GROUNDWATER INVESTIGATION QUALITY ASSURANCE PROJECT PLAN FOR WASHINGTON WORKS PLANT

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DUPONT

CORPORATE REMEDIATION GROUP
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1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) discusses the procedures and practices developed to ensure that all information, data, and decisions derived from or based on data acquired during the groundwater investigation at DuPont Washington Works are technically sound, usable, and properly documented.

The groundwater investigation is undertaken in compliance with the Consent Order entered into by and between the West Virginia Department of Environmental Protection (WVDEP), the West Virginia Department of Health and Human Resources – Bureau for Public Health (WVDHHR-BPH), and E. I. du Pont de Nemours and Company (DuPont). The groundwater investigation is to be performed as one of a series of tasks in order to determine whether there has been any impact on human health and the environment as a result of releases of ammonium perfluorooctanoate (C-8, also known as FC-143), CAS Number 3825-26-1, to the environment from DuPont operations.

The overall quality assurance objective is to ensure that data of known and acceptable quality is generated during field investigations. Procedures and practices presented in this QAPP also will ensure that all measurements will be performed to yield consistent results representative of media and conditions measured, which accurately reflect project objectives.

The QAPP outlines procedures for:

- Project organization
- Quality assurance objectives for data measurement
- Sampling procedures
- Sample and document custody procedures
- Calibration procedures and frequency
- Analytical procedures
- Data reduction, validation, and reporting
- Internal quality control checks
- Performance and system audits
- Preventive maintenance
- Data measurement assessment procedures
- Corrective action approach
- Quality assurance reports to management

This QAPP provides a mechanism for controlling and evaluating the quality of data acquired throughout the course of the groundwater investigation at Washington Works (and associated landfills). Because data collected during this investigation will form the basis for evaluating the presence and extent of C-8 in drinking water, groundwater, and surface water, appropriate control of field and analytical procedures and the assurance of

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data usability and representativeness are crucial to successfully achieving the groundwater investigation objectives.

This QAPP also provides quality assurance guidelines to be followed during the field investigation. The scope of the groundwater investigation includes the Main Plant and associated landfills (Local, Letart, and Dry Run).

Sample analysis will be performed according to laboratory standard operating procedures (SOPs). All analyses will be performed by a DuPont Corporate Remediation Group (CRG) selected laboratory that has been audited by DuPont.

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2.0 PROJECT DESCRIPTION

2.1 Site Location and Description

The DuPont Washington Works facility is located in Wood County, West Virginia, about seven miles southwest of Parkersburg, West Virginia, along Route 892. The site covers about 1,200 acres in the Ohio River Valley and is located along the south bank of the Ohio River. The Local Landfill is located immediately adjacent to the Main Plant off the southern perimeter. The Letart Landfill is located just north of the town of Letart in Mason County, West Virginia. The Dry Run Landfill is located west of the town of Lubeck in Wood County, West Virginia and is about eight miles southwest of the Washington Works Main Plant and the Local Landfill. A water use and well survey search is being completed for the area within a one-mile radius from the plant and landfill perimeters.

Additional background information (i.e., the site's physical environment, environmental setting, assessment of water quality, site conceptual model, data gaps, etc.) are included in *Compilation of Historical Data for Washington Works* (DuPont CRG, 2002).

2.2 Current Site Investigation

The overall objective of the groundwater investigation is to collect data of sufficient quality and quantity to ensure that the primary goals of the groundwater investigation may be accomplished.

The Consent Order identified a series of tasks to be performed by the Parties (WVDEP, WVDHHR-BPH, and DuPont) in order to determine whether there has been any impact on human health and the environment as a result of releases of C-8 to the environment from DuPont Operations at the Main Plant and associated landfills (Local, Letart and Dry Run). One of these tasks was the development of the C-8 Groundwater Investigation Steering Team (GIST). The GIST was assembled to assess the presence and extent of C-8 in drinking water, groundwater, and surface water at and around the DuPont Main Plant, and the Local, Letart and Dry Run landfills.

Pursuant to the Consent Order, three specific key tasks are to be performed by DuPont and evaluated by the GIST. The primary objective of Task B is to develop and implement a monitoring plan that determines the presence and extent of C-8 in drinking water, groundwater and surface water in and around the DuPont Main Plant, and the Local, Letart and Dry Run Landfills, and to provide a compilation of available groundwater/surface water monitoring and hydrogeologic characterization data for each location.

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To achieve the project objectives for this phase of the groundwater investigation, DuPont will perform the following activities:

- Conduct a distance-phased groundwater well and water use survey.
- Conduct groundwater and surface water sampling and analysis in compliance with NPDES permits for the main plant and landfills.
- Develop and implement a monitoring plan that determines the presence and extent of C-8 in drinking water, groundwater, and surface water.
- Prepare a compilation of all available groundwater/surface water results and hydrogeologic characterization data.
- Collect additional information required for the groundwater investigation.

These activities will be described in the work plan that will be developed after the GIST approves of the recommendations presented in *Compilation of Historical Data for Washington Works* (DuPont CRG, 2002)

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3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

DuPont CRG in Wilmington, Delaware, will be the lead organization in conducting the groundwater investigation. Data will be reported to, and oversight will be provided by, the GIST. Laboratory analytical testing will be conducted by Exygen Research (Exygen), located at State College, Pennsylvania, or another DuPont-approved laboratory. Potesta & Associates Inc., Charleston, West Virginia, will assist the project team in performance of off-site sampling.

A description of the program organization is provided in this section. The responsibilities associated with the positions are described in the following paragraphs. The persons described will be charged with ensuring the collection of usable data and assessing measurement systems for precision and accuracy.

3.1 Project Organization Chart

The lines of authority for this specific project are found in Figure 1, which includes the individuals discussed below.

3.2 Management Responsibilities

3.2.1 Project Director

Mr. Andrew Hartten, DuPont CRG is the project director for the project. His responsibilities will be as follows:

- Providing strategic-level review of technical activities
- Providing direction involving drinking water, groundwater, surface water, and hydrogeologic investigations
- Approving project-specific procedures and internally prepared plans, drawings, and reports
- Providing guidance to the project team
- Acting as the DuPont representative to the GIST

3.2.2 Project Manager

Mr. Mark Houlday, URS Diamond Group (URSD) is the project manager for the site. He will be the primary point of contact with DuPont and will be responsible for all technical, financial, and scheduling matters. His other responsibilities will be as follows:

- Assigning duties to the project team and orienting the team to project needs and requirements
- Disseminating project-related information from DuPont

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- Acting as liaison with subcontractor organizations (unless specifically delegated to others)
- Interacting with the QA officer and health and safety officer to ensure that these programs are functioning effectively
- Serving as the collection point for project team reporting of nonconformance with QA procedures or changes in project documents and activities

3.2.3 Health and Safety Officer

Ms. Katherine Sova (URSD) is the health and safety officer for the project. She will be responsible for developing, reviewing, and approving of the project health and safety plan (HASP). She will ensure that the project HASP is consistent with applicable state and federal regulations and will also be responsible for implementing the HASP.

3.2.4 Technical Consultants

Senior staff members with expertise in the disciplines associated with the site investigation are available to the project as needed. These individuals will participate in the project as directed by the project manager.

3.2.5 Technical and Support Staff

Individuals in this category will participate in the technical activities associated with the project and will be coordinated by the technical lead or project manager.

3.3 QA Responsibilities

3.3.1 Quality Assurance Officer

Mr. Michael Aucoin (URSD) will be the QA officer for the project. His responsibilities are as follows:

- Developing and reviewing the QAPP
- Administering the QAPP
- Supervising day-to-day QA activities
- Notifying personnel of nonconformance or changes in procedures
- Determining the system and performance audit schedules, if required

3.3.2 Project Chemist

Mr. Michael Aucoin will also be the URSD project chemist for the project. He will schedule all sample container orders and analytical requests with the laboratory. He will also be the point of contact between the laboratory and project team. He will coordinate review of data generated by the laboratory.

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3.4 Laboratory Responsibilities

Exygen or another DuPont approved laboratory will provide analytical services for this project. The GIST will be notified of any change in the designated laboratory.

3.4.1 Laboratory Personnel

The key laboratory personnel for this project will be the laboratory project managers. The analytical laboratory project manager will be responsible for execution of the analytical testing program for the project. The laboratory project manager will be responsible for laboratory analyses and data processing. The laboratory project manager will be the point of contact for the project chemist and QA officer and will be assisted by the laboratory QA director, who is responsible for ensuring that laboratory internal QA procedures are followed and for processing QA data.

The laboratory has signed a contract with DuPont detailing the terms and conditions for services. This contract includes a guarantee to dispose of samples following analysis in accordance with all pertinent federal, state, and local laws and ordinances.

3.5 Data Review Responsibilities

Environmental Standards, Inc. (ESI), Valley Forge, Pennsylvania, will be the third-party data reviewer for the project. ESI will provide an independent review and validation of approximately 10 percent of the data points collected.

3.6 Field Responsibilities

3.6.1 Project Geologist

The project geologist is to be determined and will be responsible for the following:

- Coordinating or leading the site investigation and sampling teams
- Interacting with the project chemist regarding sampling events
- Evaluating site groundwater and surface water data
- Leading the preparation of reports and documentation

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4.0 QUALITY ASSURANCE OBJECTIVES

To ensure that the data collected during the groundwater investigation is of adequate and consistent quality, data quality objectives (DQOs) in terms of precision, accuracy, and completeness have been established. The sampling and analysis and associated QA efforts are aimed at achieving these DQOs in a timely, cost-effective, and safe manner. Data collected during previous investigations provided baseline information on contamination around the site.

4.1 Data Quality Characteristics

DQOs are statements of the level of uncertainty that a decision-maker is willing to accept in results derived from environmental measurements. The uncertainty for sample parameter results may arise from a combination of factors, including sampling procedures, sample matrix characteristics, non-homogeneity of samples, and the inherent accuracy and precision limitations of analysis methods. DQOs are quantitatively and qualitatively described in terms of data quality characteristics (DQCs), which include precision, accuracy, representativeness, completeness, and comparability (see Section 13.0). These characteristics are defined as follows:

- *Comparability*

  Comparability expresses consistency in sampling and analytical procedures so that one data set can be compared to another.

- *Representativeness*

  Representativeness expresses the degree to which sample data accurately and precisely represents a selected characteristic of a population, parameter variations at the sampling point, a process condition, or an environmental condition.

- *Precision*

  Precision is defined as the agreement between numeric values for two or more measurements that have been made in an identical fashion.

- *Accuracy*

  Accuracy is the degree of agreement of a measurement with an accepted true value.

- *Completeness*

  Completeness is a measure of the amount of the usable data obtained from the measurement system compared to the amount that was expected under normal conditions.

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4.2 Data Quality Objectives

4.2.1 Data Quality Objective for the Groundwater Investigation

The purpose of the groundwater investigation is to characterize water samples in and around the Washington Works Main Plant and associated landfills (Local, Letart, Dry Run) that may have been impacted by plant operations. To accomplish this, the precision, accuracy, and completeness acceptance criteria required for the groundwater investigation are listed in Table 1. All measurement data will be calculated and reported in units consistent with specified methodologies (see Section 8.0) to ensure comparability of historical data.

4.2.2 Measurement System Characteristics

Measurement system characteristics are considered to be key performance measures used to indicate that the laboratory is performing the referenced method correctly. These characteristics are range, sensitivity, selectivity, accuracy, and precision.

Range

The reporting range can be represented by the difference between the limit of quantitation (LOQ) and the highest calibration standards analyzed, at which comparable precision and accuracy have been demonstrated. The reporting range of the analytical method can be extended on a sample specific basis by dilution. Per the SOP, the reporting range for C-8 in water, without dilution, is 50 to 1000 nanograms/liter (ng/L).

Sensitivity

Sensitivity relates to the ability of a measurement system to accurately measure the analyte or property of interest over a range.

Sensitivity is demonstrated for C-8 by injection of a calibration standard at the LOQ and five times the LOQ. In addition, a method detection limit (MDL) study per 40 CFR 136 is performed for each instrument used to analyze samples.

Selectivity

Selectivity is defined as a measurement system's ability to accurately discriminate the analyte of concern from other analytes in the matrix that may interfere.

Selectivity for C-8 is demonstrated by the presence in the chromatogram of a peak of a daughter ion at 369 amu from a parent of 413 amu. The 413-amu parent corresponds to the PFOA anion, while the daughter ion (369 amu) represents the loss of carbon dioxide. This transition does not discriminate between linear and branched forms of PFOA; therefore, both, if present, would be included in the calculation.

Selectivity is further demonstrated by adequate instrument tunes, and by control of the LC/MS/MS cone and quadrupole voltages.

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Accuracy

Accuracy is the difference between the mean of the test results for the analyte of interest and the known value of the analyte concentration or value.

Accuracy of the C-8 determination is demonstrated through the use of matrix spikes with every field sample. Matrix spike recoveries must fall in the range of 70 to 130%, unless the sample concentration is significantly higher than the spike concentration. In addition, results for laboratory method blanks must be less than the LOQ.

Precision

Precision is a measure of the variability of test results obtained from applying a measurement system to samples that are obstensibly the same.

Per the SOP, every field sample is analyzed as a laboratory replicate in order to generate sample-specific precision data for analysis of C-8. Precision is assessed during the analytical run sequence through analysis of check standards. The check standard response must be within 15% of the average response of the equivalent concentration calibration standards.

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5.0 SAMPLING PROCEDURES

Samples collected during this investigation will be analyzed for C-8 and will include drinking water, groundwater, and surface water.

5.1 Preliminary Activities

The following preliminary activities will be completed before sampling personnel enter the field to ensure proper preparation for each sampling event:

- Coordination between sampling and laboratory personnel will be established so that sample integrity is retained at all times during the sampling event.
- The laboratory will be notified of the upcoming sampling event so it can prepare the list of parameters to be analyzed for each site, the replicate requirements, and the number of extra bottles needed, if any, for quality control testing will be specified to the laboratory manager.
- All proper field forms (i.e., field logbooks, custody seals, and chain-of-custody forms) will be prepared for use to enable proper documentation of the sampling event.
- A preliminary inspection and calibration of all field equipment will be performed to ensure accurate measurements of field parameters (i.e., pH, specific conductance, dissolved oxygen, turbidity, and temperature).
- All field personnel will be trained in the sampling protocols contained herein.

The following steps will be performed before beginning each sampling event to ensure sampling is implemented correctly and safely:

- The sample location will be identified.
- All equipment to be used during the sampling event will be inspected, pre-cleaned, and decontaminated.
- Field meters to be used during sampling (i.e., pH and specific conductance meters) will be checked to ensure proper calibration and precision response. Buffer and standard solutions will be laboratory checked to ensure their accuracy.
- All forms to be used in the field (e.g., field logbook, chain-of-custody sheets) will be assembled.
- Sampling personnel will review sampling protocols. In addition, health and safety protocols will be reviewed to help ensure that no injuries occur during the sampling event.
- The locations of underground utilities will be determined and marked, as appropriate. Washington Works excavation or other permits, if necessary, will be obtained.

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5.2 General Decontamination Procedures

All equipment in direct contact with the material to be sampled will be decontaminated prior to sampling to prevent cross-contamination of samples collected. In addition, care will be taken so as not to allow anything to come into contact with a sample or sample area, which may affect its composition.

Sampling equipment will include bailers, tubing, and pumps. All of these items will come in direct contact with the sample and have potential to impact analytical results. Therefore, care will be taken to ensure the cleanliness of all sampling equipment. When possible, pre-cleaned or disposable sampling equipment will be used (e.g., bailers for sampling wells). Field decontamination will be permitted for bailers and pumps, provided the following method is applied:

- Wipe off any residual sludge or water with a Chem-wipe.
- Rinse the equipment with deionized water.
- Rinse the equipment with methanol.
- Place in zip-sealed bag until next use

In addition to the decontamination procedures outlined above, the person collecting the sample will wear clean latex gloves and will limit his/her contact with the samples.

Sample bottles and containers will be prepared by the contracted laboratory and will be sealed to ensure cleanliness. Sample bottles will not be cleaned in the field.

A personnel decontamination area will be set up at each sample location prior to starting sampling activities. Procedures for the decontamination of protective equipment and the removal of respiratory and personal protection clothing to avoid transfer of constituents from clothing to the body are discussed in the HASP.

To the extent that it is economically feasible and technically acceptable, disposable personal protective equipment (PPE) will be used. Where the work scope restricts use of disposable PPE, decontamination facilities will be provided.

5.3 General Instructions For Water Sampling

Water sample bottles will not be pre-rinsed with site water prior to sample collection. Gloves will be worn during sampling activities and replaced between samples. All samples will be held chilled (not frozen to 6°C) with wet ice from collection to shipping.

In order to minimize the possibility of introducing C-8 contamination into samples, the following protocol will be followed:

- Avoid glass.
- Avoid PTFE (Teflon).
- Avoid aluminum foil.
- Do not use Post-a-Notes.
- Avoid blue ice.

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- Avoid pre-wrapped foods or snacks.
- Wear clothing that has been washed at least six times.
- Use only containers supplied by contract laboratory.

The field team leader or a senior member of the field team will be responsible for water sampling and laboratory coordination. The laboratory will provide necessary sample containers with the shipping containers (i.e., shuttles). Containers and any preservative added to the containers will be in accordance with EPA document SW-846 protocol. All samples requiring refrigeration will be shipped at approximately 4°C (not frozen to 6°C).

Field equipment will consist of some or all of the following:

- Polyethylene collection bottles (laboratory provided)
- Field sampling record
- Sufficient ice to maintain the samples at approximately 4°C (not frozen to 6°C)
- Methanol and deionized/distilled water
- Conductivity meter, pH meter, temperature probe, Redox probe, dissolved oxygen probe, turbidity meter
- Glass beakers
- PID and/or FID for organic vapor analysis
- Pumps and/or bailers for purging
- Rope
- Stainless-steel or polypropylene leader to attach rope to sampling device
- Bailers or other sampling devices (preferably dedicated or pre-cleaned)

Preparing for sampling includes acquiring all of the necessary monitoring equipment listed above and site-specific information to perform the required monitoring.

5.4 Drinking Water Sampling

The following procedure will be followed during residential (tap) sampling:

1. Locate an appropriate tap water source (prior to any treatment systems).
2. Wipe the tap water faucet and the exterior of the sampling bottle using a Chem-wipe moistened with methanol.
3. Open the valve and allow water to run for at least two minutes to flush the valve system and supply lines.
4. Remove the bottle cap, wipe the bottle lip using a Chem-wipe moistened with methanol, place the bottle under the tap, and fill. If the bottle will not fit under the tap faucet, then look for another appropriate source. Do not use a secondary container to fill the bottle.
5. Recap the sample bottle.

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6. Wipe the bottle using a Chem-wipe moistened with methanol and affix a sample label.
7. Place the sample in a cooler of ice.
8. Complete the chain-of custody form.

5.5 Groundwater Sampling

Groundwater will be sampled from residential and monitoring wells. Prior to initiating sampling activities at a given location (e.g., landfill), a complete round of depth to water levels will be measured to the nearest one hundredth of a foot.

To the extent possible, monitoring wells will be purged and sampled beginning from the least suspected to most suspected contaminated well to minimize the potential for cross-contamination. Total well depths necessary to calculate the required pump placement will be tabulated and will accompany the sampling team in the field.

Prior to sample acquisition, monitoring wells will be purged using a low flow protocol. The low-flow pump will be lowered gently and set at approximately the middle of the screen. If the static water level is below the top of the screen, then the pump will be lowered to the middle of the water column. In either case, the pump intake will be placed a sufficient distance above the bottom of the well to avoid mobilization of any accumulated sediments. Well purging will begin at a rate of 0.2 to 0.5 L/min. Water level in the well will be monitored during purging, and the purge rate will be lowered, if possible, if well drawdown is noted.

During low flow purging, the water quality parameters pH, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (Eh), temperature, and turbidity will be monitored using a flow through cell. Purging is complete when all field parameters have stabilized (variations in values are within 10 percent of each other for three consecutive readings taken 3 to 5 minutes apart). Once field parameters have stabilized, samples will be collected directly from the end of the discharge tube.

Alternatively, if low flow purging is not practical due to field conditions, monitoring wells will be evacuated to a minimum of three volumes of water standing in the well casing. The depth of the purge pump intake will depend on well yields. The ideal intake will be at the static water level in the well. The pump intake will be adjusted as the water level responds to pumping. Shallow wells whose screened interval extends above the water table and cannot be purged of three well volumes due to slow recovery rates will be pumped dry and allowed to recover before sampling. The water level in deeper wells will be pumped to just above the screened interval and will be allowed to recover before sampling.

If standard purge protocols are to be used, measurements of pH and specific conductance will be collected during well purging, and well evacuation will stop when at least three volumes are evacuated and three consecutive readings of pH and specific conductance have stabilized within 10 percent.

Pre-cleaned or dedicated, 1¼-inch-diameter, bottom-loading bailers will be used to collect grab groundwater samples for transfer into the proper sample containers if

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standard purge protocols are used. Monofilament polypropylene or stainless steel wire leaders attached to nylon or polypropylene rope will be used to raise and lower the bailer. The bailer will be lowered to the screened interval for sample collection. If well yields are low at the site, the samples will be collected at or near the screen as the well recovers and provides a sufficient volume for sample collection. Each of the wells exhibiting suitable recovery will be sampled within two hours of evacuation.

Sample containers will be filled to at least the container shoulder. After the sample containers are filled, they will be labeled appropriately and placed in a sample shuttle containing ice or ice packs. Samples requiring refrigeration for preservation will be stored at approximately 4°C (not frozen to 6°C) during storage and shipment.

The following procedure will be followed during groundwater sampling:

1. Wipe the exterior of the sampling bottle using a Chem-wipe moistened with methanol.
2. Remove the bottle cap, wipe the bottle lip using a Chem-wipe moistened with methanol, and fill from the bailer or hose. Do not use a secondary container to fill the bottle.
3. Recap the sample bottle.
4. Wipe the bottle using a Chem-wipe moistened with methanol and affix a sample label.
5. Place the sample in a cooler of ice.
6. Complete the chain-of custody form.

5.6 Surface Water Sampling

The following procedure will be followed during groundwater sampling:

1. Wipe the exterior of the sampling bottle using a Chem-wipe moistened with methanol.
2. Submerge the sample bottle below the water surface and unscrew the bottle cap.
3. Fill the water bottle by turning the bottle parallel to the water surface and slowing rotating so that the mouth of the bottle is up right. This procedure will ensure that water from the surface microlayer is not pulled into the sample bottle.
4. Recap the sample bottle under water.
5. Wipe the bottle using a Chem-wipe moistened with methanol and affix a sample label.
6. Place the sample in a cooler of ice.
7. Complete the chain-of custody form.

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5.7 Disposable Equipment

All disposable equipment and other materials that are not decontaminated for reuse will be disposed of in an acceptable manner.

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6.0 SAMPLE AND DOCUMENT CUSTODY PROCEDURES

Sample chain-of-custody will be initiated in most cases by the laboratory with the selection and preparation of sample containers. To reduce the chance for error, the number of personnel assuming custody of the samples and sample containers will be held to a minimum.

On-site monitoring and sampling data will be controlled and entered onto appropriate records. Personnel involved in the chain-of-custody and transfer of samples will be trained on the procedures and their importance and purpose prior to sampling initiation.

6.1 Field Sample Custody

A chain-of-custody form will accompany the sample container from the initial sample container selection and preparation at the laboratory to sample collection and preservation in the field to the return of the samples to the laboratory. The chain-of-custody form will trace the path of each individual sample container by means of a unique identification number. When requested, sample designation/location numbers will be pre-printed by the laboratory on the chain-of-custody form and bottle labels.

The project manager or field team leader will notify the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped as well as the anticipated date of arrival. Sample shipping containers (i.e., shuttles) will be provided by the laboratory. The shipping containers will be insulated. A sample container partially filled with water will be included in each shuttle to serve as a temperature blank. All sample bottles within each shipping container will be individually controlled and labeled. Sample identification labels will be provided by the laboratory. All sample bottle labels will include the following information:

- Site name
- Sample number
- Analysis required
- Preservatives

Personnel receiving the sample containers will verify the integrity of the seals on each cooler. Shuttles with broken seals will be returned to the laboratory with the contents unused, assuming the cooler is intact. The receiving personnel will break the seal, inspect the contents for breakage, and sign the chain-of-custody form to certify receipt of the sample containers. A temporary seal then will be affixed to each cooler.

Once sample containers are filled, they will be placed immediately in the cooler on ice to maintain the samples at approximately 4°C (not frozen to 6°C). The field sampler will indicate the sample designation/location number in the space provided on the chain-of-custody form for each sample, unless chain-of-custody forms are preprinted. Date and time of sample collection will be entered by the field sampler. The chain-of-custody forms will be signed and placed in the cooler. The samples should be shipped to the

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laboratory on the same day as they were collected and will be delivered to the laboratory no later than 72 hours after sample collection. The cooler with samples will be shipped to the laboratory using an overnight express service.

The "remarks" column of the chain-of-custody form will be used to record specific considerations associated with sample acquisition such as sample type, container type, sample preservation methods, analysis to be performed, and the possible need to dilute the sample due to indication of high levels of contamination. The source of reagents, field blank water, and supplies will be documented on the chain-of-custody form or the field notebook. The laboratory will maintain a file of the completed original forms. Copies will be submitted as part of the final analytical report. If samples are split and sent to different laboratories, each sample will receive a unique chain-of-custody form.

6.2 Laboratory Sample Custody

Receiving, storing, and tracking samples submitted to the laboratory will be conducted according to laboratory SOPs intended to ensure that invalid laboratory data resulting from sample contamination, loss, deterioration, or tampering has not occurred. Internal laboratory chain-of-custody procedures will follow laboratory SOPs.

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7.0 CALIBRATION PROCEDURES AND FREQUENCY

A calibration program will be implemented to ensure that routine calibration and maintenance is performed on all field instruments. Field team members familiar with field calibrations and equipment operations will maintain instrument proficiency by performing the prescribed calibration procedures outlined in the operation and field manuals accompanying the field monitoring instruments. Air monitoring instruments (e.g., PID) used in the field to collect data for sample screening and health and safety purposes will be calibrated each day prior to the initiation of fieldwork using the manufacturer's instructions. The instruments will be calibrated using appropriate zero and indicator gases.

The pH, conductivity, and temperature meters will be calibrated prior to each day's use according to the manufacturer's instructions. More frequent calibrations will be performed as necessary to maintain analytical integrity. The pH meter will be calibrated at a minimum of two values that bracket the anticipated pH values of the samples to be analyzed and that are three pH units or more apart. The conductivity meter will be calibrated using a standard solution of known conductivity.

Following calibration, each instrument will be tagged identifying the person who calibrated the instrument and the calibration date. Calibration records for each field instrument used during the investigation will be maintained, and copies of the records will be stored in the project QA files. An example form record (for the PID) is presented as Figure 2.

Calibration of the liquid chromatograph-tandem mass spectrometer (LC/MS/MS) and other analytical equipment will be performed according to laboratory SOPs. Mass calibration checks meeting criteria must be performed. The correlation coefficient (R) for calibration curves generated for C-8 analysis must be ≥ 0.992 ($R^2 \geq 0.985$). If calibration results do not meet the criteria listed in the SOP, then appropriate steps must be taken to adjust instrument operation, and the standards or the relevant set of samples should be reanalyzed.

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8.0 ANALYTICAL PROCEDURES

Drinking water, groundwater, surface water and samples collected at Washington Works will be analyzed by a DuPont-approved laboratory for C-8.

C-8, or ammonium perfluorooctanoate (APFO) forms perfluorooctanoic acid (PFOA) in aqueous solution. PFOA is extracted from water using C_{18} solid phase extraction (SPE) cartridges. Quantitation of PFOA is accomplished by LC/MS/MS analysis using selected reaction monitoring (SRM). Levels of PFOA found are mathematically converted and reported as APFO.

Chemical parameters, sample containers, holding times, and preservatives are presented in Table 2. The analytical procedure used by the laboratory will be consistent with applicable laboratory SOPs as specified in Table 3.

Quantitative reporting threshold limits are sample dependent and may vary as the sample matrix varies. Factors influencing the threshold limits include sample matrix, interferences, and high concentrations of analytes. The LOQ to be reported for C-8 analysis is 50 ng/L. The LOQ was determined based on an evaluation of the concentration of interest and laboratory background concentrations and is intended to enable the data user to make technically correct decisions for the purposes of the groundwater investigation. The actual LOQs may vary from sample to sample in accordance with the standard laboratory practices (e.g., dilution resulting from high analyte concentration).

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9.0 DATA REDUCTION, VERIFICATION AND REPORTING

9.1 Data Reduction

Data reduction involves the process of generating qualitative and quantitative sample information through observations, field procedures, analytical measurements, and calculations. Data reduction occurs through

- The work plan through sample locations and naming conventions.
- The field sampling process by using field logs and field measurements.
- Field communications with the laboratory in sample analysis requests.
- Field operations with collection, preservation, and chain-of-custody documentation.
- Laboratory operations with sample receipt and handling, sample preparation and analysis, collation of raw data, and generation of laboratory results.
- Post-laboratory operations with the collation of analytical results in a format suitable for documents such as reports, maps, and trend plots.

Data reduction steps include field operations, laboratory operations, and report preparation operations. Specific QC measures developed to ensure accuracy throughout the data reduction process are described in Sections 11.0 and 13.0.

9.2 Data Verification

Data verification is the process of verifying that qualitative and quantitative information generated relative to a given sample is complete and accurate.

All C-8 data will be reviewed for compliance with the laboratory SOP and usability according to a prepared checklist (see Appendix A).

Ten percent of the data points will be validated by a third party reviewer, such as ESI, for compliance with the laboratory SOP and data usability. *Region III Modifications to the National Functional Guidelines* will be used as a guide for report formatting and application of qualifiers. Validation will take place concurrent with data reporting in order to expedite reporting of C-8 results. A formal report will be generated by the validator, which will include judgments on data usability and data qualifiers applied by the validator. This report will be forwarded to the GIST.

9.3 Data Reporting

The laboratory will report C-8 results to three significant figures. C-8 results will be reported to the LOQ. Reported concentrations will not be corrected for contaminants found in associated method and field blanks. Deliverables will include a narrative and appropriate laboratory raw data and QC Summary forms.

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The laboratory will report C-8 results for a laboratory replicate of each field sample. These results will be evaluated for precision by comparing the field sample result to the corresponding laboratory replicate result. If both results are less than the LOQ, the replicate sample for that analyte is considered to have passed the precision criteria. If one or both results is between one and five times the LOQ, the replicate is considered to have met the criteria if the two results differ by less than the LOQ. If one result is less than the LOQ and the other is not, and if the two results differed by a value less than the LOQ, the replicate is said to have met the acceptance criteria. Finally, if both results are at least five times the LOQ, the replicate is considered to have met the criteria if the relative percent difference (RPD) between the two results is less than or equal to 20%. RPD is the absolute value of the difference of two measurements divided by their average.

When the precision criteria outlined above is met, DuPont will report the average of the field sample and lab replicate results reported by the laboratory. If criteria for precision is exceeded, the higher of the sample and lab replicate results will be reported by DuPont. Finally, when one result (from the sample/lab replicate pair) is above the LOQ and one below, the result which is above the LOQ will be reported. C-8 results will be recorded in the Corporate Environmental Database (CED) and reported as FC-143 for consistency with historical results.

EID817293

10.0 INTERNAL QUALITY CONTROL CHECKS

As part of the QA program, samples will be collected and prepared to provide control over the collection of environmental measurements and subsequent review, interpretation, and validation of generated analytical data. Two types of QA samples will be prepared or collected: field (e.g., equipment rinsate) blanks and duplicate (i.e., replicate) samples. The two types of QA samples are discussed in more detail below. Split samples may also be collected by third parties, as discussed below.

10.1 Field Blanks

Field blanks will be collected during sampling of drinking water, groundwater, and surface water. These blanks will provide a check on possible sources of contamination such as sample bottle preparation, blank water quality, and sample handling. Field blanks also will be used to indicate potential contamination from ambient air or sampling equipment used to collect and transfer samples.

Field blanks will be collected using two identical sets of pre-cleaned sample containers. One set of containers will be empty and will serve as the sample containers to analyze. The second set of containers will be filled at the laboratory with laboratory-demonstrated analyte-free water. The water will originate from one common source and physical location within the laboratory and will be the same water as the method blank water used by the laboratory. Field blanks will be handled, transported, and analyzed in the same manner as the samples acquired that day. After sampling at the suspected most impacted field location, analyte-free water will be rinsed over decontaminated sampling equipment and placed in the empty sample container for analysis (it may be necessary for the laboratory to provide extra water to ensure sufficient volume of blank water to eliminate headspace). The rationale for collecting equipment rinsate samples at the suspected most impacted area is to simulate a worst-case scenario regarding sampling equipment cross-contamination and ambient air contributions to sample contamination. When there is no sampling equipment to be rinsed, as for tap water sampling, a bottle to bottle transfer of the blank water will take place in order to collect a field blank sample. Field blanks will return to the laboratory with the same set of sample bottles they accompanied to the field.

Other guidelines for the use and integrity of field blanks include:

- Field blanks should not be held on-site for more than four calendar days.
- The clock governing holding times for the field blank will begin at the time of sample collection when analyzed using EPA document SW-846 protocol.
- Field blanks will be collected and analyzed at a rate of at least one per day and at a rate of one in 20 (minimum of one per day) samples. Field blanks will be analyzed for the same parameters for which the environmental samples collected that day are analyzed.

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10.2 Duplicate Samples

Collecting duplicate samples allows the evaluation of the laboratory's performance by comparing the analytical results of two samples from the same location. Duplicates will be collected for aqueous and soil matrix samples at a rate of 5 percent. Duplicates will be labeled as independent samples (i.e., blind duplicates) so that the samples will not be identified as duplicates by the laboratory.

Duplicates of aqueous samples (surface and groundwater) will be obtained by alternately filling sample containers from the sampling device for each parameter. VOC sample containers, if any, will be filled from the same aqueous sample retrieval and will be the first set of containers filled. If sample bottles are filled directly, then the sample container for each set of parameters will be alternately filled. Procedures for collecting drinking water, groundwater, and surface water samples are provided in Sections 5.3 through 5.6 of this QAPP.

Although moisture content, particle size, and adsorption properties of various soils inhibit the ability to achieve replicability, soil duplicate samples may also be collected. Sample locations for duplicate soil samples will be selected to ensure collection of representative samples and sufficient sample volume to fulfill all QA/QC protocols.

10.3 Split Samples

To maintain the integrity of any samples split with other parties, primary contractor personnel and sampling equipment will be used to collect all samples. Other parties, if any, will provide their own equipment (e.g., sample containers, blank containers, preservatives, chain-of-custody forms) and will adhere to the protocols outlined in this QAPP.

EID817295

11.0 PERFORMANCE AND SYSTEM AUDITS

QA auditing will be performed under the direction and approval of the QA officer. The QA officer will plan, schedule, and approve system and performance (i.e., field) audits based on procedures tailored to project requirements. These audits will be implemented to verify, document, and enforce project performance objectives and subcontractor personnel and measurement system(s) protocols. At times, the QA officer may request additional personnel with specific expertise from within the company and/or project groups to assist in conducting the audit(s).

An audit checklist is presented as Figure 3. Unannounced audits will be performed as deemed necessary by the QA officer. The field audit will be conducted while measurement systems are operational, if possible.

Audit reports will be written by the auditor after gathering and evaluating all resulting data. Noncompliances will be logged, documented, and controlled through audit findings, which are attached to and made a part of the audit report. These audit finding forms will be directed to the project manager to resolve the noncompliance in a specified and timely manner. All audit reports, audit findings, and acceptable resolutions will be approved by the QA officer prior to being issued. QA verification of acceptable resolutions may be determined by a re-audit or documented surveillance of the item or activity. Upon verification acceptance, the QA officer will close out the audit report and findings. Copies of all audit reports and audit findings will be maintained as part of the project file.

EID817296

12.0 PREVENTATIVE MAINTENANCE

All field equipment will be subjected to a routine maintenance program before and after each use. The routine maintenance program for each piece of equipment will be in accordance with the manufacturer's operations and maintenance manual. All equipment will be cleaned and checked for integrity after each use. Repairs will be performed immediately after any defects are observed and before the item of equipment is used again. Equipment parts with a limited life (e.g., such as batteries, membranes, and some electronic components) will be periodically checked and replaced or recharged as necessary according to the manufacturer's specifications.

Each piece of field equipment will have its own log sheet that contains the equipment identification number, information on maintenance procedures, and the date and nature of the last maintenance. Since most equipment will be used on an irregular, as-needed basis, all equipment will be properly stored when not in use.

Laboratory equipment maintenance will be regularly performed by the subcontracted laboratory. It will be the laboratory's responsibility to maintain and document the maintenance of properly functioning equipment so that the data is usable and reproducible. Upon request a description of the laboratory's equipment, maintenance procedures will be provided by the subcontracted laboratory.

EID817297

13.0 DATA MEASUREMENT ASSESSMENT PROCEDURES

The DQOs for the Washington Works groundwater investigation were established in terms of representativeness, comparability, precision, accuracy, and completeness of the data set. The laboratory analysis SOP will be used to specify the quality of data and define the analytical techniques required to produce the DQOs. The laboratory analysis SOP provides an assessment of the laboratory's analytical capabilities and staff qualifications to perform the specified level of quality. The appropriate laboratory QC procedure is specified in each analytical method.

13.1 Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a measured characteristic of a population, parameter variations at the sampling point, a process condition, or an environmental condition. The degree of representativeness is dependent on the objectives of the measurement results. Thus, representativeness can be classified into the following four objective levels:

- *Level 1*
  Sample is only representative of the point of sampling (e.g., drum, storage tank, and single point within a stream or land area)
- *Level 2*
  Sample is part of a set and represents a defined area or portion of land or water—not just the point of sampling (e.g., stream transect, sampling grid of a land area, underground aquifer)
- *Level 3*
  Sample represents a relationship between the source of contamination and the location sampled (e.g., source and monitoring well, source and stream)
- *Level 4*
  Sample is a nonrepresentative sample used for assessment purposes only (e.g., preliminary assessment, spot check)

The objective of the sampling, monitoring, and analysis will be that results are representative of the medium investigated (e.g., soil, water) and its condition to a degree consistent with the desired objective level. Objective levels 1, 2, and 3 as described above will be used to accomplish the Washington Works groundwater investigation objectives.

13.2 Comparability

For this project, all measurement data will be calculated and reported in units consistent with standard practice to allow comparability of new and future data. Data comparability also includes seasonal trends.

The groundwater investigation will use results generated by appropriate laboratory SOPs. The current and future use of these methods will allow data produced during the

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groundwater investigation to be comparable to data generated during subsequent sampling and analysis programs.

13.3 Precision

Precision means the measurement of agreement of a set of replicate results among themselves without assuming any prior information as to the true result. Precision will be quantitatively assessed by evaluating relative percent difference values for field duplicates and laboratory replicates. To determine the precision of the analytical method, a program of replicate analyses will be followed. The laboratory will split a sample into two subsamples and analyze each independently at the frequency listed in the appropriate method. A comparison of results of field duplicates will assist in evaluating the overall representativeness of the data.

The results of the replicate analysis will be used to calculate the QC parameter [relative percent difference (RPD)] for precision evaluation. The following equation is used to calculate RPD:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} = x100$$

where,

D_1 is defined as the first subsample value

D_2 is defined as the second subsample value

The frequency of laboratory replicates is described in the laboratory SOP. In addition to evaluating the method precision, duplicate or split samples will be collected in the field and analyzed independently. These results will be used to evaluate the total system's variability, including sampling variations. The identity of the field splits will not be known by laboratory personnel.

The analytical precision produced by laboratory replicate analyses will be evaluated by both the laboratory and DuPont, while field splits will be evaluated only by DuPont. The evaluation of both types of data will be in accordance with the referenced SOP and this plan.

13.4 Accuracy

Accuracy means the nearness of a result or the mean of a set of results to the true value. Accuracy is assessed by means of reference samples and percent recoveries. Accuracy for this project will be quantitatively assessed by evaluating relative percent recoveries of items such as matrix spike and laboratory control spike samples. Accuracy will be qualitatively assessed by evaluating instrument performance checks and field blanks. To determine the accuracy of an analytical method, a program of sample spiking will be followed. The spiking frequency will be as stated in the referenced SOP. The results of sample spiking will be used to calculate the QC parameter (i.e., percent recovery) for accuracy evaluation.

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The following equation will be used:

$$\%\ Recovery = \frac{SSR - SR}{SA} = x\ 100$$

where,

SSR = Spiked sample result

SR = Sample result

SA = Spike added

The frequency for the spiking is per the laboratory SOP.

13.5 Completeness

The objective of the groundwater investigation sampling and analysis program is to characterize waters at Washington Works and associated landfills. The completeness goals to meet this objective are listed in Table 1. Completeness will be determined following periodic evaluation of the accuracy and precision results of the project data sets.

$$\frac{Valid\ Data}{Total\ Data\ Generated} x\ 100 = \%\ Complete$$

Usable data will be determined in accordance with the referenced method (see Section 9.0). The percent complete will be used to determine whether the data quality meets the objectives for the groundwater investigation.

If the completeness objectives are not met for individual parameters, the reasons for the invalid data will be reviewed by DuPont. Depending on the reasons (e.g., holding time exceeded) and the effect of the incomplete data on the accomplishment of the groundwater investigation objectives, additional samples may be collected and analyzed. This subjective evaluation will also be conducted if a sample does not generate data C-8. Such a data gap could result from sample container loss or sample custody not being maintained. If it is determined by DuPont that the missing results are critical to accomplishing the objectives (e.g., a groundwater sample to be used for risk assessment purposes is lost) additional sampling will be performed to obtain the missing data.

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14.0 CORRECTIVE ACTION APPROACH

The following procedures have been established to ensure conditions adverse to quality, such as equipment malfunctions, performance deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected. These conditions may be noted during the field audit, field activities, data reduction and evaluation, and/or validation of laboratory reports.

When a significant condition adverse to quality is noted in the field, in the laboratory, or at the office, the cause of the condition will be determined, and corrective action will be initiated by the QA officer to preclude repetition. The nature and cause of the condition, reference documents, and planned corrective actions will be documented and reported to the field team leader, project manager, QA officer, and involved subcontractor management, as appropriate. Implementation of the corrective action will be documented by the QA officer. All project personnel are responsible, as part of their standard work duties, to promptly identify and report conditions adverse to quality and implement the appropriate corrective action.

Corrective actions will be initiated, at a minimum, when:

- Procedures or data are determined to be suspect; all field and laboratory procedures that are not conducted according to the groundwater investigation plan and the guidance documents cited therein will be considered suspect. Data generated by these procedures will be considered suspect.
- Equipment or instrumentation is found to be faulty; equipment or instrumentation that does not operate according to manufacturer's specifications and/or does not properly calibrate will be considered faulty.
- Representativeness of samples and test results is questionable; results that conflict with on-site observations, other laboratory results, or historical and background data will be considered questionable. Questionable results will be considered nonrepresentative of the conditions present at the sampling location.
- Quality assurance requirements have been violated.
- Design approvals have been circumvented.
- Field audits and/or management assessments result in the determination that corrective actions are necessary.

14.1 Corrective Action Procedure Description

The project manager will use appropriate staff such as field staff, QA auditors, document and sample control personnel, and laboratory groups to monitor ongoing work performance in the normal course of daily responsibilities.

The QA officer or designated auditors will review (audit) field activities, laboratory reports, and office records. Items, activities, or documents that are in noncompliance

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with QA requirements will be documented, and corrective action will be implemented. All findings will be logged, maintained, and controlled by the QA officer.

A corrective action request (CAR), presented as Figure 4, will be used to identify the adverse condition, the reference document(s), and the recommendation of corrective action(s) to be implemented. The CAR will be sent to the person responsible for the item or activity requiring action. The individual receiving the CAR will implement the recommended corrective action of an equivalent corrective action and return the completed form promptly to the QA/QC officer after affixing his/her signature and date. The QA officer will maintain a status control log of CARs and responses, confirm the adequacy of the intended corrective action, and verify implementation of the corrective action. At a minimum, the QA officer will issue and distribute CARs to the originator, project manager, and involved personnel (including subcontractors). CARs will be maintained in the project file.

It will be the project manager's overall responsibility to ensure that all corrective actions are acted upon promptly and satisfactorily.

EID817302

15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Periodic reports detailing the results of QA/QC activities described in previous sections (see Section 9.0, 11.0, and 14.0) will be submitted to the project director through the project manager as required. These documents will include reports on:

- Significant deviations from protocol as stated in the QAPP.
- Field system and performance audits.
- Laboratory system and performance audits.
- Corrective action and follow-up.

EID817303

TABLES

EID817304

Table 1

DUPONT WASHINGTON WORKS GROUNDWATER INVESTIGATION PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES FOR WATER SAMPLES

C-8*	Laboratory SOP (LC/MS/MS)	20	70-130	90**

*also known as FC-143 or ammonium perfluorooctanoate (APFO).

**Completeness objective may be 100% for designated sampling events.

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Table 2

DUPONT WASHINGTON WORKS GROUNDWATER INVESTIGATION
SUMMARY OF HOLDING TIMES AND
PRESERVATION FOR WATER SAMPLES

Analyte/Preparation	Preservation	Container**	Maximum holding time	Sample Preservation Guidelines
C8*	Laboratory SOP (LC/MS/MS)	P	14 days	Cool 4°C

*also known as FC-143 or ammonium perfluorooctanoate (APFO).

**All samples are to be stored at nominal 4°C (not frozen to 6°C).

P = Polyethylene

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Table 3

DUPONT WASHINGTON WORKS GROUNDWATER INVESTIGATION
ANALYTICAL METHODOLOGY
WATER SAMPLES

Parameter	Preparation Method		Analytical Method
	Soil	Water	
C8*	SOP	SOP	LC/MS/MS

*also known as FC-143 or ammonium perfluorooctanoate (APFO).
**Methods are from laboratory SOP.

EID817307

FIGURES

EID817308

Figure 1

PROJECT ORGANIZATION DIAGRAM

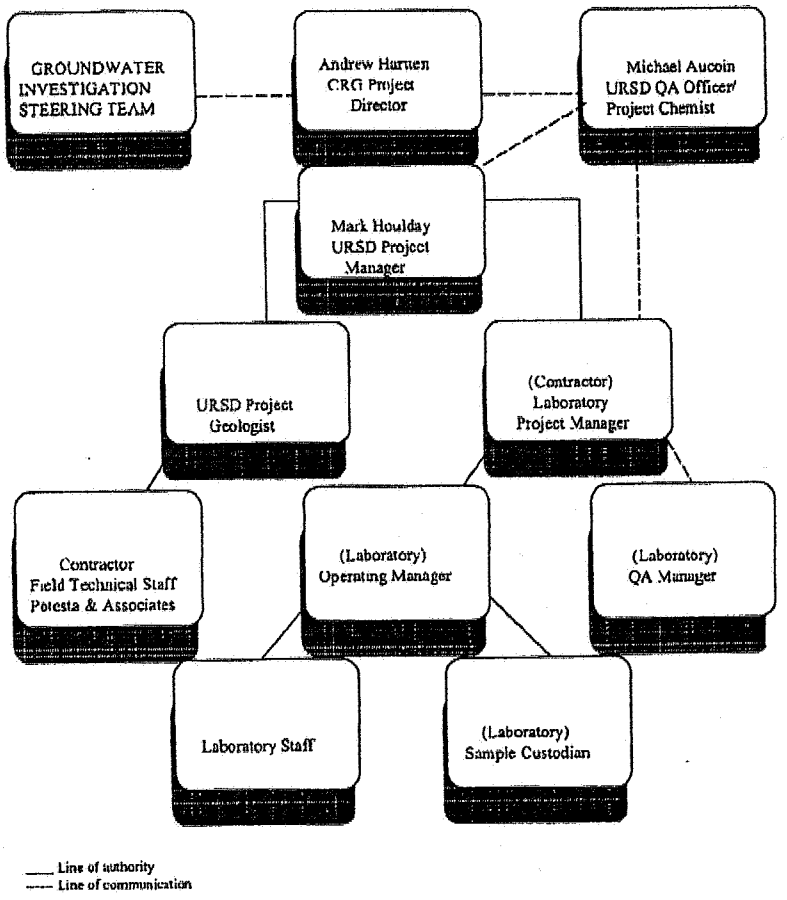

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Figure 2

DAILY INSTRUMENT CALIBRATION CHECK SHEET
Quality Assurance Project Plan
DuPont Washington Works Groundwater Investigation

INSTRUMENT: ______________________________

SERIAL NO.: ______________________________

Date	Pure Air Y/N	Calibration Gas (ppm)	Battery Check (good/bad)	Calibrated By	Remarks

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Figure 3

AUDIT CHECKLIST
Quality Assurance Project Plan
DuPont Washington Works Groundwater Investigation

PROJECT: _____ PROJECT MANAGER: _____

SITE LOCATION: _____

AUDITOR: _____ DATE: _____

Question	Yes	No	Comment/Documentation
Field:			
1. Was an on-site safety officer appointed?			
2. Did site personnel receive a copy of the site-specific sampling and analytical plan in a timely manner to allow for sufficient review?			
3. Are copies available in the field during sampling?			
4. Was a briefing held off site, before any site work was begun, to acquaint personnel with sampling equipment, assign field responsibilities, and review safety procedures?			
5. Do field personnel have a field notebook?			
6. Are the site survey grid stakes present?			
7. Do the number and location of samples collected follow the procedures as specified in the site-specific sampling and analysis plan?			
8. Are samples labeled?			
9. Are samples being collected following the procedures?			
10. Was a chain-of-custody form filled out for all samples collected?			
11. Are samples preserved as specified?			
12. Are the number, frequency, and type of samples (including blanks and duplicates) collected as described in the sampling analysis plan?			
13. Are the number, frequency, and type of measurements and observations taken as specified in the site-specific sampling and analysis plan?			

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Figure 3

AUDIT CHECKLIST
(Continued)

Question	Yes	No	Comment/Documentation
Field:			
14. Are operating procedures for field equipment available?			
15. Is a record maintained of the calibration of field equipment?			
16. Is field equipment being calibrated as required?			
17. Are geophysical cross sections correlated to geologic data?			
18. Is safety equipment being used by field personnel?			
19. Is emergency safety equipment available as required in the health and safety plan?			
20. Are well designations clearly labeled (i.e., well numbers)?			
21. Are caps on wells locked if not being used?			

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Figure 4

CORRECTIVE ACTION REQUEST
Quality Assurance Project Plan
DuPont Washington Works Groundwater Investigation

Number: _____ **Date:** _____

To: _____

You are hereby requested to take corrective actions indicated below and as otherwise determined by you (A) to resolve the noted condition and (B) prevent it from reoccurring. Your written response is to be returned to the project quality assurance officer by _____.

Condition:

_____

_____

Reference Documents: _____

Recommended Corrective Actions: _____

_____

_____

Originator	Date	Approval	Date	Approval	Date

Corrective Action

(A) Resolution: _____

_____

_____

(B1) Prevention: _____

_____

_____

(B2) Affected Documents: _____

_____

Signature: _____ **Date:** _____

Q.A. Followup

Corrective Action Verified By : _____ **Date:** _____

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EID817313

APPENDICES

EID817314

FC-143 Data Package Review

Location –

Jobname -

Lab – Exygen Research

Lab Report No. -

NARRATIVE – confirm target compound is APFO, review text against SOP for sample prep/analysis, note if QC criteria not being met

RESULTS SUMMARY – attach a copy of results summary to this document

Confirm sample results reported as APFO (QC samples, raw data may show PFOA)

Evaluate precision for each sample and lab rep pair – if both results > 5X LOQ calculate RPD, compare to 20% (40% for solids); if either or both results are ≤ 5X LOQ, calculate difference (using LOQ for non detects) and compare to LOQ (2X LOQ for solids)

If precision criteria met, report average of sample/lab rep; if precision criteria not met, or if one result above and one below LOQ, report the higher of the two results

MATRIX SPIKE RECOVERY – spike recovery must meet criteria (70-130%) unless sample concentration is > 4X spike concentration. Spike value is 500 - 500,000 ng/L.

COC REVIEW/SAMPLE RECEIPT

Samples relinquished by field

Samples received at lab next day

Samples packed in wet ice

Sample temperature upon receipt (not frozen to 6 C)

HOLD TIME – 14 days from date of collection to analysis date

EID817315

FC-143 Data Package Review

Location –

Jobname -

Lab – Exygen Research

Lab Report No. -

RUN SEQUENCE – check raw data report:

Initial 6 point calibration

Each standard repeated during sequence

Check standard (250 ppt) within 15% of average response for 250 ppt calibration standards

LCS @ LOQ (recovery should be 70-130%)

LCS @ 10X LOQ (recovery should be 70-130%)

Recalculate one or more results

METHOD BLANKS – less than LOQ

LC/MS/MS OPERATING CONDITIONS

LM/HM Res 1 – should be 13 - 14

LM/HM Res 2 – should be 11-14, not greater than LM/HM Res 1

Cone voltage – should be 10

Scanning method – 413-369 transition

MASS CALIBRATION

Confirm sample analysis within one week of mass calibration meeting criteria

All masses must be found within 0.2 amu of known masses

INITIAL CALIBRATION – initial 6 standards, with no weighting

Correlation coefficient $R \geq 0.992$

Coefficient of determination $R^2 \geq 0.985$

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EID817316

Location –

Jobname -

Lab – Exygen Research

Lab Report No. -

CONTINUING CALIBRATION – all standards, with 1/x weighting, no more than two standards excluded

$R^2 \geq 0.985$

RETENTION TIMES – no more than 2% drift during run sequence

COMMENTS

Reviewer -

Date -

EID817317

EID817317