PROJECT DESIGN AND SAMPLING PLAN

PFAS in Groundwater Associated with Class B Biosolids Land Application Sites

Department of Natural Resources and Environmental Control

Division of Water

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DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

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1.0 INTRODUCTION AND BACKGROUND

The Clean Water Act (CWA) of 1972 and its amendments govern water pollution in the United States. One aspect of the CWA is section 405(d) that requires the Environmental Protection Agency (EPA) to establish requirements and management practices for the use and disposal of sewage sludge (biosolids). In 1993, EPA issued regulation 40 CFR Part 503, Standards for the Use or Disposal of Sewage Sludge. Prior to development of the regulations, a survey was conducted to identify contaminants of concern found in biosolids. A comprehensive risk assessment was then conducted to determine which of these contaminants found in biosolids posed risk to public health and the environment. Ultimately numeric limits and management practices were developed to limit exposure to these contaminants and two classes of biosolids were designated, Class A and Class B. Class A biosolids undergo a more effective pathogen reduction method and in Delaware's regulations, all Class A biosolids must also meet more stringent limits for heavy metals thus less site-specific controls are required than for the land application of Class B biosolids. However, according to the EPA, the utilization of Class A and Class B biosolids are equally protective of human health and the environment, provided that the applicable management practices imposed by each pathogen reduction option are followed. Every 2 years, the EPA is required to refine its risk assessments and reevaluate contaminants that are present in biosolids and develop new numeric limits and management practices that protect public health and the environment from reasonably anticipated adverse effects of chemical and microbial pollutants during the use or disposal of biosolids. When new limits for contaminants are developed and implemented at a federal level, states are required to have standards at least as stringent.

Per- and polyfluoroalkyl substances (PFAS) which are a large group of human-made emerging contaminants of concern that include perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). PFAS have been used in industry and consumer products since the 1940's as stain and soil repellents for carpets and clothing textiles, oil and grease resistance for food contact paper, and surfactants in firefighting foams. PFAS are highly persistent in the environment and some bioaccumulate in humans. There is evidence that continued exposure above specific levels to certain PFAS may lead to adverse health effects (ITRC, 2022).

According to existing data, PFAS are found in virtually all biosolids at varying concentrations (PCWR et. al, 2020; Bogdan, 2021). Analytical methods continue to be developed to better detect PFAS and to determine which PFAS are the most impactful to human health and the environment. The EPA has dedicated many resources towards developing risk-based action levels for PFAS and recently developed standards (a.k.a. Maximum Contamination Levels, or MCLs) for PFOA, PFOS, PFHxS, PFNA, HFPO-DA (Gen X Chemicals), and a Hazard Index standard for mixtures containing two or more of PFNA, PFHxS, PFNA, HFPO-DA in drinking water. EPA has also recently designated PFOA and PFOS as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Additionally, EPA is currently conducting a risk assessment on biosolids but it is limited to PFOA and PFOS, and the EPA is not scheduled to complete the risk assessment for biosolids until the end of 2024 (USEPA, 2024). Thus, federal PFOA and PFOS action levels for biosolids will not likely be developed until 2025. As the EPA's initial risk-based action levels will likely be limited to PFOA and PFOS, many uncertainties related to other PFAS compounds will remain and more scientific data is needed to develop these other risk-based action levels and to improve our understanding of the impacts of biosolids application to our groundwater resources.

While research is ongoing at federal and state levels, wastewater and biosolids continue to be land-applied within the State of Delaware in accordance with the requirements of existing Department of Natural Resources and Environmental Control (DNREC) regulations and permits. In 2023, Delaware generated approximately 14,400 dry tons of biosolids and about 6,523 dry tons of biosolid were land applied in Delaware including 186 dry tons (~3%) from out of state sources. Roughly 7,877 dry tons of Delaware generated biosolids were land applied in Pennsylvania.

Beginning in 2022, DNREC implemented a project design and sampling plan (DNREC, 2022) to investigate the concentrations of certain PFAS compounds in wastewater influent, effluent, septic tank pump outs, and biosolids at selected wastewater treatment plants (WWTPs) across the state. All biosolids and wastewater sampled as part of the study contained varying levels of PFAS. One of these studies involved DNREC selecting a long term biosolids land application facility

(study site) to characterize PFAS and better understand the potential PFAS impacts from these sites to soil and groundwater. At the biosolids study site, PFAS was found in all downgradient monitor wells at levels many times greater than the EPA's current MCLs for drinking water.

Based on the data generated from DNREC's biosolids study, the land application of biosolids threatens to impact groundwater beneath and downgradient of biosolids application sites with PFAS at levels exceeding current drinking water standards and has the potential to impact downgradient drinking water wells. Drinking water wells installed in the unconfined aquifer are especially vulnerable to impacts of PFAS from biosolids land application activities.

To examine PFAS beneath and downgradient of Class B biosolids application sites, DNREC developed this project design and sampling plan to investigate the concentrations of certain PFAS compounds in groundwater in areas throughout the state that have been determined to be at the highest risk of PFAS impacts from historical Class B biosolids land application activities. Future studies may look at areas that received the application of Class A biosolids or other wastewater treatment residuals. Should elevated PFAS be identified in groundwater upgradient of public or private drinking water wells, DNREC will expand this study and sample wells that are most likely impacted. Additionally, DNREC may expand this study in the future and sample soils for PFAS at the selected Class B land application sites to evaluate PFAS behaviors in various types of soils and their relationships with PFAS in the groundwater beneath.

Section 2.0 presents the sampling plan for sampling groundwater at or near selected Class B biosolids land application facilities; Section 3.0 discusses quality assurance and quality control; Section 4.0 shows the tentative project schedule; and Section 5 summarizes the proposed activities.

2.0 GROUNDWATER SAMPLING

This phase of the study will entail the monitoring for PFAS concentrations in groundwater at or near selected Class B biosolids land application sites that were determined to have an elevated potential of risk of impacting groundwater with PFAS. The criteria used to determine sampling are shared in Section 2.2.

2.1 Class B Biosolids Application – Historical Information

Class B Biosolids is sewage sludge that is treated by an EPA and State of Delaware approved "Process to Significantly Reduce Pathogens" (PSRP), a "Vector Attraction Reduction" method, and monitored for "Ceiling Concentration" limitations for 10 heavy metals in accordance with requirements in Federal and State regulations. Land permitted for Class B biosolids application in the State of Delaware is limited and application sites are permitted on a field-by-field basis. Prior to obtaining a Class B biosolids agricultural utilization permit, a permittee must submit all information required in DNREC's biosolids regulations (DNREC, 1999). Information required includes, but is not limited to, detailed soils information to determine the suitability of the land for land application activities, detailed testing of the biosolids for certain chemicals of concern including 10 heavy metals, and a network of monitor wells sufficient to characterize potential impacts from land application activities to groundwater.

Class B biosolids were land applied at all of the study sites via surface application with incorporation and/or subsurface injection at a depth of up to approximately 10 inches beneath the soil surface. DNREC's biosolids regulations and permits limit the quantity of biosolids that can be applied to an agronomic rate. Typically, the nitrogen requirement of a crop determines the quantity of biosolids that can be applied (DNREC, 1999).

2.2 Facilities for Groundwater Sampling

All Class B biosolid land application facilities in Delaware were evaluated. Based on the size and history of the facilities, as well as the existence and amount of downgradient domestic wells from the facilities, five facilities were selected for this study. Table 1 lists a summary of the selected facilities and Figure 1 shows their regional locations.

Facility Name	Approximate Application Acres	Approximate Number of Private Wells < 0.5 Miles Downgradient	Approximate Years of Biosolids Application
Clean Delaware Milton Site	170	60	30
Clean Delaware New Market Site	34	10	30
Clean Delaware Harbeson Site	24	10	30
Sussex County Hettie Lingo[1] and Tower Site	125	10	20[2]
Synagro Application Site Fields 22 and 24[3]	306	20	20[4]

Table 1 - Biosolids facilities selected for PFAS in water and drinking water study

[1] Beginning in 1993 through the mid 2000's, Mountaire was permitted to land apply Class B biosolids on this site. Sussex County applied biosolids starting in the mid 2000's and ceased in 2012.
[2] Spray irrigation activities began in 2012 on the north end of the field and by 2017 the entire field was dedicated to spray irrigation.
[3] Fields 22 and 24 were formerly known as field 7. Currently under the spray irrigation program, field 22 is known as fields 2 and 3 and field 24 is known as field 4.
[4] Spray irrigation activities began in 2009 and continue to date. Class B biosolids application began in 1993 and ceased in 2016.

The following sections present brief descriptions of each facility selected for this study.

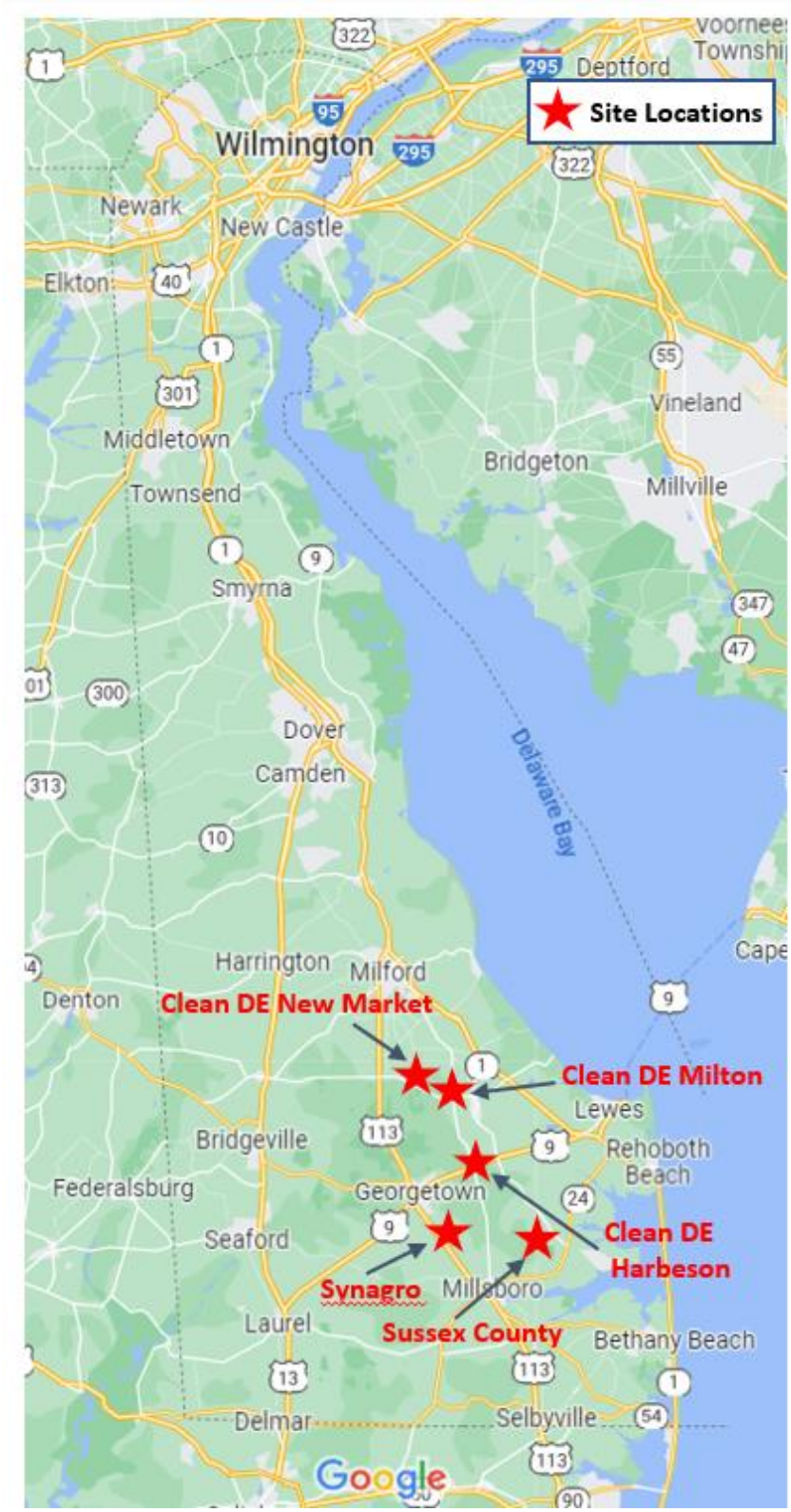


Figure 1 – Regional Location Map - Selected Class B Biosolids Land Application Sites

2.1.1 Clean Delaware Milton Farm Land Application Site

- State Permit Number: AGU 220X-S-03
- Current Status: Active
- Facility Location: Approximately 1 mile northwest of Milton, Delaware
- Biosolids Application Dates: 1992 to present
- Facility Description: Clean Delaware land applies several different materials. Sludge (biosolids) from municipal, commercial, and industrial wastewater treatment plants are treated to Class B pathogen reduction requirements prior to being accepted by Clean Delaware for land application. Septic tank pump-outs are treated onsite by lime stabilization (pH is increased to a pH of 12 for at least 2 hours) and stored in a 200,000 above ground storage tank (AST) prior to application onto designated fields. Additional materials land applied include, but were not limited to, brewery wastewater and grease trap waste.

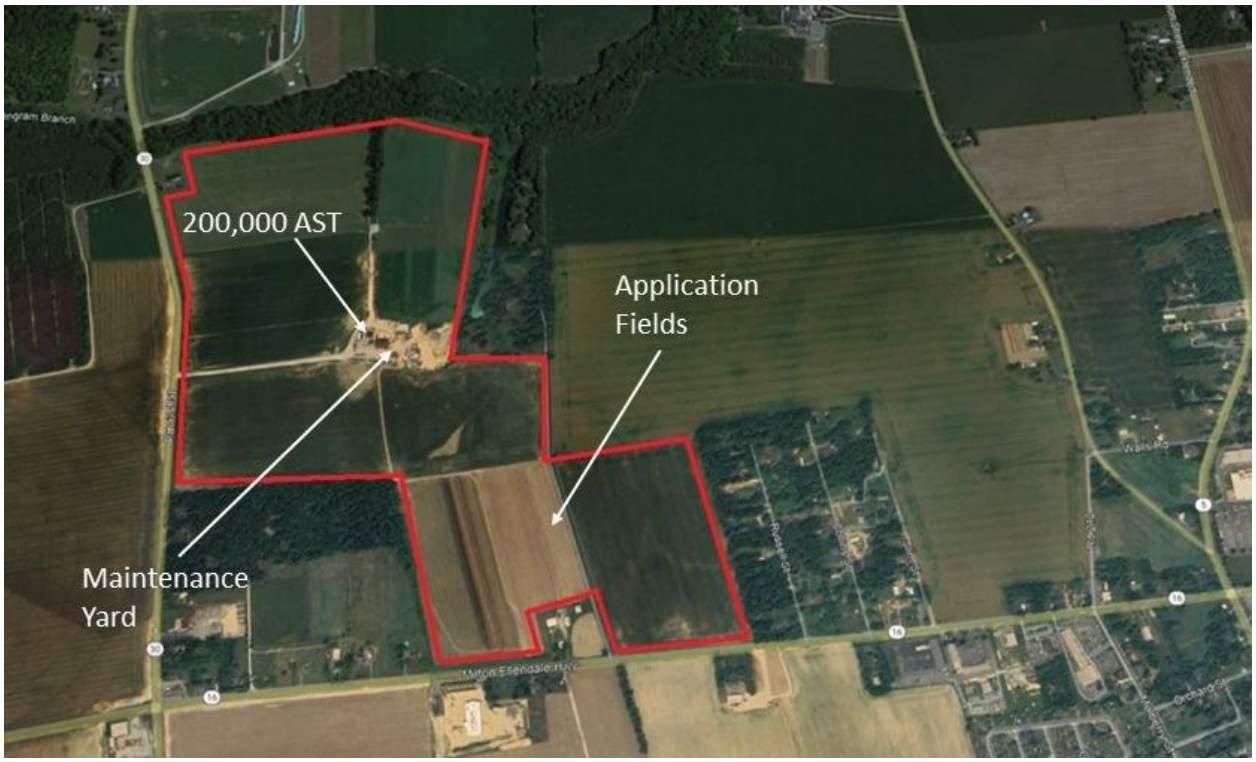


Figure 2 - Location and Layout of the Clean Delaware Milton Application Site

2.1.2 Clean Delaware New Market Farm Land Application Site

- State Permit Number: AGU 1702-S-03 (expired)
- Current Status: Inactive permit – this site is no longer utilized for land application. Traditional agricultural practices are utilized at this location and nutrients are obtained by applying commercial fertilizer.
- Facility Location: Approximately 1 mile northwest of Milton, Delaware
- Biosolids Application Dates: 1992 to 2013
- Facility Description: Clean Delaware land applies several different materials. Historically at this site, Clean Delaware land applied municipal, commercial, and industrial wastewater sludge (biosolids) treated to Class B pathogen reduction requirements, in a wastewater treatment facility prior to acceptance. Additional materials historically land applied include, but were not limited to, brewery wastewater and grease trap waste.

Figure 3 - Location and Layout of the Clean Delaware New Market Application Site

2.1.3 Clean Delaware Harbeson Farm Land Application Site

- State Permit Number: AGU 220X-S-03
- Current Status: Active
- Facility Location: On the south side of Route 9, approximately 500 feet east of Route 5 in Harbeson, Delaware
- Biosolids Application Dates: 1992 to present
- Facility Description: Clean Delaware land applies several different materials. Historically at this site, Clean Delaware land applied municipal, commercial, and industrial wastewater sludge (biosolids) treated to Class B pathogen reduction requirements in a wastewater treatment facility prior to being accepted by Clean Delaware. Additional materials land applied include, but may not be limited to, brewery wastewater and grease trap waste.

Figure 4 - Location and Layout of the Clean Delaware Harbeson Application Site

2.1.4 Synagro Land Application Site, Fields 22 and 24

- State Permit Number: AGU 1601-S-03 (expired)
- Current Status: Active – currently permitted for the land application of wastewater generated by the Town of Georgetown.
- Facility Location: Approximately 3.5 miles southeast of Georgetown, Delaware
- Biosolids Application Dates: 1993 to 2016
- Facility Description: Synagro formerly land applied Class B biosolids primarily generated at Vlasic foods in Millsboro, DE. The biosolids were comprised of wastewater treatment solids generated in the production of pickle products and wastewater from the facility's restrooms. Additionally, Class B biosolids generated from the town of Georgetown, the Town of Selbyville, the Town of Laurel, and sources as approved by DNREC, were permitted to be applied onto the aforementioned application sites.

Figure 5 - Location and Layout of Synagro Application Site Fileds 22 and 24

2.1.5 Sussex County Hettie Lingo and Tower Application Sites

- State Permit Number AGU: 1601-S-03 (expired)
- Current Status: Active - Biosolids application ceased at Hettie Lingo in 2012. Starting in 2012, portions of Hettie Lingo were permitted for the land application of wastewater generated by the Sussex County Inland Bays Facility. Currently, the entire Hettie Lingo field received the land application of wastewater. The Tower Field was originally permitted in 2015 and continues to be an active Class B biosolids application location.
- Facility Location: Approximately 3.5 miles southeast of Georgetown, Delaware
- Biosolids Application Dates: Hettie Lingo 1993 to 2012, Tower Field 2015 to present
- Facility Description: Synagro formerly land applied Class B biosolids primarily generated at Vlasic foods in Millsboro, DE. The biosolids were comprised of wastewater treatment solids generated in the production of pickle products and wastewater from the facility's restrooms. Additionally, Class B biosolids generated from the Town of Georgetown, the Town of Selbyville, the Town of Laurel, and sources as approved by DNREC, were permitted to be applied onto the application sites.

Figure 6 - Location and Layout of Sussex County Hettie Lingo and Tower Fileds 22

2.3 Wells for Groundwater Sampling

Groundwater from monitor wells associated with selected Class B biosolids land application facilities will be sampled. Hydrological reports were reviewed and groundwater flow direction data were considered when groundwater sampling locations were selected. In general, at least one upgradient monitoring well and two downgradient monitoring wells were selected for sampling at each facility.

Groundwater monitor well samples will be named in the following format:

Facility Code-GW+DNREC ID-(*Quarter*), where Facility Code is defined as CM=Clean Delaware Milton Farm, CH= Clean Delaware Harbeson Farm, CN=Clean Delaware New Market Farm, SX= Sussex County Hettie Lingo and Tower Fields, and SN=Synagro Fields 22 and 24; GW = groundwater; DNREC ID is the unique well permit ID issued by DNREC; and *Quarter* is the number of the quarter of the sampling event. For example, **CM-GW242592-2** will be the groundwater sample collected from the Clean Delaware Milton Farm facility, from DNREC well ID 242592, during the second (quarter) sampling event.

As shown in Table 2, a total of 23 monitoring wells from the selected 5 facilities will be sampled for this study. Additional information and the locations of wells from each facility are presented in subsequent sections of this report.

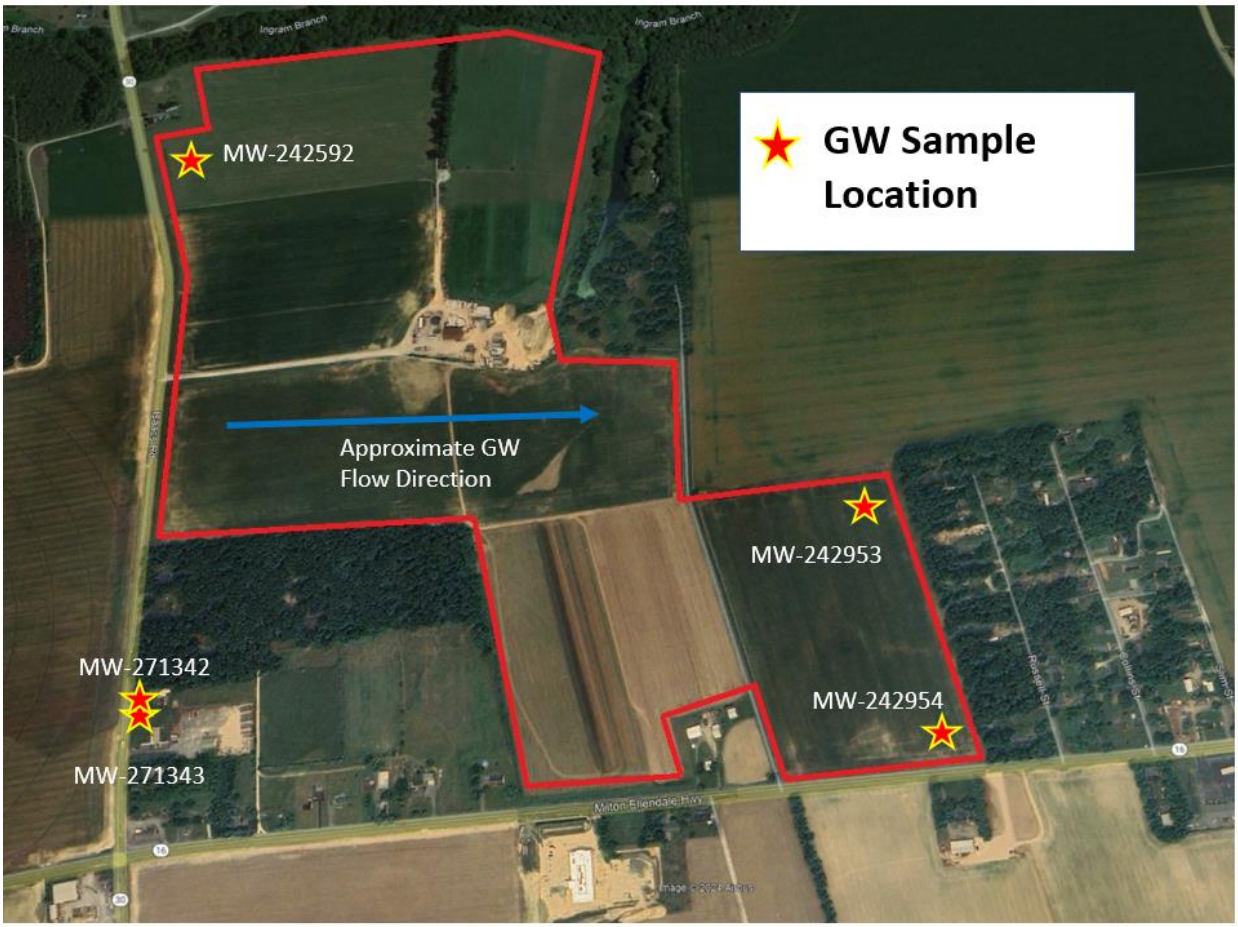
Facility Name	Field Name	DNREC Well ID#	Approximate Screen Interval (ft below grade)	Location
Clean Delaware	Milton Farm	242592	10-20	upgradient
Clean Delaware	Milton Farm	242953	10-20	downgradient
Clean Delaware	Milton Farm	242954	10-20	downgradient
Clean Delaware	Milton Farm	271342	28-38	upgradient
Clean Delaware	Milton Farm	271343	58-68	upgradient
Clean Delaware	New Market Farm	242584	5-15	downgradient
Clean Delaware	New Market Farm	242585	10-20	downgradient
Clean Delaware	New Market Farm	242587	10-20	upgradient
Clean Delaware	New Market Farm	250843	30-40	downgradient
Clean Delaware	Harbeson	242580	10-20	side/downgradient
Clean Delaware	Harbeson	242581	10-20	downgradient
Clean Delaware	Harbeson	242582	10-20	upgradient
Clean Delaware	Harbeson	250844	30-40	downgradient
Sussex County	N/A - in woods	86150 (MW-6)	10-20	upgradient
Sussex County	Hettie Lingo	283993 (MW-21)	10-20	downgradient
Sussex County	Hettie Lingo	238299 (MW-22)	13.5-28.5	downgradient
Sussex County	Tower	238969 (MW-25)	10-20	side/downgradient
Sussex County	Tower	238970 (MW-26)	9-19	downgradient
Synagro	Field 22	178258 (MW-9)	8-18	upgradient
Synagro	Field 22	156323 (MW-3)	5-25	side/downgradient
Synagro	Field 24	243003 (MW-7)	10-20	downgradient
Synagro	Field 24	178315 (MW-8)	8-18	downgradient
Synagro	Field 22	156321 (MW-1)	Unknown – 5-25 feet?	downgradient

Table 2 - Monitor well information for wells to be samples as part of study

2.3.1 Clean Delaware Milton Farm Site Location

There are 15 active groundwater monitor wells at the facility, 3 of which are selected for groundwater sampling in this study (DNREC ID 242592, 242953, and 242954). Additionally, 2 upgradient off-site monitor wells (owned by DNREC) were selected for groundwater sampling in this study (DNREC ID 271342 and 271343). Figure 7 shows the locations of the biosolids application fields and the selected groundwater monitor wells.

Figure 7 – Proposed sampling locations at the Clean Delaware Milton Farm



2.3.2 Clean Delaware New Market Farm Site Location

There are 5 active groundwater monitor wells at the facility, 4 of which are selected for groundwater sampling in this study (DNREC ID 242584, 242585, 242587, and 250843). Figure 8 shows the locations of the biosolids application fields and the selected groundwater monitor wells.

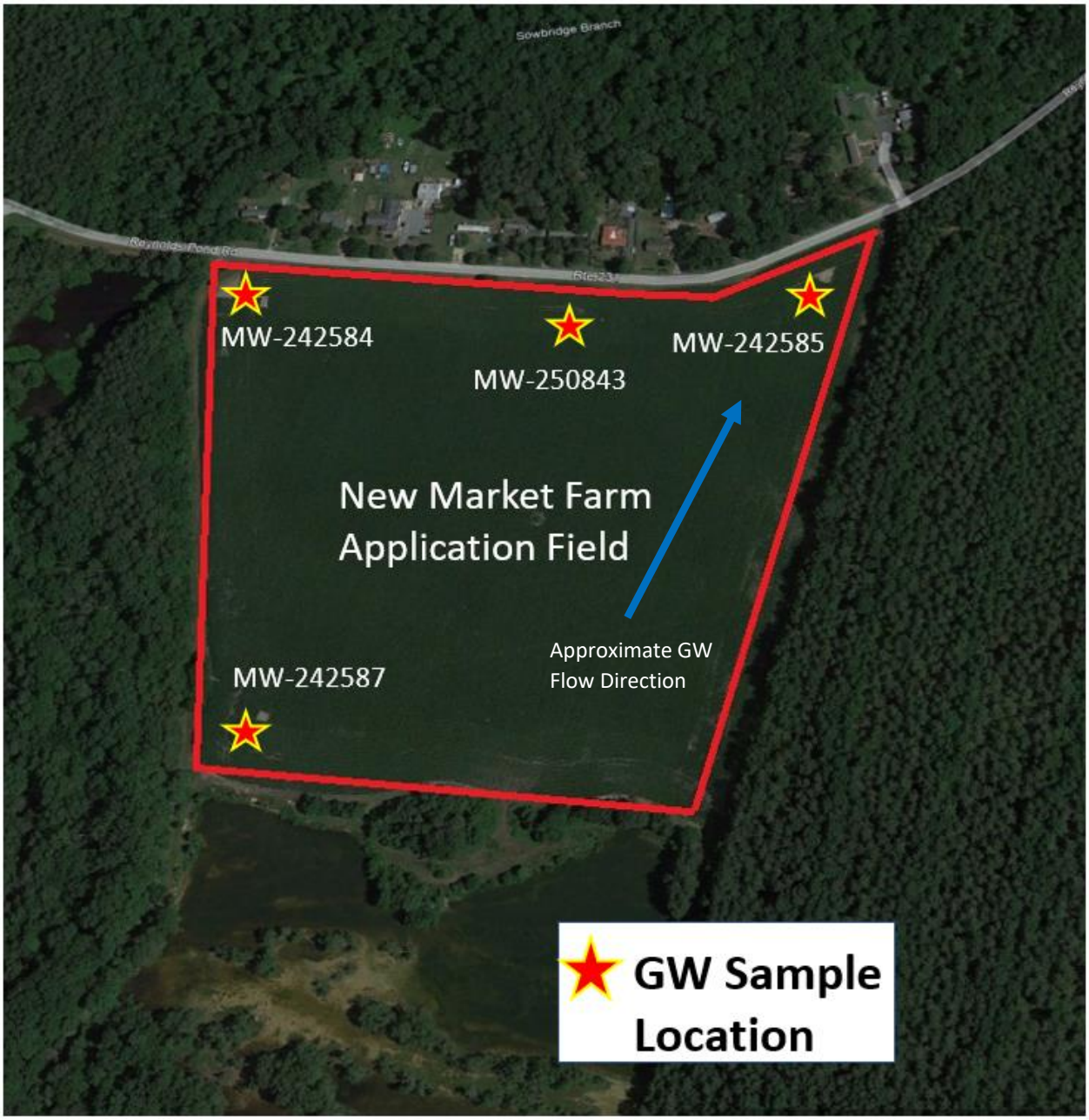


Figure 8 – Proposed sampling locations at the Clean Delaware New Market Farm

2.3.3 Clean Delaware Harbeson Farm Site Location

There are 5 active groundwater monitor wells at the facility, 4 of which are selected for groundwater sampling in this study (DNREC ID 242580, 242581, 242582, and 250844). Figure 9 shows the locations of the biosolids application fields and the selected groundwater monitor wells.

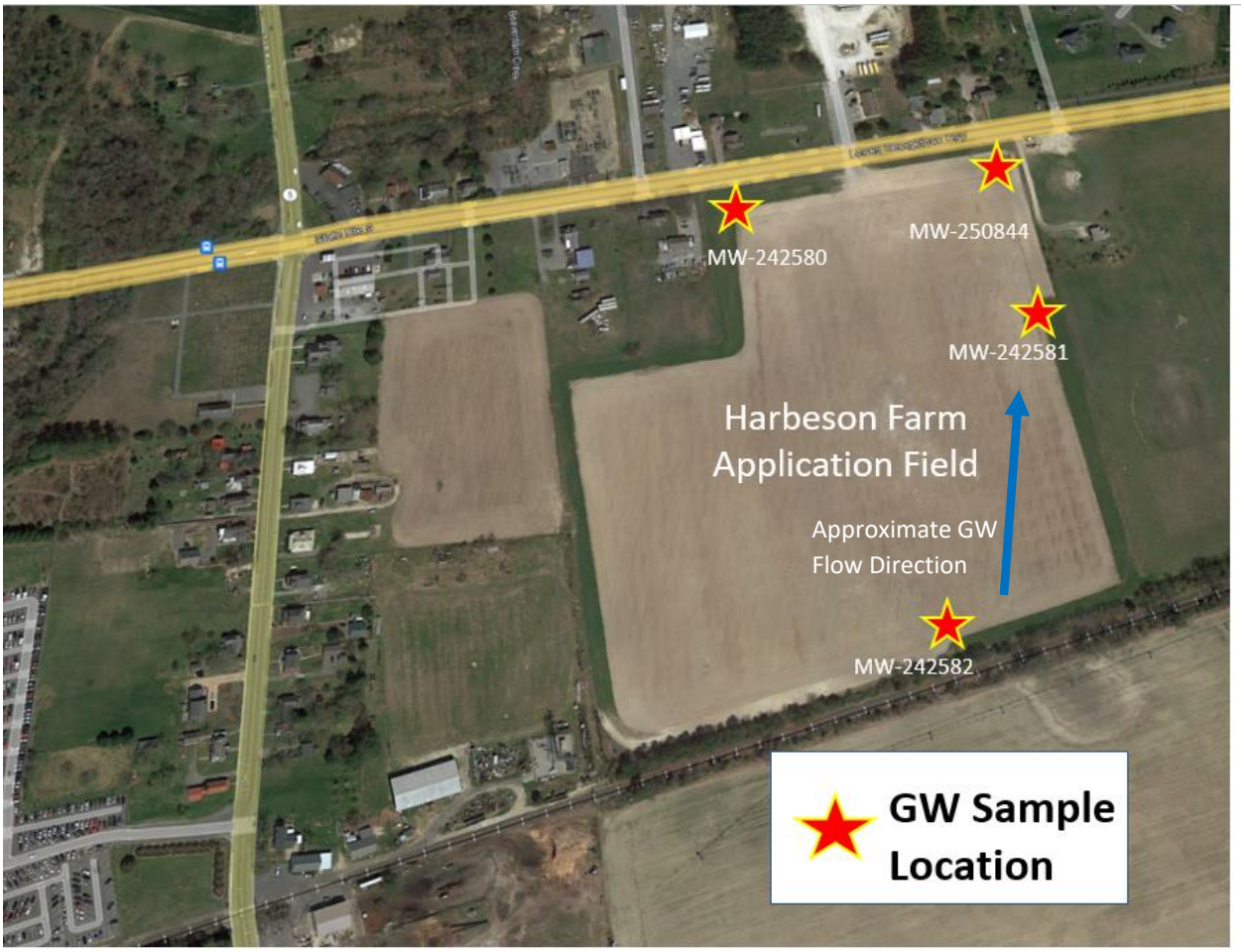


Figure 9 – Proposed sampling locations at the Clean Delaware Harbeson Farm

2.3.4 Sussex County Hettie Lingo and Tower Farm Site Locations

There are 13 active groundwater monitor wells at the Hettie Lingo farm and 4 monitor wells for the Tower Field. A total of 5 monitor wells are selected for groundwater sampling in this study (DNREC ID 86150, 283993, 238299, 238969, and 238970). Figure 10 shows the locations of the biosolids application fields and the selected groundwater monitor wells. Application of biosolids began in 1993 and ceased in 2016. In 2012, spray activities began on the north end of the site and by 2017, had transitioned to encompass the entire field. Application on the Tower field commenced in 2012 and the field continues to receive biosolids application.

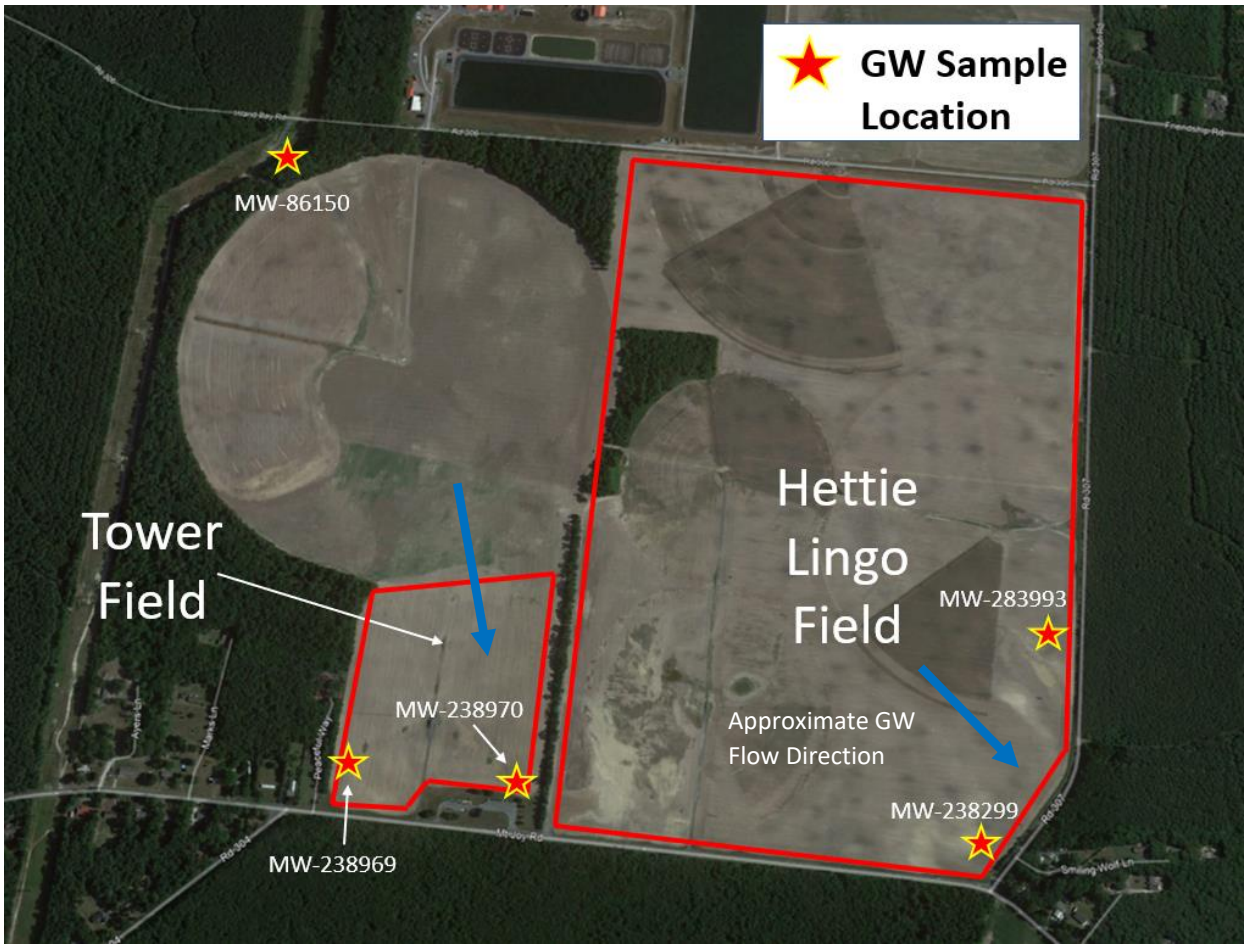


Figure 10 – Proposed sampling locations at the Sussex County Hettie Lingo and Tower Farms

2.3.5 Synagro Site, Fields 22 and 24 Facility Locations

There are 11 active groundwater monitor wells at Fields 22 and 24 (formerly field 7), 5 of which are selected for groundwater sampling in this study (DNREC ID 178258, 156323, 24003, 178315, and 156321). Figure 11 shows the locations of the application fields and the selected groundwater monitor wells. Biosolids application occurred from 1993 through 2016. The spray irrigation of Town of Georgetown began in 2009 and continues to date (during several years, portions of the fields were utilized for biosolids application and/or spray irrigation). Currently under the spray irrigation program, Field 22 is known as Fields 2 and 3 and Field 24 is known as Field 4.

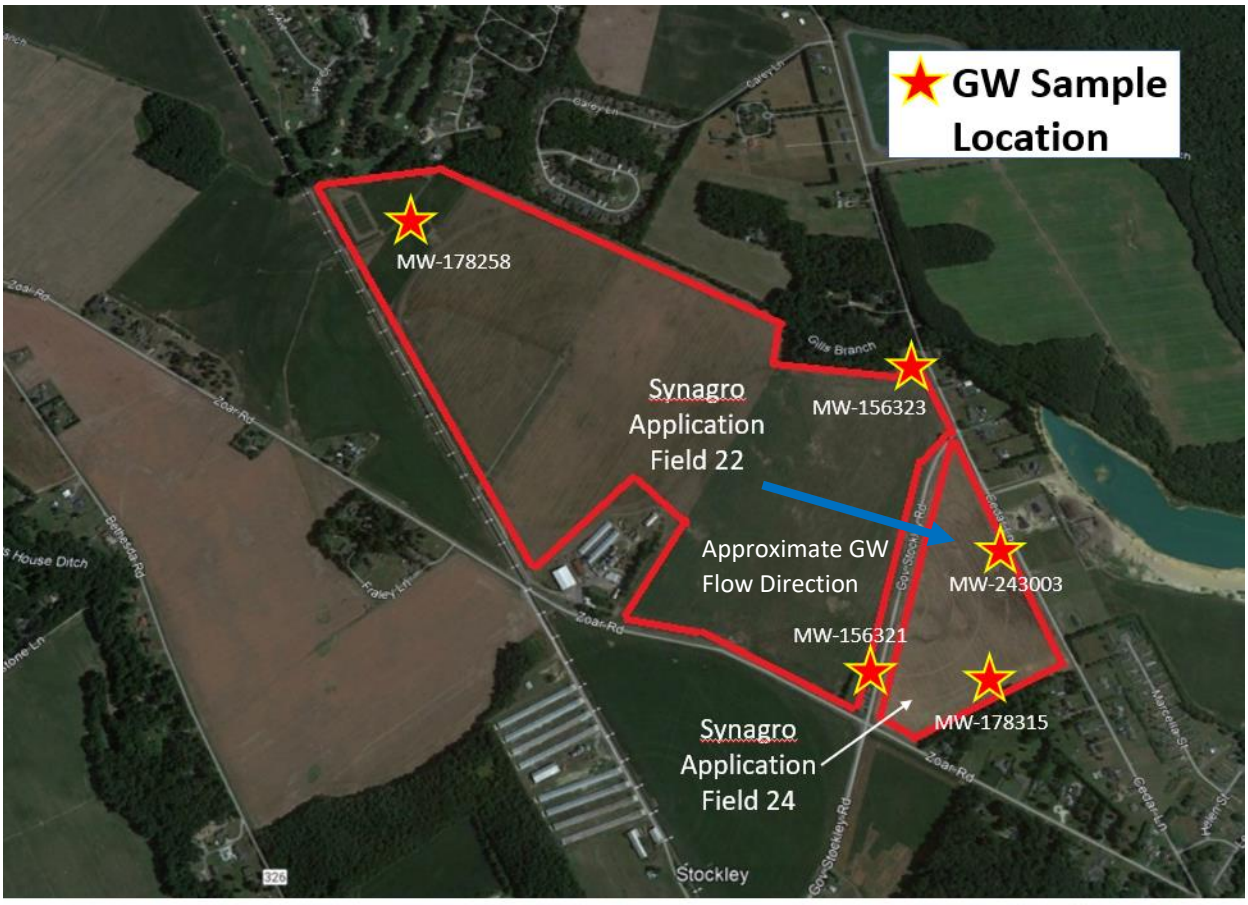


Figure 11 – Proposed sampling locations at the Synagro/Town of Georgetown Application Sites (fields 22 and 24)

3.0 QUALITY ASSURANCE AND QUALITY CONTROL

A Quality Assurance Project Plan (QAPP) will be developed for this study prior to the start of sampling. DNREC will select qualified contractor(s) and laboratory(ies) to perform sample collection and analysis. These contractors and laboratories will be required to submit Standard Operating Procedures (SOPs) and Quality Assurance and Quality Control Plans (QA/QC) to DNREC for approval prior to contracting. All samples will be analyzed using EPA Method 1633.

4.0 SAMPLING FREQUENCY AND PROJECT SCHEDULE

Groundwater from selected wells will be sampled quarterly for a year (i.e., 4 samples from each well). The total number of samples is estimated to be 110 (including 92 groundwater samples from 23 selected wells, plus blanks and duplicates).

This project design and sampling plan will be finalized in August 2024. Sampling team(s) will be selected from State certified-listed contractors in September 2024 when communication with selected facilities should also be finalized. It is anticipated that field sampling activities would begin in October 2024.

If, after the second sampling event, laboratory results from any of the selected monitoring wells confirm the existence of PFAS compounds at concentrations above EPA MCLs for drinking water or above current Delaware Hazardous Substance Cleanup Act (HSCA) screening levels (SLs) for water, domestic wells downgradient of the monitoring well(s) will be sampled for PFAS analysis. A separate project design and sampling plan will be prepared for the follow-up work.

5.0 SUMMARY

DNREC-Division of Water intents to conduct a study on PFAS in groundwater. Five Class B biosolids land applications sites were selected for this study. Samples from 23 monitor wells will be collected quarterly for one year, totaling 92 groundwater samples. With blanks and duplicates,

the total number of samples that will be collected for this study is approximately 110 samples. Field sampling activities are expected to begin in October 2024.

Reference

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