REPORT
JANUARY 2025

Mattabassett WPCF Odor Evaluation

Prepared for:

THE MATTABASSETT DISTRICT

MATTABASSETT DISTRICT

CDM Smith

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Executive Summary

This report summarizes the findings and recommendations from the odor assessment conducted by CDM Smith for the Mattabassett District Water Pollution Control Facility (WPCF). Despite the robust existing odor control system that includes several odor control units, the facility has been receiving odor complaints from nearby residents, presumably related to its operation. This assessment included air sampling, hydrogen sulfide (H_2S) monitoring, offsite odor investigations, an airflow survey, liquid sampling, and preliminary odor dispersion calculations.

Major results from the sampling are summarized in the following:

- The existing carbon unit at the centrate pump station seems to be undersized allowing odors to build up at the headspace of the process unit. A particular odor was detected at the related odor control unit outlet and mostly related to insufficient capacity of removal of the carbon media wet well during the visit.
- A continuous air flow leak identified at the biotrickling filter's (BTF) nutrients tank unit at the inlet odor control duct could pose a significant source of fugitive emissions from the sludge storage tanks headspace.
- High H_2S levels were detected during the monitoring period at the Middletown Inlet Box, which were not reflected by the existing monitoring station.
- The wet scrubber OC unit associated with the sludge dewatering process showed severe signs of deterioration and chemical leakage.
- Additional ventilation and make-up air provisions are recommended for the detritor unit processes to ensure adequate airflow in worker-accessible spaces per NFPA standards.
- Moderate to minor issues with the odor control airflow balance on several units were identified during the airflow survey.
- The offsite sampling found few instances of nuisance odors in the surrounding neighborhood, though it can be difficult to quantify fugitive odor events without constant monitoring.
- Some portions of the sewer pipe along South Street presented slopes of less than the recommended standards according to Cromwell, CT city records.

Below is a summary of the main conclusions and recommendations based on the sampling and analysis data to better address and mitigate current odor nuisances:

- Upgrade the existing carbon unit at the centrate pump station with a larger unit and confirm that the carbon media is effective for the specific odorants at that location.
- Repair or replace the BTF at the sludge storage building, ensuring that the existing nutrient tanks are sealed tightly to prevent air leaks, particularly at the existing black sump.
- Evaluate the effectiveness of the upstream calcium nitrate dosage dynamics applied to Middletown's pump station before reaching the inlet box. Install a vapor phase odor control

system at the Middletown Inlet Box to serve as an additional barrier against odor peak concentrations. Repair or replace existing H_2S sensor to accurately measure gas levels at the inlet box.

- Replace the existing 3,000 CFM BTF OC unit associated with the sludge dewatering process. The new unit will be an upgraded replacement for the existing wet scrubber unit, which shows signs of severe deterioration.
- Provide approximately 7,000 CFM of standalone odor control ventilation system and associated work for workers' accessible to Detritor No.2.
- Conduct a thorough Test, Adjust, and Balance (T.A.B) procedure to provide optimal performance of the existing odor control infrastructure. Although an airflow survey was completed as part of this assessment, the previous T.A.B was performed in 2014, and significant changes may have occurred since then.
- Consider developing a thorough dispersion model using the data from the offsite odor sampling to better understand odor dispersion in the area.
- Investigate the sewer on South Street to review if it has a steep enough slope per the record drawings, maintaining an adequate flow rate to prevent backups that could cause odors in the neighborhood.

1.0 Introduction

The Mattabassett District Water Pollution Control Facility (WPCF), located at 245 Main St, Cromwell, CT 06416, processes wastewater from New Britain, Berlin, Cromwell, Middletown, Newington, Rocky Hill, and Farmington, and discharges clean water into the nearby Connecticut River. In operation since 1968, the Facility treats on average 20 to 30 million gallons per day. The facility consists of administration, laboratory & maintenance, dewatering, and incinerator buildings and the following unit processes: pump station, detritors, primary clarifiers, aeration tanks, secondary clarifiers, biosolids storage, and ash lagoons. See **Figure 1.1** for an aerial photograph.

The WPCF frequently receives odor complaints from a location approximately 2,000 feet from the northern fence line of the plant, primarily reported from a few properties on South Street in Cromwell, CT. The WPCF has containment ventilation and odor treatment systems in place for its preliminary, primary, and solid processes that mainly consist of carbon adsorbers and chemical wet scrubber technologies.

A potential odor source that is not currently ventilated to any of the existing odor control units is the Middletown 12’-0” x 8’-0” inlet box located on the east side of the detritor units. However, the conveyed wastewater from this location is treated with calcium nitrate to mitigate the H_2S generation at the inlet box caused by the influent septicity.

CDM Smith was engaged to conduct vapor phase sampling and monitoring to better understand the performance of the existing odor control systems and ventilation rates. Additionally, offsite olfactory sampling, which included protocols from Section 22a-174-23 of the Regulations of Connecticut State Agencies, and an assessment of the existing odor control infrastructure at the identified locations were performed. These efforts aimed to determine if there is a correlation between the odors generated at the WPCF and the complaint locations. The findings of these investigations, along with conclusions and recommendations to better address any odor issues identified, are presented in this report.

Figure 1.1 Aerial View of the WPCF and Major Buildings/Processes

2.0 Overview of Existing Conditions

2.1 Data Review

The data review outlined in the scope for this memo included the following references:

- 2016 Wright-Pierce Record WPCF Drawings
- Previous Hydrogen Sulfide (H_2S) and Volatile Organic Compounds (VOCs) Record Information
- Existing Odor Control Systems Construction Submittals and Operation and Maintenance (O&M) Manuals
- South St., West St., Timber Hill Rd., Community Field Rd., River Rd. Sewer Record Drawings

2.2 Site Visit & Desktop Evaluation of Design Airflows

A site visit was conducted on June 21, 2024, by CDM Smith Process & HVAC team members with the assistance of the Mattabassett District Executive Director and the Operations Manager. The WPCF team identified the following locations as potential sources of odor generation, which are also presented in **Appendix A**:

- **Station No. 1.** Sludge Storage Tanks
- **Station No. 2.** Sludge Disposal Building
- **Station No. 3.** Centrate Wet Well
- **Station No. 4.** Detritor Units
- **Station No. 5.** Sludge and septage receiving area
- **Station No. 6.** Middletown inlet box connection

Using the record drawings to determine the ventilated room and process spaces and the size of the existing odor control equipment, CDM Smith performed a desktop evaluation to determine the design airflow exchange rates of the spaces of concern and compared them with the National Fire Protection (NFPA) 820 standards for protection against fire and explosion hazards specific to wastewater treatment facilities. This section presents a summary of the conditions observed during the site visit along with the associated odor control ventilation rates for the identified critical locations.

2.2.1 Station No. 1 Sludge Storage Building

Located at the north end of the plant, adjacent to the ash lagoons, this building was designed to house the WPCF sludge storage tanks and their controls. The headspace of these tanks is ventilated through two 22-inch FRP ducts that merge into a single 22-inch FRP duct connected to a 5,400 CFM two-stage odor control system, consisting of one BTF followed by a chemical wet scrubber. **Table 2.1** provides a summary of the dimensions and approximate ventilation rates of these tanks.

Table 2.1 Sludge Tank Dimensions and Estimated Ventilation Rates

Tank Diameter (FT)	Tank Headspace – full height (FT)	Area of Each Tank (FT^2)	Volume of Each Tank (FT^3)	Estimated Airflow per Tank (CFM)	Approx. ACH per Tank	Existing Unit Fan Size (CFM)
52.4	15.8	2,155	38,676	5,157	8	5,400

During the site visit, it was observed that the BTF unit was not functioning properly. The conveyed foul air leaks through small openings at the top of the recirculation tank as fugitive emissions (as circled in red on **Figure 2.1**). Essentially, the foul air is bypassing the BTF vessel and reaching the wet scrubber without undergoing biological treatment. Additionally, it was reported that that nutrients have not been added to the BTF process for a long time. Observed pH and H2S readings showed pH levels of approximately 4, indicating poor system performance, assuming the instrumentation measurements are reliable.

The second stage of the odor control system (wet scrubber) is practically handling all the odor abatement on its own. While the equipment is in functional condition, signs of wear and tear are evident as shown on **Figure 2.1**, particularly in the fiberglass reinforced plastic (FRP) material of the vessel and the supporting base. The horizontal steel beam supporting the base of the vessel shows significant corrosion due to chemical spills and exposure from the unit operation.

According to 2024 NFPA 820 standards, Table 6.2.2(a), Row 10, the the recommended ventilation rate for the holding tanks is 12 ACH to be classifed as Class I Division 2, which corresponds to nearly 8,000 CFM per tank.

Figure 2.1 Sludge Storage Tanks OCS-2131 BTF-Wet Scrubber Odor Control Unit with Signs of Corrosion on the Base of the Wet Scrubber Stage

2.2.2 Station No. 2. Sludge Disposal Building & Dewatering Process

Located south of the sludge storage building, this building was designed to house the following components:

- Basement: Fluidized bed incinerator, dewatering sludge pumps equipment, dewatering processing odor control system, and chemical (sodium hypochlorite, sodium hydroxide, and alum) and polymer storage tanks.
- First floor: Fluidized bed incinerator, control, and electrical rooms, three centrifuges, enclosed sludge collection and transfer screws, two grit classifiers, grit classifier, chemical and polymer receiving stations, and some office spaces.

The sludge disposal building, and the dewatering process have two independent odor control systems: a 3,000 CFM wet scrubber located in the basement and a 30,000 CFM single-stage radial-flow carbon unit located outdoors. The wet scrubber captures foul air generated from the headspace of the sludge mechanical equipment it through an 18-inch FRP duct header. The carbon unit handles foul air in the building space, conveyed through a 54-inch FRP main duct.

Tables 2.2 and **2.3** provide a summary of the dimensions and approximate headspace ventilation rates of the related equipment and building space. It is unclear whether the grit room ventilation equipment is conveying foul air to the wet scrubber or the carbon units since both odor control systems merge at the same grit room and mechanical equipment.

Table 2.2 Sludge Dewatering Process Dimensions and Estimated Ventilation Rates

Unit Process	Number	Height (FT)	Volume (FT^3)	Estimated Airflow per Unit (CFM)	Approx. ACH	Existing Unit Fan Size (CFM)
18’ x 5’ Centrifuge	3	2.8	765.0	153	12	N/A
10’ x 2’ Grit Classifier	3	3.2	190.0	38	12	N/A
22’ x 1 ½’ Grit Screw Conveyor	1	2.0	132.0	26	12	N/A
9.3’ x 1.5’ Sludge Collection Screw Conveyor	3	2.0	83.5	17	12	N/A
53’ x 2’ Main Conveyor #1	1	2.0	215.0	43	12	N/A
42’ x 2’ Main Conveyor #2	1	2.0	170.0	34	12	N/A
24’ x 20’ Grit Room	1	1	11,000.0	2,200	12	N/A
Totals				2,510	12	3,000

Heavy corrosion was observed on the FRP vessel of the wet scrubber odor control unit in the basement, along with sodium hydroxide and sodium hypochlorite spills on floor, posing an environmental hazard (see **Figure 2.2)**. Mattabassett staff noted that a previous inspection about a year ago also found deterioration of the media support inside the unit. The existing H_2S monitoring devices are not working. However, the ductwork that conveys foul air from the headspace of the first-floor mechanical equipment to the chemical odor control system looks to be in good condition.

Figure 2.2 Dewatered Process Wet Scrubber OCS-2121 Odor Control Unit with Major Signs of Corrosion, Prominent Deterioration of the FRP Vessel, and Chemical Spills

Table 2.3 Sludge Disposal Building Areas and Estimated Ventilation Rates

Space Area	Area (FT^2)	Height (FT)	Volume (FT^3)	Estimated (CFM)	Approx. ACH	Exist. Fan (CFM)
Basement			**165,875**			
Sludge Dewatering Room	5,950	18.0	107,450			
Sodium Hypochlorite Room	950	18.0	17,285	16,587	6	N/A
Polymer Mixing Area	820	18.0	14,740			
Misc. Chemicals Areas	1,460	18.0	26,400			
First Floor			**145,550**			
Sludge Dewatering Room	5,950	22.5	134,550	13,455	6	N/A
Grit Room[1]			11,000			
Totals				**30,042**	**6**	**30,000**

During the visit, the following areas that are vented to the external 30,000 CFM carbon unit were inspected:

First Floor

- Dewatering Room: There is a large roll-up door on the north side of the Sludge Dewatering Room that is routinely left open to mitigate how warm and humid the space gets, especially in

[1] Grit Room space ventilation is included in Table 2.2

the summer. During the site visit, the roll-up door was closed, and no odors were detected next to the door space. However, odors from the sludge handling process were noticeable in the process area. The foul air ductwork to the carbon unit features poor space coverage with no low pick-ups and only three 48” x 48” registers located at a single pickup location along a single vertical run of duct on the east side of the 5,950 sq ft space next to the grit room (**Figure 2.3**).

Figure 2.3 First Floor and Basement Room Space Foul Air Pickup Locations

The first floor of the building has inadequate ventilation and is not being cooled effectively. The existing make-up air unit AHU-5A on the roof supplies 13,250 CFM to the first-floor area, or approximately 7.5 ACH – however, the air supply ductwork is limited to one area on the west side of the space.

According to 2024 NFPA 820 standards, Table 6.2.2(a), Row 12b, the Sludge Dewatering Room can be classified as Class I Div II when it is ventilated at a minimum of 6 ACH. These spaces require fire protections measures such as portable fire extinguishers and fire alarm systems as recommended by state and local standards.

- Electrical Room: A strong amine (fishy) odor was detected in this room, suggesting inadequate air circulation or not enough positive air pressure towards the main room causing the foul air to enter the electrical room every time the door is open. There are 2 split system units, AC-4 & AC-5, providing cooling to the space.
- Grit Room: Despite having the option to ventilate this space to either the carbon or wet scrubber units in the basement, a strong offensive odor was detected during the visit. The only ventilation to this space is from a transfer grille on the west wall between the Grit Room and the Sludge Dewatering Room that is meant to supply 665 CFM. There is an exhaust register on that same wall that ties into the carbon adsorber odor control system, which is short circuiting the supply and exhaust air and likely does not create air circulation that reaches the entire room.

Basement

- The ventilation of the entire basement space to the 30,000 CFM odor control carbon unit consists of a single foul air pickup location with two 24” x 48” registers near the chemical storage area and approximately 80 ft from the main stairs, which makes it inefficient for capturing the foul air coming from the first floor on the west side of the room. The client also reported problems with fumes during chemical unloading, which is exacerbated by the lack of low exhaust pick-ups in the space. This can also cause early depletion of the carbon adsorber media that should be dedicated to mitigating odors caused by the treatment processes and not chemical fumes.
- Generator Room: It was reported that this space gets cold during the winter and the client requested that the louver on the south wall be replaced with one that is motor operated and can be opened and closed more easily. In addition, there is a transfer grille on the east wall between the Generator Room and Chemical Room which connects to the distribution duct with registers seemingly supplying airflow to the Generator Room). Without a fan pulling or pushing air through that duct, and instead relying on make-up air from the AHU-5A duct across the room, it is unlikely this transfer grille and ductwork are ventilating the generator room space.
- Just outside the Generator Room there is ductwork that once served AHU-9 but currently has an in-line fan supplying ventilation to the Generator Room from a large plenum with grating open to the outdoors. This accounts for why the space is so cold during the winter even with the other louver closed.

2.2.3 Station No. 3. Centrate Pump Station

Located outside, on the south side of the sludge disposal building, there is a wet well that receives the liquid waste from the sludge centrifuge process. The headspace of the wet well is ventilated to a 40 CFM carbon unit mounted on top of the wet well that contains a carbon adsorber media of 0.20 g/c.c. of capacity and a layer of potassium permanganate ($KMnO_4$) with a 6-inch header duct. **Table 2.2-4** provides a summary of the dimensions and approximate ventilation rates at this location.

Table 2.4 Centrate Wet Well and Estimated Ventilation Rates

Wet well Diameter (FT)	Wet well Height (FT)	Wet well Area (FT2)	Volume (FT^3)	Estimated Airflow (CFM)	Approx. ACH per Tank	Existing Unit Fan Size (CFM)
8.0	11.2	50	560	37	4	40

According to 2024 NFPA 820 standards, Table 6.2.2(a), Row 5a, the centrate wet well can be classified as Class I Div II if ventilated at a minimum of 12 ACH. However, since this space is intended to be non-worker accessible, ventilation can be provided at a lower rate (6 – 8 ACH) according to the standards.

Figure 2.3 Centrate OCS-2117 Carbon Unit

2.2.4 Station No. 4. Detritor Units

Located on the back side of the sludge dewatering room and on the west side of the Middletown inlet box, the detritor units are housed by two aluminum framed glazed buildings with translucent roof panels that are separated by a covered corridor. The room space of these units is currently ventilated though two to 16-inch FRP ducts connected to a 20-inch FRP header that conveys the foul air to a 4,500 CFM radial-flow single-stage carbon unit located at the west side of the aluminum buildings. **Table 2.5** provides a summary of the dimensions and approximate ventilation rates of these buildings.

Table 2.5 Detritor Building Areas and Estimated Ventilation Rates

Space Area	Area (FT^2)	Height (FT)	Volume (FT^3)	Estimated Airflow per Unit (CFM)	Approx. ACH	Existing Unit Fan Size (CFM)
Detritor (each)	1,850	17.8	32,760	4,370	8	4,500

According to the NFPA 2024 NFPA 820 Standards, Table 5.2.2(a), Row 5a, there is potential for ignition of flammable gases and floating Class I liquids (flash point < 37.8C or 100F) where this unit process takes place, and the space needs to be ventilated at a minimum rate of 12 ACH to maintain a Class I Division 2 area classification.

Therefore, both buildings are likely to be classified as Class I Division 1[2]. Based on the existing carbon unit, it looks like the odor control system was designed to work with one detritor room at a time. If both spaces are vented out to the odor control system, the ACH will be reduced by a half (4 ACH), which can exacerbate corrosion issues as it was observed inside the detritor buildings (**Figure 2.4.**).

Figure 2.4 Detritor Building (ventilated to the OCS-2111 Carbon Unit) with Noticeable Signs of Corrosion, likely due to H_2S.

2.2.5 Station No. 5. Sludge and Septage Receiving Area

Located north of the aeration tank gallery, these units receive external waste that is discharged using a camlock system that connects the discharge of the tanker trucks to the top of the tank. The tanks are below grade and partially covered by an aluminum structure with glass similar to the one previously described for the detritors. **Table 2.6** provides a summary of the dimensions and approximate ventilation rates of these rectangular tanks.

[2] In these environments, the presence of ignitable mixtures is considered continuous, intermittent, or periodically under normal operating conditions. Therefore, electrical equipment and wiring in these areas must be specially designed and installed to prevent ignition of the flammable substances.

This classification helps confirm safety by guiding the proper selection and installation of electrical equipment to minimize the risk of ignition in these hazardous environments.

Table 2.6 Septage/Sludge Receiving Tanks Dimensions and Estimated Ventilation Rates

Unit	Area (FT^2)	Height (FT)	Volume (FT^3)	Estimated Airflow per Unit (CFM)	Approx. ACH	Existing Unit Fan Size (CFM)
15' x 26' Tank	390	13.0	5,140	690[3]	8	14,000[4]

According to 2024 NFPA 820 standards, Table 6.2.2(a), Row 4a, the sludge and septage receiving tanks can be classified as Class I Div II when ventilated at a minimum of 12 ACH. These spaces require the fire protections measures such as hydrant protection and portable fire extinguishers as recommended by state and local standards.

Mattabassett staff reported that nuisance odors in this area fluctuate depending on truck unloading operations. The area above the tanks is open to the atmosphere and total enclosure may not feasible due to fire code regulations. Each tank is ventilated with 8-inch FRP ductwork drops connected to a 20-inch header that conveys the foul air to a 36-inch inlet ductwork into a major 14,000 CFM radial flow dual-stage carbon unit (OCS-2113) located northeast side of the office building that also serves to handle the headspace of the primary sedimentation units (See **Figure 2.5**).

[3] Estimated based on total airflow to the existing odor control unit.
[4] The existing 14,000 CFM radial-flow dual stage unit OCS-2113 carbon unit provides odor control to the combined headspaces of the sedimentation basin and the septage/sludge receiving tanks.

Figure 2.5 Septage and Sludge Receiving Station Ventilated to the OCS-2113 Carbon Unit

2.2.6 Station No. 6 Middletown Inlet Box

Located on the southeast side of the detritor building, this box receives preliminary treated wastewater conveyed via two 36-inch force mains from Middletown. The wastewater undergoes liquid phase treatment using calcium nitrate to mitigate the production of H_2S before arriving at the facility. **Table 2.7** provides a summary of the dimensions and required headspace ventilation rates of the related unit.

Table 2.7 Middletown Inlet Box Dimensions and Estimated Ventilation Rates Required

Unit Process	Number	Height (FT)	Volume (FT^3)	Estimated Airflow per Unit (CFM)	Approx. ACH	Existing Unit Fan Size (CFM)
12’ x 8’ Inlet Box	1	8	770	160	12	N/A

According to 2024 NFPA 820 standards, Table 5.2.2(a), Row 1a, the Middleton Inlet Box can be classified as Class I Div II when ventilated at a minimum of 12 ACH. These spaces require the fire protections measures such as hydrant protection and portable fire extinguishers as recommended by state and local standards.

Recorded historical data indicates that the average H_2S concentration in the headspace at this location is less than 0.4 mg/L.. It is unclear if the instruments that log this information are properly calibrated and reliable. The inlet box is protected by aluminum gas-tight floor plates. However, the wet well currently lacks provisions for a dedicated odor control unit to manage any emissions (see **Figure 2.7**).

Figure 2.7 Middletown Inlet Box (Southeast corner of the Eastern Detritor)

3.0 Sampling, Analysis, and Monitoring

Odors in domestic wastewater are usually caused by gases produced by the decomposition of organic matter or by substances added to the wastewater. Fresh wastewater has a distinctive, somewhat disagreeable odor, which is less objectionable that the odor of wastewater which has undergone anaerobic decomposition. The most characteristic odor of stale or septic wastewater is that of H_2S, which is produced by anaerobic microorganisms that reduce sulfate to sulfide.

The importance of odors at low concentrations in human terms is related primarily to the psychological stress they produce rather than to the harm they do to the body. Offensive odors can cause poor appetite for food, lowered water consumption, impaired respiration, nausea and vomiting, and mental perturbation. In extreme situations, offensive odors can lead to the deterioration of personal and community pride, interfere with human relations, discourage capital investment, lower socioeconomic status, and deter growth. Also, some odorous compounds like H_2S are toxic at elevated concentrations.

Over the years many attempts have been made to classify odors in a systematic fashion. The major categories of offensive odors and the compounds involved are listed in Table 3.1 along with the corresponding threshold values. All of these compounds may be found or may develop in domestic wastewater, depending on local conditions.

Table 3.1 Major Odorous Compounds and their Corresponding Odor Threshold Associated with Untreated Wastewater[5]

Odorous Compound	Odor Threshold (typical), ppm	Characteristic Odor
Ammonia	0.035 – 53 (1.5)	Ammoniacal, pungent
Chlorine	0.0095 – 4.7 (0.15)	Pungent, suffocating
Crotyl mercaptan	0.00003	Skunk-like
Dimethyl sulfide	0.0001 – 0.02 (0.002)	Decayed vegetables
Diphenyl sulfide	0.00005 – 0.005 (0.0004)	Unpleasant
Ethyl mercaptan	0.000009 – 0.03 (0.0002)	Decayed cabbage
Hydrogen sulfide	0.00007 – 1.4 (0.003)	Rotten eggs
Indole	0.0001 – 0.0003 (0.0001)	Fecal, nauseating
Methyl amine	0.02 – 8.7 (0.11)	Putrid, fishy
Methyl mercaptan	0.00002 – 0.04 (0.0007)	Decayed cabbage
Skatole	0.00000007 – 0.05 (0.0002)	Fecal nauseating
Sulfur dioxide	0.009 – 5.0 (0.6)	Pungent, irritating
Thiocresol	0.00006 – 0.01 (0.0002)	Skunk, rancid

Specific odorant concentrations, as shown on **Figure 3.1**, can be measured by instrumental methods and odors can be detected (measured) by sensory methods. In analytical testing, gas chromatography (GC) methods are typically used to determine the composition of a matrix of compounds of a collected sample and monitoring of individual compounds (typically H_2S and NH_3) during a specific period, while in

[5] Tchobanoglous, G., Stensel, H. D., Tsuchihashi, R., Burton, F. L., Abu-Orf, M., Bowden, G., Pfrang, W. (2014). Wastewater Engineering: Treatment and Resource Recovery. Germany p.104: McGraw-Hill Education.

sensory methods, human objects (often a panel of subjects) are exposed to odors that have been diluted with odor-free air, and the number of dilutions required to reduce an odor to its minimum detectable threshold odor concentration (MDTOC) are noted.

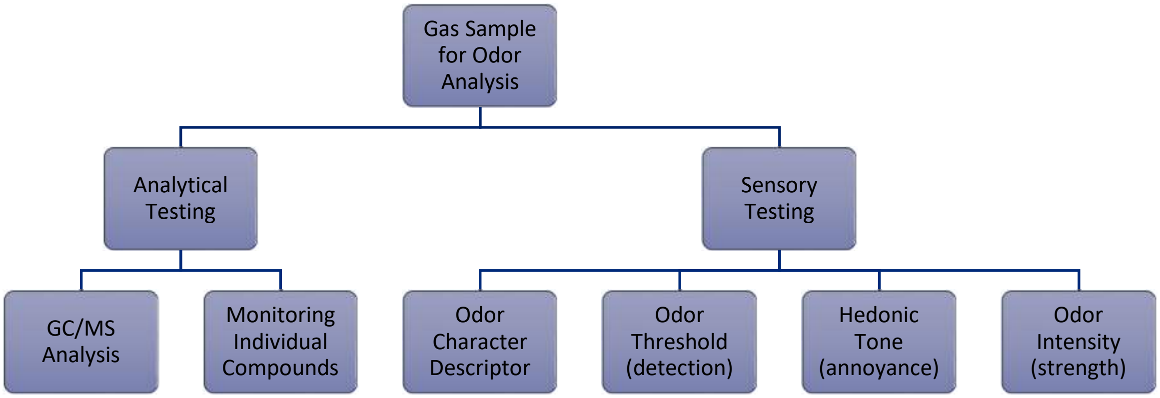

Figure 3.1 Classification of Methods Used to Detect Odors

A plan for samples taken through the WPCF and inside and outside of the plant fence line (Appendix A) was developed based on the following criteria:

- Critical locations previously identified by the client as potentially related to cause odor issues
- Site walk performed on 06/21/2024
- WPCF record drawings

Six major testing methods were developed to evaluate the performance of existing odor control systems at specified sites within the WPCF and aimed to investigate any potential correlation between systems' efficiency, plant operation, and the reported odor concerns in the surroundings areas of the plant:

1. Analytical testing for volatile organic compounds (VOCs), total reduced sulfur compounds (TRSCs), and miscellaneous wastewater compounds within the WPCF at twelve locations as indicated in the Sampling & Monitoring Schedule (Appendix A)
2. Full sensory testing for odors within the WPCF at ten different locations as indicated Sampling & Monitoring Schedule (Appendix A).
3. Olfactory field testing for odor concentration and description inside and outside the WPCF at seventeen locations as indicated in the Sensory Sampling Schedule (Appendix B).
4. Monitoring for H_2S at twelve different locations as indicated in the Sampling & Monitoring Schedule (Appendix A).
5. Airflow survey plan at six different locations within the WPCF as indicated in the Airflow Survey Plan Schedule (Appendix A).
6. Liquid phase sampling at the Middletown Inlet box.

3.1 Analytical Testing

Odors from wastewater treatment plants result from a diverse range of chemical compounds known as odorants. These odorants can include sulfur- or nitrogen-based compounds, organic acids, aldehydes, and ketones. The most common odorants in wastewater treatment plants are H_2S, reduced-sulfur organic compounds (such as mercaptans, dimethyl disulfide, and dimethyl sulfide), and to a lesser extent, nitrogen-based compounds . Additionally, VOCs play a significant role in contributing to malodorous emissions during biological waste treatment processes. These VOCs encompass various families, such as alcohols, ketones, esters, organic acids, aldehydes, aromatics, terpenes, hydrocarbons, and nitrogen-bearing compounds and could be related to industrial loads when present at high concentrations.

EPA TO-15 and ASTM D5504 are two typical methods used to determine the concentration of odorants in the headspace of wastewater treatment processes. EPA TO-15 employs gas chromatography coupled with mass spectrometry (GC-MS) to analyze VOCs in air samples collected in specially prepared canisters. This method is highly sensitive and capable of detecting a wide range of compounds at very low concentrations. ASTM D5504, on the other hand, focuses specifically on sulfur-containing compounds, using gas chromatography with a sulfur chemiluminescence detector (GC-SCD). This method is particularly useful for identifying and quantifying sulfur-based odorants such as H_2S, mercaptans, and sulfides, which are common in wastewater treatment.

For sampling collection, 1-L Tedlar® bags were filled using a vacuum chamber sampling system. The vacuum chamber contains the bag and a fitting connecting the bag to the sampling tube outside the chamber. An air sampling pump was used to evacuate the chamber causing the bag to fill. The bag was initially filled with the sample gas and then emptied. This purge step brings the Tedlar® bag inner surface into equilibrium with the sample. The bag was then filled again to collect the actual sample. The collected samples were packed and sent it to ALS Environmental, Simi Valley, CA for analysis. Following the same protocol, 10-L Tedlar® bags were used to collect air samples for formaldehyde, ammonia (NH_3), acetaldehyde, and other wastewater vapor phase compounds that are not included in EPA TO-15 and ASTM D5504 methods. These samples were sent to St Croix Sensory Inc., Stillwater, MN for analytical analysis using selected-ion flow-tube (SIFT)-MS.

The goal of this sampling was to confirm the main sources and causes of odor generation, estimate the concentration of H_2S and/or NH_3 to select the appropriate loggers sensitiveness, and assess if the most appropriate method or technology for odor control is currently being used.

Onsite sampling at the WPCF was completed in a single day on July 16, 2024. The weather was clear and the ambient temperature approximately 90^{o} Fahrenheit (F) during the time of sampling. Sampling started in the morning with a team of three CDM Smith engineers who followed the sampling plan in Appendix A and completed the sampling such that the bag/grab samples were successfully shipped out for overnight delivery to the noted laboratories for analysis; all samples were subsequently received intact. The lab results were received on July 31st and tabulated over the following month.

3.2 Sensory Testing

It has been shown that, under carefully controlled conditions, the sensory (organoleptic) measurement of odors by the human olfactory system can provide meaningful and reliable information. Therefore, the sensory method is often used to measure the odors emanating from wastewater treatment facilities.

VOCs and RSCs generated by certain wastewater treatment processes can become diluted in the environment as the plume of foul air moves away from the source and field loggers may not accurately detect the correlation between the odor source and the receiver due to their detection limits. Therefore, additional parameters such as odor detection and recognition thresholds (as specified in EN13725:2022 and ASTM E679-19), characterization, hedonic tone, intensity, persistency, and other miscellaneous wastewater vapor phase compounds can provide valuable insights into the nature of perceived odors and help establish correlations. Table 3.2. includes a detailed description of each parameter.

Table 3.2 Factors that must be Considered for the Complete Characterization of an Odor.

Factor	Description
Character	Relates to the mental associations made by the subject in sensing the odor. Determination can be quite subjective. Typical odor descriptors are listed in the last column of Table 3.1.
Detectability (Threshold)	The number of dilutions required to reduce an odor to its minimum detectable threshold odor concentration (MDTOC)
Hedonics (tone)	The relative pleasantness or unpleasantness of the odor sensed by the subject
Intensity	The perceived relative strength of the odor above the detection threshold. Usually measured by the butanol olfactometer or calculated from the D/T (dilutions to threshold ratio) when the relationship is established.
Persistency	The rate at which the odor intensity changes with concentration. Persistency can be represented as a dose response function.

Following the same protocol to sample for VOCs, RSCs, and miscellaneous wastewater compounds, samples for sensory testing were collected using the 10-L Tedlar® sample bags to determine odor control performance of the existing equipment at the locations indicated in **Appendix A**. The lab results were received on July 29th and tabulated over the following month.

3.3 Olfactory Field Testing

Field odor sampling was also performed using the Nasal Ranger™ field olfactometer rented from St. Croix Sensory Inc. (**Figure 3.1)** and a Kestrel™ weather station. CDM Smith engineers took an odor sensitivity test prior to using the Nasal Ranger to confirm that the Nasal Ranger users have standard olfactory sensitivity. The Nasal Ranger measures odor strength by comparing odorous air at various dilution levels to odorless filtered air and can be used to investigate citizen odor complaints.

Figure 3.1 Nasal Ranger Instrument (Courtesy of St. Croix Sensory, Inc.)

The user holds the instrument to their face and breathes filtered air through the mask for one minute to "zero" the nose, then turns the dial to the first dilution level of 60 D/T. The user takes two breaths at the desired inhalation rate as signified by a green light on the Nasal Ranger. The user then turns the dial one more position to the next "blank" and notes if they detected an odor at 60 D/T. If not, the dial is turned to the next position, 30 D/T, and the user takes another two breaths. This process is repeated for dial positions 15, 7, 4, and 2 D/T until the user detects an odor, at which time the dilution level is recorded. If the user detects an odor in the air without the Nasal Ranger instrument but does not detect an odor at the last dial position (2 D/T), the odor strength is recorded as "<2". If no odor is detected both with and without the Nasal Ranger, the odor is recorded as "non-detect" (ND). It is important to note that if an odor is detected at any D/T dial, the odor in that area is given as a range. For example, a 7 D/T detection means that the odors in the area is between 7 D/T and 15 D/T.

The locations selected for odor sampling were determined based on the past five years of complaint records and input from the client. The majority of public complaints were concentrated north of the WPCF extending beyond the four-lane Connecticut Route 9 expressway, within the boundaries of Timber Hill Rd., South St., Lincoln Rd., and Ranney Rd., as detailed in **Appendix A.**

At each sampling location, weather data—including temperature, wind direction, wind speed, barometric pressure, and humidity—were recorded. Additionally, odor strength readings were taken using the Nasal Ranger, and odor descriptors were noted.

3.4 Hydrogen Sulfide and Ammonia Monitoring

Once the results of the lab analyses described above were received, the correct range of Acrulog™ gas loggers were selected based on the H_2S and NH_3 results. The loggers were installed for a two-week monitoring period at the locations indicated in the Sampling & Monitoring Schedule (Appendix A). The loggers were also used to determine the performance of each odor control system. The loggers are designed to monitor real-time gas levels in harsh and hazardous environments like wastewater and mining. Loggers were directly rented from Detection Instruments Corporation and their detection levels of the selected instruments range from 2,000 ppb to 2,000 ppm and from 0 ppm to 50 ppm for H_2S and NH_3, respectively.

Figure 3.2 illustrates both a standalone Acrulog™ monitor and a Low Range Sampling System (LRSS) assembly equipped with two monitors. Monitors are typically suspended in the headspace of tanks for data logging purposes when used independently. However, in scenarios involving significant positive or negative pressure, it is recommended to employ the monitors in conjunction with an LRSS assembly. This assembly includes a sample line kit attached to a vacuum pump, enabling the monitor to continuously sample for H_2S or NH_3 sources at a fixed flow rate. With fully charged batteries, the monitor is capable of operating for up to two weeks.

Figure 3.2 Acrulog™ Standalone Monitor (left) & LRSS Assembly with Acrulog™ monitors (right).

For the LRSS assembly, a connection to an external power source is necessary. This method yields a continuous record of H_2S and NH_3 concentrations, revealing patterns over time that shed light on the behavior of these compounds, which are key indicators of odor origination. However, it is crucial to recognize that odors can stem from various sources, not limited to H_2S or NH_3. Therefore, monitoring exclusively for these substances might not provide a comprehensive understanding of the underlying causes of odor.

3.5 Additional Sampling – Section 22a-174-23 (2006)

The Regulations of Connecticut State Agencies, Section 22a-174-23 (2006), aim to determine if the emission of any related odorous compounds constitutes a nuisance that negatively impacts public health or welfare, or interferes with the enjoyment of life or property.

Performing supplemental sampling during the week of December 9, 2024, will further validate the original assessment. This process ensures that any potential odor issues are thoroughly identified and addressed, reinforcing a commitment to regulatory compliance. Additionally, it ensures the facility meets state regulatory standards and minimizes the impact on the surrounding community.

The proposed locations of the additional sampling are presented in **Figure 3.3.** and includes the following two protocols based on the Regulations of Connecticut State Agencies:

Figure 3.3 Proposed Locations for Additional Sampling per Section 22a-174-23.

Sampling Protocol No. 1: Olfactometry Sampling

- Number of locations: Three (3)
  - Two (2) along the northern property perimeter
  - One (1) along the southern perimeter near the facility main entrance
- Sampling frequency per location: Three (3) sample readings every 15 minutes within a period of 60 minutes, conducted over 2 days
- Total readings: Eighteen (18)
- Criteria for odor to be considered a nuisance: Dilution equal to or higher than 7:1 for the three samples taken
- Instrumentation: Nasal Ranger and Weather Station

Sampling Protocol No. 2: Air Sample Characterization – Table 23-1, Sec. 22a-174-23

- Number of locations: Three (3)
  - Two (2) along the northern property perimeter
  - One (1) along the southern perimeter near the facility main entrance

- Sampling frequency per location: Three (3) sample readings every 5 minutes within a period of 15 minutes, conducted over 2 days.
- Total samples to be collected: Eighteen (18)
- Criteria for odor to be considered a nuisance: 15-minute average concentrations exceeding the values provided in the table 3.3.

Table 3.3 List of Compounds and Related Limit Values per Section. 22a-174-23

Substance	Concentration Limit (ppm)	Method
Chlorine	0.024	NIOSH 6011
Ethyl acrylate	0.00037	OSHA 92
Formaldehyde	2.49	NIOSH 2016
Methyl methacrylate	0.0010	NIOSH 2537
Phenol	0.12	OSHA 32
Styrene	0.15	TO15
Toluene	11.0	TO15
Perchloroethylene	71.0	TO15
MEK	17.0	TO15
Ethyl mercaptan	0.00040	ASTM D5504
Methyl Mercaptan	0.0010	ASTM D5504
Hydrogen Sulfide	0.0045	ASTM D5504

Assumptions and considerations:

- Since the regulation for Table 23-1 does not specify the sampling frequency, three samples were collected every five minutes to determine the 15-minute average for Sampling Protocol No. 2.
- The prevailing wind direction at this time of year is generally from the northwest. Wind was monitored to attempt sampling under worst-case scenario conditions, aiming to impact the residential areas north of the WPCF, which would typically occur with winds from the south or southeast during summertime.
- Odor sampling during fall is not representative of worst-case conditions. Low temperatures can reduce microbial activity, slow decomposition rates, increase the solubility of oxygen, and consequently reduce the septicity of the wastewater.

3.6 Airflow Survey

Because the primary goals of odor control systems are to effectively manage odors produced by specific processes in wastewater treatment facilities and to provide the safe conveyance of foul air at the necessary air changes per hour (ACHs), an airflow survey inspection was also carried out. This inspection assessed the airflow and duct pressure at strategic points within the WPCF, following a site visit that highlighted the condition of the existing odor control equipment and related issues.

The evaluation included checks on fan performance, damper functionality, ductwork arrangement, and the comparison of actual versus designed airflow rates in the locations presented in **Appendix A.** The survey aimed to verify that the critical systems, identified during the site visit, are handling the expected airflow rates, thereby maintaining the design efficiency, and ensuring optimal odor control. This comprehensive approach confirms that both the sensory and mechanical components of the odor control strategy are aligned and functioning as intended.

This survey involved measuring the present operational capacity against the initial performance specifications. The findings will inform any necessary adjustments or upgrades to align the systems with their intended design efficiency, ensuring optimal odor management and environmental or occupancy compliance. Survey was performed by CFM Test & Balance Corporation, a certified TABB professional located in Bethel, CT, on August 14th, 2024.

3.7 Liquid Phase Sampling

Performing liquid phase sampling for parameters such as temperature, pH, ORP, DO, and total dissolved sulfide is a fundamental aspect of wastewater treatment monitoring. This process is critical for several reasons related to odor generation and control:

- Temperature: Influences the rate of chemical and biological reactions. Higher temperatures can accelerate microbial activity, which can increase the breakdown of organic matter and potentially reduce odors. However, it can also lead to increased volatilization of odorous compounds.
- pH: The pH level determines the water's acidity or alkalinity. A balanced pH is crucial for the survival and efficiency of microbial communities. It affects the solubility and biological availability of gases like H_2S, a primary odorant in wastewater.
- Oxidation-Reduction Potential (ORP): ORP is an indicator of the electron activity in water, reflecting the ongoing oxidation or reduction reactions. Positive ORP values suggest conditions that favor oxidation, which can help in breaking down odor-causing compounds, while negative ORP values indicate reductive conditions, potentially leading to odor generation.
- Dissolved Oxygen (DO): DO is essential for aerobic digestion of organic matter, a process that helps control odors. Maintaining adequate DO levels prevents anaerobic conditions, which can lead to the production of H_2S, a major contributor to odors in wastewater. Strategies to increase DO include aeration or the addition of oxygen-releasing compounds. Under anoxic conditions (DO levels below 0.5 mg/L), odors can be generated due to septicity.
- Total Dissolved Sulfide: Sulfides, particularly H_2S, are key contributors to wastewater odor. Monitoring sulfide concentration is vital for evaluating the potential for odor generation. Controlling sulfide concentrations through oxidation or sequestration can effectively reduce odor.
- Salinity: Salinity can influence septicity in wastewater. Higher salinity levels can affect the microbial communities in wastewater, potentially impacting the processes that lead to septicity. Values of less than 1,000 mg/L usually do not affect microbial activity related to septicity.
- Conductivity: This parameter is a measure of its ability to pass an electrical current. This ability is influenced by the presence of dissolved salts and other inorganic chemicals, which conduct

electricity. Septicity in wastewater is often associated with high conductivity, which can indicate the presence of dissolved salts and other ions. Conductivity values that suggest increasing septicity typically range from 60 to 137 mS/m.

Seasonal monitoring data is important in understanding wastewater characteristics. The inclusion of a liquid sample from the Middletown inlet box, which lacks a vapor phase odor control system, can provide information on the potential for odor generation and help identify appropriate vapor phase odor control technologies to efficiently manage any H_2S peaks, even though the influent wastewater undergoes pre-treatment with calcium nitrate.

Liquid phase data for temperature was collected at the Middletown inlet box. pH, oxidation reduction potential (ORP), dissolved oxygen (DO), and temperature were measured as a grab sample using a 556 YSI Multiprobe system. Additionally, total dissolved sulfide was measured with a LaMotte 4456 kit.

3.8 Gaussian Dispersion Equation

The Gaussian dispersion equation is a widely used mathematical approach for predicting how pollutants disperse in the atmosphere, and it is also applicable to odor dispersion modeling. It assumes that the concentration of pollutants follows a normal (Gaussian) distribution in the lateral (y) and vertical (z) directions from the source. This means that the highest concentration is at the centerline of the plume, decreasing symmetrically as you move away from the centerline as represented in **Figure 3.4**.

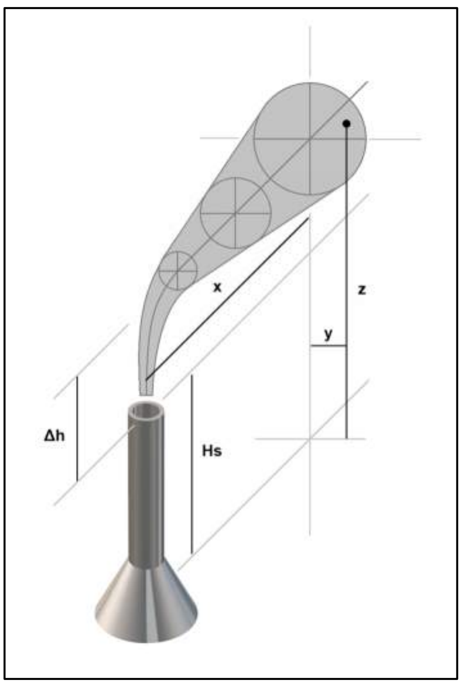

Figure 3.4 Plume Dispersion Coordinate System

The concentration (C) of the pollutant (or odor) at any point downwind from the source is given by the **Equation No.3.7.1.**

$$C(x,y,z) = \frac{Q}{2\pi\sigma_y\sigma_z u} \exp\left(-\frac{y^2}{2\sigma_y^2}\right)\left[\exp\left(-\frac{(z-H)^2}{2\sigma_z^2}\right) + \exp\left(-\frac{(z+H)^2}{2\sigma_z^2}\right)\right] - \textbf{Equation 3.7.1}.$$

Where:

- Emission Rate (Q): The amount of pollutant released per unit time.
- Wind Speed (u): The speed of the wind, which helps transport the pollutants.
- Dispersion Coefficients (σ_y and σ_z): These represent the spread of the plume in the lateral and vertical directions, respectively. They depend on atmospheric stability and distance from the source.
- Effective Stack Height (H): The height at which the pollutants are released, considering both the physical stack height and the plume rise due to thermal buoyancy.
- (x) is the distance downwind from the source.
- (y) is the lateral distance from the centerline.
- (z) is the height above ground level.

A preliminary exercise was conducted to better understand the impact of the highest concentrations of H_2S and odor sampled at the plant on two selected locations beyond the plant fence line. While **Equation 3.7.1** is useful for this purpose, it has some limitations, as listed below, that could be better addressed with a more advanced and dynamic modeling tool.

- Simplified Assumptions: Assumes steady-state conditions, uniform wind speed and direction, constant atmospheric stability, for a few data points, which may not always be realistic.
- Complex Terrain: The model may not accurately predict odor dispersion in areas with complex terrain or varying meteorological conditions.
- Variable Emissions: Odor emissions can be highly variable, making it challenging to model accurately.
- Additional variables must be taken into consideration, especially with odors such as odor threshold and human perception, which can be subjective to everyone.

4.0 Results

4.1 Analytical Testing

Measuring RSCs and VOCs is crucial for odor assessment in a wastewater treatment facility due to their significant contribution to malodors and potential health and environmental impacts. These parameters are used to provide information about the quality of the odors and whether there is a potential for industrial wastewater contribution to impact odors at the plant. Industrial compounds may not always constitute an odorant. However, they could make odor difficult to mitigate and/or require special attention. This data can also be used to support the plant if the plant emissions are ever questioned as being hazardous.

RSCs like H_2S, methyl mercaptan (CH_4S), and dimethyl sulfide are primary contributors to the unpleasant, pungent odors typically associated with wastewater treatment plants. These odors are often described as smelling like rotten eggs, cabbage, or decaying organic matter.

- H_2S: Even at low concentrations, H_2S has a very strong odor, making it a key target for odor control measures.
- CH_4S: Another potent odorant, often contributing to a garlic or rotten cabbage smell, which is noticeable at very low concentrations.

VOCs like toluene, xylene, and other organic compounds can contribute to a wide range of odors, from sweet to solvent-like to musty smells. VOCs can interact with other compounds, creating complex odor profiles that may be difficult to control without proper monitoring.

The RSCs relevant data is summarized in Table 4-2. The locations where samples were taken and the full ASTM D5504 analysis that includes results for 20 parameters are presented in **Appendix A & B**. Table 4-2 shows only the parameters that were identified in the analysis. Parameters not shown were not detected (ND). In general, RSCs have particularly low odor thresholds, with some being less than 1 part per billion (ppb). Several inlet locations to the related odor control units showed relatively high concentrations at the ppm level, which could indicate the predominance of anaerobic conditions, dead zones pockets, or long retention times. It was also noted that the CH_4S levels are moderated as identified in Table 4-1. The other RSCs remained relatively low in comparison with the two compounds previously mentioned.

Table 4.1 Sampling locations presenting high concentrations of H_2S and CH_4S.

Location	H_2S (ppm)	CH_4S (ppm)
Sta No.1. BTF-Wet Scrubber Inlet Sludge Storage Tanks	43.0	4.1
Sta No.2A. Wet Scrubber Inlet Sludge Dewatering Room	7.5	0.8
Sta No.4. Detritors	5.7	0.2
Sta No. 5. Septage Receiving 8-inch Duct	77.0	4.0
Sta No. 7 Middletown Inlet Box	18.0	0.3

Also, the moderate presence of dimethyl disulfide (DMDS) in the headspace of the sludge storage tanks may cause a strong, unpleasant odor, often described as similar to garlic or decaying vegetables. In this context, DMDS can be produced during the anaerobic digestion of organic matter, particularly from the breakdown of sulfur-containing compounds.

The VOC relevant data is summarized in Table 4-3. The full TO-15 analysis includes results for over 75 parameters is presented in **Appendix B**. Table 4-3 shows only the parameters that were identified in the analysis. Parameters not shown were not detected (ND). Relatively high levels of toluene are often found in wastewater sludge of municipal wastewater treatment plants as identified for the sludge storage and dewatering process. It can originate from various sources, including industrial discharges and household products. Also, during the anaerobic digestion process of sludge, toluene can be formed as a byproduct.

Additional odorous compounds were identified in the vapor phase of the evaluated matrices using the GC-SIFT method. Table 4-4 presents some of these compounds. However, the presence of NH_3, aldehydes, and other thiol-like compounds was found to be very low, suggesting that these substances may not significantly impact the odor composition at the facility.

Regarding the diamines, the presence of 1,5-diaminopentane, also known as cadaverine, at moderate levels in the foul air of the sludge storage tanks could triggers some odor nuisance in the proximity of these process units due to its strong and unpleasant odor. In the context of waste activated sludge, this compound can be produced during the anaerobic digestion of organic matter, particularly proteins.

The presence of 1,5-diaminopentane in sludge can indicate the breakdown of amino acids and proteins, which is a common process in wastewater treatment. This compound, along with others like putrescine (1,4-diaminobutane), contributes to the characteristic odors associated with sludge. A comprehensive list of the parameters analyzed using this method is provided in **Appendix B**.

Table 4.2 ASTM D5504 RSCs Concentrations (ppb) Measured at the Mattabassett District WPCF on 07/17/2024.

Parameter	Location	Sta No.1 Inlet	Sta No.1 Outlet	Sta No.2A Inlet	Sta No.2A Outlet	Sta No.2B Inlet	Sta No.2B Outlet	Sta No.3 Inlet	Sta No.3 Outlet	Sta No.4 Inlet	Sta No.4 Outlet	Sta No.5	Sta No.7
	Time	8:50	9:05	9:30	10:00	10:30	10:45	11:35	11:53	11:00	11:15	12:15	12:00
Hydrogen Sulfide		43000	25	7500	17	97	6.6	660	6.7	5700	11	77000	18000
Carbonyl Sulfide		22	56	12	18	ND	ND	14	21	32	ND	ND	8.8
Methyl Mercaptan		4100	8	810	10	11	ND	500	ND	230	ND	4000	330
Ethyl Mercaptan		6.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethyl Sulfide		430	ND	100	ND	ND	ND	91	120	17	ND	620	7.5
Carbon Disulfide		5.7	8.7	ND	2.9	ND	5.6	ND	3.8	4.1	ND	ND	ND
n-Propyl Mercaptan		6.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethyl Disulfide		6.2	260	4.1	ND	ND	ND	16	1800	ND	ND	ND	18
Diethyl Disulfide		ND	ND	ND	17	ND	ND	ND	ND	ND	ND	ND	ND

Table 4.3 EPA TO-15 VOC Concentrations (ppb) Measured at the Mattabassett District WPCF on 07/17/2024.

Parameter	Location	Sta No.1 Inlet	Sta No.1 Outlet	Sta No.2A Inlet	Sta No.2A Outlet	Sta No.2B Inlet	Sta No.2B Outlet	Sta No.3 Inlet	Sta No.3 Outlet	Sta No.4 Inlet	Sta No.4 Outlet	Sta No.5 Inlet	Sta No.7 Outlet
	Time	8:50	9:05	9:30	10:00	10:30	10:45	11:35	11:53	11:00	11:15	12:15	12:00
Propene		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	270
n-Heptane		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	69
Chloroform		ND	ND	ND	ND	ND	ND	ND	ND	9.4	ND	ND	ND
Toluene		3,400	4,000	460	780	12	ND	730	ND	8.2	ND	210	65
n-Octane		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	120
2-Methylpropene[6]		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	610
n-Pentane[7]		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	248

[6] 1 µg/m³ of 2-methylpropene is approximately 0.44 ppb
[7] 1 µg/m³ of n-pentane is approximately 0.34 ppb.

Parameter	Location	Sta No.1 Inlet	Sta No.1 Outlet	Sta No.2A Inlet	Sta No.2A Outlet	Sta No.2B Inlet	Sta No.2B Outlet	Sta No.3 Inlet	Sta No.3 Outlet	Sta No.4 Inlet	Sta No.4 Outlet	Sta No.5 Inlet	Sta No.7 Outlet
Cyclopropane[8]		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	128
3-Heptene[9]		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	55
Sulfur Dioxide[10]		>496	>418	ND	ND	ND	ND	>38	ND	ND	ND	>144	ND
Dimethyl Sulfide[11]		248	ND	55	ND	ND	ND	39	59	ND	ND	248	ND
Dimethyl Disulfide[12]		441	ND	36	ND	ND	ND	65	467	ND	ND	2591	ND

Table 4.4 Miscellaneous Wastewater Compounds (ppb) Measured at the Mattabassett District WPCF on 07/17/2024

Parameter	Location	Sta No.1 Inlet	Sta No.1 Outlet	Sta No.2A Inlet	Sta No.2A Outlet	Sta No.2B Inlet	Sta No.2B Outlet	Sta No.3 Inlet	Sta No.3 Outlet	Sta No.4 Inlet	Sta No.4 Outlet
	Time	8:50	9:05	9:30	10:00	10:30	10:45	11:35	11:53	11:00	11:15
1,4-diaminobutane		28	16	2	4	0	6	9	5	18	0
1,5-diaminopentane		863	134	856	707	777	818	638	378	413	378
2,3-butanedione		74	6	55	50	48	58	44	21	23	19
acetaldehyde		327	1	40	73	54	33	140	92	96	28
acetic acid		27	1	20	6	11	4	17	9	2	0
ammonia		317	0	54	46	82	67	29	6	66	18
butanal isomers		25	11	1	5	0	65	2	4	4	0
butanoic acid isomers		101	9	4	31	0	89	16	29	26	0
decanal		32	15	2	6	1	2	10	5	53	1
formaldehyde		49	13	41	49	48	42	41	55	46	33
monoterpene isomers		31	3	3	5	5	1	7	2	7	0
pentanal isomers		30	3	2	5	1	2	6	2	8	0

[8] 1 $\mu g/m^3$ of cyclopropane is approximately 0.58 ppb
[9] 1 $\mu g/m^3$ of 3-heptene is approximately 0.25 ppb
[10] 1 $\mu g/m^3$ of sulfur dioxide is approximately 0.38 ppb
[11] 1 $\mu g/m^3$ of dimethyl sulfide is approximately 0.39 ppb
[12] 1 $\mu g/m^3$ of dimethyl disulfide is approximately 0.26 ppb

4.2 Sensory Testing

The performance of five odor control units was tested on July 17, 2024. Each unit was sampled at the inlet and outlet ports to determine the removal efficiency of odors, as presented in **Table 4.5**. Most of the odor descriptors identified at each source were typical of a wastewater treatment process, consisting mainly of decay and sulfur, with the latter being more predominant. An exception was the outlet at Station 2B, which was more associated with plastics and chemical descriptors. This anomaly is consistent with an apparent blockage of the airflow through the ½-inch PVC outlet port of the 30,000 CFM carbon adsorber odor control unit.

It is important to highlight the strength of odors sampled at the foul air inlet to Station No. 1 Sludge Storage Tanks and Station No. 4 Detritors, which significantly exceeded those of other processes by 550 times and 90 times, respectively. The high odor concentrations at these locations, along with the nature of the descriptors, may indicate that these processes are subject to long retention times. This increases the septicity of the streams, consequently elevating the concentration of unpleasant odors.

Regarding odor intensity and hedonic tone, most samples exhibited a slight to moderate intensity and an unpleasant character, as anticipated. The highest intensity and worst hedonic tone values were observed in samples from Sta. 1 Sludge Storage Tanks and Sta. No. 3 Centrate, consistent with observations from other parameters. The persistency remained relatively consistent across all samples. Detailed information on results of these tests is presented in **Appendix D**.

Table 4.5 Odor Data

Station No.	Field No./Time	Sample Description	Assessors Percentage	DT	RT	I	HT	DR	Removal Efficiency
Sta. No. 1. Sludge Storage Tanks	Inlet 8:50AM	---		550,000	290,000	- - -	- - -	- - -	99.7%
	Outlet 9:05AM	Decay = 4.0	23%	1,600	820	5.8	-5.2	-3.21	
		Sulfur = 5.1	76%						
Sta No. 2A. Sludge Disposal Building (Basement)	Inlet 9:30AM	Decay = 1.4	23%	1,000	640	4.1	-3.7	-2.37	19.0%
		Sulfur = 3.4	76%						
		Plastics = 2.5	50%						
	Outlet 10:00AM	Decay = 3.4	23%	810	420	4.5	-3.3	-2.44	
		Sulfur = 3.7	76%						
		Plastics = 1.5	23%						
Sta. No. 2B. Sludge Disposal Building (Outdoors)	Inlet 10:30AM	Decay = 2.6	23%	1,100	640	4.5	-4.7	-2.68	90.0%
		Sulfur = 4.2	76%						
		Plastics = 0.6	23%						
	Outlet 10:45AM	Plastics = 1.6	76%	110	60	2.7	-0.7	-1.86	
		Chemical = 2.2	23%						

Station No.	Field No./Time	Sample Description	Assessors Percentage	DT	RT	I	HT	DR	Removal Efficiency
Sta. No. 3. Centrate PS	Inlet 11:35AM	Decay = 3.5	23%	16,000	8,700	6.4	-6.2	-2.60	69.3%
		Sulfur = 6.4	76%						
	Outlet 11:55AM	Decay = 4.9	50%	4,900	2,400	4.7	-5.2	-2.63	
		Sulfur = 4.2	76%						
Sta. No. 4. Detritors	Inlet 11:00AM	Inlet		90,000	45,000	- - -	- - -	- - -	99.6%
	Outlet 11:15AM	Sulfur	76%	340	170	2.3	-1.6	-1.63	
		Plastics	50%						

4.3 Olfactory Field Testing

The olfactometer data was collected using the Nasal Ranger at designated locations over five non-consecutive days. The field odor sampling location map is shown in **Figure 4.1**. The Nasal Ranger data is included in **Appendix E** and includes weather information as well as odor descriptors.

Figure 4.1 Nasal Ranger Sampling Locations

Samples were collected on July 31st, August 2nd, August 13th, August 14th, and August 22nd. Within the plant, regular low-level odor emissions were detected near the screenings enclosure and at the Middletown inlet box, ranging from 2 to 60 D/T. According to Mahin, T.D.,2000[13], 7 D/T is considered the threshold for nuisance odors in Connecticut. However, along the plant's fence line, odors were minimal, with the highest reading below 2 D/T.

The following figures show the results of the offsite sampling for each day, including odor strength, odor descriptors, and wind direction. All values are in Odor Units OU/m3 (D/T).

Figure 4.2A – Offsite Odor Sampling Results from 7/31/2024

[13] Mahin, T.D., Pope, R. and McGinley, M., When is a smell a nuisance? (2000) Water Environment & Technology, 12 (5) pp. 49-53.

Figure 4.2B – Offsite Odor Sampling Results from 8/2/2024

Figure 4.2C – Offsite Odor Sampling Results from 8/13/2024

Figure 4.2D – Offsite Odor Sampling Results from 8/14/2024

Figure 4.2E – Offsite Odor Sampling Results from 8/22/24

Offsite, few instances of nuisance odors were detected. Most noticeable odors in the nearby neighborhood were grassy smells from mowed lawns. The sampling location at 9 Piney Ridge Road had a musty odor on three of the sampling days, but it was below 2 OU. Other locations with unpleasant odors included the intersection of Ranney Rd and South St (musty smell <2 OU), intersection of Main St and South St (cigarette smoke and gasoline from car driving by), and the intersection of Timber Hill Rd and West Street (garbage/mulch odor). These odors were only observed on one day each and were all below 2 OU.

Due to the transient nature of nuisance odor events, it is difficult to quantify offsite odor issues since the staff taking measurements with the Nasal Ranger may not be present during the time of an odor event. This is a common challenge for treatment plants located close to residential areas where natural wastewater odors can be perceived as offensive.

4.4 Hydrogen Sulfide and Ammonia Monitoring

On August 22, 2024, equipment for logging H2S was set up and programmed to collect data over two two-week periods (August 22 to September 5 and September 5 to September 19). After these periods, a CDM Smith engineer retrieved the equipment for download and analysis. Due to the low concentrations of NH3 (< 1 ppm) measured from grabbed samples (**Table 4-4**), it was decided not to monitor this parameter since the available logger's concentration range is 0 to 50 ppm. Logged H2S concentrations are tabulated in **Table 4-6**, and **Appendix C** include the logged data charts. The logging instruments were applied according to the location ID on the sampling plan map as follows:

- Station 1: Sludge tanks (BTF and wet scrubber) concurrent inlet and outlet samples using a LRSS sampling system.
- Station 2A: Sludge disposal building basement (wet scrubber) concurrent inlet and outlet samples using a LRSS sampling system.
- Station 2B: Sludge Disposal Building carbon unit, concurrent inlet and outlet samples using a LRSS system.
- Station 3: Centrate PS odor unit, concurrent inlet and outlet samples using a LRSS system.
- Station 4: Detritor building odor unit, concurrent inlet and outlet samples using a LRSS system.
- Station 5: Sludge receiving tank and septage receiving tank
- Station 6: Fence line (north end of plant)
- Station 7: Middletown Inlet Box headspace sample

Table 4.6 Logged H2S Data Summary

Location	Average H_2S Logged (ppm)	Peak H_2S Logged (ppm)
Sta. 1 **Sludge Tanks BTF/Wet Scrubber Inlet**	41.0	86.0
Sta. 1 Sludge Tanks BTF/Wet Scrubber Outlet	0.0054	0.525
Sta. 2A Sludge Disposal Building - Wet Scrubber Inlet	6.5	18.0
Sta. 2A Sludge Disposal Building - Wet Scrubber Outlet	0.0001	0.008
Sta. 2B Sludge Disposal Building - Carbon Unit Inlet	0.21	0.77

Sta. 2B Sludge Disposal Building - Carbon Unit Outlet	0.0026	0.106
Sta. 3 Centrate PS – Carbon Unit Inlet	1.895**	2.5*
Sta. 3 Centrate PS – Carbon Unit Outlet	0.00	0.016
Sta. 4 Detritor Building – Carbon Unit Inlet	37.9	120.0
Sta. 4 Detritor Building – Carbon Unit Outlet	0.005	0.09
Sta. 5 Sludge Receiving Tank	0.07	81.0
Sta. 5 Septage Receiving Tank	0.22	180.0
Sta. 6 Fence Line	0.0005	0.073
Sta. 7 Middletown Inlet Box Headspace	139.4**	220*

*Exceeded limits of logger

**True average is higher because the H_2S concentration exceeded the instrument's limits

The following is a discussion of the results from the H_2S monitoring phase.

4.4.1 Sta. 1 Biotrickling Filter Followed by Chemical Scrubber (OCS-2134)

This location has been identified as a possible source of odors due to the non-functioning BTF and a potential leak near the inlet. The inlet sample from this location shows higher levels of H_2S for the first eleven days, followed by lower levels on the last three days. However, as the lower levels appear to show a diurnal tren similar to the previous days, it is likely this period of lower concentration is related to an operational change rather than a failure of the H_2S logger. H_2S levels are related to retention times in the sludge storage tanks, so days with shorter retention times will display lower levels of H_2S.

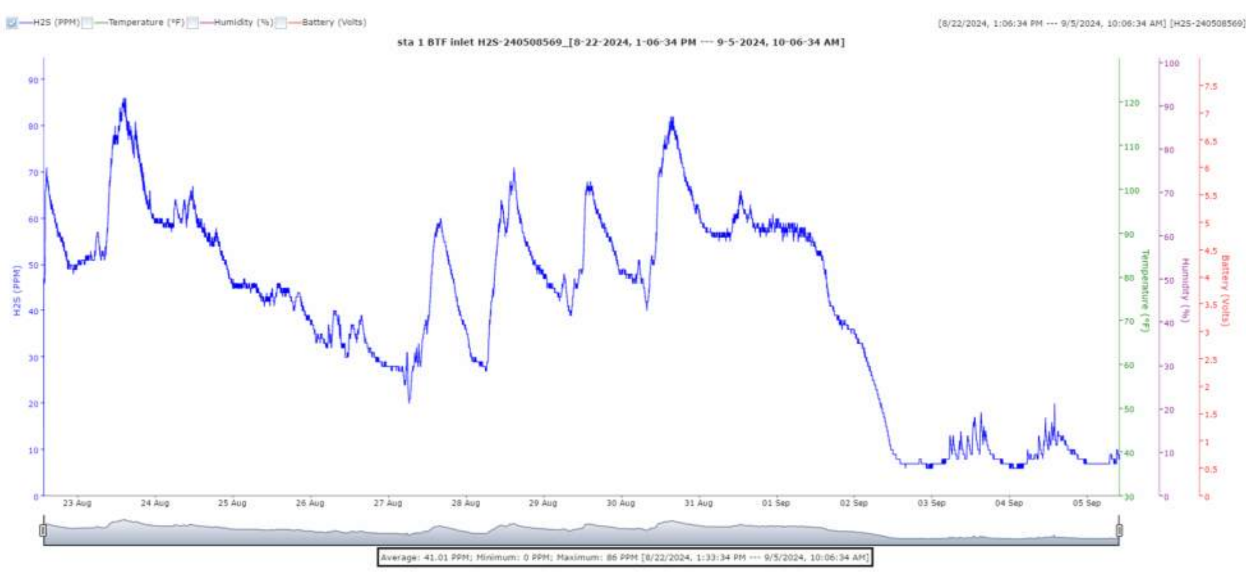

Figure 4.3 Sludge Storage Tanks – BTF Inlet H_2S Results

The outlet results show lower concentrations of H_2S with a few individual spikes up to 535 ppb, indicating that the wet scrubber is reducing some odor, but the overall odor control system is not optimized due to the non-functional BTF. The spikes in the outlet does not appear to be directly correlated to the inlet concentration and could potentially be related to the operational/chemical usages of the chemical scrubber.

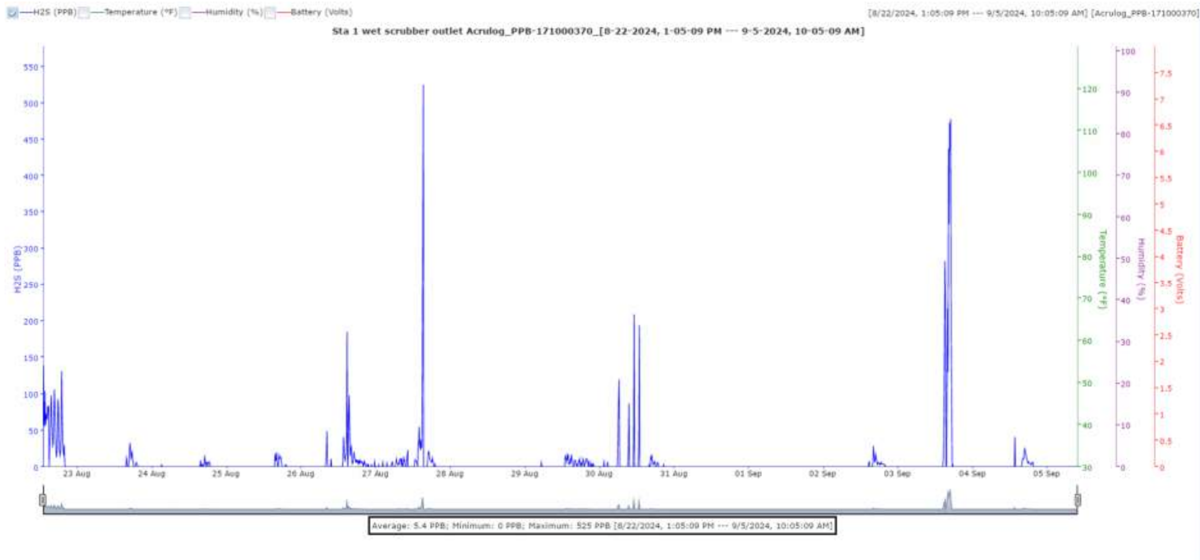

Figure 4.4 Sludge Storage Tanks – Wet Scrubber Outlet H_2S Results

4.4.2 Sta. 2A Wet Scrubber (OCS-2121)

The dewatering building basement wet scrubber had low levels of H2S at the outlet, suggesting it is functioning to control odors. However, the unit appears to be in poor condition with chemical leakage and is recommended for repair or replacement.

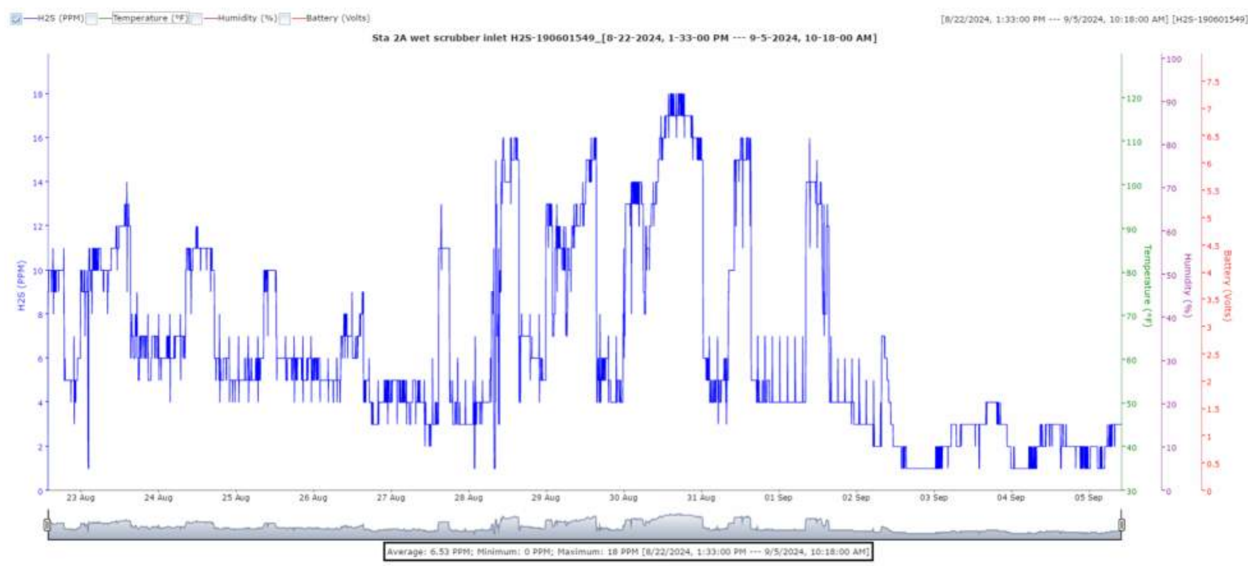

Figure 4.5 Dewatering Building Basement Wet Scrubber Inlet H2S Results

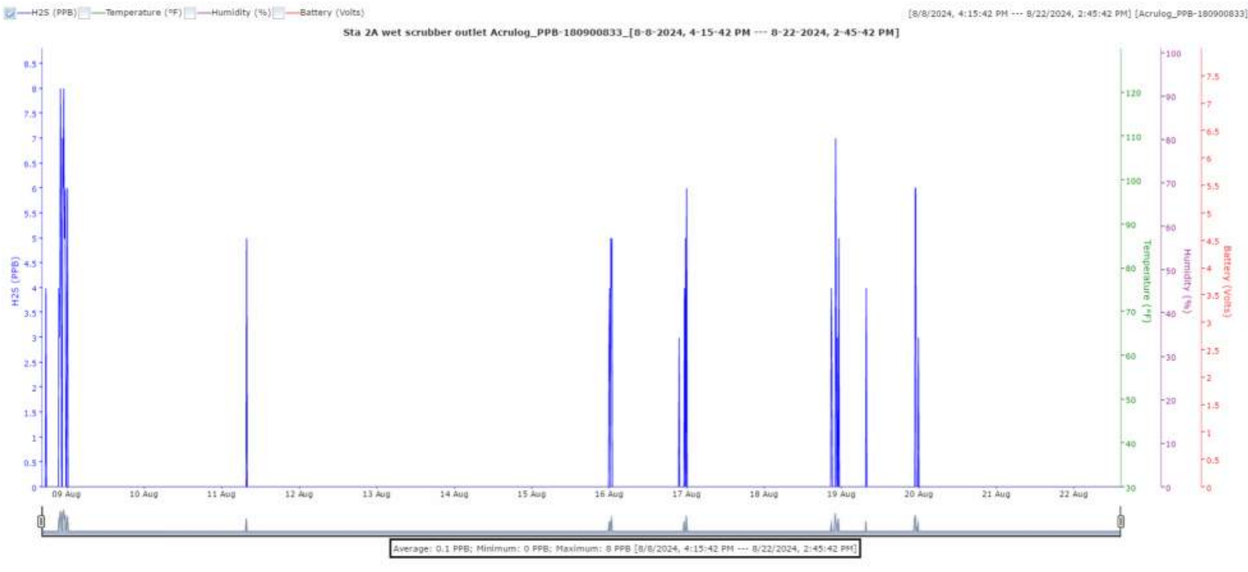

Figure 4.6 Dewatering Building Basement Wet Scrubber Outlet H2S Results

4.4.3 Sta. 2B Carbon Unit (OCS-2115)

The carbon unit for the sludge disposal building appears to be reducing odors compared to the inlet levels.

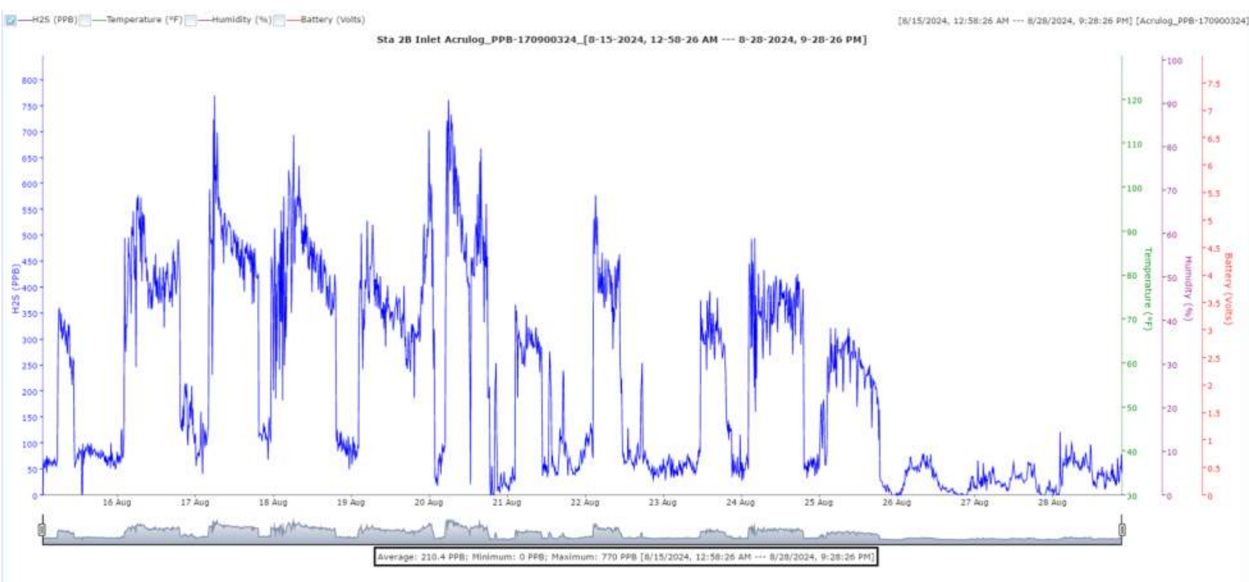

Figure 4.7 Sludge Disposal Building Carbon Unit Inlet H2S Results

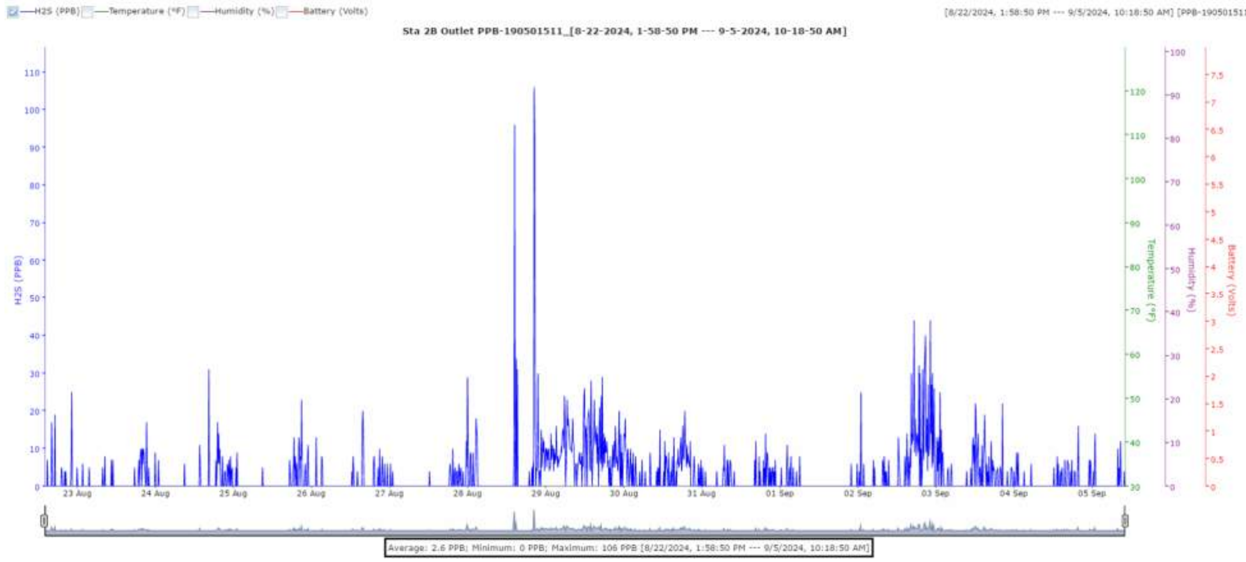

Figure 4.8 Sludge Disposal Building Carbon Unit Outlet H2S Results

4.4.4 Sta. 3 Activated Carbon OCS (OCS-2118)

This location had high H_2S concentration at the inlet but very low concentrations at the outlet. However, a strong unpleasant odor was noted during field visits. This suggests that there are odors at this location due to sources other than H_2S. It is possible that odors are escaping from other sources such as the nearby gooseneck vent. The lab sample showed that the RSCs were being generated within the OCS, especially DMDS.

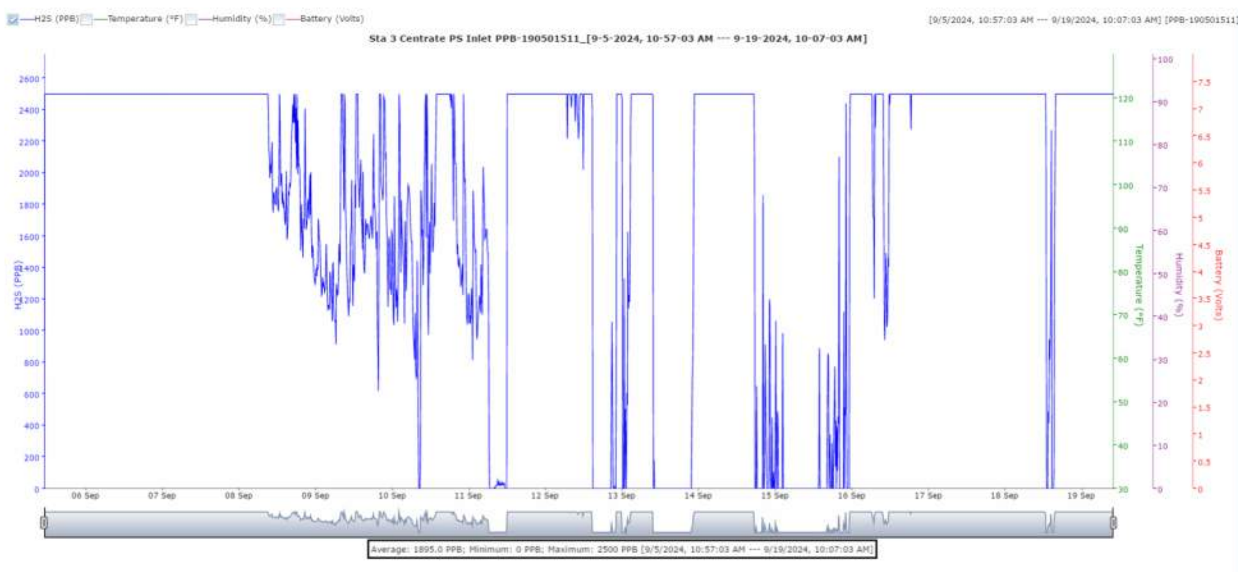

Figure 4.9 Centrate Pump Station – Odor Control Inlet H_2S Results

Figure 4.10 Centrate Pump Station – Odor Control Outlet H_2S Results

4.4.5 Sta. 4 Detritor Building Carbon Unit (OCS-2111)

The data for the inlet to the detritor building carbon unit has a stretch of nod ata between September 8th and September 12th. It is unclear what caused this gap in the data, and the true average is likely higher than the reported 38 ppm.

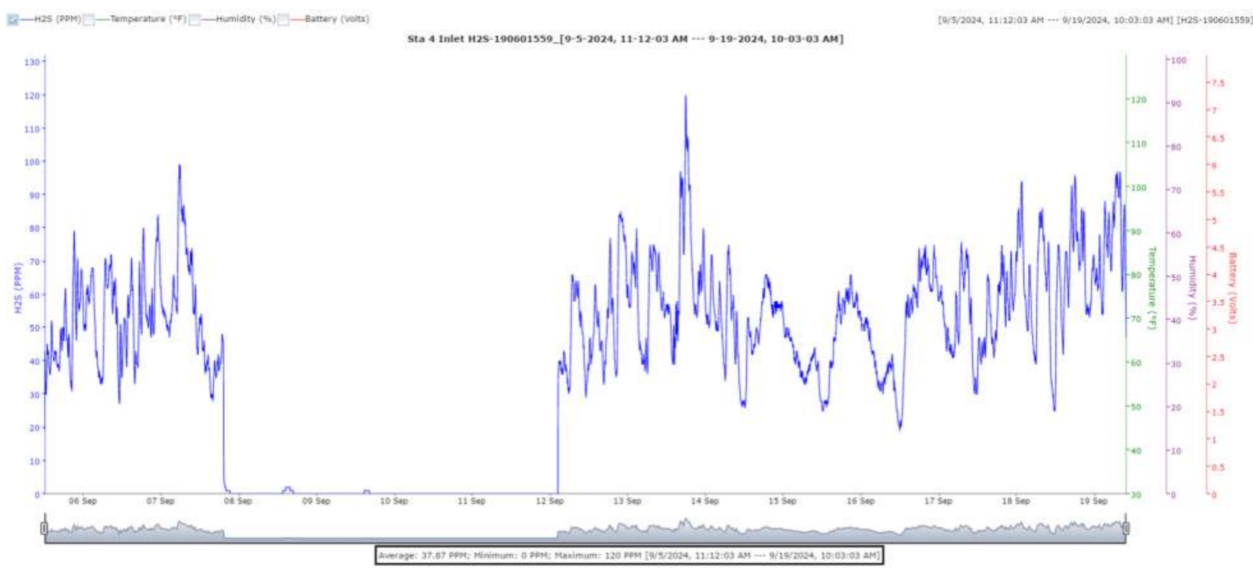

Figure 4.11 Detritor Building Carbon Unit Inlet H2S Results

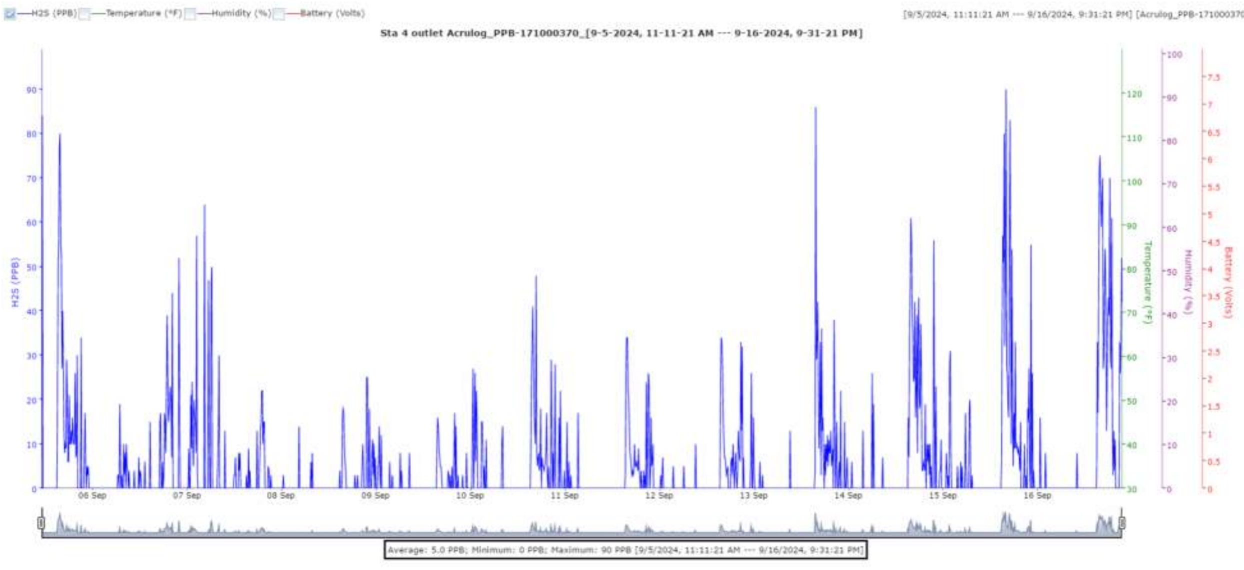

Figure 4.12 Detritor Building Carbon Unit Outlet H2S Results

4.4.6 Sta. 5 Activated Carbon OCS (OCS-2113)

The results at the septage and sludge storage tanks are consistent with the grab samples from these locations. The averages reported in Table 4.6 are skewed by high values of

Figure 4.13 Septage Receiving Tanks H2S Results

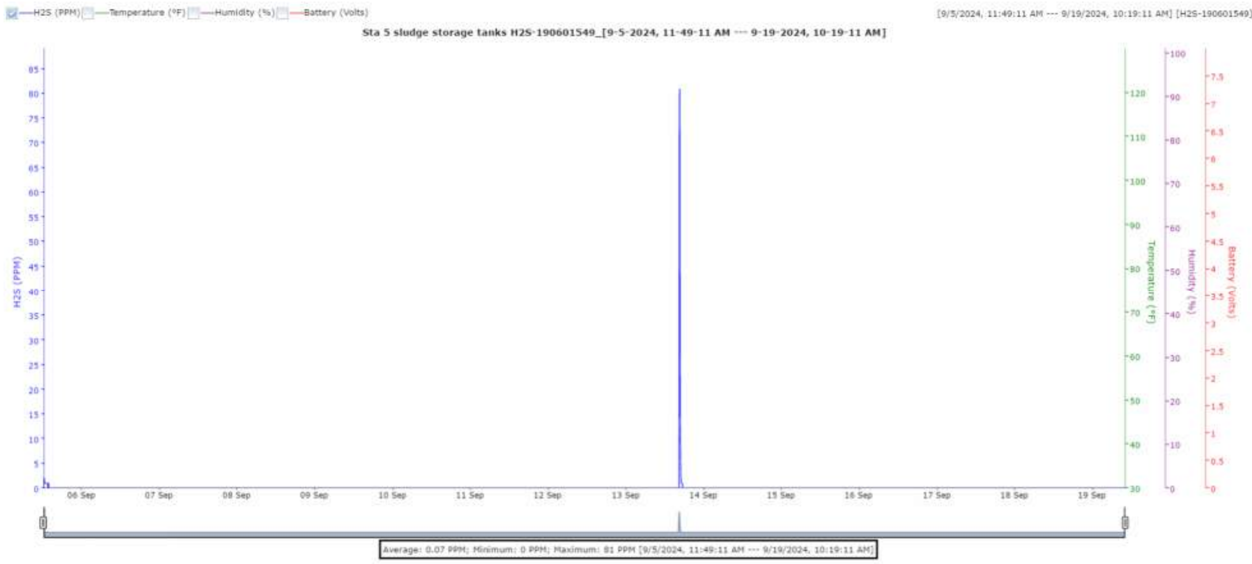

Figure 4.14 Sludge Receiving Tanks H2S Results

4.4.7 Sta. 6 Middletown Inlet Box

This location had extremely high concentrations of H_2S, averaging 139.4 ppm and exceeding the instrument maximum of 220 ppm on multiple occasions. The H_2S concentrations tended to rise in the evening, stay high overnight, then decrease in the morning. The data also suggests that the existing H_2S monitoring device at the Middletown Inlet Box is not working properly since that unit has an average reading of approximately 0.3 ppm.

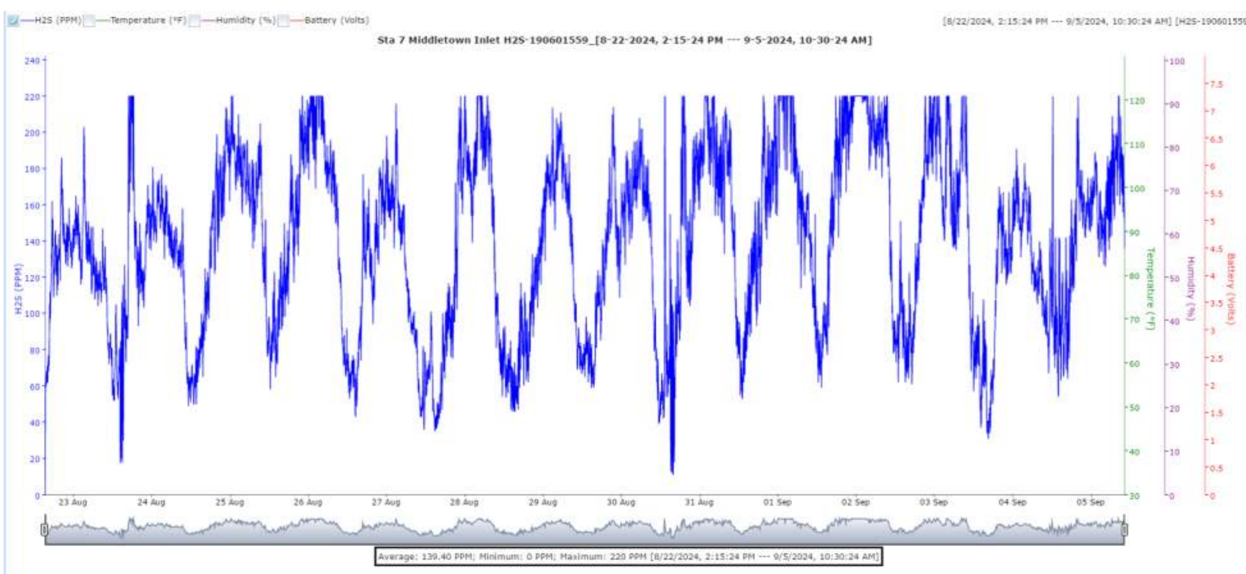

Figure 4.15 Middletown Inlet Box H_2S Results

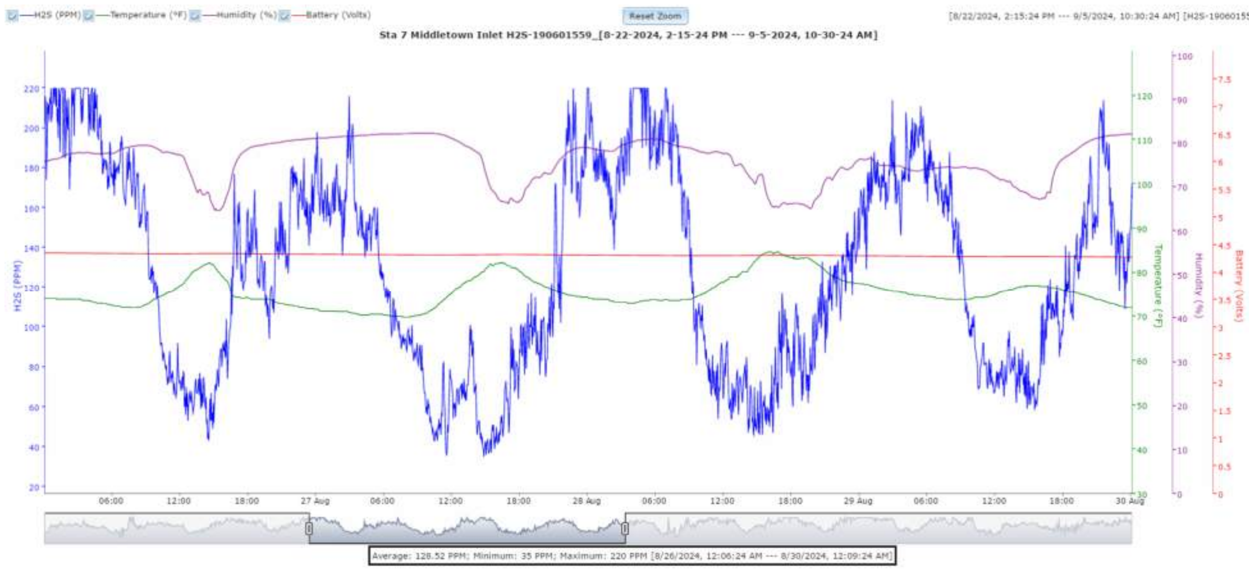

Figure 4.16 Middletown Inlet Box H_2S Results for August 26-30th (zoomed in to show times)

4.5 Additional Sampling per Section 22a-174-23

Additional olfactory and analytical sampling was performed on December 10 and 12, 2024, following the sampling protocol discussed in **Section 3.5.** Three locations along the fence line of the plant were selected for analysis. At each location, three samples were taken each day for the compounds listed in **Table 3.3**. Additionally, three olfactory samples were also taken at each location at 15-minute intervals. Over the two days, eighteen analytical and olfactory samples were collected, comprising both analytical and olfactory samples.

The results are summarized below. Importantly, none of the olfactory or analytical samples exceeded the nuisance threshold as defined in Section 22a-174-23.

4.5.1 Analytical Sampling

Of the eighteen total analytical samples taken over the two days, toluene was the only compound detected at any of the locations. All other compounds listed in **Table 3.3** were below the detection limit for the analysis methods. The toluene results are summarized in **Table 4.7** and full results are included in **Appendix H.** It is important to note that the lab analyzed only six of the eighteen chlorine samples, all of which fell below the detection limit. Therefore, it is unlikely that the additional measurements would have yielded significantly different results.

Table 4.7 Analytical Sampling Results

Location	Toluene (ppb)
Location 1, Sample 1	1.30
Location 1, Sample 2	1.40
Location 1, Sample 3	1.00
Location 2, Sample 1	1.90
Location 2, Sample 2	2.30
Location 2, Sample 3	1.40

Location	Toluene (ppb)
Location 3, Sample 1	1.40
Location 3, Sample 2	3.70
Location 3, Sample 3	1.10
Location 1, Sample 1	0.89
Location 1, Sample 2	0.75
Location 1, Sample 3	0.76
Location 2, Sample 1	1.20
Location 2, Sample 2	1.20
Location 2, Sample 3	0.74
Location 3, Sample 1	0.89
Location 3, Sample 2	0.92
Location 3, Sample 3	ND (below limit)

According to Connecticut State Regulations Section 22a-174-23, the concentration limit for toluene is 11 parts per million. The sampling results, which average around 1.3 parts per billion (0.0013 parts per million), are about 10,000 times smaller than the acceptable limit.

4.5.2 Olfactory Sampling

The results of the olfactory sampling are summarized on the following figures. Of the eighteen samples, seventeen had readings of non-detect, while one was an odor strength of 2 D/T. Nuisance odors are typically classified as 7 D/T or higher. Results of the olfactory sampling are presented in **figures 4.17** and **4.18.**

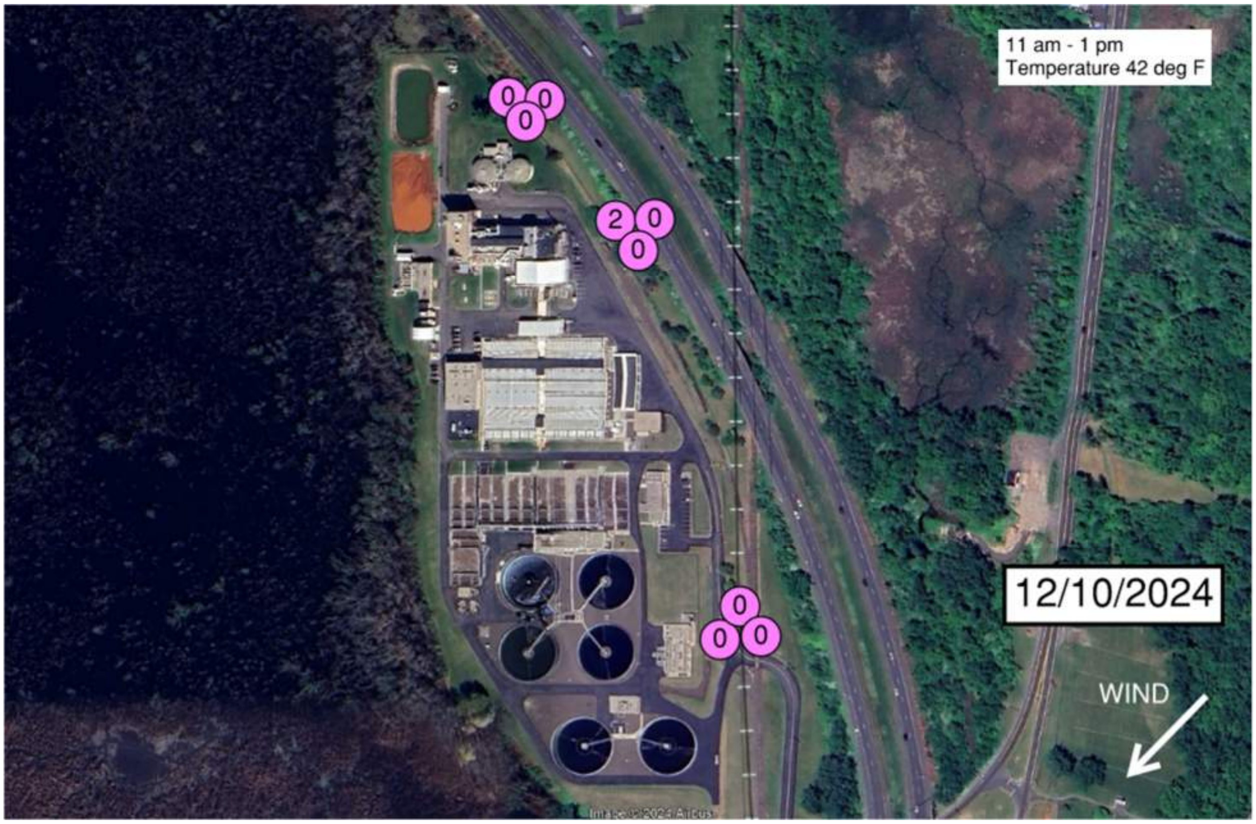

Figure 4.17 Additional Olfactory Sampling Results from December 10, 2024

Figure 4.18 Additional Olfactory Sampling Results from December 12, 2024

4.5.3 Middletown Inlet H_2S Monitoring

Additional H_2S monitoring was conducted at the Middletown Inlet Box during the December 2024 sampling period to ensure accuracy of the previous data and provide another comparison to the facility's existing H_2S sensor at this location. Two monitors, one with a 0-2000 ppb detection range and one 0-200 ppm, were installed at the Middletown Inlet Box and left for a week to gather data. The results are shown on the graphs below. The average for the ppb instrument is inaccurate since the H2S levels exceeded the detection level of the instrument for much of the sampling period, so it cannot calculate an accurate average. The PPM instrument measured an average of 70 ppm over the sampling period, suggesting that the earlier results were accurate and there may be an issue with the existing instrument.

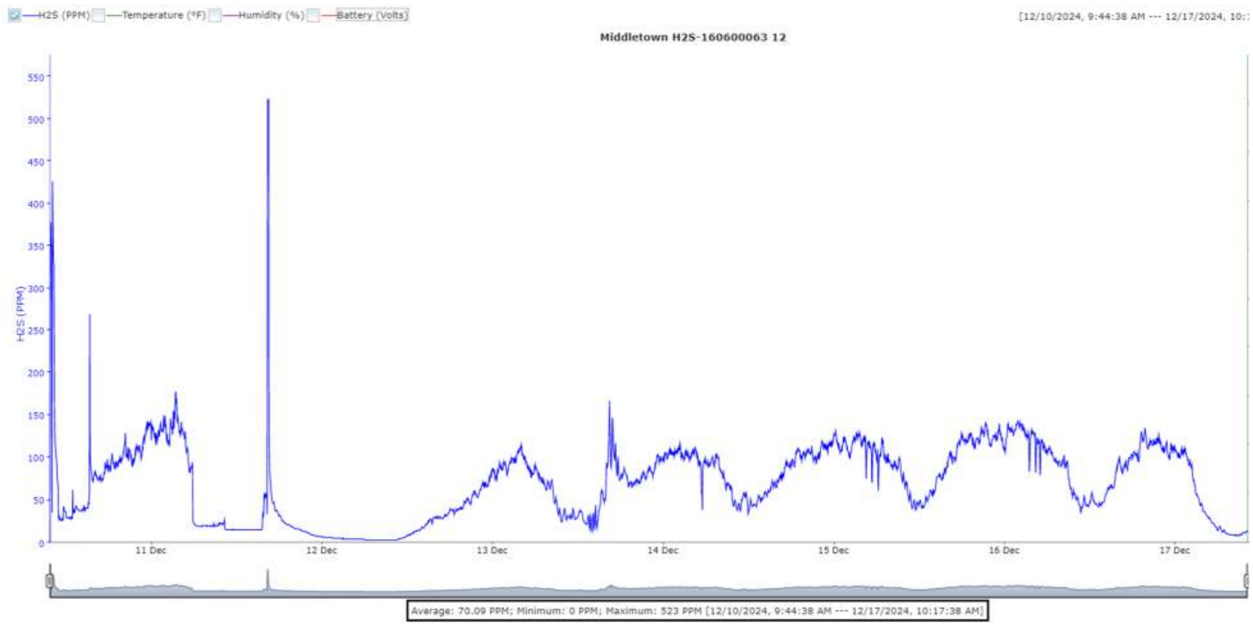

Figure 4.19 Middletown Inlet Box PPM Monitor Results

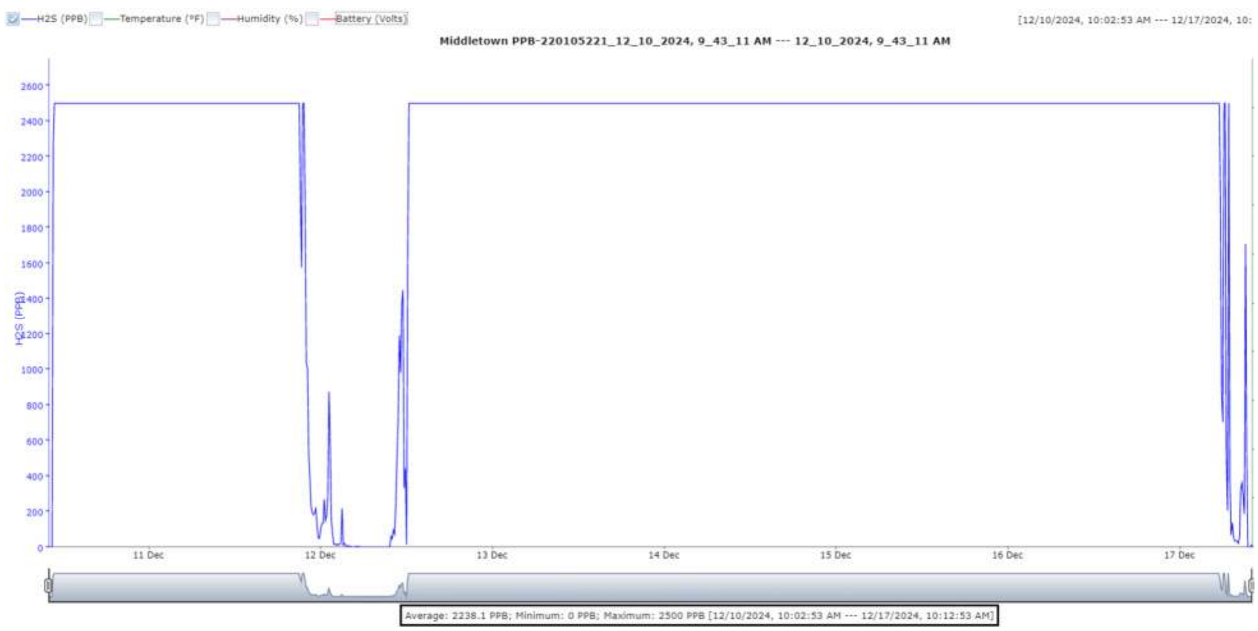

Figure 4.20 Middletown Inlet Box PPB Monitor Results

4.6 Airflow Survey

An airflow survey evaluation was conducted to assess the performance of various components of the odor control systems across multiple stations within the WCPF on August 15, 2024. The evaluation focused on comparing designed versus actual airflow rates alongside pressure differential measurements to determine system efficiencies.

Station No.1 Sludge Storage Building

Airflow and pressure differential measurements were taken at the fan inlet/outlet locations of the existing BTF-wet scrubber odor control system. Additionally, speed and airflow readings were conducted on the 22-inch FRP ductwork header that carries the foul air from the sludge tanks headspace. A summary of the findings is listed as follows:

- Blower:
  - Airflow Rate: Originally specified at 5,400 CFM, the actual reading was found to be 4,282 CFM, indicating an approximate 21% deficit.
  - Total Static Pressure: Originally specified at 13.3-inch of w.c., the actual reading was found to be 13.93-inch of w.c., indicating an approximate 5% increase.
  - Fan Speed: Originally specified at 2,723 RPM, the actual reading was found to be 2,750 RPM, indicating an approximate 1% increase.
  - Motor BHP: Originally specified at 17.90 HP, the actual reading was found to be 20.59 HP, resulting in an approximate 15% increase.
- 22-inch Duct Header:
  - Airflow Rate: Mirrored the blower’s performance with a 21% deficit with 20% of the damper open.
  - Static Pressure: Measured at -2.76-inch of w.c., compared to the inlet fan static pressure of – 5.40-inch of w.c., characteristic of a medium pressure system (typically between 2 and 6-inch of w.c.).

Station No. 2A Dewatering Process

- Blower:
  - Airflow Rate: Originally specified at 3,000 CFM, the actual reading was found to be 2,645 CFM, indicating an approximate 12% deficit.
  - Total Static Pressure: Originally specified at 9.6-inch of w.c., the actual reading was found to be 8.36-inch of w.c, indicating an approximate 13% decrease.
  - Fan Speed: Originally specified at 2,872 RPM, the actual reading was found to be 2,836 RPM, indicating an approximate 1% decrease.
  - Motor BHP: Originally specified at 6.45 HP, the actual reading was found to be 4.15 HP, resulting in an approximate 36% decrease.
- 18-inch Duct Header:
  - Airflow Rate: Mirrored the blower’s performance with a 21% deficit with the damper fully open.
  - Static Pressure: Measured at -5.03-inch of w.c., compared to the inlet fan static pressure of – 6.71-inch of w.c., characteristic of a medium to slightly high-pressure system.
- 18-inch Duct – Branches

  - 12-inch Duct to Grit Room (1,220 CFM): Notably underperformed with a 76% deficit from design with the damper fully open, indicating potential blockage or malfunction. Static pressure of –4.05-inch of w.c., characteristic of a medium pressure system.
  - 8-inch Duct to Centrifuge (576 CFM): Notably underperformed with a 76% deficit from design, indicating potential blockage or malfunction. Static pressure of –3.54-inch of w.c., characteristic of a medium pressure.
  - 6-inch Duct to Conveyor STS-1761 (355 CFM): Notably underperformed with a 61% deficit from design with damper partially open at 80%, indicating potential blockage or malfunction. Static pressure of –4.35-inch of w.c., characteristic of a medium pressure.
  - 6-inch Duct to Conveyor STS-1762 (295 CFM): Notably underperformed with a 44% deficit from design with damper partially open at 80%, indicating potential blockage or malfunction. Static pressure of –2. 52-inch of w.c., characteristic of a medium pressure system.

Station 2B Sludge Disposal Building:

- Blower:
  - Airflow Rate: Originally specified at 31,175 CFM, the actual reading was found to be 21,147 CFM, indicating an approximate 32% deficit.
  - Total Static Pressure: Originally specified at 5.09-inch of w.c., the actual reading was found to be 6.59-inch of w.c, indicating an approximate 30% decrease.
  - Fan Speed: Originally specified at 830 RPM, the actual reading was found to be 827 RPM, indicating less than 1% decrease.
  - Motor BHP: Originally specified at 33.6 HP, the actual reading was found to be 83.72 HP, resulting in an approximate 150% decrease.
  - This fan was found to be considerably high on amps. An increase of almost 2x the original configuration.
- 54-inch Duct Header:
  - Airflow Rate: Mirrored the blower's performance with a 30% deficit with a damper half open.
  - Static Pressure: Measured at -1.28-inch of w.c., compared to the inlet fan static pressure of – 3.99-inch of w.c., characteristic of a low to slightly medium-pressure system, which is also consistent with the measured duct velocity of less than 1,500 fpm.
- 54-inch Duct – Branches/Registers
  - Basement (17,250 CFM): 48" x 48" Registers: Notably underperformed with a 67% deficit from design with 90% partially open, indicating potential blockage or malfunction. Static pressure of –0.10-inch of w.c., characteristic of a very low-pressure system.

  - First Floor (13,260 CFM): Access to this location was not possible due to the height at this location. Airflow measurements were calculated based on mass balance with approximately 11% surplus compared with the original design.
  - Grit Room (665 CFM): 10” x 10” Registers: Minor deficit of 7.5% from design with 60% partially open. Static pressure of –0.59-inch of w.c., characteristic of a very low-pressure system.
  - Carbon Vessel Pressure Differential: the value 2.62 is relatively high. A possible indicator of this condition may be an increased resistance in the media due to saturation or clogging, which leads to high energy consumption. Media replacement or overall system maintenance might be required.

Station No. 3 Centrate PS:

- Blower:
  - Airflow Rate: Originally specified at 40 CFM, the actual reading was found to be 25 CFM, indicating an approximate 38% deficit.
  - Total Static Pressure: Originally specified at 6.74-inch of w.c., the actual reading was found to be 6.70-inch of w.c, indicating less than 1% decrease.
  - Fan Speed: Originally specified at 3,480 RPM, the actual reading could not be measured.
  - Motor BHP: Originally specified at 0.37 HP, the actual reading was found to be 5.37 HP, resulting in an approximate 1,350% increase.
- 4-inch Duct Header:
  - Airflow Rate: Mirrored the blower’s performance with a 38% deficit with no damper.
  - Static Pressure: Measured at -1.51-inch of w.c., compared to the inlet fan static pressure of – 6.62inch of w.c., characteristic of a medium to high-pressure system.
- Carbon Vessel Pressure Differential: 4.68 inch of w.c. is relatively high. A possible indicator of this condition may be an increased resistance in the media due to saturation or clogging, which leads to high energy consumption. Media replacement or overall system maintenance might be required.

Station No. 4 Detritors:

- Blower:
  - Airflow Rate: Originally specified at 4,500 CFM, the actual reading was found to be 3,686 CFM, indicating an approximate 18% deficit.
  - Total Static Pressure: Originally specified at 3.90-inch of w.c., the actual reading was found to be 3.97-inch of w.c, indicating an approximate 2% increase.
  - Fan Speed: Originally specified at 1,472 RPM, the actual reading was 1,571, indicating a minor increase of 7%.

  - Motor BHP: Originally specified at 4.12 HP, the actual reading was found to be 4.23 HP, resulting in an approximate 3% increase.
- 16-inch Duct Headers:
  - Airflow Rate No.1: Mirrored the blower's performance with a 18% deficit with no damper.
  - Static Pressure: Measured at -1.28-inch of w.c., compared to the inlet fan static pressure of – 2.62-inch of w.c., characteristic of a slightly medium-pressure system, which is also consistent with the measured duct velocity close to 1,500 fpm in the lower end.
- 20-inch Duct Branches:
  - Detritor No.1 (2,500 CFM): overperformed with a 180% surplus from design with damper fully open. Static pressure of –1.26-inch of w.c., characteristic of a medium-D
  - Detritor No.2 (2,500 CFM): It was inactive at the time of the airflow survey.
- Carbon Vessel Pressure Differential: the value 1.68 within an adequate range. Maintaining the pressure differential within the optimal range (1 to 2 in WC) provides efficient operation and effective odor control while minimizing energy consumption and wear on the system.

Station No. 5 Sludge/Septage Receiving:

- 8" Sludge Receiving:
  - Airflow Rate: Originally specified at 488 CFM, the actual reading was found to be 501 CFM, indicating an approximate 3% surplus.
  - Static Pressure: Measured at –0.32-inch of w.c., characteristic of a low-pressure system, which is also consistent with the measured duct velocity below 1,500 fpm.
- 8" Septage Receiving:
  - Airflow Rate: Originally specified at 488 CFM, the actual reading was found to be 834 CFM, indicating an approximate 170% surplus.
  - Static Pressure: Measured at –1.36-inch of w.c., characteristic of a low-pressure system. However, the measured duct velocity of 2,389 fpm is more characteristic of a medium-pressure system.

The survey identified significant discrepancies between the designed and actual airflow rates across multiple stations, suggesting potential inefficiencies or issues within the system. These variances underscore the need for further investigation and possible adjustments to provide optimal performance and adherence to design specifications. Additionally, the 30,000 CFM blower on Station 2B exhibited relatively high amperage readings, which may indicate clogged filters or blocked ducts. Further inspection is required to determine the exact cause. The detailed report is included in **Appendix F.**

4.7 Liquid Phase Analysis

Liquid analysis data from samples collected on August 8th, 2024, at the Middleton Inlet Box are summarized in **Table 4.8**. The ORP and dissolved sulfide data indicates septicity. Septic conditions are expected throughout the preliminary influent box and primary treatment effluent channel but should not increase significantly. ORP measures the tendency of a solution to either gain or lose electrons, which reflects its oxidizing or reducing conditions.

Table 4.8 Liquid Measurements

Process or Location	Liquid Phase Sampling						
	Temp. (°C)	Conduc. (mS/m)	Salinity (ng/L)	pH	DO(mg/L)	Dissolved Sulfide (mg/L)	ORP (mV)
Middletown Inlet Box	22.80	104.3	0.52	7.70	0.01	1.50	-194.70

Septicity occurs when wastewater becomes anaerobic, leading to the production of H_2S and other odorous compounds. A negative ORP value (typically less than -125 to -150 mV) indicates a reducing environment where oxygen is depleted, favoring the growth of anaerobic bacteria that produce sulfides and organic acids, characteristic of septic conditions. Based on the DO concentration of the sample collected, the process is under anoxic conditions, which favors septicity.

Dissolved sulfide in wastewater can generate H_2S, typically under anaerobic conditions where sulfate-reducing bacteria (SRB) thrive. These bacteria use sulfate as an electron acceptor to oxidize organic matter, producing sulfide as a byproduct. Dissolved sulfide can react with hydrogen ions to form H_2S gas. Typical values of dissolved sulfide that can lead to the generation of excess H_2S in wastewater are generally 1 to 2 mg/L. At these levels, H_2S can produce a noticeable odor similar to rotten eggs. Even small amounts of dissolved sulfide can result in significant H_2S production under turbulent conditions. The dissolved sulfide concentration can still be lowered by increasing the calcium nitrate dosage but further investigation is required.

Monitoring ORP helps operators detect and manage septicity by identifying anaerobic conditions and taking corrective actions, such as aeration or adding nitrates to increase ORP and prevent the formation of odorous compounds.

4.8 Preliminary Calculation of Dispersion

For this exercise, H_2S and odor concentrations peak concentrations measured at the sludge storage tanks were selected as worst-case scenario conditions to calculate the potential downwind concentration from a point emission source using the USEPA Screen 3 model.

Wind speed and direction also play an important role on odor dispersion. The analysis of the wind rose data for Hartford Brainard Airport from 2018 to 2024 indicates that the predominant wind directions are from the north-northwest and south-southeast, meaning that areas to the southeast and northwest of the odor source are more likely to be impacted as presented in **Appendix G**. The average wind speed of 3.22 m/s and the low percentage of calm winds (0.94%) suggest consistent air movement, which can significantly influence the spread of odors. Understanding these wind patterns is essential for predicting odor impact and implementing timely control measures. Dynamics of wind vectors were not taking into consideration.

The WKC's five-step online tool (Online Air Dispersion Model | WKC Group) was employed for this purpose. It is important to note that this is a preliminary exercise, and a more robust and dynamic model, such as AERMOD, is required for a more comprehensive and conclusive dispersion analysis. **Table 4.9** presents the input data to determine the concentration at the two selected locations beyond the plant fence line.

Table 4.9 Input Data & Calculated Concentrations at Selected Locations

Parameter	Value	Comments/References
Atmospheric Stability		
Surface Wind Speed	3 – 4 m/s	Based on April's monthly average (7.9 mph) (2010 – Present). Cromwell Wind Forecast, CT 06416 - WillyWeather
Time of the Day	Daytime	
Solar Radiation	Strong	Based on Hartford, CT monthly average (5.49 mWh/m2/day). Solar Energy & Solar Power in Hartford, CT | Solar Energy Local
Resultant Atmospheric Stability Class	B	Based on to the Pasquill-Gifford Stability Categories. READY Tools - Pasquill Stability Classes (noaa.gov)
Wind Speed at Stack Height		
Environment	Urban	
Anemometer Height	2 m	Assumed (~6.5 feet)
Wind Speed at Anemometer Height	3.5 m/s	Assumed (~7.8 mph)
Stack Height	5 m	Assumed (~16.5 feet)
Wind Speed at Stack Height	4.02 m	Calculated. Based on EPA's wind power's law ISC3 Dispersion Models, Volume II, p.1-4, 5 Document Display | NEPIS | US EPA. *Stack emissions were considered for this exercise. Note that this is an approximation. Actual fugitive emissions from the nutrients' tank must be modeled for accuracy.*
Plume Rise		
Stack Diameter	0.56 m	Based on 22-inch Sludge Storage Tanks Duct Header
Stack Gas Exit Velocity	8.23 m/s	Based on Airflow Survey 1,622 FPM Appendix F. p.4
Stack Gas Exit Temperature	308.15 K	Assumed (95.0 F)
Ambient Temperature	302.04 K	Based on July's Average Highest (84.0 F) Cromwell, CT Climate Averages, Monthly Weather Conditions (weatherworld.com)
Plume Rise	0.68 m	Calculated. Based on the Davidson-Bryant formula. EPA Effective Stack Height, p.14 Document Display | NEPIS | US EPA
Effective Stack Height	5.68 m	Calculated. $H_s = h_s + \Delta H$
Dispersion Parameters		
Distance Downwind	150m/690 m	Approximate distance between sludge storage tanks and 9 Pine Ridge Road (490 ft)/86 South St. (2,260 ft).

Parameter	Value	Comments/References
σ_y Urban (m)	46.6m/195.5m	Calculated. Crosswind dispersion coefficients (D y) for the Gaussian plume equation | Download Scientific Diagram (researchgate.net)
σ_y Urban (m)	38.6m/215.3m	Calculated. Vertical dispersion coefficients (D z) for Gaussian plume equation | Download Scientific Diagram (researchgate.net)
Downwind Concentration	H2S = 0.12g/s | n-butanol = 166.12 g/s	Calculated. Based on a peak concentration of 43.0 ppm H2S | 550,000 OU/m3 (67,650 ppmv as n-butanol)
Distance Crosswind (y)	0 m	Assumed
Height Above Ground	2 m	Assumed
Downwind Concentration		
Downwind Concentration @ 490 ft	H2S = 5.22 µg/m^3 | n-butanol =7,220 µg/m^3	Calculated per Equation 3.7.1 – 3.74 ppb H2S | 2.38 ppm n-butanol (20 OU/m3)
Downwind Concentration @ 2,260 ft	H2S = 0.23 µg/m^3 | n-butanol = 312.46 µg/m^3	Calculated per Equation 3.7.1 – 0.17 ppb H2S | 103 ppb n-butanol (<1 OU/m3)

5.0 Conclusions and Recommendations

Over the past decade, several odor-related complaints have been linked with the operation of the WPCF. This assessment aimed to determine if there is a correlation between the odors generated at the facility and the complaints registered in recent years. Additionally, it sought to provide recommendations to improve the mitigation of odor dispersion to potentially affected locations beyond the facility's fence line, should a correlation be found.

The odor control system at the WPCF facility comprises several standalone units and employs various technologies to mitigate gas nuisances generated at each unit process. In general, with adequate ventilation rates and proper operation and maintenance, these systems should efficiently address most of the odors at the critical locations identified in this assessment. A summary of the major findings of this assessment is presented below:

- The WPCF provides a robust odor control system for each unit process.
- Existing odor control units exhibited high removal rates of odor and H_2S
- No direct correlation between plant operations and odor dispersion at nuisance levels was identified from the evaluation.
- Areas with the Highest H_2S Concentrations:
  - Sludge Storage Tanks
  - Middletown Inlet Box
- Areas with the Lowest H_2S Concentrations:
  - Sludge Disposal Building
  - Septage Receiving Area
  - Fenceline

To further enhance the effectiveness of the odor control systems and mitigate odor dispersion, the following recommendations are proposed:

- Increase ventilation rates as feasible (i.e., Detritor and Centrate Units).
- Perform a testing, adjusting, and balancing (TAB) of the odor control systems.
- Improve ductwork configuration in the dewatering building.
- As the odor control units age, perform regular maintenance of existing odor control units.
- Improve existing odor control provisions (liquid or vapor phase odor control alternatives) at:
  - Middletown Inlet Box
  - Septage Receiving Locations
- Perform regular calibration of H_2S monitoring devices and include a meteorological station.

In this section, conclusions based on the findings at each evaluated location along with a recommended plan moving forward will be provided. A separate subsection will discuss the potential correlation between the odors generated at the facility and the data collected beyond the facility's fence line.

5.1 Sta. 1 Sludge Storage Building

This location is critical due to the high H_2S (43 ppm) and toluene (13 ppm) concentrations found in samples taken from the inlet of the existing odor control unit and the headspace of the sludge storage tanks. These findings align with the elevated odor concentration of over 550,000 D/T measured at the same site. Although the current unit reduces odor concentration with 99.7% efficiency and greater than 99% efficiency for H_2S, a continuous leak of foul air (ranging from 40 ppm – 80 ppm H_2S) from the BTF's nutrients tank releases nuisance gases into the environment. Odor perception fluctuations beyond the plant fence line can occur, depending on wind speed and direction. Modeling is required to determine the radius of influence for this condition.

Given the current ventilation rate of approximately 6 ACH (4,282 CFM measured) for each tank, the tanks' headspace is classified as Class 1 Division 1 according to NFPA 820 standards. Consequently, the same classification should be applied within a 3-foot radius of the BTF's leaking location, requiring that any control panel enclosure within this radius be explosion-proof.

As a short-term solution, it is highly recommended to fix the leak at the BTF's nutrients tank seal to prevent the escape of foul air into the environment. A comprehensive evaluation to determine the operability of the BTF-Wet Scrubber system is also required. Based on our understanding, this evaluation was already performed August 2023. Manufacturer's recommendations to re-establish the system's operability should be taken into consideration.

The complexity of the gas matrix generated at this stage requires both biological and chemical technologies to efficiently remove odor precursors such as toluene. Additionally, a comprehensive evaluation to mitigate the septicity of the sludge stored in these tanks is necessary. This can be achieved by either reducing retention times or applying oxidizing agents to handle the high loads of sulfide.

Optimization between the full odor control system operation and the control of septicity at the source is encouraged. It is our understanding that the tanks do not operate simultaneously. However, if both tanks are used simultaneously, an upgrade of the existing odor control unit is also recommended to provide proper ventilation.

5.2 Sta. 2A & 2B Sludge Disposal and Dewatering Building

The odor control system for this building addresses two separate spaces: the process headspace (conveyors, centrifuges, and associated equipment) and the room space that houses these processes.

The process headspace is managed by a wet scrubber located in the building basement, which currently provides approximately 20% efficiency for odor removal and greater than 99% efficiency for H_2S removal. Although the odor concentration (1,000 D/T) is not as high as that produced at the sludge storage tanks, the system's poor efficiency does not adequately mitigate all odor precursors, primarily associated with VOCs. Specifically, toluene appears to be generated within the chemical scrubber. This inefficiency is likely due to the poor condition of the 3,000 CFM wet scrubber (Sta. 2A OCS-21), which shows signs of severe structural deterioration. Despite a well-configured ductwork system and overall ventilation rate of approximately 12 ACHs along the entire conveyance run, the odor control system remains non-operational. Replacement is urgently needed, as foul air is essentially passing through the system untreated and being released into the atmosphere. The area classification within 3 feet of the wet-scrubber exhaust is considered class 1 division 2 per NFPA standards.

The room space is ventilated to a 30,000 CFM external carbon adsorber unit (Sta. 2B OCS-2115) located on the south side of the building. However, the overall ventilation rate measured at the inlet was found to be 70% of the design airflow, corresponding to approximately 4 ACHs. This leaves the entire room space classified as Class I Division 1, indicating a hazardous area due to the presence of flammable gases or vapors under normal operating conditions.

Additionally, the configuration of the existing ductwork system for capturing foul air needs optimization. Currently, there is a single location with three registers on each floor to capture the foul air from the approximately 2,500 sq. ft. area. This setup does not allow all the air to be collected and vented out to the odor control system, creating short circuit zones with poor air quality. Expansion and reconfiguration of the ductwork system are recommended.

Even though H_2S concentrations are low, it is highly recommended to perform further inspections by a certified industrial hygienist and a fire protection professional to determine fire and explosion risks and recommend appropriate safety measures to confirm the safety of personnel and equipment. It is advised to avoid keeping all doors closed until the results and recommendations of this evaluation are provided. While maintaining the doors open may cause odor dispersion into the environment, safety must take precedence.

Additionally, the measurements performed at the outlet port of the existing odor control unit might not be fully reliable. The descriptors identified were mostly related to plastics and chemicals, which could indicate a blockage in the sampling port line. An inspection of this line is recommended to confirm there are no obstructions, followed by resampling to better determine the unit's performance.

5.3 Sta. 3. Centrate Pump Station

The Centrate Pump Station directly receives the concentrated wet waste from the centrifuges and is equipped with a 40 CFM carbon canister unit that currently only provides an airflow rate of 25 CFM to the odor control unit, which corresponds to less than 3 ACH. This not only allows for nuisance gases to build up inside of the wet well, but also creates a Class I Division 1 condition within three feet radius of the carbon canister unit. The existing unit currently seems to provide a good removal of H2S and mercaptans, but very poor to remove dimethyl sulfide and other VOCs, which can be an indicator that the media used should be revaluated. However, The 1350% increase in HP suggests that the media could be saturated or plugged.

As presented in **Table 2.4**, the existing carbon unit at the centrate pump station does not provide sufficient air for achieving the recommended 12 ACHs per NFPA 820 standards for this type of process. This is consistent with the client's perception that the existing unit might be undersized and needs more frequent media changeouts due to a quick carbon exhaustion. During the visit, a bitter-sweet odor was detected in the carbon adsorber outlet and wet well. Ventilation restrictions at the current location of the odor control stack may also have an impact on a continuous air flow circulation into the wet well (see **Figure 2.3**).

A relatively high odor concentration (16,000 OU/m³) is currently being treated at this location with an efficiency rate of approximately 70%. This suggests that either the carbon canister media is undersized for the actual gas loading, or the carbon media characteristics are inadequate for removing some compounds found in the gas matrix. It is recommended to upgrade the size of the carbon adsorber unit to provide at least 6 ACH. Additionally, evaluating the most suitable type of carbon media based on vapor phase characterization is essential. The exhaust stack should also be directed to discharge air vertically to mitigate direct horizontal dispersion.

5.4 Sta. 4 Detritor Units

The primary purpose of the detritors is to remove heavy, abrasive, and insoluble inorganic particles, such as sand, gravel, and other grit, from the raw wastewater coming from the influent pump station. Due to the high likelihood of septic conditions at this stage, as evidenced by the septicity on the perimeter walls of these buildings. Due to this space can be considered as worker's accessible space, it is recommended that the buildings housing this process be ventilated at a minimum of 12 ACH. This will help prevent hazards and deterioration of the overall structure. Additionally, significant signs of corrosion on the internal walls indicate a substantial buildup of sulfur-related compounds.

No mechanical make-up air ventilation was observed in any of the detritor buildings during the site visit. The only positive air ventilation source noticed is provided through a gable end vent located on the south side of each of the two buildings housing this process, which were designed to operate at 12 ACH each (4,500 CFM). However, the airflow survey indicated that the current airflow to the existing odor control unit was 3,868 CFM, providing only approximately 10 ACH, which does not meet the area classification per NFPA standards. Similar to the sludge storage tanks, simultaneous ventilation of both buildings is not recommended unless the existing odor control unit (OCS-2111) is upgraded to a larger size capable of handling 12 ACH. The existing carbon adsorber is a single radial type and might be reconfigured to a dual-stage if both detritors are intended to be used simultaneously in the future. Manufacturer's evaluation of the current system is recommended to explore this or other options such as providing an additional carbon adsorber unit to increase the capacity of the odor control system at this location.

The detritor building should be fabricated using non-combustible standards and fire protection measurements such as portable fire extinguishers and combustible gas detection system shall be in installed. No mechanical ventilation for odor control negative pressure was identified for this process other than an existing gable vent that does not guarantee efficient circulation of foul air to the existing OC unit. With an approximate size of 46' x 40' and an average height of 13' (record drawing S-8) per room, it is recommended to provide a minimum rate of 5,000 CFM to achieve 12 ACH. Additional inspection from other disciplines such as architectural is recommended to make sure the building meets local standards.

Even though a significant reduction in odor concentration (99.6%) was observed, similar to the sludge disposal and dewatering room, it is important to note that this value might not fully represent the actual performance of the unit. The sample description from the outlet port of the existing carbon adsorber unit showed a high predominance of plastic descriptors, which could indicate a blockage in the sampling line. An inspection of this line is recommended to confirm there are no obstructions.

5.5 Sta. 5 Sludge and Septage Receiving Area

The two septage and sludge receiving bays are located in between the solids handling and the primary sedimentation areas. Plant personnel have reported some instances of odor nuisance during the truck unloading operation. This situation can be variable and is more related to the truck and practices of each operator.

The sludge and septage receiving facilities often face significant challenges due to the septic nature of the waste they handle. This waste, stored for extended periods at its original source, undergoes anaerobic decomposition, leading to the production of high levels of H_2S and VOCs. The long retention times exacerbate these conditions, resulting in a highly odorous and potentially hazardous environment, which is consistent with the collected data at this location.

During the airflow survey, it was observed that the 8-inch damper pickup, which conveys foul air from the sludge receiving bay to the dual-stage primary settling’s 14,000 CFM carbon adsorber, was 50% open. This significantly constrains the airflow. Fully opening this damper may help balance the flow at both locations to 800 CFM, increasing the ventilation rate from 6 to 9 ACH. This adjustment will not change the space classification from Class I Division 1 but will help reduce H2S buildup in the headspace of the underground tank.

Additionally, it is recommended to provide a dedicated and automated 700–800 CFM carbon adsorber unit with an extension arm equipped with two hoses to ventilate the trucks during unloading operations. This will help capture emissions generated inside the tanker, preventing their dispersion into the environment.

5.6 Sta. 6 Middletown Inlet Box

The inlet box on the southeast side of the detritor building receives approximately 6.0 MGD from Middletown, CT upstream pump station. The force mains conveying wastewater from this municipality are treated with Calcium Nitrate (or Bioxide) to oxidize dissolved sulfur compounds and reduce H_2S generation upon entering the inlet box. However, data from grab samples and H_2S monitoring collected showed high concentrations of H_2S that were not consistently reflected by the existing monitor located in a control panel next to the inlet box.

High concentrations of H_2S at the inlet box could be associated with optimal dosage of Bioxide upstream of the inlet box, as this oxidant has been proven effective in reducing H_2S and controlling corrosion for applications of this type. The existing H_2S monitor should be inspected for accuracy. It is also recommended to work with Middletown and/or the Bioxide provider to efficiently optimize the dosage of this chemical. A feasible alternative to address this issue would require a chemical injection system with a remote H_2S monitoring probe at Mattabassett's inlet box. This probe would communicate with the upstream chemical dosing station, allowing for adjustments to the chemical dosage based on H_2S concentration readings.

Additionally, it is recommended installing a dedicated vapor-phase odor control system to mitigate any H_2S fluctuations that may not be immediately neutralized by the oxidizing agent. Based on the size of this unit process, a small carbon adsorber unit with a capacity of approximately 200-250 CFM will suffice for ventilating the headspace at this location. The proposed unit can be installed on the north side of the existing inlet box, next to the parking area.

5.7 Other Conclusions and Recommendations

5.7.1 Airflow Balance

To confirm optimal performance of the existing odor control infrastructure, a thorough Test, Adjust, and Balance (T.A.B) procedure is recommended to review optimal performance of the existing odor control infrastructure. Although an airflow survey was recently completed, the previous T.A.B was performed in 2014, and significant changes may have occurred since then. It is generally recommended to conduct T.A.B procedures every 5 years to maintain system efficiency and performance. This process involves measuring and adjusting the airflow rates, static pressures, and fan speeds to match the design specifications. This process involves inspecting all components for any signs of wear or blockage that could affect performance, using calibrated instruments to measure the airflow and static pressure at various points in the system, and comparing these readings with design values to identify any discrepancies. The dampers, fan speeds, and other control settings can be adjusted as necessary to achieve the desired balance. Regular T.A.B testing helps maintain efficiency, reduce energy consumption, and provide effective odor control. Persistent issues should be addressed by a professional HVAC technician.

5.7.2 Dispersion

Based on the desktop analysis, untreated H_2S and odors released into the atmosphere from the sludge storage tanks' headspace, with winds blowing at 7.9 mph towards 9 Pine Ridge Road (490 ft) and 86 South St (2,260 ft) beyond the plant's fence line, it was concluded that there could be a potential for odor dispersion impacting both locations. The H_2S and odor (as n-butanol) concentrations were determined to be 3.74 ppb and 2.38 ppm at the first location (9 Pine Ridge Road) NE of the plant fence line, and 0.17 ppb and 103 ppb, respectively, at the farther location (86 South St) NW of the plant fence line. Comparing these levels with the odor threshold from Table 3.1, it can be concluded that both locations might experience intermittent odor nuisances described as sulfur and decay when the wind blows in the NE and NW directions. It is important to highlight that this is a preliminary approximation and will require further validation using a dynamic model. Also, it is important to note that this exercise was based on a peak value and specific conditions and should not be considered as representative. For an accurate assessment, the use of a dispersion modeling tool is recommended using the results of the olfactory field testing.

5.7.3 Cromwell, CT Sewer

After reviewing the 1968 record drawings from the Town of Cromwell, it was found that there is a possibility of water stagnation and odor generation in the sewer pipe along South Street between houses 96 and 100. This can be caused by low flow conditions, extended detention times, higher temperatures, and the accumulation of organic matter. According to TR-16 recommendations, an 8-inch pipe requires a minimum slope of 0.4% to provide adequate flow. Given that larger pipes need less slope, a 6-inch pipe should have a slightly higher minimum slope than 0.4% to maintain proper flow. With an 800-foot length and a 0.4% slope, the 6-inch pipe should generally maintain adequate flow, but if the flow rate is too low, solids can settle, creating anaerobic conditions that produce foul-smelling gases like H_2S. Proper ventilation, regular maintenance, and cleaning by the Department of Public Works are essential to prevent blockages and buildup, ensuring consistent flow and minimizing odors. If necessary, chemical treatments such as calcium nitrate can also help neutralize persistent odors. The potential for stagnation should be investigated as a source of odors in this specific area.

5.7.4 Additional Sampling – Section 22a-174-23 (2006)

A total of eighteen samples were collected at three separate locations of the WPCF fence line for chemical and olfactory analysis and quantification. Of the eighteen total analytical samples taken over two days, toluene was the only compound detected. All other eleven compounds listed in Table 23-1 of Section 22a-174-23 were below the detection limit of the standard methods listed in Table 3-1. Additionally, from the olfactory analysis, seventeen readings were non-detect, while only one had an odor strength of 2 D/T. Based on the criteria in Section 22a-174-23 (2006), none of the samples taken during the sampling period qualify as a nuisance.