Perfluoroalkyl carboxylic acids			
Perfluorobutanoic acid	PFBA	375-22-4	
Perfluoropentanoic acid	PFPeA	2706-90-3	
Perfluorohexanoic acid	PFHxA	307-24-4	
Perfluoroheptanoic acid	PFHpA	375-85-9	
Perfluorooctanoic acid	PFOA	335-67-1	
Perfluorononanoic acid	PFNA	375-95-1	
Perfluorodecanoic acid	PFDA	335-76-2	
Perfluoroundecanoic acid	PFUnA	2058-94-8	
Perfluorododecanoic acid	PFDoA	307-55-1	
Perfluorotridecanoic acid	PFTrDA	72629-94-8	
Perfluorotetradecanoic acid	PFTeDA	376-06-7	
Perfluoroalkyl sulfonic acids			
Perfluorobutanesulfonic acid	PFBS	375-73-5	
Perfluoropentansulfonic acid	PFPeS	2706-91-4	
Perfluorohexanesulfonic acid	PFHxS	355-46-4	
Perfluoroheptanesulfonic acid	PFHpS	375-92-8	
Perfluorooctanesulfonic acid	PFOS	1763-23-1	

Perfluorononanesulfonic acid	PFNS	68259-12-1	
Perfluorodecanesulfonic acid	PFDS	335-77-3	
Perfluorododecanesulfonic acid	PFDoS	79780-39-5	
Fluorotelomer sulfonic acids			
1*H*,1*H*, 2*H*, 2*H*-Perfluorohexane sulfonic acid	4:2FTS	757124-72-4	
1*H*,1*H*, 2*H*, 2*H*-Perfluorooctane sulfonic acid	6:2FTS	27619-97-2	
1*H*,1*H*, 2*H*, 2*H*-Perfluorodecane sulfonic acid	8:2FTS	39108-34-4	
Perfluorooctane sulfonamides			
Perfluorooctanesulfonamide	PFOSA	754-91-6	
N-methyl perfluorooctanesulfonamide	NMeFOSA	31506-32-8	
N-ethyl perfluorooctanesulfonamide	NEtFOSA	4151-50-2	
Perfluorooctane sulfonamidoacetic acids			
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9	
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6	
Perfluorooctane sulfonamide ethanols			
N-methyl perfluorooctanesulfonamidoethanol	NMeFOSE	24448-09-7	
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	1691-99-2	
Per- and Polyfluoroether carboxylic acids			
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6	
4,8-Dioxa-3*H*-perfluorononanoic acid	ADONA	919005-14-4	
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1	
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5	
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6	
Ether sulfonic acids			
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1	
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9	
Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7	
Fluorotelomer carboxylic acids			
3-Perfluoropropyl propanoic acid	3:3FTCA	356-02-5	
2*H*,2*H*,3*H*,3*H*-Perfluorooctanoic acid	5:3FTCA	914637-49-3	
3-Perfluoroheptyl propanoic acid	7:3FTCA	812-70-4	

METALS			
Target Analyte Name	Abbreviation	CAS Number	Method
Aluminum	Al	7429-90-5	6010D
Antimony	Sb	7440-36-0	6010D
Arsenic	As	7440-38-2	6010D
Barium	Ba	7440-39-3	6010D
Beryllium	Be	7440-41-7	6010D
Cadmium	Cd	7440-43-9	6010D
Calcium	Ca	7440-70-2	6010D
Chromium	Cr	7440-47-3	6010D
Cobalt	Co	7440-48-4	6010D
Copper	Cu	7440-50-8	6010D
Iron	Fe	7439-89-6	6010D
Lead	Pb	7439-92-1	6010D
Magnesium	Mg	7439-95-4	6010D
Manganese	Mn	7439-96-5	6010D
Nickel	Ni	7440-02-0	6010D
Potassium	K	7440-09-7	6010D
Selenium	Se	7782-49-2	6010D
Silver	Ag	7440-22-4	6010D
Sodium	Na	7440-23-5	6010D
Thallium	Tl	7440-28-0	6010D
Vanadium	V	7440-62-2	6010D
Zinc	Zn	7440-66-6	6010D
Mercury	Hg	7439-97-6	7471

Parameter	Method Number
Cation Exchange Capacity	EPA 9081
Grain Size with Hydrometer	ASTM D7928
Total Organic Carbon	EPA 9060
pH	EPA 9045D
Percent solids	SM 2540G
SPLP	EPA 1312

E2.2 Appendix 2: Chain of Custody Examples

Form-095- ***New Jersey Department of Environmental Protection***
External Chain of Custody and Sample Analysis Request Form
(With Shipping Container)

Laboratory Information

Name of Laboratory: _____ *Individual Preparing Sample Bottles and Shipping Container(s)*

Address: _____ Name: _____

_____ Title: _____

Time/Date Sample Shipping Container Sealed: _____ Laboratory Affixed Seal Number: _____

NJDEP Information

Division: _____ Bureau: _____ Phone: (____) _____ Job Number: _____

Requested Analysis

NJDEP Field Sample Number	*Time/Date* Sampling Start	Time/Date Sampling Stop	Parameter	Method	Preserv.	Container Volume	Container Quantity	Matrix

Preservative Added: (Check One) ☐ Laboratory ☐ Field ☐ Unpreserved

Contract Number: _____ Task Number: _____ Report Format: _____

External Chain of Custody

Relinquished	Received	Time/Date	Reason For Change of External Custody
XXXXXXXXXXXXXXXX	_____	_____	Break Seal/Sample

Individual Resealing Shipping Container: Name: _____ Title: _____

Time/Date Sample Shipping Container Resealed: _____ NJDEP Affixed Seal Number: _____

Time/Date Sample Shipping Container Opened: _____

Time/Date Internal Chain of Custody Initiated on NJDEP Form 077 (Internal Chain of Custody): _____

Distribution: ☐ – Original (Sent With Report) ☐ – Contractor Spare, Retain With Report File
☐ – Sample Custodian ☐ – NJDEP Sampling Personnel

Form-096 ***New Jersey Department of Environmental Protection***

External Chain of Custody and Sample Analysis Request Form

(Without Shipping Container)

Laboratory Information

Name of Laboratory: _____ *Individual Preparing Sample Bottles and Shipping Container(s)*

Address: _____ Name: _____

_____ Title: _____

Time/Date Sample Shipping Container Sealed: _____ Laboratory Affixed Seal Number: _____

NJDEP Information

Division: _____ Bureau: _____ Phone: (____) _____ Job Number: _____

Requested Analysis

NJDEP Field Sample Number	*Time/Date* Sampling Start	Time/Date Sampling Stop	Parameter	Method	Preserv.	Container Volume	Container Quantity	Matrix

Preservative Added: (Check One) ☐ Laboratory ☐ Field ☐ Unpreserved

Contract Number: _____ Task Number: _____ Report Format: _____

External Chain of Custody

Relinquished	Received	Time/Date	Reason For Change of External Custody
XXXXXXXXXXXXXXXX	_____	_____	Break Seal/Sample
_____	_____		_____
_____	_____		_____
_____	_____		_____

Individual Resealing Shipping Container: Name: _____ Title: _____

Time/Date Sample Shipping Container Resealed: _____ NJDEP Affixed Seal Number: _____

Time/Date Sample Shipping Container Opened: _____

Time/Date Internal Chain of Custody Initiated on NJDEP Form 077 (Internal Chain of Custody): _____

Distribution: ☐ – Original (Sent With Report) ☐ – Contractor Spare, Retain With Report File
☐ – Sample Custodian ☐ – NJDEP Sampling Personnel

New Jersey Department of Environmental Protection

Internal Chain of Custody

Instructions: Use 1 form for each 20 samples of aliquot.

Laboratory Person Breaking Field Seal on Sample Shuttle & Accepting Responsibility for Sample

Laboratory:____________________ Location: ____________________

Name:____________________ Title: __________ Field Sample Seal No.:

____________________ Date Broken:____/____/____ Military Time Seal Broken: ____________

Case No.:____________________ Analytical Parameter/Fraction:________

Sample No.	Aliquot/Extract No.

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		SIGNATURE	SIGNATURE	
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