VERMONT AGENCY OF NATURAL RESOURCES

Perfluoroalkyl Substances (PFAS) Statewide Sampling Plan

JUNE 2019

VERMONT

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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INTRODUCTION

Since the discovery of PFOA contamination in Bennington in 2016, the Agency of Natural Resources (ANR) through the Department of Environmental Conservation (DEC) has undertaken a proactive, systematic investigation to identify the most likely sources of per- and polyfluoralkyl substances (PFAS) contamination and to confirm the presence or absence of contamination through site investigation and characterization.

Since 2016, knowledge about PFAS use, presence, and toxicology has expanded rapidly. Vermont has been at the forefront of this effort and has played a key role in sharing knowledge with other states and the federal government as everyone grapples with PFAS contamination.

Working with partners in state government, ANR has begun a substantial shift and expansion of its PFAS investigation and management efforts to understand the full extent of the risk posed by these ubiquitous, man-made chemicals, and regulate them to protect public health and the environment. During the 2019 legislative session, ANR worked with the Vermont General Assembly and stakeholders to advance that work through the development and passage of S.49.

Under S.49, the Secretary of Natural Resources was directed to publish a plan for public review and comment to complete a statewide investigation of potential sources of PFAS contamination. This plan is submitted to fulfill that requirement. The report also provides an update on PFAS investigations that have been completed since 2016 as reported in its July 2018 Contamination Status Report, as well as other efforts the DEC has completed in response to this emerging contamination issue.

PFAS IN VERMONT: WHAT WE KNOW

The State of Vermont is a national leader in understanding and addressing the impact of PFAS contamination. The State has conducted a series of investigations around the state and reviewed existing testing data to identify, characterize and address risks to public health and environmental contamination as quickly as possible.

To date, the State has either tested for or evaluated data in four major categories: (i) PFAS impact monitoring, (ii) PFAS industrial uses, (iii) intensive PFAS use, and (iv) PFAS in waste streams. For detailed information on past PFAS sampling, please see Appendix A.

Over forty public water systems in Vermont have been tested for PFAS along with hundreds of private wells. The sampling conducted at public water systems can be characterized in four ways: sampling done as part of the EPA's Third Unregulated Contaminant Monitoring Rule (UCMR3), targeted sampling following the identification of areas of PFAS use either due to an industrial activity or as a result of fire-fighting activities, a 2018 pilot study at 10 Vermont schools to assess vulnerability of the on-site supply from PFAS, and public water systems voluntarily sampling for PFAS. Please see Appendix A for additional information.

As part of the Saint-Gobain/Chemfab investigation in Bennington, the DEC investigated background levels of PFAS in shallow soils throughout Vermont. Results from the study showed that while there are low levels of PFAS present in surface soils throughout Vermont, the concentrations of PFOA found in this study were well below the direct contact standard of 300 ppb. In a few locations elevated background levels were identified with no known source. Additional work is needed to determine if these levels pose a risk to local drinking water supplies. The study can be found in Appendix B and online .

In February 2016 the DEC initiated an investigation into potential perfluoroalkyl substances (PFAS) contamination from two former Teflon fabric-coating facilities, operated by ChemFab, located in Bennington and North Bennington. This investigation lead to the discovery of widespread contamination in drinking water wells in the Bennington area, primarily by one PFAS compound perfluorooctanoic acid (PFOA). This initial investigation led the state to identify and investigate other potential industrial sources of PFAS, including wire coating facilities, semi-conductor manufacturers, battery manufacturers, and tanneries. Results of those investigations have directed additional site investigation and remedial actions; more information can be found in Appendix A.

In 2016 following the discovery of PFOA in Bennington, the DEC identified another PFAS compound, Perfluorooctanesulfonic acid (PFOS), as an emerging chemical of concern. PFOS is used to manufacture firefighting foam, known as Aqueous Film-Forming Foam (AFFF). The DEC investigated six locations where AFFF is known to have been used. At the Southern Vermont Airport in Clarendon, the DEC tested for 21 PFAS compounds and detected PFAS in 25 out of 77 wells. The DEC also learned that many Vermont fire departments still had stocks of PFOS-containing AFFF, so the DEC in partnership with the Department of Public Safety initiated a firefighting foam takeback program. Please see Appendix A for additional information.

PFAS IN VERMONT: WHAT WE KNOW

The DEC has also conducted sampling at waste management facilities, including the one currently operating lined landfill, closed lined landfills, and closed unlined landfills. Lined landfills have collection systems to capture the leachate produced whereas unlined landfills can directly discharge leachate to the ground and have the potential to impact groundwater. In January 2018, the presence of PFAS within lined landfill leachate was confirmed through preliminary sampling completed by the DEC. In addition, the presence of PFAS has also been confirmed in groundwater at regulated unlined landfills over the course of regular groundwater monitoring in 2018. PFAS in landfill leachate is pervasive and has been detected at significant concentrations with the potential for environmental impact.

In January 2018, the DEC investigated PFAS contamination at six municipal wastewater treatment facilities (WWTFs) that receive leachate from Vermont landfills. Results of this testing showed PFAS contamination in the part per trillion (ppt; ng/L) range in wastewater influent and effluent samples and concentrations in the part per billion (ppb; µg/kg) range for sludge samples. Complete sampling results can be found in Appendix A and the expansion of sampling to understand the extent and degree of contamination will be discussed later in the report.

TESTING METHODOLOGIES

The science, knowledge and technical capacity around PFAS continues to evolve and expand. In particular the methodologies used to detect PFAS in various environmental media other than water and the ability to detect lower and lower concentrations continue to advance. In 2016, an additional bottleneck was limited lab capacity around the country to test for the presence of PFAS compounds, but given the need in many states, capacity at the EPA and private labs has rapidly expanded.

There are currently very few multi-laboratory validated and published methods for the analysis of PFAS. EPA Method 537.1 (USEPA 2018) is the only validated, published analytical method available to analyzes for 18 PFAS analytes. However, this method is applicable to testing drinking water and groundwater.

Additional quantitative methodologies are in development, but none have received the same level of validation as the EPA Method 537.1. We anticipate that analytical testing methods for PFAS in various environmental media will continue to advance and improve in the coming years.

In the evolution of analytical methods for PFAS, there are several qualitative techniques that are available. These techniques have not been multi-laboratory validated or standardized, and each has uses and limitations.

PFAS IN VERMONT: WHAT WE KNOW

These approaches include the following:

- Absorbable Organic Fluorine (AOF) paired with Combustion Ion Chromatography (CIC) measures total organofluorine in a sample but does not differentiate between PFAS chain length
- Proton Induced Gamma-ray Emission (PIGE) Spectroscopy is a non-destructive analytical technique that measures elemental fluorine and is not specific to PFAS nor does it differentiate between PFAS chain length
- Quantitative Time of Flight mass Spectrometry (QTOF-MS) can tentatively identify PFAS structures and chemical formulas through library matching or data analysis; this methodology has been shown to yield a higher probability of false positives
- Total Oxidizable Precursor Assay (TOP Assay) which converts precursor compounds to terminal PFAS compounds to provide a total that is not indicative of environmental conditions

NEXT STEPS IN STATEWIDE SAMPLING

Since 2016, the State has been actively identifying, investigating, and managing the risks posed by PFAS contamination. This plan identifies the next steps to identify the extent of and to inform the appropriate response to PFAS contamination and its associated risks.

This work builds upon a strong and growing knowledge base within state agencies, and the sampling and investigations undertaken since 2016, which are detailed in Appendix A. This work will also continue to be adaptive to knowledge gained and evolve as we better understand the toxicology, fate, transport, and potential uses of this class of chemicals.

The Agency of Natural Resources worked with the General Assembly and various stakeholders to develop the requirements in S.49. Many of the sampling objectives laid out in this plan support and are needed to implement the regulatory requirements of S.49.

NEXT STEPS IN STATEWIDE SAMPLING

PFAS IMPACT MONITORING

Public Water Supply Sampling

Understanding impacts to Public Water Systems in Vermont is critical to fully understanding the impact PFAS is having on public health in Vermont. As part of S.49, the Agency of Natural Resources will oversee the monitoring of all Public Community Water Systems (PCWS) and all Non-Transient, Noncommunity Water Systems (NTNC) by December 1, 2019. This entails sampling at approximately 700 water systems. To assist municipally owned water systems, the State of Vermont is working to establish agreements with vendors that can be accessed by water system owners, to collect samples and conduct the analysis of PFAS concentrations at a fixed cost.

S.49 directs a specific monitoring frequency based on initial results at these facilities until such a time as the Agency of Natural Resources adopts a revised Vermont Water Supply Rule that will specify the monitoring requirements at PCWS and NTNC's. The final rule is anticipated to be adopted on or before February 1, 2020.

Next Steps: By December 1, 2019, all PCWS and NTNC systems will be required to test for PFAS

In addition, the DEC will conduct a limited pilot testing project at a public water system where samples will be collected and analyzed using different laboratory methods to evaluate PFAS that are not quantified using standard laboratory methods. The results of the different methods will be evaluated to determine the advantages and disadvantages of each method as it relates to the quantification of PFAS compounds.

Surface Water Sampling

States around the country have detected PFAS compounds in their surface waters. As part of the investigative work done in Bennington, PFAS was detected in both surface water and fish.

As part of the work obligated by S.49, the DEC will develop a surface water criteria for five PFAS compounds: PFOA, PFOS, perfluorohexane sulfonic acid (PFHxS), perfluorononanoic acid (PFNA), and perfluoroheptanoic (PFHpA)acid. Developing a surface water standard is a multi-faceted process and involves significant research, investigation, and scientific analysis. Therefore, the first step required by S.49 is to develop a plan for public review and comment about how the State will develop surface water standards by January 15, 2020.

To accomplish this effort in the most efficient and effective manner the DEC will work with other New England states to create the scientific record that will underpin a surface water standard. This collaboration will enable participating states to move forward with standards more quickly than if each conducted the research independently.

NEXT STEPS IN STATEWIDE SAMPLING

By January 1, 2024, ANR will adopt surface water quality standards that are protective of aquatic organisms and protective of human health through the consumption of fish and shellfish. This will require the development of procedures to derive bioaccumulation factor (BAF) values to develop ambient water quality criteria. The standards will take into account the following factors:

· Site specific and statewide BAF for (5) PFAS
· Ambient PFAS monitoring data
· PFAS concentrations in wastewater effluent, landfill leachate, and biosolids
· Monitoring requirements in permits

Next Steps: ANR will publish the draft plan for public comment by Jan 15, 2020, which will detail surface water, fish, and other aquatic organism testing that will be necessary to derive the surface water standard.

PFAS INDUSTRIAL USES

Building on the existing body of work around understanding the impact of PFAS in industrial uses, the State has been researching and collaborating with other states to understand potential industrial uses of PFAS. The State has identified electroplating facilities as a potential source of PFAS, and will continue to evaluate new information when available.

Electroplating
PFAS has been commonly used as a wetting agent/fume suppressant for chrome, copper, nickel and tin electroplating. Research has identified several active and historic electroplating businesses in Vermont. One of these, Eveready - St. Albans (chrome plating of flashlight parts), has already been investigated and is described in Appendix A. All identified electroplating locations have been evaluated for proximity to public and private drinking water sources, and these locations are being evaluated to determine priorities for sampling of at risk water supplies.

Next Steps: DEC will begin testing at high risk locations July-September 2019 and will conduct additional sampling as needed based on the results of the testing at the prioritized sites.

INTENSIVE PFAS USE

PFAS can be found in many different types of products and intensive use of these products over time has the potential to lead to contamination. The State has identified product use in car washes and waxes as a potential source of contamination. DEC will continue to work to identify other potential sources of commercial PFAS use in collaboration with other states and technical organizations. Once a potential source of contamination is identified, the next step is to identify the proximity of the site to public and private drinking water sources to determine the risk of contamination and prioritize next steps. Once a site is prioritized the sampling data determines the extent and degree of contamination and helps to inform a site characterization and remediation plan if needed.

NEXT STEPS IN STATEWIDE SAMPLING

Car Washes

PFAS are commonly found in car wax, making car washes a potential source of PFAS contamination. Research identified 79 car washes in Vermont. All identified locations have been evaluated for proximity to public and private drinking water sources. This screening has allowed the prioritization of sites for further evaluation based upon their risk to drinking water supplies. Testing these at high risk locations will begin during the summer of 2019.

Next Steps: DEC will begin testing at high risk locations July-September 2019 and conduct additional sampling as needed based on the results at the prioritized sites.

PFAS IN WASTE STREAMS

The DEC will conduct a more detailed investigation into the concentrations of PFAS in landfill leachate, WWTF influent and effluent, surface water and biosolids (additional detail below). This investigation will occur in two phases, and DEC expects to finalize the contract to complete the first phase work by July 1, 2019.

The first phase of the investigation will include the following testing:

- leachate samples to be collected in 8 separate sampling events from 5 lined landfills;
- influent and effluent samples to be collected in 8 separate sampling events from 6 WWTF facilities that accept landfill leachate;
- influent and effluent samples to be collected in 8 separate sampling events from 6 WWTF facilities that do not accept landfill leachate and have no known potential industrial sources of PFAS;
- influent and effluent samples to be collected in 4 separate sampling events from 11 WWTF facilities that do not accept landfill leachate and do accept waste from potential industrial sources of PFAS;
- surface water samples to be collected in 4 separate sampling events both upstream and downstream from a WWTF that accepts landfill leachate;
- Class A Biosolid samples collected in 3 separate sampling events at 3 facilities;
- Class B Biosolid samples to be collected from in 3 separate sampling events at 9 facilities; and
- sludge samples to be collected from in 3 separate sampling events at 10 facilities.

Based on the results of phase one, the DEC will prioritize investigative needs for phase two, if needed. This investigation could include the testing of industrial discharges from facilities that have a pretreatment discharge permit with the DEC.

NEXT STEPS IN STATEWIDE SAMPLING

Unlined Landfills

Eight unlined, regulated landfills have outstanding requests from DEC to test for PFAS as part of groundwater monitoring obligations at the facilities. The DEC will be following up on these requests and requiring this analysis in 2019. As necessary, enforcement of this sampling request will be pursued. As determined by the extent of any PFAS detections, an evaluation of potentially impacted water supplies will be completed at each landfill and subsequent supply wells sampling will occur as needed. This sampling will be completed by the permit holder for each of these facilities and reported to the DEC.

The seventeen regulated unlined landfills that have reported detections of PFAS above the current Vermont groundwater enforcement standard will be required to complete ongoing groundwater monitoring to assess the degree and extent of PFAS contamination at the facility. These facilities will also be required to take corrective actions if PFAS contamination has impacted drinking water wells or other sensitive receptors. The requirement for this work is being incorporated into post-closure care certifications and sampling will be completed by the permit holder and reported to the DEC. In addition, unlined landfills that have had contamination addressed under the federal Superfund program will have additional work done to assess whether or not there is any PFAS contamination.

In addition to the regulated unlined landfills, there are just as many unregulated unlined dumps – dumps that were no longer in operation on July 1, 1987, when Act 78 became effective. These unregulated dumps are located in almost every municipality in the State. Many of these dumps primarily received household waste and are not considered to be significant contributors of PFAS to the environment. An analysis of where each of these dumps is located, what sensitive receptors, such as drinking water sources exist in close proximity to these dumps and the potential for dumping of other types of waste needs to be conducted. The highest risk locations should be evaluated to determine if PFAS is being released to the environment and to inform the need to assess other similar locations.

Next Steps: By December 31, 2019, DEC will require the remaining eight unlined, regulated landfills to conduct PFAS sampling. The DEC will identify, as historic records allow, the unlined, unregulated landfills to determine potential high-risk sites for evaluation by June 30, 2020.

Lined Landfills

PFAS concentration within landfill leachate can fluctuate depending on factors such as the waste composition, waste age, and weather. The January 2018 sampling completed by the DEC at the five lined landfills in the state confirmed the presence of PFAS at concentrations that require further evaluation. As mentioned above, the DEC has developed a sampling plan which will monitoring PFAS concentrations within landfill leachate collected by the five lined landfill systems over the course of 2019. This sampling is anticipated to begin in June of 2019 and be completed by the end of the year, with approximately eight sampling events completed during that time. This should provide a more robust data set for understanding the variability of PFAS concentrations within landfill leachate and will better inform future sampling decisions.

NEXT STEPS IN STATEWIDE SAMPLING

In addition to assessing PFAS concentrations within the landfill leachate, the DEC is requiring the currently operating landfill in the State to review and evaluate wastes that are disposed within the landfill. Unlike the closed landfills, the active landfill can potentially impact the concentration of PFAS within the leachate by controlling the types and volumes of waste disposed at the facility. This work is being completed in 2019 through a condition of the October 2018 certification issued to the solid waste facility. The Permittee is being required to identify and evaluate waste streams with the potential for high concentrations of PFAS and has submitted a sampling plan for DEC review and approval. The sampling is currently underway with targeted waste streams being sludges, contaminated soils, construction and demolition debris, bulky wastes and food packaging.

Next Steps: A full report on this work, which is part of phase one of the aforementioned sampling effort, including the data, will be available for public review by November 30, 2019 and will inform additional actions by the DEC regarding the best management practices for waste types identified as a concern and additional sampling required (phase two, which will be completed by December 31, 2020).

Wastewater Treatment Facilities

Informed by the January 2018 wastewater treatment facility (WWTF) investigation of influent, effluent and sludge, the DEC is expanding evaluation of PFAS concentrations at WWTFs with additional sampling and analysis in 2019. WWTFs that accept potential materials of concern, such as landfill leachate or industrial discharge, along with those that do not accept such wastes will be evaluated throughout this process. The work is to occur in two phases. As mentioned above, throughout 2019 efforts will target the influent, effluent, sludge and biosolids of identified WWTFs, with a report on the investigation being prepared by November 15, 2019. This work will then inform the extent of the second phase, which will evaluate discharges from industrial facilities that may be contributing to PFAS loading at the WWTFs, along with a separate evaluation of PFAS concentrations within Vermont's surface waters. This work is scheduled to be completed by the end of 2020.

Next Steps: A full report on this work, which is part of phase one of the aforementioned sampling effort, including the data, will be submitted to the DEC by November 15, 2019 and will inform additional actions by the DEC regarding the best management practices for waste types identified as a concern and additional sampling required (phase two, which will be completed by December 31, 2020).

Land application sites

In addition to the testing described above for WWTF sludge, land application of biosolids sites will be evaluated to determine the presence and extent of contamination, and the proximity of locations to drinking water sources. Testing these at-risk locations will begin during the summer of 2019. In addition, land application sites with existing groundwater monitoring wells will be required to test for PFAS contamination.

Next Steps: DEC will begin testing prioritized at-risk land application sites between July-September 2019.

CONCLUSION

ANR welcomes and encourages all public comment on this draft plan. While the plan will be finalized by July 1, 2019, like any good plan, it will be reviewed and updated as needed to ensure the plan achieves the desired goals.

It is important to note that ANR will implement this testing plan as expeditiously as possible given available staff and lab capacity. Prioritization of this significant body of work will take into consideration the risk to public health and the environment from known and emerging contaminants. To complete the full body of technical and scientific work necessary to identify, locate and remediate this class of emerging contaminants will require additional or reprioritized state resources.

Additionally, S.49 places new and additional responsibilities on the regulated community (both municipal and private). Public water system owners and operators will likely need assistance with the cost of sampling and remediation costs if PFAS contamination is found.

PUBLIC COMMENT

Please submit a comment in one of the following ways prior to June 17, 2019:

- Online at the following website: https://dec.vermont.gov/commissioners-office/pfoa
- By email to Chuck Schwer at chuck.schwer@vermont.gov
- By mail to the following address:

Waste Management and Prevention Division
1 National Life Drive – Davis 1
Montpelier, VT 05620-3704

APPENDIX A: VERMONT PFAS INVESTIGATION TO DATE

The State of Vermont is a national leader in understanding and addressing the impact of PFAS contamination. The State has conducted a series of investigations around the state and reviewed existing testing data to identify, characterize and address risks to public health and environmental contamination as quickly as possible.

To date, the State has either tested for or evaluated data in four major categories: (i) PFAS impact monitoring, (ii) PFAS industrial uses, (iii) intensive PFAS use, and (iv) PFAS in waste streams. The results of that sampling work are detailed below.

PFAS IMPACT MONITORING

Public Water Supplies

UCMR 3 Data

Ten public water systems in Vermont were sampled under EPA's Third Unregulated Contaminant Monitoring Rule (UCMR 3). Groundwater sources were sampled twice per system; surface water sources (including surface water purchasing) were sampled four times per system. Samples for PFOA, PFOS, PFBS, PFHpA, PFNA, and PFHxS were collected from these systems between 2013 and 2015. All PFAS-related results under UCMR 3 were non-detect. Note that the reporting limits for this data were higher than those we have seen from recent sampling:

Contaminant	UCMR 3 Reporting Limit (ppt)
PFBS	90
PFHpA	10
PFHxS	30
PFNA	20
PFOA	20
PFOS	40

Targeted Sampling around the State

Following the identification of areas of PFAS use either due to nearby industrial activity or as a result of fire-fighting activities, targeted sampling at public drinking water systems was performed at several locations though out the state, which included Pownal, Bennington, North Bennington, Brattleboro, Pittsford, Clarendon Airport, and Cavendish.

APPENDIX A: VERMONT PFAS INVESTIGATION TO DATE

PFAS IMPACT MONITORING

A. Pownal/Bennington/North Bennington: Based on information made available pertaining to the industrial and land uses in the area, 11 public water systems in the Pownal, Bennington, North Bennington, and Shaftsbury area were sampled for PFAS (Including Williamstown Massachusetts which provides water to Pownal Fire District 3 in Vermont). Five public water systems in this area were found to have detections of PFAS compounds above the Vermont Health Advisory of 20 ppt. There were four Transient Non-Community (TNC) systems (Publyk House, Harwood Hill Motel, Sunset Playland, and Bennington LDS Church) and one community system (Pownal Fire District 2). All these systems now have treatment installed and have subsequently sampled for PFAS and there have been non-detect results in the finished water following treatment. There was other sampling performed at public water systems in these respective geographic vicinities that were non-detect for PFAS.

B. Brattleboro: Upon discovery that the local fire department used the area around the groundwater wells for training, including the use of Aqueous Film-Forming Foam, the Brattleboro completed sampling for PFAS. The wells are not the main supply source, but supplement the surface water source, however, there were no detections for PFAS in Brattleboro's wells.

C. Pittsford: Due to the proximity of the State Fire Academy and the use of Aqueous Film-Forming Foam, Pittsford-Florence Water Department was sampled for PFAS. There were no detections for PFAS in the Pittsford-Florence system.

D. Clarendon Airport: Due to the documented use of Aqueous Film-Forming Foams at the Clarendon Airport, sampling at two public water systems was performed. These systems were the Rutland Airport Business Park Association and the Clarendon Elementary School. There was one detection for PFOA at Clarendon Elementary with a concentration of 2.2 ppt, however, upon re-sampling, all results were non-detect. The Rutland Airport Business Park Association system, however, had multiple samples with detections for PFAS chemicals and did exceed the Health Advisory. Treatment was subsequently installed at the Rutland Airport Business Park Association water system.

E. Cavendish: Due its proximity to a potential source of contamination, upon permitting a new source well, the Source Permit for this system required sampling for PFOA and PFOS. The sample was non-detect for PFOA and PFOS.

APPENDIX A: VERMONT PFAS INVESTIGATION TO DATE

PFAS IMPACT MONITORING

School Pilot

In 2018 the DEC in collaboration with VDH and AOE launched a pilot to test 10 public drinking water systems operated by schools. PFAS has been identified in various cleaning products and waxes that may be used to maintain flooring in schools. A pilot study was conducted to determine if disposal of wash water on the ground surface or into an on-site septic system could cause a release of PFAS to the environment and if PFAS contamination is present in on-site drinking water supply wells at schools.

At least two rounds of sampling were performed at each school. In the first round of sampling, five of the ten schools were shown to have detections for PFAS, three at levels below the Health Advisory and two above. The second round of sampling identified seven of the schools were non-detect, with three schools with detected PFAS, only one was above the Health Advisory. A treatment system was installed at one school (the Warren School). Subsequent monitoring at this school has shown PFAS levels above the Health Advisory while finished water sampling shows that the treatment is effectively removing PFAS.

Water System Initiative Sampling

Approximately ten systems around the state voluntarily conducted PFAS sampling out of concern of the potential contamination. Of these ten, only one system that had a detection for PFAS. The only detection being Stowe Water Department with a PFOA concentration of 2 ppt.

Statewide Soil Sampling

As part of the Saint-Gobain Chemfab Bennington investigation the DEC, partnering with the University of Vermont, investigated background levels of PFAS in shallow soils throughout Vermont. A full report on this study can be found here. The University of Vermont was awarded the grant to conduct this study. A total of 66 properties throughout Vermont were sampled and analyzed for 17 targeted PFAS. The results of the testing reported PFAS concentrations in all soil samples, with total PFAS ranging from 0.54 to 35 ug/kg. At most locations PFOS and PFOA were the greatest contributor to the PFAS total. PFOS was the predominant compound detected in Vermont shallow soils and accounted for 13% to 80% of the total PFAS detected in the sample.

Results from the study showed that there are low levels of PFAS present in surface soils throughout Vermont and that there may be elevated levels of PFAS at the upper range of background in these soils with no known source for this PFAS. The concentrations of PFOA found in this study were well below the direct contact standard of 300 ppb. Additional work is needed to determine if these levels pose a risk to local drinking water supplies.

APPENDIX A: VERMONT PFAS INVESTIGATION TO DATE

PFAS INDUSTRIAL USES

Teflon Coating Fabric Facility

In February 2016 the Department of Environmental Conservation (DEC) initiated an investigation into potential perfluoroalkyl substances (PFAS) contamination from two former Teflon fabric coating facilities located in Bennington and North Bennington, and both operated by Chemfab. This investigation lead to the discovery of widespread contamination in drinking water wells, primarily by perfluorooctanoic acid (PFOA), in the Bennington area. Over 630 drinking water wells were tested, 465 wells had detections of PFOA and of these over 335 drinking water wells had detections above 20 part per trillion (ppt) (groundwater standard). Due to the extensive PFOA contamination in drinking water and groundwater in the Bennington area, DEC began an investigation into other media which may have been contaminated by PFOA including soil, surface water, sediment and fish.

To address the widespread contamination in drinking water, point-of-entry treatment (POETs) systems were installed on all wells with contamination above the 20 ppt standard. In addition, most homes have been, or will be, connected to municipal water.

In May 2019 the State of Vermont signed the second of two consent decrees with St. Gobain to treat or connect to all affected residents to municipal water systems. Homes not connected to municipal water, including those with point-of-entry treatment systems will continue to be monitored until there is no long term risk to public health. In addition, the two former St. Gobain facilities are being tested to determine if the buildings require additional remediation.

Wire Coating Facilities

Shortly after the discovery of the contamination in Bennington, the Warren Wire facility, a former wire coating facility in Pownal, was investigated for PFAS contamination. Warren Wire had two facilities located in Pownal Village and Pownal Center. As part of the investigation, DEC sampled over 150 drinking water wells for PFAS.

A large-scale Granulated Activated Carbon (GAC) treatment system was installed on the public water supply well to remove the PFAS contamination, while private wells received POETs. Additional site investigation and monitoring in Pownal is ongoing, which includes collecting soil, groundwater and surface water samples. These samples will provide information needed to define the degree and extent of PFAS, the best remedy for impacted water supplies and other sensitive receptors and to confirm the source(s) of PFAS.

<u>Additional Wire coating operations</u>

Following the discovery of contamination at the former Warren Wire facilities, the DEC evaluated additional wire coating facilities throughout Vermont. These facilities included:

1. Phoenix Wire facility (South Hero)
2. Champlain Cable facility (Colchester)
3. Harbour Industries facilities (Shelburne and Colchester)
4. Supertemp facilities (South Burlington and Winooski)
5. Belden Wire & Cable facilities (Essex and Williston.)

APPENDIX A: VERMONT PFAS INVESTIGATION TO DATE

PFAS INDUSTRIAL USES

The evaluation of these wire coating facilities included identifying water supply wells in close proximity to the facility and sampling water supply wells located within a one-mile radius around the facility. No drinking water supplies were identified near Belden Wire (Williston) and Harbour Industries (Colchester). EPA Region 1's Site Assessment program helped with the collection and analysis of samples at the three remaining facilities. PFAS contamination was not discovered in any of the water supplies tested. The Champlain Cable property and the former Harbour Industries property (Shelburne) had elevated levels of PFAS contamination in groundwater onsite. These facilities are required to conduct further investigations and long term monitoring to ensure that public health and the environment is protected.

All known wire-coating facilities in Vermont have been investigated.

Semi-Conductor Facility

The DEC requested an investigation for PFAS contamination at the Global Foundries (formerly IBM) facility in Essex Junction. The investigation identified elevated levels of PFAS contamination in groundwater. The groundwater contamination is contained on site via pump and treat and the PFAS in water is removed before it is discharged to the Winooski River. No PFAS was detected in any of the drinking water wells sampled within a one-mile radius of the facility.

This facility is conducting long term groundwater monitoring to ensure that public health and the environment is protected.

Battery Manufacturing

The DEC requested that the Eveready Battery manufacturing facility in Bennington and the former flashlight manufacturing facility in St Albans investigate these locations to determine if PFAS contamination was present from their operations. Sampling at the Bennington facility identified low levels of PFAS in groundwater around the facility, but most of this PFAS could be attributable to the former Chemfab facility. Low levels of various PFAS were detected in several existing monitoring wells located at the former Eveready facility in St Albans. Concentrations were all below groundwater enforcement standards except in one monitoring well. Long term groundwater monitoring is being conducted at the St. Alban's facility. This monitoring has demonstrated the PFAS from the Eveready Battery facility is not moving offsite in groundwater from this location.

Tanneries

PFAS use has been associated with certain processes formerly utilized at Tanneries. Drinking water wells and groundwater monitoring wells located near the former Pownal Tannery Superfund Site were sampled for PFAS. Several drinking water wells were identified to be impacted by PFAS above the standard. POETS were installed at these locations. Groundwater monitoring wells associated with the Tannery also indicated elevated concentrations of PFAS in groundwater. Leachate from the Pownal Tannery Landfill also had elevated levels of PFAS detected.

The DEC and EPA are continuing to investigate the degree and extent of impacts from PFAS and identify potential solutions to remediate or mitigate impacts.

APPENDIX A: VERMONT PFAS INVESTIGATION TO DATE

INTENSIVE PFAS USE

Firefighting Foam Release

The DEC investigated several locations where Class B Aqueous Film-Forming Foam (AFFF) was used. AFFF is used for emergency response and training and most of this foam contains PFAS. The DEC sampled six locations where AFFF was used:

1. Air National Guard facility (South Burlington)
2. Camp Ethan Allen Training Site (Jericho/Underhill)
3. Vermont Fire Training Academy (Pittsford)
4. Southern Vermont Airport (Clarendon), and
5. Vehicle accidents where AFFF foam was used to extinguish or protect against a chemical fire:
    - Gasoline tank truck accident in Bethel; and
    - Truck fire in Rockingham.

PFAS was detected in a water supply well at the Air National Guard site at concentrations above groundwater standards in a groundwater recovery trench and in a private well used primarily for agricultural purposes. In response, a GAC water treatment system was installed on the agricultural well to remove the PFAS contamination. Additional site investigation is planned for 2019.

PFAS was detected in a water supply well at the Camp Ethan Allen Training Site, above standards. At this time, this water supply is not being used for drinking. No PFAS was found in drinking water supplies within one mile of the Vermont Fire Training Academy, though some PFAS has been found in an onsite training water recycling underground tank. Additional site investigation is planned for these two locations in 2019.

At the Southern Vermont Airport in Clarendon, six private residential water supply wells and a public drinking water system serving the Rutland Business Park had concentrations of PFAS above s standards. In response, GAC water treatment system was installed on the public drinking water system and POETS were installed on the private wells. To date, 77 bedrock supply wells at and around the Airport have been sampled for PFAS. PFAS was detected in 25 wells. The Agency of Transportation, owner of the Airport, is continuing to operate and maintain the treatment systems and sample impacted and threatened supply wells. DEC has been working closely with VTrans to plan and complete surface water and sediment sampling and an expanded site investigation. Additionally, the Office of the State Geologist was brought in to complete a study of the bedrock hydrogeology.

AFFF Takeback Program

The DEC worked with the Division of Fire Safety to survey all fire departments in Vermont that may have used or store(ed) PFAS-containing AFFF (Class B). 89 fire departments responded to the survey with 29 departments responding that they have Class B AFFF in storage, with some of the AFFF being more than 20 years old. The survey identified a clear need for the disposal of Class B AFFF.

APPENDIX A: VERMONT PFAS INVESTIGATION TO DATE

INTENSIVE PFAS USE

In the Fall of 2018, the DEC initiated the AFFF Takeback Program. A total of 10.24 tons (approximately 2,150 gallons) of AFFF concentrate was collected from 38 municipal and city Fire Departments throughout the State. Many of the containers collected were in poor condition and some fire departments had pumper trucks filled with legacy AFFF formulations, in service and ready for use for their next Class B fire. Fire departments provided positive feedback for the takeback program as they did not want to cause environmental damages in their communities as a result of responding to emergencies.

PFAS IN WASTE STREAMS

Landfills

Since landfills serve as the repository for the wide variety of industrial and commercial products that contain PFAS, the DEC required testing of these facilities. The fate of PFAS within a landfill is controlled by the biological and abiotic processes that occur with time and which may release PFAS from the waste and into the leachate. As such both historic (closed) and current (active) landfills can serve as a potential source of PFAS to the environment. In Vermont there are three categories of landfills that require investigation to determine the extent and variability of PFAS contamination: regulated unlined landfills, regulated lined landfills and pre-regulatory unlined landfills (often called dumps). Unlined landfills have no leachate collection system and as such PFAS containing leachate may be discharged to groundwater. Lined landfills collect leachate and, in Vermont, dispose of that leachate at wastewater treatment facilities.

The presence of PFAS within landfill leachate was confirmed through preliminary lined landfill sampling completed by the DEC in January 2018. The presence of PFAS has also been confirmed in groundwater at regulated unlined landfills over the course of their regular groundwater monitoring programs in 2018. PFAS in landfill leachate is pervasive and has been detected at significant concentrations with the potential for environmental impact.

	Landfills with PFAS Groundwater Contamination	Lined Landfill Leachate
# of landfills sampled	31	5
% with detections	87%	100%
% with exceedances of current standard	54%	No current standard
Sum of 5 VT currently regulated PFAS (min-max; ppt)	N.D – 3,091	143-5,410

APPENDIX A: VERMONT PFAS INVESTIGATION TO DATE

PFAS IN WASTE STREAMS

Each regulated unlined landfill with a positive PFAS detection was evaluated for potential impact to nearby drinking water wells. Ten unlined landfills were identified with the potential for water supply impacts; however, the detection of PFAS above the health advisory was identified from only one landfill (Shaftsbury Landfill); which resulted in the installation of two POETs.

Vermont has five lined landfill systems, including the currently operating New England Waste Services of Vermont landfill in Coventry. These lined landfills actively collect leachate for transportation and disposal at wastewater treatment facilities (WWTF) and as such can contribute to the PFAS loading associated with a WWTFs discharges. The January 2018 sampling analyzed leachate from each of these five landfills and identified PFAS in all samples. A full report on this lined landfill sampling can be found here. The DEC established recommended guideline concentrations for two PFAS compounds, PFOA and PFOS, within landfill leachate. These concentrations were 120,000 ppt for PFOA and 1,000 ppt for PFOS. These guideline concentrations were developed to ensure that receiving waters of WWTFs permitted to receive landfill leachate would not exceed Minnesota's surface water criteria (standards), as Vermont has no such standard currently.

No lined landfill samples taken exceeded these guideline values.

Wastewater Treatment Facilities

In January 2018, the DEC investigated PFAS contamination at six municipal wastewater treatment facilities (WWTFs) that receive leachate from Vermont landfills. These WWTFs included Randolph, Barre, South Burlington-Airport Parkway (AP), Burlington-Main, Newport and Montpelier. Samples of wastewater influent, effluent, and sludge were collected and analyzed using available methods see PFAS in Vermont: What We Know; Testing Methodologies) Results of this testing showed PFAS contamination in the part per trillion (ppt, ng/L) range in wastewater influent and effluent samples (presented in Table 2a) and concentrations in the part per billion (ppb; µg/kg) range for sludge samples (presented in Table 2b).

Table 2a presents the minimum, maximum and average concentrations of five PFAS compounds in wastewater influent and effluent samples. A comparison of influent to effluent sample concentrations of five PFAS compounds within the same WWTF showed a lack of consistent trends. Research has shown that there are many parameters affecting the formation and transformation of PFAS during wastewater treatment. Situations where effluent concentrations of some PFAS were higher than the influent, and situations where effluent concentrations of some PFAS were lower than influent were observed. Additional evaluation is needed to better understand how various wastewater treatment system processes affect PFAS behavior in WWTFs.

APPENDIX A: VERMONT PFAS INVESTIGATION TO DATE

PFAS IN WASTE STREAMS

Table 2a. PFAS compounds (ng/L) measured in wastewater treatment facility influent and effluent

	Influent			*Effluent*		
Compound	*Min*	*Max*	***Average***	*Min*	*Max*	***Average***
PFHpA	< 3.33	33.8	**8.4**	1.66	52.5	**13.7**
PFOA	< 3.33	93.9	**19.4**	3.14	50.6	**22.4**
PFNA	< 0.666	5.91	**1.9**	0.357	9.07	**2.8**
PFHxS	< 3.33	11.7	**4.8**	1.09	7.55	**3.7**
PFOS	< 2.66	16.0	**6.7**	1.18	9.83	**3.9**

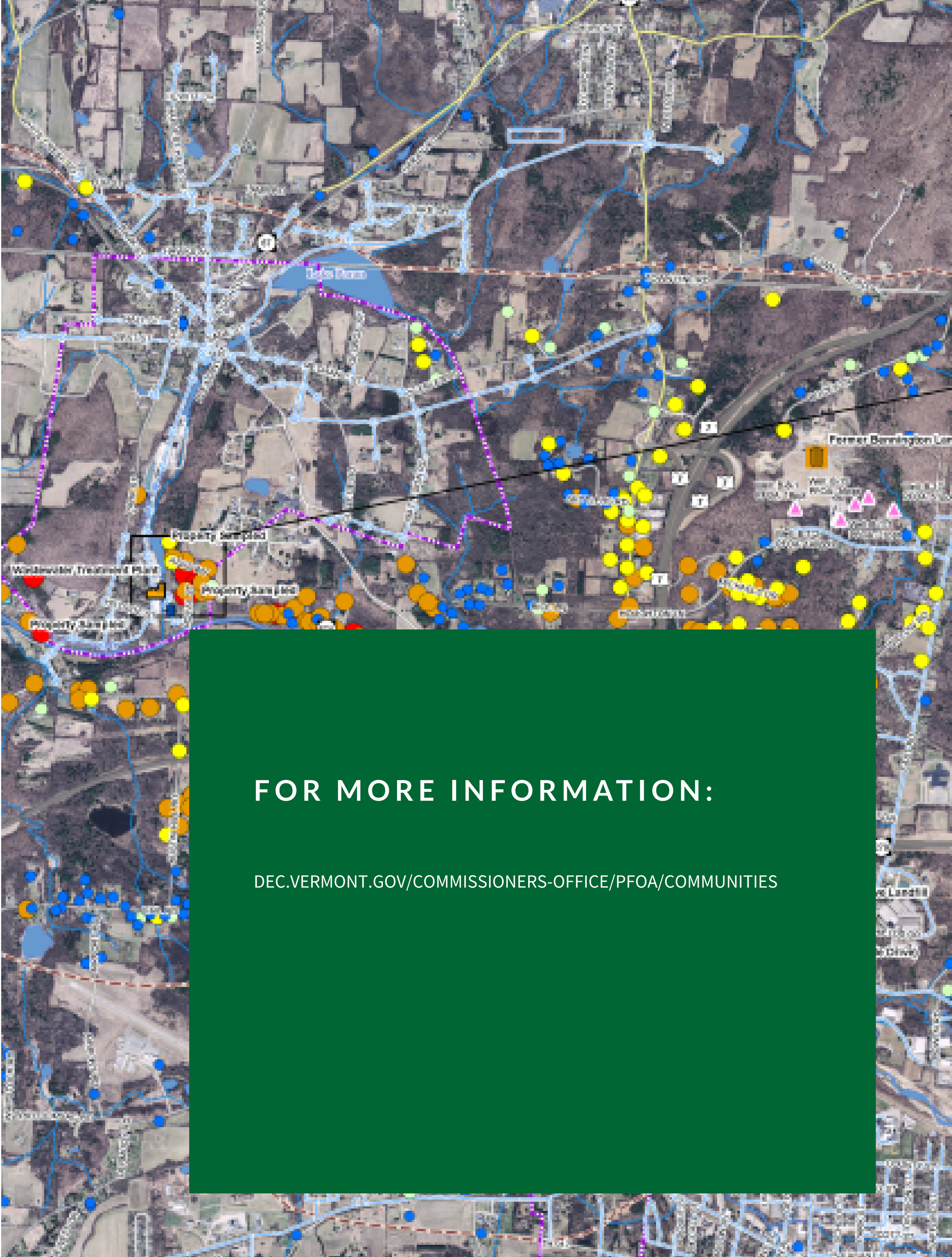
Tables 2b and 2c presents analysis results of five PFAS compounds in sludge samples collected at the same six WWTPs. Results showed average concentrations for PFHpA, PFOA, PFNA, PFHxS and PFOS in the low part per billion range, at 0.854, 4.33, 2.12, 0.680 and 8.01 mg/kg, respectively. PFOA and PFOS were found in the highest concentrations, with the greatest concentration of PFOA and PFOS detected in sludge samples from the Randolph (13.1 ppb) the South Burlington-AP (15.8 ppb) WWTFs. Sludge samples from the South Burlington-AP and Burlington Main WWTFs were also subjected to a synthetic precipitation leaching procedure (SPLP), a laboratory method that simulates the natural leaching process that occurs to materials on or in the ground as a result of precipitation and is used to determine the potential a material left on the ground has to impact groundwater. Although data is limited, results indicate that greater concentrations of PFAS in sludge correlates to greater concentrations in sludge leachate.

Table 2b. PFAS compounds (mg/kg) measured in WWTF sludges

Compound	*Randolph*	*Barre*	*South Burlington AP*	*Burlington Main*	*Newport*	*Montpelier*
PFHpA	1.03	< 0.345	< 0.359	2.04	0.929	0.423
PFOA	13.1	2.99	1.05	0.671	5.24	3.16
PFNA	2.92	1.91	1.26	1.71	3.64	1.20
PFHxS	0.744	< 0.396	< 1.25	< 0.637	< 0.603	< 0.941
PFOS	5.56	8.50	15.8	6.02	7.23	6.85

Table 2b. PFAS compounds measured in WWTF sludges (ppb) and sludge leachate (ppt)

Compound	*South Burlington AP Sludge (ppb)*	*South Burlington AP SPLP (ppt)*	*Burlington Main Sludge (ppb)*	*Burlington Main SPLP (ppt)*
PFHpA	< 0.359	< 1.99	2.04	< 4.06
PFOA	1.05	5.77	0.671	4.25
PFNA	1.26	5.23	1.71	3.96
PFHxS	< 1.25	< 2.17	< 0.637	< 4.06
PFOS	15.8	31.6	6.02	3.34



FOR MORE INFORMATION:

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